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PREFACE

This thesis is the final part of the Master of European Forestry Programme 2004 – 2005. The subject of the thesis comes from my interest in nature conservation and, especially, biodiversity issues. First time I used the Swedish assessment was in 2002 during studies at SLU in Alnarp (Sweden) at the forest ecology course. Later, in 2004, I met Börje Drakenberg when studying at the Introductory Course of the Master of European Forestry Programme in Garpenberg (Sweden). We used the method at the one day field trip and it interested me much. That is why I decided to test the method in Polish forests.

SUMMARY

During last 2000 years dramatic changes have occurred in Europe and many features of old forest have been lost or declined. The primal goal of many plantations in Europe has been for many decades to provide wood and not much attention was paid to other aspects of forestry. The changes in European forests and introduction of intensive plantations with clear-cuts had tremendous impact on biodiversity. During the early 1990s concern for the loss of biodiversity was introduced on the political agenda and the global processes promoting restoration and maintenance of forest biodiversity started. The term sustainable forest management has become popular and new guidelines for multiple-use forest management were created. One of the major goals of sustainable forestry is restoration and maintenance of high biodiversity and the management activities should be adjusted to the needs of nature conservation.

Throughout the development of international policy focused on biodiversity, the need for tools for assessment and evaluation of forest diversity has arisen. Different assessment methods have been elaborated and tested. One of the biodiversity assessment method developed and used in Sweden is the "Assessment of Forest Biodiversity Potential" (Drakenberg and Lindhe, 1999), here called "The Swedish assessment". It is a method of indirect assessment of biodiversity, which is based on disturbance regimes in the forest. The main objective of this work was to investigate if the Swedish assessment could be used in Poland and if this kind of assessment is needed in Polish forestry.

The literature review was conducted to find background information on biodiversity and methods of its assessments in Europe, forests in Poland and Sweden and forestry and nature conservation in Poland. The Swedish assessment was used during the field work in Poland. The Swedish assessment was applied in 25 stands in three Polish national parks (Drawa, Kampinos and Pieniny).

Poland and Sweden are situated in the same geographical region and have similar climatic conditions, apart from the northern part of Sweden. Both countries are located in the same vegetation zones (apart from the Boreal zone that covers northern part of Sweden). They are characterised by the same types of forests and the same disturbance regimes, however in different proportions. All the main forest types occurring in Poland and Sweden could be classified into one of the six forest categories of the Swedish assessment. Therefore the assessment can be used in both countries. Nevertheless, some adjustments are needed for the Polish version of the assessment.

There is no regular assessment of biodiversity potential of forest areas in Poland. The new protection areas can be created when some organisation, institution or private person report area that they consider as worth of being protected. Before, a detailed documentation describing values of the area must be prepared. No system of assessment of the biodiversity potential similar to the Swedish assessment was found in Poland. All evaluations of the values of forest areas are based on the descriptions of the stands.

The author believes that the Swedish assessment could be a useful tool of selection of valuable areas in the managed forests. It could be included into programs of nature conservation in forest districts. The assessment could also be an indirect tool of management and an education tool for foresters. It could also be a help in selecting NATURA 2000 areas. The author suggests a step-wise introduction of the assessment in Poland, starting with workshops introducing the method and continuing with a project of implementation of the assessment in the whole country. Along the way more research on the use of the Swedish assessment in Poland should be carried out.

Some adjustments are needed if the Swedish assessment is to be used in Poland. Some of the investigated stands were out of the scope of the assessment. Probably new forest categories would have to be created for Polish conditions (for example fir dominated stands). Fire is not a main disturbance regime in Poland, therefore some questions in the Swedish assessment concerning fire are not relevant. The author also suggests that questions in the assessment should be different for lowland and mountain stands.

The stands chosen for the assessment had high conservation values. The assessment carried out in the stands also gave a high score to all the stands. This confirms that the assessment could be used in Polish high value forests. There were differences between scoring in various forest categories. For example 14 – 15 points means high value in the F category (fire adapted pioneer tree forests, usually with pine), whereas in W category (forests influenced by water, usually with alder) 18 – 20 points means high value of the forest. In general, the lower score in particular categories, the lower the age of the stand. It is understandable, since many features crucial for biodiversity occur only in older stands. The most common features in the investigated stands were features from the “dead wood” group. This result is surprising, since, according to Polish research, dead wood is missing in Polish national parks. Only three out of 23 national parks were chosen and 25 stands were investigated, therefore results may not be representative for the whole Poland, however they can give some insight into features common in Polish national parks.

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1. INTRODUCTION

During the last 2000 years dramatic changes have occurred in Europe (Bradshaw, 1998). Due to rapid land-use changes and technological advances many features of old forest have been lost or declined (Bengtsson et al. 2000). As a result of human's activities the amount of broadleaves has decreased from 66 to 33 % in Europe since 19th century (Angelstam, 2002). Introduction of intensive plantations with clear-cuts have accelerated the rate of changes in forest ecosystems. Primal goal of many plantations in Europe has been for many decades to provide wood (Gamborg and Larsen, 2003) and not much attention was paid to other aspects of forestry. The changes in European forests had tremendous impact on biodiversity (Bradshaw, 1998). Lack of features characteristic for natural forest, like deciduous trees, dead wood and others, can explain reduction in forest species (Angelstam, 1998). For example old large trees are very important for forest ecosystems, however they are rarely maintained and protected in managed forests in Poland (Medwecka-Kornaś, 1994).

In the early 1990s concern for the loss of biodiversity was introduced on the political agenda. It was the main issue of UNCED meeting in 1992 in Rio de Janeiro. The meeting started global processes promoting restoration and maintenance of forest biodiversity, like the Ministerial Conference "Environment in Europe", the ministerial process "Ministerial Conference on the Protection of Forests in Europe (MCPFE), NATURA 2000 concept and others (Larsson, 2001 b). The primal goal of the European forest, wood production, decreased in significance and the forest management approach changed into multiple-use paradigm. The term sustainable forest management has become more and more popular. The main idea of this wide concept is to design modern silviculture and management in a way that "they are environmentally more benign and more sensitive to nature conservation values while at the same time maintaining a production function" (Gamborg and Larsen, 2003). Modern forestry has new values in addition to timber production. One of the major goals of sustainable forestry is restoration and maintenance of high biodiversity (Nilsson et al. 2001). The challenge is to both assure an acceptable flow of wood and to maintain old-growth characteristics of the forest (McCarthy, 2001). Due to changes in the approach to forestry, forest management practices started to change as well. There is a visible trend in Europe to convert plantations into more diverse forest (Gamborg and Larsen, 2003) and to restore the deciduous forests (Angelstam, 2002). Although many forest reserves have been created, they alone are not sufficient to preserve biodiversity of European forest, because they are simply too small. That is why the ideas for changes in forest management to maintain and promote biodiversity came into focus. The goal is to create such management methods that would be acceptable for both biodiversity and timber yield (Bengtsson et al. 2000).

The traditional view on forests was that each forest ecosystem sooner or later develops into stable climax system, if no large disturbance occurs. A new view is more dynamic and assumes that change and disturbance are natural features of ecosystems (Bengtsson et al. 2000). According to this approach most species in European forests have evolved under and adapted to past natural disturbances and, therefore, understanding of disturbance regimes is crucial to preserve and maintain biodiversity and is a prerequisite for sustainable forest management (Bengtsson et al. 2000). Natural disturbances determine structures and processes that occur in the forest and create features responsible for high species diversity (McCarthy, 2001). According to many authors (e.g. Bradshaw, 1998; Nilsson et al. 2001; Angelstam, 2001) knowledge about natural disturbances is of great significance in preserving biodiversity. The important task of modern forestry is to create silvicultural practices that are able to mimic natural disturbance patterns (McCarthy, 2001), as well as restore features found

in natural forests which will help restoring and maintaining high forest biodiversity (Angelstam, 2002).

Several features important for biodiversity in the forest can be found in the literature (e.g. Nilsson et al. 2001; Kruys, 1998; Larsson, 2001 b). The most commonly mentioned are: proportion of older forest, higher density of snags, proportion of deciduous trees, high density of dead trees (both standing and lying), presence of large living trees. In temperate forests the presence of many species of plants is also dependent on stand history (Nilsson et al. 2001). Occurrence of features important for biodiversity is usually connected with natural disturbance regimes. For example, many species of northern Europe are directly dependent on burnt forests or on the events following fire, e.g. a high density of dying and dead trees and deciduous successions with birch and aspen (Nilsson et al. 2001).

Throughout the development of international policy for restoring and maintaining biodiversity, the need for tools for assessment and evaluation of forest diversity has arisen. Different assessment methods have been elaborated and tested. There are two main approaches to biodiversity assessment: either species (or groups of species) or various features can be used. To survey all species is a costly and almost impossible task. Therefore, indicators of biodiversity are needed. These could be indicator species or features important for a large number of species (Nilsson et al. 2001). The most common approach is the use of species as indicators of biodiversity. However, research does not show high correlation between individual species or groups of species and other groups of species. Scientists are not sure that it is possible to indicate the status of large numbers of taxa using indicator species. Forest features seem much easier and cheaper to record than species. However, it must be remembered that their correlation with species is not always clear (Gustafsson, 2000).

One of the biodiversity assessment method developed and used in Sweden is "Assessment of Forest Biodiversity Potential" (Drakenberg and Lindhe, 1999), here called "The Swedish assessment". The method is based on disturbance regimes and the value of the forest is assessed based on the features occurring there. It is a method of indirect assessment of biodiversity in which no species are directly pointed out, but the potential of their occurrence in the stand is estimated.

The main objective of this work is to investigate if the Swedish assessment can be used in Poland. Main questions to be asked are if the Swedish assessment can be used in practice in Poland, what in the Swedish version of the assessment does not fit Polish conditions, and which important features for biodiversity included in the assessment are the most common in high conservation value forests in Poland. Some practical recommendation will also be given for the adjustments in the Swedish assessment that should be done if it is to be used in Polish conditions. Another objective of the work is to investigate if this kind of assessment is needed in Polish forestry. To answer this question, information was gathered on existing methods for assessing the value of forests in Poland.

Definitions of terms that were used in the work are presented in the Table 1.

Table 1. Definitions of terms used in the work

Term	Definition
Biodiversity potential score	The sum of the "yes" answers on the questions in the Swedish assessment form (Drakenberg and Lindhe, 1999).
Disturbance	According to Angelstam (2002) it is "any discrete event in time that disrupts ecosystem, community or population structure and changes resources, substrate availability, or the physical environment"
Feature	In this work they are structures, processes and other aspects (like for example indicators of the site history) that are included in the questions in the Swedish assessment form
Forest category	One of the six categories (E, F, B, M, W, and C) used to classify stands in the Swedish assessment (Drakenberg and Lindhe, 1999). Details on the categories can be found in the Material and Methods part
Group of features	One of the six groups (site, dynamics, habitats, trees, structure and dead wood), in which questions in the Swedish assessment form are ordered. Details on the groups can be found in Material and Methods part
Structures	Physical structures, both horizontal and vertical, formed by species and communities. The examples are: gaps in the forest, size and form of trees, deadwood, growth forms and others (Gustafsson, 2000)
Processes	Include the interactions within ecosystems between biotic and abiotic factors, as well as the influence of external forces on the ecosystems. The examples are: competition, herbivory, disturbance regimes and others (Gustafsson, 2000)
The Swedish assessment	In this work the name "the Swedish assessment" is used for the indirect assessment of biodiversity potential created by Börje Drakenberg and Anders Lindhe in Sweden, called "Assessment of Forest Biodiversity Potential" (Drakenberg and Lindhe, 1999). More information about this method can be found in the Material and Methods part

2. MATERIAL AND METHODS

The literature review was performed in order to find background information about:

- protecting biodiversity in Europe,
- methods of biodiversity assessments in the European forests,
- forests in Poland and Sweden,
- forestry and nature conservation in Poland.

The Swedish assessment was used during the field work in Poland. Before this, a one-day field test of the Swedish assessment was carried out at the end of February 2005 in Sweden, in the surroundings of Uppsala. The test was carried out in cooperation with one of the authors of the method Börje Drakenberg. The aim was to learn how to use the method.

2.1. THE SWEDISH ASSESSMENT

The Swedish method to assess the biodiversity potential of forest was created at the beginning of 1990s by Börje Drakenberg and Anders Lindhe. It was a reaction to the Key Habitats inventory that started during that time. At the beginning Key Habitats inventory was rather subjective and a structured procedure of the value assessment was missing. There was a need of creating a tool to be able to assess the value of the forest, which could be a uniform framework in the whole of Sweden. There was a need for a simple tool that could be used commonly by the State representatives and by the forest owners. Traditional methods of biodiversity assessment by species inventory is costly and difficult to organise. That is why the new method was created based on the structures occurring in the forest. It was also based on forest dynamics, not on forest typology (forest communities), because forest communities were seen by its authors as a fixed, non-dynamic state (Drakenberg, 2005).

Most of the species that should be protected are adapted to primeval forest conditions. That is why the method is based on the assessment of features that are supposed to be important for biodiversity in primeval forest. The assessment was created mostly based on the experience of years of work in the forest all over the world. It is based on experience rather than scientific research, except of some consultations with scientists, for example, entomologists (Drakenberg, 2005).

The assessment method could be describes as a “check-list of elements in a matrix of disturbance related forest categories”, because it shares the stands in different categories, where the category is based on the disturbances occurring in the forest. The main idea is to assess the processes, structures and substrates occurring in the forest. These are, for example, traces of forest fires, composition of species, age of trees, ground vegetation, soil and water characteristics, occurrence of dead wood and so on. Some of the elements taken into account in the method have direct function as potential habitats for different rare species (e.g. dead wood), others contribute to the general niche diversity (e.g. site features). There are also elements of the assessment that are indicators of the previous stand history (e.g. signs of forest fires) (Drakenberg, 2005).

When creating the assessment, the primary target was to be able to find stands of high ecological value. However, soon it was realised that the assessment can also be a good tool for the forest management. It can be used as an education tool, which can help managers to

learn about forest features important for biodiversity. It can also help to train foresters in what is important for biodiversity and how to manage the forest to increase structures valuable from a biodiversity conservation point of view (Drakenberg, 2005).

The regional versions of the assessment are widely used by a large number of forest actors in Sweden, under a copy rights agreement, for example companies as Sveaskog, Korsnäs, Holmen, all forest owner's associations, the State Forestry and Forestry Society managers. Adapted versions of the method also exist for other countries, like Denmark, Latvia, Armenia and northern China (Larsson, 2001). It is not known how well the assessment is used by the companies. No research was found on if they use the results of the assessment for the improvements of the forest management.

At first, the method was used without any research on if there is a correlation between number of points and number of rare, red-listed species. Later three tests were carried out to check it (Drakenberg, 2005). One of them were the project by WWF carried out in Latvia, another was a master thesis carried out in Sweden by the student Jessica Larsson (Larsson, 2001). Both tests showed high correlation between the number of points in the assessment and the occurrence of rare species. The test made by Larsson took into account red-listed species and signal species of bryophytes and lichens. The third test research, by the Swedish researcher Lena Gustafsson is still ongoing but the first results do not show high correlation between the amount of red-listed species and the score of the assessment (Gustafsson, 2005).

The main idea of the assessment method is the number of yes-or-no questions, which are grouped into six forest categories. There are 80 questions in the assessment form. Some questions are relevant to one category of forest, but not to another. This is the case when the particular element is not important for the biodiversity of particular forest category, or when it is even negative for biodiversity in this category of forest. For example, old stumps with several fire-scars in forest on drier ground composed of pine or pioneer species is considered to be a positive value, whereas the same feature would indicate an interruption of continuity in the old spruce forest (Drakenberg and Lindhe, 1999). The questions are divided into six groups of different features, namely: site, dynamics, habitats, trees, structure and dead wood.

There are two versions of the original assessment: nemoral (Appendix 2) and hemiboreal (Appendix 3), but they only exist in Swedish language. In English only a boreal version has been created (Appendix 4). For the research in Poland a nemoral English version was prepared (Appendix 5), based on the Swedish nemoral version.

The six forest categories in the assessment are the following:

- Early succession stages of forest after disturbance (E) – early succession stages of forest after disturbance, like forest fires, wind storms or beaver dams. These forests often have large amount of dead wood, both standing and lying, as well as damaged but surviving trees. There are some small areas that have not been affected by disturbance. Most sites after harvest are classified to this category.
- Fire-adapted pioneer tree forests in mid- and late succession stages (F) – drier forests with a history of stand-level fires. This kind of stands used to be very common in European boreal forests. In natural conditions, new tree occurring after the fire join the surviving trees to create multiple age pine forest. On more fertile sites, also deciduous pioneer species, like birch, aspen, alder and sallow may occur.

