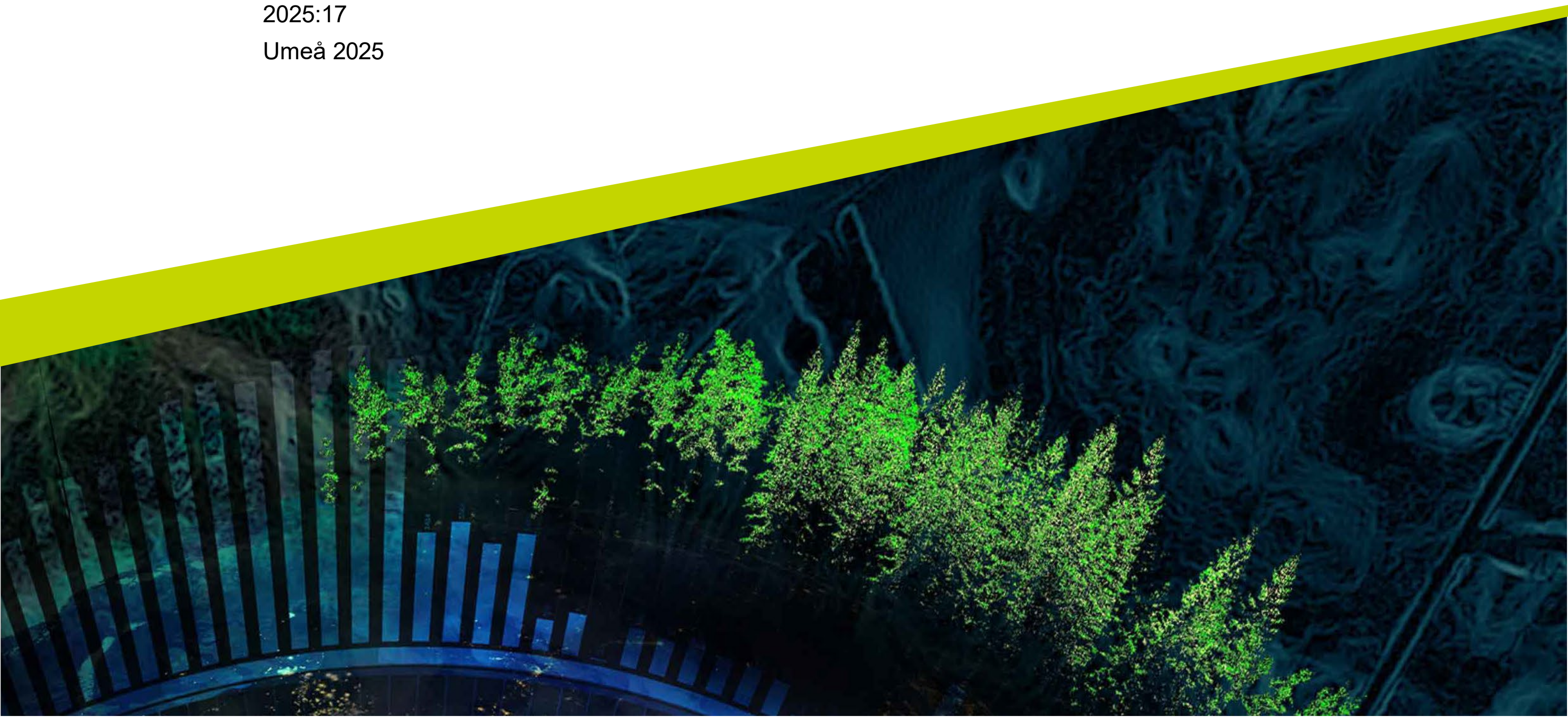
Multiple goal representation within voluntary set asides and natural disturbance-based ecosystem management

Carl Rising

Degree project • 60credits
Swedish University of Agricultural Sciences, SLU
Department of Wildlife, Fish, and Environmental Studies
Jägmästarprogrammet
Examensarbete / SLU, Institutionen för vilt, fisk och miljö
2025:17
Umeå 2025



Multiple goal representation within voluntary set asides and natural disturbance-based ecosystem management.

Carl Rising

Supervisor:	**Johan Svensson, Swedish University of Agricultural Sciences, Department of Wildlife, Fish and Environmental Studies**
Examiner:	Fredrik Widemo, Swedish University of Agricultural Sciences, Department of Wildlife, Fish and Environmental Studies

Credits:	60 credits
Level:	First cycle, A2E
Course title:	Mastersarbete I skogsvetenskap
Course code:	Ex0967
Programme/education:	Jägmästarprogrammet
Course coordinating dept:	Department of Wildlife, Fish and Environmental studies
Place of publication:	Umeå
Year of publication:	2025
Copyright:	All featured images are used with permission from the copyright owner.
Title of series:	Examensarbete / SLU, Institutionen för vilt, fisk och miljö
Part number:	2025:17
Keywords:	Biodiversity conservation, Biodiversity restoration, Forest dynamics, green infrastructure, Landscape management, Protected areas

Swedish University of Agricultural Sciences
Faculty of forest science
Department of Wildlife, Fish and Environmental Studies

Abstract

To mitigate landscape fragmentation, promote biodiversity and recreational values the Swedish forestry company Sveaskog created the concept of ecoparks. This thesis aims to evaluate if the current management system for forest planning reflects the ambition for increased nature conservation and ecosystem services. Data was collected and combined from the forestry plans of the ecoparks and compared to documented national interests of Sweden, thereby using the national interests as a proxy for potential multiple values within the ecoparks. The analysis suggests that these national interests and the multiple values and goals of the ecoparks are not effectively represented in the forest management plans, despite the ecoparks' publicly communicated profiles emphasizing multifunctional values and land use. To address this lack of representation, a revised goal classification system was developed, based on natural disturbance dynamics in boreal forests. This framework potentially allows Sveaskog to more accurately represent the multiple values already present in its voluntary set-asides and could also be adapted for use in alternative forest management on private lands. The revised system offers a complementary, small-scale implementation pathway to enhance current forest planning with a voluntary, multifunctional perspective. In this way the revised system is a more flexible tool for alternative forest management planning and further illustrates the multiple values of forests.

Keywords: Biodiversity conservation, Biodiversity restoration, Forest dynamics, Green infrastructure, Landscape management, Protected areas

Table of contents

List of tables

List of figures

Abbreviations

Abbreviation	Description
A	Absent
ASIO	Model for frequency and intensity of fire disturbance in boreal forests
BN	Boreonemoral ecoregion
CBD	Convention On Biological Diversity
CC	Clear Cuttings
CCF	Continuous Cover Forestry
CD	Cohort Dynamics
ED	Even Aged Dynamics
EEA	European Environment Agency
FSC	Forest Stewardship Council
GC	Goal Classification
GCS	Goal Classification System
GD	Gap Dynamics
GI	Green Infrastructure
I	Infrequent
IMP	Impediments
LSÅ	Lowest legal age for final felling
MF	Multifunctionality
NI	National Interest
NFI	National Forest Inventory
NO	Nature Conservation Untouched
NR	Nature reserves
NRL	Nature Restoration Law
NS	Nature Conservation Create
NSBESKRIVN	Nature conservation description
NVO	Areas of interest for nature conservation
NW boreal	Northwest boreal ecoregion
NWFP	Non-Wood Forest Products
O	Often
PC	Partial Cuttings
PEFC	Program For The Endorsement Of Forest Certification
PF	Production Enhanced Consideration
PG	Production General Consideration
R/RF	Recreation Enhanced Consideration
RACs	Reindeer Herding Community's
REN	Areas of importance for reindeer herding
RI – Wind	Areas of importance for wind power
S	Seldom
SE boreal	Southeast boreal ecoregion

1. Introduction

Boreal forests have a long history of changing and competing land usage (Östlund et al., 1997). Swedish forests have historically played a multifunctional role by providing many different values simultaneously (Puettmann et al., 2009), whereas forest management has traditionally aimed to optimize economic revenue through maximizing timber and biomass production (Ericsson et al., 2000; Puettmann et al., 2009; Enander, 2007). Despite Swedish forests accounting for only 0.4% of the global forest cover, the Swedish forest industry accounts for 10% of the timber, sawn logs, and pulp traded internationally (Angelstam et al., 2020). Despite extensive forest management, Sweden hosts the last intact forest landscapes of the European Union in the Scandinavian mountainous green belt (Svensson et al., 2020). Large parts of northern Sweden, Finland, and Norway are also the traditional lands of the Sami people with legal rights as an indigenous people in the Swedish constitution. Furthermore, the Swedish and Nordic people have a strong and long relationship with nature and the forest (Hörnsten, 2000). The "allemansrätt," public right to access nature, makes all land in Sweden open for recreational activities and small-scale resource use. These complex demands on the forest to deliver multiple ecosystem services simultaneously challenge the dominating focus on wood biomass production. Setting forests in a state that better accommodates multiple interests and demands requires restoration at multiple scales and dimensions (Svensson et al. 2023)

