RUDECO
Vocational Training in
Rural Development and Ecology

Module № 12

Management of Biological Resources of Rural Areas

TAMBOV STATE UNIVERSITY NAMED AFTER G.R. DERGAVIN

Responsible University

Tambov State University named after G.R. Derzhavin

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Preface

The book is addressed to a wide range of readers whose interests are in matters of rural sustainable development. The methods of biological resources use (harvesting, storing, primary and complete processing), legislative regulations of nature management and environmental requirements to conservation of biological diversity at resource withdrawal are reviewed in the appropriate chapters. The given information is a result of long-term practice existing in the organizations, whose specialists assisted in this monograph writing, analysis of the European countries experience as well as knowledge synergy of composite authors. The scientists from Tambov State University named after G.R. Derzhavin, Warsaw University of Life Sciences, Omsk State Agrarian University, and Stavropol State Agrarian University took part in the writing of book. The text rubrication allows focusing on the basic lines of nature management mainly in forest-steppe zone (the use of forests, water bodies, open spaces, and game hunting bioresources). The last chapter includes the cases of rational resource management based on the Russian and West European practices. The text set forth below is performed as a popular science and available for persons with higher education. Interpretation of highly specialized terms is given in the section “Glossary”.

The present guide is one of the series of the guides that were developed within the framework of the project TEMPUS 159357-TEMPUS-1-2009-1-DE-TEMPUS-JPHES “Vocational Training in Rural Development and Ecology” (RUDECO) under TEMPUS programme.

The project RUDECO aims to improve the vocational training system in the sphere of rural development and ecology and involves various agricultural universities in Russia and Europe. The project goal is to facilitate the universities in acquiring the necessary qualifications by means of conceptualization and development of study guides (modules), as well as by training the instructors who will participate in the vocational training of governmental employees.

The grant beneficiary and coordinator from the European Union is the University of Hohenheim, Germany, a highly recognised university. The project is implemented by an international consortium which encompasses from Germany the Agency for Development of Agriculture and Rural areas of the Federal State Baden-Württemberg, the Academy for Spatial Research and Planning, the Enterprise «Terra Fusca Engineering»; the University of Udine (Italy); the Slovak University of Agriculture (Slovakia); the National Institute of Higher Education in Agronomy, Food and Environmental Sciences (France); the Agency de Services et de Paiements (France); the Warsaw University of Life Sciences and the Association of Sustainable Development of Poland.

Eleven Russian higher educational institutions participate in the project on behalf of Russia, along with the Ministry of Agriculture of Russia, A.A. Nikonov State Scientific Institution All-Russian Institute of Agrarian Issues and IT of the Russian Agricultural Academy, the administrations of Tambovskaya and Orlovskaya oblasts, as well as representatives of environmental organizations. The educational institutions engaged are: V.R. Fillipov Buryat State Agricultural Academy, Kostroma State Agricultural Academy, V.P. Goryachkin Moscow State Agroengineering University, Novosibirsk State Agrarian University, P.S. Stolypin Omsk State Agrarian University, Orel State Agrarian University, K.A. Timiryazev Russian State Agrarian University-Moscow Agricultural Academy, Samara State Agricultural Academy, Stavropol State Agrarian University, G.R. Derzhavin Tambov State University, Yaroslavl State Agricultural Academy.

The project goals are:

- Development of the vocational training system in the sphere of ecology and rural areas at 11 agrarian universities of Russia, enabling them to obtain a higher qualification
- Development of 12 modules for representatives of governmental agencies on the national, regional and local level
- Training of the representatives of Russian public institutions and representatives of public administration of various levels in the sphere of ecology and rural development using professional training from certified instructors
- Formation of the concept «training for trainers» using the support of European partners;
- Development of international cooperation of Russian institutions of higher education

The elaborated modules are:

- **Sustainable development: key terms and theoretical basis** (Introductory Module 1, Russian State Agrarian University-Moscow Timiryazev)
- **Sustainable rural development: approaches for regional and local programmes elaboration** (Module 2, Russian State Agrarian University-Moscow Timiryazev)
- **Ecolabeling and marketing of environmental and regional products from rural areas** (Module 3, Orel State Agrarian University)
- **Eco-tourism and tourism in rural areas (**Module 4, Buryat State Academy of Agriculture)
- **Conversion of conventional farming into organic farming** (Module 5, Yaroslavl State Agricultural Academy)
- **Environmental regulations and laws** (Module 6, Stavropol State Agricultural University)
- **Ecological related problems of intensive agriculture (plant and animal production)** (Module 7, Omsk State Agrarian University)
- **Participatory approach in rural development** (Module 8, Kostroma State Agricultural Academy)
- **Reducing pollution in rural areas caused by agricultural, industrial and municipal solid waste** (Module 9, Novosibirsk State Agrarian University)
- **Sustainable use of water resources in rural areas** (Module 10, Samara State Agricultural Academy)
- **Food safety and product quality control** (Module 11, Moscow State Agroengineering University named after Goryachkin V.P.)
- **Management of biological resources of rural areas** (Module 12, Tambov State University)

The introducing module on the key terms and theoretical basis of sustainable development basis is an ideal preparation for all the above listed specific modules. Persons who start to get involved in the field of ecology and sustainable rural development, we recommend to read this basic module first, before deepening one of the other topics. Readers interested in the modules and further training can address also all involved university partners to get further information or training about the listed modules.

This book on the module ”Management of biological resources of rural areas” was prepared by experts from the Tambov State University, and also by colleagues from the Warsaw University

of Life Sciences, Omsk State Agrarian University, Stavropol State Agrarian University. Contact information is provided in the Annex.

To readers whose activity is connected with module subject “Management of biological resources of rural areas” also can be useful acquaintance with modules: “ Sustainable development: key terms and theoretical basis” (Module 1), “Sustainable rural development: approaches for regional and local programmes elaboration” (Module2), “Eco-tourism and tourism in rural areas” (Module 4), “Environmental regulations and laws” (Module 6), Participatory approach in rural development (Module 8), “Sustainable use of water resources in rural areas” (Module 10).

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Introduction

The module “Management of rural bioresources” includes the detailed description of use and protection problems of non urbanized resources which are not associated with soil fertility and commercial logging. The concern of methodological and methodical approaches is directed to the increase of rural economy diversification, building of complete and rational systems of bioresources development. Attraction o f experts from the leading universities of the Russian Federation and countries of the European Union facilitates generalized best practices of this resource group management, that do not disturb ecological balance and do not reduce biological diversity. In different sections the exploitation principles of forests, parks, and water bodies resources exploitation are examined. In addition much consideration is given to the rationalization of game parks activity and to the description of the most effective forms of integrated nature management. In each section of module the range of problems includes available methods, means of nature conservation, harvesting standards, technologies in processing and making of finished and half-finished products ready for realization.

1 Management of forest biological resources

1.1 Preparation of wild fruits, berries and nuts

The main types of wild fruits, berries and nuts

The main types of wild berries are marsh berry, cow-berry, blueberry, swamp blueberry, raspberry and salmonberry.

Wild berries are a source of essential bioactive substances for every human being. The plants that refer to the vaccinium family *(Vacciniaceae)* and the rose family *(Rosacea)* are of the primary economic value. The rose family is represented by raspberry *(Oxycoccus sp.)*, dewberry *(Vaccinium vitis-ideea)*, wild strawberry *(V. uliginosum)* and hawthorn *(V. myrtillus)*. The rose with its numerous types is related to the rose subfamily. Apple *(Malus sylvestris)*, pear *(Pirus sp.)*, mountain ash *(Sorbus sp.)*, blackthorn *(Vepres sp.)*, bird cherry *(Padus sp.)*, sweet cherry *(Cerasum sp.)* and shadberry *(Ludus sp.)* are related to the apple subfamily *(Pomoideae)*. Other families are represented by one or several types that have economic value. [1]

The rules of gathering and storage of berries

During hot days the best times to gather berries are morning when dew disappears and evening. In the middle of the day when the sun is very hot the process of gathering should be stopped as the berries which are gathered at such time are not sappy and they will fade or spoil very fast. The berries which are gathered in the morning are more sappy and aromatic. They can stay fresh longer and they are transported better.

It is not recommended to gather berries during soppy weather. Wet berries are spoiling very easily. Such fruits require very fast processing. During the cold weather without rain it is possible to gather berries for the whole day. But in the evening when dew appears it is reasonable to stop gathering. The berries, which are aimed to be transported and consumed, are taken within receptacle but the berries which are aimed to be dried, pickled, salted can be taken without. [2, 3]

Table 1.1 The calendar showing blossom and ripening period of berries [4, 5, 6]

Specificname	May	June	July	August	September	October
Cow-berry *(Vaccinium sp.)*	B	B		R	R	
Veronica *(Veronica sp.)*	B	B		R		
Swamp blueberry *(V. uliginosum)*	B	B	R	R	R	
Wild Strawberry *(Fragaria vesca)*	B	B R	B R	B R		
Marshberry *(V. oxycoccus)*	B	B	B	R	R	
Marsh berry *(Oxycoccus microcarpus)*		B	B	R	R	
Marsh berry *(O. macrocarpus)*		B	B		R	R
Raspberry *(Rubus arcticus)*		Ц	R	R		
Raspberry *(R. saxatilis)*	B	B	R	R		
Красника *(V. praestans)*		B	B	R		
Cloudberry *(R.chamaemorus)*	B	B	R			
Blueberry *(V. myrtillus)*	B	B	R	R		
Caucasian blueberry *(V. arctostaphylos)*		B	B R	R		
Huckleberry *(V. ovalifolium)*	B	B		R	R	

Table 1.2 The calendar showing blossom and ripening period of bush berries [4, 5, 6]

Specificname	March	April	May	June	July	August	September	October
Kolomikta-vine *(A. kolomikta)*				B	B	R	R	
Actinidiapoligama *(A. polygama)*					B		R	
Actinidia giraldii *(A. giraldii)*				B	B			R
Barberry *(Berberis vulgaris)*		B	B				R	R
Heteropodal barberry *(B. heteropoda)*			B				R	
Siberian barberry *(B. sibirica)*			B	B			R	
Amur Barberry *(B. amurensis)*			B				R	R
Blood-red hawthorn *(Crataegus sanguinea)*			B	B			R	R
Common hawthorn *(C. oxycantha)*			B	B		R		
Single-seed hawthorn *(C. monogyna)*			B	B			R	
Silver Hawthorn *(C. orientalis)*				B	B		R	
Hawthorn *(C. pontica)*			B				R	
Hawthorn *(C. atrosanguinea)*				B			R	R
Dahurian hawthorn *(C. dahurica)*				B		R		
Chinese hawthorn *(C. pinnatifida)*			B	B		R	R	R

Black elderberry *(Sambucus nigra)*			B	B	B	R	R	
Red elderberry *(S. racemosa)*			B		R			
Woodland grape *(Vitis sylvestris)*			B				R	
Amur grape *(V. amurensis)*				B	B		R	
Thunberg grape *(V. thunbergii)*					B	B	R	R
Japanese grape *(V. coignetiae)*				B	B		R	R
Bird cherry *(Prunus avium)*		B	B	R	R			
Frutescent cherry *(P. fruticosa)*		B	B		R			
Small-fruited cherry *(P. microcarpa)*			B	R				
Cherry glandular *(Cerasus glandulosa)*		B	B		R			
Arrow-wood *(Viburnum lantana)*			B		R	R		
Honeysuckle *(Lonicera caerulea)*			B	B R	R			
Kamchatka honeysuckle *(L. kamtschatica)*				B	B	R		
Turchanov honeysuckle *(L. turczaninowii)*				B	R	R		
Pallace honeysuckle *(L. pallasii)*			B	B R	B R R		R	
Serviceberry *(Amelanchier ovalis)*		B	B	R	R	R		

Cranberry *(Viburnum opulus)*			B	B	B	R	R	
Cranberry *(V. burejaeticum)*			B	B	B	R	R	
Mongolian cranberry *(V.mongolicum)*			B	B		R	R	
Cranberry *(V. sargentii)*				B	B	R	R	
Cranberry *(V.orientale)*				B	B		R	
Common dogwood *(Cornus mas)*	B	B				R	R	
Gooseberry *(Grossularia reclinata)*			B	B	R			
Gooseberry *(G. acicularis)*				B	R	R		
Gooseberry *(G. burejensis)*			B			R		
Chinese mognolia vine *(Schizandra chinensis)*			B	B			R	R
Raspberry *(Rubus idaeus)*			B	B	R	R		
Raspberry *(R. sachalinesis)*				B		R		
Common juniper *(Juniperus communis)*		B	B	B			R	R
Common sea-buckthorn *(Hippophae rhamnoides)*		B	B			R	R	R
Mountain ash *(Sorbus aucuparia)*			B	B			R	R
Mountain ash *(S. tauricola)*			B				R	R

Mountain ash *(S. tormanilis)*			B	B		R	R	
Mountain ash *(S. tianshanica)*			B	B		R	R	
Mountain ash *(S. siberica)*				B		R	R	
Mountain ash *(S. amurensis)*			B	B			R	R
Mountain ash *(S. sumbusifolia)*				B	B		R	R
Black currant *(Ribes nigrum)*			B	B	R	R		
Currant *(R. procumbens)*				B	R	R		
Current *(R. pausiflorum)*			B	B	R			
Currant *(R. horridum)*				B	R			
Redcurrant *(R. rubrum)*		B	B		R	R		
Currant *(R. spicaturn)*				B	R			
Currant *(R. hispidulum)*			B	B	R			
Currant *(R. altisimum)*				B		R		
Currant *(R. triste)*				B		R		
Bird cherry *(Prunu spadus)*			B	B		R	R	
Cinnamon rose *(Rosa cinnamomea)*			B	B	B	R	R	

Wild rose *(R. acicularis)*				B	B	R	R	
Dog rose *(R.canina)*			B	B	B	R	R	
Wild rose *(R. laxa)*				B		R	R	
Dahurian rose *(R. dahurica)*				B	B	R	R	
Ramanas rose *(R. rugosa)*				B	B			

Table 1.3 The calendar showing blossom and ripening period of fruits [4, 5, 6]

Specificname	March	April	May	June	July	August	September	October	November
Apricot *(Armeniaca prunus)*	B	B		R	R	R			
Siberian apricot *(A.sibirica)*	B	B	B		R	R			
Manchu apricot *(A. mandschurica)*		B	B		R	R			
Quince *(Cydonia sp.)*			B	B			R	R	R
Alycha *(Prunus sp.)*	B	B	B	R	R	R	R	R	R
Common pear *(Pyrus communis)*		B	B			R	R		
Russian pear *(P. rossica)*		B	B		R	R			
Caucasian pear *(P. caucasica)*		B	B		R	R	R		
Pear *(P. ussuriensis)*			B			R	R		
Medlar			B					R	R

(P. caucasica)									
Blackthorn *(Prunusspinosa)*		B	B		R	R			
Wildapple *(Malus sylvestris)*			B	B		R	R		
Apple (M. orientalis)		B	B			R	R		
Apple *(M. kirghisorum)*		B	B			R	R		
Apple *(M. baccata)*			B				R		
Apple *(M. mandchurica)*			B				R		

B − Blossom

R − Ripping

Storage period

Berries can be divided into perishable and such for long term storage. The first group includes wild strawberry *(Fragaria sp.)*, raspberry *(Rubus sp.)*, blueberry *(Vaccinium myrtillus)*, swamp blueberry *(V. uliginosum)* and others. The second group includes cranberry *(V. vitis-ideea)*, mountain ash *(Sorbus sp.)*, viburnum *(Viburnum sp.)* and some other berries.

The storage period is defined by ripeness of the berries and ripening process. Wild berries, that are planned to be kept, are gathered at the stage when they are not fully ripened or completely ready. Berries, which are taken before ripening period or with damages, or were frozen, cannot be kept for long. Wild marsh berry and cranberry can be stored for long term period as they are resistant to the diseases. This can be explained by chemical compounds and structure of those particular berries. Also the presence of organic acids increases the resistance. It contains benzoic acid, essential oil, phenol connections, and glycoside. The surface of berries is just a thin layer that protects them from evaporation.

The ways of conservation

Conservation suggests all the ways of processing raw materials that provide with steady safety of foodstuffs from spoiling. It is salting, pickling, drying, and sulfitation.

As the result of biological peculiarities wild berries can be spoiled very fast. That's why the period of consumption is limited. Using different ways of conservation it is possibly to use berries in food industry. The main principle of processing of wild berries is to increase the resistance of the berries saving their taste and quality. [1]

Sulfitation

While producing semi-prepared products it is necessary to use antiseptics to increase their storage period.

Sulfitation is one of the most simple and widely used ways of chemical conservation. It can be carried out wet and dry.

While using the first method of sulfitation (wet) berries are fumed by the sulfuric dioxide – the gas, which appears after sulfur is burned, afterwards they are put into a 5-6 % solution of sulfurous acid at the rate of 1 kg of berries per 1.5-2 gm of acid. For better preservation fruits with thin fruit tissue (strawberry *(Fragaria sp.)*, raspberry *(Rubus sp.*) are sulfited by a solution of sulfurous acid with 0.6 gm of calcium bisulfate (lime). For this method only ripe, fresh, and clean berries will be suitable.

For the second method (dry) a separate camera is needed; walls, ceiling and floor should be absolutely dry. Berries should be put into columns not higher than 2.5 m. To burn sulfur a chauffer is used. For 1 kg of berries 1 kg of sulfur is needed. The process of fumigation lasts for 8 hours. Fumed berries are immediately put into the barrels, closed and kept at the temperature not high then 10 °C.

Sulfited berries cannot be consumed without preparatory treatment. Berries for jam can be desultited in boiling water. If long heating is needed for the desulfitation process, what can lead to

fruit deformation, berries should be soaked in cold water in advance, reducing the blanching time. During this process the sulfurous acid is resolving and the product becomes harmless. [1]

Drying process

Drying as a method of conservation is based on the breakdown of the life-sustaining activity of microorganisms on dehydrated products. All berry types can be dried. For drying only fresh, ripe berries which are selected from the extraneous bodies are suitable. Berries with tough peel (cranberry *(Oxycoccus sp.)*, black currant *(Ribes nigrum)*) are blanched and dried in the natural conditions or in special dryers.

Drying process can be done with the help of infrared drying equipment. The drying temperature should not exceed 60°C, thus the cell membrane is not destroyed and sugar is prevented from caramelization, vitamins are saved on a level of 80-90%.

Table 1.4 The amount of berries needed to get 1 kg of dry berries

Specificname	The amount of dry elements %		The amount of berries needed to get 1 kg of ready product without a regard to loss
	Ininitialproduct	Indryproduct	
Cowberry *(Vaccinium sp.)*	13	82	6.6
Blackcurrent *(Ribes nigrum)*	15	82	5.8
Cranberry *(Oxycoccus sp.)*	10.5	82	8.2
Cherry *(Prunus subgen)*	15	82	5.8
Swampblueberry *(Vиouliginosum)*	11.8	82	7.3
Apple *(Malus sp.)*	20	82	4.2
Blueberry *(Vи myrtilus)*	13.5	82	6.4
Chokeberry *(Aronia melanocarpa)*	19.5	82	4.4

Table 1.5 Qualitative measures of finite product

Humiditylevel	Nomorethan 15%
Leveloftotalash	Nomorethan 5%
The amount of fruits that lost their natural color	Nomorethan 3%
The amount of unripe fruits	Nomorethan 2%
The presence of other parts of the plant (fruit-stalks, leaves)	Nomorethan 0.5%
The amount of fruits with fruit-stalks	Nomorethan 3%
The level of mineral impurity (earth, sand)	Nomorethan 0.2%
The level of organic impurity (other berries)	Nomorethan 0.5%
The presence of inedible berries	Notallowed
The presence of mold and rot	Notallowed
The presence of foreign smell	Notallowed

If dry berries are put into hot water later, they obtain the features of fresh berries. Taste and aroma of the product can be defined in the regenerated form. [7]

Freezing

The main advantage of freezing is a very high quality of the products. Not only principle food elements are saved, e.g. carbohydrates, vitamins (the loss of vitamin C is not more than 10%), but also color, taste, aroma and constituency. Prepared fruits and berries are put for crust freezing at a temperature of -30-35° and afterwards they are kept at a temperature of − 18-25° for long-term periods.

The production of berry powder

The powder made of dry berries can be applied in:

- Pharmacology for creation of biologically active supplements
- Gastronomy – for jellies, gravies, fillings, sauces, cream coloring
- Confectionary industry, in the form of food color, flavorings and fat stabilizers, applied in fruit-berry waffle production. Into fatty fillings berry powder is loaded in the form of water paste (2 gm on 100 gm of product). It is known that berry powder improves the quality of the product
- Since ancient times dry honeyberry was used as a supplement to the bread for fruit flavour
- Dry berries are used for vitamin tea that is very healthy because of the special treatment

Powders can be produced with the help of contact method (roll dryers are used) and convective method (spray-type dryers). The advantage of powders is their restorability when water is added, and the disadvantage is clump formation while storage and low amount of vitamin C. [8]

Nutritive value and medicinal properties of berries and fruits

Berries and fruits contain a significant amount of sugars, organic acids, vitamins, minerals and other important medicinal and nutritive substances. It is found that the berries and fruits which are eaten with other products improve digestion, promote proteins, fats and minerals absorption.

Vitamin composition of wild fruits and berries are extremely varied with vitamins C, P, B complex, K, E and carotene prevailing.

Carotene (provitamin A). Fat-soluble pigment of carotene is split up in the body to the vitamin A form.

The role of vitamin A is enormous. It is part of the visual (light sensing) cells in the retina and causing normal perception of light. Vitamin A insufficiency causes disturbed visual acuity, growth retardation, weight loss, keratinization of the surface layers of skin epithelium, and decrease of the body's resistance to infectious diseases.

Forest rowan *(Sorbus aucuparia)* and sea buckthorn *(Hippophae sp.)* are the leaders in vitamin A content.

Vitamin K is actively involved in blood coagulation.

The highest amount of vitamin K is found in black currant *(Ribes nigrum)*, blackberry *(Rubus caesius)*, mountain ash *(S. aucuparia)* and wild rose *(Rosa sp.)*.

Vitamin E has antioxidant properties. Vitamin E deficiency leads to violation of metabolic processes in the body.

Only the fruits of wild sea buckthorn *(Hippophae sp.)* and cloudberry (*Rubus chamaemorus)* are rich in vitamin E.

Vitamin C (ascorbic acid). The role of vitamin C in the body is significant. It increases the antitoxic function of the liver, inhibits the development of atherosclerosis, and it is involved in the blood, increases the body's resistance to infectious diseases, etc.

Vitamin C is in large amounts in wild rose *(Rosa sp.)*, black currant *(R. nigrum)*, and buckthorn *(H.sp.)*, and mountain ash *(S. aucuparia)*.

Vitamin P (bioflavonoids). This is a large group of compounds related by chemical structure.

These compounds increase the strength of capillaries; promote the absorption of vitamin C in the body, and are involved in redox processes that regulate the work of some of the endocrine glands (especially the thyroid). The usage of P-vitamin activity substances is effective in atherosclerosis, hypertension, rheumatism, tonsillitis and other diseases related to insufficient strength of blood capillaries.

The following plants are most rich in vitamins of this group: briar (*Rosa sp.*), black currant (*Ribes nigrum*), rowan (*S. aucuparia*), bilberry (*Vaccinium myrtillus*), saskatoon (*Amelanchier sp.*), blueberries (*V. uliginosum*), cranberries (*V. vitis-idaea*), viburnum (*Viburnum sp.*), blackberries (*Rubus sp.*), buckthorn *(Hippophae sp.)*, honeysuckle (*Lonicera sp.*), cranberry (*Oxycoccus sp.*).

Vitamins B complex. Wild fruits and berries of this group contain a significant amount of nicotinic acid; it is an important member of the redox processes in the body. At vitamin B insufficiency profound disorder of the gastrointestinal tract, nervous system, and blood production processes is observed.

It is contained in rose hips (*Rosa sp.*), bilberry (*Vaccinium myrtillus*), blackberry (*Rubus sp.*), and wild apples (*Malus sylvestris*).

Choline and inositol are also related to vitamin-like substances.

Choline – regulates metabolism of proteins and fats; it has antisclerotic effect and is found in sea buckthorn *(Hippophae sp.)*, hawthorn (*Crataegus sp.*), wild rose (*Rosa sp.*), viburnum (*Viburnum sp.*), irge (*Amelanchier sp.*), and honeysuckle (*Lonicera sp.*).

Inositol – decreases blood cholesterol levels; it is found in strawberries (*Fragaria sp.*), apples (*Malus sylvestris*) and other fruits. [9]

1.2 Importance of nut plants

Nut plants include cedar pine, Siberian cedar (*Pinus sibirica*), Korean pine (*P. koraiensis*), elfin cedar (*P. pumila*), Circassian walnut (*Juglans regia*) and Manchurian walnut (*J. mandshurica*), hazel (*Coryllus sp.*), pistachio (*Pistacia vera*), almond (*Prunus sp.*), sweet chestnut (*Castanea sativa*), oriental beech (*Fagus orientalis*), hornbeam (*Carpinus sp.*), oak (*Quercus sp.*). However, only three plants have industrial importance: Siberian cedar (*Pinus sibirica*), hazel (*Coryllus avellana*) and Circassian walnut (*J. regia*), which account for more than 98.4%, including Siberian cedar (*P. sibirica*) close to 80 % of the total mass of nut crop. [10]

1.2.1 European hazel (Coryllus avellana)

General description

European hazel is a large shrub with branched stems up to 7.3 meters high. The leaves are alternate, rather large, rounded, with short tip on apex, cordate base, duplicodentate on margins and in addition, at the upper part with a few large indentions, slightly drooped, dark green above, and paler below. Fruits – nuts, with a dense nutshell, surrounded by a green leaf-shaped spathe – cupule formed from spread out bractlets. Nuts are crowded by 2-5, rarely solitary. The nuts are light brown with a shape from oval to almost spherical, length of 10-18 mm and diameter of 8-15 mm.