- Beech forests affected by gap dynamics (B) – beech forests with a mix of other broadleaved trees, which in a natural stage are disturbed either seldom or in small scale by gaps in the canopy.
- Noble broadleaved forests affected by gap dynamics (M) – noble broadleaved forests with elm, maple, lime or ash with a mix of other broadleaved trees that naturally are disturbed in a small scale through gaps in the canopy.
- Water level fluctuation-affected deciduous forest (W) – forests along rivers and lakes, seasonally inundated, usually composed of alder, pubescent birch and osiers. These stands can usually maintain more or less perpetual pioneer trees dominance without being out-competed by spruce. After human interventions such stands are often created by coppicing.
- Cultural landscape forests and woodlands (C) – this category comprises a group of different forests and woodlands, characterised by present or historic grazing or mowing for hay. More fertile sites were usually used for meadows, less fertile – for pastures.

For each forest category 50 questions were selected. These are the questions that are most relevant for high biodiversity in a particular category. They are marked with a ring in the corresponding column in the field form. Elements that are regarded as less relevant for particular forest category, or even negative for biodiversity there, lack rings in the corresponding column.

In the present research two categories – the first (E) and the last (C) were excluded. Neither early successional stages of forest development (category E) nor cultural landscape (category C) were in the scope of the research. The assessment form was changed to include only four categories (F, B, M and W) of late successional, more or less natural forest. The questions that were not relevant for the chosen categories were excluded. Out of 80 questions, 76 were left in the assessment form (Appendix 5).

The authors of the assessment recommended that the sites assessed should be influenced by similar disturbance dynamics over the whole area. If the site obviously has a mix of forest categories, it should be divided into more homogenous sub-sites. The authors recommended that the minimum size of the assessed site should be 0,1 hectare. During the field work in Poland, the minimum requirement was that the area should not be smaller than 0,5 hectare. If there was a doubt on which category to use two categories were used. Later the final category was chosen after a consultation with Börje Drakenberg.

The questions on the left part of the assessment form refer to general site features and habitats, as well as to indicators of dynamic processes and the site history. The questions on the right of the assessment form refer to stand characteristics. In many questions, the words “several”, “substantial amount” or “conspicuous” are used. “Several” means average of more then two per hectare. “Substantial amount” means that the certain element occurs in such amount that it should be possible to notice it when assessing the stand without looking for it specifically. “Conspicuous” means that certain element is “catching the eye”, that it is notable.

After answering all questions in the assessment form, “yes” answers should be summed up (each “yes” answer gives one point). This means that each element assessed adds the same value to the stand. It is of course a simplification but it is difficult to assess what is more important for biodiversity, for example, what is more beneficial for the stand value – dead

wood or an area with rocky outcrop. The score of the assessment represents overall sum that shows a combination of many aspects that together contribute to the value of the stand.

Theoretically, the maximum score can be 50 points, but in practice, some elements occurring in the particular stand categories are contradictory or mutually exclusive. It is because in each category there are different types of forest included. They are related to each other, but still different, with different features occurring in them.

It must be remembered that any assessments are subjective processes and must be treated with caution. The score is a general estimate of the biodiversity potential or value of the stand for from nature conservation point of view. When comparing the score from different stands and when planning management of an area one must be flexible and consider additional aspects. These are site size, location, relative rarity and potential for nature conservation actions. The final management decision belongs to the manager and should not be a simple choice between the site with higher and lower score.

2.2. STUDIED AREA

Poland is a Central European country, situated between Germany in the West, Belarus and Ukraine in the East, Slovak and Czech Republics in the South and Baltic Sea in the North. The area of Poland is 312 685 square kilometers and the population equals 38.5 million citizens. The climate of the country is transitional between oceanic and continental. In the western and northern Poland the temperate, oceanic type predominates. It is characterized by mild, cloudy summers, moderately severe winters and frequent precipitation. The Eastern part of Poland is characterized by more continental climate with hard winters and more hot dry summers. The warmest month is July, the coldest one – January. The terrain of Poland is mostly a flat plain with mountain ranges along its southern border. Almost the whole area of Poland has been influenced by 4 glacial periods, therefore there are a lot of remnants from these times (moraines, sanders, etc). Prevailing soils are podzolic and brown ones (82% of the country area). Other types (black, marshy, limestone soils) are not very commonly met. The forest cover in Poland is 28.5%. The most common tree species are Scots Pine (69%), Norway Spruce (6%) and Oak (7%).

Sweden is situated in the northern part of Europe. Its border countries are Norway (West), Finland (North – East) and Denmark (South – West). In the Southeast it borders to the Baltic Sea. The area of Sweden is 449 964 square kilometers and the population of the country amounts almost 9 million citizens. The climate differs depending on the region of Sweden. It is temperate in the South with cold, cloudy winters and cool, partly clouded summers, and subarctic on the North. The warmest month is July, the coldest one - January. The southernmost part of Sweden is flat, the rest of southern part – more leveled with mosaic of fields, hills and lakes. It is higher on the North with many hills, mountains and large river valleys. Poor podzolic soils are predominant in the country. More rich, clay soils can be found in the southernmost part of Sweden, as well as around the glacial lakes. Forest is covering more than half of the country (55%) with prevailing Norway Spruce (44%), Scots Pine (39%) and Silver Birch (10%).

2.3. NATIONAL PARKS

Stands were chosen in the national parks for a couple of reasons. First of all, stands with high values (usually reserves) can be found in national parks, which is not always the case in the managed forest. In addition, national parks usually have a very good documentation of the natural values within their borders. This information can be found in the plan of protection for the national park. Moreover, Polish national parks are located evenly throughout the country (Figure 1), so they represent various kinds of environments. In the three different national parks studied it was possible to find stands of all forest categories needed for the research. They represented both lowland and mountainous types of stands.

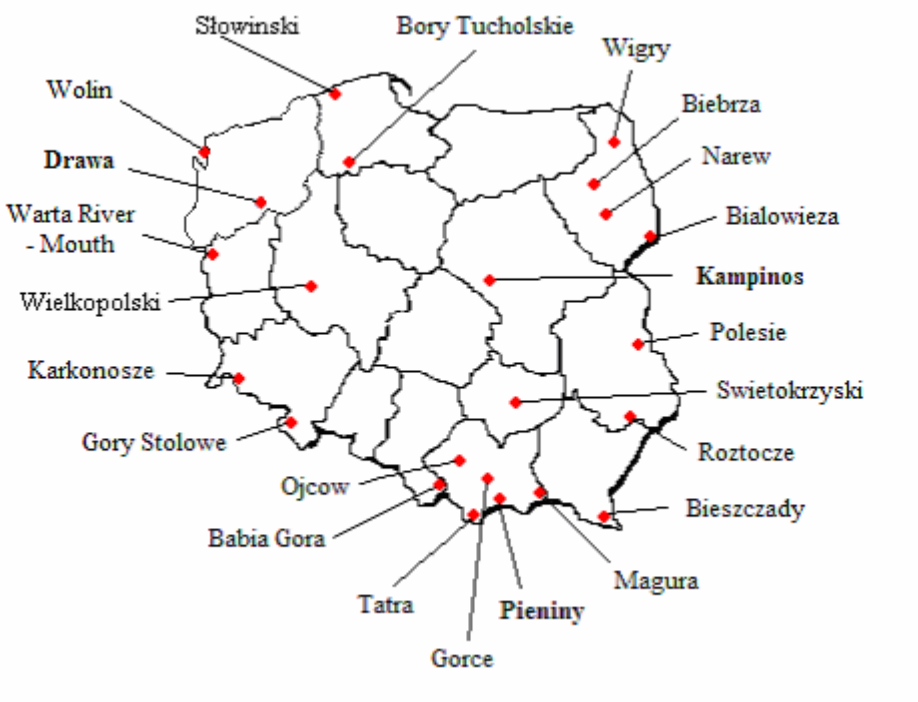

Figure 1. National parks in Poland (chosen parks in bold).

The stands were chosen by the representatives of the parks according to directions given by the author of this work. They were told to choose stands representing four forest categories taken into account during the research. The chosen stand should have presented high conservation value. They should have been rather old and have species composition that fits to the site conditions. All of the chosen stands were located in the reserves under either strict or partial protection.

For each park several stands were chosen (Table 2, 3 and 4) for the assessment. Pictures of each stands were also taken. Altogether 25 stands were chosen in the parks. Description of each stand can be found in the Appendix 1.

The following tree parks were visited during the period 31.03 – 11.04.2005 in order to carry out the assessment in the chosen stands:

1. Drawa National Park
2. Kampinos National Park
3. Pieniny National Park

Drawa National Park (Figure 2, 3 and 4) lies in the central-west Poland and is a part of the forest complex - Drawa Primeval Forest, situated in Mysliborz-Walcz Lake District. The park was established in 1990, on the area of 8,691 hectares. Currently its total area is 11,342 hectares. 368 hectares are strictly protected.

Figure 2. Mixed broadleaved forest by the Drawa river in Drawa NP.

The most valuable features of the park are the water ecosystems. The landscape of the park was shaped by the glacier and it has a lot of glacial formations. Characteristic features are the rivers Drawa and Płociczna with their picturesque meanders. They are both similar in character to mountain rivers, with spectacular canyons and gorges. Steep river banks can reach up to 35 m of height. There are also many interesting lakes in the park. The lakes vary in terms of trophic character and size, from the largest of 370 ha to the really small ones.

Figure 3. Drawa river in Drawa NP.

Figure 4. Beech forest in the strict reserve "Radęcin" in Drawa NP.

Soils in the park are rather poor – sands on the planes, sands, peat and alluvial soils in river valleys and brown soils in the Drawa river basin.

There are 1000 species of vascular plants in the Drawa National Park. Most valuable species include: orchids, cranberry, sundews, mud sedge, club-mosses, Daphne, and Turk's cap lily. Over 200 species of mosses, and 210 of fungi are also found here. There are about 140 plant communities represented, including 18 forest and shrub communities. The most typical forest

community is a Pomeranian beech forest. The oldest of beech and oak trees grow in the strict protection zones "Radecin" and "Debina". However, coniferous stands prevail in the park and the dominant species is Scots Pine. Tree stands of age over 81 years cover about 40% of the afforested area of the Park. Interesting elements are also peat-bogs, mostly of lake origin, They are habitats for many species and plant communities.

The Park fauna is very rich, especially birds fauna (154 species). There are 7 species of reptiles, among them swamp turtle that is very rare in Poland. Beaver was reintroduced in the area in 1978. River otter can be found occasionally. Mammal fauna is represented by about 40 species. Good oxygen conditions and cleanliness of the waters enable the presence of threatened species of fish.

Table 2. Data of the stands chosen in Drawa National Park
(*share of the species in the stand: 1 = 10%; Oak (p) = penduculate oak; Oak (s) = sessile oak); forest community after Matuszkiewicz (2002)

Stand	Type	Forest site	Forest community	Area	Share * Species Age
1	B	Broadl.fresh	Melico-Fagetum	0,58	7 Beech 347, 1 Oak (p) 347, 1 Beech 137, 1 Beech 62
2	B	Broadl.fresh	Melico-Fagetum	2,43	5 Beech 152, 4 Beech 167, 1 Beech 122
3	B	Broadl.fresh	Luzulo pilosae-Fagetum	8,04	4 Beech 133, 3 Beech 93, 2 Beech 157, 1 Beech 62
4	B	Broadl.fresh	Galio-Carpinetum	2,70	5 Beech 147, 1 Oak (p) 147, 1 Alder 117 , 1 Hornbeam 117, 1 Ash 117, 1 Birch 117
5	M	Broadl.fresh	Galio-Carpinetum	1,31	2 Beech 157, 1 Oak(p) 157, 1 Beech 257, 1 Oak(p) 257, 1 Maple 82, 1 Lime 82, 1 Hornb 82, 1 Larch 82, 1 Hornb 72
6	M	Broadl.fresh	Luzulo pilosae-Fagetum	1,90	2 Beech 80, 2 Lime 80, 2 Aspen 80, 1 Hornb 80, 1 Beech 57, 1 Hornb 57, 1 Oak (s) 127
7	M	Broadl.fresh	Galio-Carpinetum	3,67	2 Beech 147, 2 Oak (s) 147, 1 Ash 107, 1 Hornbeam 107, 1 Alder 97, 1 Ash 77, 1 Alder 77, 1 Ash 47
8	W	Broadl.flooded	Circaeo-Alnetum	1,53	10 Alder 96

Kampinos National Park (Figure 5 and 6) is located north-west of the city of Warsaw. It occupies a part of the Vistula proglacial valley in the Warsaw Basin with a large forest complex – Kampinos Primeval Forests.

Landscape of the park was formed over 12 thousand years ago, when the rivers flowing down from the south met the ice-front of the withdrawing Scandinavian glacier and turned creating an 18 km wide channel. This way, the accumulation terrace of the Vistula proglacial valley separated from the postglacial plateau.

Figure 5. Pine forest on the sand dune in Kampinos NP.

The park terrain is built of river sands and gravels. There are also a lot of sand dunes, created at the end of glacial period. Some of the dunes reach up to 30 m height. Most of them are stabilised by vegetation, mainly forest. Along the Vistula river there are marsh belts with deposits of low-moor peat. The same kind of peat can be also found in belts of some dunes (the so called deflation basins).

There are several large rivers getting together in the region of the park (Vistula, Bug, Narew, Wkra, and Bzura), but there are no lakes in the park.

Figure 6. Black alder forest in Kampinos NP.

Flora of the Kampinos National Park is represented by about 1,100 species of vascular plants. A very interesting species, rare in Poland, is the river birch *Betula obscura*. 115 species of bryophyte and 50 species of lichens were found here. The vegetation varies very much in different parts of the park. The dunes are dominated by pine and dry-ground forests with lime and hornbeam, while the marshes by various types of meadow communities, sedges, and alder forest. In the Park there are over 50 plant communities. Out of them 12 are forest communities.
The park fauna consists of over 16,500 species. Insects (over 2,030 species) and birds (199 species) present the highest variety. There are 6 species of reptiles and 13 species of amphibians in the park. The park has successfully been reintroducing a few animal species: moose (since 1951), beaver (since 1980) and lynx (since 1992).

Table 3. Data of the stands chosen in Kampinos National Park (*share of the species in the stand: 1 = 10%; Oak (p) = penduculate oak; Oak (s) = sessile oak); forest community after Matuszkiewicz (2002)

Stand	Type	Forest site	Forest community	Area	Share* Species Age
9	F	Mixed broadleaved fresh	Tilio-Carpinetum	5,46	6 Pine 149, 4 Oak (p)124, II fl: 5 Hornbeam 74, 4 Oak (p) 51, 1 Hornbeam 51
10	F	Coniferous fresh	Peucedano-Pinetum	11,99	10 Pine 119
11	F	Coniferous fresh	Peucedano-Pinetum	9,91	10 Pine 76
12	F	Coniferous fresh	Querco roboris-Pinetum	12,59	10 Pine 184
13	F	Mixed coniferous fresh	Querco roboris-Pinetum	4,72	8 Pine 164, 2 Oak 56
14	W	Broadl.flooded	Ribeso nigri-Alnetum	2,80	10 Alder 104
15	W	Broadl.flooded	Ribeso nigri-Alnetum	8,62	9 Alder 94, 1 Alder 66
16	W	Broadl.flooded	Ribeso nigri-Alnetum	7,75	Alder 74

Pieniny National Park (Figure 7, 8 and 9) is situated in the Pieniny Mountains, in the southern part of Poland, by the Polish-Slovak boarder. The total park's area is 2,346 hectares, of which 1,311 hectares are owned by the State. Forests cover is 1,665 ha, out of which 750 ha are under a strict protection.

Figure 7. Famous pine on the steep slope over Dunajec River in Pieniny NP.

The park area is build of a variety of limestone. The hardest type of limestone (cornstone) builds almost vertical, white, rocky walls along the Dunajec river. Pieniny are not very high mountains, the highest peak Wysoka is 1,050 m over the sea level. The geological structure is very diversified, which results in occurrence of various development stages of mineral and

organic soils in the park. They differ from very shallow to very thick, from stony to loamy, from acidic to alkaline. The most common soil types are calcareous and brown soils.

The area of the park lies within the Dunajec river catchment zone. In the Pieniny 377 natural water sources have been registered (290 pernament ones). The Dunajec river plays an important role among the factors that shape the relief of the mountains.

The Polish part of the Pieniny mountains is very small (nearly 100 km) but 1,100 species of vascular plants, 400 species of algae, 330 species of mosses and liverworts, 400 species of lichens, 640 species of mushrooms and 560 species of fungi micro-organisms parasitic to plants were registered. Over 70% of the Park area is covered by forests. The most common forest ecosystems are: Carpathian beech forest, thermophilous fir and beech forests, sycamore forest with *Scolopendrium vulgare*, relict pine forests and Carpathian alder forests.

About 6,500 animal species have been found, but probably as many as 13,000 to 15,000 species live here (which constitute almost a half of Polish fauna). There are 61 species of mammals, 17 species of fish, 10 amphibian species, and 6 reptile species listed. There have been 95 out of 160 species of nesting birds found in the park, including such rare species like eagle owl, wall-creeper, rock thrush and others.

Figure 8. Beech slope forest in Pieniny NP.

Figure 9. Large sycamore and fir in Pieniny NP.

