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An Approach to Assessment of Naturalness for Forest Stands in Lithuania

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Abstract

Forest policies are developing towards achieving higher ecological and nature protection standards. European COST action E27 "Protected forest areas in Europe – analysis and harmonisation (PROFOR)" highlights the need of more precise assessment of forest naturalness on a national level. In this paper official existing classifications related to forest naturalness in Lithuania are discussed and the shortcomings of such classifications are highlighted. We presented an analysis of the existing situation and also proposed six definitions of different forest naturalness classes with their describing criteria.

Key words: level of forest naturalness, forest stands, natural development

Introduction

The aim of this paper is a deeper analysis of broadly used terms and concepts of *forest naturalness.* Naturalness is the degree of a continuous gradient between natural and artificial (Angermeier 2000). *Primeval forest, natural forest, semi-natural forest, cultural forest and artificial forest* - are terms indicating different levels of forest naturalness. These terms are well discussed abroad, but not scientifically defined on the national level in Lithuania. Definitions derived from overseas are not applicable to local conditions and also the diversity of opinions among scientists sometimes causes confusion. Internationally recognised classification proposed by FAO (Food and Agriculture Organization) defines three quite broad classes related to forest naturalness (UN-ECE/FAO 2000). This classification system can be applicable internationally, due to national differences a more detail classification would not work well for all countries. However the main drawback of the FAO classification is the middle category "semi natural forests" which covers almost all European forests, except virgin forests in the strict sense (1st category) and plantations (3rd category). Forest stands classified according to such a classification system give a very strained picture when the real situation is more complex. The use of unified classification for a large area as Europe is certainly restricted due to significant regional differences of forest development. Northern Europe comparing with central or southern Europe applies more naturalistic silvicultural management e.g.

lower usage of non native tree species (Parviainen and Frank 2003).

Naturalness of forests is one criterion describing the ecological value of the forest ecosystems (Lane and Tait 1990). Angermeier (2000) argues the use of technology by humans is destroying the natural development of ecosystems and thus it is possible to assess naturalness of ecosystems objectively.

In some European countries (e.g. Great Britain) where there are no natural woodland ecosystems, assessing the level of naturalness is a very important factor defining the values of forests. The most natural and most valuable type of forest being ancient semi-natural woodland, such forests are continuously wooded since 1600 and earlier contained forest communities similar to primary forests (Lane and Tait 1990).

On the European level the discussions on forest naturalness has been initiated at the COST E27 Protected forest areas in Europe (PROFOR) – analysis and harmonisation (established in 2001). Clarification of the concept of naturalness is just one aspect among the tasks of this action and the aim of such an investigation is to find out how forest naturalness is perceived in the European countries. The primary result indicated a number of countries having their own developed concepts of naturalness and official classifications of forests by the level of naturalness. Nonetheless, about 50% of European countries have no widely accepted concept nor official classifications on forest naturalness (Welzholz in press).

Forest naturalness type classification by German scientist von Hornstein (1950, 1951) is just one exam-

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ple of such proposals for classifying naturalness. Von Hornstein suggested different forest types depending on the naturalness of forest plant community and naturalness of the site: *primary, secondary, close-to-nature, far-from-nature, alien-to-nature and artificial* forest types. In Germany assessment of forest naturalness differs among the different lands depending on the state of the lands' forests, in total there are 18 systems of naturalness assessment that are described in the scientific literature (Welzholz 2003). Further Welzholz's (in press) analyses of understanding the concept of naturalness in Germany describes "natural" forest as two possible options: 1, in a sense of 'virgin forest': *Forest evolved without any human interventions. In its structural features it approximately corresponds to the climax forest stage, if the natural development was not hampered by "natural catastrophes".* In a more liberal sense: 2, *Forest containing running far-reaching natural processes and predominantly consisting of native tree species, i.e. tree species occurring by nature, yet in the structure, showing direct or indirect human influence.* As an example there is presented a number of related terms that are used to describe forest naturalness (distance from nature, primeval landscape, natural landscape, virgin forest, primeval forest, primary forest, and ancient wood).

Analysing experiences of forest naturalness in other countries provides obvious evidence of great differences in understanding the concept of naturalness. Such differences between understandings of forest naturalness in different countries are due to the different scale of assessment. For example, in the Czech Republic, naturalness is assessed for certain purposes (creation of databank, optimisation of the network of unmanaged forest that may have various stands and ecosystems of various levels of naturalness) (Vrška and Hort 2003).