Habitat loss due to land use and human activity is widely regarded as one of the driving forces of biodiversity loss (Hanski, 2011, Tilman et al., 2017). The effect of climate change adds further complexity to forest management and restoration efforts (Girona et al., 2023). In a changing climate, prestoration, a restoration approach for adapting species choice and management methods to changing climatic scenarios, will be increasingly significant for maintaining and restoring biodiversity and ecosystem functionality (Svensson et al., 2023). Green infrastructure as a concept for addressing conservation and restoration of sufficient quantities of functional and representative habitat networks, have been introduced as a concept to address these complex challenges (Bubnicki et al., 2024).This thesis explores the current goal classification system for forest planning used in Swedish forestry based on the large-scale voluntary set-aside Ecoparks with by the Swedish forestry company Sveaskog as a case study. Here, the goal classification is explored concerning its potential to reflect a multifunctional approach also considering other goals in forests and forest landscapes than wood biomass production and nature conservation.

This paper aims to explore how the multifunctional capacity of forest landscapes is framed by the goal classification system by applying Sveaskogs ecoparks in Sweden and further conceptualize a revised system that reflects multifunctionality and restoration to improve multifunctional premises. The following research questions were identified to answer the aim.

1. What is the distribution of goal classes within Sveaskog Ecoparks, and how does this reflect the nature conservation ambition and profile of these?

2. How are multifunctional values and multifunctional forestry potential reflected in the goal class distribution?

3. How can the goal classification system be conceptualized further reflecting multifunctional forestry, in Sveaskog Ecoparks and generally?

1.1 Multiple goals in forests and forest landscapes

From the 1950s onward and in a Swedish context since the 1990s, the management objectives of forestry have continuously broadened from a singular purpose of sustainable timber production to a more holistic approach considering a multitude of values, expressed as ecosystem services(Nabhani et al., 2024). The public is demanding more areas for recreation, and increased biodiversity conservation, and the forest is expected to play an important role in climate change mitigation (Fridén et al., 2024). The public demand for the forest to deliver more ecosystem services to the public is ever-increasing, and the Swedish forest provides a wide range of ecosystem services in the form of recreation, hunting, and other non-wood forest products (NWFP). Ecosystem services are all products and services provided by the ecosystem to humans and society and contributes to our welfare and quality of life (Naturvårdsverket, 2025). Ecosystem services can be commercial such as wood production or non-commercial such as deadwood for biodiversity or recreational premises (Strengbom et al., 2018). Providing ecosystem services such as timber yield has been easier to quantify than the value of a recreational experience or biodiversity (Enander, 2007, Östlund et al., 1997).

Science the 1990, the multifunctionality management approach have gained popularity due to its ability to converge social, environmental, political and economic interests(Erdozain et al., 2024). Apart from providing NWFPs, the Sami people's reindeer herding rights on public and private land are of great cultural importance and specific to the northern half of Sweden, these practices contribute to the diverse landscape values (Başkent, 2018). The most common and most researched NWPFs in a Swedish context are biodiversity, recreation, hunting, berry and mushroom picking, reindeer husbandry, and water conservation (ibid). The production of ecosystem services on private and public land provides economic revenue to the Swedish economy and rural communities (Başkent, 2018, Eriksson and Tollefsen, 2018). Management systems to promote NWFP, such as medicinal plants, forest berries, and edible mushrooms, are challenging to incorporate into forest planning (Başkent, 2018).

The picking of wild berries, mushroom picking, and hunting are of great cultural as well as economic value in Sweden (Başkent, 2018, Neumann et al., 2022). In a Swedish context, the berries most picked are Lingonberry (*vaccinium vitis-idea*) and the European blueberry (*vaccinium myrtillus*). Sweden and Finland are considered to be the leading suppliers of wild berries on the world market (Eriksson and Tollefsen, 2018). Berries and mushrooms can be harvested on all public and private land by anyone based on the public right to access nature (ibid). Swedish forests produce around 400,000 tons of berries yearly, and between 10-30 tons are harvested for commercial and private use, providing a net profit of 400-500 million Sek yearly (Swedish NFI,2024).

Forest management with the goal of maximizing production value is performed on 70% of all forest land in Sweden (SLU 2024), while other uses such as hunting and the right to public access cover approximately 100% of all forest land. The latter mentioned usages are strongly supported in the Swedish hunting law (SFS 1987:259), and in the national interests described in the Swedish environmental code (Svensson et al., 2020). Hunting has an important cultural status, especially in rural communities (Neumann et al., 2022). There are approximately 300,000 registered hunters in Sweden (The Swedish Environmental Agency, 2024). Hunting in Sweden is estimated to provide 20,000 tons of wild meat annually. Among Swedish forest owners, recreational activities such as hunting are highly valued, and many Swedish forest owners manage their land partly for wildlife promotion (Neumann et al., 2022).

Reindeer (*Rangifer tarandus)* are present in the form of traditional Sami reindeer husbandry by the Sami people in most of northern Sweden (Kivinen et al., 2012). The modern form of reindeer husbandry can be traced back for at least 400 years (Lundmark, 1982). Reindeer husbandry is not only an important source of income but also a cultural bearer of Sami cultural identity and traditional practices. The Sami people's status as an indigenous people is protected by the Swedish constitutional law. The traditional reindeer herding of the Sami people is further legally protected and managed in The Reindeer Husbandry Act (1971, p 437) that defines the right to herd reindeers on 55% of the Swedish land area as an exclusive right for the Sami people (Eggers et al., 2024). The husbandry area is divided into 51 individual reindeer herding community (RHCs) (ibid). After being implemented in 2024, The Consultation Order dictates that government administrative authorities, forest companies, etc., must consult the Sami consul representing the RHCs before management decisions are taken that can have a direct impact on Sami interests. Modern forestry practices negatively affect the abundance of the reindeer main food source, ground lichens and tree lichens (Eggers et al., 2024). Adaptive forest management could increase the amount of ground lichen habitat with 22% within 15 years (ibid). Adaptive forest management would result in 11-22% decrease of net revenues in terms of wood production for the forest owner (ibid). Currently reindeer husbandry generates 230 million Sek annually, further illustrating the many cultural and economic values of generated NWFPs on Swedish forest land (Sametinget, 2024).

Apart from the direct financial revenue from processed meat, mushrooms, berries, jam, and other NWFPs, natural landscapes with high recreational values also contribute to Swedish ecotourism. There are existing forestry management actions and management models to predict and maximize one or several of these NWFPs(Gauthier et al., 2023). Developing accurate berry harvest models can be used within forestry planning programs such as Heureka (Bohlin et al., 2021). Berry harvest has also been incorporated into the economic analysis of forest management (Pukkala et al., 2011). Studies have also shown that production forests can incorporate rehabilitation forests and positively affect human well-being with a small loss of economic net present value(Nordström et al., 2015). Maximizing one ecosystem service will affect the forest's ability to provide other ecosystem services leading to conflicts between different forest values(Gauthier et al., 2023).

