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Assessment of Biodiversity Impacts in Swedish Forestry – Attitudes and Experiences in the Product Chain

Master of Science Thesis in the Master Degree Programme, Industrial Ecology

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ABSTRACT

Biodiversity is decreasing and is expected to decrease even more in the future. The fundamental roles of biodiversity make this decrease critical and impacts on biodiversity should be taken into account in a lot of situations. That is not often the case today partly because of the complexity of biodiversity itself, the nature of the impacts on it, and the difficulties when it comes to assigning a value to it. There are numerous suggestions how to handle those questions presented in the literature. Even if different steps are taken in order to improve biodiversity in the real world, examples of the use of any methods for assessment of the effects are not that many.

This study investigates the interest for and possibilities and problems connected to future application of biodiversity assessment methods in forestry and forest related industry sectors by interviews and mail contact with a number of companies and other organisations in the mentioned sectors. The answers are used as examples and compared to some suggestions regarding biodiversity assessment methods found in a parallel literature study and shows quite different views on what is wanted and needed.

The study shows that present work with biodiversity is often focused on prerequisites for biodiversity and that assessment of actual biodiversity and biodiversity impact is very rare. Certifications are considered as important, but no follow-up is actually done to check whether biodiversity is improved. Regardless of if an assessment is made by the forest owners or by the forestry organisations or by the certification organisations, an assessment of some kind seems important in order to secure that the measures taken to improve biodiversity or the prerequisites for biodiversity really have the intended effects. The study also indicates a need for better communication and cooperation both within the studied sector and between the people that develop new and better tools and methods and between the people that are going to use them, are recommended.

Keywords: Biodiversity, biodiversity impact assessment, forest.

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Kristina Arn
Göteborg, 2013

Content

1 Introduction

Biodiversity is decreasing and is expected to decrease even more in the future. The fundamental roles of biodiversity make this decrease critical and impacts on biodiversity should be taken into account in a lot of situations. That is not often the case today partly because of the complexity of biodiversity itself, the nature of the impacts on it, and the difficulties when it comes to assigning a value to it. There are numerous suggestions how to handle those questions presented in the literature. Even if different steps are taken in order to improve biodiversity in the real world, examples of the use of any methods for assessment of the effects are not that many.

1.1 Purpose

The purpose of this work is to investigate the interest for and possibilities and problems connected to future application of biodiversity assessment methods in forestry and forest related industry sectors and to try to construct a requirement specification for a functional method.

1.2 Objective

The objective is to:

1. investigate how a selection of companies and other organisations with connections to forestry
    a. works with biodiversity and biodiversity impact assessment today
    b. would like to work with those questions in the future
2. investigate differences between todays practice and needs and wants for the future
3. suggest some prerequisites for a functional method that could be used to fulfil the needs identified.

1.3 Scope

The project focused on biodiversity in the forest and the biodiversity impact from wood-fibre and wood-fibre products. The industries contacted therefore came from the forestry, the pulp and paper or the packaging and furniture sector in Sweden. Due to the restricted time available, it was only possible to contact a few organisations and any deeper dialogue with the chosen organisations was impossible. There were also limitations when it came to the number of persons that could be contacted in one organisation.

The aim is not to compare and evaluate how the individual organisations work with biodiversity issues. The organisations are rather used as illustrations and examples of work with and attitude towards biodiversity questions that could be found in the forest related sector. The results presented from the industrial contacts should for this reason not be regarded as a complete mapping of the biodiversity related work carried out by a specific organisation. As a consequence of the limitations mentioned above, the result presented from the industrial contacts is also not to be regarded as representative for the sector as a whole.

2 Background

In the following sections, some background information is presented in order to give better prerequisites to understand the research questions and the work done. The background is based on facts found in the literature search. Basic facts about biodiversity, biodiversity assessment and forest and forestry are found in chapter 2.1, 2.2 and 2.3 respectively.

2.1 Biodiversity

Biodiversity," the diversity of life on earth" (Millennium Ecosystem Assessment 2005) is defined in the Convention on Biological Diversity as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems" (CBD 2002). This convention is an international agreement made in 1992 in Rio and the purpose is to maintain the diversity within species, between species and of ecosystems.

2.1.1 Levels and aspects on biodiversity

As mentioned in the definition in CBD (2002), the diversity exists on different levels:

- within species (genetic diversity)
- between species
- within and between ecosystems

The genetic diversity is for example the genetic differences between varieties of crops. Diversity on the species level means many different species. Today there is around 1.75 million known species but the scientists estimate the real number to be around 13 million, with a range of the estimations from 3 to 100 million species (CBD 2012b). The ecosystem level of biodiversity is coupled to the numerous numbers of ecosystems on earth, each ecosystem adapted to the type of nature where it is, for example deserts, forests, lakes and agricultural landscapes. An ecosystem is characterized not only by its species but also by how the species interact with each other and with their environment, i.e. air, water and soil (Bernes 2011; CBD 2012b).

2.1.2 The importance and values of biodiversity

The decrease in biodiversity has been more rapid the past 50 years than any time before and is expected to decrease even more in the future (Millennium Ecosystem Assessment 2005). The loss is already exceeding the suggested planetary boundaries when considering extinction rates and a continued loss at present rate will significantly diminish the resilience of ecosystems (Rockström et al. 2009). This will have negative impacts on human well-being since the life support processes become less reliable (Slootweg 2005).

One of the reasons to the importance of biodiversity is that it is a basis for evolution and thereby a prerequisite for the adaption to a changing environment and with that also for the survival of life (CBD 2002). Biodiversity loss leads to more unstable ecosystems. Natural disasters, such as droughts and floods, as well as human-caused stresses, for example pollution will have more severe effects in an ecosystem with losses in biodiversity (CBD 2012b).

Biodiversity is fundamental for the ecosystems and the "ecosystem services" that human well-being depends on. Ecosystem services are the benefits that come from ecosystems when the ecosystems work properly. They are divided into four groups: provisioning (for example food and fuel), regulating (for example climate regulating and diseases), cultural (for example spiritual and aesthetic) and supporting (for example primary production and soil formation). There is a strong connection between losses in biodiversity and changes in these ecosystem services (Millennium Ecosystem Assessment 2005).

The ecosystem service concept is not uncontroversial. A review of studies of the historic development of the concept is made by Gómez-Baggethun et al. (2010). The original idea with the concept was to use it as a way to raise interest for biodiversity. Now, there is more focus on the use of the ecosystem service concept as a way to create a market, i.e. a commodification of the ecosystem services. According to Gómez-Baggethun et al. (2010) this commodification has contributed to the view of ecosystem functions as exchange values. To replace the ecosystem services, for example pollination or pest control, would however be very expensive or even impossible (CBD 2012b). Valuing the biodiversity and the ecosystem services in economic terms is also a controversial issue. There are existing valuation methods for mainly the provisioning ecosystem services based on peoples´ willingness to pay. Most of the supporting, regulating and cultural services are not valued by use of these methods and the intrinsic value that many people put on biodiversity is not valued either since it is difficult to directly observe or measure the willingness to pay for services not traded or not privately owned (Millennium Ecosystem Assessment 2005).

2.1.3 Drivers for biodiversity loss

The loss in biodiversity is caused by direct and indirect drivers. Direct drivers, the drivers of direct importance for the biodiversity decrease, are:

- habitat change
- climate change
- invasive alien species
- overexploitation of species
- pollution

And the indirect drivers for biodiversity losses are:

- demographic drivers
- economic drivers
- socio-political drivers
- cultural and religious drivers
- scientific and technological drivers

There have always been changes in biodiversity and ecosystem services due to natural causes but the anthropogenic indirect drivers dominate today. The development goes towards a more homogeneous species distribution, increasing extinction rate and a declining genetic diversity. These changes will have negative impacts on human well-being by changing ecosystems and the "ecosystem services". This will lead to higher costs and risks and the poor will be disproportionately affected (Millennium Ecosystem Assessment 2005).

2.1.4 Biodiversity loss in Sweden

The main drivers for biodiversity loss mentioned in the previous section are of different importance in different biomes (Millennium Ecosystem Assessment 2005), i.e. major communities with plants and animals that require similar environmental conditions (Encyclopædia Britannica). According to the report about biodiversity by Millennium Ecosystem Assessment (2005), pollution, i.e. for example the anthropogenic increase in nitrogen and phosphorous that causes nutrient loading, is the driver with highest impact on biodiversity in the boreal forest. Habitat change, climate change and invasive species will have growing importance. A somewhat different opinion is presented by Bernes (2011) in "Biodiversity in Sweden" where habitat changes are stated as the main driver that causes decrease in biodiversity and in Sweden those changes mainly result from forestry and agriculture. Pollution has had some influence as well but the fastest growing threat towards biodiversity is climate change. With rising average temperatures, the climate zones move north changing the conditions for species. The changes are taking place relatively quickly and the species do not have as much time as they need to adapt to the new circumstances. In the cases when the adaption process means moving to another area with more suitable conditions, for example lower temperatures, such an area have to exist (Naturvårdsverket 2011).