Table 4. Data of the stands chosen in Pieniny National Park (*share of the species in the stand: 1 = 10%; Oak (p) = penduculate oak; Oak (s) = sessile oak); forest community after Matuszkiewicz (2002)

Stand	Category	Forest site	Forest community	Area[ha]	Share* Species Age
17	F	Mountain broadl.	Pinus sylvestris - Calamagrostis waria	1,29	7 Pine 110, 2 Pine 70, 1 Spruce 70
18	F	Mountain broadl.	Pinus sylvestris - Calamagrostis waria	1,24	8 Pine 110, 2 Pine 60
19	B	Mountain broadl.	Dentario glandulosae-Fagetum	2,10	7 Beech 170, 2 Fir 170, 1 Beech 100
20	B	Mountain broadl.	Dentario glandulosae-Fagetum	1,73	6 Beech 150, 1 Fir 150, 1 Spruce 90, 1 Beech 90, 1 Sycamore 50
21	B	Mountain broadl.	Dentario glandulosae-Fagetum	1,62	9 Beech 110, 1 Spruce 110
22	W	Mountain broadl. flooded	Alnetum incanae	1,26	6 Alder 25, 1 Salix 25, 3 Ash 45
23	F	Mountain broadl.	Dentario glandulosae-Fagetum	1,31	6 Larch 100, 2 Sycamore 100, 2 Fir 130
24	B/M	Mountain broadl.	Dentario glandulosae-Fagetum	3,01	6 Fir 150. 3 Beech 150, 1 Sycamore 40
25	B/M	Mountain broadl.	Dentario glandulosae-Fagetum	1,69	9 Fir 120, 1 Beech 120

Stands 24 and 25 were not included in the analysis. It was because their forest category was not sure and they were all classified into two categories, each of which got different score.

3. RESULTS FROM THE LITERATURE REVIEW

This section regards issues related to natural conditions of Poland and Sweden, forestry and nature conservation in Poland and assessment of biodiversity.

3.1. VEGETATION ZONES

The main vegetation zones in Poland and Sweden are (after Essen et al. 1997):

- Boreal zone – divided into 3 zones: southern, middle and northern boreal zones,
- Hemiboreal zone – also called by other authors (e.g. Diekmann, 1994) boreo-nemoral zone,
- Temperate zone – also called by other authors (e.g. Diekmann, 1994) nemoral zone.

Boreal zone stretches in northern Sweden and goes down into the middle of the country. From the middle of Sweden there is hemiboreal zone, which also reach north-eastern Poland (Falinski, 1986). Temperate (nemoral) zone starts in the very southern part of Sweden and covers most of Poland (besides the hemiboreal part).

Boreal zone is dominated by the coniferous tree species (Scotch pine and Norway spruce) and many temperate (nemoral) deciduous species are absent. The hemiboreal (boreo-nemoral) zone is dominated by coniferous tree species but there are also deciduous forests depending on favourable climatic and/or edaphic conditions. Most of temperate (nemoral) deciduous species are still here but not in large areas. Temperate (nemoral) zone in natural condition would be covered almost exclusively with deciduous species with beech dominating (Diekmann, 1994), excluding sites situated in the lowlands of the north-east, on very poor sandy or swampy ground, where coniferous woodlands have naturally played a dominant role (Ellenberg, 1988). However, due to human activities many deciduous stands have disappeared and coniferous plantations were planted.

3.2. FOREST DYNAMICS AND MAIN DISTURBANCE REGIMES

Forest dynamics are connected with disturbance regimes. There are large-scale disturbance regimes such as fire, wind, floods and insects outbreaks, and small-scale disturbance regimes such as gap formation caused by fungi, insects and single tree-fall (Angelstam, 2002). Other disturbances are browsing and grazing by animals and in same cases insects herbivores (Larsson, 2001 b). Some authors also mention forestry practices as disturbances influencing forest ecosystems. Some silviculture measures can mimic natural disturbance regimes, however usually many features of natural forests decline in managed forests (Bengtsson et al 2000).

Three types of forest dynamics can be described (after Angelstam, 2002):

- Successional dynamics – occurs after a large-scale disturbance and has a series of development stages, like stand initiation, young phase, middle-aged phase, harvestable phase, aging phase and old-growth phase. Last two phases can be rarely seen in managed forest, because they demand high age of the forest. Succession following

large-scale disturbance is noted as a major factor affecting *Picea abies, Betula spp*. and *Populus tremula* (Gustafsson, 2002),

- Cohort dynamics – is relevant for tree species that show clear adaptations to low-intensity disturbances. A good example is Scotch pine on dry sites in boreal forest and low-intensity fires. Such fires produce stands with several age cohorts of trees,
- Gap dynamics – occurs in the absence of large disturbances, when the death of a single tree or groups of trees creates gaps in the forest where shade-tolerant trees can regenerate. Ellenberg (1988) describes the rhythm of natural forest influenced by the gap dynamics. In such forest the following phases of development are present: optimal phase, terminal phase, decay phase and regeneration phase. According to Ellenberg (1988) such dynamic pattern can be found in many types of forest, e.g. in beech, oak, mixed hornbeam, spruce and mixed fir and spruce forests.

3.3. MAIN FOREST TYPES AND MAIN DISTURBANCE REGIMES

Larsson (ed. 2001) presents main forest types for biodiversity assessment in Europe. According to his work the following forest types are present:

In Sweden:

- North boreal spruce forest
- North boreal pine forest
- Middle boreal spruce forests
- Middle and south boreal and hemiboreal pine forest
- South boreal forest
- Hemiboreal spruce forest
- Mixed oak forest
- Lowland and submontane beech forest
- Pine plantation
- Spruce plantation

In Poland:

- Hemiboreal spruce forest
- Mixed oak forest
- Mixed oak-hornbeam forest
- Lowland and submontane beech forest
- Swamp and fen forest with alder
- Pine plantation
- Spruce plantation

Boreal forests occur in Sweden, but not in Poland. They are dominated by mainly coniferous species, either Norway spruce (*Picea abies*) or Scotch pine (*Pinus silvestris*) or both. In natural conditions they are affected either by fire (North boreal pine forest, Middle and south boreal and hemiboreal pine forest) or by small-gaps dynamics caused by wind and pathogens (North boreal spruce forest). The stands can be also affected by both fire and smaller scale disturbances, depending on location (e.g. North boreal spruce forest is mostly affected by occurrence of small gaps but more on east it can also be influenced by fire) or successional stage (e.g. for Middle boreal spruce forests and in South boreal forest fire is a main disturbance factor but in later successional stages small-scale gap dynamics is also important) (Larsson, 2001 b).

Hemiboreal spruce forest occurs in southern Sweden and in north-eastern Poland. It consists of Scotch pine, Norway spruce, deciduous species like *Betula spp*, *Populus tremula, Salix* and broadleaves like*: Quercus, Fraxinus* and *Tilia.* Key factor maintaining forest biodiversity is a complicated mixture of natural and cultural disturbances. These range from strong effects of wind in the west and effects of forest fire on drier sites on the east (Larsson, 2001 b).

Mixed oak forest occurs in southern Sweden and in north-eastern Poland. It consists of oak (*Quercus*) and birch (*Betula*). This kind of forest is in natural conditions influenced by gap-dynamics. In Central Europe mixed oak forest is a stage in a succession which ultimately culminates in a beech forest climax (Larsson, 2001 b).

Mixed oak-hornbeam forest occurs in Poland but not in Sweden. In this forest oak (*Quercus spp*.) and hornbeam (*Carpinus betulus*) dominate. Other species like ash (*Fraxinus*), (*Tilia*) and others are a part of the forest as well. Mixed oak-hornbeam forest substitute beech forest where beech cannot grow. Presently there are not many sites with this type of forest. Little is known about natural disturbances in mixed oak-hornbeam forest but it seems like small-scale gap dynamics predominate (Larsson, 2001 b).

Lowland and submontane beech forest occurs in Poland and in southern Sweden. Beech (*Fagus silvatica*) dominates. The main factor that shapes the structure of the forest is small gap dynamics. Beech is sensitive to fungus *Fomes fomentarius* that is often the cause of gaps creation (Larsson, 2001 b).

Swamp and fen forest with alder is not a very common type of forest. It occurs on some sites in Poland. Common alder (*Alnus glutinosa*), Downy birch (*Betula pubescens*), oak (*Quercus robur*), and ash *(Fraxinus excelsior*) are the main species. The base status of the forest is maintained by ground-water influence or periodic flooding. Uprootings are frequent and create canopy gaps, mosaic structures and niches for many plants and animals (Larsson, 2001 b).

Pine plantation and spruce plantation are very common in both Sweden and Poland. That are usually artificial monocultures introduced by man. However, there is an increasing tendency to modify commercial plantation to be better for biodiversity, but still maintaining commercial viability (Larsson, 2001 b).

3.4. FORESTRY AND NATURE CONSERVATION IN POLAND

In this section general information on Polish forestry and nature conservation will be given.

3.4.1. State of forests and organisation of the SF National Forest Holding

The forest cover 28,5 % of Poland, which is about 8,9 million hectares. 78,4 % of it (7,6 million hectares) is managed by the "State Forests" National Forest Holding. It is an organizational unit lacking legal personality and it has had a more than 80-year tradition in the implementation of their mission to carry out sustainable forest management. The Holding manages forests that are the property of the Treasury. The main principles of the forest management are the following:

- Persistence and universal protection of forests,
- Sustainable utilisation of all their functions,
- The enhancement of forest resources (Raport roczny, 2003).

The main body of the Holding is the General Director. On lower level, we find 17 Regional Directories with Regional Directors and, even lower, 439 forest districts. Forest districts are

further divided into sub-districts. Organisation of the „State Forests" National Forest Holding is presented in the Figure 10.

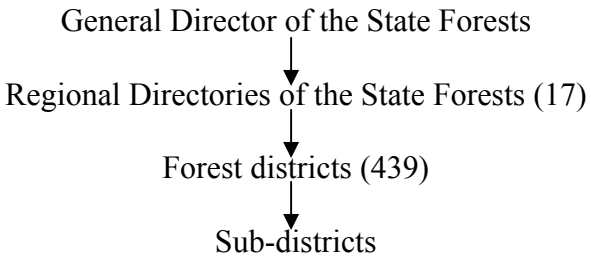

Figure 10. Organisation of the State Forests National Forest Holding (Raport roczny, 2003).

The main species in Poland is Pine, followed by oak, birch, spruce, beech and alder. Species composition of state forests is shown in the Figure 11.

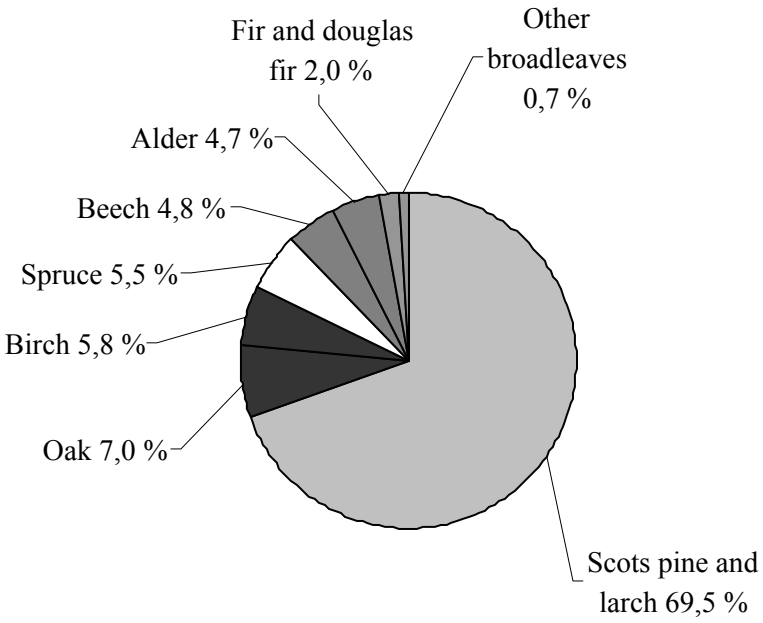

Figure 11. Species composition in Polish forests (Raport roczny, 2003).

Average standing stock in state owned forests is 215 m^3/ha, and 119 m^3/ha in private forests (state for the year 2002). In 2002 26,5 million m^3 were harvested (Raport roczny, 2003).

3.4.2. Forest management

Basic document for the forest district is a forest management plan prepared for each 10 years. The plan must be approved by the Minister of Environment. The forest management plan includes: up-to-date description of stands, plan of cuttings (final felling and others), plan of silviculture, plan of fire protection, plan of tourist infrastructure, program of nature conservation, etc. GIS and aerial photos are used for the creation of plans (Instrukcja Urzadzania Lasu, 2003).

The inventories needed for the plan's preparation are carried out for each forest district. Most of the plans are prepared by the Biuro Urządzania Lasu i Geodezji Leśnej (BULiGL) (Forest Management and Geodesy Bureau). It is a state enterprise that is made up by 12 terrain departments. They carry out management works commissioned by the State Forest Holding, as well as national and landscape parks and private forest owners. Program of nature conservation, within the management plan, includes: complex description of the state of nature in the forest district, taking also into account forests that do not belong to the State Forest Holding, main tasks of the nature conservation and the ways of implementing them, as well as a map of the natural and cultural values (Instrukcja Urzadzania Lasu, 2003).

The State Forests Information System (SILP) has been in operation since 1998 and is a tool assisting in the pursuit of forestry management at all levels of administration of the State Forests National Forest Holding. Until recently it was one of the few consolidated information systems operating anywhere in Poland. However, development in ICT has ensured that the current expectations as regards the way the system might be used in the everyday work of foresters are much different from what they once were. Coming up against these wishes on the part of those who most use the SILP, the SF General Directorate is working constantly towards a modernisation of the system and a fuller use thereof (Instrukcja Urzadzania Lasu, 2003).

3.4.3. A plan of protection and management of a national park

The plan of protection of a national park is prepared for each 20 years. Moreover, annual protection tasks for each park are prepared, with detailed description of activities in particular areas. The plan includes similar information like the ones in the forest management plan (description of the stands and planning of different activities). In addition, it includes the description of plant communities and their correlation with the site index (Rozporzadzenia… 2004).

Forest management in national parks differs from the one in managed forests. The main goal of the management is naturalisation of the stands and production is not so important. The stands that are not suited to the site are slowly re-built. This process is usually "a step behind the nature", which means low interference in the forest and the use of natural processes taking place (for example artificial regeneration in naturally occurring gaps). The silvicultural practices are similar in national parks and managed forests. However, the names of particular activities differ, for example in a national park they can have "sanitary cutting" instead of "commercial thinning" (Kamiński, 2004).

Active protection in a national park can have different forms:

- Stabilising – when the stand does not need to be re-build but small activities are carried out in case of special events like, for example, gradation of pests,
- Reconstructive – when the stand needs to be re-built,
- Active protection with a "zero level of activity" – it is almost a strict protection, but some activities can be carried out in case of some catastrophes (Kamiński, 2004).

3.4.4. Sustainable forest management

Decree no 11a of the General Director about the improving of forest management on ecological bases is a document, which gives guidelines for "ecological" and sustainable forest management (Zarządzenie nr 11a). The main idea is to avoid schematic methods of forest management and silviculture and try to adjust them to the particular site conditions. The aim of it is to as accurate as possible adjust biocoenose to biotope. Main goals included into the decree are: maintenance of biological diversity, productivity of the forests, their health and vitality, protection of soil and water resources, maintenance of forest contribution to the global carbon cycle and consideration for social aspects of forests and forestry (Zarządzenie nr 11a, 1999).

The FSC certification process in Poland started in 1996, when two regional directorates in Gdansk and Szczecinek were certified. The following years Poland has increased the area of certified forest and presently 16 out of 17 Regional Directorates of State Forests have finished a process of certification and got certificates. There is only one Regional Directorate without the certificate, but the process of certification is ongoing and should be finished by the end of 2005 (Lasy Panstwowe – web-page).

There are 19 Promotional Forest Complexes (LKP) in Poland. The first ones were created in 1994. Total area of LKPs is 990 469 ha, which constitutes over 11 % of area managed by the State Forests. Their aim is to implement and pursue pro-environmental forestry methods. They should test new technologies in everyday forest management and organise training of foresters. One of their important objectives is also environmental education. The Complexes were created to represent different natural-forest regions, showing variety of habitat conditions, stand species compositions, production options, as well as different threats to forest ecosystems (Lasy Państwowe – web-page).

3.4.5. Silviculture

When carrying out forest regeneration, there is a rule of compatibility of the species with the site. Adequate species mix should be chosen, including main, admixed and biocenotic species. There are rules of choosing the amount of particular species, depending on site quality and forest region. The most common species to be planted are: Scotch Pine, Norway Spruce, Beech and Oak. It of course depends on the site conditions and the region of the country (Zasady hodowli lasu, 2000).

There are five main groups of silvicultural systems (Zasady hodowli lasu, 2000):

- The clear cutting systems,
- Shelterwood systems,
- The group systems,
- The strips and group systems,
- The selection system.