Alternative forest management approaches to mitigate loss of biodiversity and maximize ecosystem services have focused on restoring structural elements of natural forests lost in production forests. In Management systems such as Natural Disturbance Emulation and Close-To-Nature Forestry, this is mainly done by leaving large trees and creating deadwood substrates in the forest(Pommerening, 2024). It's of interests to note that "close to nature" forestry is rooted in continuous cover forestry methods developed in central Europe(ibid). Closer to The Swedish Forest service have previously (Skogsstyrelsen 2021) had a narrow definition of non clearcut forestry and later broadened the definition(Skogsstyrelsen, 2023a). This new definition is only a definition for the silvicultural system and include a temporary shelterwood to promote natural regeneration. The Swedish Forest Agency non-clear-cut forestry definition does not match the definition of continuous cover forestry (CCF), nor the holistic ideas and categories. The six categories of CCF defined are

"*continuity of forest cover, ecosystem/natural management, structural diversity, retention, thinning/ harvesting methods and programmatic semi-synonyms"(Pommerening, 2024).*

The Multiple goal approach relies on several different management systems such as CCF and clearcuts based on what is suitable for different forest types to maximize multiple ecosystem services simultaneously(Nordström, 2020). By dividing the landscape into different zones suitable for different management systems or zooning the landscape, different forestry management approaches can be used to their full potential simultaneously with the intent of combining several different management approaches to maximize multifunctionality(Blattert et al., 2023). The triad landscape concept organizes forest land into intensive, extensive, and unmanaged forest reserves. Intensive management is characterized by maximizing timber production(ibid). The unmanaged forest reserves are characterized by a lack of active management. Extensive management is a multifunctional management approach with several combined focuses in each forest stand. These combined values can be recreational, timber, biodiversity, and hunting(ibid). According to Blattert et al (2023), the multifunctionality in forests was maximized when using intensive forest management on 20% of the land. Setting 30% of the forest land aside for conservation and using an extensive multifunctional management approach on the remaining 50% of the forest land. In their analysis, the management zoning with the highest MF, multifunctionality, resulted in a net income of 61% of the maximum Net Present Value, NPV. However, can the Goal Classification system and other tools for forest planning reflect the complexity of a multifunctionality of the Swedish forest and be used in a multifunctional management approach?

1.2 Legal framework and a brief history of Swedish forest law

In a Swedish context, the legal framework and forest policies during the mid-20th century primarily focused on securing a sustainable yield of timber and other wood-based biomaterials for the Swedish forestry industry (Östlund et al., 1997, Enander, 2007). The first Forestry Act in Sweden was adopted in 1903, but the law's implementation was still uncertain, making the legislation ineffective and the goals unclear (Enander, 2007). From 1940 and onwards, the Swedish government implemented stricter regulations to clarify uncertainties in how the Swedish Forestry Act should be implemented to ensure steady supplies of biomass for industrial users;(Enander, 2007, Appelstrand, 2012).
The forest management of the 1800s severely lowered the standing volume in Swedish forests (Enander, 2007). The management norm consisted of cutting larger-diameter trees and leaving the lower-diameter trees without planting seedlings or performing other regenerative measures. This lack of sustainable management and the need for a steady supply of timber to Swedish industry was the catalysator for the first Forestry law in Sweden. As illustrated in Table 1, the Swedish Forestry Act was revised in 1918,1923, 1948, 1974, and 1983 with increasingly stricter demands on the private forest owners to ensure high biomass production for the Swedish industry(Enander, 2007). This culminated in the Swedish Forestry Act of 1983 with strict demands to own an updated forestry plan, to perform thinning's, and to clear-cut a certain percentage of old forest. The Swedish Forestry Act of 1993 marks a major shift in Swedish forestry as the revised Act abolished most of the previous demands and stated equal priority to production and environmental goals in the portal paragraph, giving fewer specific regulations and more freedom to the forest owner (Lindahl et al., 2017, Enander, 2007). The revised law also included a more pronounced consideration of other values provided by forests. This approach to forest policy with a relaxed legal framework and "freedom under responsibility" is referred to as the Swedish model (Lindahl et al., 2017).

Table 1. Overview of policy and legal demands in Swedish forestry law 1903-1993 (Enander, 2007).

Regulation	1903	1918	1923	1948	1974	197
Obligation to reestablish forest after final fellings	x	x	x	x	x	x
Protection of young to middle aged forests		x	x	x	x	x
Demands for sustainable forestry				x	x	x
Demands for nature and enviormental consideration in forestry					x	x
Obligation to notify final fellings					x	x
Obligatio to preform pre commercial thinnings in young stands						x
Obligation to reestablish forest if the exsisting forest cover is to thin or consists of non desierd speices (§5 3-stands)						x
Obligation to preform thinnings in young forests						
Obligation to harvest a certain proportion of older forests						
Obligation to have a forestry plan						

Despite legal recognition of nature conservation, socio-cultural values, and reindeer husbandry. The core Act regulations, e.g. paragraphs 5 and 10, are constructed to maximize wood biomass production on a stand scale, for Norway spruce and Scots Pine only. The same paragraphs also describe the system boundaries for clear-cut free forestry as defined by the Swedish Forest Agency (Appelqvist, 2021). Directives concerning biodiversity and Annex 1 habitats is well reflected. Values apart from production and nature conservation have been and are currently of less interest from a legal point of view(Lindahl et al., 2017). The legal system is adapted to increasing productivity and not to diversify management systems. But the interest and the need for more alternative management is growing, this is also noted by the Swedish forest service in their rapport regarding the potential for alternative forest management in Sweden (Skogsstyrelsen, 2023a).According to the rapport the unsustainable forest management practices of the past are closely associated with alternative management systems outside of clear-cuts, in the eyes of forest owners (Skogsstyrelsen, 2023a). The Swedish Forest Agency notes that historical views and traditions heavily affect even the agency's communication regarding alternative forestry management strategies. The rapport notes the similarities in attitudes and communication to when nature consideration became part of Swedish sustainable forest management in the 1990s, and the importance of greater government control and guidance to initiate changes in attitudes and practical forestry(Skogsstyrelsen, 2023a). The historical management of forests in the 1800s can be seen as the ghosts that still haunt Swedish forestry discourse, legislation and policy making.

Recently, the EU Nature Restoration Regulation (NRR) was decided and thus will be implemented in all member states. Specifically, NRR put in place regulations that aims for securing positive development along the intentions outlines in the EU Biodiversity Strategy (Commission, 2020) and the EU Species and Habitats Directive (European Union, 1992). Despite the focus on biodiversity improvement in European forests, also ecosystem services broadly are reflected. The nature restoration regulations specific targets concerning forest ecosystem consists of seven goals or indicators. The indicators are achieving an

"*Increased trend for standing deadwood, for lying deadwood, uneven aged forest, forest connectivity, abundance of forest birds, stock of organic carbon, share of forest land dominated by native trees, of tree species mixture*."

The EU countries are expected to send in their National Restoration Plan to the EU commissions within 2 years, 2026. The restoration strategy concerning forest ecosystems must address six out of the seven indicators. The indicators of uneven aged forests, forest connectivity and tree species mixture are difficult to achieve with even aged forest dynamics of rotational forestry. The increasing of deadwood and stock of carbon would increase by exempting more forest land from active management. A mixture of alternative management actions in combination with rotational forestry could potentially help Sweden improve several indicators while minimizing the possible negative effects. Instead of either managing a stand for production or nature conservation the multiple use strategy could implement several management systems with the goal of maximizing the common good.

1.3 Ecoparks and formally protected forests

Following the Swedish model recognizing ..., the Swedish government utilizes a set of conservation instruments to protect forests with high conservation values. In a Swedish legal context, these protected areas can be differentiated into two

groups: formally protected land with strict legal protection against any commercial forestry; and formalized set-asides and voluntary set-asides that permit some commercial forestry (Skogsstyrelsen, 2019a). Formally protected set-asides in Sweden are generally smaller areas, only 3% of formally protected forests, such as nature reserves and national parks, are >1000 hectares.
To increase the nature conservation ambition on a landscape level, the Swedish state-owned forestry company Sveaskog created the concept of Ecoparks (Sveaskog, 2023). The Sveaskog Ecoparks are larger forest areas with higher biodiversity values that their forest holdings in general, set aside to be utilized for sustainable forestry combined with increased nature conservation efforts and increased care for other ecosystem services, with specific emphasis on recreational values (Sveaskog, 2023). The parks are legally protected through an agreement between Sveaskog and the Swedish Forestry Agency. However, the agreements are restricted to a 50-year time period before they require renewal. This provides less strict protection than a formally protected nature reserve or national park, but the relaxed legal protection also allows protected areas to be combined with sustainable harvest (Sveaskog, 2023). The first Ecopark (Omberg) was created in 2003 and the latest of the 37 currently existing ecoparks (Öjesjöbrännan) was added in 2014 after a large-scale forest fire. The 37 parks span across the boreal and boreonemoral ecoregions of Sweden. The ecoparks consist of 241,000 hectares of forest land(Sveaskog, 2023). Of these, 175,000 hectares are considered productive forest land according to the second paragraph of the Swedish forestry law (Skogsvårdslagen, (1979:429)). Each ecopark has an ecopark plan for the future management of the forest and the forest values. Specific goals and subgoals of each park are formulated in the ecopark management plan and differ between each park.