Looking back, the first driver of importance for the biodiversity loss in Sweden was overexploitation through hunting and fishing. The birds and mammals that became extinct in those days have come back from other countries. That species from other countries come to Sweden is partly a natural development, but many of the species have come here by help of humans and have shown to be invasive, spreading in the country and affecting the native species by competing for food and space and also bringing diseases (Bernes 2011). One example is the North American signal crayfish (Swedish Environmental Protection Agency 2012). Invasive species are thereby threatening the endemic species and could for example extinguish species or populations, change ecosystems or bring new diseases. Introducing alien species can affect the genetic biodiversity and thereby first affect the biological characteristics of a particular species, but later on also the diversity on species and ecosystem level (Laikre and Palmé 2005).

The most important reason why biodiversity is decreasing is as mentioned habitat changes caused by humans and our way to use land and water. The Swedish landscape today consists of large areas of either forest or cropland and a very small diversity on ecosystem level (Bernes 2011).

2.1.5 Actions taken

Various actions are taken in order to change the development with increased biodiversity losses. The Convention on Biological Diversity has already been mentioned. The convention is an international treaty and sets the overall goals and policies, but it is largely the countries themselves that have to achieve the goals. The governments therefore have to develop national biodiversity strategies and integrate those in other environmental work (CBD 2012b).

The conservation of threatened species, which is part of the convention, could be done in different ways. Ex situ conservation is off-site conservation in for example zoos or seed-banks, whereas in situ conservation in an on-site conservation of an endangered species in its natural habitat. Protected areas are also a way to conserve biodiversity and one of the things that countries are committed to in CBD (Millennium Ecosystem Assessment 2005; CBD 2012b). There are also other commitments, as for example restoring degraded ecosystems,

preventing introduction of alien species, promoting public participation and educating people and raising awareness about the importance of biodiversity (CBD 2012b). Discussions about how the biodiversity issue could be improved include for example the opportunity to create payments and markets for biodiversity and the ecosystem services (Millennium Ecosystem Assessment 2005). But that is, as mentioned in section 2.1.2, not uncontroversial.

2.1.6 Red-list

Species that will possibly become extinct in the near future are classified and put together in red-lists. Those lists exist both on a global scale but in many countries also on a national scale. The classification standard by IUCN (World Conservation Union) is also used for the Swedish red-list. Species are grouped into six categories from "least concern" (LC) to "regionally extinct" (RE). The categories between are named "near threatened" (NT), "vulnerable" (VU), "endangered" (EN) and "critically endangered" (CR). There are also cases where knowledge is lacking so that a proper categorisation can´t be made, "data deficient" (DD) (Bernes 2011; IUCN 2012; SLU 2012a). On a global level, there are also two other categories: "extinct in the wild" (ew) and "extinct" (ex) (IUCN 2012). The Swedish lists do only say something about the national situation and not anything about how a disappearance would affect biodiversity on a global level (Bernes 2011). The total number of red-listed species in Sweden is more than 4200 (Swedish Species Information Centre 2010).

2.2 Assessment of Biodiversity

Some basic facts about how biodiversity is assessed, including inventories, indicators and problems connected to assessment, will be presented in this section. There is also a brief presentation of environmental assessment methods and existing suggestion in the literature on how to better incorporate biodiversity.

The importance of biodiversity and its decrease makes it crucial to be able to monitor and assess biodiversity. Since it is impossible to measure biodiversity directly as it is defined in CBD, a number of indicators are suggested for the assessment (Michelsen 2008). An indicator is defined as "a measure or metric based on verifiable data that conveys information about more than itself" (Partnership 2011). The most frequently used indicator when it comes to biodiversity is number of species. To use for example the number of species as an indicator for biodiversity is of course a simplification and there are also other things important for biodiversity, as for example areas that enable invasions and the abundance of species (Michelsen 2008). The complexity makes it difficult to find good indicators of the overall biodiversity (Millennium Ecosystem Assessment 2005) and the indicators proposed are often only able to capture one dimension (Curran et al. 2011; Vačkář et al. 2012). In order to face that problem, subsets of indicators are needed to assess the changes in biodiversity properly (Normander et al. 2012).

Inventories of biodiversity on the eco-system level often rely on indicators that reflect the prerequisites or potentials for biodiversity in an area, for example dead wood, old trees or deciduous trees in a coniferous forest instead of indicators that is more directly connected to biodiversity, such as number of species (FSC 2010; Bernes 2011). The use of indicators connected to biodiversity potentials, is for example recommended in "Guidelines for site assessments related to the environment", Appendix to the Swedish FSC Standard (FSC 2010). An indicator could also be a certain species, an indicator species that says something about the prerequisites for biodiversity in the area. This is an indirect and frequently used way to assess the biodiversity on

ecosystem and biotope level (Bernes 2011) and substrate, processes and structures are used in a couple of methods for environmental valuation, for example a method developed by Skogsbiologerna and used by forest owners and forest organisations (Skogsbiologerna 2012). The same idea, to look at the potential for biodiversity rather than the actual biodiversity is present also in other assessment methods, for example Michelsen (2008) who has developed a method for assessment of land use impact on biodiversity.

Examples of indicators used for biodiversity assessment or identification of areas with high conservation values:

Species related indicators

- Number of species (Michelsen 2008)
- Red-listed species (Swedish Forest Agency 2012c)
- Indicator species ("signal art" in Swedish) (Swedish Forest Agency 2012c)

Structural or process related indicators

- Dead wood or amount of decaying wood (Michelsen 2008; Bernes 2011; Swedish Forest Agency 2012c)
- Old trees (Bernes 2011; Södra 2012c)
- Deciduous trees in a coniferous forest (Bernes 2011)

The genetic diversity is more complicated to measure. There is seldom one single way to tell how many genetic varieties of one species that exist (Bernes 2011) and indicators for genetic diversity are very rare (Curran et al. 2011).

Swedish Forest Agency is carrying out a variety of different inventories in the forests in Sweden. The inventories have different focus, for examples how much forest that is felled and regeneration of land in Sweden (Swedish Forest Agency 2012g). There are also inventories specialised on biodiversity but those are first focused on the areas that are considered important since rare species occur. A follow-up is planned after ten years in order to evaluate for example if the areas put a-side are big enough and if the forests are managed in a proper way. In those inventories, red-listed species and signal species are the indicators used. Additionally dead wood and the amount of different tree species is checked (Swedish Forest Agency 2012c).

A couple of international conventions and directives influence the handling of biodiversity questions. Beside the Convention of Biological Diversity (CBD) already mentioned, there are for example the Habitats Directive (Council Directive 92/43/EEG) with the aim to maintain biodiversity by conserving natural habitats that could disappear (SLU 2012b), the Birds Directive (Directive 2009/147/EC**)** which aims to conserve wild birds (European Commission 2012), the Ramsar Convention dealing with wetlands (NE, 2012) and the Convention on Migratory Species. Those conventions require the parties that have signed to make environmental impact assessments (EIA) and strategic environmental assessments (SEA) in order to highlight the biodiversity issues affected by development thereby fulfilling the goals of the conventions (conservation of biodiversity, sustainable use of biodiversity resources and fair and equitable sharing of biodiversity benefits). Impact assessments are important for taking biodiversity aspects into account in decision making situations (IAIA 2005).

Environmental impact assessments (EIA) are made in order to evaluate possible environmental, social and economic consequences of a project or a development. The possible negative consequences could thereafter hopefully be reduced or avoided. Strategic environmental impact assessment (SEA) is on the other hand a tool or a method that for example is used in connection to evaluation of proposed policies, plans or programmes. Also in this case environmental consequences are treated together with economic and social issues (CBD 2012c).

Beside those methods (EIA and SEA) used for environmental impact assessments, there are also other tools and methods used for environmental assessment purposes, for example Life Cycle Assessment (LCA). LCA quantifies the potential environmental impacts from a product seen over the whole life cycle, from cradle to grave (Tillman 2004). LCA is not considered to be without weaknesses when it for example comes to the possibility to include biodiversity issues in the assessment (Jeswani et al. 2010; Curran et al. 2011). An awareness among the researchers that present assessment methods are insufficient, have resulted in proposals regarding how the existing methods/tools could be improved or combined with each other in order to give a more complete picture as well as to make the methods/tools more interesting for a potential user (Jeswani et al. 2010). The proposals made are numerous and different reviews, by for example Curran et al. (2011) and Finnveden et al. (2009) can be found in scientific journals.