In each group there are from 1 to 4 systems (together 14 systems). According to Matthews (1989) these systems can be described in the following way.

In the clear cutting systems all trees in the stand are removed at the same time. Then the area is regenerated, usually through planting (sometimes sowing), but there is also the possibility of leaving seed trees or using the seeds coming from the neighbouring stand (e.g. for spruce). Clear cutting systems are mostly used for light-demanding species.

In a shelterwood system, the trees are cut over the whole cutting area but some of them are left evenly spread over the stand. The aim of it is to prepare the stand for natural regeneration and/or to protect the seedlings. It is usually used for the species with heavy seeds. It can also be called "the uniform system" or "compartment shelterwood system" when the canopy is opened out over the whole compartments at the same time.

In the group systems gaps of 0,05 – 0,2 ha are cut in the stand with or without leaving shelter trees. When the young trees have grown large enough to withstand the climatic conditions, the trees in the rest of the stand are removed. The area around the gaps is regenerated naturally (using shelterwood) or by planting. The main goal of these systems is to change monocultures into stands with more species and uneven-aged. It is used either in pine and birch stands (with planting around the gaps) or in pine, beech and oak stands (with natural regeneration around the gaps).

In the strip and group systems the gaps or strips (or both) are cut in the stand. The new regeneration comes naturally. When sufficient regeneration has appeared, the gaps (strips) are widened in steps. The widening continues until the whole stand is regenerated. This way of cutting is used in fir, beech, oak and spruce (or mixed of this species) stands with the main goal to create mixed, multi-species stands.

The selection system means that single trees (or groups of trees) are taken out from the stand. The process of regeneration takes place all the time and young trees use the remaining trees as a shelter. All the age groups are present in the stand. It is used in fir and mixed-fir stands as well as in the mountain spruce stands.

The use of different systems in Poland is shown in percent in the Figure 12.

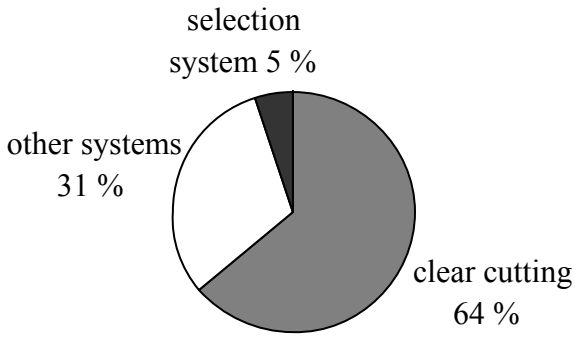

Figure 12. The use of silvicultural systems in Poland (Raport roczny, 2003)

3.4.6. Classification of forests

The classification of lowland and highland forest sites is based on both fertility and moisture of the soils (Table 5 and 6). There are four trophic classes (coniferous, mixed coniferous, mixed broadleaved, broadleaved and flooded broadleaved) and five hydratic classes (dry, fresh, wet, marshy and flooded).

Table 5. Classification of lowland forest sites (Instrukcja Urzadzania Lasu, 2003)

Fertility	Coniferous	Mixed coniferous	Mixed Broadleaved	Broadleaved	Flooded Broadleaved
Moisture					
Dry	+				
Fresh	+	+	+	+	
Wet	+	+	+	+	+
Marshy	+	+	+	+	+

Table 6. Classification of highland forest sites (Instrukcja Urzadzania Lasu, 2003)

Fertility	Mixed coniferous	Mixed Broadleaved	Broadleaved	Flooded Broadleaved
Moisture				
Fresh	+	+	+	
Wet	+	+	+	+
Marshy				+

The classification of mountain sites depends on both fertility and moisture and on the vegetation zone (Table 7).

Table 7. Classification of mountain forest sites (Instrukcja Urzadzania Lasu, 2003)

Vegetation zone	Fertility / Moisture	Coniferous	Mixed coniferous	Mixed Broadleaved	Broadleaved	Flooded Broadleaved
High mountain		+				
Mountain	Fresh	+	+	+	+	
	Wet	+	+	+	+	+
	Marshy	+	+			+

Forest communities classification used in Poland comes from the work of professor Matuszkiewicz (2002). Based on his work, forest communities are classified taking into account characteristic species combination.

3.4.7. General information on the system of protected areas in Poland

In the new Act on Nature Conservation (Ustawa o ochronie przyrody, 2004) the following forms of nature conservation are presented:

- national parks,
- nature reserves,
- landscape parks,
- protected landscape areas,
- NATURA 2000 areas,
- monuments of nature,
- documentation sites,
- ecological arable lands,
- landscape – nature complexes,
- species protection of plants, animals and fungi.

Over 40 % of the area in Poland is under some form of nature conservation.

A national park is established under the Regulation of the Council of Ministers. A park includes protected areas with particular scientific, natural, social cultural and educational values, of the area of at least 100 ha. In national park all nature elements and specific landscape features are under either strict, a partial or landscape protection. The main goals of a national park are to preserve biodiversity and all elements of nature, restore a proper state of natural resources, and reconstruct distorted natural habitats for different species. Each park should have a plan of protection. National parks are open for sightseeing, and fees, determined by director of the park, may be charged for the entry (Ustawa o ochronie przyrody, 2004).

By the end of 2004 twenty tree national parks have been established in Poland.

A nature reserve is established under the ordinance of the governor of a voivodship. A reserve is an area including areas in natural or slightly changed state. It also protects habitats of different species and elements of inanimate nature. The value protected in the reserve should have essential value for the environmental, scientific, cultural and landscape reasons. Each reserve should have a plan of protection (Ustawa o ochronie przyrody, 2004).

There are 1354 nature reserves in Poland (Główny Urząd Statystyczny – web-page), divided into 9 main categories, where the main goal is to protect:

- fauna – 133 reserves,
- landscape – 99 reserves,
- forest – 691 reserves,
- peat – bog – 134 reserves,
- flora – 162 reserves,
- water – 28 reserves,
- inanimate nature – 70 reserves,
- steppe – 33 reserves,
- halophytes – 4 reserves.

More than 70 % of reserves are managed by the State Forests. The area of individual reserves ranges from 0,5 ha to 5000 ha (on average around 100 ha).

A landscape park is established or enlarged by the ordinance of governor of the voivodship. A landscape park is an area protected for landscape features and natural, historical and cultural values. Its aim is to protect these values, as well as dissemination of the knowledge on these values. It should promote sustainable development of the area. Each landscape park should have a plan of protection (Ustawa o ochronie przyrody, 2004).

Presently there are 119 landscape parks in Poland (Institute of environmental protection 2002) with a total area of about 2,5 million ha (almost 8 % of the area of Poland).

A protected landscape area is established by the ordinance of governor of the voivodship. A protected landscape area encompasses area protected for the sake of a unique landscape. These areas are valuable because of their function of ecological corridors, as well as a function of satisfying the needs of tourism and recreation (Ustawa o ochronie przyrody, 2004).

NATURA 2000 network is a new tool for biodiversity conservation in Europe that should provide long-term survival of many species and habitats. Creation of NATURA 2000 areas is based on 2 European Directives: Directive 79/409/CEE, adopted in April 1979 which concerns the conservation of wild birds (also known as the "Birds Directive") and Directive 92/43/CEE, adopted in May 1992 which concerns the conservation of natural habitats and wild fauna and flora (also known as the "Habitats Directive") (Ustawa o ochronie przyrody, 2004). The coherent ecological network of NATURA 2000 protected areas will consist of:

- Special Protection Areas (SPA) – to conserve species of birds listed in Annex I of the Birds Directive,
- Special Areas for Conservation (SAC) –to conserve habitat types as well as plant and animal species listed in the Annexes to the Habitats Directive.

In Poland "preliminary conception of NATURA 2000 areas" was elaborated in 2003. This project has included 285 areas – 181 SAC and 180 SPA (some areas have been recognised as both SAC and SPA). Total area of the proposed network is over 40000 km^2 (13 – 14 % of the area of the country). In March 2004 the Ministry of Environment elaborated a list of areas proposed for NATURA 2000 network. This list consist of 272 areas – 201 SAC and 71 SPA. However, there is still no final version of the NATURA 2000 network in Poland.

Monuments of nature are single objects of animate and inanimate nature of special environmental, scientific, cultural, historical and landscape value (Ustawa o ochronie przyrody, 2004).

Documentation sites are places of occurrence of various geological formations that do not emerge on the earth surface. They should have a special scientific and educational value (Ustawa o ochronie przyrody, 2004).

Ecological arable lands are fragments of ecosystems worth of protection because of significant importance for biodiversity. They are usually very small areas like water reservoirs, groups of trees and shrubs, peat – bogs, dunes, etc. (Ustawa o ochronie przyrody, 2004).

Landscape – nature complexes are fragments of natural and cultural landscape particularly attractive because of their scenic or esthetical features (Ustawa o ochronie przyrody, 2004).

3.5. ASSESSMENT OF BIODIVERSITY IN SWEDEN

Ongoing forest biodiversity monitoring and assessment programs in Sweden are the following (for details see Gustafsson, 2000):

- The Swedish National Forest Inventory and the National Survey of Forest Soils and Vegetation,
- The Swedish Environmental Monitoring Program,
- The biodiversity evaluation scheme of "Skogsbiologerna" (here called "the Swedish assessment"),
- Green book keeping system,
- The Angelstam model for biodiversity assessment,
- Polytax,
- Flora guardians.

3.6. ASSESSMENT OF BIODIVERSITY IN POLAND

In this section information about the creation of nature conservation areas, forest biodiversity inventories and nature conservation on forest district level in Poland will be given.

3.6.1. Creation of nature conservation areas

According to Polish law, national park is established under the Regulation of the Council of Ministers. A reserve, a landscape park or a protected landscape area are created under the ordinance of the governor of a voivodship (administration unit, like a province). Exceptionally a reserve it can be created by a Minister of Environment if it is situated on the border between two (or more) voivodships. Other forms of protection (monuments of nature, documentation sites, ecological arable lands and landscape – nature complexes) are created under the ordinance of the governor of a voivodship or through the decision of the local administration (Ustawa o ochronie przyrody, 2004).

An area can be reported as worth of being protected by different institutions or organisations, for example NGO, forest district or even a private person. Usually a forest area is considered as worth of being protected if it encompasses a unique site type, has a rare or specific species composition and/or high age of trees (Tracz, 2005). When an area is reported as worth of being protected, the governor of a voivodship should check if this area is valuable. However, in practice reports that do not include documentation of natural values of the area are ignored (Pawlaczyk, 2005). Therefore, before reporting the area as worth of being protected, the documentation of natural values of the area should be prepared. Such documentation usually includes information on the values worth of being protected, like rare species, unique habitats, interesting inanimate nature formations and others.

National parks, nature reserves and landscape parks should have a management plan. In the plan description of all natural and cultural values in the area should be included. Detailed information on flora, fauna, inanimate nature formations, plant communities, ecosystems and cultural sites and objects of an area must be given. The plan should also give detailed

information on the conservation activities planned in the area, as well as the ways of carrying them out.

3.6.2. Forest biodiversity inventories

There is no regular inventorying of nature resources in forests. Only occasional taxonomic observations are made as part of forest ecological studies. Most commonly they take into account invertebrates (insects) and the vascular plants.

The introductory extraordinary survey of natural resources on forest and non-forest areas was carried out in 1995 on the territory under the supervision of the State Forests. It registered the most important forest species (37 tree and shrub species, 247 ground vegetation species, 34 bird species and 6 mammal species). It also registered some spatial objects (nature reserves, old parks and other forest objects like e.g. seed stands), point-sites (monuments of nature and documentation stands) and other forms of nature protection (Thematic report on forest ecosystems in Poland, 2001).

3.6.3. Nature conservation at forest district level

On the level of forest district forest inventory is made to create a forest management plan. The inventory of the forest is carried out according to guidelines of forest management (Instrukcja Urzadzania lasu, 2003), which are the same for all Polish forests.

One part of the management plan is a program of nature conservation. It should include information about the values present in the forests, as well as the tasks of the nature conservation and the ways of implementing them.

According to the instruction for creating a program of nature conservation in the forest district (Instrukcja sporzadzania… 1996) the program should include:

- inventory of rare and protected species, alien species and interesting or rare forms of unanimated nature,
- inventory of the chosen stands distinguished due to their characteristics, natural values or rare forest communities,
- inventory of viewpoints, interesting landscapes, cultural sights and other interesting objects,
- inventory and description of threats to forest ecosystems.

Generally, the program includes description of all aspects that could be important from the perspective of nature conservation. In addition, it is recommended to include ecological evaluation of the state of the forest. It can contain evaluation of the tree species compatibility with the site, as well as description of the form of current site state and form of forest degeneration.

A plan for the nature conservation actions should also be included in the program. For conservation areas (reserves, landscape parks, etc.) already existing in the forest district, only preliminary recommendations for conservation actions are given. Final decision about the

management of these areas is taken in the cooperation with the Voivodship Conservator of Nature.

There was a Danish project Dancee carried out in Bialowieża Forest in Poland in 2001 where the objective was to prepare management guidelines for the Bialowieża Forest. During this project workshops for the Polish foresters were organised. The main goal of the workshops was to show the foresters different way of looking at forest, taking into account its ecological values. During workshops an indirect assessment of biodiversity was used in the forest. It had the form of the Swedish assessment, however it was shorter and simplified. There was no division into forest categories and the number of question was much lower. The assessment had been prepared in the Polish language and adjusted to Polish conditions. In this project the assessment was called “biodiversity index”. The use of the assessment was appreciated by the foresters; nevertheless it caused a discussion on the problems connected with it (Brzeziecki, 2005).

4. RESULTS FROM THE FIELD WORK

In this section results from the field work in Poland will be presented.

4.1. SCORE OF THE STANDS AND IMPORTANT FEATURES

All the stands surveyed according to the Swedish assessment got a high score, ranging from 8 to 21 points (Figure 41). Average score was 15,3 (median 15).

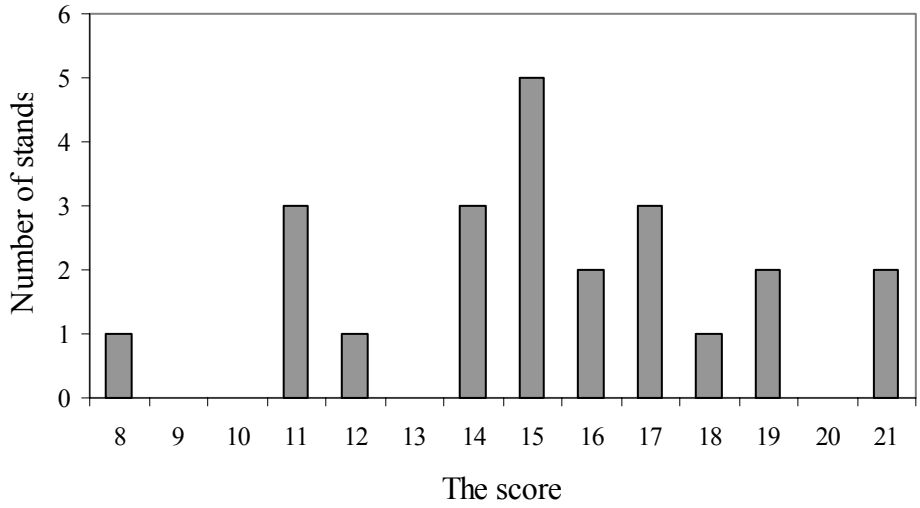

Figure 41. Number of stands with the particular score

The highest score was obtained by the stands in the forest categories W and M, the lowest – in the category F. In the particular categories, the lower score was usually connected with the lower age of the stand. Only stand 22 got a high score, despite the low age (Table 8).

Table 8. The score given in the assessment to all the surveyed stands * xerothermic pine stand

Stand	Category	Species (Share Species Age)	Score
9	F	6 Pine 149, 4 Oak (p)124, II fl: 5 Hornb 74, 4 Oak (p) 51, 1 Hornb 51	14
10	F	10 Pine 119	15
11	F	10 Pine 76	8
12	F	10 Pine 184	17
13	F	8 Pine 164, 2 Oak 56	16
17	F	7 Pine 110, 2 Pine 70, 1 Spruce 70 *	11
18	F	8 Pine 110, 2 Pine 60 *	11
23	F	6 Larch 100, 2 Sycamore 100, 2 Fir 130	15
1	B	7 Beech 347, 1 Oak (p) 347, 1 Beech 137, 1 Beech 62	21
2	B	5 Beech 152, 4 Beech 167, 1 Beech 122	15
3	B	4 Beech 133, 3 Beech 93, 2 Beech 157, 1 Beech 62	12
4	B	5 Beech 147, 1 Oak (p) 147, 1 Hornbeam 117, 1 Alder 117, 1 Ash 117, 1 Birch 117	14
19	B	7 Beech 170, 2 Fir 170, 1 Beech 100	16
20	B	6 Beech 150, 1 Fir 150, 1 Spruce 90, 1 Beech 90, 1 Sycamore 50	15
21	B	9 Beech 110, 1 Spruce 110	11
5	M	2Beech157, 1Oak(p)157, 1Beech257, 1Oak(p)257, 1Maple 82, 1Lime82, 1Hornb82, 1Larch82, 1Hornb72	18
6	M	2 Beech 80, 2 Lime 80, 2 Aspen 80, 1 Hornb 80, 1 Beech 57, 1 Hornb 57, 1 Oak (s) 127	15
7	M	2 Beech 147, 2 Oak (s) 147, 1 Hornb 107, 1 Ash 107, 1 Alder 97, 1 Ash 77, 1 Alder 77, 1 Ash 47	19
8	W	10 Alder 96	21
14	W	10 Alder 104	17
15	W	9 Alder 94, 1 Alder 66	17
16	W	Alder 74	14
22	W	6 Alder 25, 1 Salix 25, 3 Ash 45	19

Out of 74 questions in the assessment form 58 were relevant for the investigated stands. The features from the other 16 questions were not present in the stands. These questions were: 14, 15, 17, 19, 25, 26, 27, 29, 34, 35, 37, 40, 55, 56, 60 and 63. The most common features were features in the "dead wood" group. Quite common were also features in "trees", "structures" and "site" groups. Features connected with forest dynamics and habitats were not very common (Table 9 – 14).