Picking and stocking

The nuts are picked in autumn at maturity stage. Nutting is started with the first appearance of the fruit separation from the cupule; the nuts are picked with cupules by manual tearing. The nuts are dried by spreading as a layer of 3-4 cm; and mixing the nuts 2-3 times a day for 7-10 days. The nuts are separated from the cupule by shaking in sacs. The rest are winnowed on a winnowing machine. [11]

Table 1.6 Nutritive value and medical properties of European hazel (Coryllus avellana)

Nutritivevalue	
Calories	653 kcal
Proteins	13 g
Fats	62.6 g
Carbohydrates	9.3 g
Dietaryfibers	6 g
Organicacids	0.1 g
Water	5.4 g
Saturatedfattyacid	4.5 g
Mono- anddisaccharide	3.4 g
Starch	5.9 g
Alkali	3.6 g
Vitamins	
Vitamin PP	1.1 mg
Beta-carotin	0.042 mg
Vitamin A	7 microgram
Vitamin B1 (thiamine)	0.46 mg

Vitamin B2 (riboflavin)	0.15 mg
Vitamin E	21 mg
Vitamin PP (niacinequivalent)	4.7 mg
Macro- andmicroelement	
Calcium	188 mg
Magnesium	160 mg
Sodium	3 mg
Potassium	445 mg
Phosphorus	310 mg
Iron	36 mg

1.2.2 Circassian walnut (Juglans regia)

General description

This deciduous tree is up to 20-35 m with a highly developed root system. Fruit – a dry drupe with fleshy inedible cupule, which dries out and cracks when it ripens. The fruit size may be small, medium and large. Shape – round, oval, oblong-oval, oblong, flattened laterally, ovoid, etc. The surface of the shell/scale is almost smooth, fine and coarse wrinkled, sometimes grumous with numerous cells. [12]

Picking and harvesting

The nuts are harvested both fully ripe and immature. Immature nuts are harvested in June (when they reach the size of ripe fruit, but their valves are not woody and the walnut can be pricked with a needle). The fruits are harvested as they mature (3-4 times per season) by flicking with special poles (with hooks on the ends). Gathered nuts are purified from the outer shell, quickly washed and dried in the sun or in the dryer. In a dry place with a temperature of 10 degrees they can be stored for a year and in the refrigerator at zero degrees temperature - 2-4 years. [13]

Table 1.7 Nutritive value and medical properties of Circassian walnut (Juglans regia)

Nutritive value	
Calories	656 kcal
Proteins	16.2 g
Fats	60.8 g
Carbohydrates	11.1 g
Dietary fibers	6.1 g
Water	3.8 g
Saturated fatty acids	6.2 g
Mono- and disaccharides	3.9 g
Starch	7.2 g
Alkali	2 g
Vitamins	
Vitamin PP	1.2 mg
Beta-carotin	0,05 mg
Vitamin A	8 micrograms

Vitamin B1	0.39 mg
Vitamin B2	0.12 mg
Vitamin B3 (pantothenic)	0.8 mg
Vitamin B6 (pyridoxine)	0.8 mg
Vitamin B9 (folic)	77 micrograms
Vitamin C	5.8 mg
Vitamin E	2.6 mg
Vitamin K (phylloquinone)	2.7 micrograms
Vitamin PP (niacin equivalent)	4.8 mg
Macro- and microelements	
Calcium	89 mg
Magnesium	120 mg
Sodium	7 mg
Potassium	474 mg
Phosphorus	332 mg
Chloride	25 mg
Sulphur	100 mg
Iron	2 mg
Iodine	3.1 microgram
Zinc	2.57 mg
Manganese	1.9 mg
Selenium	4.9 microgram
Fluorine	685 microgram
Cobalt	7.3 microgram
Copper	527 microgram

1.2.3 Pine nut (Pinus sibirica)

General description

Pine nut is the common name of seeds for several species of plants from pine genus with edible seeds. Modern experts distinguish two kinds of these nuts, namely, taiga and solid or small or large. In Russia, these nuts are often referred to as the Siberian cedar pine seeds, which are ever-green and reaches a height of 35 to 44 meters. [14]

Picking and stocking

Siberian, Korean and European cedars are grown in Russia. But the stocking of nuts occurs mainly in the Siberian forests.

At present the gathering is prohibited in Russia because of damage to trees. The main way of commercial harvesting of pine nuts is the picking up of fallen cones (fallers). It is forbidden to use a split to prevent the damage of fruit-bearing branches in the crown. The cutting of fruit-bearing trees with a purpose to get the nuts is prohibited too. [15]

To get nuts pine cones are usually broken up or crushed. Then the nuts are separated from the rubbish, scales and dried. Drying should be done in a room at a temperature no lower than 35 ºC

and at low humidity. The nuts are stored in a cool dark place; the duration of storage should not exceed one year. [16]

Table 1.8 Nutritive value and medical properties of Pine nut (Pinus sibirica)

Nutritive value	
Calories	674 kcal
Proteins	23.7 g
Fats	60 g
Carbohydrates	20.5 g
Vitamins	
Vitamin PP	4.37 mg
Vitamin B1 (thiamine)	33.82 mg
Vitamin B2 (riboflavin)	88.05 mg
Vitamin B5 (pantothenic)	0.21 mg
Vitamin B6 (pyridoxine)	122.4 mg
Vitamin C	2 mg
Vitamin E	0.05 mg
Vitamin PP (niacin equivalent)	8.3042 mg
Macro- and microelements	
Calcium	8 mg
Magnesium	234 mg
Sodium	72 mg
Potassium	628 mg
Phosphorus	35 mg
Iron	3.06 mg
Zinc	4.28 mg

1.3 Mushroom usage

Mushrooms are very wide group of organisms that counts around 100 thousand species. Among all this variety only 10-15 thousands of mushroom species of edible and medicinalmushrooms have an economic value (cepe *(Boletus edulis),* chanterelle *(Cantharellus cibarius),* polypore *(Inonotus obliquus)* etc.).

Mushroom classification

All mushrooms can be divided into 4 groups: edible, inedible, conditioned edible and poisonous.

First group of edible mushrooms consists of mushrooms, which do not contain poisonous substances. According to their nutrition and economic value these mushrooms are divided into four categories:

1. B. edulis, Lactarius resimus, L. deliciosus

2. Leccinum percandidum, L .scabrum, Suillus sp., Psephenidae sp.

3. Xerocomus sp, Suillus bovinus, Lactarius necator, L. flexuosus, Psephenidae sp., Pieridae sp., Laserpitium sp., Russula sp., Vulpecula sp., Armillaria sp

4. Lactarius subdulcis, L. rufus, L. vellereus, Tricholoma equestra

To the second group of inedible mushrooms we can refer mushrooms which do not contain poisonous substances, but they have unpleasant smell and bitter taste. These mushrooms do not lead to intoxication but they can be a reason for some light indigestion.

Conditioned edible mushrooms are the mushrooms, which contain poisonous irritating matters, but these matters can be destroyed during the processing. They are ready for being consumed after seething, sometimes soaking, pickling and drying.

Poisonous mushrooms contain poisonous substances in their fruit bodies on all stages of development – toxins. There are three categories of poison that mushrooms contain. First one is poisons of topical action. They lead to indigestion (light intoxication). The signs of intoxication appear in 1-2 hours. Some edible mushrooms can be the cause for light intoxication in case they are undercooked.

The second category includes poisons which affect the nerve system, for example contained in *Amanita muscaria*. The signs of intoxication reveals in 0.5- 2 hours in a form of vomits, sweating, pseudesthesia, fainting, etc. In sometime the symptoms disappear but bed rest and consultation of a specialist are needed.

The third category includes poisons which lead to death. Death cup *Amanita* contains it. The process of intoxication starts in 8-48 hours. It affects brain centres that regulate organ functioning that leads to destruction of the organism. [17]

Such mushroom division is nominal as human reaction is quite individual.

According to the ways of nutrition 5 groups are revealed:

1. **Xylophiles.** It consists of 2 subgroups: parasitic fungi (tinder (Fomes fomentarius), honey fungus (Armillariella mellea)) and saprophytic fungi, which can be found on decaying wood

2. **Edaphic saprophytes.** They can be found in the forest or on open areas (champignon, fairy ring fungus)

3. **Myccorrhizal fungi.** They live in symbiosis with plant roots (Boletus edulis, Leccinum scabrum, L. Percandidum, Xerocomus sp., Russula sp.)

4. **Coprophilic fungi.** They can be found on manured ground (Coprinus sp.)

5. **Charbophilic fungi.** They grow on conflagrations. (Pholiota carbonaria) [18]

Factors that influence mushroom productivity and growth

There are no strict periods for mushroom harvesting because it depends on the hydrothermal regime of the environment. The optimum for mushroom gathering is a year with lots of rain, warm weather from May up to August and a dry autumn without light frost. The biological characteristics of every species of mushrooms define its harvest period, which is nearly the same every year. In

every forest the productivity depends primarily on the richness of the area and the age of the trees. Young stands at the age of 15 or 30-40 years are considered to be the most productive areas for mushroom growth. An additional factor is a warm and thin layer of the forest floor. In plantations where trees are older than 40 years the debris layer is quite thick and the warming up process is very slow. In such places you should look for sparse stands, e.g. forest borders. While thinning stands the conditions for mushrooms are improving. Glades also can be referred to areas preferred by mushrooms. It is known that after some years with good harvest a break takes place. With regard to the level of damage made by insects operating stock is considered to be 50 % of biological biomass.

Due to the close connection of mushrooms to environmental factors, their existing will be influenced also by other activities of using natural resources. For example, pasturing by cattle and other animals in forests or open areas, strongly breaks successional processes on these areas and, therefore, promotes or prohibits the existence of specific mushroom species. [19]

Table 1.9 The places of common growth of mushroom [19]

Kinds of mushrooms	Types of common growth
Cepe (*Boletus edulis*)	Birch, spruce, pine and mixed mature and over mature grass and moss, humus-rich stands of trees. Exceptions: aspen forests, wetlands, forests with high grass and moss porous, dense blueberry and cowberry.
White agaric (*Lactarius pubescens*)	Young birch and mixed coniferous-birch forests of low density, meadows with low grass, hay, wet places. It forms mycorrhiza with birch.
Milk mushroom *(L. resimus)*	Birch, but more often pine-birch or birch-spruce forests, light soils in composition. It forms mycorrhiza with birch.
Yellow chanterelle *(Cantharellus cibarius)*	Sparse birch, aspen forests and forest edges. Pine and birch forests, dry patches and moist forests with developed moss and lichen rocky pine forests. It forms mycorrhiza with birch, spruce and pine.
Yellow, annulated or late boletus *(Suillus luteus)*	Young pine forests, forest edges, burned-out forests. It is found along roads and forest trails. It forms mycorrhiza with pines, larch.
Granulated boletus *(S. granulatus)*	Young pine stands of low density, old rose, sedge, forbs.
Honey mushroom *(Armillariella mellea)*	Forests of different tree species by composition. It is found on stumps, fallen trees and trunks of living trees. Especially abundant in the forest clearings and windfall sites.
Rough boletus *(Leccinum scabrum)*	Birch or mixed forests with birches. It forms mycorrhiza with birch.
White boletus *(L. holorus)*	Waterlogged sphagnum birch. It forms mycorrhiza with birch.
Black boletus *(L. Melaneum)*	Net birch or moist forests mixed with other species. It forms mycorrhiza with birch.
Reddish-brown bBoletus *(L. testaceoscabrum)*	Dry middle-aged birch and mixed forests with birch wood. It forms mycorrhiza with birch.
Red boletus *(L. aurantiacum)*	Mixed aspen with no tall grass. It forms mycorrhiza with aspen, sometimes with other species of poplar, birch, pine, spruce.
Orange agaric *(Lactarius deliciosus)*	Young spruce and pine forests. It forms mycorrhiza with spruce and pine. It grows singly and in groups, on a sunny, bright area on the edges of forest roads, forest edges. It prefers areas with compacted soil and a thin layer of the forest floor.

Time for mushroom gathering

The first wave or the first layer (1-2 week period) appears in third decade of May – first decade of June. It is the time of blossom of chokeberry, ear formation. In a small amount on sunny areas cepe *(Boletus edulis)*, brown cap boletus *(Leccinum scabrum)* and russule appear *(Russula sp.)*.

The second wave of mushrooms (2-3 weeks) starts in the second part of July and coincides with willow weed blossom. It is the time for winter crops harvest.

The third wave is long-lasting – from the middle of August to November. The highest productivity of this period is the period of yellowing leaves (September). During this period fruit bodies of all the edible and poisonous mushrooms can be found. [1]

Table 1.10 The calendar of mushroom gathering [4, 20]

Specific name	May			June			July			August			September			October		
Cepe *(Boletus edulis)*							G	G	G	G	G	G						
Coral milky cap (white) *(Lactarius pubescens)*									G	G	G	G	G					
Coral milky cap (pink) *(L. torminosus)*									G	G	G	G	G					
Milk Mushroom *(L. scrobiculatus)*												G	G	G	G			
Milk Mushroom *(L. resimus)*										G	G	G	G	G	G			
Milk Mushroom *(L. necator)*										G	G	G	G	G				
Boletus *(Boletus luridus)*							G	G	G	G	G							
Chanterelle *(Cantharelhis cibarius)*							G	G	G	G	G	G	G					
Annulated mushroom *(Suillus luteus)*						G	G	G	G	G	G	G	G	G				
S. variegatus									G	G	G	G	G	G				
Xerocomus subtomentosus									G	G	G	G						
Kuehneromyces mutabilis					G	G	G	G	G	G	G	G	G					
Pholiota aurivella										G	G	G	G	G	G			
P. squarrosa												G	G	G				
Brown cap boletus *(Leccinum scabrum)*							G	G	G	G	G	G						
Orange cap boletus *(L. percandidum)*				G	G	G	G	G	G	G	G	G	G					
Saffron milk cap *(Lactarius deterrimus)*												G	G	G				

Saffron milk cap *(L. deliciosus)*												G	G	G				
Morel *(Morchella conica)*		G	G															
Morel *Gyromitra esculenta*		G	G															
G. esculenta	G	G	G	G														
G. gigas	G	G	G	G														
Russule (*Russula fragilis*)									G	G	G	G	G	G				
Russule *(R. vesca)*									G	G	G	G	G	G				
Russule *(R. aeruginea)*										G	G	G	G	G	G			

G − the time of mass gathering mushrooms

Rules of mushroom gathering

Mushrooms should be gathered without mushroom spawn. While gathering mushrooms from *Boletus* and small mushrooms with short bodies they should be cut, while gathering Agarics it is possible to pluck, because such kind of mushrooms can be easily broken at the place where the mushroom body is connected with the spawn.

While gathering shelf *(Inonotus obliquus)* the fungus bodies should be axed from the trees, the spongy and light-colored part is cut and only the external, hard middle part is left. It should be cleaned from wood remains.

Nutrition value of mushrooms

Mushrooms are considered to be a very important product. They contain lots of proteins, fats and sugar, minerals, phosphorus, ferrum and even zinc, manganese, iodine, cuprum and vitamins A, B1, B2, C, D and PP1. Mushrooms contain more proteins than some vegetables and fruits. One kilo of Cepe contains proteins that in its amount exceed 2 times the amount of proteins in beef and three times the amount in fish. Mushrooms also contain fats which acceptability is 95 %, that coincides with the acceptability of animal fats. Dry cepe *(Boletus edulis)* are more caloric than eggs and sausage and mushroom broth is more caloric than those made of meat.

But not all mushroom parts are equally nutritive. In mushroom caps is less fungin, but there is a high level of aromatic substances, therefore they are better digested. Acceptability of mushroom bodies is much lower, because they contain more fungin.

Table 1.11 The content of trace elements in mg / kg air-*dry matter [21]*

Kinds of mushrooms	Fe	Zn	Mg	Cu	Ni	I	Co	Mo
Boletus edulis	216	91.7	35	19.8	3.3	0.17	1.10	0.02
Lactarius pubescens	130	75.0	66	12.9	3.4	0.11	0.15	0.02
L. tormmosus	282	158.8	45	12.6	5.3	0.17	0.08	0.02
L. resimus	68	40.8	25	46.0	1.7	0.10	0.07	0.02
L. necator	86	59.0	55	25.3	4.2	0.20	0.21	0.02
Lycoperdon perlatum	116	181.1	34	89.2	2.2	0.29	0.06	0.16
Tricholoma equestre	164	9.9	34	33.3	1.9	0.49	0.06	0.02
Macrolepiota procera	216	60.4	26	61.0	2.5	0.19	0.08	0.10
Xerocomus subtomentosus	137	52.6	29	7.1	3.2	0.12	0.20	0.06
Armillariella mellea	189	25.6	30	14.4	5.2	0.09	0.07	0.02

Leccinum scabrum	194	175.1	35	20.5	5.2	0.92	0.18	0.09
L. versipelle	204	51.4	37	40.5	4.4	2.00	0.76	0.04
Lactarius sp.	262	129.9	42	24.1	2.2	0.90	0.07	0.02
Tricholoma albobrunneum	530	290.8	97	31.0	6.7	0.16	0.12	0.18
Lactarius flexuosus	110	205.5	38	25.4	2.0	0.12	0.08	0.02
Stropharia semiglobata	218	118.7	46	66.2	3.2	0.26	0.30	0.03
Russula vesca	205	114.7	40	55.3	1.9	0.16	0.09	0.02
Agaricus campestris	130	158.4	38	100.0	7.4	0.38	2.00	0.75

Table 1.12 The chemical composition of fresh mushrooms,% *[21]*

Kinds of mushrooms	Water	Protein	Fat	Carbo hydrates	Fibre	Ash	Energy value, kDzh/100 g
Boletus edulis	89.4	3.7	1.7	1.1	2.3	0.9	96.6
Leccinum scabrum	91.6	2.3	0.9	1.4	2.1	0.7	96.6
Lactarius resimus	88.0	1.8	0.8	0.5	1.5	0.4	67.2
Suillus sp.	83.5	2.4	0.7	0.5	1.2	0.5	37,8
Armillariella mellea	90.0	2.2	1.2	0.5	2.3	1.0	71.4
Leccinum percandidum	91.1	3.3	0.5	1.2	2.5	0.8	92.4
Lactarius sp.	88.9	1.9	0.8	0.5	2.2	0.7	71.4
Gyromitra esculenta	92.0	2.9	0.4	0.2	0.7	1.9	67.2
Russula vesca	88.0	1.7	0.7	1.5	1.4	0,6	63.0
Agaricus campestris	91.0	4.9	1.01	0.1	0.9	1.0	113.4

Technology of mushroom conservation

To prepare mushrooms the following types of processing are used – drying process, pickling, vinegar pickling and freezing.

Drying process

Drying process is one of the simplest way of mushroom processing. Dry mushrooms can be stored for long time without loss of taste and aroma. Mostly Cepe *(Boletus edulis)*, Orange cap boletus *(Leccinum percandidum)*, Annulated boletus *(L. scabrum)*, and morels *(Morchella sp.)* are dried.

For being dried only fresh, hard and healthy mushrooms are taken. They are cleaned from sand, earth, leaves and needles. Gathered mushrooms are cleaned by the wet capron material and they are sorted according to their size. It is forbidden to wash mushrooms before drying, because

they may adsorb lots of water and can be spoiled. The bodies should be cut at a distance of 1.5-2 cm from the cap.

Mushrooms can be dried in the sun, in an oven, in a bake oven and even upon the cooker. Before all these methods of drying the mushrooms are put into an oven for 2-3 hours at the temperature of 40-50 degrees, and later the temperature is increased up to 60-70 degrees.

When drying in the sun the mushrooms are put on cords and they are hung separately. The drying process should be constantly watched. In case of rain and during the night, when the humidity level increases, mushrooms are taken indoors.

The best place for drying mushrooms is the Russian oven, because the quality of the final product is very high. Prepared mushrooms are put with their tops on the sieves or plating or they are put on big needles. After that they are placed into the oven at a temperature of 60- 70 degrees. It is not recommended to start the drying process at high temperature, mushrooms can be cooked or burned. At lower temperature the drying process is very slow, they can be spoiled.

To dry mushrooms in the bake oven 2 or 3 lattices are needed. These lattices are used instead of dripping pans. They are made of wire with broad holes. The mushrooms are equally distributed on the lattices and put into the bake oven at a temperature of 60-70 degrees. The door of the oven is half-opened for better air circulation. [1, 22]

Salting process

All the Agarics are good for salting. Sometimes Aspen mushrooms and Cepe can be processed that way. There are two ways of salting: cold and hot.

Cold salting. Cleaned and washed mushrooms are soaked in a cold room for 2-5 days in a cold salty water. The water should be changed 2-3 times in 24 hours in order that the mushrooms do not turn sour. The period of soaking depends on the level of laticife and their bitterness. For example, milk mushrooms *(Lactarius resimus)* should be soaked for 3-5 days while orange milk cap *(L. deliciosus)* should not be soaked at all, they are needed to be washed. When bitterness in the mushrooms disappears they are ready for being salted. Then the mushrooms are put into vessels like barrels, glass bottles or loam banks with their tops down, layers should be 5-8 cm thick, and between every mushroom layer should be a thin layer of salt. In domestic conditions the amount of salt is 3% to total mushroom weight. In the factories while mass mushroom production the amount of salt can be increased up to 4-5%. At the bottom of the barrel and on the top of mushrooms pepper and laurel leaf are placed at the rate of 20 gm of laurel leaf and 10 gm of allspice on 1 kilo of mushrooms. While making home-made mushrooms it is possible to add garlic, dill, black currant leaves or clove. Then the vessel is covered, and on the top of the cover a tightening weight is placed. Metal stuff, bricks and lime stones cannot be used as tightening weight. After 2-3 days the surplus of salt solution is poured out and new portion of mushrooms is added. This operation is repeated until the process of sedimentation is over, when the barrel is totally full. If in 3-4 days the surplus doe not appear the tightening weight should be increased. Saffron milky cap *(L. deliciosus)*, which is made by cold salting, can be consumed in 5-6 days, milk mushrooms *(L. resimus)* in 30-35 days, coral milky cap *(Psephenidae sp.)* in no less than in 40 days, for some mushrooms it takes near 50 days.

Hot salting. It differs from cold salting only in one point: before salting the mushrooms are preheated. Washed mushrooms are boiled in salty water. The boiling time is different for different types of mushrooms, for example, for cepe 10-15 minutes is needed but for saffron milky cap it needs just to pour boiled water on them. The flesh of some mushrooms is very fragile, that's why the best way to salt them is hot salting. After 5-8 minutes of boiling in hot water the flash of the mushrooms becomes elastic. After pre-boiling the mushrooms are put into a sieve, the water comes out and after that they are salted in a cold way.

Cepe *(Boletus edulis)* and aspen mushrooms *(Leccinum percandidum)* are salted very rarely. Only small, hard, young mushrooms are suitable for salting. Their tops are cut from the bodies, then caps are washed and boiled for 10 -15 minutes, after that they are poured with cold water and when they are dried they are put into barrels, with salt at the rate of 2.5 gm on 1 kg of mushrooms. Then procedure continues according to the rules described above.

Saffron milk cap mushrooms *(Lactarius sp.)* are not boiled or soaked, becausetheir aroma is needed to be saved. The amount of salt for one kilo can be reduced up to 20 gm. While cold salting, this type of mushrooms becomes dark. That is why it is better to salt them in the hot way. They save their color and remain hard.

Milk mushrooms are very tasty when they are salty. Before consumption small salted milk mushrooms (cap diameter 2-3 cm) are put into cold water for 6-8 hours. Then the mushrooms are drained, dried and put into vessels. Salty mushrooms should have a pleasant taste and smell, which is characteristic for a particular mushroom type, the flesh should be hard and the caps undamaged and clean. Foreign flavors and smells are not allowed. While passing ready mushrooms to the processing places it is important to remember that different species of mushrooms should be separated from each other. The rate of broken mushrooms should not exceed 5-12%, for russula – 15%. The amount of sand should not exceed 0.1 %. At the very beginning the salt solution is very dark and waterish, but after some time it becomes lighter and thicker. It is needed to store such mushrooms in a cold place at the temperature from 0 to +8 degrees.

If the temperature will be low, the mushrooms will become fragile and will start to crumble. in the case of the temperature being higher than +8 degrees the mushrooms can become sour. [1, 23, 24]

Vinegar pickling

Mushrooms are cleaned from sand and needles before. If the amount is big, then the mushrooms are sorted according to their type. If it is not for mass production, then the mushroom caps and bodies are separated and cut into 3-4 pieces. Bodies are pickled separately from the caps. It is recommended to remove the tissue from the caps of annulated boletus. Other mushrooms from the boletus family are better hit with boiled water and washed with cold water, otherwise they will become dark. Some mushrooms are just needed to be boiled in salty water before pickling. Mushrooms of different types should be pickled separately. For example, if Aspen mushrooms (*Leccinum percandidum)* and annulated boletus *(L. scabrum)* are pickle in the same vessel, then boletus will become dark. If rough boletus is boiled together with the orange cap boletus the first one will be overcooked – the second one will be undercooked. Big caps will be ready faster than small ones, therefore they should not be cooked together. [25]

Freezing process

Freezing is one of the best methods to process mushrooms for the future use.

Only hard and small mushrooms are suitable. The temperature in the freezing room should be -18 or lower. First the mushrooms are put into the freezing cameras and afterwards into plastic bags, which should be hermetic, because during the freezing process the mushrooms can fade and lose the water so as the quality.

Brown cap boletus *(Leccinum scabrum)*, Orange cap boletus *(L. percandidum)*, and Cepe *(Boletus edulis)* are not recommended to be washed before freezing because the first layer of the caps adsorbs lots of water. They should be wiped with a wet sponge. It is recommended to dice big mushrooms. Boiled or fried mushrooms can be frozen.