The literature study made in this project resulted among other things in a review of different proposals regarding how to solve the biodiversity impact assessment problem, or at least some parts of it. The methods can be categorised based on the existing environmental methods from which the new biodiversity expanded methods were constructed. A categorisation scheme is found in Appendix A. The LCA-based methods, are sometimes just expansions of LCA with impact categories that indirectly has an influence on biodiversity, for example land use or climate change. A summary of the methods found is presented in Appendix B. The table presents some examples on theories regarding how to solve the biodiversity assessment problem. Some of the methods are more like frameworks for further method developments and nothing that is practically applicable today. There are also methods with a stronger link to industrial applications, for example the Biotope method by Burke et al. (2008), developed together with an industrial partner for use in their operations. This method is together with two other assessment methods for biodiversity impact, ReCiPe and Corporate Ecosystem Services Review, investigated by Ahlström et al. (2012). The three methods are found to treat the biodiversity issue in different ways and therefore be suitable for different scenarios. Even these methods, already used by organisations in their environmental work and to some extent developed in cooperation with industry, are considered to need improvements since none of them is perfect. Ahlström et al. (2012) discuss whether the fact that ReCiPe is built on LCA, which is a rather spread environmental impact assessment method, will make it easier for organisations to adopt that method in comparison to the other biodiversity impact assessment methods investigated in the case.

The assessment of biodiversity, as mentioned earlier, depends on the use of indicators, there are also reviews concentrating on indicators, for example Vačkář et al. (2012). Curran et al. (2011) consider the indicators used in LCA to be one of the problems since there is too much focus on the compositional aspects on biodiversity, while other aspects are almost absent. The mentioned review contains a categorisation of indicators with respect both to the level of biodiversity (genetic, species, community or landscape) and with respect to an attribute (composition, function or structure). LCA does not contain any indicators for genetic diversity today (Curran et al. 2011). The methods found in the literature study in this project, use both direct indicators, for example

species richness (Vogtländer et al. 2010) and red-listed species (Söderman 2006; Burke et al. 2008), as well as more indirect ones, as for example “conditions for maintained biodiversity” , “ecosystem scarcity” and “ecosystem vulnerability” (Michelsen 2008)

Assessing biodiversity is difficult. Beside the complexity of biodiversity and the problems to find useable indicators, there are also other problems mentioned in the literature as well as in contact with industrial representatives. Some problems are connected to the biodiversity baseline, .i.e. what to use as a comparison for the biodiversity assessments made. There are many variations of different kinds over time and it is not sure that a long-term data set exists. The uncertainty associated with biodiversity assessments should be followed by some uncertainty values that take for example the baseline change into account (Magurran et al. 2010). A couple of other factors are mentioned by the industrial contacts interviewed in this study. Those factors will be presented later in the report (section 4.1.2) but one issue is the question about knowledge. The review of biodiversity assessment methods done in this study, show that a couple of the methods involve experts and expert knowledge.

2.3 Forest and Forestry in Sweden

Some information about forest is presented in the coming sections in order to give an idea about the importance of forestry and the connection between forest, forestry and biodiversity. Basic forest information is found in section 2.3.1 and a brief presentation of the connection between forestry and biodiversity is made in section 2.3.2.

2.3.1 Forest

The forest is important in many aspects. It provides raw material for the industry that produces for example wood, paper and cardboard or pellets for bioenergy production. The forest binds the soil. The climate question is also closely related to forest management, since the trees and the ground act as carbon dioxide reservoirs. The forest has recreational values as well (Swedish Forest Agency 2012e) and offers habitats for numerous species, animals, micro-organisms and plants that interact with each other and make up the forest biological diversity (CBD 2012a).

More than half of Sweden is covered with forest: 22.5 million ha productive forest out of 40.8 million ha total land area (Swedish Forest Agency 2012h). The dominating trees are spruce and pine but in the south of Sweden there are also deciduous forests (Swedish Forest Agency 2012f). Swedish Forest Agency makes inventories in order to identify key biotopes and areas of special importance with regards to biodiversity (Swedish Forest Agency 2012d). Around 82 000 key biotopes are registered today covering approximately 380 000 hectares (Swedish Forest Agency 2012i). The government has set goals for the environment with the aim of securing biodiversity as such and protect threatened species and biotope types (Swedish Forest Agency 2012a).

Around 50 % of the productive forests are owned by private persons. Companies, private and state-owned, have 39% of the productive forest area. The government owns 3 % and the rest is owned by other groups (Swedish Forest Agency 2012b). Many of the small owners are members in some of the four big forest owners associations with totally more than 112 000 members (LRF 2012).

Forests could be categorised into old-growth forests, forests not seriously disturbed by human activities or natural disasters for at least the last 200 years, and into second-growth forests, a forest that has developed after the trees for some reason have been removed in an area. Tree-plantations have trees of only a couple of genetic varieties and of the same age. They are cut and the land replanted again. The plantations where it is only a couple of species have a smaller biodiversity and are therefore probably less sustainable than the other forest types (Miller and Spoolman 2009). Even if a large part of Sweden is covered with forests, only a couple of per cent of it is defined as old growth forest. Most of the forest has been felled some time (Naturvårdsverket 2011).

2.3.2 Forestry-impacts on biodiversity

Already in the 19th century there was an intensive use of the forests but the impacts were not big since it was small-scale forestry, which resulted in a varied landscape and maintained biodiversity. When the forestry changed to become large-scale, rationalized and mechanized in the 20th century, the prerequisites for biodiversity changed as well and biodiversity decreased (Bernes 2011; Jansson et al. 2011). More than 100 species have disappeared from Swedish forests since the 19th century and the number of red-listed species is today more than 2000. Also frequently appearing species have decreased in number (Bernes 2011; Jansson et al. 2011). There are also examples of animals and plants that have been favoured by the large-scale forestry but the biodiversity as a whole has been decreased (Bernes 2011).

There are several reasons to why modern, large-scale forestry has had such big impact on biodiversity. Trees are for example felled before they become old. A reduced number of old trees affect the species needing old trees to establish and live and this makes it difficult for other species in the food chain to survive as well. Modern forestry also results in less dead wood, since trees are not allowed to become old and die, which in turn affects all the species dependent on dead wood in some stage of their life. The reduction in dead wood is considered to be one of the most severe problems that modern forestry has brought looking at the decrease in biodiversity (Bernes 2011). The changes in forestry also contributed to habitat changes with the large-scale transformation of old-growth forests and increased fragmentation which made it more difficult for species to spread (Jansson et al. 2011). Habitat changes are, as stated earlier, considered to be one of the main drivers to biodiversity losses and these changes are mostly caused by agriculture and forestry (Naturvårdsverket 2011)

Environmental awareness has led to changes in forestry and forest management. Protected areas are considered to be the most important measure to stop the decrease in biodiversity. There is also a need to restore habitats. Other measures taken are connected to the harvesting when for example dead wood and some so called development trees are left and new high stumps made (Jansson et al. 2011).

3 Method

The method used in this study consists of:

1. Literature study
2. Analysis of actors in the product chain

3.1 Literature study

The literature study carried out had several purposes. The first purpose was to search background information before contacting the companies and organisations about biodiversity as such, the threats and the possible ways to work with biodiversity related issues. The literature study also had as a purpose to give information about what companies and other organisations to contact in the next step, the analysis of actors in the product chain, and to give some information about the biodiversity work carried out by a specific organisation. Some parts of the literature study results are presented in the previous chapter and other information collected in the literature study will be presented together with other results later in the report.

3.2 Analysis of actors in the product chain

In order to investigate how the present biodiversity work is carried out and to identify needs and wants for the future in forest related sectors, contact was taken with companies and other organisations representing different steps in the product chain from forest to consumer products such as packaging or furniture. The sample was made with the purpose to reflect and represent those different steps and to have at least two or three organisations from each step.