Table 9. Occurrence of Site features

Question SITE	**Occurence**
1	12
2	2
3	2
4	2
5	3
6	4
7	9
8	8
9	5
10	1
11	6
12	2
13	4
Together	60

Table 10. Occurrence of Dynamics features

Question DYNAMICS	**Occurence**
14	
15	
16	14
17	
18	4
19	
20	8
21	7
22	4
23	4
24	2
Together	43

Table 11. Occurrence of Habitats features

Question HABITATS	**Occurence**
25	
26	1
27	
28	1
29	
30	9
31	4
32	10
33	1
34	
35	
36	1
37	
Together	27

Table 12. Occurrence of Trees features

Question TREES	**Occurence**
38	2
39	4
40	
41	8
42	6
43	3
44	4
45	2
46	21
47	5
48	11
49	3
Together	69

Table 13. Occurrence of Structure features

Question STRUCTURE	**Occurence**
50	1
51	22
52	9
53	3
54	14
55	
56	
57	4
58	4
59	5
60	
Together	62

Table 14. Occurrence of Dead wood features

Question DEAD WOOD	**Occurence**
61	17
62	1
63	
64	7
65	2
66	21
67	1
68	4
69	13
70	3
71	10
72	2
73	11
74	1
Together	93

The most common questions that gave the score were 46, 48 and 66. They concerned the size of trees and amount of small downlogs (Figure 13).

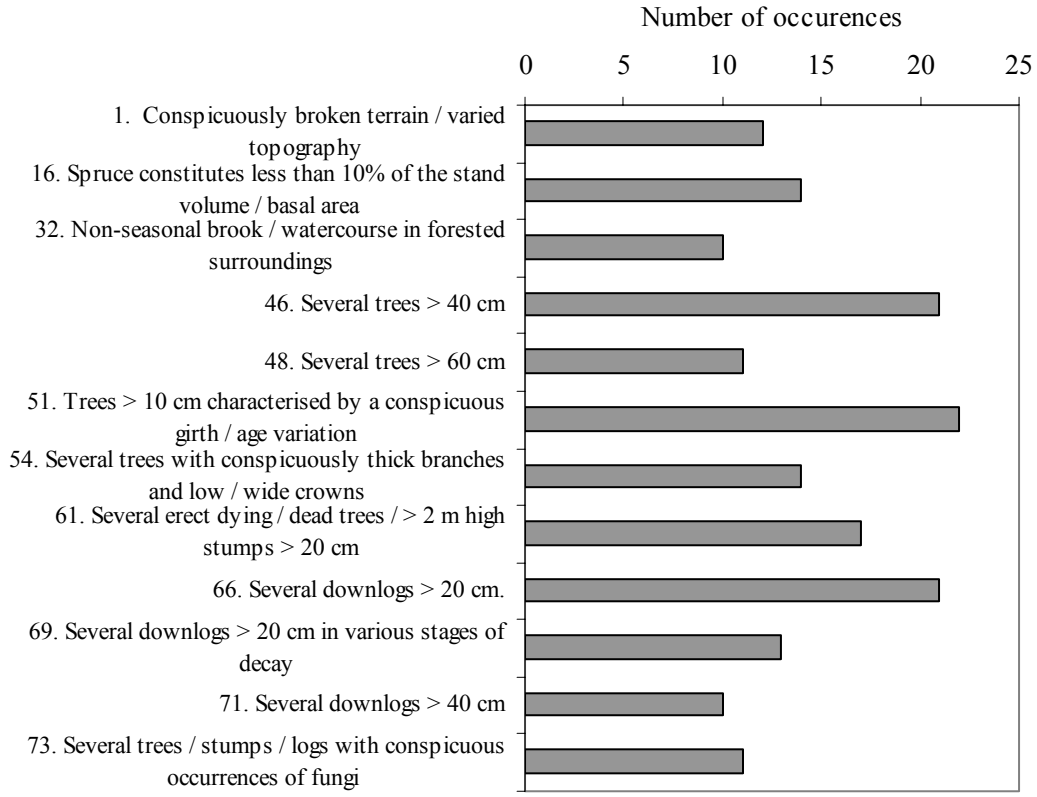

Figure 13. The most common questions that gave the score

5. DISCUSSION

5.1. THE METHODOLOGY

Assessment of biodiversity in the forest by inventory of species has many shortcomings. First of all it is costly and difficult to organise. There are few biologists that have a wide knowledge covering different groups of species; therefore teams of scientists are needed to carry out the inventories. Because of this, inventories often focus on the groups of species which are relatively easy to detect, like large animals or vascular plants. This causes negligence of other group of species. Even if the inventory tries to cover more groups of species, it is difficult to avoid overlooking species that occur sparsely in some areas or in time intervals. Moreover, scientists are often focused on the "undisturbed", old-growth forests which are believed to contain the largest amount of important species and they tend to underestimate biodiversity of sites drastically affected by natural disturbances or by human activities. In addition, species inventories usually do not involve forest managers. By this, a potential of the biodiversity assessment to educate and to be used as a management tool is lost (Drakenberg and Lindhe, 1999).

Assessing biodiversity by using indicators can be a way to avoid problems connected with species inventories. However, it is not always sure if particular groups of species are good indicators to indicate biodiversity of other groups of species. Gustafsson (2000) concludes that there is still little evidence that one group of organisms can be used to predict the occurrence of other such group.

The Swedish assessment looks for structures and processes instead for the species. This helps to avoid many limitations of traditional species inventories. An underlying assumption of the assessment is that species occur primarily in habitats that contain particular features. It focuses on sites with many niches that can provide habitat for various species. The assessment will not detect all the species, for example a presence of rare fungi on the single piece of dead wood left in the stand. It is rather a way of finding sites that have potential of being valuable habitats for many rare species. It can also help to promote features that enhance biodiversity in managed forests. The assessment is easy in use and does not demand much training before (one or two days is enough), so it can be used by ordinary foresters and managers. The assessment was created as a tool of finding stands of high ecological value. However, it soon became a tool for educating about features important for biodiversity in the forest. It can also be a good tool for operational planning over large areas. If resources are available, areas with high biodiversity potential selected with the use of the assessment can become targets for further, more detailed inventories (Drakenberg and Lindhe, 1999).

Nevertheless, there are weaknesses of the indirect methods of biodiversity assessment. There has not been much research carried out on how the score obtained in the assessment correlate with the number of rare species in the forest. However, according to the authors of the Swedish assessment, the correlation of the scoring with the species is not so important. The method is based on the common knowledge that dead wood, large broadleaves or other features like this are crucial for the rare species. Even if not many species of interest were found in the particular stand with the high score, it does not mean that the features that gave the score are not significant for the biodiversity (Drakenberg, 2005).

Other shortcoming of the method is that there is no research on how well the assessment is used by large companies and how (and if) they use the results of the assessment in the management of their forests. Other draw back of the assessment is that it is not quantitative, so it is not possible to compare assessment results with conservation targets (Angelstam and Dönz-Breuss, 2004). The Swedish assessment is also not sufficient in the situations when detailed inventory of a particular area is needed.

One of the problems concerning the indirect biodiversity assessment mentioned by foresters during the Dancee workshops in Bialowieża, was that the method is not good to assess the value of very young stands. Such stands usually do not have features important for biodiversity. They occur rather in older stands. In the case of the young stands the assessment could rather be used as a tool of showing foresters what could be done in the stand in the future. It is obvious that, for example, dead wood or old trees are not present in the very young stand. However, the management could be directed in the way to create such features in the stand in the future.

5.2. THE SWEDISH ASSESSMENT IN POLAND

Both countries are situated in the same geographical region and have similar climatic conditions, apart from the northern part of Sweden, which differs much from Poland. Vegetation zones of Poland and Sweden are the same, apart from the Boreal zone. This zone occurs only in Sweden, not in Poland. Because of similar vegetation, the same forest dynamics take place in both countries and the same disturbance regimes are crucial for the development of forest diversity. However, fire is not very important in most of Poland. It could be essential only on drier sites in the north-eastern part of the country, whereas in natural forest in Sweden this disturbance factor is in of great importance. Main forest types (after Larsson ed. 2001 b) are also more or less the same in Poland and Sweden; however there are no boreal forests in Poland and no mixed oak-hornbeam forest is present in Sweden. Nevertheless, a large area of both countries is covered by similar vegetation, due to human activities, who have introduced artificial coniferous plantations.

All the forest types presented by Larsson (ed. 2001 b) could be classified into one of the six forest categories of The Swedish assessment. Therefore the author believes that the Swedish assessment could be used both in Sweden and Poland. Yet, some adjustments are needed if the assessment is to be introduced in Poland.

There is no regular assessment of biodiversity potential of forest areas in Poland. The new protection areas can be created when some organisation, institution or private person report area that they consider as worth of being protected.

When an area for nature conservation is to be created in Poland the documentation presenting its values has to be prepared. Such documentation is usually a description of the state of the area, focusing on the values important from the perspective of nature conservation, like rare species, interesting habitats, etc. Some areas for nature conservation have to have a plan of protection. Apart from projected activities, such plan should include detailed description of the elements of nature in the area. When the forest inventory is done on the level of forest district, according to the program of nature conservation, it should include information important for the nature conservation. Also in this case, the description of important values is given.

No system of assessment of the biodiversity potential similar to the Swedish assessment was found in Poland. All evaluations of the values of forest areas are based on the description of flora, fauna, plant communities and so on. In some cases, local species inventory is carried out.

Would it be beneficial for Poland to implement the Swedish biodiversity assessment?

On one hand, there are a lot of areas for nature conservation in Poland. These areas cover over 40 % of the country. Probably there is little need of creating more areas for nature conservation. On the other hand, according to "Thematic report on forest ecosystems" prepared for the Convention on Biodiversity (2001), there is "a need for periodical inventorying of nature resources in forests and forest land". The need exist not only for managed forests but also for forests under less strict forms of protection (like landscape parks, protected landscape areas and others). Natural values of national parks and of many nature reserves are usually well inventoried and described.

Even if over 40 % of the area of Poland is more or less protected, some valuable areas may still not be discovered. It is easy to miss a small valuable area, especially when it is located in the managed forest. However, costly and time consuming species inventories in all managed forests to find such areas seem pointless. The Swedish assessment could be a tool of selection of valuable areas in the managed forests. After choosing valuable areas with the help of the assessment, further, more detailed investigation of the area, as well as species inventory could be carried out.

The author believes that the Swedish assessment could be included into programs of nature conservation of the forest districts in Poland. By now, the individual description of each area should be done in the district, according to special guidelines, which seems very costly and time consuming. The Swedish assessment would be a very good tool for finding areas that are valuable for biodiversity on the level of a forest district. If such area is found using the assessment, further detailed inventory could take place. In addition, the Swedish assessment included into a program of nature conservation could have educational role. Experience from the workshops organised in Bialowieża in 2001 shows that such assessment was appreciated by foresters as an education tool. During the workshops foresters discussed also the problems connected with the assessment. An important issue was a problem of taking into account forest dynamics. The question was how to use the assessment in the clear-cut management system. It was argued that in such system, the young forest after clear-cut will have very low value, according to the score of the assessment.

The assessment can also be an indirect tool for the management in the forest. When using the assessment, the forester learns which features are crucial for forest biodiversity. By, for example, implementing particular silviculture methods such features can be promoted. If the foresters use the assessment, they will learn which features are important for biodiversity and which silvicultural systems could create such features. There are many types of cutting in Poland; nevertheless, clear-cuts are still the most common type. The use of the Swedish assessment could make Polish foresters realise what they can do to improve biodiversity of the forest. The important question is the use of the assessment in the forest managed by the clear-cutting system. In young stands managed this way, the score given by the assessment would be very low. However, as mentioned before, the knowledge about the features important for biodiversity gained when using the assessment, can help foresters to plan their management the way that will improve the scoring in the future.

The Swedish assessment could also be a tool of selecting forest NATURA 2000 areas. In Poland there is still no full network of NATURA 2000 created. The assessment could be a helpful tool for large-scale operational planning of such areas.

To implement the Swedish assessment in Poland, some adjustments must be made. When using the Swedish assessment in Polish forests some differences between Polish and Swedish natural conditions were realised.

One problem that occurred when using the Swedish assessment in Poland was connected with the classification of stands to particular forest category. Because of the fact that the assessment is adapted to Swedish conditions, two stands (24 and 25) fall outside the scope of it. These are stands with silver fir and some beech and sycamore. To include fir-dominated stands in the assessment quite a lot of adjustments would need to be done. Because of climatic conditions fir seldom grow in Sweden and therefore fir dominated stands are not included in the Swedish assessment. To adjust the Swedish assessment to Polish conditions, more forest categories would have to be added, like for example such silver fir-dominated stands.

On the other hand, most of Sweden belongs to boreal vegetation zone where many stands are in natural conditions maintained by fires. Even if Poland is covered by almost 70 % by pine, in most of the country fire was naturally not a main disturbance regime. Only in north-eastern Poland fire had some importance. In none of the investigated stands signs of fire were found (questions 14 and 15 of the assessment). On the other hand there for sure are some areas where fire used to be a natural disturbance regime (Drakenberg, 2005). These could be places located more east or on the poor, sandy soils. In such places assessment questions concerning fire could be relevant. However, more knowledge is needed about the natural occurrence of fire in Poland. In addition, the use of the assessment by the Polish foresters could make them realise that in some stands fire is important disturbance and not always an enemy that should be fight by all means.

The author also thinks that it is difficult to compare the scores from the mountain and lowland stands. For example, in the forest category W (alder stands) stand 22 located in the mountains got about the same score as lowland stands, even if it was much younger. When taking only lowland alder stands, it can be seen that the lower age of the stand, the lower the score. But this relation cannot be seen in case of the mountain stand 22. That is why the author believes that the same assessment form cannot be used both in the mountain and lowland stands. There should be some adjustments that would change the assessment for the use in the mountains. Such adjustments should include features that are important in mountain forests, for example different terrain types, age and size aspects and so on. Otherwise there were no big problems with the use of the assessment in Poland. However, it must be remembered that only three national parks were visited and 25 stands surveyed using the assessment. More problems may occur, if more stands were investigated.

Some representatives of the visited national parks showed great interest in the assessment and asked a lot of questions about it. It looks like some Polish parks would be very interested in the implementation of the assessment in their areas. Some park representatives had also interesting comments and suggestions about the assessment. In Pieniny National Park they were wondering on the practical use of the assessment. They though that there should be some scale of the score that would allow not only to compare different stands but also to give precise recommendations about their management. They meant by this that particular score should mean particular management recommendations. This is a question to discuss if such

strict guidelines should be prepared for the use of the assessment. However, the author believes that, depending on circumstances, sometimes it is good to have precise rules, but sometimes it is better if the rules are more flexible and possible to adjust to situation.

If the Swedish assessment were to be introduced in Poland, it could be done step-wise. First, workshops introducing the assessment could be organised for the foresters. Later, the project of implementation of the assessment in the whole country could be prepared and tested. The assessment could be first introduced in the Promotional Forest Complexes. The Complexes were created to promote sustainable forestry and to test new methods and technologies. The author believes that they would be a perfect location for the tests of the Swedish assessment in Poland. During the first steps of the assessment implementation more research is needed on its use in Poland.

5.3. SCORE OF THE STANDS AND IMPORTANT FEATURES

The stands chosen for the assessment were, according to representatives of the parks, representing high conservation value. The result of the Swedish assessment also showed high value of the stands. This confirmed that the assessment could be used in Polish high conservation forests. The score obtained by the stands was high, which shows high potential biodiversity or, in other words, high value. There are of course differences between scoring in various forest categories. For the stand in F category 14 – 15 points mean high value, whereas for example for category W such score is not so high. In this case the score about 18 – 20 points means high value (Drakenberg, 2005).