Tastiness of frozen mushrooms after the defrost process directly depends on the freezing process. Mushrooms are defrosted at room temperature. It is forbidden to hit them with boiled water and to defrost on the open fire. [26]

1.4 Preparation of medicinal herbs

Main types of medicinal plants

All the necessary information can be found on the next web-sites: http://medgrasses.ru/, http://www.belena.biz/. [27, 28]

Table 1.13 Parts of medicinal plant and period of their gathering [29]

Part of the plant	Gathering period	Rules of gathering	Precaution
Grass	At the period of the beginning or full flowering	Plants with thin, softwood stalks can be cut off directly over the ground. At the rough stalks – only the tops. If the same plant is used for gathering two or three times a year it is necessary to leave some parts of a plant, thus it can develop new shoots. The higher it is cut off, the faster it grows	It is not recommended to tear off the plants with hands as it can be taken out with its root
Flowers	At the period of maximum flowering	Gathering of flowers needs to be done always during afternoon, in good weather, at least once a day; in hot days – twice a day. If medicinal raw materials are flower petals, they are collected accurately and put in baskets. Small inflorescences in the form of a head or the baskets are taken one by one, at the basis of a stalk or together with a stalk which is no longer than 1 cm, and they are put into baskets. Umbels are cut by scissors or secateurs. Flowers in the bushy inflorescences, blossoming in different time: gradually from the bottom to the top, are collected several times from the same plant during full blossoming	Faded, degraded, and damaged flowers are not good for gathering
Leaves	Before or during blossoming period	Leaves of spring plants used for salads in the fresh form (nettle *(Urtica sp.),* dandelion *(Taraxacum sp.)*, primrose *(Primula sp.)*) are preferably collected when they were hardly came out, soft, gentle-green, - they already	Faded, degraded, leaves and those damaged by insects are not suitable for gathering

		contain all necessary elements in the highest concentration. Leaves are broken with hands; usually developed, low and middle-sized stem leaves are collected	
Roots and rootstocks	During late autumn after seeding or in early spring	Gathering of roots and rootstocks is made as follows: they are dug out by a shovel or a special pitchfork in the distance of 10-15 cm from a stalk. It is impossible to pull out roots, they will brake and the bark and lateral roots can be scratched. A part of underground bodies always stays for the further vegetation, and the roots are covered with soil. After excavation the soil is shaken off from roots and rootstocks , they are cleaned from small roots and the rotten parts. Some roots are immediately washed in water, then dried. Other roots shouldn't be washed, as together with water they lose valuable medical elements	At gathering roots and rootstalks it is important to remember that they cannot be soaked even for a short period of time
Fruits	The beginning of ripening	Fruits, which can be easily crushed, are collected with the whole fruit system, for example berries of elder. All fleshy fruits should be collected during dry sunny days. Dried fruits are well stored; however their gathering is complicated because of non-simultaneous maturing of fruits on the same plant. The ripening period can be long and on plant blossoms can be fruits near to already ripened, which fall down. To avoid loss, the first ripening umbels are separately cut off, especially if the plant contains valuable substances. During such gathering of fruits only high quality product can be taken. When the majority of fruits are ripe, the whole plant or tops with fruit systems are cut and tied into bunches. When other fruits ripen, bunches are threshed on panels specially placed under them, then fruits are spread to a thin layer and left on the air. Different impurities are taken away, e.g. leaflets, garbage, etc. Gathering of dried fruits is done differently. They are taken during cloudy days and before dew disappears, thus they do not fall down. Seeds are collected before full ripening of the fruits in order to avoid loss (after ripening they drop out of them)	Overripe and wet fruits can be easily crashed, turn mold and spoil
Buds	They are gathered in early spring before gemmation, when they are swollen. During this period they are rich with elements. Gathering is finished when the bud starts to open	Birch buds are broken from tree branches or taken from dried up ones, small branches and shoots, which are intended to become brooms, are cut. After that they are separated from the branches and some mouldy parts and are sorted	Buds are taken mostly from cut trees during weeding of young forests. The number of gathered buds depends on the amount of cut trees. To gather buds from growing tress is forbidden and it is considered to be a crime
Bark	In spring only	Bark is taken from young, longstanding, over	It is possible to take bark off

	from young brunches. When buds swell is the best period for disbarking, because only at this time it comes off from a stem	ground shoots, sometimes from stems, roots of trees and bushes. The bark should be clean and glade, smooth and glassy. First of all the shoots should be cleaned from side brunches, next a cut is made across the shoot for about 20-30 cm. After a cut is carried out along the shoot stalk and then the barkit is hooked using a knife and taken away. The taken bark resembles pipes	from trees and bushes, which fell after cutting and at places, where collection of bark is permitted by administration

The rules of preparation

When preparing of annual plants it is necessary to leave some part of plantings untouched – for next year production and sowing.

When preparing longstanding plants it is necessary to leave the root system, separate parts of the plant and separate plants entirely for vegetative and seed reproduction. On the same area the preparation of a given plant can be repeated only after some years.

Preparation of raw materials should be done during dry, sunny weather and at a certain time depending on the plant species.

It is impossible to gather very dusty or polluted over ground parts of plants, which grow near roads, near industrial enterprises, etc.

It is not recommended to stuff freshly plucked plants into bags, boxes and other containers, because the bark can be deformed, warmed up, or become caked. The bark can losethe characteristic smell and color, get brown or become unsuitable for medical application.

The rules of drying

Drying can be warm (with artificial heating in oven) and airy (under natural conditions in the sun), which is used to prepare the majority of herbs, leaves, flowers and buds. Airy drying in the shadow is done under a shed with good ventilation. The material is placed in a thin layer and constantly turned. Different material types need a different regime of drying. Rhizomes and roots are dried in the sun or by the method of warm drying at a temperature of 50-60°C. Herbs, that contain essential oils, need to be dried at a temperature of 30-35°C, but not higher, otherwise oils can evaporate. Materials which contain vitamin C (wild rose *(Rosa sp.)* and hawthorn *(Crataegus sp.)*) are dried at high temperature of 80-90 °C. Dried material should not stick or be cracked while squeezing. Dry fruits and seeds are prepared in the sun or in dryers, glycosides (marsh gilled *(Adonis vernalis)*, May lilies *(Convallaria majalis)*) at 55-60°C, the high temperature prevents action of enzymes as well as medicinal elements, which can destroy these glycosides. [30]

Natural drying is a drying process using the of warmth of sun rays. This method is the simplest. It can be done sunny and shady. When leaves are dried in the sun, the contained chlorophyll is destroyed and they turn their color into brown. Flowers also lose their color, the number of active elements is decreased. Some berries can be dried in the sun and next put into an oven or special oven at the temperature of 60-80 °C.

Solar drying is mostly used for roots, fruits and bark of some medicinal plants. Washed materials are dried from water. The drying process takes place on open space – canvas, layers or paper

- but not newspapers – are used, where parts of the plant are distributed in a thin layer. The main condition of such kind of drying is a strong ventilation.

Air curing is done in ashed, on the attic under an iron roof, in air-dryers, installed in the sheds. The materials is put on shelves with wired or gauzed net. The main requirement is a good ventilation. In such way leaves, grass and flowers can be dried. Layers should be 1-2 cm thick and should be turned 1-2 times per day. Parts of plants which have a smell are dried separately from the materials without any strong aroma. During the drying process the major amount of water evaporates: from grass- 70 %, from leaves – 80%, from lowers – 75%, roots – 65%, bark - 45%. [1]

Table 1.14 The calendar of preparation of medicinal herbs [4, 31, 32]

Specific Name	February	March	April	May	June	July	August	September	October
Spring Adonis *(Adonis vernalis)*				Grass					
Sweet flag *(Acorus calamus)*						Grass			
Crystal tea ledum *(Ledum palustre)*				Leaved brunches					
Black henbane *(Hyoscyamus niger)*					Leaves				
Pendent White Birch *(Betula verrucosa)*				Leaves and buds					
Red hawthorn *(Crataegus sanguínea)*				Flowers and fruits					
Cowberry *(Vaccinium vitis-idaea)*			Leaves						
Heliotrope *(Valeriana officinalis)*							Roots and rootstalks		
Bachelor's-button *(Centaurea cyanus)*						Flowers			
Bean trefoil *(Menyanthes trifoliata)*				Leaves					
Pepper plant *(Persicaria hydropiper)*						Grass			

Marsh-pepper smartweed *(P. hydropiper)*					Grass				
Lady's thumb *(P. maculosa)*						Grass			
Common melilot *(Melilotus officinalis)*						Grass			
Common origanum *(Oiíganum vulgare)*				Grass					
Garden angelica *(Archangelica officinalis)*					Roots				
Grey wormseed *(Erysimum diffusum)*						Grass			
Delphinium *(Delphinium dictyocarpum)*						Grass			
John's wort *(Hypericum perforatum)*					Grass				
Wild srawberry *(Fragaria vesca)*					Leaves and fruits				
Calendula *(Calendula officinalis)*						Inflorescence			
Cranberry *(Viburnum opulus)*								Bark and fruits	
Great nettle *(Urtica dioica)*				Leaves					
Common groundse *(Senecio vulgaris)*							Grass and roots		
Burnet bloodwrt								Rootstalk	

(Sanguisorba officinalis)									
Alder buckthorn *(Fraangula alnus)*			Bark						
Tillet *(Tília cordata)*					Flowers				
Bastard toadflax *(Linaria vulgaris)*						Grass			
Burdock *(Arctium lappa)*				Roots					
Common raspberry *(Rubus idaeus)*						Fruits			
Foalfoot *(Tussilago sp.)*				Flowers and fruits					
Juniper *(Juniperus sp.)*						Berries			
Tule mint *(Mentha arvensis)*						Grass			
Common dandelion *(Taraxacum officinale)*				Grass and roots					
Common comfrey *(Symphytum officinale)*				Roots					
Lady's purse *(Capsella sp.)*				Grass					
Tansy *(Tanacetum sp.)*						Inflorescence			
Peony *(Paeonia anomala)*				Roots					
Siberian fir *(Abies sibirica)*				Buds and needles					
Wolf's claws				Grass and spores					

(Lycopodium clavatum)									
Common plantain (*Plantago sp.*)				Grass					
Absinth sage *(Artemisia absinthium)*						Flowering tops			
Quinquelobate motherwort *(Leonurus quinquelobatus)*						Grass			
Wild Chamomile *(Matricaria recutita)*						Flowers			
Mountain Ash *(Sorbus aucuparia)*				Flowers and fruits					
Common licorice *(Glycyrrhiza sp.)*				Rhizome					
Scotch Pine (*Pinus sp.*)				Needles and buds					
Field caraway *(Carum carvi)*					Grass				
Mealberry *(Arctostaphylos uva-ursi)*					Leaves				
Milfoil *(Achillea sp.)*						Grass			
Black poplar *(Populus nigra)*			Buds						
Heartease *(Viola tricolor)*					Grass				
Field horsetail *(Equisetum arvense)*				Grass					

Horseradish *(Armoracia rusticana)*				Roots					
Thyme (*Thymus sp.*)					Grass				
Bur beggar-ticks (*Bidens tripartita*)						Grass			
Bird cherry *(Padus sp.)*				Flowers and fruits					
Blueberry *(Vaccinium myrtillus)*						Leaves and berries			
Celandine *(Chelidonium sp.)*					Grass				
Cinnamon rose *(Rosa majalis)*						Flowers an fruits			
Horse sorrel *(Rumex confertus)*								Root	

Curative effects

The curative effects of many kinds of herbs, which are applied now in medical practice, are connected with the presence of various biologically active substances in the herbs, which, when they enter a human body, have specific physiological effects. These physiologically active substances have various structures and refer to various classes of chemical compounds.

Alkaloids

Alkaloids are complicated natural nitrogen-containing compounds of various chemical structures which are contained in vegetative raw materials in the form of bases or salts. In the XX century segregation and unification of alkaloids was of very big importance for traditional medicine. In medicine the salts of alkaloids are used, becausethey are better dissolved in water and their physiological activity intensifies because of the increase in the level of its biological availability. The medical products that contain alkaloids actually occupy one of the most considerable places in the control system of physiological processes. They can affect the organism both of healthy and sick persons, and they play a significant role in the treatment of various illnesses. Pharmacological values of alkaloids are very wide, thus it is impossible to list them in detail. Schematically it is possible to present them as follows: tranquilizing and stimulating influence on central nervous system, hypertensive and hypotensive efect, vasoconstrictive and vasodilating influence on the cardiovascular system; the most various influences on media systems, functional activity of muscular system, etc.

In our native flora is a whole group of alkaloidal plants (pilocarpus, belladonna, periwincle, ephedra, tea, jug and many others), which are valuable raw materials for manufacture of various medical preparations. The amount of these compounds in plants often fluctuates depending on environmental conditions, time of gathering, stages of biological development of plants, and specificity of its cultivation. However, in most cases the greatest amount of alkaloids is defined during the period of budding and flowering of vegetative objects. It varies from absolutely insignificant quantities (traces of alkaloids) up to 2-3 % of the total weight of dry vegetative raw materials.

Glycosides

A big group of substances of anitrogenous nature, consisting of a sugary part (glycon) and non-sugary part (aglycon). Effects of glycosides are basically defined by their non- sugary part. Unlike alkaloids, glycosides can be destroyed by enzymes of plants at storage (auto fermentation) and by the influence of various physical factors. As enzymes can easily split glycosides the glycosides start to break up quickly and to lose their medical value, in the fresh-cut plants. Therefore, when gathering plants which contain glycosides, it is necessary to consider that the following: it is necessary to dry raw materials quickly and to prevent them from getting wet while storing, because the enzymes do not start to act when the material is dry. In medicine the following groups of glycosides are usually used: cardiac glycosides, anthraglycosides, saponins, bitterness, flavonoidal glycosides, etc. Cardiac glycosides are of great value. Till now among all means applied for treatment of diseases of the cardiovascular system vegetative preparations have the biggest share. To the plants that produce glycosides of cardiac action in their cells refer various kinds of foxglove, lily of the valley, and the Adonis. These plants are of great importance for treatment of the basic cardiovascular diseases. The plants which contain cardiac glycosides are considered to be poisonous be-

cause of high toxicity. The substances have steroid structure and they are close to hormones. Glycosides that have cathartic action are called anthraglycosides, They have wide application in medical practices and they are contained in buckthorn, aloe, pie plant, and others. Anthraglycosides are low-toxic, have red-orange color and can be stored for long time. Some plants which contain bitter glycosides are used in medicine as bitterness that raises appetite. Bitter glycosides are contained in dandelion, wormwood and others. Bitterness intensifies vermicular motion of the stomach and increase appearance of gastric juice, which stimulates digestion. More than 70 families contain saponins, where the primary ones are the pink family and the primula family. They are applied in medicine as expectorant (snakeroot, Jacob's-ladder), diuretic (bug tea), and choleretic (hypericum). Some plants which contain saponins can reduce arterial tension, lead to nausea, sweating. Recently flavonoidal glycosides have become of big importance. The name is given because of their yellow color, they refer to phenol connections. Flavonoidal glycosides contain vitamin P, produce germicide, have choleretic effect, and help to remove radioactive elements from the organism.

Coumarins and furocoumarins

These substances are contained in the plants in a pure form or as sugary compounds like glycosides. They are very difficult to be dissolved in water and they are very sensitive to light. Plants that refer to the parsley family, legume family contain it, especially in roots and fruits. 150 coumarin connections are known. For medicine furocoumarins are of great importance. They possess various pharmacological qualities. Some of them are used as vasodilator and spasmolytic remedy, others as antitumor remedy.

Essential oils

Essential oils are aromatic volatiles contained in different parts of plant, mainly in flowers, fruits and leaves.

Essential oils can be easily steam-distilled from plants. Visually these compounds look like fat oils, but according to its chemical content they cannot refer to oils since they are a mixture of different terpenoid substances and their derivatives. More than 2000 essential-oil containing plants are known (mint, valerian, mother-of-thyme, common origanim, melic, wormwood, salva, dill). The amount of essential oils depends on different aspects as biological peculiarities or climate. Therefore, it fluctuates from small traces up to 18-20% of the dry mass of the plants. The most typical pharmacological properties are anti-inflammatory, antibacterial, antivirus, and antihilmintic effects. Besides that some essential oils have influence on the cardio-vascular system and the central nervous system, have tranquilizing and pain-relieving properties, reduce blood pressure and influence brain and heart activity. Expectorant properties are known; essential oils initiate breathing and improve functions of the gastrointestinal tract. They are also used in the chemical-pharmacological industry to improve or change the taste and smell of medications (rose, mint, coriander and other essences) in food industry and distillery. Under the influence of oxygen and humidity the content of the essence can change – some components oxidize, they lose their smell, or the oils resinfy. Light also can lead to change in color and content, therefore it is necessary to follow the rules of gathering, drying, processing, storing and preparation of plants, that contain essential oils.

Resins

They are very close to essential oils according to its chemical structure. They are contained in the plants together with essence. Usually resins are thick and stick having typical smell. Liquid resins are called balsams. Coniferous plants as well as birch bud, roots of rhubarb and other plants contain lots of resin. Some of the resins have medicinal properties, mainly antibacterial and anti-hilmintic efffects. In medicine resins are used for making plasters, tinctures, sometimes they are taken in a pure form as a laxative remedy.

Tanning agents

Tanning agents are derivatives of polyatomic phenols and they are contained in nearly all plants. Tanning connections can be found in different parts of plants, especially in roots and wood of trees and bushes and also in some grass plants (oak, birch, bird cherry, John's wort, worm wood, blueberry, tansy). Tanning agents are low-toxic. Some plants that contain big amounts of tanning agents are used as astringents and antibacterial remedies at gastrointestinal diseases for gargling and alveolar pyorrhea. Anti-inflammatory effect of tanning compounds is based on interaction of protein components with tannins; eschar appears on mucous places that prevents from further development of the inflammatory process. Tanning agents which are applied on burnt parts, scratches and wounds stimulate eschar. Therefore, they are applied as styptic, anti-inflammatory remedies. Besides that these agents are used at alkaloid poisoning and salts of heavy metals. When interacting with oxygen, tanning agents oxidize and turn their color into red, dark red color and become insoluble in water (apples, potatoes, radish become red on the place of cut).

Vitamins

Vitamins are complex organic substances, of which a very little amount is needed for normal development of the human organism. Vitamins play the most important role in digestion and usage of main digestive elements – proteins, fats, carbohydrates. Under the deficit of vitamins some organs and even systems stop functioning, the productivity decreases. Nowadays 30 vitamins are known in nature. The majority of them can be found in medicinal plants. Animal organism needs to gain from outside 20 vitamins, others are synthesized in their organism. Physical and chemical properties of vitamin A, B1(thiamine), B2 (pyridoxine), B6, B12, B15, D, E, F, K, P (rutin), PP (nicotinic acid), ascorbic acid, inositol, choline, biotin. The human need in vitamins depends on his living conditions, work, health, season of the year, and other factors. Except enumerated active elements of medicinal herbs, curative properties can be explained by the presence of other types of chemical compounds (organic acids, fat oils, phytoncids, enzymes, mineral salts, microelements and others). In the majority of cases the curative effects are not connected with the single element but with the whole complex of elements. In this case the application of only one single active element does not result in the curative effect which can be received by the use of the whole plant or its extraction (for example valerian, wild rose, foxglove and others). [33, 34]

1.5 Preparation of timber saps (tapping of growing stocks)

Tapping is a usage of trees in order to get soft resin, latex, gum, sugary juice, and other products made of plants.

Nowadays, in Russia birch and maple tapping is widely spread for sugary saps extraction. To get resin coniferous species are used.

Rules of sap extraction

Birch and maple tapping is done in different regions of our country. It can be done in different ways, using different methods – from growing trees as well as from stubs.

Table 1.15 Preparation of sap extracted from deciduous (Birch and Maple) [1, 35]

		Notes
Birch sap extraction		
The place of extraction	Legal bodies and citizens should procure timber saps on the lands which belong to forestry according to the rules of the procurement of secondary forest resources and realization of minor forest use For citizens it is allowed to procure timber saps only on territories, which are provided by the forest fund for this purpose, and this process should be done maintaining the technology, which is used in forestry. Only plantings of the I – II class of quality are recommended for tapping, or plantings of other species with impurity three and more birch units with the fullness – 0.4-0.7, with the amount of trees having stem diameter no more than 20 cm – not less than 200 trees on 1 hectare (Table 1.16)	It is forbidden to extract saps at riversides, lake costs, water reservoirs and other water objects; at the easement areas, acres, right-of-ways and near other transport and communication routes, ininhabited areas, on the territory of historical-cultural reserves, memorial parks, archeological monuments, etc. On territories, which are under security surveillance, extraction of saps can be done only if it is not forbidden by that the authority of the respective area It is not recommended to extract saps from trees which grow nearby swamps, because they have a very low sugar level
The period of tapping	Middle of march – second part of April	The precise period for tapping is very difficult to set. It depends on weather conditions. For example, the sap may start to flow during the period of march thaw, but frosts can appear and this process will stop. The period of sap flow should be defined by making a prick with the awl with depth of 6 cm on the birch, if the tree is ready for tapping, the first drop of sap will appear
Tapping time	10.00 – 18.00	
Technology of extraction		
Preparatory stage	Selection of healthy trees of appropriate size	Diameter of the stem not bigger than 20 cm, with well-developed crown
	Detection of drilling channel sizes depending on the stem diameter	Table 1.17
	Tree enumeration with respect to tapping sectors and composition of a register	On the basis of the reeven sheet the technological card is made. It forms a basis for definition of requirement for workers, the equipment, tools, vehicles etc. After that the estimate of expenses is made and planned prime cost of juice prepared in this season is defined
The main stage	Channel drilling	The cut or drilling hole should be

		made in a stem at 40-50 cm above the ground, in up-down direction, the depth of the hole is 2-3 cm allowing to go under the bark, but if the birch is very thick it should be deeper. It is recommended to drill at the North-East side of the stem (Table 1.18)
	Adjustment of trays and other appliances for sap collection and vessels for saps	Plastic or aluminum tray is pushed into the hole, birch bark or any other semi-circular appliance that allows sap to flow into vessel can be used
	Sap collection	Usually it is possible to get 2-3 l in 24 hours from the birch. Big tree can give even more – around 7 l. However it should not be a purpose to get maximum of sap from one tree, it is better to use 5-10 trees to get 1 l per 24 hours from each, than to take 5 l from the same tree. This can lead to tree death
Final stage	Equipment transportation	
	Processing of sapping channels	It is ecommended to grease sapping channels with a specially made tincture or normal oil paint. Appliance of grease or paste protects the wood from contamination by different types of parasites and insects. The receipt of the special paste (ingredients) provides in table 1.19
The peculiarities of maple extraction		
The technology for maple extraction is nearly the same as for birch. Some differences are explained by biological features. In general, the sugar content is higher than in birch sap, therefore it is more profitable. Compared to birch, maple has high generative ability. Shallow sapping channels with a diameter up to 20 mm can be healed in 2-3 years. Therefore, it is possible to tap maples for 50-70 years or even 100 years, due to regeneration of drilling channels. Sap flow of maples starts 5-7 days earlier than that of birch. Because of the high level of sugar the sap flow is possible even at low temperature (from 0 to minus 2 degrees).		
Sap extraction from stumps		
Positive aspect	Wounds which are made on the stem during the extraction process lead to quality loss of timber, it is impossible to produce veneer from the damaged part of the stem. Intensive tapping reduces the live time of the tree. Stump tapping is absolutely harmless with respect to these aspects.	
Tapping period	It can be done for one season exactly after the forest clear cut. Research data show that it is reasonable to cut birch forest during the spring period, because during this period it is the most productive.	
Technology of extraction	The technology of sap extraction from stumps is the same as for trees. In order to increase the quality of sap, stumps should be covered with plastic foil.	

Table 1.16 Calculation of birch sap resources in pure birch forest I-III quality class (numerator – sap resources t/h; denominator – minimal amount of stems on one hector)

The least diameter (cm) when tapping process can be started	Fullness						
	1,0	0,9	0,8	0,7	0,6	0,5	0,4
20	45/372	41/335	37/298	34/261	31/224	29/187	27/150
22	35/289	32/260	29/231	27/202	25/173	23/144	22/115
24	25/220	23/198	22/178	20/154	18/110	17/88	17/66

Table 1.17 Acceptable amount of drilling holes depended on diameter

Tree diameter (cm)	Acceptable amount of drilling holes
20-26	1
27-37	2
35-45	3
40 and more	4

Table 1.18 Sap outcome depending on the stem side

The side of the tree with sap channels	Sap Outcome
North side	275
West side	125
East side	169
South side	75

Table 1.19 Paste composition for sap channels

Ingredients	Purpose	Weight content
Asbestos	Filler	14.4-19.4
Nitrocellulose	Filler	4.4-6.4
Mica	Filler	8.8-11.8
Boracic acid	Repellent	4.4-5.4
Tricresilphosphat	Repellent	8.0-10.0
Dimethyl-diphenyl urea	Activator	1.2-2.2
Polymethilmethanerinat	Thickener	4.8-5.8
Acetone	Solvent	54.0-59.0

Medical properties of birch sap

Birch sap contains 1-4 % of sugar and other minerals: Potassium 273 mg/l, sodium 16, calcium 13, magnesium 6, aluminum 1-2, manganese 1, ferrum 0.25, silicon 0.1, titanium 0.08, cuprum 0.02, strontium 0.1, barium 0.01, nickel 0.01, zirconium 0.01, phosphorus 0.01 mg/l and you can also find a very little degree of nitrogen.

Birch sap contains organic acids, tannins, minerals, ferrum, calcium, glucose, fructose, phytoncides.

Birch sap increases the resistance of the organism to flu, infections, allergies, it has antihelminthic and diuretic effects. It is useful to wipe the skin with birch sap while having different diseases like eczema, acne, it moisturizes and deeply cleans soft skin.

Systematic intake of birch sap has general health-improving energetic effect. However, it is harmful for people who have an allergy to birch pollen. [36, 37]

Medical properties of maple sap

Maple sap contains a big amount of compounds useful for health. It is rich in sugar, organic acids, enzymes, salts of calcium, magnesium, iron and microelements. Maple sap also contains ascorbic acid and other organic acids.

Besides, maple sap contains 4 % of sweetening agents (84% - sucrose). Maple sap possess very high tastiness, it contains P and Fe which are high digestible and also vitamins. It is taken fresh as a general health-improving remedy. [38]

Economic variable of birch and maple tapping

The usage of hardwoods in our country is featured by low economic effectiveness. Commercial output from 1 ha of pure birch forest with a timber supply of 250 m^3 amounts to about 170 thousand rubles, the profitability is 5 %. Therefore, a real opportunity to increase the effectiveness of birch forest usage is tapping.

If on average it is possible to stock 10 tons of sap per season, then at a price of 15 thousand rubles for 1 ton it is possible to gain additionally 150 thousand rubles per year from 1 ha of forest. During 5 years of tapping 1 ha of birch forest will provide with 750 thousand rubles, what exceeds the income from timber wood realization. The profit from 1 ton of sap fluctuates between 4.5 – 9 thousand rubles in different regions of our country. Economic indicators of birch sap procurement are shown in the Table 1.20

Table 1.20 Effectiveness of birch sap extraction at 200 trees (stubs) on 1 ha

Index	Tapping (trees)	Tapping (stubs)
Sap outcome from 1 ha, ton	9.8	16.1
Full self-price of 1 ton of sap, rubles	7237	4600
Trade price of 1 ton of sap, rubles	15000	15000
Profit, rubles	8763	10400
Profitability, %	65.8	160.9

Stub tapping is economically more profitable and harmless, because it does not harm the trees and does not reduce the viability of the trees. If it is necessary to cut birch forest, it will be more profitable to cut trees in spring. In this case it will be possible to get not only wood of high quality but also birch sap (nearly 16 tons from 1 ha). The additional profit will be approximately 10 000 rubles per ha. [1]

Soft resin storing

Soft resin storing is an entrepreneurial work, which is connected with coniferous planting tapping, resin storage and transportation.