In Lithuanian forestry literature the issue of forest naturalness is not discussed or referred to very often. The main logical reason for this may be the predominant focus on the research of forest productivity rather than on the protection of biological diversity.

However, the global concern on conservation of forests shapes the Lithuanian national forestry and nature protection policies towards sustainable use with a greater emphasis on conservation of natural values of forests. The set of new legal documents regulates the forestry system and protection of forests in Lithuania. Protection of forests is defined by the Forest Law (1994, last update 2001) ascribing all forests to one of four management groups. The Law on Protected areas (1993, last update 2001) defines the system and categories of protected areas in Lithuania.

"Lithuanian forestry politics and its fulfilment strategy" among the other objectives makes reference to ensure the sustainability of forest ecosystems and conservation of biological diversity *(Lietuvos...* 2002*).* Sustainability of forest ecosystems should be reached by the special means described in the document. Among such means are a new inventory of natural and close to natural forests (according to FAO classification), their protection regime specification and establishment of new protected territories first of all on most valuable habitats of nature objects. However, using the results of such inventory at the national level is highly questionable.

Existing forest naturalness classifications in Lithuania

Only two categories relating to naturalness are observed in the official Lithuanian forest statistics (Table 1). However, these categories indicate only the naturalness of forest stand origin, in other words the amounts on naturally regenerated and planted forest areas. Such classification is very limited in describing forest naturalness and moreover it doesn't include the combined method of origin.

Table 1. Forest areas and naturalness of stands in Lithuania

Land use category	1998.01.01		2002.01.01		2003.01.01	
	Area		Area		Area	
	ha	%	ha	%	Ha	%
Forest land area, total	1978435	92,0	2034329	93,2	2045287	93,7
Forested area, total	1887974	87,8	1938219	88,8	1950981	89,3
Natural and semi-natural forest	1463952		1485248		1491497	
Plantations	424196		452971		459484	

Source: State Forest Survey Service (2003)

Until the commencement of the "Woodland Key Habitat (WKH) inventory in Lithuania" project (2001), only strict nature reserve forests were automatically viewed as the most natural and undisturbed forests in the country. In Table 2, Lithuanian forest characteristics are presented according to FAO methodology. In this classification system the category of *forest undisturbed by man*, only refers to forests of strict reserves in the 5 and 5A site productivity index (Lietuvos... 1998). The same data as in Table 2 were presented in the Ministerial Conference on the Protection of Forests in Europe publication "State of Europe's forests 2003" (Ministerial... 2003). Nonetheless, the results of the WKH project indicate small forest patches bearing characteristics of natural forests are in existence all over the country and not necessarily only in protected areas. The concept of WKH is based on the presumption that these areas are

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almost untouched (naturally formed) forest area where there is a high probability to find rare and threatened habitat specialist species of plants, lichens, mosses, fungi, insects and molluscs (Andersson and Kriukelis 2002).

Table 2. Forest area according to FAO "naturalness" (TB-FRA-2000)

Indices	Area, ha
Forest total	1 978 000
Forest undisturbed by man (strict reserve forests in the 5 and 5A site productivity index)	12 000
Semi-natural forest (affected by economic activities)	1 682 000
Plantations (planted tree species comprise more than 80%)	284 000

Analysing FAO's three forest naturalness definitions it becomes quite clear that most Lithuanian forests would fall into the category of semi-natural forest. This conclusion is obvious as forests undisturbed by man only exist in very small patches and mainly in strictly protected or non-productive forests. Also, plantation (artificial) forests are not common in Lithuanian forestry practice. At the European level, examples of undisturbed by man forests exist only in protected areas and serve as experimental forests for biodiversity research (Schuck *et al*. 1994). Placing the biggest share of Lithuania's forests into the group of semi-natural forests reduces the understanding in variation of their levels of naturalness and the manner of their development. One more argument opposing the three classes of forest naturalness proposed by FAO is too narrow for national conditions; all forests in Lithuania are ascribed to one of the four management groups (Forest Law 1994, last update 2001). The first of the management groups is called Strict Reserve Forests. Different forestry measures take place in all of the three other forest management groups: special purpose forests, protective forests and finally exploitable forests. However, only the first group of Strict Reserve Forests are maintained without introducing any active intervention and this is where the largest proportions of natural or developing towards natural state forest occur. However even in these forests minimum intervention exists as all reserves are accessible, in some of them quarter lines are managed, forest fires are distinguished and scientific research is carried out. Therefore, all exploitable forests host different levels of naturalness depending on many factors such as natural conditions, accessibility, productivity, management peculiarities and others. On the other hand, forests found in the other management groups, are considered as forests of protected areas, being influenced by different management objectives. Thus the level of naturalness among protected forests will vary significantly.