The lower score in particular categories was connected with the lower age of the stands. It is understandable, because in younger forest less features crucial for biodiversity occur. Only the stand 22 obtained a high score (on the same level as other stands), despite its low age. It can probably be explained by the fact that this stand was located in the mountains and it seems not possible to compare mountain and lowland stands using the same assessment form.

The most common features that occurred in the stands were features belonging to the "dead wood" group of features. There was much dead wood, both standing and lying, in the stands. This result is rather surprising, because it was reported by Pawlaczyk and Knysak (2005) that dead wood in amounts sufficient for high biodiversity is missing in the national parks of Poland. Even during Dancee workshops in Bialowieza dead wood was the feature that was most commonly lacking in the forest (Brzeziecki, 2005). However, no score was given in any stand for the question 63 – substantial amounts of erect dying / dead trees / > 2 m high stumps > 20 cm. The dead wood occurred only in the amount called "several". In addition, many of the stands were situated in strict reserves and, according to Pawlaczyk and Knysak (2005) sufficient amount of dead wood can only be found in national parks within strict reserves.

Not much score was given for the features in the "habitats" group of features. This group mostly contains features that are connected with the terrain characteristic (like sloping forest or water bodies). Such features usually occur randomly in the forest and cannot be influenced by forest management. The same remark can be related to the "site" group of features. The features in "dynamics" group were also not given much scores. This group contains features connected with fire, which is not a common disturbance regime in Poland. Other features in this group concern very specific aspects (for example coppicing or inundation) that can be

related only to particular forest categories. That is why they do not give score for many stands.

For the research tree national parks that differ in landscape and types of stands were chosen. However, it must be remembered that only 25 stands were investigated, so the results can not be representative for the whole Poland. Nevertheless, they can give some insight on the important features occurring in Polish national parks.

5.4. LIMITATIONS OF THE WORK

The author's first idea for this work was to investigate both high value stands in the national parks and "normal" managed stands. Then it was planned to check, if the high value stands gave higher score in the Swedish assessment than the "normal" managed stands. After visiting one "normal" stand, the author resigned from this approach. It was pointless to visit many managed stands, because it seemed obvious that all of them will get very low score (probably between 3 and 5). "Normal" managed forest in Poland usually is not very old, has almost no dead wood and its history is usually a history of long-term "normal" forestry management. Therefore, the only score it can get is from the randomly occurring terrain features.

Another idea was to compare stands in the national parks to each other. The author planned to do it by creating some kind of scale on which the stands could be situated. Then it could be seen if stands of a little lower value (according to author's scale) get fewer points in the Swedish assessment than the stands of a little higher value. Also this approach failed, because it was very difficult to create any scale, based on the information about particular stands. In Poland there is no assessment of value of the forest that would allow comparing particular stands to each other. The only information that can be obtained, is data from forest inventories. If there are some particularly important values in the forest, it can be protected. However, even if the forest is protected, the only information available about it is that the forest has "a high value", but there is no scale how high this value is.

5.5. FUTURE RESEARCH

More research is needed on the use of the Swedish assessment in Polish conditions. More field tests should be done, also in other parts of Poland and not necessarily only in national parks. Research is also needed on the correlation between the high score of the assessment and the "real" biodiversity (the number of species) in Poland.

6. CONCLUSIONS

1. The Swedish assessment could be used in Polish conditions, because of similar geographical conditions and vegetation zones in Poland and Sweden.
2. The Swedish assessment could be introduced in Poland as a part of the programs of nature conservation in forest districts, as a tool of selection of valuable stands that could be intended for further investigation. It could also be used as a tool of selection of the NATURA 2000 areas.
3. The field test in Poland confirmed that the Swedish assessment could be used in Polish high conservation forests.
4. The most common features found in high value forests in Poland were connected with the occurrence of dead wood.
5. More research is needed if the Swedish assessment is to be used in Polish conditions.

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8. REFERENCES

8.1. LITERATURE

Angelstam, P. 1998. Composition of boreal forest in a forest history gradient. In: Gustafsson, L., Weslien, J.-O., Palmer, C.H., Sennerby-Forsse, L. (eds.) 1998. Biodiversity in managed forests – concepts and solutions, Sweden 1997. SkogForsk, Report No.1

Angelstam, P. 2002. Reconciling the linkages of land management with natural disturbance regimes to maintain forest biodiversity in Europe. I: J. A. Bissonette and I. Storch, eds. Landscape ecology and resource management: linking theory with practice. Island Press, Covelo CA and Washington, D.C., 193-226.

Angelstam, P., Dönz-Breuss, M. 2004. Measuring biodiversity at the stand scale – an evaluation of indicators in European forest history gradients. Ecological Bulletins 51: 305-332

Bengtsson, J., Nilsson, S.G., Franc, A., Menozzi, P. 2000. Biodiversity, disturbances, ecosystem function and management of European forests. For.Ecol.Manage. 132, 39-50

Bradshaw, R. The long-term control of forest biodiversity. 1998. In: Gustafsson, L., Weslien, J.-O., Palmer, C.H., Sennerby-Forsse, L. (eds.) 1998. Biodiversity in managed forests – concepts and solutions, Sweden 1997. SkogForsk, Report No.1

Drakenberg, B., Lindhe, A. 1999. Indirekt naturvärdesbedömning på beståndsnivå – en praktiskt tillämpbar metod. Skog och Forskning 2. English version, Field assessment of forest ecological values – a structures and substrates approach at the stand level, can be found at the web-page: http://www.ssc-forestry.com/skogsbiologerna/default.asp

Diekmann, M. 1994. Deciduous forest vegetation in Boreo-nemoral Scandinavia. Acta phytogeographica Suecica, 80

Essen, P.-A., Ehnström, B., Ericson, L. And Sjöberg, K. 1997. Boreal forests. Ecological Bulletins 46: 16:47

Ellenberg, H. 1988. Vegetation ecology of central Europe. Fourth edition. Cambridge University Press

Faliński J.B. 1986. Vegetation dynamics in temperate lowland primeval forests. Geobotany 8. Dr W. Junk Publishers.

Gamborg, C., Larsen, J.B. 2003. „Back to nature" – a sustainable future for forestry? Forest ecology and management 179: 559-571

Gustafsson, L. 2000. Indicators and assessment of biodiversity from a Swedish forestry perspective. SkogForsk, Report No.1

Kruys, N. 1998. Dead trees in a managed boreal landscape: a survey of quality and quantity. In: Gustafsson, L., Weslien, J.-O., Palmer, C.H., Sennerby-Forsse, L. (eds.) 1998.

Biodiversity in managed forests – concepts and solutions, Sweden 1997. SkogForsk, Report No.1

Larsson, J. 2001 a. Evaluation of the Forest Biodiversity Potential Method – An Indirect Biodiversity Assessement. Master thesis nr 70. Instututionen för naturvårdsbiology, SLU, Uppsala

Larsson, T.-B. (ed.) 2001 b. Biodiversity evaluation tools for European forests. Ecological Bulletins 50

Matthews, J.D. 1989. Silvicultural systems, Clarendon Press, Oxford.

Matuszkiewicz, W. 2002. Przewodnik do oznaczania zbiorowisk roslinnych Polski. Vademecum geobotanicum. Wydawnictwo Naukowe PWN

McCarthy, J. 2001. Gap dynamics of forest trees: A review with particular attention to boreal forests. Environ. Rev. 9: 1-59

Medwecka-Kornaś, A. 1994. Ochrona flory i roślinności na obszarach leśnych: stan i zadania. Ochrona Przyrody 51: 3-21

Nilsson, S.G., Hedin, J., Niklasson, M. 2001. Biodiversity assessment in boreal and nemoral forests. Scand. J. For. Res. Suppl. 3: 10-26, 2001

Pawlaczyk, P. Knysak, R. 2005. Lasy parków narodowych a organizmy związane z martwym drewnem. Czy polskie parki narodowe skutecznie chronią rożnorodność biologiczną ekosystemow leśnych? Parki Narodowe, 1: 2-8

8.2. OTHER REFERENCES

Brzeziecki, B. 2004. Szkoła Główna Gospodarstwa Wiejskiego. Warsaw, Poland. Personal communication

Drakenberg, B. 2005. Skogsbiologerna AB. Uppsala, Sweden. Personal communication

Gustafsson, L. 2005. Swedish University of Agricultural Sciences. Sweden. Personal communication

Instrukcja Urzadzania lasu. 2003 (Guidelines of Forest Management)

Instrukcja sporządzania programu ochrony przyrody w nadleśnictwie. 1996. Ministerstwo Ochrony Środowiska, Zasobów Naturalnych i Leśnictwa, Warszawa, Polska

Kamiński, M. 2004. Wigierski Park Narodowy. Poland. Personal communication

Pawlaczyk, P. 2005. Lubuski Klub Przyrodników. Poland. Personal communication

Raport Roczny – Państwowe Gospodarstwo Leśne Lasy Państwowe. 2003 (Annual Report The State Forests National Forest Holding)

Rozporządzenia Ministra Środowiska w sprawie rocznych zadań ochronnych dla parków narodowych. 2004

Thematic Report on forest ecosystems in Poland for the Convention on Biodiversity. 2001. Ministry of Environment, Poland

Tracz, W. 2004. Szkoła Główna Gospodarstwa Wiejskiego. Warsaw, Poland. Personal communication

Ustawa o ochronie przyrody. 2004. Act on Nature Conservation 2004. Dz.U. z 2004 r. Nr 92, poz. 880. Poland

Zarządzenie nr 11a (Decree no 11 a) Dyrektora Generalnego Lasów Państwowych z dnia 11 maja 1999 r. zmieniające Zarządzenie Nr 11 Dyrektora Generalnego Lasów Państwowych z dnia 14 lutego 1995 roku w sprawie doskonalenia gospodarki leśnej na podstawach ekologicznych. 1999. Poland

Zasady hodowli lasu. 2000 (Sylvicultural Principles)

8.3. WEB PAGES

Krajowy Zarząd Parków Narodowych (National Board of National Parks) – http://www.mos.gov.pl/kzpn/ind_gb.htm

Lasy Panstwowe (State Forests) – http://www.lp.gov.pl/

Główny Urząd Statystyczny (Polish Official Statistics) – www.stat.gov.pl

APPENDIX 1

Description of the investigated stands

Figure 14. Stand 1, large dimensions trees.

Figure 15. Stand 1, dead wood.

Figure 16. Stand 2, large beech trees.

Stand 1 (Figure 14 and 15)

Very old beech stand with some penduculate oak (10 %); under strict protection; very large dimensions of trees; trees of different age and diameters; terrain surrounded by beech forests; a lot of signs of woodpeckers' activity; much dead wood, most of it of large dimensions, both standing and lying; many trees, stumps and logs with conspicuous occurrence of fungi.

Stand 2 (Figure 16)

Old beech stand; located on quite steep slope (N – NE) by the river Drawa; not a strict reserve, but not much managed either, since it is located in a steep terrain (slope); trees of large dimensions; quite much dead wood both standing and lying but not so large (only several above 40 cm); almost no occurrence of fungi.

Stand 3 (Figure 17)

Old beech stand; a few penduculate oaks and hornbeams; not a strict reserve and a flat area, a quite managed stand which can be seen in the absence of dead wood; there was some dead wood, but not much and not of large dimensions; rather big trees (tree layer composed of trees over 60 cm) and large variation in the diameters; several stems with mosses, but no fungi occurrence.

Figure 17. Stand 3, flat area.

Stand 4 (Figure 18)

Old beech stand (50 % of beech) with some penduculate oak, hornbeam, alder, ash and birch; large variation of the trees' diameters; stand by the river on the S-W slope (not very steep); sun exposed; it looked like part of it was flooded sometimes; quite much dead wood, both standing and lying, but usually decomposed much and not very large dimensions (none over 40 cm); some trees, stumps or logs with conspicuous occurrences of fungi; natural regeneration, mostly age 40 – 70: beech, hornbeam, alder, aspen, Salix, birch.

Figure 18. Stand 4, large variation of the trees' diameters.

Stand 5 (Figure 19)

Old mixed stand with beech, penduculate oak, maple, lime, hornbeam and larch; located on the very steep slope by the river; not a strict reserve, but because of terrain conditions, almost not managed; seasonally some part of the forest is flooded by water; trees of large dimensions; some dead wood, both standing and lying, but not large dimensions (only several downlogs over 40 cm); some trees, stumps or logs with conspicuous occurrences of fungi.

Figure 19. Stand 5, trees of large dimensions.

Figure 20. Stand 6, a slope by the river.

Stand 6 (Figure 20)

Mixed stand, not very old; composed by beech, lime, aspen, hornbeam and sessile oak; located on the very steep slope by the river; surrounded by the broadleaved forests; large differentiation of trees diameters; not very large tree dimensions; some dead wood, but not very much and no large dimensions; some trees, stumps or logs with conspicuous occurrences of fungi.

Figure 21. Stand 7, a large downlog.

Figure 22. Stand 8, coppice.

Figure 23. Stand 9, pine with oak.

Stand 7 (Figure 21)

Quite old mixed stand composed by beech, penduculate oak, hornbeam, ash and alder; located on the slight slope, by the river (and water power plant); large variation in trees diameters; quite much dead wood, both standing and lying, also large dimensions (several downlogs over 60 cm); a few very old, rotten high stumps; some trees stumps or logs with conspicuous occurrences of fungi; a lot of signs of woodpeckers activity.

Stand 8 (Figure 22)

Alder stand almost 100 years old; located on the slope by the river; surrounded by the forest buffering local climate; site characterized by very wet forest, seasonally inundated; many trees on buttresses; signs of former coppice activities; site characterised by a conspicuous herb component; large variation in trees diameters; several stems with conspicuous occurrences of mixed mosses; some dead wood, but not very much and not large dimensions (several downlogs over 40 cm); a lot of signs of woodpeckers activity.

Stand 9 (Figure 23)

Quite old pine (60 %) stand with an admixture of penduculate oak (40 %) and with second floor composed by hornbeam and oak; located on the slight slope, going down to wetland area; surrounded by pine and broadleaved forest; large variation in trees diameters; little dead wood and only small dimensions; some blueberries and junipers; a lot of signs of woodpeckers activity.

Stand 10 (Figure 24)

Pine stand; located on the sand dunes; surrounded by the pine forests; large variation in trees diameters; under pine a lot of stunted oak with very low, wide

crowns; quite much dead wood, especially lying on the ground, but with not very large dimensions (up to 30 – 35 cm); no occurrence of fungi; much blueberry and junipers (up to 1 m high).

Stand 11 (Figure 25)

Rather young (76 years) pine stand; located on the very flat area on sandy soils; surrounded by the pine forests; large variation in trees diameters; many stunned trees and much dead wood, but small dimensions (most below 20 cm); quite much oak trees (below 10 cm diameter); much blueberry.

Stand 12 (Figure 26 and 27)

Old pine stand; a little oak under pine; stand located on the sand dune; surrounded by the pine forests; in the stand large area of sandy, sun-exposed, sparsely vegetated ground; many of the trees over 50 cm; large variation in trees diameters; some dead wood both standing and lying, however not very much; several downlogs over 40 cm; some trees stumps or logs with conspicuous occurrences of fungi; much Cladonia lichens, Calluna dwarf shrubs and juniper shrubs (very large); a lot of signs of woodpeckers activity.

Figure 26. Stand 12, large junipers.

Figure 24. Stand 10, stunned oak under pine.

Figure 25. Stand 11, young pine.

Figure 27. Stand 12, sun-exposed, sparsely vegetated ground.

Stand 13 (Figure 28)

Old pine stand with admixture of penduculate oak (20 %); located on a flat area of sandy soils; surrounded by pine forests; substantial amounts of trees over 40 cm, many pines about 50 cm; large variation in trees diameters; many stunted oaks; quite much dead wood, both standing and lying, but not very large dimensions (up to 30 cm); some trees stumps or logs with conspicuous occurrences of fungi; much blueberries; a lot of signs of woodpeckers activity.

Figure 28. Stand 13, large pine tree.

Stand 14 (Figure 29)

Alder stand over 100 years old; located by the ditch from the 20s of twentieth century, which floods the surroundings in the spring; site characterised by very wet forest; surrounded by mixed forests with pine, oak and hornbeam; substantial amounts of trees on buttresses; conspicuous herb component; signs of former coppicing activities (many trees); large variation in trees diameters but not many large trees (several trees over 40 cm); not much dead wood and only small dimensions (below 40 cm).

Figure 29. Stand 14, trees on buttresses.

Figure 30. Stand 15, wet alder forest.

Stand 15 (Figure 30)

Alder stand, a little below 100 years old; located by the ditch, flooded seasonally, very wet; surrounded by alder forests; substantial amounts of trees on buttresses; conspicuous herb component; signs of former coppicing activities (some trees); large variation in trees diameters but not many large trees (several trees over 40 cm); quite much dead standing wood, but not much dead lying logs; some fungi on trees but not large polypore; a lot of signs of woodpeckers activity.

Stand 16 (Figure 31)

Quite young (74 years) alder stand; located by the ditch, flooded by it; very wet forest; surrounded by mixed forest with pine and hornbeam; substantial amounts of trees on buttresses; conspicuous herb component; signs of former coppicing activities (some trees); not many large trees (several trees over 40 cm); not much dead wood, only several logs over 20 cm; some trees stumps or logs with conspicuous occurrences of fungi.