The rules of storing are written by order of the ministry of natural resources of the Russian federation from 21 of June 2007 #156 “About rule affirmation of resin storing”. The text of this order you may read at: http://www.mnr.gov.ru/part/?act=more&id=3932&pid=867. [39]

1.6 Placing of beehives and apiaries

Ecological functions of honey bees

Honey bees pollinate about 80% of entomophilous plants, other insects - 18%, wind-pollinated are about 2% of flowering plants. As a result of plowing and extensive use of chemical plant protection, the species composition and abundance of insect pollinators in the agricultural regions does not exceed 10-20%. Entomophilous crop pollination by bees is one of the main agricultural practice that raises productivity, and improves the nutritional and flavor of the fruits and sowing conditions of the seed. Taking 80% of cross-pollinated crops, the bees contribute to colonization of entomophilous plants of forest, bush, field, garden, and meadow. With intensive pollination they steadily renew, and provide shelter and a food source for many insects, birds and animals, enhance the soil, etc. The bees improve the hereditary properties of entomophilous plants, especially major perennial crops, the cultivation of which does not only create a good forage livestock but also improves soil fertility, and reduces the quantity and quality of the weed, and supports the existence of the local fauna. All this helps to stabilize natural populations in the environment. [40]

Forest lands

In Russia the forests occupy large areas and are important for beekeeping. In assessing the melliferous value of forests one must distinguish the following:

1. solid stands of trees
2. edges, woodlands, glades and clearings
3. slashes

Solid stands of trees - the area occupied by the dense forest - is valuable for bees mainly in deciduous forests, where the composition of stands includes linden, Norway maple (*Acer platanoides*), elm (*Ulmus sp.*); in the south of the European part of Russia also chestnut (*Castanea sp.*), white maple (*A. pseudoplatanus*); in the Far East – Amur cork tree (*Phellodendron amurense*). If there are none of the mentioned trees, the dense forest is almost out of melliferous value, because underbrush and grasses grow poorly. In this case a small amount of honey can only be received in the early spring from lungwort (*Pulmonaria officinalis*), Siberian squill (*Scilla sibirica*), anemones (*Anemone sp.*), some willow bushes and other honey plants, flowering before leafing on the trees. Therefore, in the non-chernozem forest zone with its pine and mixed forests, the area occupied by dense forest does not have any melliferous value. In the zone of sparse forest stands the honey flow is much higher, because it has more shrubs and grasses.

The forests most poor with respect to honey flow consist of only one of any melliferous tree species. For example, solid aspen, birch, and especially dense spruce forests, where grass sometimes does not grow at all. Solid linden wood or forests with large percentage of lime usually produce an extremely large amount of nectar for an extremely short period of time (12-14 days), so the bees do not have time to assemble it and hence a lot of nectar is lost. This should be considered

when one selects land for apiaries and places with honey plants blooming at different time, even if the lime amount is lower, should be preferred, because it prolongs the honey flow and makes it more sustainable.

Margins, light forests, glades and clearings. The stronger the "fragmentation" of the forest (the line of the forest edge is winding, larger lawns, meadows and woodlands), the more melliferous is the forest . These lands are better insolated and rich in honey herbs and shrubs. In the middle and northern belts of forest edges, clearings and glades is a lot of forest raspberry *(Rubus idaeus)*, blackberry *(R. sp.)*, willow shrubs, buckthorn *(Frangula alnus)*, wolf bark (*Daphne mezereum)*, honeysuckle *(Lonicera sp.)*, heather *(Calluna vulgaris)*, bilberry *(Vaccinium myrtillus)*, lingonberry *(V. vitis-idaea)*, mountain ash *(Sorbus sp.)*, field maple *(Acer campestre)*, Tatarian maple *(A. tataricum)*, wild apple *(Malus sylvestris)* and pear *(Pyrus sp.)*, hawthorn *(Crataegus sp.)*, etc. In the grass cover the following plants can be found: fireweed *(Epilobium sp.)*, Siberian angelica *(Angelica silvestris)*, angelica officinalis *(Archangelica officinalis)*, goutweed *(Aegopodium sp.)*, pink clover *(Trifolium hybridum)*, meadow knapweed *(Centaurea jacea)*, cornflower pinnate *(Centaurea scabiosa)*, seaport hedgenettle *(Stachys recta)*, oregano *(Origanum sp.)*, thistle *(Carduus sp.)*, lungwort *(Pulmonaria officinalis)*, snowdrop *(Galanthus sp.)*, golden rod *(Solidago virgaurea)*, figwort *(Scrophularia nodosa)*, ground ivy *(Glechoma hederacea)*, common cow-wheat *(Melampyrum nemorosum)*. In addition to these honey plants one can find a lot of yellow acacia *(Caragana arborescens)* in the forests of Eastern Siberia and the Altai and in the Far East - lespedeza *(Lespedeza sp.)*. In the forests of the southern edges and clearings it is possible to meet thickets of such honey shrubs as clematis (*Clematis sp.*), privet (*Ligustrum sp.*), dogwood *(Cornus sp.)*, Saskatoon *(Amelanchier sp.)* and some others.

Forest clearings in the area of mixed and coniferous forests represent the most honey yielding part of the forests. In the forests of central, northern parts and Siberia on forest clearings and burns the thickets of premium honey plants grow - fireweed *(Epilobium sp.)*, raspberry *(Rubus idaeus)*, angelica *(Archangelica sp.)*. Here usually all honey plants grow, which can be found on forest edges, but in much larger quantities. On burns the honey plants begin to appear in the second year and store for 5-6 years, and then they are gradually displaced by young forest, mostly aspen. On burns the honey vegetation keeps much longer than on forest clearings. In the deciduous forests the forest clearings are not so important for honey flow as in subors because fireweed *(E. sp.)* and a little raspberry *(R. idaeus)* usually do not grow there.

Forest lands usually give a good spring honey flow when honey plants are not yet in bloom in fields, meadows, and pastures. On the forest lands the adverse effect of drought over nectar secretion is less strong than it is in the open field. The most important species for beekeeping from wild honey plants are maple, willow, raspberry, buckthorn, heather, willow, and angelica. [41]

Table 1.21 Melliferous plants in forest lands [42]

Melliferous plant	Blooming stage		Efficiency of honey with 1 hectare
	Average period	Duration, days	
Timber species			
Small-leaved Lime (*Tilia cordata*)	June , July	12-14	500-1000
Big-leaved Lime *(T. platyphyllos)*	June , July	12-14	800-1000
Linden *(T. taquetii)*	July	10-13	750-1000
Amur Lime *(T. amurensis)*	July	13-15	750-1000
Manchurian Lime *(T. mandshurica)*	July	13-14	680-900
Amur corktree *(Phellodendron amurense)*	June	13-15	250-280
Norway Maple *(Acer platanoides)*	April, May	7-10	150-200
Tatarian Maple *(A. tataricum sp.)*	May	7-10	100-110
Black Sugar Maple *(A. mono)*	April, May	7-10	to 1000
Small-leaved Maple *(A. ginnala)*	May	7-10	200-250
Green bark Maple *(A. tegmentosum)*	June	5-20	50-70
Goat-willow *(Salix caprea)*	March, April	5-15	120-150
White Willow *(S.alba)*	April, May	5-20	120-150
Mountain ash *(Sorbus sp.)*	May	5-10	30-40
Bird Cherry *(Padus sp.)*	May	10-12	5-6
Bushes			
Wild raspberry *(Rubus idaeus)*	June	25-40	100-200
Hawthorn Raspberry *(R. sachalinensis)*	May, June	35-40	90-100
Honeysuckle *(Lonicera tatarica)*	May	15-20	200
Arrow Wood *(Viburnum opulus)*	June	15-30	15
Lespedeza *(Lespedeza sp.)*	July-September	50-60	210-250
Glossy buckthorn *(Frangula alnus)*	May - August	60-80	15-35

Sub shrubs			
Blueberry *(Vaccinium myrtillus)*	May June	30	20-30
Red bilberry *(V. myrtillus)*	May June	30	15-20
Heather *(Calluna vulgaris)*	July August	30-40	180-200
Herbs			
Siberian Cow Perish *(Heracleum sibiricum)*	June July	15-20	60-90
Rose bay *(Chamerion angustifolium)*	June	45-60	350-400
Garden Angelica *(Angelica silvestrisb)*	June July	15-20	60-90
Evening Primrose *(Oenothera sp.)*	June July	30-40	30-40
Greek valerian *(Polemonium caeruleum)*	June July	20-25	150-200
Atractilodes (Atractylodes ovata)	August September	15-25	80-90
Amur *(Saussurea amurensis)*	August September	15-20	56-65
Plectranthus sp.	July - September	45-50	105-115
White clover *(Trifolium repens)*	June August	50-65	50-118
White-pink clover *(T. hybridum)*	June	50-70	52-125
Purple clover *(T.pratense)*	June July	30-45	66-200
Birds-foot Trefoil *(Lotus corniculatus)*	July	25-30	20-30
Vetch, Tare *(Vicia sativa)*	June	25-30	10-20
White sweet- clover *(Melilotus albus)*	June August	45-50	160-500
Annual herbs			
Serradella (Ornithopus sp.)	June- September	50-65	9-13
Chickling Vetch *(Lathyrus sp.)*	June, July	30-40	15-40
Crimson clover *(Trifolium incarnatum)*	June, July	15-25	13-51
Донник белый *(Melilotus albus)*	Июль-сентябрь	45-50	200-280
Olive cultures			
Sunflower *(Helianthus sp.)*	July August	19-30	13-57

White mustard (*Sinapis alba*) *(Sinapis alba)*	June	20-25	35-152
Sinapis *(Brassica juncea)*	June	20-25	14-168
Winter rape *(B. napus)*	May, June	25-35	50
Snakeroot *(Actaea cimicifuga)*	August, September	30-35	20-30
Melliferous plants of forest parks, wood strips and green lands			
White Camelthorn *(Faidherbia albida)*	May June	14-20	to 1000
Yellow Camelthorn *(Caragana arborescens)*	May	12-14	50-200
Гледичия трехшипная *(Gleditschia triacanthos)*	June July	40-45	200-250
Жимолость съедобная *(Lonicera edulis)*	May	16-20	15-30
Honeyberry *(L. maximowiczii)*	May	16-20	30-36
Snowberry *(Symphoricarpos sp.)*	August September	30-40	to 400
Barberry *(Berberis sp.)*	May June	15-20	80-200

Beekeeping products

The basic products of a melliferous bee are honey and wax. In the past, sweet honey was used in food and wax went to candle manufacturing, now the variety of products of beekeeping has been considerably extended. Except honey and wax it is possible to get different products like uterine milk, propolis, poison, flower pollen and beebread – the products are widely applied in medicine, perfumery, cosmetics and veterinary science.

Honey

Honey – a sweet substance with a pleasant smell. It is produced by bees from the nectar of flowers of entomophilous plants, honeydew and mixtures of these sugary liquids (the latter is not often used). Having high antibacterial properties it contains all the essential micronutrients for humans, including potassium, phosphorus, calcium, chlorine, sodium, magnesium, iron, manganese, cobalt, copper, etc. In total it has 30-37 ingredients. Mineral content in honey varies from 0.006 to 3.45%.

Forest honey has a colour from light amber to light brown, but it is always darker than honey from the meadow and field. It has high aromatic and flavouring properties. [41]

Table 1.22 Honey classification according its originality [43]

Type	Way of extraction	Features
Floral	Made by bees from floral nectar or collected from extrafloral honey caps of	Natural honey can be monofloral, if collected by bees from the flowers of one kind (willow, crimson, lime, heather, buckwheat), and polyfloral – from several kinds of plants (fruit-trees

	entomophilous plants	and berry blooms, meadow or field herbs, buckthorns *(Frangula sp.)* and raspberries *(Rubus sp.)*). Such kinds of honey are considered to be the most valuable
Honeydew	Honeydew is made by bees during honey fall or honey dew processing, which is collected on plant stems and leaves	Honeydew honey is considered to be the least valuable. In comparison to floral honey it contains more mineral salts and dextrins, and less sugar. Honeydew honey can be different in color, taste and aroma. When it is gathered from deciduous trees, it has dark-brown color, when from coniferous trees, it is light. During hot days there a lot of honey fall can found on leaves and stalks of peas. The honey made by bees from such a fall is muddy and viscous, with an unpleasant smell; it has salty, sweet-luscious taste. Bees begin to gather fall when hot weather starts, when the nectar stops to appear on the flowers
Sugary	It is received when bees process sugar syrup which is given on apiaries to bees in order to replenish fodder stocks in beehives, to stimulate bee-family formation during unproductive period.	On sale sugary honey is considered to be simulation, however, during its processing bees enrich it with enzymes, pollen and some other useful substances. After that it becomes an intermediate product between natural flower honey and sugar

With respect to technical methods of production, honey is divided into centrifugal (evacuated from the honeycombs by help of a centrifuge), celled or selected honey (in the honeycombs with closed combs), free-flow honey (leaked from combs into a container), broken, crushed or pressed honey (leaked from the comb through their crushing or pressing), and heated or bathed honey (flowing from the comb at high temperatures).

Nutritional value and medicinal properties of honey

In honey are more than 300 chemical compounds and minerals. Total content of solids in the mature honey amounts to 15-21%, the majority among them are carbohydrates which are represented by 36-40% of fructose, glucose at 32-35%, 2-3% disaccharides (sucrose), 8% of maltose and others (Table 1.23)

Table 1.23 The content of chemicals and minerals in different varieties of honey [41]

Honey varieties	Glucose and fructose	Sucrose and other sacchrides	Nitrogenous substances	Mineral substances	Dextrins	Water
Floral (on the avarage)	73.3	1.2	0.42	0.22	3.6	18
Buckwheat	75.0	1.1	0.97	0.04	1.5	18
White	73.6	-	0.21	0.20	7.9	18
Honeydew	65.2	4.8	0.82	0.96	10.1	18
Sugar	65.7	4.9	-	-	8.2	18

Most floral honey contains a relatively low amount of protein – 0.1-1.5%, in honeydew honeys their contents are higher. With respect to the protein composition of honey there are over 20 essential amino acids. In different types of honey more than 15 enzymes, which catalyse oxidation-reduction, hydrolysis and other processes in the organism, were discovered. Honey contains a small

amount, to 0.43%, of various acids with the highest proportion of organic acids (malic, lactic, etc.). In the honey 37 types of ashy elements were found. (Table 1.24)

Table 1.24 The content of macro-and micronutrients in honey [41]

Macroelements		Microelements	
Name	Content, mg per 100 g	Name	Content, microgram per 100 g
Potassium	36	Iron	800
Calcium	14	Iodine	2
Magnesium	3	Cobalt	0,3
Sodium	10	Manganese	34
Sulphur	1	Copper	59
Phosphorus	18	Fluorine	100
Chlorine	19	Zinc	94

Vitamins in honey are few, but they appear in combination with other important substances for the organism (Table 1.25)

Table 1.25 The content of vitamins in honey [41]

Vitamin name	Content, mg
Ascorbic acid (C)	2,00
Pyridoxine (B6)	0,10
Biotin (H)	0,04 мкг
Niacin (nicotinic acid, PP)	0,20
Pantothenic acid (B3)	0,13
Riboflavin (B2)	0,03
Thiamine (B1)	0,01
Folacin (folic acid)	15,0 мкг

Wax

Wax is a biologically active product possessing high bactericidal properties which are not lost even after technical processing. It considerably surpasses all known products in the level of vitamin A. In 100 gm of wax 4 gm of provitamin A is contained while in 100 gm of carrots it is about 0.01 gm. Because of these qualities wax is widely applied in medicine and cosmetics, it is a part of some ointments and nutritious creams, it is used in industry.

Natural beeswax contains: esters (70-75%), free fatty acids (15%), carbohydrates (11-18%), ashy elements (0.3%), water (0.4%). [1]

A piece of good bee wax splits into little pieces at a hammer blow. On the demolition place it has a fine-grained structure. The ingot surface is smooth, homogeneous and shiny. Wax is exclusively steady. Neither time, nor light or dampness change its quality. In the liquid state wax possess a high viscosity, which decreases when temperature rises. Therefore, when processing wax raw material it should be sodden and in order to squeeze wax out of it the temperature should be close to 100 °C.

To boil wax raw materials soft water is taken, e.g. distilled water, rain or snow. It is not recommended to process wax raw materials in metal or zinced ware, as fat acids of the fused wax reacts with iron, wax emulsifies with water, it becomes brown or grey and its outcome and quality decreases.

In a small amateur apiary it is possible to filter wax under usual house conditions. For this purpose empty combs are put in to an enameled bucket and covered by a metal grid. Then water is added into the bucket and this bucket is put on a cooker. Under the influence of temperature the wax starts to melt and emerges on the water surface, it is poured out or collected with a big spoon into another vessel. To the remaining raw materials hot water is added again, mixed, boiled and the wax is taken away. After this procedure, the remaining weight is drained through a gauze. A good wax outcome (70-80 % from raw materials) can be realised by help of steam wax melters, which are sold in specialized shops. [43, 44, 45]

Royal jelly

Royal jelly is rich with in fats, carbohydrates, amino acids, mineral salts, vitamins and hormones the albuminous forage (secret), formed by young bees.

The fresh royal jelly is white, slightly creamy. It has a sharp sourish taste and a light specific smell, resembling sour cream. It contains 18 % of albumens, 10-17 % of sugar, 5.5 % of fat, more than 1 % of mineral salts. The structure of proteins of royal jelly includes about 20 amino acids; it is rich with vitamin B. [43, 44, 45]

Propolis

Propolis is also known as a bee balm. This substance is resinous, with a pleasant smell of essential oils, useful not only for bees, but also for people. Propolis is used to cure burn wounds, callosities, teeth, respiratory systems and stomach aches.

Bees cover internal walls of beehives with propolis in order to strengthen them, they use it to close up cracks, to polish combs, and to reduce space for wintering. As a result a healthy microclimate appears in a beehive that protects it from putrefactive microbes.

Propolis consists of pitch and balm – 50 %, wax – 30 %, essential oils – 10 %, pollen, and some other inclusions – 10 %. It is rich in vitamins, microcells, and possesses bactericidal effects. Two kinds of propolis are distinguished. The first type is produced by bees in the form of balsam while digestion of pollen grains, the second kind is brought by bees from plants and trees: poplar, pine, birch, sunflower and some herbs.

In Russia are a lot of coniferous trees, birch trees and fruit gardens. Thus, there is no lack in propolis. The lost part of propolis is filled by bees again. Throughout all summer it can be scratched out of the beehives, frameworks and ceilings, and from beehive grooves. The prepared propolis is rolled into lumps, wrapped into plastic or parchment and placed into densely closed storages of brown glass or in plywood boxes. [43, 44]

Pollen

Pollen is a complex product of plants and an essential protein food for the bees. Proteins and fats, organic acids, mineral salts, trace elements and vitamins, nutrients and enzyme stimulants are contained in pollen, altogether more than 100 nutritional and medicinal substances, ncluding a complete set of essential amino acids (Table 1.26). A strong bee family gathers and consumes 20-25 kg of pollen per season. Lacking pollen, a family is poorly developed, stops detuning honeycombs and does not produce marketable honey.

Table 1.26 The content of chemicals and minerals in pollen [41]

Name of the element	Content in 100 g of pollen	
	gram	%
Water	21.3-30.0	3-4
Dry substance	70.0-81.7	70-75
Protein (in terms of crude protein)	7.0-36.7	11-35
Sugar (total content) including: Glucose Fructose	20.0-38.8 14.4 19.4	20-39 48 52
Lipids	1.38-20.0	1-20
Ashy elements	0-5.5	1-7
Vitamins	All groups	
Antibiotics	Some quantity is detected	

Under good weather conditions it is possible to get with help of a pollen trap 100-150 gm of a valuable product from one family in one day, in one month it amounts to 3-4 kg. The largest quantity of pollen is brought by the bees during the first half of the season when the family intensively increases its brood for the main honey flow. Before the main honey flow the pollen trap should be taken away from the beehive to give the family the chance to switch completely over to honey gathering.

The best time for pollen collection is 10–11 a.m. before mass departure of drones for pairing with queens, because they stay at the entrance and disturb the flight of working bees. In the morning bees bring more pollen to the beehives. During the second half of the day they mainly collect nectar.

It is necessary to dry the collected pollen in the wind in the shade until the grains become harder and start to stick together. Afterwards, that pollen is packaged in plastic bags or put into glass storages. [43, 44]

Beebread

Beebread is the pollen preserved by the bees. It is necessary for bringing up the brood and to extract wax and royal jelly. The flower pollen, which is brought by bees in the beehive, is put into free combs, tramped down with the head, poured over with fresh honey and sealed with wax lids.

The chemical compound of beebread is close to the chemical compound of pollen. Beebread contains more sugars, basically because of the honey added by the bees and lactic acids (3–4 %), which appear as the result of mass fermentation. These components provide its conservation and long retention. Because of the high level of proteins and vitamins beebread is used in cosmetics, medicine and food industry.

As a beekeeping product beebread should not become moldy, should not have more than 3 % of impurity (wax, propolis, wood pieces) and not above 15 % of humidity. Beebread should have a grain structure, a sweetish-sour honey taste with a pleasant smell of combs and bread and a brown color with a greenish or yellowish shade. [46]

Bee poison

Bee poison is a secretion of poisonous glands, which the bee uses together with a sting to protect itself against enemies. The bee dies after stinging an animal or a person. As a beekeeping product, bee poison is applied in medicine to medicate radiculitis, rheumatism, the peripheral nervous system, bronchial asthma and vascular diseases. The poison of a bee has a beneficial influence on the general health condition, it improves appetite and dreaming activity. However, some people are allergic to bee poison. Even a single sting is very dangerous for them, and a poison smell, as well as the crushed bee, causes the feeling of disgust and nausea. Bee poison is colorless, quickly drying in the air, bitter and a very burning liquid. The reaction of venom is acidic, the specific weight is 1.131, solids content amount to 41%. Bee venom is composed of organic compounds, free amino acids, volatile oils, enzymes, trace elements, and a number of other chemicals.

For the mass production a special device is used, consisting of a venom selecting frame, a circuit breaker and a battery. Under compliance with the guidelines for collecting the venom, this procedure does not affect the productivity of the bee family and the quality of the raised brood. [41]

The organization of apiaries

The main condition of successful functioning of an apiary is the location. It should correspond to the native habitat of the bees. The apiary should be located on a dry flat place. For snow runoff a small incline is needed. The apiary should be protected from prevailing winds and sun blaze. It is impossible to place an apiary near reservoirs, roads or cattle-breeding complexes. The beehives of an apiary are placed in chessboard order. As optimum is considered a placing of beehives when one bee family is on 20-40 m^2, the distance between the beehives should be not less than 4 m.

The expenditures spent for labor on apiary service are not big. On the average to look after bee family for about a year requires about 14 hours or a little more than one hour per month. During the spring-and-summer period more time is required – not less than 1.5 hours for one family. Rational beekeeping is a profitable branch.

In the last decade the amateur beekeeping was widely spread. The main reason was the disintegration of the major branch of agriculture. Mobile apiaries and frame beehives appeared and modern honey extractors have begun to be applied. Experienced beekeepers can get 100 kg of honey per season from one bee family, but nevertheless small apiaries are unproductive. Expenses on their maintenance grow faster than the market prices for the beekeeping products. [1]

1.7 Haymaking and pasturing of cattle in the wood

The concept of forest grasslands and pastures

Forest pastures are areas with grass, which is used for grazing of animals (cattle) without damaging of forests, regrowth of valuable tree species, deforestated and other sites planned for natural regeneration of valuable tree species. [47]

Forest meadows are areas suitable for hay (haying). They do not include the unforested areas (cuttings down, glades) which are not expected to have natural forest regeneration; areas requiring measures for improvement and areas of low value crops, not projected for reconstruction. [48]

Table 1.27 Types of hay lands and pastures

Classification 1	Floodable	Uupland		Swamped			
Location	Overflow areas, near lakes	Interfluve areas, terraces above flood-plains, on places after fire post-agricultural areas		On lowlands			
Classification 2	clean	Unclean					
		hilly		*bushed*		*afforested*	
		weak	strong	weak	strong	weak	strong
Characteristics	Without bushes, stubs, trees, stones, or equally covered by more than 10 % of these structures	Covered with hills by 10-20 %	Covered by more than 20 % with hills	Evenly covered with bushes by 10-30 %	Covered with bushes and trees by 30-70 %	Covered with trees or bushes by 10-30 %	Covered with trees by 30-70 %

Classification 3	Contemporary	Constant	Melliorative
Charaterestics	Haymaking is done everywhere where is a productive plant stand	Allowed only on constant hay lands, established by forestry	Swamped areas, covered with trees and bushes, which need radical improvement

Classification 4	Areas of tall crops	Areas of tall grass	Areas of short grass	Gramineous	Integrate

Rules and norms of haymaking and pasturing of cattle in the wood

Haymaking and cattle pasturing in wood funds can be carried out by organizations and citizens only if they have a wood ticket for secondary use.

Wood tickets can be issued on the basis of offers of owners of wood funds and forest users, who are confirmed (coordinated) bythe regional (city) administration.

For haymaking primarily suitable agricultural lands belonging to the state forest fund are used. For haymaking one can use unforested cuttings, clearing and other non-forest areas, which are not expected to undergo natural regeneration of the forest, until production on them wood cultures and the suitable areas for the mowing, demanding carrying out actions for their improvement

(drainage, destruction of bumps, etc.). Grazing is allowed in all forests and areas of the state forest fund and non-forested areas, excluding forest reserves, protected forest areas, national parks and nature parks, forest parks, forests having scientific or historical value, natural monuments, state shelterbelts, forests of importance for erosion control of valuable forests, forests of the first and second zone of sanitary protection of water sources, and forests of the first and second zone of sanitary protection of resorts.

Grazing is forbidden:

1. on areas of forest crops before they reach the height,which protects them against damage by the cattle, on forest seed, spruce-fir, willow, poplar and nut plantations, and in areas with activities to provide assistance for natural regeneration
2. the natural regrowth and plantations with the development of viable undergrowth till young growth and undergrowth reaches the height, which protects them against damage by livestock
3. on the clear cuts and other non-forested areas, intended for natural regeneration of conifers and hardwoods
4. in areas endangered by erosion

Norms of cattle pasture are established by the local authorities. It is recommended to take 1-1.5 hectares for pasture by one head of cattle or four-five heads of small cattle in wooden area; 2 hectares for the same number of animals in mixed forests and 3 hectares in coniferous forests. Pasture of cattle in woods is regulated by special rules. It is forbidden to feed the cattle on areas occupied by wood cultures; in plantings where is undergrowth less than 1.5-2 m high; on fresh (till 3 years after cutting) clear cuttings; in parks, reserves and other valuable forest lands. [49, 50]

Consequences of cattle pasturing in the forest

Rational regulation of cattle pasturing in the forest can promote cattle breading, while unregulated and unlimited pasturing can be harmful for forest and for cattle.

Negative consequences are direct damage of forest vegetation and deterioration of growing conditions for plantings. Damage of forest vegetation is trampling of plantlets of valuable species, grazing or breakage of the tops of young plants, gnawing of bark and the damage of roots and stems of young trees.

