Forest Stewardship Council
FSC Sweden

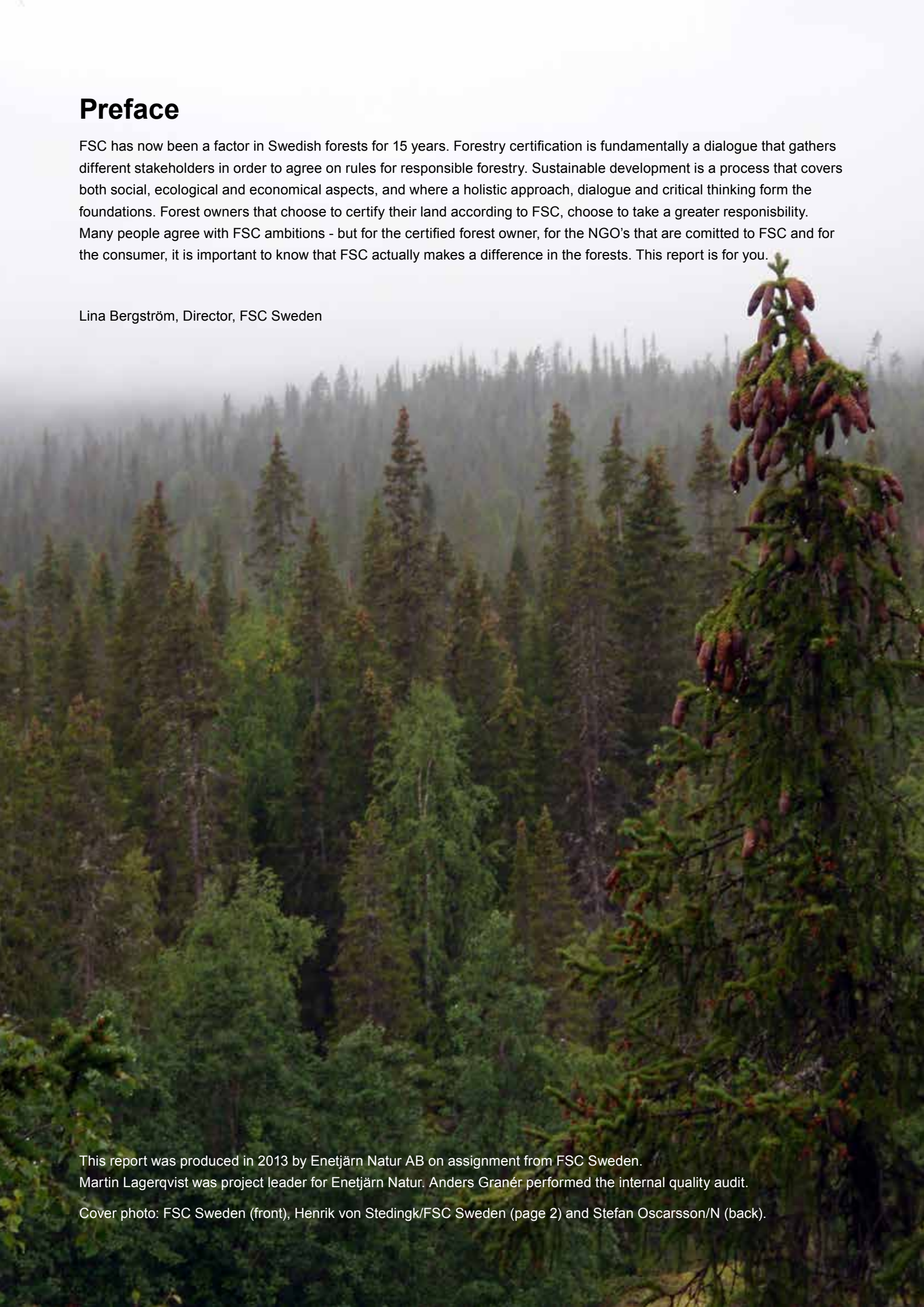
The contribution of FSC®-certification to biodiversity in Swedish forests

Report 2 |2013

Preface

FSC has now been a factor in Swedish forests for 15 years. Forestry certification is fundamentally a dialogue that gathers different stakeholders in order to agree on rules for responsible forestry. Sustainable development is a process that covers both social, ecological and economical aspects, and where a holistic approach, dialogue and critical thinking form the foundations. Forest owners that choose to certify their land according to FSC, choose to take a greater responisbility. Many people agree with FSC ambitions - but for the certified forest owner, for the NGO's that are comitted to FSC and for the consumer, it is important to know that FSC actually makes a difference in the forests. This report is for you.

Lina Bergström, Director, FSC Sweden



This report was produced in 2013 by Enetjärn Natur AB on assignment from FSC Sweden.
Martin Lagerqvist was project leader for Enetjärn Natur. Anders Granér performed the internal quality audit.

Cover photo: FSC Sweden (front), Henrik von Stedingk/FSC Sweden (page 2) and Stefan Oscarsson/N (back).

FSC®- certification provides value for biodiversity

More than half of Swedens productive forest area is certified in accordance with FSC. By certifying their land the land-owner is committed to comply with FSC regulations for responsible forestry. According to FSC, responsible forestry implies consideration to the environment, to the people who work in the forest, to the local residents and to the Sami people. It also implies practicing economically viable forestry.

This report describes how some of the requirements in FSC's forestry standard provide value for biodiversity exceeding what is stated in the Swedish Forestry Act.