Proposed forest naturalness classification in Lithuania

Forest naturalness can be viewed from different aspects, resulting in the shaping of the assessment, for example: naturalness of the vegetation composition, naturalness of the tree species composition, naturalness of the site development, naturalness of the vegetation development. However, in our understanding of naturalness it is important to cover all main aspects of forest development influencing the current level of naturalness in forest stands. This idea is logical and can be explained simply for example; the natural tree composition can be reached even if the lower layer vegetation or structural composition is changed through management.

There are different proposals described for forest naturalness assessment. One tool to identify the natural or near-natural forests is the amount of cut stumps (Uotila 2002). The estimated number of <5 cut stumps/ha is viewed as an amount that does not significantly influence the natural conditions of a stand (Uotila 2002). In general, naturalness of the ecosystem is a function of naturalness at different levels of the system. It is easier to assess naturalness of a single element e.g. tree than of the whole system e.g. forest (Angermeier 2000). Natural ranges of ecosystem variations and their functional and evolutionary limits enable the objective assessment of naturalness (Angermeier 2000).

Six levels of forest naturalness applicable on the Lithuanian national scale, making precautions to existing forestry practices, forest protection system, natural country conditions and historical developments (Table 3). The main aspect defining different classes of forest naturalness in Lithuania is the comparison of the potential natural forest areas and the current existing examples of forest exploitation. This approach is also supported by Gilg (2005), who states that forest naturalness evaluation requires measuring the degree of artificialization of a forest, meaning that the difference between current forest naturalness and its maximum potential naturalness should be assessed.

The natural vegetation type in Lithuania is forest, however only 30% of the country is currently covered by forest, with the biggest share of existing forests being influenced by economic activities. Land use change is the most crucial factor negatively affecting biodiversity of natural ecosystems (Sala *et al*. 2000). In the temperate climatic zone the maximal age of trees in natural stands is about 300 years. Nevertheless, the maximum age in exploitable stands is <100 years (Angelstam and Arnold 1993). One feature of the forest environment is the internal differentiation into lower structural elements (e.g. layers,

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niches, soil horizons, gaps, sites permanently or temporarily devoid of plant cover places of dead matter accumulation and other) with their specific interrelations. Such internal differentiation in spite of various seasonal and long-term changes is a common and repeatable feature of all types of stable forest ecosystems and it ensures continuity of the most important ecological processes, richness, diversity and specificity of the species composition in the ecosystem. The degree and character of such internal diversity varies among different forest types. A multi-layered stand forms when it is composed of a greater number of tree species (Falinski 2004). Obviously internal differentiation will differ greatly in natural and managed forest of the same type. A detail description of all structural features of all natural forest types occurring in Lithuania is hardly possible due to the absence of naturally developed and non managed representative samples of such forests needed for investigation (Šaudytė 2003). However, the character of different forest type development is known to some extent and described in the literature. Forests of strict reserves cannot ideally represent all natural forest types and moreover the history of most strict reserves exceeds only slightly more than ten years.

The following definitions in Table 3 describe the 6 possible levels of forest naturalness in Lithuania. It is important to note that first class *Virgin forest* can hardly be found in Lithuania; however this class needs to be singled out as a point of reference.

Table 4 presents the criteria for defining six levels of forest naturalness. Information needed to identify each criteria can be obtained by using stand-wise forest inventory databases and also by on site evaluation. Pre-selection of certain classes of naturalness can be carried out by using databases. However, in all cases the final decision should be taken after an on site evaluation.

The evaluation of forest and the decision to what group of naturalness it belongs to can be in some cases easy and sometimes more complicated. For example, to recognise artificial forest (plantation, park) type is usually quite simple only by using the definition. To assess other classes of naturalness the precise evaluation of criteria describing certain classes of naturalness may be needed. In the course of stand development the level of forest naturalness can shift from less natural to more natural and vice versa.

We also propose some characteristic features of forest ecosystems that are helpful for assessing the naturalness of forest ecosystems (Table 5).