Deterioration of growing conditions for plantings includes: compaction of clay soil, mellowing of sandy soil, scalping of soil. Damage of young plantations can lead to infection with mushroom spores. The pasturage on a fresh clear cut is very harmful during the first years of formation of the plantation.

During long-term pasturing the areas can become degraded. Pasturage on hillsides can lead to soil erosion. The harm to forestry differs depending on the peculiarities of plantings and clear cuttings, soil, the amount of forage and heads of cattle and season of pasturing. Especially spring pasturing in young plantations on clay soil is harmful. The maximum damage can be caused by sheep and goats; pasturing by cattle is less harmful.

The pasturing with small herds in the under-populated northern part of the forest zone is not much destructive. This type of pasturing is more harmful in over-populated parts, where it is a popular activity in agriculture.

Pasturing cattle in the forest is under the attack of ticks, gadflies, mosquitoes, botflies and other insects that can cause different diseases. Cattle also can suffer from poisonous plants. (Table 1.28)

Table 1.28 Plant species limiting the use of pastures [1]

English name of the plant	Latin name of the plant
High aconite	*Aconitum exelsum*
Marsh labrador	*Ledum palustre L.*
Marsh calla	*Calla palustris*
Windflower	*Anemone nemorosa*
Cowbane	*Cicuta virosa*
Daphne	*Daphne mezereum*
Wild angelica	*Angelica silvestris*
Marsh marigold	*Caltha palustris L.*
Sorrel	*Oxalis acetosella*
Lily of the valley	*Convallaria majalis*
Cow wheat	*Melampurum sylvaticum*
Large yellow foxglove	*Digitalis grandiflora*
Bracken fern	*Pteridium aquilinum*
Eastern pasqueflower	*Pulsatilla patens*
Water horsetail	*Equisetum fluviatile*
Marsh horsetail	*E. palustre*
White hellebore	*Veratrum lobelianum*
Wartwort	*Chelidonium majus*

However, there is a positive influence of pasturaing on the forest, since light soil mellowing can assist forest renovation. It might also lead to environmental conditions, which allow to restore populations of specific species (thus grazing may be useful as a tool for species protection, see also chapter 2.2). Animals destroy maggots of some harmful insects and promote fir trees when eating shoots of soft-wood broadleaves. Pathways caused by cattle-driving reduce the spread of low fires.

If forest pasturing is necessary, then it should be regulated. This includes: the right choice of pasture lands (lands with big stock of grass), regulation of load with cattle on the pasture according the number of heads, duration of pasturing. It is not recommended to pasture cattle during spring when the ground is still wet and during the rainy season or to mix in one herd different types of cattle with different needs in forage and water resources. It is better to use the same area for pasturing and to organize activities to increase productivity by seeding, fertilizing and drainage. [51]

2 Management of bioresources of open spaces

2.1 The usage of meadow resources

Meadow definition

Meadows are plant communities, which are based on long standing grassy plants, mesophytes, which require for their development moderately humid and rich, warm soil with sufficient aeration.

When the humidity level increases, and when the temperature of the soil and the level of oxygen decreases, the plant communities turn into swamps, where hygrophytes prevail.

When the soil becomes more dry and the temperature grows steppe plant communities are formed, where xerophile species prevail. There are no strict boundaries between the different types of grass land. Between meadows and real steppes are so called meadows or steppes rich in herbs, where not xerophiles but xeromesophyte and mesophyte species prevail. Cenosesis also referred to meadows with the presence of halophytes but halomesophytes – brackish meadows. Such areas develop under conditions of dry climate with bad a drainage, with a high level of easily soluble salts in the soil. They can be formed near sea costs and terraces. [52]

Meadow types

Water (flood-plain) meadows, which are located in the valley of a river, mainland meadow and mountain meadow are distinguished.

Water (flood-plain) meadows

Water meadows are located in the river valleys and lakesides lowlands, which are flooded with high water.

Flood-plain meadows can be found in all zones and they occupy 25 million hectares, of which 14 million hectares are hay lands and 11 million hectares are pastures.

Flood plain meadows provide with hay and grass for pasturing which, as a rule, are of better quality than those of other meadow types. The harvest on those meadows is more efficient and resistant. A characteristic feature of floodplain meadows is that they are annually flooded with high waters during the spring leaving alluvial deposits or so called silt deposit. In favourable conditions of the floodplain regime while periodical flooding and as a result of the alluvium deposit conditions for good grass layer are created. Although soils differ depending on natural zone and location in the floodplain itself (riverbed part, central floodplain, terrace part) they all are very fertile, have very good aeration and they are loose.

According to duration of the flood the meadows are divided into short-term, medium-term and long-term floodplain meadows.

Short-term floodplain meadows are flooded for a period of 15 days. They can be found in all regions of Russia along river-valleys of small rivers and big rivers with high level of water.

Medium-term floodplain meadows are flooded for a period of 15-25 days. They can be found also in all the zones of Russia and they mostly occupy the valleys of big rivers.

Long-term floodplain meadows are flooded for a period of 25 and more days, they are spread in all the zones of CIS and usually occupy valleys of big rivers. The majority of long-term floodplain valleys are used slightly as they are situated in the tundra in low lands of big rivers of Siberia – Pechora, Ob, Yenisei, Lena and others.

Flood duration is a very important factor in herbage formation. There are plants which have different degree of steadiness to flood. There are examples of plants that can be found in different types of floodplain meadows (on short-term floodplain meadows, medium-term floodplain meadows, long-term floodplain meadows). It is necessary to note that the majority of valuable herbs are not resistant to long-term flood and only very few (smooth brome grass *(Bromus sp.)*, dog grass *(Elytrigia repens)*, couch grass *(Lathyrus palustris)*, ribbon grass *(Glyceria sp.)*, lathyrus, manna grass) can handle flood for 40-50 days. In the river valley three or more separate parts are distinguished:

1. Closest part to the bed of the river
2. Central or middle part
3. The closest part to the terrace, far from the river bed, borders with cost or riverine terrace

The part closest to the bed of the river occupies a narrow strip along the functional or the old river bed. It is characterized by a more powerful sandy sediments, where elevations (tops) interchange with lower places. Here herbage is mainly developed from the rootstock grasses, which need more water and aeration of the soil. The meadows of these parts can be divided follows:

1. Meadows of high level, herbage of which in forest zone contains of hard motley grass (cowperish (Heracleum sp.) and other Umbelliferae) and plants with well developed rootstock, in steppe zone it is a mixture of steppe plants with meadow grass
2. Meadows of medium level (mostly waterish) with different types of grass, with valuable wide leaves, legumes and motley grass
3. Meadows of low level (mostly wet) with different types of plants, like couch grass (Elytrigia sp.), brome (Bromus sp.), meadow grass (Poa pratensis), bent (Agrostis sp.) and others

The central part of the floodplain occupies the territory that neighbours to the bed part of the river valley; it is the widest part, with flat relief and sandy-argillaceous sedimentations. Meadows of the central part are also divided with respect to meadows of high, medium and low level with different herbage.

1. Meadows of high level, which are weakly flooded and which often lack water during the summer period, differs with respect to low herbage, loose-shrub grass – timothy (Phleum sp.), red meadow fescue (Festuca rubra), motley grass with the mixture of legume prevail
2. Meadows of middle level are most productive according to its forage value compared to meadows of high level. Here grass herbs and grass-legume herbs prevail in the herbage – timothy,

foxtail, meadow grass, meadow fescue; legume grass – Lucerne, clover, tufted vetch; motley grass – blue cornflower, geranium, bedstraw, and buttercup

3. Meadows of low level of the central plain, annually flooded, with over-humid soils, especially in the first part of the summer, differ with big herbage, where hygrophilous plants prevail (white bent (Agrostis sp.), slough grass, (Beckmannia sp.) reed grass (Phalaris sp.), big motley grass and sedge – sharp (Carex acuta) and glebous (C. cespitosa)

The terrace part adjoins the valley side, according to the relief it is the lowest part of the flood plain, it has argillaceous, alluvial deposits. The soil of this part of the flood plain contains a significant nutrient stock for plants, is characterized by unchangeable water regime and by over-damping. Meadows of the terrace part of the plain are located on humus, sometimes saline ground. Among them meadows with rich watering by spring waters, with plantings, where fescue, meadow grass *(Festuca pratensis)*, sedge *(C. cespitosa)*, hair grass prevail, can be found. Floodplain meadows are widely spread in different climate and regional zones, in every zone they have their own peculiarities. [53]

Dry meadows

Dry meadows are divided into upland meadows and lowland meadows; they are distributed over forest, forest-steppe and steppe zones.

Upland meadows are situated on watersheds or on valley slopes. They are not flooded with high waters and the only source of watering is precipitation. The moisture storage on uplands is quite insignificant and the soil dries up very fast, especially on slopes because all the water flows down the slopes to the bottom of the valleys.

Upland meadows usually appear on the areas of former forests. The soil here is very poor and not enriched over the years. Humus is formed very slowly because of dryness. In the southern regions the uplands have the character of steppes.

Plantings of upland meadows contain some valuable legume grass and even fodder cereals, but at the same time there is a lot of useless motley grass, which is even dangerous for the cattle. Herbage is very low. In dry years these meadows are not mown, and during years of plenty of rain uplands give such an insignificant amount of grass that it is more productive to use it for cattle grazing.

According to its economic value uplands are low productive. It is wiser to plough them for agricultural use or to seed artificial pastures.

Lowland meadows as well as upland meadows are located outside the floodplain. If uplands occupy upper parts, tops of the hills and slopes, then lowland meadows are referred to kettles, cup holes, to the bottom of balks and valleys. The location of lowland meadows already defines its distinctive feature – waterlogged soil.

Indeed, water storage here is very high. In spring during snow melting a huge amount of water flows down the plain slopes. Besides, initially the snow layer is much thicker than on the uplands, from where snow is blown during snowstorms. Humus is brought together with spring waters

to the lowland meadows. Seasonal floods happen very often, and water stays there for a long time. This water is standing and usually it dries and soaks in to soil very slowly.

On the lowland meadows as well as on floodplain meadows silt deposit sediments but in smaller amount. That is why the soil is very rich, especially with humus substances, accumulating here for ages because of high level of moisture that promotes peat formation. When digging a pit in such soil, a layer of peat soil can be observed, which looks like black earth, however, this similarity of soils of lowland meadows with black earth is only external. During the decomposition of organic substances in a swamp soil air can hardly go through. Therefore, soil turns sour. Decomposition of organic substances goes with low oxygen access, as the result peat is formed. That is why swamp soil needs to be dried and winded up and fertilized with minerals. After that the soil of lowlands can produce excellent crops. It can be field crops, but it is wiser to make long-standing artificial meadow, seeding needed plant mixture. To make pastures on lowland meadows is not recommended, soft humid soil promotes formation of hummocks and compaction of top layers of the soil. Aas a result the meadow degrades very fast.

Vegetation that covers lowland meadows before fertilizing is absolutely of no economic value. It is mostly sedge of different types and motley grass, among which are a lot of dangerous plants for cattle – horsetails, buttercups. Moss growth is very frequent here, preventing from air access to the soil, which turns soil sour. [54]

2.2 Beekeeping

Types of grassland

In assessing nectar bearing capacity of meadows one should distinguish upland meadows, flood land, wetlands and areas overgrown with bushes.

Dry meadows. In the forest non-black earth zone dry meadows are important for beekeeping. They usually have a lot of white (*Trifolium repens*) and pink clover (*T. hybridum*), cornflower meadow (*Centaurea jacea*), providing with a good honey crop. In addition to these major honey plants within the watershed common dandelion *(Taraxacum sp.)*, gipsy rose *(Knautia sp.)*, winter cress *(Brassicaceae sp.)*, geranium grass *(Geranium pratense)*, mountain clover *(T. montanum)*, Dandelion Fall *(Leontodon autumnalis)*, campion *(Lychnis sp.)*, hawk's-beard *(Crepis sp.)*, mouse peas *(Vicia cracca)*, etc can be found. While each of these honey plants alone provides with only small amounts of nectar, in total we obtain a significant addition to honey gathering from meadows with major honey plant.

The first spring honey flow within a watershed begins in mid-May, with flowering of dandelion and winter cress. Forages from the meadows are usually low, but stable. The highest intake of honey (2-3 kg per day per family) begins in early June, with the flowering of white clover *(T. repens)*, and continues till the meadows are mown. During the fall, these areas provide small supporting honey flow with the aftermath of white clover *(T. repens*) and autumn Dandelion *(Leontodon autumnalis)*. To the south, as the climate becomes drier, grasslands turn into steppe, and strong honey plants of arid steppes appear: white *(Melilotus albus)* and yellow sweet clover *(Melilotus officinalis)*, globe thistle *(Echinops sp.)*, mother-of-thyme *(Thymus serpyllum)* and others.

Meadows (floodplains, marshes). In the southern regions with hot climates and light soils flood lands are rich with honey plants. White *(T. repens)* and pink clover *T. hybridum)* produce and secrete nectar well here, as well as field mint *(Mentha arvensis)*, marsh-beet *(Limonium sp.)*, saline aster *(Aster laevis)*, waxweed *(Lythrum salicaria)* (in wet places), swallow-wart *(Vincetoxicum sp.)* and many other honey plants. But in areas with a cold climate, due to abundant rainfall and heavy clay soils the meadows are poorly melliferous, because they are overgrown with grasses, sedges and other unmelliferous herbs. Though white *(T. repens)* and pink clover *(T. hybridum)* can grow here, but they are rarely visited by bees than on dry land, as they are overgrown with the grass. Among other honey plants, on water meadows we can occasionally find marsh woundwort *(Stachys palustris)*, meadowsweet *(Filipendula sp.)*, water avens *(Geum rivale)*, and meadow geranium *(Geranium pratense)*.

Marshy meadows in central and northern regions are poor with respect to honey plants, of which we can only find occasionally marsh woundwort *(Stachys palustris)*, marsh cinquefoil *(Comarum sp.)*, water avens *(Geum rivale)*, meadowsweet *(Filipendula sp.)*, and loosestrife *(Lythrum salicaria)*. Significant nectar bearing capacity is characteristic for swampy meadows in areas with warm climates. Here on the overflow land of southern rivers one can find thickets of loosestrife *(L. salicaria)*, mouse peas *(Vicia cracca)*, marsh-beet and some other honey plants.

Grasslands, overgrown with shrubbery, usually have higher nectar bearing capacity than open ones, as along with meadow vegetation there is a considerable number of forest honey herbs and shrubs. [41]

Table 2.1 Meadow bee plants [55]

Name	Blossom period
Caucasian clover *(Trifolium caucasicum)*	Mid summer
Mountain clover *(T. montanum)*	May-August
Foxtail clover (meadow) (*T. pratense)*	June-July
Tick trefoil (*Hedys arum)*	June-August
Meadow clary (*Salvia pratensis)*	May-September
Annulate clary *(S. verticillata)*	June-August
Meadow geranium *(Geranium pratense)*	June-September
Spiked loosestrife (*Lythrum salicaria)*	June-July
Marsh gilliflower (*Coronaria flos-cuculi)*	May-August
Clammy campion *(Viscaria viscose)*	End of May-July
Tufted vetch (*Vicia cracca*)	May-August
Bramble vetch (*V. tenuifolia*)	June
Pinnate cornflower (*Centaurea scabiosa*)	June-July
Brown scale centaury (*C. jacea*)	June-July
Sharp houseleek (*Sedum acre)*	June-July
Caucasian stonecrop (*S.caucasicum*)	June-August
Kabardian stonecrop (*S. telpbium*)	July-September
Purple stonecrop (*S. purpureum*)	July-September
Straight betony (*Stachys recta*)	June-September
Marsh betony (*S. palustris*)	June-August
Field scabious (teasel) (*Knautia arvensis*)	June-July

Fall dandelion (Leontodon autumnalis)	July-September
Meadow saffron (Coichicum autumnale)	September-October
Milk vine (Vinecetoxicum officinale)	July-August
Meadow salsify (Tragopogon pratensis)	May-August
Silverweed cinquefoil (Potentilla anserina)	End of May-September
Hawk's-beard (Crepis biennis)	June-July
Greater burnet (Sanguisorba officinalis)	June-July
Cow berry (Comarum palustre)	May-July
Dandelion (Taraxacum officinale)	May-October
Sawwort (Serratula sp.)	July-August
Yellow scabious (Scabiosa oehroleuca)	End of May-August
Siberian cow-parsnip (Heracleum sibiricum)	June-July
Angustifoliate cow-parsnip (H. flavescens)	June-July
Glague (Aegopodium podagraria)	End of May-July
Rush flower (Butomus umbellatus)	June-July
Comfrey (Symphytum offieinale)	May-August
Prickly comfrey (S. asperum)	May-June
Licoricея (Glycyrrhiza glabra)	June-July
Sea aster (Aster tripolium)	July-September
Ledum (Ledum palustre)	May-June
Water avens (Geum rivale)	May-June

2.3 Medical meadow plants

Table 2.2 Medical meadow plants

Name	Usable part	Growth place	Medicinal properties	Blossom
Marsh flagroot *(Acorus calamus)*	Root	Marsh meadows	Germicide	May-July
Sandy strawflower *(Helichrysum arenarium)*	Blossom cluster	Meadows, forest borders (mostly on sandy soil)	Choleretic and stimulating stomach work agent	July-September
Officinal valerian *(Valeriana officinalis)*	Rootstock	Floodlands, forest borders	Sedative and general health-improving agent	May-July
Blue cornflower *(Centaurea cyanus)*	Flowers	Meadows, uplands	Urinative, slightly choleretic and anti-inflammatory agent	June-September
Officinal veronica *(Veronica officinalis)*	Leaved plant tops	Meadows with acid peaty soil, forest borders	Limited use, basically for diseases of upper air passages	June-September
Snakeweed *(Polygonum bistorta)*	Rootstock	Floodlands, water body banks	Anti-inflammatory and binding agent	May-July
Officinal sweet clover *(Melilotus officinalis)*	Leaved plant tops with flowers	Meadows, dry wastelands	Anticonvulsive, carminative and purgative agent	June-September
Common St.-John's wort *(Hypericum perforatum)*	Leaved plant tops with blossom cluster	Dry meadows, cuttings	Analgetic, binding, styptic, spasmolytic, anti-inflammatory and urinative agent	June-August
Golden rod	Tops of	Meadows of	Preparations are used for	July-

(Solidago virgaurea)	stems	different types	urolithiasis and renal lithiasis	October
Bay willow *(Epilobium angustifolium)*	Top part of the plant with blossom clusters and leaves	Fallow meadows, cuttings, sandy and peaty soil	Anti-inflammatory, sedative and binding agent	July,
Giant clover *(Trifolium pratense)*	Top part of the plant (blossom cluster with top leaves)	Meadows, glades, forest borders	Urinative, expectorant and bactericidal agent	May-September
Dense Mullein *(Verbascum densiflorum)*	Blossom clusters	Sandy soil on meadows and forest borders	Expectorant action	June-July
Burnet bloodwort (*Sanguisorba officinalis*)	Rootstock	Floodlands	Bactericidal, binding, styptic agent	July-August
Tormentil *(Potentílla erecta)*	Rootstock	Floodlands	Binding, anti-inflammatory, bactericidal and styptic agent	May-October
Great burdock *(Arctium lappa)*	Roots, leaves, fruits	Meadows of different types	It is used for rheumatism, kidney diseases	June-July
Coltsfoot *(Tussilago)*	Leaves, flowers	Meadows, clay slopes	Expectorant, anti-inflammatory, wound healing and choleretic agent	April-May
Common dandelion *(Taraxaácum officinale)*	Roots, leaves	Occuring everywhere	Purgative, choleretic, anti-inflammatory agent	May-July
Ginger plant *(Tanacetum vulgare)*	Flower head	Occuring everywhere	Choleretic, anti-inflammatory agent	July-September
Waybread *(Plantago major)*	Leaves	Occuring everywhere	Anti-inflammatory, soporific, anaesthetic, wound-healing, bactericidal and anti-allergic agent	June-September
Motherwort *(Artemisia vulgaris)*	Leaved tops of the plant and roots	Broken grasslands, grazing lands, fields	Tonic, sedative, blood-makins. Choleretic action	June-September
Devil's grass *(Elytrigia repens)*	Leaves, rootstock	Occuring everywhere	Urinative, sudatory and expectorant agent	June-July
Waterwort *(Gnaphalium uliginosum)*	Overground part of the plant	Fallow lands, swamped river banks	Healing agent	July-August
Creeping thyme *(Thymus serpyllum)*	Leaved sprigs	Stepped meadows	Bactericidal, anticonvulsive, sedative, analgetic agent	June-August
Bloodwort *(Achillea millefoliu)*	Flowers, stems, leaves	Occuring everywhere	General health-improving, spasmolytic, anti-inflammatory agent	June-September
Heartsease *(Viola tricolor)*	Overground part of the plant	Occuring everywhere	Expectorant and urinative agent	May-October
Common horsetail *(Equisetum arvense)*	Overground part of the plant	Flood lands	Urinatory, anti-inflammatory, styptic and binding agent	June-August

Common succory *(Cichorium intybus)*	Roots, bloomed tops of the plant		It is used for joint pains, for treating intestinal diseases	July-August
Bur beggar-ticks *(Bidens tripartita)*	Leaves and young blooming tops of the plant	Occuring everywhere	Antiallergic and healing agent	June-September
Horse sorrel *(Rumex confertus)*	Roots and leaved tops of the blooming plants	Flood lands	Anti-inflammatory and binding agent	May-June

2.4 Haymaking and pasturing on the open space

Cattle pasturing

The importance of pastures

Pastures have all-important value in livestock husbandry. On a pasture the organism of animals becomes stronger. Animals become resistant to diseases, develop and breed better. When pasturing on cultural pastures, non-contagious gastric and pulmonary infectious and other diseases of animals, which are usually connected with long stay in stables, disappear. When pasturing on cultural pastures the animals show a high productivity.

Table 2.3 The pasture choice for different animal kinds

Animals	Recommended pasture type
Milk cows	High productive pastures, with fresh juicy plants where grass and legume prevail in herbage are recommended
Calves from 3 months – 1 year	Preferably pastures of the best quality, separated from cows, because their day regime differs from cows and from other young animals of different age groups
Sheep	Preferably more dry pastures with low thick various herbage. Sheep eat grass and legume grass with great pleasure and many other plants of motley grass. It is known that halophytic pastures (especially annual) promote sheep multifetation
Horses	It is recommended to leave dry pastures with various plentiful herbage

When choosing pastures for animals of different kinds and groups it is necessary to consider the distance of the pasture from water, places of staying or the farm. Excessive movements to water places and to stables are reflected in the productivity of cattle, as the result of unnecessary waste of energy on walking. The approximate distance from a pasture to a water place or a stable is (km):

1. For a herd of milk cows – 1-1.5
2. For calves − 0.5-1
3. For other cattle – 2-2.5
4. For sheep − 2.5-3
5. For a herd of horses – 5-6

Influence of pasturing of the cattle on meadow lands

Changes in meadow communities due to pasturaing are called pasturable digression. Cattle influences meadow communities differently, depending on kind, quantity, duration of stay and frequencies of repeated feed (Image)

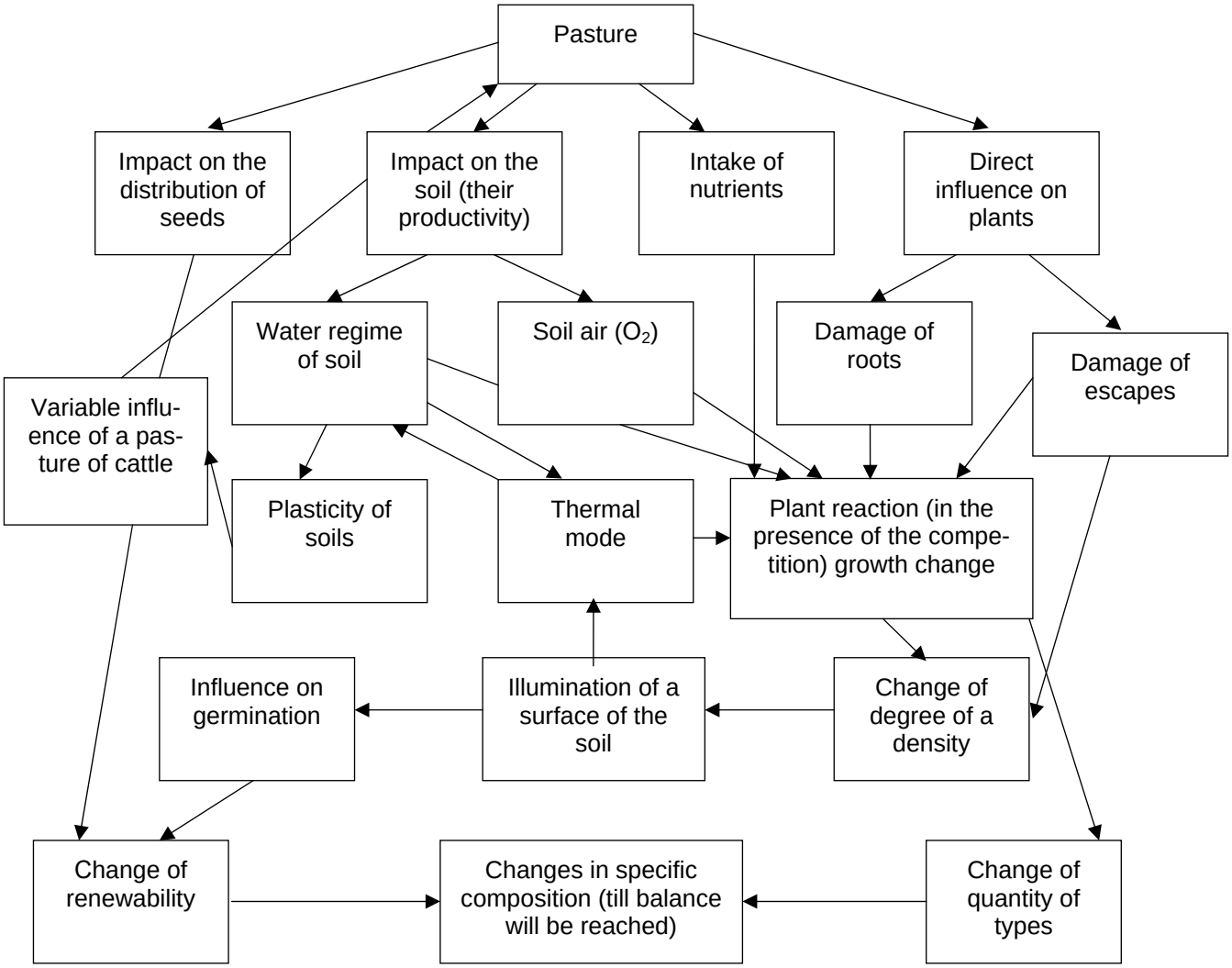

Fig. 2.1 Scheme of influence of pasturing factors (A. Ellenberger, 1963) [57]

The pasturing can influence the areas in two ways: directly due to herbage when the plants are bitten or broken by animals, and indirectly – through change in the soil regime.