Five environmental aspects have been identified where scientific research shows a value for biodiversity, where the value is quantifiable and where the FSC standard provides greater value for biodiversity than the Swedish Forestry Act: 1. Retention trees, 2. Dead wood, 3. Conservation areas and woodland key habitats, 4. Deciduous forests and 5. Forest fires.

Additional environmental aspects (red-listed species, buffer zones, landscape planning, forest roads, damage to soils and water) are discussed briefly at the end of the report. For these aspects it is difficult to evaluate the difference between forestry legislation and the FSC standard, or there is a lack of scientific research on how the FSC standard provides additional value for biodiversity.

The contents of this report is based on scientific research, and gives examples to highlight the benefit of FSC certification for biodiversity.

FSC'S TEN BASIC PRINCIPLES

FSC has ten basic worldwide principles that set the foundation for an environmentally adapted, socially responsible and economically viable forestry.

The Swedish forest management standard states the rules that FSC certified forest owners must follow and is based on the international principles. This report focuses on principle number 6, which is about the impact of forestry on the environment. According to principle 6, "Forest management shall conserve biological diversity and its associated values, water resources, soils, and unique and fragile ecosystems and landscapes, and, by so doing, maintain the ecological functions and the integrity of the forest."

The UN Convention on biological diversity defines 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.

The FSC standard demands that conservation trees be retained during harvesting and that buffer zones are left around lakes and watercourses. (Photo: Henrik von Stedingk/FSC Sweden)

Retention trees

Retention trees are living trees retained for nature consideration during clear-cut harvesting. Both individual trees as well as small tree groups can be retained. Retaining trees will secure the input of old and dead trees in the upcoming forest generation. These are important for many forest-dwelling species, but are relatively sparse in todays forest landscape. Retention trees are intended to remain in the forest until they are naturally decomposed. Typically coarse trees, hollow trees, canopy trees, and deviating tree species that are important for biodiversity are classed as biodiversity value trees.

FSC LOOKS AHEAD INTO THE NEXT FOREST GENERATION

The Swedish Forestry Act regulations state that individual trees or tree groups shall be retained during harvesting. Priority is given to trees of natural or cultural value. Both FSC and the Swedish Forestry Act require tree retention during harvest, but only FSC sets a goal for retention; to achieve 10 eternity trees per hectare during the next forest generation. In addition, FSC demands that all biodiversity value trees shall be retained (these may be included among the 10 eternity trees).

MORE RETAINED TREES - BETTER FOR BIODIVERSITY

By retaining all biodiversity value trees in accordance with FSC standard the conditions for biodiversity are improved considerably. Biodiversity value trees such as old hollow trees, canopy trees and old trees that have survived disturbances are valuable for many species and are utilised by more vertebrates and insects than regular mature trees.

The more trees that are retained, the better the conditions are for forest-dwelling species. Many eternity trees risk being storm-felled in the exposed post-harvest environment. They then become a source of coarse dead wood. Retained trees also provide greater variation in stand structure as

Glossary

Retention trees - *Trees that are retained for nature consideration during harvesting. Can be biodiversity value trees.*

Development trees - *Trees that do not have any particular conservation value at present, but can be retained in order to develop into coarse, old trees and later become dead trees.*

Eternity trees - *Alternate name for retention trees as they will continue to grow into the next forest generations. However, no trees live for ever, but eventually become dead wood and provide food for decomposers.*

Biodiversity value trees - *Trees with high conservation value, e.g. large old trees, large trees with thick branches or flat crown, deviating tree species.*

Canopy trees - *Sparsely located trees that are considerably older than the rest of the stand.*

Retained trees contribute to structural variation in the growing stand (Photo: Henrik von Stedingk /FSC Sweden).

well as tree dimension, age, size and species, thus creating more habitats for tree-inhabiting species.

RETENTION TREES AS LIFE-BOATS

Retention trees provide an ecological function as ”life-boats”, i.e. facilitating survival of forest-inhabiting species during the clear-cut and young forest stages, and before the new forest generation has achieved a closed canopy. Epiphytic lichens, mycorrhiza fungi and smaller ground-dwelling animals such as ground beetles and salamanders utilise the trees as life-boats. Many bryophytes and vascular plants have difficulties in surviving the harvesting stage even if a large proportion of trees are retained.

In order for long-term survival of populations, it is important for species to disperse from retention trees to the new growing stand. For example, certain mycorrhizal fungi that survive on the roots of retained trees can spread to root of young trees. Even some epiphytic lichens can disperse from retained trees to surrounding trees .

STRUCTURAL VARIATION IS IMPORTANT

Retention trees provide important structures, such as hollow trees and old trees on clear-cuts and in young stands. They also contribute to a structural continuity over time. Retention of more trees makes clear-cuts resemble natural disturbances such as fires and storms to a greater extent. This is beneficial for species adapted to forest disturbances. Retained trees improve clear-cut quality for birds and insects adapted to disturbance. Some raptors and woodpeckers show preference for clear-cuts with retained trees in comparison to both productive stands and clear-cuts without retention trees. A Swedish study showed that the number of bird territories in an area increased with the number of retained trees. The increase was significant for both retained coniferous and deciduous trees.

Retention trees are beneficial for small mammals as they can utilise the tree litter (dead organic matter that has not been transformed into humus) such as twigs, needles and leaves for shelter.