A forest in the category of virgin forest (primeval forest) refers to all development stages that are observed within the stand and not only the later stages

Table 3. Terms and definitions of six proposed levels of forest naturalness in Lithuania

Term	Definition
Virgin forest (primeval forest)	Forest formed without human impact. Species composition and stand structure corresponds to an over mature (climax) forest community that was formed without the influence of natural catastrophic events.
Natural forest	Forest formed without active human intervention on the territories where virgin forest was destroyed due to natural catastrophes or due to human activities. Tree species composition of natural forest is very similar to virgin forest, however, stand structure and share of certain species can be different.
Semi-natural forest (near natural forest)	Naturally regenerated forest or natural regeneration was combined with artificial regeneration (planting, sowing). The forest development was influenced by human activities, however, tree species composition and stand structure is similar to a natural forest.
Semi-cultural forest	Forest that is continuously affected by human activities (cuttings, afforestation, drainage and etc.) and depends on the type of activity. Stand composition is formed by local tree species, but they cannot be characteristic of natural site type. Stand structure of semi-cultural forest depends on human activities and natural processes of stand development.
Cultural forest	Forest of introduced species, stand structure of which may be similar to natural forest, also it can be forest composed of local tree species, but structure of the forest community is obviously different from the natural forest, e.g. park type recreational stand.
Artificial forest (plantation, park)	Forest where processes of natural forest communities are not observed. Such forests are usually established on intensively cultivated soils and are treated to reach certain goals. These forests are usually short rotation plantations, artificially created parks and seed plantations.

(Schuck *et al.* 1994). However if a stand of virgin forest was not destroyed by natural catastrophic events in spite of the great mixture of trees and different age classes the dominant component is old growth trees. Virgin (ancient, primeval, old growth) forest is more or less equally understandable in many countries, but the definitions of natural forest differ considerably among countries (Schuck *et al.* 1994).

Discussion and conclusions

For identification of nature conservation forest areas, the most important criteria are naturalness, diversity and rarity (Usher 1986). Naturalness, even though it is difficult to assess, is one of the most basic aspects for biological conservation (Angermeier 2000). In the temperate vegetation zone, small patches of natural mixed and mature forests can only be found on physically restricted areas e.g. isolated islands, steep slopes. Such stands are most significant for science and nature conservation (Nilsson 1997). When assessing the effectiveness of sustainable forest management it is very important to have information on the degree of forest naturalness (Welzholz in press).

In detail the naturalness criterion on a national (Lithuania) scale was analysed. Such an analysis was missing and the levels of naturalness are not defined scientifically in Lithuania. Currently, the growing con-

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Table 4. Indication of different levels of stand naturalness

Criteria	Levels of forest stand naturalness					
	Virgin forest (primeval forest)	**Natural forest**	**Semi natural forest (near natural forest)**	**Semi cultural forest**	**Cultural forest**	**Artificial forest (plantation, park)**
origin	natural	natural	natural, mixed	afforestation, mixed, natural	afforestation, mixed	afforestation
stand tree species composition	species of climax communities is dominant	characteristic to the site species prevail, succession communities tree species might dominate	admixture of singe site type non characteristic but native tree species is possible	domination of natural site type non characteristic native and admixture of non native tree species is possible	domination of site type non characteristic and non native tree species is possible	domination of site type non characteristic and non native tree species is possible
mixture of the stand	mixed, except extreme site conditions	mixed, except extreme site conditions	mixed, except extreme site conditions	unmixed (one tree species) stand possible	unmixed stand possible	usually unmixed
forest continuation (time of forest existence on the particular area)	continuous forest cover	more than two forest stand generations	more than one forest stand generation	more than one forest stand generation	forest is >20 years	no limits
stand age structure	absolutely or conditionally mixed aged	mixed aged or conditionally single aged	mixed aged or conditionally single aged	might be single aged, but in young stands old growth trees should be observed	might be single aged	usually – single aged
stand spatial structure	two or multi-storey with exception of stands on extreme site conditions	multi-storey, young and premature stands might be single storey	might be single storey stand	might be single storey stand	might be single storey stand	usually – single storey stand
impact to the site: drainage	not drained	not drained	might be drained long time > 60 years ago	might be drained > 30 years ago	might be drained recently	might be drained
fertilisation	not carried out	not carried out	might be carried out > 20 years ago	might be carried out recently	might be carried out recently	might be carried out
damage of the upper soil layer	no signs	no signs	not significant signs of soil damage conducted during the cuttings or afforestation works	significant soil damage by scarification is possible	various damages are possible	various damages are possible
border with agricultural lands	not possible	not characteristic	might be possible	might be possible	might be possible	characteristic
impact to the stand: clear cuttings	never carried out	not carried out for >100 years	not carried out for >70 years	not carried out for >10 years	might be carried out recently	carried out
impact to the stand: final non clear cuttings	never carried out	not carried out for >50 years	carried out only selective cuttings	carried out various not clear cuttings	carried out various not clear cuttings	carried out
impact to the stand: sanitary cuttings	not carried out	not carried out for >50 years	carried out leaving number (part) of dead standing trees	carried out intensively	carried out intensively	carried out intensively
impact to the stand: thinning	not carried out	not carried out for >50 years	carried out by forming characteristic of natural stands composition	carried out	carried out	carried out
standing and lying deadwood	dead standing and dead lying wood of various decay stages is abundant	dead standing and dead lying wood of various decay stages is abundant	dead standing and lying dead wood is present	recently died standing trees and single old lying trees might be present	only recently died standing trees might be present	only recently died standing trees might be present
forest community's composition and structure of lower layers	composition and structure characteristic of the site type	composition and structure characteristic of the site type	composition characteristic of the site type	composition characteristic of the forest environment	composition might be not characteristic of the forest environment	not characteristic of the forest environment