Figure 31. Stand 16, high stump.

Stand 17

Xerothermic, dry pine forest, similar to stand 18, but with over 10 % of spruce; located on he very steep slope; on the S – SW facing slope (steeper then 15 %); with small stream going through it; on lime-rich soils; dense spruce undergrowth under the pine; site characterised by a conspicuous component of *Lonicera*; large variation in trees diameters but not many large trees (several trees over 40 cm); several trees with conspicuously thick branches and wide crowns; very little dead wood (several downlogs over 20 cm); occurrence of hazel and small junipers.

Figure 32. Stand 18, steep slope.

Stand 18 (Figure 32 and 33)

Xerothermic, dry pine forest; located on he very steep slope; on the S – SW facing slope (steeper then 15 %); close to the river Dunajec; on lime-rich soils; scree-slope covering about 10 % of the area, sun exposed and sparsely vegetated; large variation in trees diameters; no trees of large dimensions (none over 40 cm); several trees with conspicuously thick branches and wide crowns; not much dead wood (several downlogs over 20 cm); much junipers but not higher then 1,5 m; other shrubs over 2 m.

Figure 33. Stand 18, scree-slope.

Stand 19 (Figure 34)

Old beech stand with 20 % of fir; located on a quite steep slope (steeper than 15 %), N – NE facing; surrounded by beech forest; several canopy gaps less than 0,1 ha with natural regrowth of main species; large trees (several over 60 cm), many with multiple stems; large variation in trees diameters, some trees are much larger then the stand in general; several trees with conspicuously thick branches and wide crowns; quite much dead wood, both standing and lying, however not extremely much; several stems with conspicuous occurrence of mixed mosses; some trees, stumps or logs with conspicuous occurrences of fungi.

Figure 34. Stand 19, a large beech tree.

Stand 20 (Figure 35)

Old beech stand with some fir, spruce and sycamore; located on a slight slope; several canopy gaps less than 0,1 ha with natural regrowth of main species; beech of large dimensions (several tress over 60 cm); several large sycamores (over 40 cm); large variation in trees diameters, some trees are much larger then the stand in general; several trees with conspicuously thick branches and wide crowns; quite much dead wood but not extremely much, some windthrown trees with upturned roots; several hazel bush over 2 m.

Figure 35. Stand 20, beech with fir under.

Figure 36. Stand 21, a windthrown tree with upturned roots.

Stand 21 (Figure 36)

Quite old beech stand with some admixture (10 %) of spruce; located on a quite steep slope (steeper than 15 %), N – NE facing; by the spring brook in the forested surroundings; 15 years old fir regrowth under the main stand; neighbouring with the open area on the west; large variation in trees diameters; several trees with conspicuously thick branches and wide crowns; not much dead wood and not very large dimensions, only several downlogs and standing dying trees over 20 cm; some windthrown trees with upturned roots.

Figure 37. Stand 22, a large ash tree.

Stand 22 (Figure 37)

Quite young alder stand with 30 % ash (20 years older than alder); small and rather narrow; located by the stream; large dimensions of ash, average 30 – 40 cm, some almost 60 cm; one large conspicuous hollow tree; site characterised by wet forest; site characterised by a conspicuous herb component; large variation in trees diameters; several trees with conspicuously thick branches and wide crowns; several stems with conspicuous occurrence of mixed mosses; not much dead wood, only several downlogs over 20 cm; some trees, stumps or logs with conspicuous occurrences of fungi; under main trees many bushes of Salix species; several hazel bush over 2 m.

Figure 39. Stand 24, dead wood.

Figure 38. Stand 23, a larch tree and dead wood.

Stand 23 (Figure 38)

Quite old larch stand (60 %) with 20 % of fir and 20 % of sycamore; located on the slight slope; surrounded by the forest with beech, fir and sycamore; with an area over 0,1 ha of forested rocky outcrop and with large boulders over 2 m high; large variation in trees diameters; trees of large dimensions, most of them over 40 cm, several over 60 cm; quite much dead wood both standing and lying, also of large dimensions (several downlogs over 40 cm); some trees, stumps or logs with conspicuous occurrences of fungi; many signs of woodpeckers activity.

Stand 24 (Figure 39)

Old fir stand with 30 % of beech and some sycamore; located on the quite steep slope (over 15 %), N – NE facing; surrounded by forest with beech, fir, larch and sycamore; large variation in trees diameters; trees of large dimensions, most of them over 40 cm, several over 60 cm; much dead wood both standing and lying, also of large dimensions (several downlogs over 40 cm); some trees, stumps or logs with conspicuous occurrences of fungi; many signs of woodpeckers activity.

Stand 25 (Figure 40 and 41)

Quite old fir stand with admixture of beech (10 %); located on a slope in the ravine over 10 m deep; by the stream; surrounded by forest with beech and fir; with many large boulders higher then 2 m; large variation in trees diameters; trees of large dimensions, most of them over 40 cm, several over 60 cm and even over 100 cm; several stems with conspicuous occurrence of mixed mosses; much dead wood both standing and lying, also of large dimensions (several downlogs over 40 cm); some windthrown trees with upturned roots; substantial amount of trees, stumps or logs with conspicuous occurrences of fungi; many signs of woodpeckers activity.

Figure 40. Stand 25, a large fir tree.

Figure 41. Stand 25, dead wood with fungi.

APPENDIX 2

Nemoral version of the Swedish assessment (original)

Part 1 (left side of the assessment)

NATURVÄRDESBEDÖMNING AV SKOGSMARK

STÅNDORT	N	O	B	Ä	V	K
1. lögonfallande bruten terräng / varierad topografi / höjdskillnader	○	○	○	○		○
2. Lodrätt klippa / sluttande rasbrant > 10 m hög		○	○	○		
3. Skogklädd / skogsomgiven klyfta / ravin > 10 m djup	○		○	○	○	○
4. Ståndorten ligger i en S – SV-exponerad sluttning brantare än 15% (3:20)		○				○
5. Ståndorten ligger i en N – NV-exponerad sluttning brantare än 15% (3:20)			○			
6. Ståndorten ligger på sandmark / sanddyner		○				
7. Ståndorten omges av skog / terräng/ vatten som ger ett skyddat lokalklimat	○		○	○	○	
8. Ståndorten omges av skog som domineras av lövträd / tall		○	○	○		
9. Ståndorten består huvudsakligen av fuktig / blöt, skogklädd mark					○	
10. Område > 0,1 ha med skogklädd hällmark / mark med grunt jorddjup		○	○	○		○
11. lögonfallande mängder av örter / måbär / skogstry / olvon / tibast	○	○	○		○	○
12. Kalk- / hyperit-rik mark / iögonfallande mängder av orkidéer / blåsippor	○	○	○	○	○	○
13. lögonfallande mängder med blåbär / övriga risväxter		○				○
DYNAMIK						
14. Spår efter skogsbrand på träd / stubbar	○	○				
15. Nyligen bränd yta > 0,1 ha med levande / döende / dött trädskikt	○	○				
16. Skogsområde > 0,1 ha där trädskiktet inte påverkats av sentida störning	○					
17. Gran utgör mindre än 10% av beståndets volym / grundyta		○		○	○	
18. Påtagligt med toppbrott / spår efter tidigare toppbrott på träd > 10 cm		○				
19. Flera krontaksluckor under 0,1 ha med naturlig återväxt av huvudträdslag			○	○	○	
20. Tjockt och iögonfallande mosstäcke på stenar och block			○	○	○	
21. lögonfallande spår av hackspettar på träd / död ved	○	○	○	○	○	○
22. Spår av säsongsvisa översvämningar i skogklädd omgivning		○		○	○	○
23. Påtagligt med träd på iögonfallande socklar					○	○
24. Spår av äldre – pågående bete / slåtter / hamling / skottskogsbruk				○	○	○
25. Pågående bete / slåtter / hamling / skottskogsbruk						○
26. Sammanlagt > 0,1 ha sandig, solexponerad och kal / glest bevuxen mark	○	○				
MILJÖER						
27. Skuggad > 2 m hög lodvägg beväxt med en blandning av olika mossor	○	○	○	○	○	○
28. Blockrikt område > 0,1 ha / flera block högre än 2 m	○	○	○	○		○
29. Område > 0,1 ha med mestadels fuktig / blöt skog	○	○	○	○		○
30. Område > 0,1 ha med tydligt sluttande, mestadels fuktig / blöt skog	○		○	○	○	
31. Område > 0,1 ha präglat av högvuxna örter / tuvade ormbunkar			○	○	○	○
32. Skog i kontakt med öppet vatten / våtmark > 0,1 ha	○	○	○	○	○	○
33. Källa / källflöde i skogklädd omgivning	○	○	○	○	○	○
34. Mestadels vattenförande bäck / å / älv i trädbevuxen omgivning	○	○	○	○	○	○
35. Som ovan och med iögonfallande slingrande (meandrande) lopp	○	○	○	○	○	○
36. Strömsträcka / vattenfall i skogklädd omgivning	○		○			
37. Öppen / halvöppen, icke-odlad mark > 0,1 ha med örter/gräs/ ljungväxter	○					○
38. lögonfallande och solexponerat skogsbryn med örter / buskar / småträd	○			○	○	○
39. Ihåligt, innanmurket träd / fågelbo av grova kvistar / flera bohål	○	○	○	○	○	○
40. Flera ihåliga, innanmurkna träd	○	○	○	○	○	○
Nemoral version Sydligaste Götaland **STÅNDORTSPOÄNG**						

Part 2 (right side of the assessment)

NATURVÄRDESBEDÖMNING AV SKOGSMARK

TRÄD	N	O	B	Ä	V	K
41. Flera hasselbuskar / idegranar > 2 m höga	○		○	○	○	○
42. Påtagligt med enar / buskar > 2 m höga	○	○			○	○
43. Som ovan och i öppna, solexponerade lägen						○
44. Flera hagtorn / oxel / fågelbär / krikon / vildapel / getapel / benved > 10 cm	○			○		○
45. Påtagligt med asp / sälg / rönn / ek > 10 cm	○	○			○	○
46. Påtagligt med alm / lind / lönn / ask > 10 cm			○	○	○	
47. Påtagligt med ädellövträd > 20 cm	○	○			○	
48. Flera alm / lind / lönn / ask > 40 cm	○		○	○	○	○
49. Flera ädellövträd > 40 cm	○	○			○	
50. Flera träd > 40 cm	○	○	○	○	○	○
51. Påtagligt med träd > 40 cm	○	○		○	○	
52. Flera träd > 60 cm	○	○	○	○	○	○
53. Flera träd > 100 cm			○			
STRUKTUR						
54. Krontaket utgörs av mer än 5 olika trädarter exkl. gran och tysklönn				○		○
55. Trädskiktet präglas av iögonfallande diameter- / åldersspridn (träd > 10 cm)		○	○	○	○	
56. Flera träd är iögonfallande äldre / grövre än beståndet i övrigt	○	○	○	○	○	○
57. Trädskiktet präglas av mycket grova träd > 60 cm			○	○		
58. Flera träd med iögonfallande grova grenar och vida / låga kronor	○	○	○	○	○	○
59. Som ovan och i öppna, solexponerade lägen	○	○				○
60. Påtagligt med träd med iögonfallande grova grenar och vida / låga kronor	○		○	○		○
61. Flera solitärträd > 60 cm	○					○
62. Påtagligt med senvuxna / krumma träd / krattskog > 10 cm	○	○	○		○	○
63. Påtagligt med basalt flerstammiga träd / skottskog > 10 cm					○	○
64. Flera träd med iögonfallande förekomster av blandade mossor/lavar/*Lobaria*	○	○	○	○	○	○
65. Flera träd med iögonfallande förekomster av busk- / hänglavar		○	○		○	○
66. Öppet / halvöppet krontak / flera iögonfallande myrstackar						○
DÖD VED						
67. Flera stående döende / döda träd / > 2 m högstubbar > 20 cm	○	○	○	○	○	
68. Som ovan och i öppna, solexponerade lägen	○	○		○		○
69. Påtagligt med stående döende / döda träd / > 2 m högstubbar > 20 cm	○	○	○	○	○	○
70. Flera vindfällen med rotvältor	○	○	○		○	
71. Flera rötbrutna träd			○	○	○	
72. Flera lågor > 20 cm.	○	○	○	○	○	○
73. Som ovan och i öppna, solexponerade lägen	○	○				○
74. Flera lågor > 20 cm med blandat, delvis sammetsaktigt (lever-)mosstäcke			○	○	○	
75. Flera lågor > 20 cm i varierande grad av nedbrytning / förmultning		○	○	○	○	
76. Påtagligt med lågor > 20 cm	○	○	○		○	
77. Flera lågor > 40 cm	○	○	○	○	○	○
78. Flera lågor > 60 cm	○		○	○		○
79. Flera träd / lågor med iögonfallande förekomster av svampar	○	○	○	○	○	○
80. Påtagligt med träd / lågor med iögonfallande förekomster av svampar		○	○	○	○	
Skogsbiologerna AB © Nemoralexcel2002.xls **BESTÅNDSPOÄNG**						

APPENDIX 3

Boreal version of the Swedish assessment (original)

Part 1 (left side of the assessment)

NATURVÄRDESBEDÖMNING AV SKOGSMARK

STÅNDORT	N	O	S	Ä	V	K
1. lögonfallande bruten terräng / varierad topografi / höjdskillnader	○	○	○	○		○
2. Lodrätt klippa / sluttande rasbrant > 10 m hög		○	○	○		
3. Skogklädd / skogsomgiven klyfta / ravin > 10 m djup	○	○	○	○	○	○
4. Ståndorten ligger i en S – SV-exponerad sluttning brantare än 10% (1:10)		○		○		○
5. Ståndorten ligger i en N – NO-exponerad sluttning brantare än 10% (1:10)			○			
6. Åtminstone en del av ståndorten ligger över 250 m.ö.h.			○			
7. Ståndorten omges av skog / terräng / vatten som ger ett skyddat lokalklimat			○		○	
8. Ståndorten består huvudsakligen av fuktig / blöt, skogklädd mark			○		○	
9. Område > 0,1 ha med skogklädd hällmark / mark med grunt jorddjup	○	○		○		○
10. Lavar täcker > 50 % av marken		○				
11. lögonfallande mängder av örter / måbär / skogstry / olvon / tibast	○	○	○	○	○	○
12. Kalk- / hyperit-rik mark / iögonfallande mängder av orkidéer / blåsippor	○	○	○	○	○	○
DYNAMIK						
13. Spår efter skogsbrand på träd / stubbar	○	○				○
14. Flera levande träd med brandärr	○	○				
15. Flera levande träd med ärr från mer än en brand	○	○				
16. Nyligen bränd yta > 0,1 ha med levande / döende / dött trädskikt	○	○				
17. Kvarstående skogsområde > 0,1 ha i en nyligen starkt störd omgivning	○					
18. Gran utgör mindre än 10% av beståndets volym / grundyta		○		○	○	
19. Flera krontaksluckor under 0,1 ha med naturlig återväxt av träd			○	○	○	
20. Tjockt och iögonfallande mosstäcke på stenar och block			○	○	○	
21. lögonfallande spår av hackspettar på träd / död ved / ringhack	○	○	○	○	○	○
22. Spår av säsongsvisa översvämningar i skogklädd omgivning / glupar			○	○	○	○
23. Spår av bävrar	○				○	
24. Spår av äldre – pågående bete / slåtter / hamling / skottskogsbruk				○	○	○
25. Pågående bete / slåtter / hamling / skottskogsbruk						○
MILJÖER						
26. Sammanlagt > 0,1 ha sandig, solexponerad och kal / glest bevuxen mark	○	○				○
27. Skuggad > 2 m hög lodvägg beväxt med en blandning av olika mossor	○	○	○	○	○	○
28. Blockrikt område > 0,1 ha / flera block högre än 2 m	○	○	○	○		○
29. Fuktigt / blött skogsområde > 0,1 ha	○	○	○	○	○	○
30. Fuktigt / blött och iögonfallande lutande skogsområde > 0,1 ha	○		○	○	○	
31. Område > 0,1 ha präglat av olika högvuxna örter / tuvade ormbunkar			○	○	○	○
32. Skog i kontakt med öppet vatten / våtmark > 0,1 ha	○	○	○	○	○	○
33. Källa / källflöde i skogklädd omgivning	○	○	○	○	○	○
34. Mestadels vattenförande bäck / å / älv i trädbevuxen omgivning	○	○	○	○	○	○
35. Som ovan och med iögonfallande slingrande (meandrande) lopp	○	○	○	○	○	○
36. Strömsträcka / vattenfall i skogklädd omgivning			○	○		
37. Öppen / halvöppen, icke-odlad mark > 0,1 ha med örter / gräs / ljungväxter						○
38. lögonfallande och solexponerat skogsbryn med örter / buskar / småträd	○			○	○	○
39. Ihåligt, innanmurket träd / fågelbo av grova kvistar / flera bohål	○	○	○	○	○	○
40. Flera ihåliga och innanmurkna träd	○			○		○
Hemiboreal version S om biol Norrlandsgränsen **STÅNDORTSPOÄNG**						