According to the FSC standard retention trees must be retained so as to secure that 10 eternity trees remain into the next forest generation. In this case retained Aspens on a clear-cut. (Photo: Henrik von Stedingk/FSC Sweden)

Dead wood

Dead wood has many important functions, as food resource, habitat or shelter. A large proportion of red-listed forest-inhabiting species depend on dead wood. It is mainly fungi and insect species that need dead wood for survival, but also birds, lichens and bryophytes utilise dead wood. A variety of dead wood types and continuous input of new dead trees is vital in order to provide high forest biodiversity.

Many wood-inhabiting species have specific demands on tree species, sun exposure, decomposition stage or tree diameter. In old-growth stands variation in dead wood quality is provided as trees are killed by disturbances or parasites. Managed forests have a lack of dead trees as most trees are harvested before they are killed from natural causes. Many dead trees are also removed during felling operations. The Swedish Forestry Act demands that fresh conifers felled by storms, snow, harvesting or other reasons are removed if the volume exceeds 5 m^3f per hectare. This is in order to avoid pests, such as bark beetles.

FSC LEAVES AND CREATES DEAD WOOD

Both FSC and the Swedish Forestry Act demand that pre-harvest dead wood be left after harvesting. However, the FSC standard demands in addition that dead wood be created. In addition to retaining dead wood the FSC standard demands that two coarse diameter fresh wind-felled

Glossary

Dead wood - *Standing or fallen trees and dead parts of trees. Typically includes tree parts larger than 10 cm diameter.*

High stump - *A tree stump cut at a few meters height and left standing.*

Log - *A dead fallen tree.*

Girdling - *Removal of all bark in a trip around the trunk of a tree with the intention of killing the tree.*

All dead wood older than one year must be retained according to FSC standard. The photo shows a retained natural high stump. (Photo: Leif Öster/Sveaskog)

trees be retained per hectare as well as creating three high stumps or girdled trees per hectare. Further requirements in FSC standard such as conservation areas and retention trees contribute to the long-term increase of dead wood available at the landscape level, as dead wood generated from these will be left to decompose. Modelling studies indicate that forests managed according to the FSC standard can host three times as much dead wood in the next 100 years compared to forests managed without FSC standards. Many red-listed wood-inhabiting beetles prefer sun-exposed wood. Dead wood on clear-cuts is more exposed to sunlight than in closed canopy forests and is therefore an important habitat.

According to the Swedish FSC standard, all dead wood older than one year must be left in the forest. Trees that pose a safety risk, block frequently used paths and roads, constitute fine diameter harvest residue or provide hatching material for pest insects are excepted from this rule. In addition, all fresh dead wood, younger than one year old, that comes from retention trees must be retained in areas set aside for conservation or in forest impediment areas. The Swedish Forestry Act states that dead trees be retained after clear-cutting and the Swedish Forest Agency specifically states in regulations that this concerns older wind-felled trees, high-stumps and snags.

HIGH-STUMPS ARE IMPORTANT FOR BIODIVERSITY

Spruce high-stumps host a different species composition than ordinary harvest stumps or logs from the same tree species. There are also more species on high stumps than on ordinary harvest stumps. This indicates that the high-stumps contribute a new habitat for biodiversity and thus complements the harvest stumps and other dead wood created during harvesting.

Many common species that occur on dead wood are not exclusively related to high-stumps, but utilise other types of dead wood as well. Because created high-stumps only constitute a small proportion of dead wood in the landscape it is unclear how important they are for the survival of the species that utilise them. However, high-stumps have been shown to be very important for two beetle species.

High-stumps on clear-cuts are the most important substrate for the beetle *Hadreule elongata* in the modern forest landscape. The beetle *Peltis grossa* is red-listed as vulnerable and utilises spruce high-stumps about ten years after clear-cutting. In a landscape in Dalarna, Sweden, more than half of the exit holes from *P. grossa* were found on high-stumps on clear-cuts despite the fact that high-stumps only constituted 7 % of the standing dead wood on the clear-cut areas. Creating high-stumps has significantly contributed to the population growth of this beetle since the late 1990's.

Most studies on the importance of high-stumps for biodiversity have been performed on spruce and beetles. At present there are few studies on different tree species and the importance of high-stumps for fungi, bryophytes, lichens and hole-nesting birds and mammals.

The beetle Peltis grossa is positively effected by high-stumps. (Photo: Dmitry Telnov/The Entomological Society of Latvia)

FSC standards demand that three high-stumps (see photo) or girdled trees be created per hectare during clear-cutting. (Photo: Henrik von Stedingk/FSC Sweden)

Conservation areas and woodland key habitats

Voluntary conservation areas of forest land are complementary to the formal public protection of valuable habitats. The forests that land owners set aside for conservation must be exempted from forestry, with the exception of management to encourage biodiversity.

MORE FORESTS SET ASIDE WITH FSC

According to the Swedish Forestry Act land-owners are not required to leave more nature consideration than the percentage of timber value regulated by intrusion restrictions (2-10 % of timber value at harvest). The FSC standard requires that forest owners exempt at least 5 % of their productive forest land from management apart from trees left as nature consideration during clear-cutting. Priority as conservation areas is given to areas of importance for biodiversity and based on landscape representativeness.