The overarching goals of the parks are sustainable forest harvest, increasing biodiversity, recreational activities, and educational purposes(Sveaskog, 2023). When forming an ecopark, the ecopark plan is reviewed by the Swedish Forest Agency. In collaboration with the Swedish Forest Agency, the goals and management plan for the area are established before the ecopark is officially formed and a nature conservation agreement is signed (Sveaskog, 2023). The ecopark-plans can be viewed as an elaborated version of normal forestry plans and utilize the same goal classification system.

1.4 The Swedish goal classification system

Forestry planning in Sweden relies on a goal classification system (GCS), which reflects the legal standpoint of economic and ecological values being of equal importance from the forestry law of 1993(Skogsstyrelsen, 2023b, Skogsvårdslagen, (1979:429)). However, the goal classification system is mainly designed to differentiate between production forests and areas to be left or developed for nature conservation. This binary division of forest land does not reflect the multiple-purpose goal of the Swedish Forestry Act (Skogsvårdslagen, (1979:429)), the Environmental Code and laws concerning hunting and public access. Considering modern demands for ecological sustainability, it becomes increasingly important to formulate new approaches to sustainable future forest management to achieve more resilient forest ecosystems (Angelstam et al., 2020, Östlund et al., 1997). Recent research indicates that Sweden does not meet agreed national and international goals for biodiversity conservation(Angelstam et al., 2020). Angelstam et al (2020) showed how Sweden has not reached Aichi Target 11, formed by the Convention on Biological Diversity, CBD, for the protection of biodiversity and well-connected protected areas by 2020.

Biodiversity cannot be maintained through reserves only; it's essential to create management plans on a landscape level to handle spatial and temporal dynamics(Fries et al., 2011). Active management of set-asides is critical for future biodiversity as reserves alone are not enough (Fries et al., 2011). Further, combining conservation management with partial harvest could provide economic incentives for the forest owner.

Efficient consideration of nature values and nonproduction values in forestry requires efficient management and management planning on both a stand-level and landscape level(Angelstam et al., 2020, Berglund and Kuuluvainen, 2021, Noss, 1983, Harris, 1984). Swedish forestry and silviculture have favored a bottom-up perspective focusing on the stand level and overlooked the landscape perspective due to production efficiency, economic incentives for the forest industry, and a lack of a complete understanding of natural forest disturbances dynamics (Berglund and Kuuluvainen, 2021).

The current Swedish Goal classification system (GCS) utilizes four main categories, with two categories for production forests and two categories for forest conservation aiming on biodiversity. It is not mandatory to have a forestry plan and these classes are not normative, still the system is adopted by the forestry sector. The GC-system is, however, mandatory for all "green forestry plans" and is necessary within the forestry plans of forest owners certified by the Forest Stewardship Council (FSC) and the Program For The Endorsement Of Forest Certification (PEFC) in Sweden.

67% of all productive forest land in Sweden is certified through either FSC, PEFC, or both (Skogsstyrelsen, 2019a). Productive forest land is defined in a Swedish context as forest land with a natural productive capacity of 1 cubic meter of biomass per hectare per year or more on average over a rotation cycle, whereas impediment forest sites like mires and areas with very shallow topsoil have lower capacity (Skogsvårdslagen, (1979:429)). It is essential to mention that all areas classed as impediments are not low productive but can be classified as impediments based on logistical problems in accessing them with modern harvesters. For example, smaller productive stands surrounded by wetlands are sometimes included in impediments for this reason.

Table 2. Presentation of abbreviations and their meaning within the Swedish Goal Classification including English terms from (Bergman and Gustafsson, 2020).

Swedish name	Swedish abbreviation	English translation	English abbreviation	Percent of the forest area left untouched	Type of forestry act permitted
Produktion generell hänsyn	PG	Production with general conservation concern.	PG	Minimum 10%	Most
Produktion förstärk hänsyn	PF	Production with enhanced conservation concern.	PE	15-50%	Most but with enhanced biodiversity consideration.
Naturvård orörd	NO	Nature conservation free development	NF	100%	None.
Naturvård skapa	NS	Nature conservation-oriented management	NM	Depending on chosen conservation strategy.	Forestry acts to promote ecological goals only.

The category Production with general conservation concern, PG, denotes the legal minimum consideration. The 30th paragraph in the Swedish Forestry Act and the 30th paragraph of the regulations stipulate that consideration must be taken for ecological and cultural values(Skogsstyrelsen, 2023b). However, the same paragraph specifies that the consideration must not limit the current land use, where limiting is understood as a tolerance level of 10% of the calculated net revenue of the standing tree volume (Skogsvårdslagen, (1979:429), Skogsstyrelsen, 2023b).

Production with enhanced conservation concern, PF varies in the percentage consideration of standing tree volume, but higher than in the PG category. Stands that are considered to have high existing biodiversity, or are primary or old-growth forests could be classified as Nature conservation free development, NO. Forest stands in the NO category are left for free development and exempt from active forestry. The Nature conservation-oriented management, NS category is used for forest areas where the aim is to improve conservation values actively. Most forestry plans made in Sweden are "green" forestry plans. To be considered a green forestry plan, 10-15% of the forest land must be categorized as NO/NS. Management suggestions for active or passive restoration will be included in the plan, mainly in the form of notes. It's important to note that a certified forest owner is not obliged to perform management actions suggested in the plan.

Apart from these four categories, a fifth category of Recreational forestry, R/RF, is sparsely used within municipal forest planning. A survey done among municipal officials working with forest planning in areas close to urban areas indicated a perceived need for such an additional goal classification to increase social values. The project was linked to the experimental area of Vätteskogen, where Sveaskog has set aside an area for experimental forest management to improve the number of visitors.

1.5 Natural disturbance emulation

In boreal silviculture, the idea that natural boreal forests are homogenous ecosystems where the forest dynamic and structure are determined by stand-replacing disturbances in the form of forest fires was the norm for decades (Berglund and Kuuluvainen, 2021). Forest fires are the most frequent disturbance in the boreal forest in scale and frequency (Drever et al., 2006). This norm has been used to argue that clear-cuts can be seen as a mechanical way of mimicking the natural disturbance of forest fires. The idea that large-scale high-severity fires were founded on early studies based on northern boreal European forests and North American forests(Berglund and Kuuluvainen, 2021). Berglund and Kuuluvainen (2021) argue that landscape and regional forest modeling based on this assumption of large-scale stand-replacing forest fires affecting all forests greatly overestimate the scale and intensity of natural fire dynamics. The landscape forest models of natural age-class distribution underestimated the natural number of forest stands older than 100 years. This simplification of natural forest dynamics has been used as a strong argument for high-intensity even-aged forest management such as clearcutting, and to promote the view of even-aged forestry as a natural norm (Berglund and Kuuluvainen, 2021, Esseen et al., 1997). During the 1990s, a model of natural fire dynamics in the boreal forest was developed as an educational tool to help private forest owners understand natural forest dynamics and how disturbances affect the forest structure. This educational model is referred to as the ASIO model. The acronym ASIO refers to four levels of firer frequency Absent, Seldom, Infrequent, and Often. This system was implemented by the Swedish forestry government agency Domänverket on a trial area (Särna) in northern Sweden, (61° 40' N; 13° 10' E), in 1991-1993. According to the ASIO model, the frequency of forest fires is inversely related to the intensity of the fire (Angelstam, 1998). Boreal forest soil classification is mainly based on two main criteria: moisture and nutrient content of the soil with a gradient in categories from very dry to wet and very poor to very rich corresponding to typical forest site categories. Fire frequency and the effect of fires can be predicted by the availability of fuel and fuel moisture content. These parameters can be linked to the site type and the ground vegetation and the ground vegetation fuel properties (Angelstam, 1998).
The ASIO-model contains four levels referring to the frequency and intensity of forest fires illustrated in the figure below (Angelstam, 1998).