Part 2 (right side of the assessment)

NATURVÄRDESBEDÖMNING AV SKOGSMARK

TRÄD	N	O	S	Ä	V	K
41. Flera hasselbuskar / idegranar > 2 m höga	○		○	○		
42. Påtagligt med enar / buskar > 2 m höga	○			○	○	○
43. Som ovan och i öppna, solexponerade lägen						○
44. Flera hagtorn / oxel / fågelbär / vildapel / getapel > 10 cm	○					○
45. Påtagligt med asp / sälg / rönn / klibbal / ek > 10 cm	○	○			○	
46. Påtagligt med alm / lind / lönn / ask > 10 cm	○		○	○	○	
47. Påtagligt med lövträd > 20 cm	○	○	○		○	
48. Flera alm / lind / lönn / ask > 40 cm				○	○	○
49. Flera lövträd > 40 cm	○	○	○			○
50. Flera träd > 40 cm	○	○	○	○	○	○
51. Påtagligt med träd > 40 cm	○	○		○	○	○
52. Flera träd > 60 cm	○	○	○	○	○	○
STRUKTUR						
53. Trädskiktet präglas av ögonfallande diameter- / åldersspridning (träd > 10 cm)		○	○	○	○	○
54. Flera träd är ögonfallande äldre / grövre än beståndet i övrigt	○	○		○	○	○
55. Flera träd med ögonfallande grova grenar och vida / låga kronor	○	○	○	○	○	○
56. Som ovan och med stammarna i öppna, solexponerade lägen	○	○				○
57. Flera solitärträd > 60 cm	○					○
58. Påtagligt med senvuxna / krumma träd / biologiskt gamla träd / krattskog		○	○		○	○
59. Påtagligt med toppbrott / spår efter tidigare toppbrott på träd > 10 cm			○			
60. Påtagligt med basalt flerstammiga träd / skottskog > 10 cm		○			○	○
61. Påtagligt med träd på ögonfallande socklar på fuktig / blöt mark			○	○	○	○
62. Flera träd med signalarter / ögonfallande förekomster av blandade mossor / lavar	○	○	○	○	○	○
63. Flera träd med ögonfallande förekomster av hänglavar		○	○		○	○
64. Påtagligt med träd som har ögonfallande förekomster av hänglavar			○			
65. Öppet / halvöppet krontak / flera ögonfallande myrstackar						○
DÖD VED						
66. Barrträd; flera stående döende / döda träd / > 2 m högstubbar > 20 cm	○	○	○		○	
67. Som ovan och i öppna, solexponerade lägen	○	○				○
68. Lövträd; flera stående döende / döda träd / > 2 m högstubbar > 20 cm	○	○	○	○	○	
69. Som ovan och i öppna, solexponerade lägen	○	○		○		○
70. Påtagligt med stående döende / döda träd / > 2 m högstubbar > 20 cm	○	○	○	○	○	○
71. Flera vindfällen med rotvältor	○	○	○	○	○	
72. Flera rötbrutna träd			○	○	○	
73. Flera lågor > 20 cm.	○	○	○	○	○	○
74. Som ovan och i öppna, solexponerade lägen	○	○				○
75. Flera lågor > 10 cm med blandat, delvis sammetsaktigt (lever-)mosstäcke			○	○	○	
76. Flera lågor > 20 cm i varierande grad av nedbrytning / förmultning		○	○	○	○	
77. Påtagligt med lågor > 20 cm	○	○	○	○	○	
78. Flera lågor > 40 cm	○	○	○	○	○	○
79. Vedsvampar: signalarter / flera träd / lågor med ögonfallande förekomster	○	○	○	○	○	○
80. Vedsvampar: påtagligt med träd / lågor med ögonfallande förekomster		○	○	○	○	
Skogsbiologerna AB © Hemiborealexcel2004.xls **BESTÅNDSPOÄNG**						

APPENDIX 4

Boreal version of the Swedish assessment (original, in English)

Part 1 (left side of the assessment)

ASSESSMENT OF FOREST BIODIVERSITY POTENTIAL

SITE	E	F	S	B	W	C
1. Conspicuously broken terrain / varied topography	○	○	○	○		○
2. Vertical cliff / scree-slope > 10 m high		○	○	○		
3. Forested gorge / ravine > 10 m deep	○	○	○	○	○	○
4. Site characterised by S - SW facing slope steeper than 15% (3:20)		○		○		○
5. Site characterised by N – NE facing slope steeper than 15% (3:20)			○			
6. At least part of the site located above 450 m. altitude / prealpine			○			
7. Site surrounded by forest / terrain buffering local climate			○		○	
8. Site characterised by normally wet / very wet forest			○		○	
9. Area > 0,1 ha of forested rocky outcrop / ground with very shallow soils	○	○		○		○
10. Lichens cover > 50 % of the ground		○				
11. Site characterised by a conspicuous herb component / *Ribes* / *Lonicera*	○	○	○	○	○	○
12. Lime- / hyperite-rich soils / conspicuous amounts of orchids / liverworts	○	○	○	○	○	○
DYNAMICS						
13. Signs of former - recent forest fire on stumps / trees	○	○				○
14. Several living trees with fire-scars	○	○				
15. Several living trees with scars from more than one fire	○	○				
16. Recently burnt area > 0,1 ha with substantial amounts of living / dead trees	○	○				
17. Forest area > 0,1 ha unaffected by a recent radical disturbance	○					
18. Spruce constitutes less than 10% of the stand volume / basal area		○		○	○	
19. Several canopy gaps less than 0,1 ha with natural regrowth of main species			○	○	○	
20. Site characterised by a thick, continous moss cover on rocks and boulders			○	○	○	
21. Conspicuous signs of woodpecker activity on living trees / dead wood	○	○	○	○	○	○
22. Seasonally inundated arrea >0,1 ha in forested surroundings			○	○	○	○
23. Signs of beaver activity	○				○	
24. Signs of former - present grazing / meadow mowing / pollarding / coppicing				○	○	○
25. Present grazing / meadow mowing / pollarding / coppicing						○
HABITATS						
26. Boulder terrain > 0,1 ha / large boulders > 2 m high	○	○	○	○		○
27. A total of > 0,1 ha sandy, sun-exposed, sparsely vegetated ground	○	○				○
28. Shaded > 2 m high conspicuous vertical cliff with a mixed moss cover	○	○	○	○	○	○
29. Area > 0,1 ha of normally wet / very wet forest	○	○	○	○	○	○
30. Area > 0,1 ha of wet / very wet, conspicuously sloping forest	○		○	○	○	
31. Area > 0,1 ha dominated by luxuriant herbs / tufted ferns			○	○	○	○
32. Forest in contact with open water / wetland > 0,1 ha	○	○	○	○	○	○
33. Spring / spring brook in forested surroundings	○	○	○	○	○	○
34. Non-seasonal brook / watercourse in forested surroundings	○	○	○	○	○	○
35. As above, and meandering in sand / silt	○	○	○	○	○	○
36. White-water / rapids / waterfall in forested surroundings			○	○		
37. Open / semi-open, non-cultivated grass- / herb- / heath-area > 0,1 ha						○
38. Conspicuous, sun-exposed forest brow with herbs / shrubs	○			○	○	○
39. Conspicuous hollow tree / nest of coarse twigs / several nesting holes	○	○	○	○	○	○
40. Hollow tree > 40 cm with a major cavity in the trunk	○			○		
General Swedish version **SITE SCORE**						

Part 2 (right side of the assessment)

ASSESSMENT OF FOREST BIODIVERSITY POTENTIAL

TREES	E	F	S	B	W	C
41. Several > 2 m high hazel / yew	○		○	○		
42. Substantial amounts of > 2 m high junipers / shrubs	○			○	○	○
43. As above / hazel and in open, sun-exposed conditions						○
44. Several hawthorn / whitebeam / crab apple / gean / buckthorn > 10 cm	○					○
45. Substantial amounts of aspen / sallow / rowan / black alder / oak > 10 cm	○	○			○	
46. Substantial amounts of elm / lime / maple / ash > 10 cm	○		○	○	○	
47. Substantial amounts of broadleaf trees > 20 cm	○	○	○		○	
48. Several elm / lime / maple / ash > 40 cm				○	○	○
49. Several broadleaf trees > 40 cm	○	○	○			○
50. Several trees > 40 cm	○	○	○	○	○	○
51. Substantial amounts of trees > 40 cm	○	○		○	○	○
52. Several trees > 60 cm	○	○	○	○		○
STRUCTURE						
53. Trees > 10 cm characterised by a conspicuous girth / age variation		○	○	○	○	○
54. Several trees stand out as consp. older / larger than the stand in general	○	○		○	○	○
55. Several trees with conspicuously thick branches and low / wide crowns	○	○	○	○	○	○
56. As above and in open, sun-exposed conditions	○	○				○
57. Several solitary trees > 60 cm	○					○
58. Substantial amounts of conspicuously retarded / stunted trees > 10 cm	○	○	○		○	○
59. Substantial amounts of formerly - recently snow-broken trees > 10 cm			○			
60. Substantial amounts of basally multi-stemmed trees / coppice > 10 cm		○			○	○
61. Substantial amounts of trees on buttresses			○	○	○	○
62. Several stems with conspic. occurrences of mixed mosses / lichens / *Lobaria*	○	○	○	○	○	○
63. Several trees with conspicuous occurrences of pendulous lichens		○	○		○	○
64. Substantial amounts of trees with consp. occurrences of pendulous lichens			○			
65. Open / semi open canopy / several conspicuous anthills						○
DEAD WOOD						
66. Conifers; several erect dying / dead trees / > 2 m high stumps > 20 cm		○	○		○	
67. As above and in sun-exposed conditions	○	○				○
68. Broadleaves; several erect dying / dead trees / > 2 m high stumps > 20 cm	○	○	○	○	○	
69. As above and in sun-exposed conditions	○	○		○		○
70. Substantial amounts of erect dying / dead trees / > 2 m high stumps > 20 cm	○	○	○	○	○	○
71. Several windthrown trees with upturned roots	○	○	○	○	○	
72. Several rot-broken trees			○	○	○	
73. Several downlogs > 20 cm.	○	○	○	○	○	○
74. Several downlogs > 20 cm in open sun-exposed conditions	○	○				○
75. Several downlogs > 20 cm with a mixed, partly velvety moss cover			○	○	○	
76. Several downlogs > 20 cm in various stages of decay		○	○	○	○	
77. Substantial amounts of downlogs > 20 cm	○	○	○	○	○	
78. Several downlogs > 40 cm	○	○	○	○	○	○
79. Several trees / stumps / logs with conspicuous occurrences of fungi	○	○	○	○	○	○
80. Subst. amounts of trees / stumps / logs with conspic. occurrences of fungi		○	○	○	○	
Skogsbiologerna AB © 2001 Excel **STAND SCORE**						

APPENDIX 5

Nemoral version of the Swedish assessment (version for the field work, in English)

Part 1 (left side of the assessment)

ASSESSMENT OF FOREST BIODIVERSITY POTENTIAL

SITE	F	B	M	W
1. Conspicuously broken terrain / varied topography	○	○	○	
2. Vertical cliff / scree-slope > 10 m high	○	○	○	
3. Forested gorge / ravine > 10 m deep		○	○	○
4. Site characterised by S - SW facing slope steeper than 15% (3:20)	○			
5. Site characterised by N – NE facing slope steeper than 15% (3:20)		○		
6. Site on sandy soils or sandy dunes	○			
7. Site surrounded by forest / terrain buffering local climate		○	○	○
8. Site surrounded by forest dominated by broadleaves / pine	○	○	○	
9. Site characterised by normally wet / very wet forest				○
10. Area >0,1 ha of forested rocky outcrop / ground with very shallow soils	○	○	○	
11. Site characterised by a conspicuous herb component / *Ribes* / *Lonicera*	○	○		○
12. Lime- / hyperite-rich soils / conspicuous amounts of orchids / liverworts	○	○	○	○
13. Conspicious amount of bluberry / other dwarf shrubs	○			
DYNAMICS				
14. Signs of former - recent forest fire on stumps / trees	○			
15. Recently burnt area > 0,1 ha with substantial amounts of living / dead trees	○			
16. Spruce constitutes less than 10% of the stand volume / basal area	○		○	○
17. Substantial amounts of formerly - recently snow-broken trees > 10 cm	○			
18. Several canopy gaps less than 0,1 ha with natural regrowth of main species		○	○	○
19. Site characterised by a thick, continous moss cover on rocks and boulders		○	○	○
20. Conspicuous signs of woodpecker activity on living trees / dead wood	○	○	○	○
21. Seasonally inundated arrea >0,1 ha in forested surroundings	○		○	○
22. Substantial amounts of trees on buttresses				○
23. Signs of former - present grazing / meadow mowing / pollarding / coppicing			○	○
24. A total of > 0,1 ha sandy, sun-exposed, sparsely vegetated ground	○			
HABITATS				
25. Shaded > 2 m high conspicuous vertical cliff with a mixed moss cover	○	○	○	○
26. Boulder terrain > 0,1 ha / large boulders > 2 m high	○	○	○	
27. Area > 0,1 ha of normally wet / very wet forest	○	○	○	
28. Area > 0,1 ha of wet / very wet, conspicuously sloping forest		○	○	○
29. Area > 0,1 ha dominated by luxuriant herbs / tufted ferns		○	○	○
30. Forest in contact with open water / wetland > 0,1 ha	○	○	○	○
31. Spring / spring brook in forested surroundings	○	○	○	○
32. Non-seasonal brook / watercourse in forested surroundings	○	○	○	○
33. As above, and meandering in sand / silt	○	○	○	○
34. White-water / rapids / waterfall in forested surroundings		○		
35. Conspicuous, sun-exposed forest brow with herbs / shrubs			○	○
36. Conspicuous hollow tree / nest of coarse twigs / several nesting holes	○	○	○	○
37. Hollow tree > 40 cm with a major cavity in the trunk	○	○	○	○
Nemoral English version **SITE SCORE**				

Part 2 (right side of the assessment)

ASSESSMENT OF FOREST BIODIVERSITY POTENTIAL

TREES	F	B	M	W
38. Several > 2 m high hazel / yew		○	○	○
39. Substantial amounts of > 2 m high junipers / shrubs	○			○
40. Several hawthorn / whitebeam / crab apple / gean / buckthorn > 10 cm			○	
41. Substantial amounts of aspen / sallow / rowan / black alder / oak > 10 cm	○			○
42. Substantial amounts of elm / lime / maple / ash > 10 cm		○	○	○
43. Substantial amounts of broadleaf trees > 20 cm	○			○
44. Several elm / lime / maple / ash > 40 cm		○	○	○
45. Several broadleaf trees > 40 cm	○			○
46. Several trees > 40 cm	○	○	○	○
47. Substantial amounts of trees > 40 cm	○		○	○
48. Several trees > 60 cm	○	○	○	○
49. Several trees > 100 cm		○		
STRUCTURE				
50. Canopy composed of more then five different tree species			○	
51. Trees > 10 cm characterised by a conspicuous girth / age variation	○	○	○	○
52. Several trees stand out as consp. older / larger than the stand in general	○	○	○	○
53. Tree layer composed of very big trees > 60 cm		○	○	
54. Several trees with conspicuously thick branches and low / wide crowns	○	○	○	○
55. As above and in open, sun-exposed conditions	○			
56. Substantial amount of trees with conspicuously thick branches and low / wide crowns		○	○	
57. Substantial amounts of conspicuously retarded / stunted trees > 10 cm	○	○		○
58. Substantial amounts of basally multi-stemmed trees / coppice > 10 cm				○
59. Several stems with conspic. occurrences of mixed **mosses** / lichens / Lobaria	○	○	○	○
60. Several trees with conspicuous occurrences of bushy / pendulous lichens	○	○		○
DEAD WOOD				
61. Several erect dying / dead trees / > 2 m high stumps > 20 cm	○	○	○	○
62. As above and in sun-exposed conditions	○		○	
63. Substantial amounts of erect dying / dead trees / > 2 m high stumps > 20 cm	○	○	○	○
64. Several windthrown trees with upturned roots	○	○		○
65. Several rot-broken trees		○	○	○
66. Several downlogs > 20 cm.	○	○	○	○
67. Several downlogs > 20 cm in open sun-exposed conditions	○			
68. Several downlogs > 20 cm with a mixed, partly velvety moss cover		○	○	○
69. Several downlogs > 20 cm in various stages of decay	○	○	○	○
70. Substantial amounts of downlogs > 20 cm	○	○		○
71. Several downlogs > 40 cm	○	○	○	○
72. Several downlogs > 60 cm		○	○	
73. Several trees / stumps / logs with conspicuous occurrences of fungi	○	○	○	○
74. Subst. amounts of trees / stumps / logs with conspic. occurrences of fungi	○	○	○	○
Skogsbiologerna AB © 2001 Excel **STAND SCORE**				