ALL WOODLAND KEY HABITATS ARE TO BE RETAINED

FSC standards contribute to increased areas of forest land excluded from regular forest management. Woodland key habitats and buffer zones surrounding conservation areas and restored areas are included in the 5 % area. If the area of woodland key habitats and buffer zones exceeds 5 %, the exceeding land area should be set aside as well. Nature consideration patches left during clear-cutting and buffer zones around these may not be included in the conservation area.

THE VALUE OF CONSERVATION AREAS AND WOODLAND KEY HABITATS

Below Sweden's montane forests there is a lack of contiguous forest areas of high natural value that can be set aside for conservation purposes. The forests are largely fragmented. Research has shown that preservation of woodland key habitats of high ecological value has positive impact on biodiversity. However, the benefit for biodiversity decreases with increased fragmentation.

Woodland key habitats are "islands" in a "sea" of managed forests. In general, woodland key habitats host greater structural variation, providing more habitats and substrates than managed forests. They also host more dead wood

Glossary

Conservation areas in the FSC - *5 % of the ownership must be set aside for conservation purposes. Land that has been transformed into a nature reserve and where the owner has received economical compensation may not be included in the 5 %. Conservation areas are also termed set-asides.*

Woodland key habitats - *According to the Swedish Forest Agency woodland key habitats are defined as "an area that is assessed to be of great importance for forest flora and fauna concerning structure, species composition, history and physical environment. Red-listed species occur or are expected to occur." In these areas there are abundant structures for biodiversity: dead wood, old trees, large boulders and rocky cliffs. According to the FSC standard all woodland key habitats shall be preserved. They may be included in the 5 % conservation areas.*

Voluntary conservation areas - *Productive forest land that the land-owner voluntarily exempts from forestry without compensation.*

Transition zones - *Areas adjacent to clear-cuts and e.g. watercourses, forest impediments, wetlands or areas that are intended for conservation or restoration. Transition zones must be left according to FSC standards. Their total area may be included in the 5 % conservation areas. Also termed buffer zones or protection zones.*

than managed forests and have higher species richness. Diversity in woodland key habitats is influenced by the surrounding forests. For instance, there are more species in woodland key habitats surrounded by closed canopy forests than in those surrounded by clear-cuts. A major reason is that microclimate (sunlight, temperature, wind and moisture) change when a forest is harvested. This indicates the importance of leaving buffer zones around existing woodland key habitats.

In addition to the 6th principle of the FSC standard, the 9th principle states how forests with high conservation value should be managed. An example of this is establishment of specific management plans in areas of high natural value, in order to promote biodiversity.

VALUE OF CONSERVATION AREAS AND WOODLAND KEY HABITATS IN A NETWORK

Apart from the differences between woodland key habitats and managed forests there is a value provided by the network of key habitats and conservation areas in the landscape. The network provides increased structural variation and availability of habitats and substrates. This improves species dispersal abilities and long-term survival in the forest landscape.

Woodland key habitats and voluntary conservation areas create conditions for developing old-growth qualities, with large amounts of dead wood. (Photo: Henrik von Stedingk/FSC Sweden)

Deciduous trees and forests

Deciduous trees and forests are a very species-rich environment and many forest species are dependent on deciduous trees for their survival. Deciduous trees establish well after natural forest disturbances such as storms and fire. They generally grow faster than conifers after disturbances and characterise early successional stages after disturbance. A decrease in forest fire frequency has had negative impacts on deciduous trees, that are poor competitors with conifers in mature forests. Forestry generally favours conifers both in selection of tree species for planting and in further management choices.

FSC SETS TARGETS FOR PROPORTION OF DECIDUOUS TREES

The FSC standard sets targets for the percentage of deciduous forest on stand and landscape level, whilst the Swedish Forestry Act lacks clear guidelines for the proportion of deciduous forest. In general, FSC standard leads to a higher proportion of deciduous trees both on stand and landscape level than the Swedish Forestry Act does.

According to the FSC standard, stands should, where possible, be managed so that deciduous trees constitute at least 10 % of the volume (5 % in northern Sweden) when mature for clear-cutting. In addition, 5 % of mesic and moist forestland should be composed of deciduous-rich stands.

Beyond the natural distribution of spruce, stands dominated by spruce should constitute <50 % of the forestland. Naturally-deciduous moist-wet land should host deciduous forests.

The Swedish Forestry Act states that naturally occurring tree species should be maintained and provided the conditions to develop well under all management conditions. Where the occurrence of such trees is insignificant, an increased proportion should be sought for. Furthermore, legislation states that broad-leafed deciduous tree species should not be replaced by other species.

DECIDUOUS TREES BENEFIT MANY SPECIES

Biodiversity benefits from an increased proportion of deciduous trees in a stand and deciduous stands in the landscape. The number of birds and bird species is greater in mixed forests, than in pure deciduous or conifer stands. The proportion of deciduous forest in the landscape is important for the bird species that prefer mixed stands. The diversity of vascular plants and of bats increases with the proportion of deciduous forest. Results for lichens are not as clear, but several red-listed lichens are benefited by an increased proportion of deciduous trees in the stand.