Under the influence of pasturing vegetation changes faster than at haymaking. At the pasturing the development of crop tops of high herbage are oppressed (timothy, fescue, foxtail, sonchus, sisymbrium, sage, bedstraw, etc.) and it intensifies the growth of low grass (meadow grass, white bent, red fescue, and other), clover and light-requiring low motley grass (dandelion, milfoil, cuff, buttercup).

In the steppe zone on black earth or on chestnut soil at the absence of pasturing motley grass with feather grass prevails. In this case, weak pasturage can lead to motley grass reduction. Moderate pasturing can promote fescue (feather and motley grass disappear). Intensive pasturing leads to disappearance of fescue and to prevalence of meadow grass, wormwood and spurge. At excessive pasturing knotgrass and couch grass prevail.

Pasturing of cattle affects turf and soil. It compacts it, oppresses the development of the moss layer, activates the development of the micro flora and the decomposition of dead organic substance. [57]

As can be seen from the image above pasturing has a significant influence on the other species living in the respective habitats. Therefore, it can be used as an active method of nature conservation, i.e. the protection of species diversity as a result of the pasturing. It influences also the other natural resources mentioned, e.g. berries, mushrooms and bees. Particularly the latter suffered from Colony Collapse Disorder in many parts of the world in the recent years – the reasons for this are still not fully understand.

Pasturing strongly inhibits successional processes, thus it is an ecological method to protect species connected with young stages of succession. On the landscape level it might be important to maintain heterogeneous landscapes of different stages of succession. For example, many bird species need such landcapes, because they breed in forest but go for hunting on open fields. Important is the choice of a suited species, because different species have different feeding strategies (grazers like cattle or horse, browsers like elk and roe deer, and intermediate feeders like red deer). Moreover, number of animals and period of pasturing have to be taken into account. Mathematical grazing models may help to adjust these parameters. Pasturing as nature conservation tool has become an element of agri-environment schemes. [58, 59]

Dangerous plants on pastures

As harmful plants are widely spread among feed grass, it is necessary to define their chemical content and their effect on the animal organism.

Plants that do not contain poisonous substances but which are referred to be harmful are considered nutritive, but their consumption can lead to damage of the animal products (meat, milk, fir), they can be harmful for the health of the animals and even can lead to death. When plants as cotton grass *(Eriophorum sp.)*, thistle *(Cirsium setosum)* or foxtail *(Setaria pumila)* are eaten by animals, they can cause heavy indigestion which can lead even to death, because they form lumps out of hair (so called phytobezoar), which prevent food income. Some dangerous plants have sharp hair or hard prickly seeds, which can damage the skin, stomach and gullet, causing inflammation. For example, feather grass *(Stipa capillata)*, and wild wheat *(Triticum sp.)* are referred to as being such grass. The most dangerous among them is feather grass *(Stipa capillata)*, sharp grains of which fall into wool, then they go into muscles and cause purulent inflammation, which also can lead to death. Wool can be spoiled by small plants: alfalfa *(Medicago sp.)*, flypaper *(Lappula squarrosa)* and others. There are also plants which can spoil the smell or taste of milk when they are consumed by cows as winter cress *(Barbarea sp.)*, mustard *(Sinapis sp.)*, reed *(Phragmites australis)*, wild cabbage *(Brassica sp.)*, wild onion *(Allium sp.)*, and wormwood *(Artemisia sp.)*. Some plants color the milk into different colors – blue, red, yellow (cowwheat *(Melampyrum sp.*), forget-me-not (Myosotis sp.), vista *(Scilla sp.)*, bedstraw *(Galium sp.)*, milkweed *(Euphorbia sp.)*, wild onions *(Allium sp.)*). Some plants, for example peppergrass *(Lepidium ruderale*), hemp nettle *(Galeopsis sp.)*, spoil the taste of the meat and gives it an unpleasant smell. [60]

Poisonous plants

Poisonous plants are the plants whose consumption provokes serious disorders in the organism, in some cases (at very serious indigestions) it leads to death. The majority of poisonous plants have unpleasant smell and the cattle does not eat it or eat just a little amount, however, as the result of the wide spread of these plants poisonings among animals are not infrequent, sometimes leading to death. The biggest danger exists for young calves, which do not distinguish between poisonous plants and therefore they get poisoned more frequently. Poisonousness (toxicity) of plants is explained by the amount of chemical compounds, basic of which are alkaloids, glycosides, essential oils and organic acids. Formation and accumulation of poisonous substances is not equally distributed in different phases of the development of the plant. With respect to hellebore, for example, the most poisonous parts are young unblown sprouts. The young parts of datura *(Datura sp.)* contain more alkaloids than the ripe parts; milk of unripe heads of poppy *(Papaver sp.)* accumulates more alkaloids, which is decreasing during the ripening process.

The amount of poisonous elements depends on local, ecological, climate and soil conditions. It is known that poisonous plants grewing in shade are more toxic than plants from open areas. In some plants poisonous elements are intensively produced during the night. At rainy and cold weather in some plants (daura (*D. sp.*), belladonna *(Hyoscyamus sp.)*) the production of poisonous substances weakens. Thus, one and the same plants can contain different amounts of toxics depending on vegetation, soil and climate conditions and geographical location. It is known that animals, which are used to the consumption of some poisonous plants, can eat them without any consequences, but the same amount of consumed poisonous plants for animals, which are not used to it, may lead to death. Such plants include chickweed and corn cockle. This shows the relative nature of poisonousness of different plants. Therefore, the mentioned plants, which are considered to be poisonous, can be discrepant. However, this circumstance should not weaken the attention to poisonous plants and to plants that are considered to be poisonous. [60, 61]

Methods of pasturing

There are two main methods of pasturing: unsystematic (unregulated) and stable (regulated).

During unregulated pasturing the animals are not limited in space. They eat only young grass, which therefore disappears from herbage very fast. During the second half of the summer cows should graze on the area with old grass, because the young grass disappeared. The old grass has low nutrition value.

Regulated pasturing means pasturing on plots, where cattle pasturing is alternated in order to maintain the level of grass and its quality, grass can be eaten only once (animals should not graze in enclosure during the period when the grass can grow again). In spring, after pasturing, when herbage is 5-6 cm height, the aftermath grows 1-1.5 cm per day, therefore pasturing on this area can be continued only in 10 days. Animals should be kept in the enclosure not more than 6 days. [62]

Organization of haying

Hay characteristics

Hay is one of the main and the most nutritious rough forage for the cattle, sheep, horses, rabbits and other animals during the winter period.

In 1 kg of good hay there are 0.4-0.5 of fodder units, 60-70 gm of digested protein, 40-50 mg of carotene (provitamin A). Besides, hay is rich in vitamin groups B, E and K, minerals, hormones and other biologically active substances.

Because of its high quality animals can satisfy their need in the general level of food (fodder units) on 40-50 %, in digested proteinon 35-45 %, more than half with respect to mineral substances and fully with respect to carotene. Therefore, a special attention should be given to the quality of prepared hay.

Quality and productivity of hay mainly depend on type of fodder land, on the period of cutting the grass, on the botanical structure of the herbage, on techniques and technology of hay preparation, on conditions of its storage and on many other factors. Each factor and even combinations of them can have an impact on the nutritional value of hay. In all variety of conditions which influence the amount of hay and its quality, the major factors are the botanical structure and the period of cutting the grass. [63, 64, 65]

As pasturing, haymaking has a significant influence on the habitat and can be used as a tool for nature conservation. Thus, mowing and haymaking are also included in agri-environment schemes.

Haying period

Untimely cut grass considerably reduces fodder and biological value of hay. At very early cutting quality indicators decrease because of loss of valuable grasses for fodder and there is a decrease in their efficiency during next several years. At a very late cut the most valuable nutrients become indigestive because of grass overgrow.

Optimum term for cutting of grass on hay is the floral initiation: the phase of budding with respect to legume grasses and the phase of ear emergence with respect to grasses. When gathering legume-grass cultures and motley grasses the time of the first hay cut is defined by the phase of development of the basic component of the herbage or according to haymaking type.

At hay preparation the process of haying starts at later phases of grass development – at full flowering - and finishes at the end of flowering and even at seed formation. Delay with haying is usually explained by the assumption that gathering of fodder units from one hectare can be higher during the period of full flowering than during the budding phase. In fact, gross output of solid grass substances, which are cut later, can be higher. However, at the attentive analysis of grass productivity, as a rule, it is not visible. The harvest increase occurs basically because of increase of cellulose in plants. At the same time digestibility of the most valuable nutrients including celluloses, sharply decreases.

It is known that there is a dependence of the maintenance of nutrients in hay and their digestibility on the period of haying. So, in 1 kg of solid matter of hay from clover-grass mix, which was cut at budding phase, was 150 gm of protein, 270 gm of cellulose; and those that was cut in the end of flowering – 90 gm and 360 gm accordingly. Digestibility of protein for cows has decreased from 65 % to 48 %, and digestibility of cellulose – from 64 % to 56 %. The quantity of digestive protein in 1 kg of hay has decreased from 98 gm till 43 gm.

During the process of herbage aging the share of leaves decreases and the share of stalks increases. Leaves are becoming much more nutritious than stalks, thus defining the nutritional value of the whole plant. Along with the process of aging the amount of nutrients in leaves and stalks in general decreases; that is connected with biological features of grass vegetation.

Phases of development of forage crops changes very quickly. Therefore, hay cutting on each type of haymaking should be started in optimum and be finished within 8-10 days. In areas of high wetness, e.g. on water meadows, the haying of some herbage can take 12-15 days.

Techniques used to dry hay on the field

To get maximum harvest of hay of the highest quality it is necessary to follow some technological rules. An important role is played by the heights of the herbage and the period of its cutting and techniques used to make the process of drying faster as flattening, turning and rolling-over in the (cutting and swath).

The height, on which the grass is cut, influences not only the amount of nutritious matters but also the quality and productivity during the next years. At a low cutting the amount of hay can be maximum but the second cutting can be less productive as grass grows slowly, more nutritious elements are needed for their development. This also leads to herbage oppression, to decrease of its productiveness and to loss of main components. To cut the grass higher than on optimum is quite negative for productivity and hay quality. The optimum for grass cutting is 5-6 cm, during the second cut – 6-7 cm, for annual grass and mixtures – 4-6 cm, for high grass – 10-12 cm from the ground surface.

During dry and clear weather the period of haying for any type of grass is not the limitative factor. In case of rain or morning dew it is reasonable to cut after the area is ventilated. When cutting wet grass the period of drying is becoming much longer and the loss of nutrients increases. A very important technological method is flattening. Nearly 70-75 % of the whole amount of water in the plant (for example clover) is contained in stalks. In normal grass the water level is on 8-10 % lower. Water-yielding capacity in legume grass, cut during good weather for hay making, differs. That is why the drying process of legume and grass is different and can take a long period. Flattening increases speed of water-yielding capacity of clover stalks by more than 20%, and it’s mixtures by 40%. Besides, flattening provides with equal dryness of the whole plant. If leaves of clover compared to the whole plant dries 2.4 times faster, than after flattening it will be dry with the same speed as the whole plant.

Without flattening the drying process for another plant, for example timothy, can be 1,5 times faster than for clover. During the flattening process of legume grass the drying speed of clover and timothy becomes equal, (clover − 0.8 per hour, timothy − 0.7 per hour). Flattening of mixed grass is very important for preparing pressed hay. Uneven distribution of water in a pressed mass

leads to the formation of heating centers and mold. It is necessary to note that flattening of normal field grass is not a key technique.

Grass flattening at a very high temperature and low humidity level should be done directly after cutting. Grass flattening on the next day is not effective and even harmful. It is connected with breakage of leaves which may get dry very fast or during bad weather with rain affection.

To fasten the drying process and to get hay of high quality it is necessary to apply turning on a par with flattening. Turning in swathes should be done after cutting, and should be repeated when the upper layers of the grass are dry. If the grass is not turned the upper layers can be overdried (25-30% of water) while the lower layers remain wet (65-75 %). As result the drying process becomes very long, hay loses the color, carotene becomes fragile, so nutrition value and biological value decrease. Due to turning the hay becomes dry equally and dries faster.

In order to reduce loss of leaves during turning it is necessary to choose a good time for this procedure. Turning hay during the day leads to big loss of nutritive matter, therefore it is better to turn hay in the morning or in the evening.

Using two of these methods – flattening and turning – especially on rich lands, where the thickness of the layer is more than 20 cm, it is possible to reduce the time of drying for 1,5- 2 days compared to ordinary way of drying.

Turning process of grass with high level of legume grass should be stopped at a humidity level not lower than 45-50 %. Otherwise the quality of the hay can be reduced and it can lead to a big loss because of leave breakage.

In the areas with a hot climate grass cut it is necessary to fell at the same time to rake it up simultaneously with grass cut. It prevents from influence of sun rays. In areas with a damp climate especially after rain or fog, to speed up drying process and decrease the loss of nutrients the turning of grass should be done when the top layer is dry. The next turning should be done in process of decrease of humidity of grass, but not below than 40-45 %. [63, 66, 67]

Techniques of hay preparation

Hay can be prepared loose, pressed, naturally dried, and actively dried.

Loose hay. To dry hay equally it is needed to be turned several times (1-2 times), the first turn is done after cutting and the second one after 2-3 hours. The hay should lay in the sun up to the time when the humidity level will reach 55-60%. Under good weather conditions it is possible to dry hay in swaths. Dried for nearly 24 hours, the grass with 30-35 % of humidity is turned and raked up into swath, then out of swathdried mass is gathered into haycocks. When it is dried up to 17 % in haycocks it is transported to the place of ricking. The size of the stack depends on the way of transportation and size of hay land.

Hay of active final drying. After cutting it is possible to dry grass on special devices: tents, poles, hangers, and fences. Drying hay in swaths to a humidity level up to 30 -35 % can be done by active ventilation in the sheds, barracks, or in special stacks. It is done with the help of fans with warm air. This procedures speeds up the drying process (2.5-3 times) and increases hay quality.

Pressed hay. This method is widely spread. The used technology is very simple. With the help of balers grass taken to the tank, where bales are made. Pressed hay can be easily transported. Its volume is 2.5-3 times smaller and the quality is higher than the quality of loose hay, it is more convenient for feeding animals.

Cut hay. Technology of preparation mostly used on nearest haymakers. Dried in swaths, hay with a humidity level of 35-45 % is gathered and cut into smaller pieces at the same time and loaded into transport. On the place cut hay is dried by fans.

Depending on botanical structure and conditions of growing 4 types of hay are known: seed leguminous, seed grass, seed legume-grass, and natural. According to physical and chemical indicators every hay type is divided into 3 classes of quality. In the hay from cultural hay land any content of harmful plants is not allowed and in the hay taken from natural lands it should not exceed 1%.

Approximate mass of 1 m^3 of hay from forest lands in small and medium stacks after one month of packing is 45 kg, in high stacks – 50 kg, after 3 months – 50 and 55 kg respectively. [1]

3 Management of bioresources of water objects

3.1 The main use of water resources in agriculture. Environmental problems

Water resources

Sustainable development is inseparably linked with rational use of natural resources, among which one of the most important places is occupied by water resources required to meet social and industrial needs of the population.

The difficulty in solving this problem lies in the fact that sources of water supply in their natural state cannot always meet the requirements for volume and quality of water. Therefore, the increase of water resources and their quality is becoming more acute. The solution to this problem may be achieved by several methods:

1. rationalization of water consumption
2. prevention of water pollution
3. regulation of water resources
4. territorial redistribution of water resources
5. use of fresh underground water and desalination of mineral (sea) water
6. improvement of use and protection of water resources[68, 69]

Rationalization of water consumption implies introduction into industry, energy sector and agriculture circulating water systems, drainless and wasteless technologies; reduction of unproductive water losses; building technologically advanced irrigation systems and reconstruction of the HMS; improvement of irrigation techniques and irrigation conditions; building water collector and drainage networks on all irrigation areas exposed to salinization; use of antifiltering surfaces; introduction of intensive farming technologies and improvement of maintenance of water conservation systems; introduction of effective methods of artificial fish farming.

Each person consumes an average amount of 650 cubic meters of water per year (1780 liters per day). However, only 2.5 liters per day, i.e. about 1 cubic meter per year, is enough to meet the physiological needs. A large amount of water is needed for agriculture (69%), 23% of water is used in industry, 6% is consumed in household usage. [68]

Prevention of water pollution. The introduction of circulating water systems, drainless and wasteless technologies will contribute to pollution of water bodies.

Traditionally, the harmful impact of agriculture on the environment is underestimated. However, back in 1960s agriculture has acquired the first place in environment pollution. This was due to two factors. The first was building of stock-raising farms and complexes without any pollution abatement of resulting manure-containing wastes and their disposal; the second was a violation of norms and rules of usage of chemical fertilizers and pesticides, which along with rain and underground water flows into rivers and lakes, causing severe damage to basins of major rivers, their fish stocks and vegetation.

The most serious threat to environment is pollution of water resources with nitrogen fertilizers. In the absence of a sealed container, natural fertilizers are easily transported by means of rain into underground and surface water. For storing organic fertilizers it is necessary to use specialized storage areas that meet the following standards:

- leakproof floor
- organized drainage system
- presence of tanks for liquid waste
- boards to prevent the spread of the stored fertilizer and inflow of water

For storing of liquid organic fertilizers sealed containers often buried in the ground are used.

In modern conditions of development of agriculture its negative impact on the environment in many cases becomes more serious than that of other sectors of social production. Related to development of agriculture are the growth of lack of water resources on large areas; reduction of species diversity of flora and fauna; salinization, swamping and exhaustion of the soil; accumulation in soil and water of a number of particularly resistant and dangerous pollutants of the environment.

The use of water resources by mankind is carried out in two ways: water consumption and water use.

Water consumption is the usage of substance of hydrosphere from natural or artificial containers for needs of population and social sector. Artificial containers include water supply systems, artificial ponds, canals, etc. For water consumption mainly fresh water is used.

Water consumption is the main cause of environmental problems associated with the hydrosphere. With increasing consumption of fresh water in agriculture, industry, energy sector and public facilities, deficit of water increases and the problem of imbalance between consumption of fresh water and return of purified water into the biosphere arises more prominently. Due to this causes the desiccation of water resources and a threat of deficit of fresh water occurs.

The biggest irretrievable water consumer is agriculture. Irrigation and livestock farming takes a great amount of water for food production. It was estimated that the production of daily rate of food products for one person requires no less than 6 cubic meters of water, part of which is used irretrievably, and another part is polluted by dissolved chemicals and returned into biosphere in this state. [70, 71, 72]

Regulation of water resources. Traditionally, people got most of the fresh water for household, industry and irrigation from surface water bodies. To ensure more stable water supply, dams are built to create water storage basins, where water is retained during periods of high flow and from which it can be drained when there is a shortage of it. In addition, dams and storage basins can serve as sources of energy, recreation areas and provide flood control. Before distribution among consumers, water is transferred to treatment facilities, where its quality is improved (if necessary), and its chlorination or other disinfection is made to destroy pathogens of water (morbific organisms). Most of the water used for household needs and industry is only "borrowed" in the sense that it is returned to nature, but already polluted.

This use of water creates three problems:

- the source can provide only a limited amount of water
- ecosystems downstream may suffer from the fact that water is diverted into another direction
- water is returned to nature already polluted, which is dangerous for human health and environment.

Irrigation is also known as irretrievable water consumption, because water is returned to the atmosphere through evaporation and transpiration, and for some time it is "lost". A big amount of this water comes from rivers to the fields through irrigation canals without any treatment. Again there arises a problem of limited water supply and damage of ecosystems downstream, because of water shortage.

A growing population, development of industry sector and increase in agricultural production lead to continuous growth of demand for fresh water. But the number of places to build dams and storage basins is limited and cannot be enlarged. Moreover, such construction also brings negative consequences. Natural river bed and lands flooded by building the storage basins are being sacrificed. There are very few rivers that are still not blocked by dams.

Territorial redistribution of water resources. Water land reclamation has been a great concern of people from the ancient times. Irrigation canals were built by the ancient Egyptians, who managed in this way to improve the soil fertility. Water land reclamation (irrigation and drainage) is one of the ways to improve the productivity of agricultural lands, which occupy 10% of the planet surface. One-sixth of these lands are reclaimed, and 40-50% of all agricultural products produced is grown on them.

Land reclamation is an objective necessity in the transformation of natural systems, turning swamps and marshy lands into high-yielding agricultural lands, social and economic transformation of the country. As an important part of intensification of agricultural production land reclamation is supposed to make a tangible contribution to supply the population with food and raw products.

The development of new agricultural lands for irrigation is often restrained by the lack of water resources, since this type of land reclamation is a characteristic feature of agriculture in southern regions.

Developing irrigation, it is necessary to ensure the use of water-saving irrigation technology, contributing to a great increase in the efficiency of this type of reclamation. In the operating zones of water conservation systems, the main causes of exhaustion of water resources are unreasonably large areas for the moisture-loving crops, heavy losses in irrigation systems and on irrigated fields, excessive water application and irrigation rates. The main causes of pollution of surface water sources are discharge of drainage and waste water from the irrigated or drained area, as well as wastewater discharge. Drainage water contains remains of mineral fertilizers used on ameliorating soil. It also contains water-soluble salts leached from saline soils. Discharged water from irrigated fields also contains products of soil erosion and organic matter. The main causes of pollution of underground water are deep filtration of irrigation water containing remains of fertilizers and dissolved salts. Nowadays in connection with the intensification of agricultural production the issue of protecting water from pollution becomes prominent. It should be remembered that drainage water that is discharged into drainage systems contains biogenic matter, pesticides and other chemical compounds which have harmful effects on natural waters.

The main issue, especially in large-scale land reclamation, is the effect of drainage reclamation on the water regime of the regions. After creating a drainage system the hydrological regime is significantly transformed. The greatest changes occur in the river flow. In the early years of initial operation of drainage systems there is some increase in annual flow in the basin due to heavy discharge of excess water. Subsequently, it may return to its initial value (as before the reclamation works). It is established that after the drainage of land, especially in the early years, the proportion of the underground supply increases in the river flow. Analysis of after-reclamation changes of the flow in summer-autumn low water showed that in this period the water content of the river increases. Spring tide flow is changing a little, mainly in the direction of its reduction, since on reclaimed land it is influenced by two main factors acting in opposite ways: increasing the capacity of the aeration zone, which causes great losses of melt water flow and increase in the speed of spring water flow with developed artificial drainage system.

Reduction in water application and irrigation rates, strict differentiation in their application on territories in accordance with natural conditions, prevention of the loss of irrigation water in irrigated fields and irrigation network, reduction and complete cessation of drainage and discharge of waste water outside the system are the main aspects of rational territorial redistribution of water resources.

Thereto it is necessary to improve hydro-economic and technical-economic calculations for determining the values of appropriate irrigation rates for different natural moisture years (average, middle-dry and dry) and their territorial variability. The use of all types of land reclamation should be based on modern principles of complex adaptive-landscape agriculture with obligatory consideration of natural and economic factors. [73, 74, 75]

3.2 The use of fresh underground water and desalination of mineral (sea) water

In long-term planning the inevitable dry years when river flows drop to abnormally low levels should be taken into account. It is believed that no more than 30% of average annual river flow can be used without risk to experience a lack of water once every 20 years. The bigger amounts of water is taken, the more frequent and abrupt the fall in water level will become.

Ground waters are basically a system of underground reservoirs. It is estimated that the total volume of ground waters exceeds the volume of surface water up to 75 times. But the underground reservoir, as well as any others, are exhausted, if the consumption of these waters is faster than its refilling, i.e. rain water weeping down to the groundwater level.

Lowering of the level of ground water affects the surface water bodies. Streams, rivers and lakes are largely supplied by springs, which are outflow of groundwater to the surface. Due to the exhaustion of groundwater another problem arises that is the underrun of salt water. In the coastal areas the springs may be located below sea level. As long as the level of groundwater on the land is above sea level, the pressure in aquifer is maintained, which supplies a constant flow of fresh water in the ocean, and the wells located near it give fresh water. However, lowering of the groundwater level or high rate of water consumption can reduce the pressure in the aquifer, which will allow salt water to flow into the aquifer and consequently into the wells.

Improvement of use and protection of water resources

It is necessary to improve the operation of the HMS, to improve the irrigation regimes of reclaimed lands, to develop and implement innovative, resource-saving technologies of irrigation of fodder and other crops because the role of land reclamation in production of crops and livestock rising is continually increasing according to the quality of the products obtained, its environmental security and expected profit.

Often for reclamation use numerous reservoirs as ponds are built, and the use of ponds for fish farming is now highly actual.

Depending on the source of water, the lay of land and geological conditions different types of fish ponds may be distinguished: ponds formed by earthen dam, blocking the gully or river bed; ponds, located in the high-water bed of the river flanked by dams; ponds can be dug, in sidehill fill and others. In the ponds spillways must be built, to ensure the discharge of excess flood waters, allowing to keep the water level in the pond at a certain height so as not to spill water over the crest of earth dams and levees. Such spillways can be of different types: earthen spillway ditch, open spillway, shaft spillway and others.

Sluiceway of simplified type consists of a pit with bars, bedstone with gate and fish-catcher. Forward flow and fish-catcher are concrete, and horizontal pipe can be made of metal, concrete or asbestos cement. Such floodgate is used in ponds, built in deep gullies and ravines. Sluiceway may be made of asbestos cement or concrete pipe embedded in the body of the dam at the bottom of the pond. The opening of the bottom water-discharge pipe is covered by a wooden shield, moving in the grooves on the channel bars on the iron rod with an angular thread.

On the small ponds of the area of 0.2-0.5 ha spillway and floodgates can be arranged in the form of two pipes, laid in the dike. The top pipe should be laid at the height of the normal water level in the pond and is designed to automatically discharge of the excess storm water. The bottom pipe should be laid at the bottom of the pond and is designed to fully drain water from the pond. From the side of a dry dam slope both pipes are equipped with gates. The pipes should be set with grids with horizontal bars. For a discharge of non-grain ponds of small area siphon floodgates may be used.

Siphon floodgates, composed of individual pipes, are placed on slopes and crest of the dam across it so that the output end of the installation is somewhat lower than the input. Input and output ends are equipped with shutters; in addition, the input end must be bared with metal grates to prevent fish, branches, etc. entering the siphon. At the top the siphon has two openings: one for the release of air from the siphon, and the other for inflow of water. Both openings are cut off by shut-off valves. Siphon floodgates are assembled from asbestos-cement and metal pipes and rubber-textile hoses.