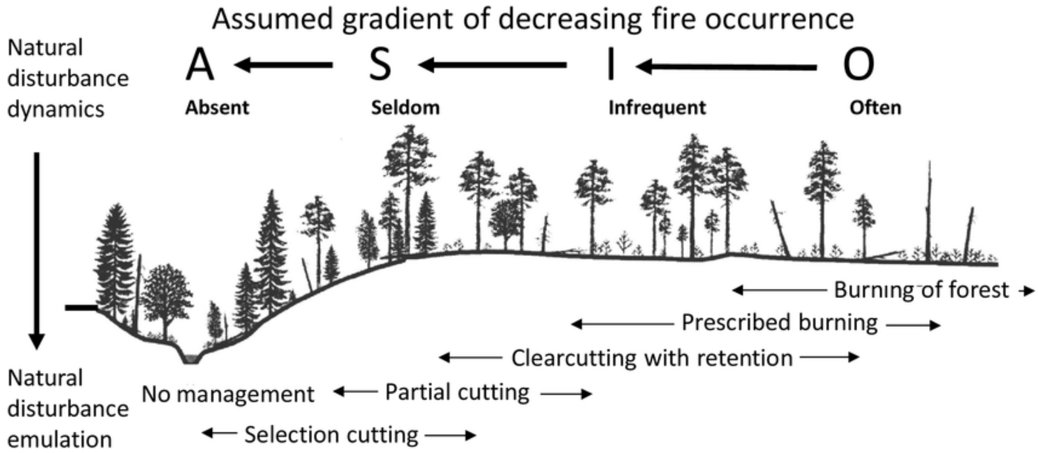


Figure 1. The ASIO model (Angelstam, 1998).

Absent -A. On permanently wet soils, fire is absent or hardly ever occurs at an ecological time scale of< 300 yrs. These forests are dominated by *Picea abies* with *sphagnum spp* mosses in the bottom vegetation. The sites are often located close to surface water in the landscape and these fire refuges naturally occur close to waterways (Angelstam, 1998). The sites in the Absent category are characterized by long continuous forest cover, gap dynamics, humidity, and a stable microclimate (Angelstam, 1998, Kuuluvainen, 1994). A large portion of these areas, such as mires, are exempt from Swedish forestry as the Swedish Forest Act's second paragraph differentiates between Productive Forest land, forest land, and forest impediments.

Seldom-S. On moist sites fire frequency is low, less than one fire per 100 yr. Two different disturbance regimes can be defined; in the case of extreme droughts with large-scale stand-replacing fires, and with gap dynamics dominated by *Picea abies* as in A. With fire more seldom occurring, the forest structure will be changed, and a natural succession of deciduous trees, followed by conifers, mostly *Picea abies*. The resulting forest will be characterized by natural continuous forest cover and gap dynamics. At both the A and S levels, there will be a constant supply of dead wood due to the natural succession and deadwood of different stages of decay although the sites (Angelstam, 1998).

Infrequent-I. The most common mesic sites are characterized by *Vaccinium spp* species as the most common ground vegetation(Angelstam, 1998), witha frequency of forest fires occurring below once per 100 years (Zackrisson, 1977). Forests are characterized by a continuous disturbance cycle of fire, followed by a period of low fire risk due to a lack of available fuel. During a 50-year period, *pluero-carpous* mosses such as *Pleurozium schreberiand* and *Hylocomium splendens* will become the most important ground fuel for potential fires(Angelstam, 1998). Due to the *pluero-carpous* mosses' inability to take up water from the soil, they are important as fuel for forest fires(Schimmel and Granström, 2011). After the first 50-year period, the mosses will cover 60 – 85% of the ground and continuous enough for a fire to spread due to available fuel in the ground vegetation, fire frequency < 50 years is less likely(Angelstam, 1998).

During long draught, ombrotrophic peat bogs with sphagnum mosses have similar fuel characteristics as the *pluero-carpous* mosses(Schimmel and Granström, 2011). The young forest will be characterized by broadleaf species such as Betula spp. and *Populus tremula*, followed by coniferous such as *Pinus sylvestris* and *Picea abies* in older forest (Angelstam, 1998).
Often-O. Forests are categorized by low-intensity, high-frequency fires (Angelstam, 1998). The frequency of fires is very high, with intervals of 60-40 years between fires (Schimmel and Granström, 2011). Forests are dominated by *Pinus sylvestris* in the tree layer, and *Cladinae* lichens provide the fuel from the ground vegetation(Angelstam, 1998). It will take 30-40 years for the lichens cover to develop after fire disturbance. The site's forest dynamics will be characterized by cohorts of pines in different age classes and a lack of a deciduous phase. The low tree mortality rate is partly due to the low-intensity fires and the natural fire adaptation of *Pinus sylvestris*(Angelstam, 1998).

The ASIO model has been an influential tool in Swedish forest planning. The model is attractive because it emphasize stand-level, assumes that the site type has the greatest impact, and determines the fire dynamics (Angelstam, 1998, Berglund and Kuuluvainen, 2021). This implies setting stand-level bottom-up targets in forest planning(Berglund and Kuuluvainen, 2021). It is evident that the GSC is partly based on ideas regarding emulation of natural disturbances.

1.6 Foresters' Attitudes to Multiple use forestry

The largest forest owner groups in Sweden is private owners (50%), private limited companies (25%), and state owned companies such as Sveaskog (14%) (Swedish NFI, 2024). The median sized forest ownership among the private forest owners are 14 hectares for men and 9 hectares for female forest owners in 2021 (ibid). The average size of a forest holdings among private forest owners where 34 hectares (ibid). Studies suggest that Swedish forest owners do not promote social values and they are not promoted in forest management, which may can be explained by different terminology and a misunderstanding of the meaning of social values in this context among the interviewed forest owners (Bjärstig and Kvastegård, 2016). The forest owners consider social values or recreational values as something they might take for granted and that they consider time in the forest an everyday part of life (ibid). The motives for forest management choices among Swedish forest owners varies but most literature emphasizes motives tied to economic profitability. Swedish forest owner's rate recreational values high when asked, but they are generally not willing to sacrificing any larger economic revenue to promote other values. Management considerations to ecosystem services are mainly tied to hunting. Among forest owners 50% could consider a minor financial loss to promote other ecosystem services than timber value.

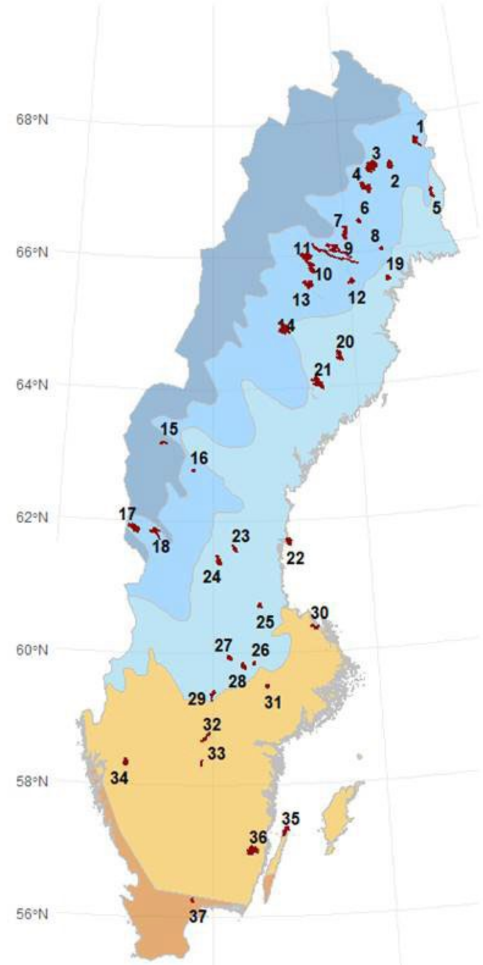
Despite ecosystem services such as hunting and the right to roam are of large cultural importance to rural community and a part of a Swedish national identity(Gunnarsdotter, 2005, Hörnsten, 2000). The right to public access to nature is a debated and the commercial use of private land with the right to roam and pick berries on all Swedish land are problematic(Bjärstig and Kvastegård, 2016). The Swedish boreal forest and its multiple values is not only a important for financial gain but also as a significant part of the National identity of Sweden. To examine how these values are represented and could be further illustrated and integrated into forest management, this study will look at the Sveaskogs ecoparks. These areas are already set aside for promoting more biodiversity, but recreational values are also integrated in the aim of the parks. Apart from this Sveaskog have a goal of using the ecoparks for educational purposes and research. The parcs is therefore be well suited for research of strategies of maximizing multiple values and alternative forest management practices.

2. Materials and methods

2.1 The context for this study

In this study, quantitative data collected from Ecopark plans. The data collected concerns 175,000 hectares of productive forest land, productive forest land In addition ... ha impediment forest area was included specifically for the comparison between ....
The 37 ecoparks are located across the Swedish land base (Fig. 2). Ecopark nr 37, Raslången, is situated on the boundary between the Nemoral and Boreonemoral ecoregionsIn the entire Boreal ecoregion, the indigenous Sami people conduct traditional reindeer (*Rangifer tarandus)* husbandry. According to 31§ in the Swedish Forestry Law, and the reindeer husbandry must be taken into consideration in planning forestry acts(Skogsvårdslagen, (1979:429)).