Information about the environmental work in the companies and other organisations (henceforth called organisations) was collected from:

- Homepages for the organisations
- Personal contact with the person who seemed most suitable to inform about environmental and biodiversity work in the organisation (often called “environmental” or “sustainability responsible”)
    - Mail contacts
    - Telephone interviews
- Printed material received from the environmental or sustainability responsible contacted

With the aim of getting a better picture of if and how the organisations work specifically with biodiversity issues and to be able to have a dialogue with the environmental/sustainability representatives even if the geographical locations made direct meetings difficult, telephone interviews were planned and a guideline for the interviews was constructed (Appendix C - Structure for contact and interview guideline)

The interviews were recorded and then transcribed or notes were taken during the interviews for later analysis of the material. Based on the objective of the study a number of questions were constructed for the analysis of the material:

1. How is the work with biodiversity carried out today?
    a. Present environmental work with focus on biodiversity related issues. (Could for example be certification systems, environmental policies, environmental goals)

b. Assessment of biodiversity (is the biodiversity assessed to any extent? Inventories? Any methods used? Indicators- species (richness, focal species, red-listed species) or substrate and structures?
c. Follow-up of measures taken (e. g after harvesting-do the measures taken at harvest contribute to a lower impact on biodiversity?)

2. What needs and wants for the future could be identified?
   a. Attitude to quantification of biodiversity. Good or bad? Possible or not? Limitations?
   b. Interest in future biodiversity assessment methods. Good or bad?

From this, the forest part of the objective (1a and 1b) was investigated. The analysed interview material was also used indirectly for the other parts of the objective. Most of the interviews and mail-conversations were in Swedish. In those cases, the quotations presented in the report have been translated by the author. The report was also sent to the interviewees for review.

The contacted organisations were, as mentioned, supposed to represent different steps in the product chain from forest to a product (for example packaging or furniture) (***Figure 1***).

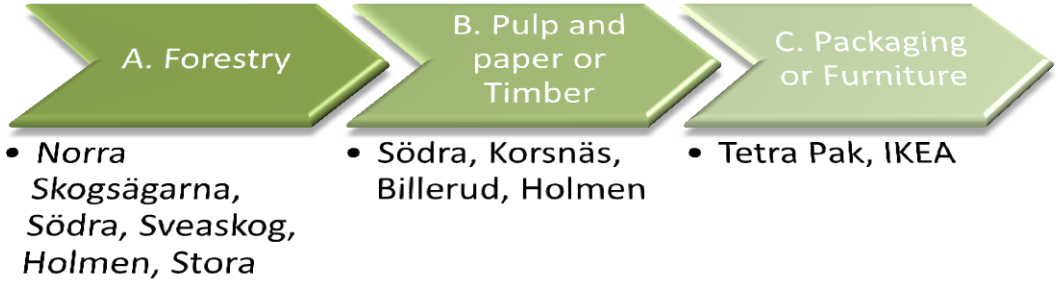

Figure 1 *The contacted organisations in the product chain (see text below for details).*

Some of the organisations contacted can be found in more than one step in the product chain, for example Södra which both owns forest and produces pulp- and paper as well as timber. The categorisation of the organisations could therefore have been made in other ways. The categorisation is made as follows:

A. Organisations that own wood and as a consequence have possibilities to work with biodiversity more directly.
B. Organisations that use forest as a raw material in their industries but don´t own any forest or do not own as much as they need and therefore have to buy forest or wood from suppliers. They have some possibilities to work directly with biodiversity.
C. Organisations further down-streams in the product chain, more far away from the forest. Their possibility to work directly with biodiversity in the forest is minimal.

The basic information about the organisations (see Appendix D), was collected from the homepages of the organisation and shows the distribution of the industrial contacts with respect to the criteria mentioned in the method part, i.e. place in the product chain.

The results regarding the industrial work, wishes and thoughts are gathered from interviews and mail contact with the following persons:

- Billerud Skog - Telephone interview with Simon Nilsson, Quality- and environmental manager.
- Holmen Skog - Telephone interview with Hanna Triumf, Business Developer Forest Management
- IKEA - Telephone interview with Anders Hildeman, Forest Manager, IKEA of Sweden AB
- Korsnäs AB - Telephone interview with and complementing mail-questions to Caroline Rothpfeffer, Environmental Manager Korsnäs AB, Skog.
- Norra Skogsägarna - Telephone interview with Jonas Eriksson, quality- and environmental responsible Skog.
- Stora Enso - Mail contact with Martin Schmalholz, Ecologist Stora Enso Skog.
- Sveaskog - Mail contact with Olof Johansson, Environment- and sustainability manager.
- Södra - Telephone interview with Gustaf Aulén, Forest Ecologist.
- Tetra Pak - Telephone interview with David Cockburn, Director Environmental Technologies.

Eight other organisations (one in step A, two in step B and two in step C of the conceptual product chain described on the previous page, as well as three bioenergy organisations) were also contacted but in these cases, the interview request were left without answer or answered with a “no”.

4 Results

Following sections will present the results from the contacts taken with companies and member-owned organisations in the forestry sector or related to it through the use of raw-material. The questions constructed for the analysis will be dealt with one by one with examples from the different parts of the conceptual product chain, on how an organisation might act and think in each question. In cases when the answers have touched subjects and phenomena that have not been presented earlier in the report, some background information from the literature study is presented for clarity.

4.1 Biodiversity work today

The question about how the work with biodiversity is carried out today in the organisations contacted is divided into three sub-questions: present environmental work (4.1.1), assessment of biodiversity and biodiversity impact (4.1.2) and follow-up measures taken (4.1.3). Examples from the three steps identified in the product chain are used to illustrate how organisations may work with biodiversity today. As mentioned in the introduction to this chapter, results from the literature study regarding important background information will be presented as well when that is found convenient for clarity.

4.1.1 Present environmental work with focus on biodiversity related issues

The interviews and the literature studies show that the present work with biodiversity is mainly built on three parts:

I. Legislation
II. Standards
III. Internal policy documents

The present environmental work that affects biodiversity will be presented in the following sections with examples from the industrial contacts.

Legislation

All organisations in question are ruled by Swedish regulation. This regulation could therefore be said to act as a minimum standard for how biodiversity work is carried out. The forest policies in Sweden have two objectives, one environmental objective and one production objective. The environmental objective states for example that biological and genetic diversity should be secured and that threatened species and natural habitats should be protected, whereas the production objective means that forest and forestry land should be used efficiently and responsibly. To reach these goals, there are different regulations regarding forest management found in the Forestry Act (Government Offices of Sweden 2012).

The Forestry Act states for example that biodiversity always have to be promoted if there is a choice of methods. There are also rules, which among other things say that a couple of old trees always should be left standing on felling sites, that too big areas should not be felled and that felling in areas rich in flora and fauna should be done carefully (Swedish Forest Agency 2012j). Compliance with legislation is checked by the Swedish Forest Agency, who carries out various inventories (Swedish Forest Agency 2012g). (For further information about inventories, see section 2.2). There are also other legislations important for the Swedish forestry, for example

Miljöbalken (NE 2012b), Vattendirektivet (NE 2012d) and Kulturminneslagen (NE 2012a) which in different ways affect forest management.

Regarding the industrial contacts, all organisations could be supposed to follow the legislation and regulations in Sweden since they act on the Swedish market. The interviews did not go into this question but the legal requirements were mentioned in connection to other things.

Standards

The use of standards that influence the biodiversity work is quite widespread. A number of different standards exist, both sector specific and more general ones. The ISO 14001 is a general environmental management systems standard. FSC (Forest Stewardship Council) and PEFC (Programme for the Endorsement of Forest Certification) are global forest management certification standards.

The use of standards is wide-spread and all the contacted organisations (step A, B and C in the product chain) works with at least one or two of the standards as could be seen in ***Table 1*** beneath. The use of more than one standard is usual, as is "double-certified" forests, i.e. both FSC and PEFC-certification.

Table 1 *Use of standards*

Organisation	ISO 14001	FSC	PEFC	references
Norra Skogsägarna	Yes	No	Yes	(Norra Skogsägarna 2012a)
Södra	Yes	Yes (S Cell, S Timber, S Skog).	Yes (S Cell, S Timber, S Skog , S Interiör)	(Södra 2012b) (Södra 2012c)
Sveaskog	Yes	Yes	No information	(Sveaskog 2012b)
Billerud Skog	Yes	Yes (42% totally FSC or PEFC certified the rest has a "controlled wood" certification)	Yes (42% totally FSC or PEFC certified the rest has a "controlled wood" certification)	(Billerud 2012c)
Holmen Skog	Yes	Yes	Yes	(Holmen 2012)
Korsnäs	Yes	Yes	Yes	(Korsnäs 2012b)
Stora Enso	Yes	Yes	Yes	(Stora Enso 2012a)
Tetra Pak	Yes	Yes	Yes	(Tetra Pak 2012c)
IKEA	No	(Yes) 16,2% FSC certified	No	(IKEA 2011)

These three standards are presented in some more detail in separate sections beneath, which also contain examples from the interviews with the organisations in the product chain.