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Table 5. Descriptive characteristics of different levels of stand naturalness

| Biological, nature elements | Levels of forest stand naturalness | | | | | |
	Virgin forest (primeval forest)	Natural forest	Semi natural forest (near natural forest)	Semi cultural forest	Cultural forest	Artificial forest (plantation, park)
Trees of biological value	characteristic : large tree, hollow tree, abundantly covered by mosses and lichens tree, dead and living trees with bracket fungi	characteristic: large tree, hollow tree, abundantly covered by mosses and lichens tree, dead and living trees with bracket fungi	occurrence is possible: large tree, hollow tree, abundantly covered by mosses and lichens tree, dead and living trees with bracket fungi	not characteristic, accidental	not characteristic	not possible
Easy identifiable indicator and specialist species of mosses and lichens	characteristic	characteristic	occurrence is possible	not characteristic, accidental	not possible	not possible
Signs of natural ecological processes	characteristic: uprooted tree, signs of fire, flooding, *Ips typographus* damaged trees, feeding traces of woodpeckers	characteristic: uprooted tree, signs of fire, flooding, *Ips typographus* damaged trees, feeding traces of woodpeckers	characteristic: uprooted tree, signs of fire, flooding, *Ips typographus* damaged trees, feeding traces of woodpeckers	not characteristic, accidental	not characteristic, accidental	not possible
Natural stand regeneration	characteristic: natural regeneration, nurse log, nurse stump	characteristic: natural regeneration, nurse log, nurse stump	characteristic: natural regeneration, nurse log, nurse stump	depends on the site type	not often	not possible

cern on nature protection induces the need for further detailed analyses and inventories.

Lithuanian National Statistics data refers to naturalness of forest stands only by the type of reforestation (natural and cultural) and according to FAO classification which is limited to the three classes – untouched forest, semi-natural forest and artificial. Broad classifications as above can be perceived incorrectly and on the other hand highly detailed classifications are not easily applicable in practice. Moreover, referring to the used forest naturalness classifications of other countries is difficult due to the differences in definition, natural conditions, management and use.

The aim of this paper was to propose useable classes of forest naturalness existing in Lithuania. There are no deep philosophical elaborations on what is natural in general. Humans' capability to change the environment is not questionable and moreover such changes in most cases are related with reduction of nature's diversity. The degree of naturalness varies accordingly to forestry traditions, practices used and also upon the natural conditions, which determines the efficiency of economic forestry activities. Bearing in mind different aspects of forest development e.g. natural processes and human activities in Lithuanian forests, six classes of forest naturalness ranging from untouched virgin forest to an artificial forest are suggested. Usefulness of this classification should be examined in practice and the criteria for different classes of naturalness may be complemented if required. One of the main achievements of this work would be the induced discussion among scientists in the region and to improve the naturalness classifications of Lithuania.

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К ОЦЕНКЕ НАТУРАЛЬНОСТИ ЛЕСНЫХ ДРЕВОСТОЕВ В ЛИТВЕ

С. Шаудите, С. Каразия, О. Белова

Резюме

Современная лесная политика направлена на увеличение важности экологических и природоохранных стандартов. Участие в европейской программе COST E27 "Охраняемые лесные территории в Европе – анализ и гармонизация (PROFOR)" выявило необходимость единых подходов к определении и классификации уровней натуральности лесных древостоев. В статье представляется анализ настоящего положения в Литве, предлагается классификация и критерии различия шести уровней натуральности лесных древостоев.

Ключевые слова: лесные древостои, уровни натуральности лесов, натуральное развитие