The data consists of 18 900 plots or forest stands, in productive forests, ranging from 0.02-850 hectares in size. The data was compiled in April 2024. The ecopark data was collected with the same procedures as when producing Swedish forestry plans, i.e. by skilled professional forester conducting several assessments of the forest structure with the aid of digital tools such as lidar laser scanning and the forest statistics provided by the National Forrest Inventory. The forester collects basic forestry data such as height, age, ground vegetation type, terrain assessments, standing tree volume, average height, and the average weighted width of trees in the stand. Apart from this data other values have also been recorded such as reindeer herding values and recreational values. Forest stands have been evaluated based on how suitable they are for reindeer herding. The reindeer herding value system have values ranging from 1-5 with 1 being the least suitable and 5 being the most suitable for reindeer herding. The value is based on available ground and tree lichens in the forest stand. A similar grading system have been used to evaluate the recreational value of a forest stand. The recreational value system is based on the subjective interpretation of recreational values.



1	Naakajärvi
2	Maunuvaara
3	Karhuvaara
4	Leipipir
5	Rautiorova
6	Vuollerim
7	Luottåive
8	Storklinten
9	Varjisån
10	Piteälven
11	Tjades-Nimtek
12	Dubblabergen
13	Ledfat
14	Jovan
15	Håckren
16	Galhammar
17	Tranuberget
18	Fjätälven
19	Rosfors
20	Skatan
21	Käringberget
22	Hornslandet
23	Grytaberg
24	Ejheden
25	Ovansjö
26	Öjesjöbrännan
27	Malingsbo
28	Färna
29	Kilsbergen
30	Forsmark
31	Ridö-Sundbyholm
32	Norra Vätterns skärgård
33	Omberg
34	Halle- och Hunneberg
35	Böda
36	Hornsö
37	Raslången

Figure 2. Map displaying the geographical location of different Ecoparks within Sweden and the ecoregions within Sweden. The colouring of the list indicates the ecoregions the park is located in. Blue- Northwest boreal, Orange-South east boreal, and Red-Boreonemoral.

2.2 Data analysis

The data was compiled from existing databases by Sveaskog in May 2024 and includes forest stand data, nature conservation data, and restoration data. In total, the database consists of approximately 18,900 cells with forest stands in each ecopark as a separate entity. The type of data used in this study consisted of the following: data from the ecopark forestry plans in excel form referred to as the ecopark database, a mapping of national interest in form of raster data, data of the overlapping intercept between national interests and ecoparks in form of excel and GIS map, and the written ecopark plans.
The data was analyzed using quantitative descriptive statistics; the resulting data was displayed using graphical methods (Cooksey, 2020). A new GCS was conceptualized and tested in a deductive analysis to determine how this could influence the representation of multiple-use potential in the Ecoparks forestry plans.

2.2.1 Data management process

The data collected from the summarized forestry plans of the 37 Ecoparks were gathered in one Excel file. Thereafter the data analysis was performed in a five-phase process outlined in (Bingham, 2023). The analysis process utilizes deductive and inductive coding strategies in the use of both existing code systems in the forestry plans and new codes created during the analysis.
During step 1 and 2, the data was organized and sorted into groups in 37 separate datasets, one for each Ecopark, with the ecoparks separated by ecoregion. This provided a better overview of each park and more manageable datasets. Information recorded regarding recreational, biodiversity, and reindeer herding values in the parks was not systematically recorded in the forestry plan and, therefore, not suitable for quantitative analysis. The focus of the analysis was on the goal classification system and the use of this system both in the individual Ecoparks and trends in the use of the system within the ecoregions. The mean size of the forest stand in each ecopark and ecoregion was analyzed. To examine if there is a significant size difference between forest stands in the ecoregions a Kruskal-Wallis test was performed. The Kruskal-Wallis was used because it was unknown if the data being analyzed was following a normal distribution, therefore the Kruskal-Wallis was suitable(Kallner, 2018).The test indicated a significant deferens and a Dunn test, post hoc pairwise comparison to compare the difference was performed. The age classification and vegetation classification were analyzed and sorted, and in steps 3-4, the sorted data was illustrated in a series of figures and trends shown in the results. In step 5, the data patterns and possible explanations were further explored.

2.2.2 Deductive data analysis

Berglund and Kuuluvainen (2021) proposed a revised model for forest management to emulate natural forest dynamics. This revised model is based on the natural age class distribution thought to prevail under natural conditions and disturbances. It suggests the type of management of each age and vegetation class, and the goal distribution of each category in the landscape to emulate natural disturbances. To test and apply the revised model for natural disturbance in the boreal forest of (Berglund and Kuuluvainen, 2021) in a deductive analysis, a set of codes for categories of age and vegetation types was used. The data was categorized into three categories by forest stand age based on the revised model. These categories were Young forest stands (0-74 years old), Middle-aged forest stands (75-149 years old), and Old forest stands (150+ years old). The vegetation types of the current vegetation classification system were categorized into the corresponding vegetation categories wet, mesic, and dry/poor used in Berglund and Kuuluvainen(2021). The concept of impediment in Swedish forest planning may also include areas of productive land with logistically problematic approaches making them ill-suited for productive forest management. These areas are still of importance for biodiversity values and GI. The data from the forestry plan data base was complemented with forest data for impediments; this data, however, does not contain the age of each stand.

The revised management model assumes that all types of disturbance dynamics may occur on all soil site types, but the proportions may vary. The model bases the frequency and intensity of natural disturbance on ground site conditions, and differs from previous models for forest disturbance, in the assumption that the prevailing natural disturbance dynamic will be non-stand-replacing, and that even-aged forest dynamics will be relatively rare in the landscape. The revised model suggests a system where most old-growth forests will be managed with alternative management methods such as gap cutting (GC) and partial cutting (PC) instead of clearcutting (CC), to emulate natural disturbances. While the majority of CC will be conducted in forest stands aged 0-74 years. This system states that 50% of all forest area should be in the 150 years or older age class. This is far from the National Forest Inventory´s estimation of the age class distribution of the study area used by Berglund and Kuuluvainen. According to the NFI, the <150 years age class contains 9% of the total forest area, while 78% of the area is dominated by trees in the age category 0-109 years old (Berglund and Kuuluvainen, 2021). According to the revised system, approximately 34% of the forest land should be managed by GC as it is characterized by gap dynamics GD. These are the forests characterized by wet to mesic soil types and spruce dominance where disturbances such as wind or deceases slowly create gaps when older trees fall. One-third of the forest land, 33%, can be managed with CC as it is characterized by even-aged dynamics ED. These would be forests characterized by mesic soil types and even-aged stands naturally created by stand-replacing fires. The remaining third of forest land should be managed with partial cuttings as it is characterized by cohort dynamics. These are the forest stands characterized by mesic to dry/poor soil type with pine dominance where the natural fire dynamic is frequent low-intensity ground fires. It is of interest to note that the lowest age for legal clear-cutting, lägsta slutavverkinings ålder (LSÅ), according to the Swedish Forestry Act and the regulations of the Forest Service, differs based on the soil-nutritional-value and the local climate of the site. The age classes in the revised model assume a final cutting age in Sweden and northern Finland of ca 80 years. according to the National Forest Inventory of 2024, the

average age of final cuttings in Sweden was 99 years in 2019 and has been declining annually.
because such the age for non-managed land is of no interest from a management perspective.

Table 3. The revised model's age class distribution according to Berglund and Kuuluvainen (2021) with the suggested management regime, and the correlating suggested goal classification

Age Class	Area %		Wet /GC	Mesic /CC	Dry/Poor/PC	
0-74yrs	25%		3%	19%	3%	
75-149yrs	25%		8%	9%	8%	
>150yrs	50%		23%	5%	22%	
Total	100%		34%	33%	33%	
		20%	14%	33%	23%	10%
		NO/NS	MB/NS	PG/PF	MB/NS	NO/NS

The vegetation classification system was organized according to the "Skogshögskolans Boniteringssystems med ståndortsindex" (Swedish Forestry collages soil nutrition value based on ground vegetation; table 4). The ground vegetation classification system utilizes different vegetation classes as indicators of the nutritional value and available groundwater. Boreal forest soil classification is mainly based on two main criteria: moisture and nutrient content of the soil with a gradient in categories from very dry to wet and very poor to very rich corresponding to typical forest site categories. The vegetation types were organized into the categories Wet, Mesic, and Dry/Poor, as illustrated in Table 3 and 4, to be able to make a comparison with the Berglund and Kuuluvainen (2021) revised model.