ISO 14001 – an environmental management standard

ISO 14001 is, as mentioned earlier in the previous section, an environmental management systems standard with the aim to establish routines for systematic environmental work. The certification does however not necessarily mean that the environmental impact from an activity is low, only that the production fulfils the certification requirements (NE 2012c).

All organisations interviewed, except one, are certified according to ISO 14001 (see ***Table 1***). ISO 14001 is not mentioned as especially important for their work on biodiversity by any of the organisations.

FSC and PEFC – two forest management certification standards

The two forest management certification standards, FSC (Forest Stewardship Council) and PEFC (Programme for the Endorsement of Forest Certification), have some basic requirements in common. Both systems contain three parts, one about forestry, one about environmental aspects and one about social aspects (Södra 2011; PEFC 2012b) Regular follow-ups, audits, is part of both the FSC and PEFC certification systems (FSC 2010; PEFC 2012c).Other things that are present in both of the certification systems are for example that forest properties over a certain size should establish a green forestry plan containing a map with further information about the character of the area. An assessment of the environmental values should be made before harvesting when no green forestry plan is available (Södra 2011).

The two forest management certification systems are sometimes also perceived as rather similar. As expressed by one of the interviewees:

> *"… In practice out in the forestry, those certification systems are rather similar by nature and requirements"*

FSC is a global certification system established in 1992 with around 148 million ha forest certified in 80 countries, mostly in Europe and North America (FSC 2012b). The FSC-certified area in Sweden is over 11 million ha (FSC 2012b) of a total productive forest area in Sweden of 22.5 million ha (Swedish Forest Agency 2012f). FSC has developed principles and criteria with the purpose to reach the wanted sustainable forest management. Those principles and criteria are the base for nationally developed FSC-standards. The national standards have to be accepted by the international organisation (FSC 2012a). This makes it possible with different FSC-standards in different countries and an FSC-label does not necessarily mean the same (Elbakidze et al. 2011). In Sweden there is also a simplified certification process for forest owners with less than 1000 ha productive forest land. These rules are called SLIMF (Small and Low Intensity Managed Forests) (FSC Sweden 2012a).

PEFC is an umbrella organisation for national PEFC organisations with around 30 endorsed national certification systems. The area certified totally is 243 million ha (June 2012) which makes this certification system the biggest in the world (PEFC 2012d). Around 11 million ha in Sweden are PEFC-certified (PEFC 2012a). National forest certification systems follow international sustainability benchmarks that are regularly revised. The national certification systems are also opened for international stakeholders as members. According to the PEFC organisations they are the "… certification system or choice for small forest owners…" (PEFC 2012d).

Quantification of the effect that certification has on for example biodiversity, is very difficult. The time aspect is one problem pointed out by one of the interviewees. The rotation period of a forest is around 100 years, whereas the certification systems have only been applied for about 15 years. There are also natural fluctuations. One of the interviewees says:

> *"The population dynamics is influenced by long-term courses of events that are very difficult to measure from one year to another and with starting point from a few single parameters"*

Despite the problems to assess the effect the certification systems have on biodiversity, the forest management standards (FSC and PEFC) are pointed out as important for their present biodiversity work by some of the organisations. Chain of custody certification, a certification within FSC and PEFC, gives possibility to trace the timber back to the source in order to for example check that the timber does not come from protected area. Chain of custody certification is therefore mentioned as an important part of the environmental and biodiversity work by the interviewees.

There has been criticism against the certification systems. For example, some environmental non-governmental organisations (NGOs), Swedish Society for Nature Conservation (Naturskyddsföreningen), Friends of Earth Sweden (Jordens vänner) and Nature and Youth Sweden (Fältbiologerna), have left FSC Sweden. They support the idea behind FSC, but want the standard to be improved and followed. The NGOs also claim that economic interests are dominating and that not following the standard, does not lead to enough consequences (Swedish Society for Nature Conservation 2010; Friends of Earth Sweden 2012; Nature and Youth Sweden 2012).

FSC Sweden is currently carrying out a study in order to investigate the effects a FSC-certification has on the Swedish forests. Preliminary results from the first part, a literature study, have been presented where it is stated that the certification system has stronger requirements in a couple of areas that are considered as important for biodiversity by science, for example forest areas set aside and creation of dead wood. But the report also says that it is impossible to measure the real effects and therefore difficult to say whether the requirements in the FSC standard are enough (FSC Sweden 2012b).

All the contacted organisations in step **A**, i.e. the forest-owning organisations, use FSC and/or PEFC as part of their environmental work. In some cases the interviewed representative states that the certification system is enough and that they therefore do not have any demand for a biodiversity assessment method. One of the interviewees also says that certifications are enough, also from a customer perspective.

The next step in the product chain, **B**, where the organisations have to buy timber from forest-owners to use in the industries, also mentions FSC- and PEFC-certification as important in the biodiversity work. The forest bought is often certified by either one or both the forest management certification systems. In the cases when the forest or timber bought is not certified, the organisation might do their own controls. There is no possibility to separate the certified and the non-certified raw material but this mixture could still be certified as FSC-mix.

The contacted organisations in step **C** work with certification systems. The two organisations in this study say that they prefer FSC-certification, presumably to PEFC-certification, and both mention this as a way to work with biodiversity. One of the organisations mentions the importance of certification near the source and means

that FSC is the alternative that offers that today. They are also involved in projects with the aim to increase FSC-certification. According to information found on Tetra Pak´s webpage, FSC-certification is considered more comprehensive and to have the highest credibility among stakeholders (Tetra Pak 2012a).

Even if certification is considered very important by many of the industrial contacts, two of the contacted organisations mentions that they would like to see some complement to improve the work with biodiversity, for example better assessment methods for biodiversity impact.

Internal policy documents

The contacted organisations also mention their internal policy documents, for example environmental policies, goals and guidelines, as answers to the question on how they work with biodiversity issues today. These internal policy documents could be seen as a try to complement and/or concretise the regulations and certificates and adapt those to the organisations´ prerequisites. The use of internal policy documents are pointed out by organisations in all the steps of the product chain (A, B and C) as examples of how they approach biodiversity issues.

The certification systems mentioned earlier also have requirements on the organisation specific environmental work which result in internal policy documents of various kinds. One example is the green forestry plans mentioned in the section about FSC and PEFC. The certification systems and the internal policy documents are therefore linked to each other.

The ISO 14001 standard requires a valuation of the environmental aspects in the organisation´s activities. One of the interviewees (step **A**), mentions this as important for the environmental work. From this valuation, the organisation in question constructs measurable environmental goals, for example to reduce the damages from transports. The organisation also has an environmental standard as well as guidelines for both sustainable forestry and for the follow-up of the forest management. The other organisations in step **A** talk about internal environmental goals and standards as well when they are asked about the present work with environment and biodiversity.

For the forest-buying organisations (step **B**), there are cases when the forest or timber bought doesn´t have any PEFC or FSC certification. The organisation might instead have some internal policy document regulating how to assess these forests; i.e. the internal policy document replaces the certification. The assessments are not only made for environmental and biodiversity purposes, but also for economic reasons:

> *"At a purchase of wood, the purchaser always goes out checking the forest. Partly to get an idea of the value of the timber (of course!) but also to control that the key biotopes or other environmental or cultural values are not destroyed by harvesting"*

The contacted organisations in step **C** are not different from the other organisations. The organisation specific environmental work is mentioned by the interviewed representatives as a way for the organisation to work with biodiversity issues. One of the organisations has for example developed their own alternative to ISO14001. They also have organisation specific control systems for the purchased timber and other forest related products to be able to classify it as responsibly managed even if it is not certified. The contacted organisations both use FSC-

certification, as mentioned in the section about certification systems, and at least one of the organisations has as an environmental goal to increase the fraction FSC-certified raw material. That is one more example of how standards, in this case a forest management certification standard, and internal policy documents go hand in hand.

Even if all the contacted organisations have some internal policy documents, this is not always lifted up as the most important thing in the biodiversity work. In a couple of cases, it is instead specific projects that are highlighted by the interviewed representatives as examples on how they work with biodiversity. It could be projects to develop new inventory methods to identify areas with high conservation values, projects with the aim of trying to develop methods for active management to favour threatened species, projects with education regarding certain factors important for the biodiversity for forest-owners or projects aiming at an increase of a certain red-listed species.

The environmental work within an organisation could also include the use of tools and methods for assessment of environmental impact as such, i.e. without a focus on the biodiversity impact. Life cycle assessment (LCA) and environmental product declarations, where the latter is based on the results from the former, is for example used by one of the contacted organisations in order to give information about the total environmental impact of one of their products.