For catching of fish from the pond it is desirable to install fish-catchers, which are usually placed in the offtake channel. A part of the channel is enhanced by ramping or concrete slabs, and at the end of the channel a blocking latticed partition wall is made, which prevents fish from escaping the fish-catcher. For small ponds a fish-catcher can be made in the form of a concrete or steel perforated box that is installed near the outlet pipe of the floodgates.

Fish barriers are needed to prevent the release of fish from fish ponds. Thereto lattices are installed on the floodgates. Inside the dam floodgates or a siphon is set to ensure a complete emptying of the pond. After the discharge of water a reclamation work should be performed on the bed of the pond: it should be cleared of trash, stumps, rocks; pits and holes should be filled in; the bed should be laid out, and a net for fish collecting should be constructed.

Bank erosion. Natural riverbeds of the streams are not able to cope with the increased flow that pulls out the soil and stones from their shores. Trees that usually secure the shore, are also undermined and fall into the stream, blocking the path of the water and directing it over to the banks, thus increasing erosion. This process of bank erosion is quite natural, but in a natural way it goes very slowly, and growth of vegetation recovers the shore. With the increase of surface flow the balance is violated and erosion is increasing rapidly. Additional damage may be caused by the flows from inappropriately placed discharge tubes that wash away ravines in the sides of valleys. A finer material is carried away by the currents, but rocks and coarse-grained sand are deposited on the bottom of the channel, raising water levels and thus increasing its impact on the coast. As a result, streams become shallower and wider. In the end, the channel can be fully impounded, and the water will break through it again in the neighboring areas. This will increase erosion and cause the loss of many trees due to waterlogged soil. Gradually narrow stream bordered by trees could turn into a wide gully, covered with fallen tree trunks, sand, and gravel.

Floods. When the surface flow through shallow streams reaches rivers, floods occur. They have always been a normal natural phenomenon, but with an increase in flow even moderate rains can cause flooding. Many suburban settlements are more and more affected by them, as in the course of urbanization the major part of storage basins in the area has been asphalted. Thus, the waters of not purified surface flow are heavily polluted. In contrast to high-quality spring water they carry all kinds of materials polluting the ground directly into streams and rivers.

Methods to prevent the devastating effects of floods are divided into two groups: structural and nonstructural. Structural methods are associated with the planning of hydraulic structures, their construction and operation, for example, when preparing for a great flood the reservoirs are emptied in order to take in the necessary amount of water. And when flooding is expected to be low, then the water in the reservoirs is "held back". Flow regulation in water storages created on all major river systems is one of the measures of flood control.

Nonstructural methods are associated with conducting of hydrological calculations and predictions. First of all, it is planning of the construction of hydraulic structures, based on the information about general rain floods or high water that may be formed in this basin and their probability. In addition, hydro-meteorological service develops forecasts, which allow to predict the high floods, and to prepare a set of measures to prevent their effects. Hydrologists have been working on new techniques that make these predictions more accurate for decades.

Surface flow does not fill up the ground water. In highly urbanized areas or in cases of excessive compaction of soil with the excess of pasturable or manufacturing load, compaction of the surface violates conditions of constant flow in streams, under which rich ecosystems are developed, and leads to environmentally unsustainable fast alternation of floods and drying. In fact, natural streams begin to differ slightly from the open storm drains and are often included in such a system:

drainage pipes are laid along their beds and buried. This is particularly unfortunate, considering our desire to preserve and protect the natural environment in increasingly urbanized landscapes.

Limited freshwater supplies are reduced even more due to pollution. The major threat is wastewater (agricultural and household), since a greater part of used water is returned to the water basins in the form of sewage.

The complex and interconnected nature of freshwater systems demands a holistic approach to the management of freshwater resources (assuming the economic activity within the storage basin), based on a balanced consideration of the needs of the population and the environment. The scope and extent of polluted zones of aeration and aquifers have always been underestimated because of the relative inaccessibility of aquifers and the lack of information on aquifer systems. In this regard, protection of groundwater is an essential element of rational use of water resources.

To include elements of quality management of water resources in hydro-economic management three objectives should be simultaneously achieved:

1. preservation of ecosystem integrity through economical activities based on the principle of protection of aquatic ecosystems, including living resources, and their effective protection against all types of degradation within the storage basin

2. protection of public health that includes not only supply of drinking water that contains no pathogens, but also the infection carrier control in the aquatic environment

3. human resource development, which is a key to forming a potential and is a indispensable condition for establishing the management of water quality

All countries, according to their capacities and available resources, and through bilateral or multilateral cooperation, including the United Nations and, if necessary, with other relevant organizations, could set the following goals:

1. to identify those resources of surface and underground water, which could be exploited for use on sustainable basis, and other major water-dependent resources that can be mastered, and at the same time to initiate programs to protect, conserve and rationally use these resources in a stable basis

2. to identify all potential sources of water and prepare plans for their protection, conservation and rational usage

3. to undertake the realization of effective programs commensurate with the level of socio-economic development to control water pollution, properly combining the realization of strategies to reduce pollution of the source along with of the implementation of ecological expertise and application of practically realizable rates of discharge of large point sources and of non-point sources with high risk rate

4. to establish, in accordance with their capabilities and needs, biological, sanitary, physical and chemical water quality criteria for all types of water bodies (surface and ground water) in order to continually improve the quality of water

5. to implement a combined approach to environmentally safe management of water resources, including protection of aquatic ecosystems and freshwater living resources

6. to develop a strategy for environmentally safe management of freshwater storages and related coastal ecosystems, including consideration of issues related to fishery, aquaculture, pascual sector, agriculture and biodiversity [68, 73, 76, 77]

4 Game resource management

Generalities

Nature management in general and game resources management in particular on the territory of the Russian Federation, are clearly governed by laws and regulations. The existing legal framework establishes terms (approved by RF Government Decree № 18 of 10.01.2009) and the volume of wildlife production classified as game resources, (Federal Law "On game and conservation of game resources and on amendments to certain legislative acts of the Russian Federation". Approved 18/07/2009) and limitations in the methods of animals acquisition (approved by RF Government Decree № 10 of 10.01.2009; Federal Law "On Wildlife" with amendments from 1.01.2008). Thus, the possible innovations in the field of game animal resource management are found in the field of spatial and functional organization of game and determination of its key facilities. Observation of the rules set out below, and the use of management approaches is aimed at improving the productivity and profitability of hunting farms, as well as providing a stable state of biocenosis and protection of biological diversity. [78]

Spatial and functional aspects for use of game animal resources

Territorial scheme of game animal resource management and ecological principles of planning in operational burden on the population is discussed in detail in this material. The experience of Western countries and some regions of the Russian Federation have shown that, for large mammals, which are mostly owned by hunting species, there is no need to allocate large protected areas, or to limit game in the administrative regions. As animals selectively cope with habitat and have spatial and functional heterogeneity of habitats, they need to be protected according to specific habitats.

Species having large habitats (which are unevenly used throughout the annual cycle) require protection of their habitats in a certain season of the year. Among the traditional game objects one distinguishes wolves, bears, elks, and migratory birds in this group.

The key objects of habitat protection for sedentary species are quality ecotypes, which have high protective properties, the abundance of available preferred feeds, conditions for nesting, etc. In this regard, the question of how to identify areas which could be the most conductive environment for its inhabitants becomes urgent. This problem is successfully solved by calculating the index of habitat suitability defined by the frequency registration of animals or traces of their activity in the specific area or terrain. It is important to note that the identified sites are not strict reserves where hunting is prohibited. Hunting is necessary to maintain the optimal density to prevent potential degradation of highly productive species. The beginning of game in high-quality habitat (called by N.P. Naumov (1936) as places of residence) must precede registration of decrease in population growth on the results of pre-hunted number of population noted, in the past hunting season, increase in the proportion of injured animals and / or with traces of bites on the body. In other habitats, the game should aim to maximize (within the allowable quota) trapping. It lets not to undermine the resource base of low-productive areas and to release places for the resettlement of animals. The latter fact ensures the necessary level of genetic diversity in a population and structuring of population, to increase its stability, and reduce the level of aggression within the species (possibility of regular resettlement among young generative animal units).

In addition, the planning of population management depends not only on species features described above, but also on the particular scheme of spatial and functional organization in population. So R. Keesing and R. Osfeld (1999) identified two main variants of spatial structure for mammals.

The system of "source-drain" implies the presence of habitat and, consequently, the population parcels (micro populations), which play different roles in ensuring the population homeostasis. The above described scheme of resource management is performed in this model.

Balance model, by contrast, takes place in a homogeneous environment where biotopes provide an equal probability of life and death of population groups. In this case the trapping of family groups should be proportional in terms of volume removal as the distribution of game in the territory. The same applies to the taking of migratory birds.

The third important condition for the organization of the system of game animal resource management, is the phase of population cycle (growth, saturation, degradation, stagnation) where the exploited population lives. This fact is usually not taken into account in the calculation of hunting quotas, but it is important in the use of animal populations on the relatively small areas (which include sections devoted to hunting farms on the long lease conditions). Matching of percentage of animals to be hunted with population-wide processes allows controlling of the reproductive potential of the population for long term. This makes the population productivity maximum and increases adaptogenic properties. Ecologists reliably established the features that characterize the passage of populations via their certain development phases. The following are the most universal and accessible features during the field observations, or in the evaluation of game and criteria of such analysis.

Phase of growth (amplification): increase in the number of animals, family, animal occurrences in unusual and low-quality habitat for a particular species from year to year, the proportion of young males, the right age pyramid (the maximum number of young individuals, fewer adults), the minimum percentage of the animals with completed generation).

Phase of saturation (the maximum number) virtually the stable number of families, increase of the number of family members, minimum anxiety (lack of fear of humans), regular meeting of the animals in unusual habitat type, registration of non-typical fodder objects, a large proportion of injured individuals; low survival rate of young animals to hunting season, high helminth infections, disease outbreaks; shared ratio of animals in different age groups is close to equilibrium.

Key objects of game resource management.

Key types of biosystems.

Any area includes a large number of hunting species. In this case, the management of hunting resources affects mainly species whose members belong to the group of trophy or traditional hunting objects in the area. However, rational nature management aimed at maintaining high productivity of habitats, conservation and restoration of biological diversity requires a concentration of research and management efforts for key types of ecosystems whose vital functions determine the species composition, geoecological, microclimatic and other relatively stable features of the existing natural communities. In addition, priority control objects are key sectors of food network (large predatory mammals, birds), and rare species. In the forest-steppe zone, the zone of broad-leaved

forest and taiga one distinguishes such key environment reorganizers as badger (*Meles meles*), marmot bobac (*Marmota bobak*), ordinary beaver (*Castor fiber*), ground squirrels (*Spermophilus*); and wild boar (*Sus scrofa*) have great importance. Their winter trails in deep snow serve as the path for large numbers of animals, and as the hunting places for predators. The list of rare species that need protection is given in the Red Book of Russia and the subjects of the Russian Federation; it is republished according to the acts of legislation with a frequency close to three years.

Phase of degradation (depopulation) decrease in the proportion of animals found in low-quality habitat for these species, the prevalence of old and nonproliferating animals in population, decrease of encountered animals, reduce in the number of family groups.

Phase of stagnation (the minimum number): rare meetings with animals, high anxiety (fear of people), the preservation of families only in the most comfortable habitat, young individuals dominate in population, more female than male in brood. [79, 80, 81, 82]

5 Integrated nature management

Based on the analysis of contemporary forms of integrated resource management and the experience of the EU countries in the field of sustainable development of rural areas, it can be concluded that; the most effective and perspective types of integrated farming include modern hunting farms and nature parks. The latter type of institutions is widely found in many countries. But only the nature parks in France are the most relevant to the principles of participatory management of agricultural development, the modern environmental policy and natural resources conservation.

The following are the characteristics of hunting farms and nature parks with directions of the priority lines of development, as well as ways to achieve sustainable development of rural areas and natural resource conservation.

Game Parks

Currently game parks extend their scope of activity and go beyond the narrow profile of the organization, dedicated exclusively to the rendering of services in the field of obtaining fauna objects. Game parks are increasingly becoming the leisure parks and the places for spending time by recreationists. This transformation results in a significant potential of game parks in the field of condition formation for sustainable development of rural areas. It is based on the following assumptions:

- Expansion of services leads to more jobs
- The need for a constant and significant flow of visitors, leading to the development of road transport and other infrastructure
- A variety of activities, leads to increased demand for specialists (hunters, livestock experts, veterinarians, agronomists, cooks, drivers, tourist profile managers, ecologists, biologists, etc.). Thus contributing to the increase in the number of jobs and the attraction of highly qualified staff to the country
- The need to provide services of a wide profile, the development of a large number of kinds of hunting, ecological and scientific tourism, watching tours of the animals are responsible for the development of nature conservation activity, zootechny and qualitative improvement of animal habitats and all these procedures also lead to optimization of ecosystems in general

A distinctive feature of game parks is the duality of their development strategy. On one hand, it is the complexity. But on the other hand it is the consistency.

Complex of activities in hunting farms consists of the following items:

- Granting the right to hunt (licensing)
- Services for hunters (support, ranging weapons, equipment rental, equipment, transportation, photography and video services, working with the production: skinning, gastronomy and the definition of trophy value)
- Rendering of tourism services (walking, riding, cycling, ecological trails, waterways, and organization of monitor animals)
- Organization of leisure and health improvement activities (bath, aromatherapy, shooting, horseback riding, biking, skiing, health trails, rational nutrition)

- Zoo technical and nature improving activities (creation of fodder fields, feeding grounds, small hydraulic structures, re-acclimatization of animals, activities to improve the quality of living conditions of the major hunting species and species edificatory

Consistency in the work of game parks is achieved, by the multiple uses of their resources and the mutual support and effectiveness in different areas of work.

For example:

1. The effective combination of staff's activity (security personnel, accompanying hunters, guides, employees, zootechnics and nature improving activities) is possible
2. The use of horses for protection of hunter sites, hippotherapy, horse riding
3. The use of towers and ambushes, as for hunting, as for the observation of animals
4. Coordinated deployment of feeding places with routes of hiking trails and places of animal observation facilitates the increase in the attractiveness of the last two types of services
5. The need of hunters to maintain a proper state of their guns in the aid of creating shooting grounds (corresponding to the technical rules of shotgun competition [83], the establishment of shooting range on the basis of shooting grounds, which can be used for shooting competitions, bow, crossbow; and be used like biathlon shooting range in winter
6. One of the most popular types of services (demanded by game parks in any region of Russia) is the service of hunting dogs

It includes:

- predatory animal baiting
- dogs training
- rapid assessment of the estrous cycle phase (fern test is effective without any additional equipment [84]
- exhibitions and dog competitions
- determination of the olfactory acuity (membrane olfactometer, model of S.A. Korytin) [85]

Regional nature parks

The discussed variety of nature parks, as noted earlier, is common in France; their distinguishing feature is the priority on creating incentive system of rural population for self-employment through the development of authentic crafts, productions, cultural features, valorization of natural and historical heritage. Rational use of resources, development of initiatives to attract green technologies and environmental protection occurs as a consequence of necessity awareness to preserve and restore the attractive features of locality.

It is noteworthy that, the nature parks are created without land allocation with a minimum limit of nature management (or with voluntary commitments undertaken by the land and resource users). Under these circumstances, the park territory should be considered as an area for development. In most cases, the basis of its ongoing dynamics is generated by sustainable tourist flows. The basic conditions of their occurrence are the following:

- the presence of notable tourist sites (landscapes, objects of flora and fauna, historical monuments, places of particular historical and cultural significance)
- presence of transport and road infrastructure
- motivation of the local people in the development of the park
- search and revival of original, colorful features of the inhabitants of the area that could become independent objects of tourism (food, souvenirs, songs, a particular style of architecture, customs, etc.)

Under these conditions or the relevant work on their creation (or revival) a number of people and organizations included in the development area gradually increases. The main field of activity is the rendering of services, such as:

- guest houses
- inclusion of tourists into the activity of the traditional methods in natural resource management (picking and stocking of plant materials for construction, cooking, pharmaceutic, etc.)
- gastronomic tourism
- a variety of tours (hiking, water, bicycle, horse, automobile tourism)
- guide service
- natural products shop
- safaris organization
- museum affairs
- costume shows and thematic festivals unique only to this area

The list of services can be unlimited; on the early stages of park creation, it is only important to focus on the types of services that have historical roots in this area.

It is at the level of nature parks described (in the previous sections of the module) that, forms of nature management take a complete aim, together with the sources of demanded and the implementation mechanisms.

Glossary

ACCLIMATIZATION – 1) the adaptation of organisms to new or changed conditions when the ability to pass all developmental stages and to provide viable posterity is acquired, and 2) a set of measures on introduction of a new species in a strange habitat

AGROBIOGEOCENOSIS – an unstable ecosystem with artificially created or depauperated species natural biotic community that produces agricultural products. Agrobiogeocenosis cannot exist without the constant human support for a long spell

AGROCENOSIS – a community created and regularly maintained by humans for the purpose of agricultural production. It is characterized by depauperated species composition and instability of functioning

AGROLANDSCAPES – an anthropogenic landscape where its native vegetation is replaced with agrocenosis on the overwhelming part of territory

AGROSTEPPE – a seminatural plan communication which is created by sowing method of the mixed hay–seeds harvested in natural steppes

AGROSTEPPES (METHOD) – the multispecific plant community restored by man and that are similar to each other in composition, structure, crop-producing power and seeds among wild seed-bearing plants; the sowing of the mixed grass crop to prepared soil is done on a new site every 2^{nd} and 3^{rd} terms. Acceleration is 40–50 times faster than self–repair of wild plants. The method was suggested by D.S. Dzybov in 1974

ANNUAL GROWTH – an increase of species number in a particular group within a year

Any population has a number of specific features: 1) it consists of the same species, 2) individuals are free to interbreed (panmixia), 3) it has the ability to exist for a long time (potential immortality), i.e. ability to homeostasis, 4) it has a certain degree of isolation

APIARY – a place where the hives are placed with the bees

BALANCE ECOLOGICAL (quasi-stationary and quasi-equilibrium state of ecological systems) – 1) the balance of natural or modified habitat-forming components and natural processes that lead to a prolonged existence of the ecosystem; 2) the dynamic equation of inflow and outflow of energy, matter and information that supports the ecosystem in a qualitatively particular state or leading to the regular sequence of one ecosystem to another in the array of syngenetic development. One distinguishes component ecological balance based on the balance of ecological components within a complex ecosystem, and territorial ecological balance which occurs when a certain ratio of intensively (agrocenosis) and extensively (pastures, natural forests, national parks, etc.) exploited sites; it provides the absence of shifts in the ecological balance of large areas in general

BEE FARMING – 1) breeding of bees for honey and wax as well as for pollination of crops as a branch of agriculture or trade, and 2) a separate farm for the breeding of bee-families; apiary

BEE-KEEPING IN FOREST – wild-honey farming and extraction of honey and wax of forest wild bees from natural hollows and raising bees in made hollows

BIOCENOSES – 1) community of diverse species of microorganisms, plants and animals, fungi and viruses inhabiting a certain territory; it sustains biogenic cycle of matter; 2) any community of interrelated organisms that occupies an area of land or water

BIOGEOCENOSES – a set of homogeneous natural phenomena (of atmosphere, geological material, flora, fauna, and the world of microorganisms, soil and water conditions) which has the own interaction specificity of its constituent components, and certain types of matter and energy exchange between them and other natural phenomena; it is a self-contradictory dialectical unity that is in constant motion and development

BIOLOGICAL DIVERSITY – the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes; this concept includes the diversity within species, between species, and diversity of ecosystems (Convention on Biological Diversity)

BIOLOGICAL DIVERSITY OF FAUNA – a diversification of fauna objects within one species, between species and ecological systems (*the law "On Fauna"*)

BIOLOGICAL PRODUCTION OF ECOSYSTEM TOTAL – the amount of organic matter produced in unit of time per unit of area (e.g., kg / ha per year) by living organisms that are part of ecosystems (biogeocenosis, landscape). Sometimes it is measured by the rate at which energy is expended by the organisms (e.g., kcal / mg of living matter per year)

BIOLOGICAL PRODUCTION PRIMARY – growth of autotrophic organism biomass (phytomass) per unit of time

BIOLOGICAL PRODUCTION PRIMARY NET – the amount of organic matter produced by autotrophs per unit of time less the respiration costs. The latter makes up to half of organic matter produced by photosynthesis

BIOLOGICAL PRODUCTION SECONDARY – growth of heterotrophic plant biomass per unit of time

BIOLOGICAL PRODUCTIVITY, BIOPRODUCTIVITY – the ability of biogeocenosis through the use of energy and matter to the reproduction of organic matter. Biological productivity is commonly assessed through biological net (net primary) and gross (total primary) production expressed by units of weight on units of area per units of time (usually per year)

BIOLOGICAL RESOURCES – genetic resources, organisms or their parts, populations or any other biotic components of ecosystems with actual or potential use or value for humanity (*the Convention on Biological Diversity*)

BIOLOGICAL YIELD OF WILD FRUITS, BERRIES AND MUSHROOMS – an yield that can be provided with a certain type of fruit, nut-fruit, berry plants and mushrooms in this area

BIOM – 1) a set of ecosystems of one natural climatic zone, and 2) a biological system that is larger than the biocenosis and that includes many closely related biocenosises

BIOMASS – 1) the mass of living matter; usually the total mass of a particular group of organisms or trophic level, e.g., biomass of producers; 2) expressed in units of mass or energy of living matter organisms per units of area or volume

BIOMASS GAIN – a quantitative increase of living matter in the community per unit of time. It is expressed in units of weight (mass) per unit of area

BIOTA – historically established complex of living organisms that live on a large area that is isolated by any barriers

BIRCH BARK – a cork part of birch bark which contains betulin in the cellular cavity. It is used in the manufacture of boxes, baskets, jars for storing of liquids (birch bark container), and as a raw material in the tar production

BROAD–LEAVED DECIDUOUS FORESTS – the southern part of the forest zone with warmer climate than in the taiga biome. The main dominant forest – oak (b. Qeurcus), lime (p. Tilia), elm (p. Ulmus), Birch (b. Betula), aspen (b. Populus)

BUNCH – a set of multiple scions developing from the lower short internodes of the stem at perennial bunch plants, e.g., grasses and sedges

CADASTRE – the systematic collection of information about the qualitative and quantitative characteristics of the objects that is made up periodically or by continuous supervision. Cadastre may include recommendations for the use of objects or phenomena, and their protective measures. One distinguishes land cadastre, water cadastre, forest cadastre, and commercial cadastre, etc.

CALENDAR OF MELIFEROUS PLANT BLOSSOMING – starting and ending data determined on the basis of long–term phenological observations over meliferous plants. The date of blossom starting is considered when 10-15% flowers of a certain type of plant are blossomed. And it is the ending day when no more than10 % flowers of this plant continue to bloom

COMPONENTS OF LANDSCAPE – the basic components of landscape represented by the separate sphere fragments of Earth envelope: the lithosphere, hydrosphere, atmosphere, and the sphere of biota distribution. Landscape components are closely linked; when one of them is changed the other are changed too so “chain reaction” is developed. One distinguishes between natural (rock, air, surface and subsurface water, soil, living matter) and anthropogenic (traces and experiences of human activity: constructions, plantations, etc.)

CONTRACT FOR UNCOMPENSATED USE (OF FOREST RESOURCES AREA) – a contract of tenancy under which the forest manager shall provide an area of forest resources to the forest user for free use for up to 49 years for the implementation of one or several types of forest exploitation. Forest areas are available for free use on the basis of decisions of state authorities of the Russian Federation adopted on the proposal of the territorial bodies of forest management. The order of granting of forest areas for free use is determined by the Forest Code of the Russian Federation, the civil law and the regulation approved by the government

COPPICE – 1) draws grown from dormant or adventitious buds, and 2) young ratoon plants

CRITERIA FOR SUSTAINABILITY – 1) quantitative and qualitative properties of mathematical models of the system dynamics that identify the corresponding structure of the system

to some form of motion stability, 2) the quantitative and qualitative variables of the ecological system that reflect the correspondence of its state with its fundamental notions of sustainable functioning of ecosystems (e.g., the energy of a system, indicators of biodiversity, the degree of cycle closure, etc.)

DENSITY OF FOREST STAND – a forestry concept of absolute density. It is calculated by the sum ratio of transversal sections of all trees at the height of 130 cm on the certain forest site to one hectare of forest

DENSITY OF FORESTATION – the degree of tree crown density in forest. It is a forestry concept. Ecological significance is similar to the concept of projective coverage. If there are no gaps between the tree crowns then the density of forestation is assumed to be 1.0. The degree of non-dense tree crowns is determined in shares by eye. It is also calculated as the area sum of cross-sectional tree stems at the level of breast per 1 hectare; it is expressed in tenths fractions of the total areas of tree stems sections per 1 ha.