Table 4. Vegetation types (in falling order based on nutritional value), the vegetation abbreviation used in Swedish forestry, significant species for the vegetation type, English name, and vegetation type category according to Berglund and Kuuluvainen (2021).

Vegtype code	**Swedish name**	**Signifcant speices for the vegetation type**	**English name**	**Vegtype category**
HO	Högörts typ	*Urtica dioica,Cirsium hetrophýllum, Páris quadrifólia, Állium ursinum*	Rich herb type	Mesic

LO	Lågört	*Hepática nóbilis, Gymniocárpium dryópteris, Óxalis acetonsélla*	Poor herb type	Mesic
0	Mark utan fältskikt		Absence of ground vegetation	Mesic
BRGR	Bredbladig grästyp	*Pternidium aquilinum, Deschámpsia caespitósa*	Broad bladed Grasstype	Mesic
SMGR	Smalbladig grästyp	*Carex arenária, Lúzula pilósa, Equisétum sylváticum, Deschámpsia flexuósa*	Thin bladed grass type	Mesic
STAFRA	Starr Fräken	*Rubus chamaemórus, Carex globuláris, Equisétum sylváticum*	Rush and horsetail type	Wet
BLA	Blåbär	*Vaccinium myrtillus*	Billberry type	Mesic
BLALING	Blåbär/Lingon	*Vaccinium myrtillus/ Vaccinium vitis-idaea*	Billberry and lingonberry type	Mesic
LING	Lingon	*Vaccinium vitis-idaea*	Lingonberry type	Mesic
KRALJUN	Kråkbär Ljung	*Empetrum nigrum, Calluna Vulgaris*	Black crowberry, Heather type	Dry/Poor
FARIS	Fattigris typ	*Vaccinium Uliginósum, Ledum palústre, Andrómeda polifólia*	Poor shrub type	Dry/Poor
LAVRIK	Lavrik	*Cladonia spp*	Lichen rich type,1/4 of ground vegetation coverd by Lichen	Dry/Poor
LAV	Lav typ	*Clandonia spp*	Lichen type, 1/2 of ground vegetation covered by Lichen	Dry/Poor

.

2.3 Comparing and contrasting with the National interests.

To illustrate the multiple values and interests within the Ecoparks, the National interests of Sweden (Riksintressen) was used as a proxy to the presumed existing values within the ecoparks. These National Interests of Sweden (NI) are displayed in map layers illustrating recreational values, reindeer husbandry pastures, heritage protection areas, and areas of importance for nature conservation goals such as National parks and other areas protected in the Swedish Environmental Code chapters 3 and 4. Thus, the NI was used as a proxy for the multifunctional values of Sweden. Maps delineating the NIs was overlaid the Ecopark forestry plan data, and intersections calculated.

Using an intercept analysis in ArcGIS Pro, the total overlapping area of the national interest and the Ecoparks was summarized. This amounted to 139 912 hectares of productive forest land. This analysis thus excluded the nonproductive forest land within Ecoparks. The total amount of Productive Forest land within the ecoparks amount to approximately 174 649 hectares. The intercept of the NI and Ecoparks cover 80% of the productive forest area of the ecoparks. The intercept of Ecoparks and NI was then organized to illustrate the distribution of Goal classes and the distribution of different national interests within and outside of the intercept. The abundance and type of values where then compared to the values represented in the ecopark forestry plans and the table of values mentioned in the individual ecopark plans.

2.4 Complementary non structured interviews

In addition to the literature review and data analysis a non-structured interview was conducted with persons actively working with multiple use forestry or non-clear-cut forest planning. The interview was conducted to give a small estimate of the potential need for alternative forest planning tools among forest planers. An email with open questions was sent to the website, Plockhugget.se, a referral webpage for entrepreneurs in non-clear-cut forest planning. The questions were forwarded to forest planners who responded in writing outlining their personal believes of the improvements that can be made to the planning systems in Swedish context and how they use the current system. This was followed up with a digital interview where I presented the aim and goal of this thesis. The questions and answers are included in the appendix.

3. Results

3.1 Existing goal classification distribution within the Ecoparks

The total GC distribution for the different ecoregions illustrated in Figure 3, indicates that a large part of the NO classified forest is in the NW boreal ecoregion. Figure 4 shows the distribution of goal classes within each ecoregion as a boxplot including the mean and outliers. The NO class is more prominently used in the NW boreal ecoregion while the PF and NS classes are more used in the SE boreal and the BN ecoregions. In the BN ecoregion, the PG class is used sparsely.

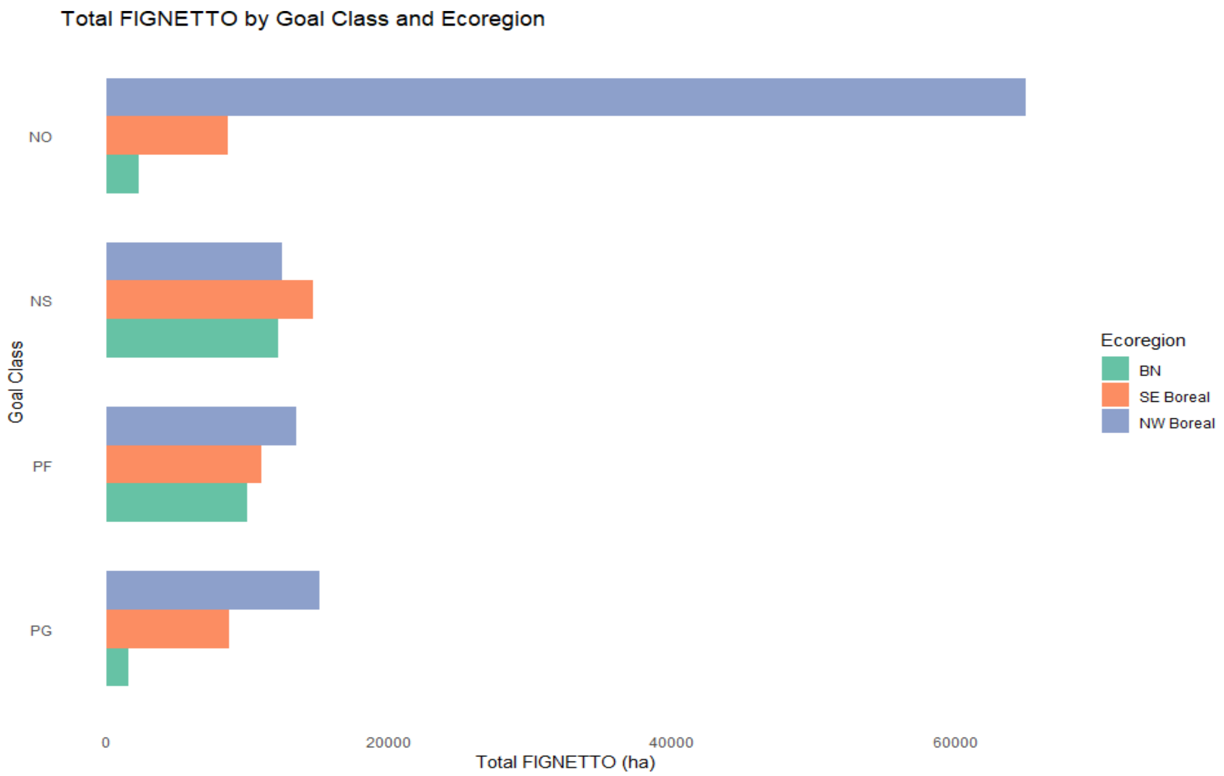


Figure 3.Distribution of productive forest land into goal classes expressed in hectares for combined Ecoparks in each ecoregion.