Glossary

Broad-leaved forests - *Forests constituted of at least 70 % deciduous trees of which at least 50 % are broadleaved tree species; Wych Elm, Ash, Hornbeam, Beech, Oak, Wild Cherry, Small-leaved Lime and Norway Maple.*

Deciduous-rich stands - *Forest stands dominated by deciduous trees during the major part of a generation.*

The FSC standard requires 5 % of mesic-moist forestland to be deciduous-rich stands. (Photo: Leif Öster/Sveaskog)

An increased proportion of deciduous forest on stand and landscape level creates conditions for biodiversity. (Photo: Henrik von Stedingk/FSC Sweden)

MANY BIRDS BENEFIT FROM DECIDUOUS TREES IN THE LANDSCAPE

A study from northern Sweden showed that bird species richness increases as the proportion of deciduous forest in the landscape increases. When species richness no longer increases with deciduous forest, the abundance of birds continues to increase. Other studies show that the number of bird territories and species richness amongst passerine birds increases with the number of retained trees on clear-cuts, especially if the retained trees are deciduous or dead trees.

Species such as the White-backed woodpecker, Long-tailed tit and Lesser-spotted woodpecker are dependent on deciduous forests and require a certain proportion of deciduous trees for long-term survival. The White-backed woodpecker needs at least 10 % deciduous forest in a landscape, whilst the long-tailed tit needs at least 15-20 % and the Lesser-spotted woodpecker at least 20 %. In addition, the total forest area must be sufficiently large for each species. A Lesser-spotted woodpecker requires at least 40-50 ha deciduous forest within a forest area of 200 ha. There must also be sufficient availability of dead wood for both woodpecker species.

The species richness of fungi, bryophytes and lichens is not only dependent on the proportion of deciduous trees in the landscape. The trees must be of sufficient quality to benefit the species. For instance the location of a tree within the stand, the number of large broad-leafed trees and occurrence of Aspen are important factors for many species. Epiphytic bryophytes on broad-leafed trees show preference for trees on slopes surrounded by other deciduous stands. Two lichens, *Collema furfuraceum* and *Collema curtisporum* are five to six times more frequent on Aspens in Aspen-rich landscapes compared with Aspen-poor landscapes. Aspen age is also an important factor as these species occur on old, large trees with coarse bark.

Prescribed burning

Forest fires are of central importance for forest ecology. Together with storms, forest fires have been the two most important recurring disturbance regimes in the forest landscape. Swedish forests have historically burned every 20 to 200 years. Fires create a mosaic forest landscape with forests in various stages of succession. During the 1800's a more efficient fire service developed at the same time as road construction commenced and forests started to provide economical value as timber. Both the opportunity and incentive to limit fire spread arose. Today, forest fires are less frequent and forestry has an important part in controlling fires. Despite the adaptation of forestry methods by retaining trees and dead wood that can benefit fire-favoured species there are still some species that are dependent on fire for their survival.

FSC-STANDARDS INCREASE THE AREA OF BURNED FORESTS

There are no requirements concerning prescribed burning of forestland in the Swedish Forestry Act regulations. The FSC standard requires larger forest-owners to burn 5 % of the annual clear-cut area on dry-mesic forestland.

Fires create new structures in the forests. Depending on the fire intensity new dead, charcoaled trees are created, at the same time as surviving trees can be transformed by fire. The most natural way to imitate fire disturbance is to burn forests without removing timber. FSC's approach to calculating the proportion of burned forest is based on regular clear-cutting with post-harvest fires. To encourage prescribed burning with standing volume, FSC has introduced a system were the burned area can be multiplied depending on how much of the standing volume is retained before burning, and whether natural regeneration is allowed after the fire (see fact box).

FOREST FIRES INCREASE BIODIVERSITY

Prescribed burning is necessary for the survival of fire-favoured species. The FSC requirements provide con-

Prescribed conservation burning benefits biodiversity. (Photo: FSC Sweden)

siderable benefits compared to forestry legislation. Many forest species have adapted to natural forest fires, but even prescribed burning provides benefits for many species.

Fire intensity and impact vary, but in general fires increase light, decrease competition and increase the amounts of dead wood. Post-harvest fires often have high fuel amounts from harvest residues, that increase fire intensity. High fire intensity can kill retained trees.

FIRES INCREASE SUCCESSIONAL VARIATION

Pine and deciduous trees are favoured by fires. This is often at the expense of spruce, that is poorly adapted to fires. Large pines can survive fires due to thick bark and high crowns. Deciduous trees that are poor competitors in closed canopy forests can easily establish after fire from seed or shoot. As some trees survive, whilst others are regenerated a multi-layered forest with trees of different ages is formed.

Glossary

Prescribed conservation burning - *A controlled fire started by humans with the aim of improving conditions for species favoured by fire.*

Pyrophilic species - *Species that are fire-dependent, e.g. the herbs Geranium lanuginosum and Geranium bohemicum, the lichen Hypocenomyce anthracophila, and the insects Hormopeza obliterata, Melanophila acuminate and Corticaria planula.*

Disturbance regime - *Natural occurences such as fire, flooding and storms that impact habitats on a more or less regular basis and benefit those species that are adapted to the specific disturbance regime.*

Geranium bohemicum is a fire-dependent species that will germinate after intense heat. (Photo: Anders Granström)

FIRE-DEPENDENT AND FIRE-FAVOURED SPECIES

A large number of species have adapted to forest fires over the centuries. Amongst insects and fungi there are over 100 pyrophilic species that only occur in recently burned forests. A competition-free environment and ready access to substrate such as burned wood and ground are important conditions for these species. About 10 pyrophilic species appear on the Swedish red-list. Several species of bryophytes and lichens are also dependent on or favour forest fires.