4.1.2 Assessments of biodiversity and biodiversity impacts

As mentioned earlier in the report (section 2.2), a direct assessment of biodiversity as defined in CBD is impossible and indicators are used instead. The contacted organisations mostly, if they assess biodiversity and biodiversity impact, rely on indirect measurements, with indicators such as dead wood, old trees, biotopes and structures or other indicators that say something about the prerequisites for biodiversity. An assessment method that is developed by Skogsbiologerna and, as described in section 2.2, relies on more indirect measurements, is for example mentioned by three of the contacted organisations.

The organisations in step **A** in the chain are the ones closest to the forest. At least two of the organisations, uses the same assessment method, mentioned above, a method mainly based on indirect measurements and structure related indicators (Skogsbiologerna 2012). To assess biodiversity or biodiversity impact makes it possible to do follow-ups (see section 4.1.3) or identify areas with high conservation values and decide which areas that should not be harvested. Assessment of the impact an organisation has on environment and biodiversity could, beside the use of a method as for example the one mentioned above, be done through projecting what the forest set a side and left today will look like in the future and by direct inventories of certain groups of species.

Also the organisations in step **B**, those that purchase forest, use assessment methods to judge whether the forest should be felled, conserved or if special consideration has to be taken. If inventories show high biodiversity values, the purchase may be stopped.

Organisations in the last step, **C**, do not mention that the do any assessment of biodiversity or of biodiversity impacts. They are rather far away from the forest and therefore dependent on how their suppliers work with biodiversity questions and if they use any assessment methods. The C-step organisations could work indirectly

with biodiversity and for example promote forest management by their suppliers. The importance of certification systems is already mentioned in section 4.1.1.

Direct inventories of certain species are made in some cases when the purpose for example is to see how different populations are affected by forest management (see also section 4.1.3). But the use of for example red-listed species to a larger extent than today is by at least one of the interviewees mentioned as something that would require both knowledge and time and therefore probably be too demanding. Another of the interviewees means that the focus on certain indicator species lead to problems since those do not say enough about how things are connected on an ecosystem level. The same opinion is presented in the Swedish Standard for Forest Certification by FSC where it is found to be more appropriate to assess the potentials for biodiversity than the actual presence of species in order to analyse the biodiversity values of an area. To base a valuation on the actual presence: "… demands extensive field work and a high level of biological competence." (FSC 2010)

Regarding the question of direct or indirect indicators, the organisations interviewed are in general negative towards more direct indicators and associate this kind of methods with more time, more work and more knowledge needed.

Some problems connected to biodiversity assessment, are presented in section 2.2, for example the base-line problems. The interviewees also talks about the difficulties to decide what kind of biodiversity that is "normal". One of the other industrial contacts instead means that the concept "biodiversity" itself is a problem since there are so many different views on what "biodiversity" actually is.

4.1.3 Follow-up measures taken

As have been touched upon in the previous section about biodiversity assessments (section 4.1.2), one of the applications for biodiversity assessment methods, is related to follow-up measurements. One of the interviewees tells that they, in that particular organisation, rely on their green forestry plans before a felling and use assessment methods afterwards, in order to check whether the felling is carried out properly or not.

Follow-ups of the environmental and biodiversity work of an organisation, could take different forms. One way is to assess biodiversity at different occasions, which make comparisons possible. But even if an assessment method that gives a number is used, the result might not be paid so much attention. One of the interviewees says as follows:

"We are following the method by Skogsbiologerna to make an environmental value assessment and you could do follow-ups regarding how the environmental value point has developed over time since we make continuous repetitions of our allocations … to see what kind of quality they have… We do it. But you can say like this. We do it but we don´t pay so much attention to the numbers every time".

The reason for the small interest in the numbers in this case, is explained by the organisation with that they feel that they have other methods to secure those things, for example with organisation specific measurable environmental goals. The follow-up is focused on those measurable goals, although these goals do not deal with biodiversity directly (authors comment).

Another way of follow-up measurements is connected to the assessment of biodiversity impact mentioned above with "projections and inventories of certain groups of species". Organisations with environmental policies, goals etcetera often follow those up in audits, internal or external. Third part auditing is part of the certification systems (FSC 2010; PEFC 2012c) and internal.

4.2 Future work with Biodiversity

The contacted organisations were asked about their thoughts regarding future biodiversity work and especially about their attitude to quantification of biodiversity. Would quantification be possible and would it be useful?

4.2.1 Attitude to quantification of biodiversity

All the organisations that have participated in the study have shown a general interest in biodiversity issues. The attitude to a quantification of biodiversity, differ a little among the organisations. There are problems recognised by the representatives and those are briefly gone through in the section about biodiversity assessments (section 4.1.2). A summary of some of the thoughts about quantification mentioned during the interviews are presented in ***Table 2*** below.

Table 2 *Attitudes to quantification*

Part in the product chain	Thoughts about quantification of biodiversity and biodiversity impact
A	• Can´t see any need today for future quantification methods. • Not possible to sum up biodiversity into one single number. • Positive to quantitative assessment of biodiversity work.
B	• A lot of knowledge would be needed to for example check species (red-listed) instead of substrates. • Hopefully a general assessment method for all forest stakeholders. Probably not focus on red-listed species but rather substrates, age, age-differences etc.
C	• Wants to quantify biodiversity impact. One number if possible. To influence suppliers and inform customers. • No need to quantify. No need for one single number.

In step **A**, there are both organisations that are positive to the quantification idea as well as organisations with a more negative or sceptic approach. Why they think as they do, have different reasons. One interviewee does not think it is possible to condense such a complex thing as biodiversity into one single number, whereas another does not see any present need and a third find it interesting but currently rather far away. This third interviewee claims to be positive to a development of a quantitative assessment method.

The attitudes to quantification of biodiversity among the organisations in step **B**, is not always known since a couple of them did not give any answer or not a clear one. One of the interviewed persons sees, as mentioned earlier, a growing need of expert knowledge if quantification will build on more direct indicators as for example red-listed species. A quantification that depends on species would also demand a better knowledge about the species in general and the prerequisites for their living.

In step **C**, there are totally different views on a future quantification. On the one hand, there is an outspoken need for some kind of quantification method and on the other, there is a scepticism regarding the possibilities to quantify anything as complex as biodiversity. The certification is in the last case considered to be enough and the organisation does not really have any use for a number saying that the biodiversity impact is 7 or 49. This interviewee points out the importance of the purpose of a quantification method. The result from a quantification might be used as a discussion material.

Quantification is, as reported above, connected to different views and thoughts. It is considered difficult and no present need or demand is identified. But there are also examples of organisations that request some form of quantification of biodiversity and biodiversity impact even if they are aware of the difficulties. When asked about why a quantification is needed, the responses varies, from making better assessment and check that steps are taken to improve biodiversity and manage forests in a good way, to influencing suppliers and informing customers.

4.2.2 Interest in future biodiversity assessment methods

The interest in future biodiversity assessment methods differ as much as the attitude to the question about quantification of biodiversity and biodiversity impacts. Since quantification is not regularly carried out today, the attitude-question could be said to be part of the question about future biodiversity assessment methods. But organisations have thoughts and ideas also about future assessment methods in general.

As reported in section 4.2.1, there are organisations that are positive to quantification even if they do not think it will be reality in the nearest future. They can see a need to develop quantitative methods to assess biodiversity and the work with biodiversity. The forestry-part (step **A**) has also felt that the industry (step **B**) is not satisfied with the use of certification systems but would like something more.

> *"Questioner: Do they want more information or is it enough that it is certified or that it meet your environmental goals?*
>
> *Interviewee: You mean the industry? I wouldn´t say that it is enough. They would like to know and are interested in what we are doing and follow-ups and such things. So I do think that a broader picture is demanded than that we should just be certified"*

But there is also the earlier mentioned example in step **A** when the interviewee considers certification as enough and do not see any demand from customers for further biodiversity assessment methods that might include quantitative measurements.

Opinions regarding future biodiversity assessment work from the organisations in step **B** are approximately the same as their attitudes to quantification. The present work with biodiversity is regarded as good enough and any quantitative assessment method would probably require a lot more knowledge. One expressed wish is that any future assessment method of biodiversity should be something that all stake-holders could agree upon since that would make things easier.

The contacted organisations are often, regardless of where in the product chain they are found, involved in projects with researchers or other projects aiming for better future biodiversity work and assessment methods. There are also networking and the previously mentioned wishes to achieve assessment methods that are used by the whole sector. Some of the contacted organisations have no thought about future work or have at least not said anything about it in the interviews.