DISKING – tillage of the upper soil layer by disks (e.g., disc harrows, hoeing ploughs, etc.). The depth of loosening, degree of mincing, mixing and turning around the soil depends on the angle of disk setting to the draft line ("angle of attack"), their shape, sharpness, weight of tools and soil properties. With the reduction of the "angle of attack" the loosening and mincing of soil is deteriorating; the soil is less mixed and turns

DIVERSITY BIOLOGICAL – the number of distinct types of biological objects or phenomena, and the frequency of their occurrence in a fixed interval of time and space that reflect the complexity of living matter in general, its ability to self-regulate their functions and the possibility of its many-sided use. Biodiversity includes all kinds of animals, plants, fungi and microorganisms, ecosystems, and the processes in them. There are three levels of biological diversity: genetic diversity reflects the genetic information in living matter of the Earth, a specific territory; species diversity reflects the number of species and the occurrence of species in a particular area; diversity of ecosystems (landscapes) reflects the number of different types of habitats, communities and ecological processes. Biological diversity is a particular case of general phenomenon in the nature diversity

DOTY TREES (SILVICULTURAL TERM) – trees with trunk injuries and defects of various origins (double trunk topped, with rot, broken, curved, etc.), which have significantly reduced commercial value. Trees that are considered defective, often of great importance for the conservation of biological diversity, as they are most suitable for nests, they have hollows, they are the substrate for fungi and other organisms associated with the dying and decaying wood

DROVE – a construction that crosses the road below the level for vehicle and intended for cattle route

ECOLOGICAL ASSESSMENT – definition about the state of environment or the severity of exposure to it by certain factors

ECOLOGICAL RELIABILITY – an ability of ecosystem relatively complete to self-regulate and self-renew (within the natural daily, seasonal, and year to year and century fluctuations) during succession and evolutional segment of its existence

ECOSYSTEM – the totality of living organisms and inanimate factors that are in dynamic equilibrium. Difference of ecosystems and biocenosis is to have the ability to maintain the viability for infinitely long time

ECOTONE – a location on the border of two ecosystems (biocenosis), characterized by an increased species diversity

ECOTYPE – set of individuals of a species adapted to the conditions of habitat and having inherited traits conditioned by the environment

ENVIRONMENTAL CAPACITY – 1) the number of specimen or communities the needs of which can be satisfied with the resources of the habitat without significant damage to its future well–being, and 2) the ability of the natural environment to include (absorb) the different substances (pollutants) while maintaining stability, and 3) the quantitatively apparent ability of habitat (number of species per unit of area, etc.) that allows ecosystems to exist without loss for its constituent components, and 4) the maximum number of population of certain species which can be kept by ecosystem not degrade, and 5) the number of animals able to live and reproduce normally on unit area for an indefinite time

ENVIRONMENTAL SUSTAINABILITY – an ability of an ecosystem to maintain its structure and functional features of the action of external and internal conditions

EROSION – the process of breaking up rocks or any other surfaces with deranging their integrity and change in physical and chemical properties as a result of mechanical abrasion of diverse physical and chemical phenomena. According to the latter one can distinguish between physical, chemical and biological erosion, water and wind erosion. Erosion is divided according to objects (e.g., soil erosion)

FACIES – the smallest natural territorial complexes, throughout which one lithological composition of rocks remains, the same character of relief, hydration, one climate, one difference between the soil and biocenosis

FALLOW LAND – the plowed, unused for a few years (usually over 10), abandoned lands on the place of the former steppes or meadows. The vegetation cover is restored gradually: at first the weeds grow, the sod is formed, the soil becomes more structural, the fertility is restored, and then there are trees and even forests

FAUNA – 1) evolutionary and historically constituted set of all species of animals living in the area, 2) a list of animals that live in the area

FAUNA – an aggregate of living organisms of all wild animal species that permanently or temporarily live in the Russian Federation and are in a state of natural freedom as well as related to the natural resources of the continental shelf and the exclusive economic zone of the Russian Federation (*the law "On Wildlife"*)

FELLING DEBRIS – waste products of wood produced at the cutting area by felling and skidding of trees, cleaning of tree stems from the barrel from the snags

FERTILITY (SOIL) – the ability of the soil to meet the needs of plants for nutrients, air, biotic, physical and chemical environment including thermal conditions and on this basis to provide

the biological productivity. It should be particularly emphasized that the account of biotic soil environment (mycorrhiza, nitrifiers, denitrifiers, and so on) factors is necessary. One distinguishes between natural and artificial fertilities

FIREWOOD – the wood that is used for fuel (firewood) and technological processing (technological wood)

FORAGE LAND – the land sites the vegetation cover of which is used for hay, haylage, silage, grass meal for pasture. It also includes natural hayfields and pasture including forest and improved reindeer pastures, fallows temporarily used for feed purposes, sites under bushes, wetlands, etc.

FOREST – 1) natural complex that consists of woody plants of one or more species growing close to each other and many other organisms of different kingdoms together with soil, subsoil, surface water and the adjacent atmosphere layer; and 2) one of the main vegetation types that consists of a set of trees, shrub, grass and other plants including animals, microorganisms biologically related to the their development and influenced on each other and on the environment

FOREST DENSITY – the number of wood–standing mass regardless of ability and efficiency of its removal for commercial purposes

FOREST EDGE – a forest zone with width of 100 m located on the border with the treeless place

FOREST EXPLOITATION – the use of forests in order to meet the needs of economy and population in different products and utilities of forest

FOREST MANAGEMENT – a system of measures aimed at the reproduction and growth, forest protection from fire, pests and diseases, regulation of forest exploitation, control over the use of forest resources, inspection and forest assessment

FOREST RAVINE – a forest in steppe zone (mainly in the ravine relief elements); it is represented by linden, linden-ash, linden-maple, linden-blackmaple, blackmaple and glague oak forests

FOREST RESOURCE POTENTIAL – the aggregate amount of forest resources. It can be defined for the territory of any rank: from a separate forest site to forests of all country or even the planet in general

FOREST STEPPE of: 1) the ecotone community on the border of the steppe biome and broadleaf forests; 2) zonal type of vegetation and landscape characterized by the watershed alternation of forest and steppe vegetation

FORESTRY – primary subdivision that is included in the forestry enterprise

FRANCHISING AGREEMENT (AREA OF FOREST RESOURCES) – an agreement under which one party (the holder) shall provide the other party (the concessionaire) the exclusive right of compensated use of forest resources under certain conditions in the relevant area of the forest resources for up to 49 years

GROUP OF FOREST – classification category that is assignable to differentiate forests according to the main socio-economic and ecological values, locations, performed functions and to determine the appropriate mode of forest management and exploitation

GROUP OF FOREST TYPES – a set of forest types that are similar in forest conditions, productivity, composition of trees, undergrowth, living ground cover and trends of forest formation processes. The same forest management activities are conducted among the types of one forest group

HABITAT OF SPECIES – the space limited set of conditions of the abiotic and biotic nature; it supports all development cycle of individuals, populations or a species in general – a place with certain conditions where this species is found

HARD-WOODED BROADLEAVED SPECIES – an economic category, which includes deciduous trees with hard wood (oak, beech, hornbeam, ash, maple, elm, stone birch, etc.). All species of birches are referred to hardwoods according to the classification accepted by most countries of the world

HAYFIELDS – the lands that are systematically used for grass growth with the purpose of haying

HONEY YIELD (HONEY GATHERING) – a period of melliferous plant flowering and intensive nectar and pollen picking by bees; the volume of honey which is taken from one bee colony or apiary for the spring and summer period. The size of honey yield depends on the amount of melliferous plants, their species diversity, duration of flowering, honey base location and other factors

INDEX OF SPECIES DIVERSITY – the ratio between the number of species and some importance factor: abundance, biomass, productivity, etc.

INDEX OF STABILITY (SPECIES) – a stability factor of species or population in the biocenosis – variation coefficient of the total biomass of species or the average number of individuals on long–term data

INTRODUCTION – deliberate or accidental transfer of individuals of any animal species outside the areal

LACE OF AREAL – uneven distribution of individuals within a species' range with condensed concentration in some areas and with depressions in the other place where the individuals are rare, irregular

LANDS OF FOREST RESOURCES – a set of forest and non–forest lands that are part of the forest resources

LANDSCAPE ECOLOGY – a scientific field that studies landscapes by the analysis of ecological relationships between vegetation and the environment, the structure and functioning of natural complexes on the topological level, the interaction of the natural complex components and the impact of society on the natural component of the landscape by the analysis of matter balance and energy balance

LANDSCAPE NATURAL – a landscape that is being formed or only formed under the influence of natural factors; and it has not never been affected by human activities (as opposed to anthropogenic or technogeneous landscape)

LANDSCAPE SUBAQUEOUS –a local water body with predominance of in-process of substance transfer with solid and liquid flow over out-process (by classification of B.B. Polynov)

LANDSCAPE SUPERAQUEOUS – an above-water elementary landscape formed on the lower parts of the relief under the conditions of close location to the underground water; it is characterized by the substance intake from the atmosphere as well as from the surface and underground water. One distinguishes the following types in this group of landscape superaqueous by the degree of geochemical autonomy and the transitivity of migratory elements due to the position of this landscape in the relief: 1) superaqueous autonomous flat weak-drained watersheds (landscapes of upland bogs); 2) transsuperaqueous geochemically weakly subordinated valleys of large transit rivers; 3) transsuperaqueous geochemically subordinated valleys of small rivers and streams; and 4) superaqueous geochemically subordinated depressions without drainage

LANDSCAPING OF SLOPES – the planting of soil-saving tree and shrub plantations on slopes or their sodding with perennial grasses

LEASE (**OF FOREST RESOURCES**) – a contract of tenancy whereby the lessor (forest management) shall give the tenant (forest user) an area of forest resources to fee for the temporary use within 49 years for the implementation of one or several types of forest exploitation. The forest products obtained in accordance with the lease are the property of the tenant. Sublease of forest area is prohibited. The rent of forest area is controlled by the Forest Code of the Russian Federation, the civil law and the disposition of the lease of forest resources that is approved by the Government. Lease agreement is concluded since the moment of state registration

LITTER – a compacted layer of dead and fallen plant parts – leaves, fruits, flowers, bark, branches on the soil surface

MATURITY OF BIOGEOCENOSIS (ECOSYSTEM) – a stable state of the ecosystem characterized by an optimal structure and function, the maximum biological productivity and minimum entropy

MEADOW – gramineous and miscellaneous plant community predominantly of rhizomatous grasses which typically have winter or summer-dry rest in vegetation

MEADOW BOTTOMLAND – a meadow located in the river high-water bed which is annually flooded with spring melt water. Bottomland meadow is floristically poorer than the other types of meadows because of the flood selected impact. Bottomland meadow is common in the forest–steppe zone

MEADOW CONTINENTAL – the meadows located on the plains outside the floodplain

MEADOW CULTIVATION – an agricultural industry which includes a set of organizational measures and techniques for rational use and development of natural as well as the creation of artificial (seeded) meadow hayfields and pasture lands

MEADOW DRY (UPLAND) – is located on the raised relief elements of watershed and above-flood-plain terraces (outside the high-water bed of rivers and lakes); it is mainly moistened with atmospheric precipitation

MEADOW LOWLAND – a mainland meadow that is located in the lows of interfluves, at the bottoms of beams and ravines, on non-water lowlands with close soil and ground water occurrence

MELLIFEROUS PLANTS – plants that make the nectar and pollen, and provide honey yield

MIGRATION – the periodic or non–periodic, horizontal or vertical movement of animals in a given time period; it has the character of permanent or one-time long-distance movements with or without return to the original habitat; it is due to changes in the conditions of existence and development characteristics of species

MUSHROOMS RESOURCE ACCOUNTING – the determination of the stock (commercial, biological). It is conducted according to regional relation tables of an average yield of mushrooms to the types of habitat conditions and taxation characteristics of plantations.

MYCOCENOSIS – biotic community of mushrooms; it is a part of biocenosis

NATURAL (ECOLOGICAL) DISTURBANCE – a change in the interaction process and composition of components and elements of the ecosystem that leads eventually to replace it with another ecosystem for the long or endless term

NATURAL BACKGROUND – physical, chemical, and other indicators that characterize the natural environment not changed by humans; these indicators reflect a level of relatively constant (within the natural long-term variations) affection of a natural factor; they allow to quantify the effects of human impacts on the environment and its individual components

NATURAL COMPLEX – a set of natural objects, phenomena or characteristics which are agglomerated. The term is used to refer to: 1) any related natural phenomena, and 2) regular spatial combinations (mosaics) of soil, vegetation and landscapes (e.g., brackishcomplexes, etc.)

NATURAL RESOURCES – the natural objects and phenomena that are used for consumption; they contribute to the creation of material wealth, the reproduction of labor force, the maintaining of human existence conditions and the improvement of life quality

NATURAL TERRITORIAL COMPLEXES (NTC) – a type of natural complex defined as the spatio-temporal system of geographic components interdependent in their placement and developing as a unit. NTC is characterized by association with a certain area within the spacial threshold criteria and defines the class of natural geosystems of local and regional dimension. NTC is often used as a generic term to refer to geosystems from facies (elementary landscape) to landscapes

NUTRITIVE BASE – the stores of feed for livestock farming and the production sources that are available to the farm, region, district, etc., or a country. Nutritive base includes feed from natural and sown hayfields and pasture lands; the sowing of fodder crops for hay, silage, feed grains, green and succulent plant feed; field wastes (straw, chaff, plant tops, etc.); the wastes of

flour, oil, sugar, beer, alcohol, starch and syrup, fish, meat, dairy and other industries; the feed of industrial production (formula feed, mineral feed, etc.); algae

OUTRUN – a pasture where the cattle grazes for long periods without return to stockyard for the night (cowhouse, sheepyard)

OVERGRAZING – the cattle grazing in quantities exceeding the pasture ability for the renewing leads to land degradation, vegetation disappearance, and the development of erosion processes

OVERGROWN – hay fields the area of which is occupied by trees and shrubs more than 20%

PASTURE – a site of land with more or less similar vegetation that is used and maintained in a productive state for cattle grazing

PERCENTAGE OF FOREST LAND – the degree of afforestation defined as a ratio of the area covered with forest vegetation to its total area; it is expressed as a percentage

PHYTOMASS – the total weight of all plant organisms, some of the group or individual plants in the community. Estimated by the Oak Ridge National Laboratory (USA), the stock of phytomass of terrestrial and aquatic ecosystems of the Earth is 1236.9 billion tons of dry matter, of which 65% are actually forest areas and 22% – in intrazonal forests and woodland of other natural areas

PIONEER PLANT AGGREGGATIONS – random combinations of plants. Phytocenosis which is formed on the exposed areas in the first stage of development is characterized by a random composition of plants, lack of compact vegetable carpet, low impact on the environment and almost complete absence of interference between individuals

POPULATION – 1) a set of freely mating individuals of the same species that inhabit a certain area for many generations, more or less isolated from the adjacent areas; 2) the basic unit of the evolutionary process at the level of which the modifying effect of natural selection is become; 3) the population of a particular habitat (biotope) that is characterized by a common rhythm of biological cycles and the character of life way (Naumov, 1966)

POPULATION DENSITY – the average number of species per unit area or volume of space

POPULATION GEOGRAPHICAL – several populations located in a geographically uniform but biocenotically diverse territory (e.g., the geographic populations of freshwater fish in such river basin of the first order as Don, Volga, Dnieper, etc.)

POPULATION LOCAL – the population limited by several geographically close habitats

PRESERVATIVES – the substances that inhibit the growth of microorganisms in the product. Thus as a rule it prevents the product from the unpleasant taste and odor, and the molding and toxin formation of microbial origin

PROTECTION OF FOREST AGAINST PLANT PESTS AND DISEASES (FOREST PROTECTION) – a field of knowledge and activity of forest management authorities and forest users; it also includes a set of rules, methods and techniques used to improve the stability, productivity, and other objective functions and the protection of forestry objects (seminary, sylvula, plantations, etc.) and forest products from pests, diseases and other adverse natural and anthropogenic factors

QUALITY OF LOCALITY – an economically significant characteristic of economically valuable group objects or land; it distinguishes them from other similar entities

RAVINE FORESTS – the forests on the slopes of ravines and gullies; commonly in the upper reaches of steppe rivers. In forest-steppe – azonal type of communities

REACCLIMATIZATION – 1) an artificial return of the extinct species of animal or plant to the previous habitat; 2) the adaptation process of organism to unusual conditions that previously were natural for it

RECREATIONAL CAPACITY – quantitatively expressed ability of territory or water area to provide for a certain number of people the psychophysiological comfort for rest and recovery without the degradation of the natural environment and anthropogenic elements in the landscape (agricultural, forestry, historical, etc.). See also Land Capacity, Allowable Recreational Load

RECREATIONAL FOREST – a developed forest which is organized in a landscape-planning system that performs hygiene and sanitary, health and recreational functions, and located in the suburbs of large cities

RENT – a monetary payment of the right to use the leasehold property (e.g., an allotment of forest resources). Procedures, terms, and payment periods of rent are determined by the contract. Amount of rent is determined based on the contractual types of forest exploitation as the product of the fixed volumes of forest exploitation (leased area of forest resources) and the corresponding rates of forest pays

SALINIZATION OF SOIL – an excess of easily soluble salts in the soil due to salinity of soil-forming rocks and due to the influx of salt by surface water (primary salinization) but it is more often caused by irrational human activity (secondary salinization). Soil is considered saline if it contains more than 0.1% of toxic salt for plants by weight or more than 0.25% of salts in the solid residue

SALINIZATION OF WATER – an excess of the normal salt concentration as a result of natural or anthropogenic causes: for sweet water more than 1 g / l, for brackish water more than 10 g / l and for salt water more than 50 g / L over the natural concentration

SAP FLOW – the movement of water and dissolved substances from the roots to the crown (ascending flow) and from the leaves to the roots, and other organs (descending flow). The trees that grow in temperate climate the sap flow begins in early spring after a period of rest and warming up of tree stem to positive temperature. During the spring sap flow the tapping of birch is conducted to get birch sap

SATURATION SPECIES – the number of species per unit of area (volume) which is the basic unit of alpha diversity

SCALE OF PLANTS ABUNDANCE – the number and density of certain plants coverage on the visual scoring with points. E.g., Gult–Drude scale with estimated value of projective cover (in %): 1) single (up to 0.16), 2) low (0.80), 3) quite a lot of (4), 4) many (20), 5) numerous (20) 6) abundant (up 100%)

SECONDARY FOREST EXPLOITATION – the use of non- arboreous forest resources (mowing, cattle grazing, placement of hives and apiaries, harvesting of tree sap, harvesting and gathering of wild fruits, berries, mushrooms and other edible forest resources, medicinal plants and technical raw material, moss, forest litter and dead leaves, reeds and other types of secondary forest exploitation)

SECONDARY FOREST RESOURCES – rind; birch bark; fir, spruce and pine boughs, Christmas trees, etc.

SECONDARY SUCCESSION – a continuity of biocenosis within the same territory in the places of biogeocenosis formed after its destruction (as a result of fire, logging, drought, erosion, volcanic eruptions, etc.)

SHRUBS – perennials plants with ligneous stems but without any expressed main stem axis; they are commonly branched from the soil surface; form the undergrowth in afforestation; the shrubs are considered as overgrowth on logged land and the territories where the growth of forest is complicated or impossible in consequence of unfavorable soil and climatic conditions. Shrubs often have height of 0.6 - 6.0 m.

SILO – a reservoir or underground room as well as a construction in the form of tower or pit (ditch). In addition to the reservoir for storage or fodder the word ‘silo’ is used to name directly juicy fodder (ensilage) for cattle animals. Ensilage has a high nutritional value by its calorie, vitamin (contains carotene, vitamin C, organic acids) and dietary properties; it is comparable to the fresh grass, and is a valuable food. Ensilage improves digestion, promotes the absorption of other roughage

SILVICS – a scientific discipline of forest nature, its biology and ecology, the laws of dynamics in space and time

SOD – the upper heavy layer of soil bound with the interwoven alive and dead roots, stems and rhizomes of perennial grasses. It is particularly well developed in the meadows, steppes and under the canopy of low timber stands without undergrowth

SOIL FORMATION – the process of soil formation as a result of interaction between organisms or their metabolic products with rocks of their eolation

SPECIES (BIOLOGICAL) – a set of individuals with common morphophysiological characteristics, and ability to mate freely with each other in natural conditions, and to give fertile posterity, and occupy areal

SPECIES COMPOSITION – a set of species in a particular community

SPECIES RESOURCES – a characteristic of community defined with either relative or absolute number of species

SPECIES RESOURCES – the number of species referred to a particular area or volume

STATE PARAMETERS OF ECOSYSTEM – the most common (integral) informative indicators of the ecosystem functioning that allow to assess its condition, the degree of deviation from the norm

STOCK BASIC – a part of renewable natural resources for the success of its renewal or the balance of environment–forming components of the ecosystem

STOCKING OF PLANT RAW MATERIAL – a system of organizational, technological, and economic measures providing the acquisition of high–quality plant raw material that meets the requirements of normative and technical documents

STOCKS OF BIOLOGICAL PRODUCTION – the number of organic matter accumulated in the community and attributed to per unit of area or volume. One distinguishes common stock, useful (for a man) stock, and dead stock (stock mortmass). This concept is close to the concept of biomass but it is only applied to the vegetation

STUMP WOOD – naturally tarred heartwood part of stumps and roots of conifers

SUBSHRUBS – low perennial plants with lignescent and much branched and often creeping wands; they do not have the expressed main stem in the adult state. The length of life for some wands is not more than 10 years and such wands can reach a height of 0.6 - 0.8 m.

SUCCESSION ANTHROPOGENIC– a succession caused by human's economical activities

SUCCESSION LANDSCAPE– a succession of landscape states towards the root or close to it dynamic state. The term is transfered from geobotany to landscape ecology by K. Troll and it is used to study the dynamics of landscapes

SUCCESSION PHYTOGENIC– a succession, caused by an unusually strong influence of vegetation

SUCCESSION PRIMARY– they begin on the substrate that is not changed by the activities of living organisms. Cenoses formation on rocks, sand, cooled volcanic lava, on clay after descent of mudflows. The main function of this type of succession is the gradual accumulation of organic matter and as a result, the creation of the soil by the first colonists

SUCCESSION PYROGEN– a succession, caused by fire, regardless of the causes

SUCCESSION SECONDARY– the alternation of biocenosises, developing on a substrate, initially changed by the complex activities of living organisms existing at that location earlier – before the fire, floods, deforestation, etc. In such places significant life resources usually remain and successions have often a restorative nature

SUCCESSION ZOOGENIC– a succession caused by unusually strong influence of animals

SUCCESSIONAL STAGE – a certain stage in the development of ecosystems in successional sequence. F. Clements (1928) distinguished six succession stages: denudation, pioneering (immigration) colonization (oykosis), interspecific competition; biocenotic reaction, stabilization (climax). The development of biocenosis from pioneering to stabilization comprises series

SUCCESSIONS – a successive alternation of one biocenosis with another one within the same territory. According to initial substrate there are primary and secondary successions, by the cause of occurrence – anthropogenic, zoogenic, phytogenic, pyrogenic. There are three conceptual way of succession: facilitation, tolerance and inhibition. By the relation with the active factors there are allogenic and autogenic ways

SUSTAINABILITY OF SPECIES – the change in the number of individuals of species over time that does not lead to a change in the role of these species in the community and that reflect the role

SUSTAINABLE DEVELOPMENT – 1) a model, which guarantees the fulfillment of the vital needs of the present generation without depriving this possibility for future generations, 2) the development, allowing ensuring stable economic growth for the long term that does not lead to degradation of the environment changes

SWAMP MEADOW – moistened area of grassy vegetation where hydrophytes dominate. It is formed as a result of excessive cattle grazing in spring when the soil is moist

SYLVULA – afforestation by the way of sowing or planting

TAIGA – a forest biome, characterized by the domination of coniferous trees

TANNING AGENTS – high-molecular phenolic compounds that are contained in plant tissues; they are able to precipitate proteins, alkaloids and other substances; they have astringent taste. These compounds are used in medicine and leather industry

TAPPING –resin (gum) extraction from conifers (often from pine). It is extracted by the special cuts (streaks) on tree stem and the further gather of flowing resin for 5–15 years (depends on local environmental conditions). Chemical tapping (the processing of streaks with such stimulators of resin outflow as concentrated sulfuric acid, yeast extract, etc.), and resin tapping (gather of stump wood at lumbering) are also used. Tapping was widely used before the 1990s. Tapping was commonly done 5–10 years before final harvest. The trees survived after tapping (especially chemical tapping) are partially lost, but some are able to live for several decades after the termination of tapping

- the first group – the forests with the primary purpose to perform water-protective, security, hygiene and sanitary, and reproductive functions, as well as specially protected natural territories
- the second group – the forests in regions with high population density and extensive network of land transport routes; the forests that mainly perform water-protected, security, hygiene and sanitary, reproductive and other functions but have the limited commercial value; the forests in regions with insufficient forest resources for conservation of which the restriction of forest use is required

- the third group – forests of multiforest areas with predominantly commercial value. It is necessary to ensure the preservation of the ecological functions of such forests at the period of logging. This group is divided into developed and reserve forests
- There are two conceptual types of populations – local and genetic

TUPRENTINE EXTRACTION – a lifetime use of pine plantations in order to extract tarry matter from trees

TYPE OF FOREST MANAGEMENT – a classification unit that characterizes the use of certain products, useful features and functions of forests (wood harvesting, turpentine harvesting, minor forest resources procurement, recreation, hunting, etc.)

TYPE OF HABITAT (TOH), OR FOREST SITE TYPE – a silvicultural classification unit, combining areas of land (including non–forested) with similar site conditions. Adopted TOH Classification System in Russia is based on two indicators – the richness of the soil (designated by the letters A – poor, to D – rich habitat) and humidity (the numbers 0 – very dry, to 5 – marshes). Accordingly, TOH is marked by letters and numbers combination, such as A1 or C3

UNDERGROWTH – young trees that have not yet reached the height of its adult species and not fructified.

VALUATION OF FOREST RESOURSES – it is realized on the basis of potential income in the form of a rent. A rent is the difference between income and expenses that include a normal (standard) profit. The value of the rent may be positive, zero or negative

WATER BODY – concentration of water on the land surface in the form of relief or in the subsurface having bounds, volume, and characteristics of the water regime (*Water Code of the Russian Federation*)

WATER RESOURCES – reserves of surface and ground water located in water bodies that are used or can be used (*Water Code of the Russian Federation*)

WEED – a plant that is undesirable in the fields and pastures, actively growing in disturbed areas and not meeting in closed virgin grass stands due to its weak competitiveness. One distinguishes ruderal (in wastelands and fallows) and segetal (in agricultural crops). Some of the weeds are very valuable fodder grasses, honey plants, and so on (dog-grass, blueweed, etc.)

WILD AND NON–WOOD RAW MATERIALS OF FOREST – resources of berry plants, mushrooms, fruit and nut trees, bushes, medicinal plants, birch sap, and bee productivity of linden trees

WOOD – the basic mass of the stock, branches and roots of woody plants; it consists of the tissues that perform conductive, mechanical and store functions in the tree

WOOD GREENERY – the leaves, pine needles and softwood of young trees (up to 0.8 cm in diameter at the bottom) of different tree species that are primarily used as a raw material for feed and vitamin preparations used in animal husbandry

WOOD PULP – the brushwood and thin trees with a diameter of 8 cm at the bottom cut obtained from pine needles, leaves, buds and softwood young trees

WOOD RAW MATERIAL – the fallen trees, tree trunks, round and split wood except the wood used without processing, stump and chopped wood, and raw waste lumber set aside for processing or being used as fuel

WOODY FORAGE – thick branches up to 1.5 cm logged from the saplings of some deciduous and coniferous (besides spruce) species and intended for animal feed

ZONALITY GEOGRAPHIC – an objective law of natural division of the geographical envelope of the Earth which is manifested in a certain change of physiographic belts and their geographical zones

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15. http://www.rgazu.ru/index.php/vestnilohotovedeniya
16. http://www.selhozizdat.ru/journals/archive/250/40087

Annex: Training material

The elaborated RUDECO modules serve for the purpose of “Vocational Training in Rural Development and Ecology” in Russia. They target on representatives of local and regional administrations and advanced students in the different fields of rural development.

All below listed RUDECO partners can be addressed in case of training interest in one of the modules. For readers of the module textbooks and training participants the project website provides the possibility to download additional material on **http://tempus-rudeco.ru/en/modules** (required password **RD-modules**), e.g. presentations and other didactic material used in the conducted trainings.

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