The lichen *Hypocenomyce anthracophila* is an example of a fire-dependent species as it only grows on burnt wood. The beetles *Tragosoma depsarium* and *Peltis grossa* are two species that prefer an increased proportion of sun-exposed wood. *Hormopeza obliterata* is another insect that is directly dependent on fire. The three-toed woodpecker *Picoides tridactylus* has indirect preference for fire as it favours large amounts of dead trees.

Several fire-dependent insects have been shown to benefit from prescribed conservation burning by forestry companies during recent years. Studies have shown that populations have increased as well as the distributions of several species.

In general prescribed burning of standing forests provides the most benefit for biodiversity, but even post-harvest burning can be positive. Burning standing forests generates the most burnt and dead wood. Studies have shown that the differences between natural fires and prescribed conservation burning are generally small and that both typically occur at low intensity in areas with low tree density. Post-harvest clear-cut burning benefits several fire-favoured vascular plants and fungi. In a short-term perspective the number of wood-inhabiting beetles increases in burned areas, irrespective of whether standing volume has been retained or not. However, species richness increases more in areas where some standing volume has been retained before burning.

The FSC standard requires prescribed burning on 5 % of the clear-cut area on dry-mesic land. The area can be weighted differently depending on how the burning is performed.

- If land-owners allow natural regeneration on the burned site, the area is multiplied by 1.2.
- If burning is performed where 15-30 % of the standing volume is retained prior to burning the area is multiplied by 1.5.
- If burning is performed where > 30 % of the standing volume is retained prior to burning the area is multiplied by 2.
- If burning is performed on land that is set aside for conservation the area is multiplied by 3.

The beetle Melanophila acuminate is fire-dependent. It can sense infra-red radiation from a forest fire from afar (Photo: Jonas Sandström).

Other types of nature consideration

FSC's forestry standard covers several types of nature consideration that are difficult to evaluate, or where there is no relevant scientific research as to how the consideration measures impact biodiversity. These are described briefly below.

RED-LISTED SPECIES

The Swedish Forestry Act regulations state that damage by forestry to red-listed animals and plants must be avoided or limited. In addition, consideration measures must give red-listed species priority. The FSC standard requires that demonstrable measures are taken to secure occurrences of red-listed species. It is difficult to point out particular measures that specifically benefit individual species. It is likely that many of the measures previously explained in this report benefit red-listed species and biodiversity in general. Since measures vary from case to case it is difficult to evaluate the impact of the FSC standard. Red-listed species are often difficult to identify, with many unknown occurrences.

BUFFER ZONES

Buffer zones are small strips of forest that are retained in connection to clear-cutting. The buffer zones are located next to particular, sensitive environments. They function as habitat for many species, as valuable parts of the landscape and as protection for aquatic environments.

Swedish forestry legislation states that "Buffer zones with trees and bushes are to be retained as much as is necessary out of consideration to plant and animal life, water quality, cultural environments, cultural relics and landscape scenery." The Swedish Forest Agency provides general advice on environments that may need buffer zones as well as how to create and manage buffer zones. The FSC standard states that buffer zones shall be created around biotopes with special conservation values, wetlands and forest impediments, along watercourses and open water areas. According to the standard, transition zones shall be permanently afforested, preferably multi-layered and topographically, hydrologically and ecologically related. The requirements in legislation and FSC standard are similar. However, neither provides quantitative measures for buffer zone widths. Buffer zones have positive impact on biodiversity but it is difficult to evaluate how the different texts in legislation and standard affect values for biodiversity.

Lung lichen (Lobaria pulmonaria) is classed as near-threatened on the Swedish red-list. Retaining trees with occurrences benefits the species. (Photo: Henrik von Stedingk/ FSC Sweden)

The fungus Skeletocutis odora is classed as vulnerable on the Swedish red-list. Retaining conservation areas or woodland key habitats benefits the species. (Photo: Henrik von Stedingk /FSC Sweden)

LANDSCPE PLANNING

Landscape planning implies the planning and management of landscapes. It is not covered by Swedish forestry legislation. However, consideration to the landscape scenery is covered. There is also a limit to the proportion of young forests in a management unit. The FSC standard requires larger forest-owners to develop landscape plans in order to plan forestry from an ecological landscape perspective with a balanced age class distribution, encompassing older forests. For smaller forest-owners it is sufficient to follow regional action plans.

The FSC standard prohibits forest plantations from open or abandoned cultural environments and requires the preservation of forest verges (between forested and open land) in connection to forest management in the stand. The standard requires forestry to be planned in relation to future shading of sun-exposed verges, islets on farming land and other small biotopes. Regulations in the FSC standard are clearer and more detailed than in forestry legislation, but it is difficult to evaluate the differences.

Temporary bridges can mitigate or prevent damage to solis and water during clear-cutting. (Photo: Emilie Westman)

DAMAGES TO GROUND AND WATER

Damages to soils and water can occur from transportation or scarification. Swedish forestry legislation requires damages resulting from forest management to be avoided or limited. The FSC standards state more specific requirements for damages from vehicles, scarification and damage to aquatic environments. Written guidelines must be developed and implemented in order to minimise damages to ground and water. Scarification must be limited and adapted to stand type. In addition, routines to avoid damage from vehicles must be available. The standard is clearer in requirements than the legislation, but both have the same aim. It is difficult to compare the two in practice.