5 Discussion

To judge from the interviews made, there is a spectrum of different approaches to biodiversity issues in the contacted organisations. Some of the differences certainly have to do with the place in the product chain. A forestry organisation has other possibilities to affect biodiversity, in a positive or negative direction, than an organisation further away from the raw material. But there are also differences within each step in the product chain, i.e. between the organisations, especially when it comes to the attitudes to future work with biodiversity.

The fact that the assessment method of forest ecological values developed by Skogsbiologerna is used by so many of the forestry organisations, could be a problem if it does not include all the important aspects of biodiversity. The method focuses on structures and prerequisites for biodiversity rather than on biodiversity itself (for example species or genetic diversity). This simplification could lead to assessments that are not consistent with reality. On the other hand could the fact that this method is used by at least three of the organisations be an advantage if the method really captures the most important aspects when it comes to biodiversity. To judge the quality of the mentioned assessment method is outside the scope of this report.

The potential problem with that standards used by nearly every actor, at least to some extent by all the contacted organisations in this study, might be focusing on the wrong factors or that the observance is not as it should with respect to biodiversity, could be handled with proper biodiversity assessment methods that could be used in follow-ups. But today, the interest of such methods seems to be limited among the contacted organisations. There can be many reasons and the question is perhaps rather who should do the follow-ups and check whether the biodiversity work by an organisation fulfils its purposes or not. Should it be possible to just trust what is stated in a standard or in legislation and other conventions regarding biodiversity or do the organisation or individual that uses those standards etcetera have a responsibility to not only check that the requirements are fulfilled but also that biodiversity is actually enhanced? Or is the fact that an assessment of the effects on biodiversity is so difficult, a reason for not making any assessment? The time aspect and the natural fluctuations in biodiversity of course make the issue even more complicated. But regardless of if it is the forest owner, the forest buyer or the legislator or the organisation setting the standards, some follow-up on biodiversity level should be done in order to check that what is intended also is reached.

The study regarding the effects of a FSC-certification that FSC Sweden is carrying out at the moment could be a step in the right direction in order to secure that the most important factors for biodiversity is actually favoured by the requirements in the standard. But the fact that also the mentioned study by FSC Sweden states that it is difficult to judge whether their certification system will contribute to maintenance of biodiversity in the long run, is perhaps a little worrying. Are the organisations, consumers and other stakeholders that rely on a certification standard aware of the short-comings and uncertainties? The study by FSC Sweden compares requirements in the standard with legislation and the conclusion that a FSC standardisation benefit biodiversity seems to be based on the fact that the standard in certain areas has stronger requirements than what is legislated. What kind of effect would in this case a stronger legislation when it comes to biodiversity issues have? The study by FSC Sweden does not include any investigation of biodiversity in reality but is based on a literature study. Would an assessment method have been used if any proper one was available and would that have affected the result? Or is it better to rely on what researchers have said is important prerequisites for biodiversity?

Regarding how an assessment of biodiversity could be done, the sample of suggestions presented in this report, shows a variety both when it comes to indicators used and what the indicators are used for and if the assessment method results in a specific number or if it is more qualitative to its nature. The sample could have been totally different, since the theories are numerous, more or less well developed and applicable. The contacted organisations would like an easy method without any high demands on time or knowledge. But the method must not be too simple and give a wrong estimation of biodiversity impact. What is worse, no assessment method or an assessment method that gives wrong values? The dominance of indirect indicators and assessment methods today would probably make it more difficult to introduce new more direct ones. One of the interviewees stress that the purpose with an assessment method must be kept in mind. So, what could a possible purpose be? If the purposes are multitude, for example use the result both to influence suppliers to decrease their biodiversity impact and for marketing purposes, does that imply the need for a multitude of tools and methods?

The complexity of biodiversity is regarded as a problem, by the people from industry and forestry as well as by the researchers who try to improve the possibilities for biodiversity impact assessments. To the complexity comes the fact that the forest is also used for production and that both the forest management standards and Swedish policies try to balance the biodiversity considerations with the production goals. This balance problem is with certainty the root of some of the criticism against the certification standards. There is a risk that the same criticism would follow an introduction of a new assessment method for biodiversity impact. Also more biodiversity including varieties on already existing environmental assessment methods, for example LCA, would probably face criticism of the same type.

Whether an organisation is interested in biodiversity or not, could depend on a lot of reasons and that is outside the scope of this study. It could nevertheless be of importance that differences exist if a new method should be introduced. The organisations that participate in this study are all regarded to have some interest in biodiversity issues, but nearly half of the interview requests made were, as mentioned earlier, answered with a "no" or left without any answer at all. If the unwillingness to participate in the study is due to an absent interest in biodiversity, the gap between the researchers and the "reality", i.e. the organisations thought to use the tools and methods the researchers develop, is problematic. There is some kind of gap also between the researchers behind some of the investigated theories and some of the organisations that take part in the study. The organisations fear methods that require more time and knowledge and are rather happy with existing methods. The researchers, on the other hand, present suggestions on new or improved biodiversity assessment methods that might need both time and expert knowledge and with results that are just approximations.

The limitations stated in the scope, have for course influenced the quality of the report. The consequences of the restricted time and the difficulties to find organisations who want to participate have led to that a limited number of interviews have been made. Wide-ranging trends and conclusions should for this reason not be made. The conclusions made in this report, only apply for the interviewees. If the way of presenting the results and referring to the interviews would have been known and communicated at the same time as the interview requests were made, it might be possible that more organisations would have participated. The organisations that perhaps feared bad publicity and therefore did not want to answer any questions, might for example have felt more comfortable if they would have known that the study only refers to step A, B and C and not to individual organisations.

Recommended future research

Future work that would be of interest would be to develop the industrial contacts, either by looking at other sectors, or by trying to get more organisations in the forestry connected sector to answer the questions. One other possible future task is the comparison between the practical work investigated in this study and the theories suggested in literature. A comparative study between the indicators used in present biodiversity studies and indicators suggested in theories in the literature could act as a guideline for development of biodiversity assessment analysis tools and methods practically useable.

6 Conclusions

The present biodiversity work in the contacted organisations is, according to this study, largely built on standards, as ISO 14001, FSC and PEFC. The internal policy documents connected to biodiversity issues are often the result of requirements in those standards.

The question about future biodiversity assessment methods, gives a picture of a shattered sector where the opinions range from very positive to improvements and developments of for example quantitative assessment methods to sceptical, due to the complexity of biodiversity, or uninterested, since the work with certification systems are regarded as enough.

Future biodiversity assessment methods need to be easy, i.e. without large time- and knowledge demands, without being too simple, thereby giving a wrong result. To change from assessments of prerequisites for biodiversity, which is mostly used today, to assessments of actual biodiversity, would probably not be unproblematic.

Certifications are considered as important, but no follow-up is actually done to check whether biodiversity is improved. Regardless of if an assessment is made by the forest owners or by the forestry organisations or by the certification organisations, an assessment of some kind seems important in order to secure that the measures taken to improve biodiversity or the prerequisites for biodiversity really have the intended effects.

A need for better communication and cooperation on biodiversity issues within the sector, both between organisations in the same step in the product chain and between organisations in different steps, could be identified. Communication and cooperation between the “reality”, i.e. for example the industry or the forestry, and “theory”, i.e. for example researchers developing new methods and tools, could be improved as well in order to find a functional method for biodiversity impact assessment.

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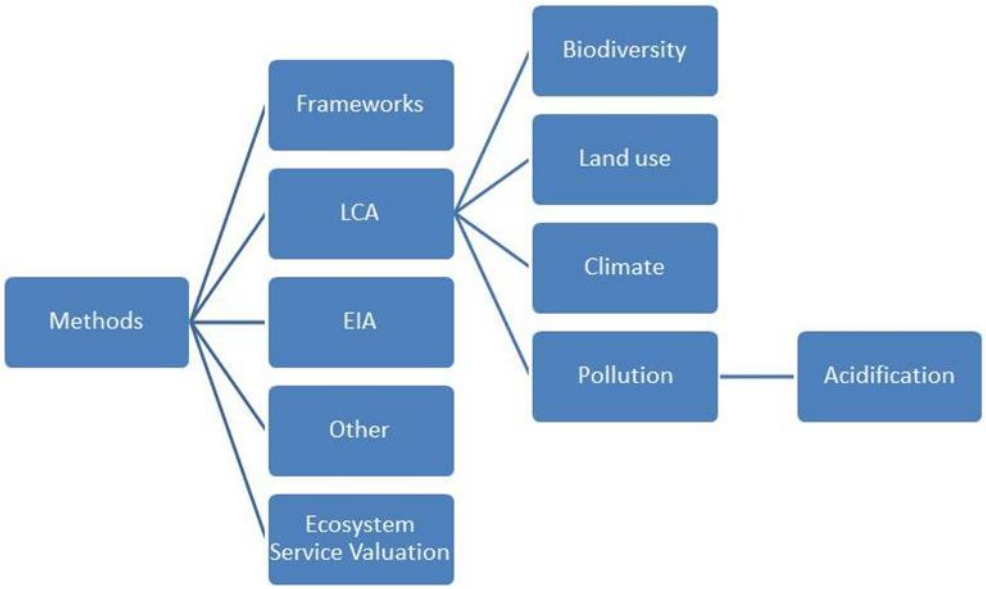
Appendix A – Categorisation of assessment methods