FOREST ROADS

Construction of forest roads can impact valuable wetlands and aquatic environments or destroy natural and cultural values. Swedish forestry legislation states that damage to natural and cultural values should be avoided or limited when roads are constructed. The FSC standard requires that damage to watercourses be avoided: natural watercourses should be preserved, migratory passages along streams should be restored and larger forest-owners should develop action plans to remove migratory barriers caused by roads. The FSC standard is more detailed than forestry legislation and includes measures that probably benefit biodiversity. However, it is difficult to find research evidence to support the requirements in the standard.

The big picture shows how the FSC adds value for conservation

This report shows how some of the FSC standards most important environmental aspects potentially create values over and above what is required by the Swedish Forestry Act. There is support from scientific research that FSC requirements are heading in the right direction for biodiversity by creating actual benefits. These benefits are primarily retention trees, created dead wood, increased areas of burned forestland, conservation areas and more deciduous trees.

The differences between FSC standards and legislation are clearest in cases where legislation lacks requirements; forest fires, creating high-stumps and voluntary conservation areas. Differences are also clear where there are specific targets - for eternity trees and deciduous forests.

But how great a benefit does the FSC standard deliver when retention trees, burning, dead wood, conservation areas and deciduous trees are all weighed together? Dead wood can be used as an illustrative example as dead trees are a factor that has direct or indirect relevance to several FSC requirements described in this report.

An annual harvest of 100 000 ha FSC-certified forestland in Sweden will provide 120 000 m^3 dead wood as high stumps (Table 1). To this, storm-felled retained retention trees can be added as dead wood. Forest burning adds more dead wood, especially if a proportion of the standing volume is retained before the fire. Increased proportion of deciduous trees adds greater variation in the quality of dead wood by adding more tree species. This is of immediate importance for many wood-inhabiting species. Conservation areas and woodland key habitats and other retained forest patches will also ad to the amount of dead wood as the trees naturally age and die.

Similar synergies can be identified for other components of the FSC standard. For instance, increasing forest fires can lead to an increase in the proportion of deciduous trees in the landscape.

In conclusion, this report shows the potential provided by the FSC standard to secure values for biodiversity. FSC has a higher ambition than the Swedish Forestry Act and the requirements are without doubt clearer.

This does not necessarily imply that todays FSC requirements are sufficient to provide ecologically sustainable forestry. Instead, the FSC standard must be regarded as a complement to other conservation efforts. Research indicates that many forest-inhabiting species require a higher level of ambition concerning retention trees or proportion of deciduous trees in the landscape in order to survive. The FSC standard is leading Swedish forestry in the right direction, but how much is enough for long-term survival of biodiversity?

In order to fully evaluate the benefits for forest species further studies must be carried out of compliance to FSC requirements in real forest landscapes. What kind of practical benefit does compliance to the standard provide in different forest landscapes? A landholding or landscape with many natural values provides challenges when coordinating action or selecting priorities. How can forest-burning, creating high-stumps and increasing deciduous trees be adapted in relation to the values provided by woodland key habitats in order to benefit biodiversity the most? Land-owners meet other kinds of challenges in landscapes that have fewer natural values. Here, issues can concern how to prioritise conservation areas and nature consideration in order to create future values for the recolonisation of species that have disappeared from the landscape.

Litterature

RETENTION TREES

Johansson, T., Hjältén, J, de Jong, J. & von Stedingk, H. 2009. Generell hänsyn och naturvärdesindikatorer – funktionella metoder för att bevara och bedöma biologisk mångfald i skogslandskapet. Världsnaturfonden WWF, Solna.

Rosenvald, R. & Lohmus, A. For what, when, and where is green-tree retention better than clear-cutting? A review. Forest Ecology and Management 255 (2008):1–15.

DEAD WOOD

Djupström L. 2010. Conservation of saproxylic species. Doctoral diss. Dept. of Ecology, SLU. Acta Universitatis agriculturae Sueciae vol. 2010:80.

Johansson, T., Hjältén, J, de Jong, J. & von Stedingk, H. 2009. Generell hänsyn och naturvärdesindikatorer – funktionella metoder för att bevara och bedöma biologisk mångfald i skogslandskapet. Världsnaturfonden WWF, Solna.

Jonsell, M., Lindhe, A., Schroeder, M. & Weslin, J. 2004. Högstubbar nyttjas av många arter. Resultat från Skogsforsk nr. 19 2004.

Lindbladh, M. & Abrahamsson, M. 2008. Gör högstubbar nytta? Fakta skog nr 15, 2008. Om forskning vid Sveriges Lantbruksuniversitet.

Weslien, J. & Westerfelt, P. 2012. Vad vet vi om högstubbar? I Kunskapssynteser naturhänsyn, opublicerad.

BURNING

Hyvärinen, E., Kouki & J., Martikainen, P. 2009. Prescribed fires and retention trees help to conserve beetle diversity in managed boreal forests despite their transient negative effects on some beetle groups. Insect conservation and density 2, 93-105.

Naturvårdsverket. 2005. Naturvårdsbränning: Vägledning för brand och bränning i skyddad skog. Rapport 5438.

Naturvårdsverket 2006. Åtgärdsprogram för bevarande av brandinsekter i boreal skog. Rapport 5610.

Wikars, L. O. 2006. Behovet av brand i skogen.

Wikars, L. O. 2004. Brandberoende insekter – respons på tio års naturvårdsbränningar. Fauna och Flora 99 (2):28-34.

CONSERVATION AREAS AND WOODLAND KEY HABITATS

Laita, A., Mönkkönen & M., Kotiaho, J. S. Woodland key habitats evaluated as part of a functional reserve network. Biological Conservation 143 (2010):1212-1227.