Assessment tools/methods and frameworks. A categorisation of the methods found in the literature study

Appendix B - Assessment methods

Sample of some assessment methods with biodiversity aspects involved

Article	Short description of the assessment method	Indirect or direct assessment of biodiversity[1]	Indicators[2]	Things of importance[3]
Brandão and i Canals (2012)	Characterisation factors for land use in LCA. BPP (Biotic Production potential)	Indirect	SOC (Soil Organic Carbon)	Land-use-specific and biogeographically differentiated data on SOC
Burke et al. (2008)	"Biotope-method"; biotopes valued before and after land-use change	≈Direct	Red-listed or endemic species (plants) Site specific indicators.	GIS information. Baseline information is needed. Local biotopes→geographical specific.
De Schryver et al. (2009)	LCA Global warming. New characterisation factors.	≈Direct	Wide range of species. Based on other studies. Characterisation factors PDF (potentially disappeared fraction) and DALY (disability adjusted life years)	
Koellner and Scholz (2007)	Framework Land-use		EDP (Ecosystem damage potential)	Not site-specific
Michelsen (2008)	Land use in LCA. Experts choosing key factors. A scaling made.	Indirect	Key factors (ES-Ecosystem scarcity, EV-Ecosystem vulnerability and CMB-Conditions for maintained biodiversity) Index constructed from key factors. Gives quality–Q	
Michelsen et al. (2011)	LULUC (land use and land use changes) in LCA. Area, time and land quality changes (carbon pools and biodiversity)	Indirect	Same biodiversity indicators as in Michelsen (2008).	

[1]Direct assessment means an assessment of biodiversity itself in some way while indirect gives an assessment of the prerequisites for biodiversity. Some cases are unclear. Those are marked with "≈" before direct/indirect.
[2]Indicators mentioned in the article.
[3] Things, that are important for use of the method, for example knowledge or background information needed, or whether the method is site specific or not.

Sample of some assessment methods with biodiversity aspects involved. Continued.

Article	Short description of the assessment method	Indirect or direct assessment of biodiversity[4]	Indicators[5]	Things of importance[6]
Milà I Canals et al. (2007)	Quality effects from different land use. Framework regarding how to include land use in LCA.		Table of indicators possible indicators. For example red-listed species, PDF and global species diversity as indicators for biodiversity	Quality and time Dynamic reference situation.
Myllyviita et al. (2012)	MCDA (Multi Criteria Decision Analysis) for identification of impact categories and for weighting in LCA. Expert panel listing	Direct		Expert knowledge
Mörtberg et al. (2007)	LEA – Landscape Ecological Assessment. Comparisons of habitat networks for focal species between present and scenarios.	Direct (species) and indirect (structures)	Focal species	Habitat modelling (GIS). Input data for example topography, wetlands, land use. Site- and problem specific
Normander et al. (2012)	BCI – Biodiversity Change Index Indicator framework Two dimensions (quantity and quality of ecosystem)	Direct and indirect (structures)	Habitat area (quantity) Habitat quality (quality - structures) Species abundance (habitat specific) (quality)	Habitat classification scheme. Habitat specific
Penman et al. (2010)	Experts put value to expected biodiversity changes (-10 to +10). The answers should, if possible, be based on published data. The questions are weighted.	Estimation of direct	Depend on questions.	Expert knowledge. Weighting of answers. Case specific
Söderman (2006)	EIA (Environmental impact assessment)	Direct	Redlisted species. Vulnerable ecological important sites	Site-specific
van Zelm et al. (2007)	LCA and acidification. Characterisation factors (fate and effect factor) time-dependent	≈ Indirect (dose-response)	240 plant species dose-response curves	European data. Possible to focus on target species. Not site-specific
Vogtländer et al. (2010)	LCA-Eco-cost. Marginal prevented costs. Land use (depletion of natural forest)	≈Direct	Species richness (from Barthlott maps)	

[4]Direct assessment means an assessment of biodiversity itself in some way while indirect gives an assessment of the prerequisites for biodiversity. Some cases are unclear. Those are marked with "≈" before direct/indirect.
[5]Indicators mentioned in the article.
[6] Things, that are important for use of the method, for example knowledge or background information needed, or whether the method is site specific or not.

Appendix C - Structure for contact and interview guideline

The first contact with the organisations was taken per e-mail where also a short introduction to the project was given. From the organisations who accepted the inquiry about an interview, interviews were booked and made per telephone.

The interviews started with a presentation part were the persons interviewed got possibility to present themselves as well as ask questions about the project and the background of the interviewer. The coming questions followed the guideline below (translated to Swedish), adjusting to the organisation, the circumstances and the situation.

1. Do you work with biodiversity today?
    a. If yes, how?
2. Do you make any assessment of your biodiversity impact today?
    a. Why/why not?
    b. If yes, how?
3. What is your opinion of quantification of biodiversity and biodiversity impact?
    a. Good/bad?
    b. Possibilities/problems?
4. Do you have any wishes regarding future assessment methods for biodiversity and biodiversity impact?
    a. Prerequisites for the ideal method?

Appendix D – Basic information about contacted organisations

Short Information about the contacted organisations

Organisation	**Short Information**	**Stage in the product chain**
Billerud Skog	Billerud Skog is a part of Billerud, a manufacturer of primary fibre-based packaging material with six production units situated in Sweden, Finland and the UK (Billerud 2012a). Billerud Skog is responsible for the biofuel and fibre raw material supply and purchasing standing and harvested wood (Billerud 2012b).	Industry B (pulp and paper)
Holmen Skog	Holmen Skog is responsible for development and managing of the forests owned by Holmen, a forest-industry group with five business areas (Holmen Paper, Iggesund Paperboard, Holmen Timber, Holmen Skog and Holmen Energi). The group is self-sufficient in wood to about 60 % (Holmen, 2012).	Forestry (A) (Industry in the group)
IKEA	IKEA is a global home furnishing company. The yearly use of timber is about 14,5 million cubic metres for products, printed matters and packaging (IKEA 2011).	Industry (C) (furniture etc.)
Korsnäs	Korsnäs AB is a producer of virgin fibre-based packaging material with production concentrated to three sites (Gävle, Frövi and Rockhammar) (Korsnäs 2012c). The primary products are Liquid Packaging Board, White Top Kraftliner, Cartonboard and Sack & Kraft Paper (Korsnäs 2012d). Korsnäs sells out their former forest land but are still managing forest areas for both small forest owners and for Bergvik Skog and gets cutting rights instead (Korsnäs 2012a).	Industry (B) (pulp, paper, carton etc.) (some forest management)
Norra Skogsägarna	Norra Skogsägarna is one of the four organisations for private forest owners in Sweden and is owned by the around 16 000 members, found in Norrbotten, Västerbotten and Ångermanland . The members together own around 1 200 000 ha forest area. Norra Skogsägarna also has four “wood processing industries” and is one of the biggest bioenergy suppliers in Norrland (Norra Skogsägarna 2012b)	Forestry (A)

Short Information about the contacted organisations. Continued

Organisation	**Short Information**	**Stage in the product chain**
Sveaskog	Sveaskog has as the main business to sell timber, pulp wood and biofuel. Sveaskog is also the largest forest owner in Sweden and owned by Swedish state through the Ministry for Industry (Sveaskog 2012a).	Forestry (A)
Stora	Stora Enso is a global group with four business areas, printing and reading, biomaterials, building and living and renewable packaging (Stora Enso 2012b). A special Wood Supply area manages wood and fuel deliveries and coordinates plantation operations (Stora Enso 2012c).	Industry (B) (packaging etc.)
Södra	Södra is one of the four big organisations for private forest owners in Sweden and are owned by the more than 51 000 members, forest owners in southern Sweden. Södra has four business areas: Wood products, Pulp, Energy and Södra Interiör (Södra 2012a).	Forestry and industry (A/B) (for ex pulp, wood products)
Tetra Pak	Tetra Pak is producing packaging and processing solutions (Tetra Pak 2012b).	Industry (C) (packaging etc.)