Skogsstyrelsen, 2007. Nyckelbiotoper – Unika skogsområden.

Timonen, J., Gustafsson, L., Kotiaho, J. S., Mönkkönen & M. 2010. Hotspots in cold climate: Conservation value of woodland key habitats in boreal forests. Biological Conservation, 144 (2011):2061-2067.

DECIDUOUS TREES AND FORESTS

Jansson, G & Andrén, H. 2003. Habitat composition and bird diversity in managed boreal forests. Scandinavian Journal of Forest Research 18:225-236.

Johansson, T., Hjältén, J, de Jong, J. & von Stedingk, H. 2009. Generell hänsyn och naturvärdesindikatorer – funktionella metoder för att bevara och bedöma biologisk mångfald i skogslandskapet. Världsnaturfonden WWF, Solna.

CBM. 2008. Certifieringsstandardernas biologiska relevans. Kapitel 5 i Certifiering: Ett medel för att nå miljökvalitetsmålen inom svenskt skogsbruk? Centrum för Biologisk Mångfald. Manuskript.

Söderström, B. Effects of different levels of green-and dead-tree retention on hemi-boreal forest bird communities in Sweden. Forest Ecology and Management 257 (2009):215-222.

Table 1. *By quantifying the FSC standard the difference between legislation requirements and FSC emerge. The table shows quantifiable areas for evaluation of benefit. A happy smiley means that scientific research supports the positive effect on biodiversity of the quantifiable environmental aspect. A neutral smiley indicates a lack of scientific evidence and that the environmental aspects are difficult to quantify.*

Environmental aspect	Swedish Forestry Act	FSC-standard	Difference in the forest	Quantification	Impact on biodiversity	Quantifiable?	Assessment
Conservation areas and woodland key habitats	Prevent or limit damage to or around care-demanding biotopes, cultural environments or cultural remnants in forests.	A minimum of 5 % of the productive forest land must be set aside. Selection is based on high natural values and representativeness. All woodland key habitats are left.	Contributes to age diversity and intact forest areas.	In total, 550 000 ha set aside.	Longer generation times, positive to late successional species that are sensitive to stand disturbances.	✓	
Forest burning	-	Large forest-owners burn the equivalent of 5 % of dry-mesic regenerated forestland.	Provides burned forestland.	600-2800 ha/ year.	Increased amount of burned forestland provides conditions for pyrophilic species.	✓	
Retention trees	Retain individual trees or groups of trees. Priority to trees with high natural value.	Retain all biodiversity value trees. At least 10 retention trees /ha to grow into the next generation.	Minimum requirements for retaining trees	10 trees/ha (800 000 m^3/ year).	Retention trees as ”lifeboats”, prolonged input of dead wood. Sun-exposed dead wood benefits many beetles.	✓	
High-stumps	-	Create 3 high-stumps or girdled trees/ha.	Input of dead wood from high-stumps or girdled trees.	3 high stumps or girdled trees/ ha (120 000 m^3/ year).	Other species utilise high-stumps compared to harvest stumps. Important for many beetles.	✓	
Landscape planning	Consideration to the landscape view	Plan forest management from a landscape ecological perspective	Balanced age distribution on the landscape level	-	Benefits to species in old forests, verges and cultural environments.		
Deciduous forests	Broad-leaved forests may not be replaced with other forests	Stands: Manage so that deciduous trees constitute >10 % of the volume at clear-cutting (5 % in N. Sweden). Landscape: 5 % of mesic and moist forestland must be deciduous-rich.	More deciduous forests.	385 000 ha deciduous-rich stands.	Many species groups are benefitted (e.g. birds, bats and vascular plants).	✓	
Red-listed species	Avoid or limit damage to red-listed animals and plants as a result of forest management.	Demonstrable action to protect known red-listed species, observed in surveys or other documentation.	Actions benefit red-listed species.	-	Easier for red-listed species to survive in managed forests.		
Damage to ground and water	Clear-cut plowing prohibited. No barriers to aquatic migratory routes. Natural river and stream beds to be maintained	Guidelines to control and minimise erosion, forest damage, road construction, and to protect water assets.	Clearer requirements.	-	Benefits to aquatic species		
Forest roads	Should not be located close to lake shores, watercourses, sensitive biotopes and public footpaths. Excavation in wetlands should be avoided.	Routines for new roads in order to avoid damage to watercourses and preserve the natural waterway. Action to remove barriers in culverts	-	-	Benefits to aquatic species		
Buffer zones	Buffer zones left for necessary consideration towards animal and plant life and watercourses.	Buffer zones in connection to biotopes with special natural values, wetlands and forest impediments, along watercourses and open water.	-	-	Less disturbance from forestry to biodiversity when protected by buffer zones. Buffer zones can also provide habitat.		

Forest Stewardship Council
FSC Sweden

The Three-toed woodpecker is one of the species that can be benefitted by the FSC standards requirements for conservation areas and woodland key biotopes as well as retention trees.

Forest Stewardship Council (FSC) is an international members organisation working for responsible management of the Worlds forests. Our mission is to promote environmentally, socially and economically viable management of the Worlds forests. The FSC develops standards, creates control systems and manages its brand so that consumers can make safe choices from responsible forestry. FSC Sweden is an independent, non-profit member of the international FSC network, with its own national standard for forestry in Sweden.