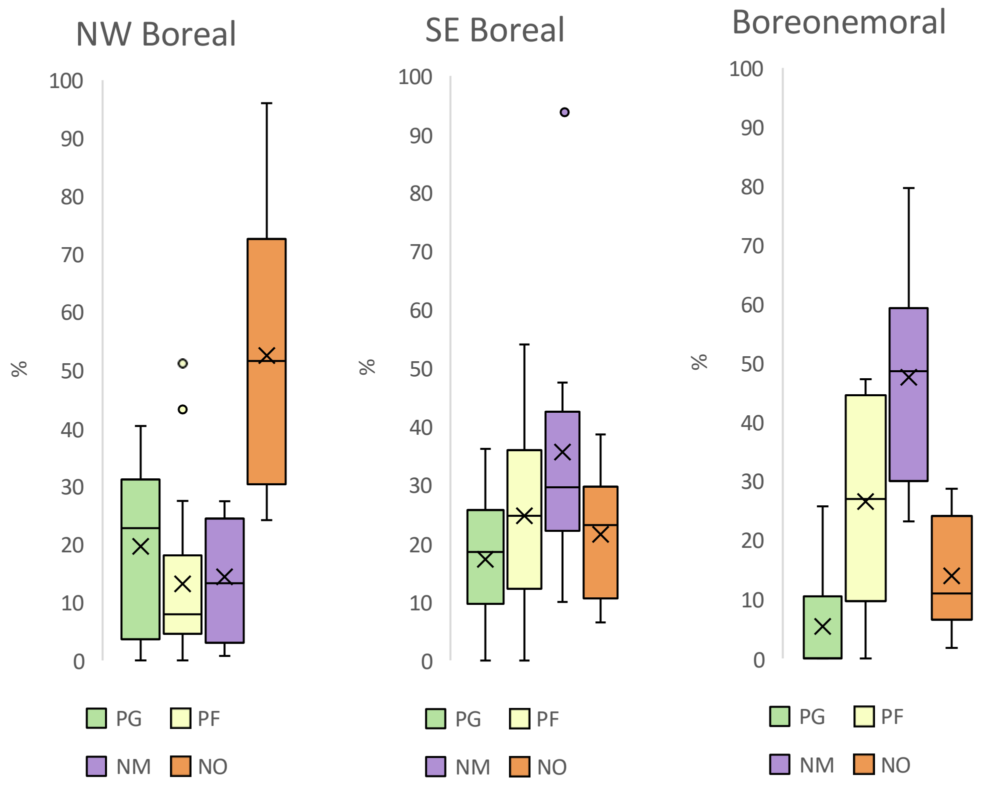
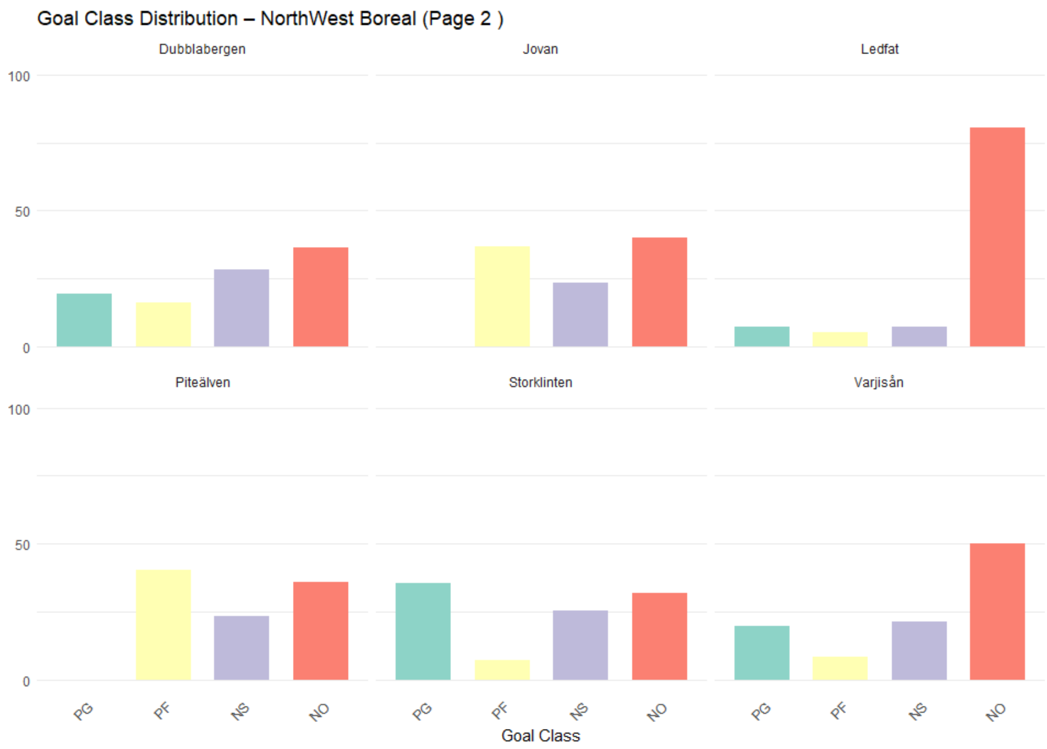


Figure 4. Distribution of goal classes across the ecoregions, displayed as a boxplot including outliers and mean values

Figures 5-7 illustrates the GC distribution in percentage for each ecopark grouped by ecoregion. The data is grouped with maximum 6 parks per page to assure the same size for easy comparison. Outliers of interest are the high amount of PG classes forest in Storklinten ecopark in the NW boreal zone. In the same ecoregion, Leipipir ecopark has the highest amount of NO classed forest, 80%. In the SE ecoregion, Öjesjöbrännan ecopark is to 100% classed NS, which is explained by its background as a fire area and set aside for natural succession. Ejeheden ecopark has the highest share of NO in the SE ecoregion.

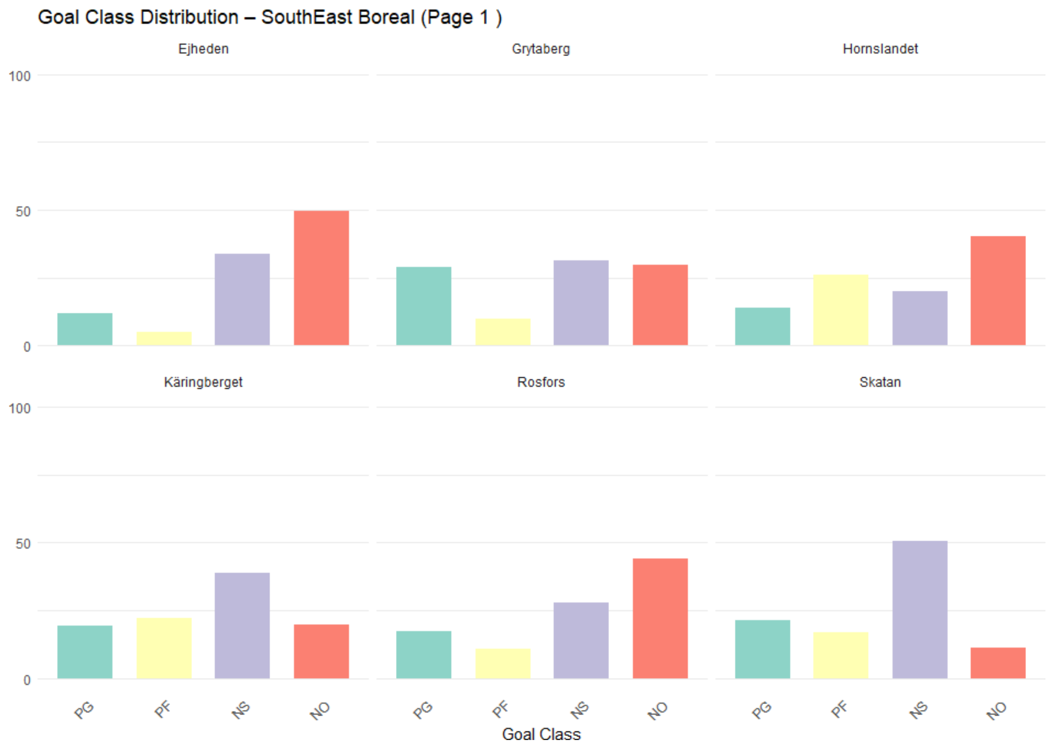
Goal Class Distribution – NorthWest Boreal (Page 1)
Karhuvaara
Leipipir
Luottåive
Maunuvaara
Rautiorova
Vuollerim
100
50
0
PG
PF
NS
NO
Goal Class



Goal Class Distribution – NorthWest Boreal (Page 2)
Dubblabergen
Jovan
Ledfat
Piteälven
Storklinten
Varjisån
100
50
0
PG
PF
NS
NO
Goal Class

Figure 5. Goal Class Distribution within Ecoparks located in the NW boreal ecoregion

.



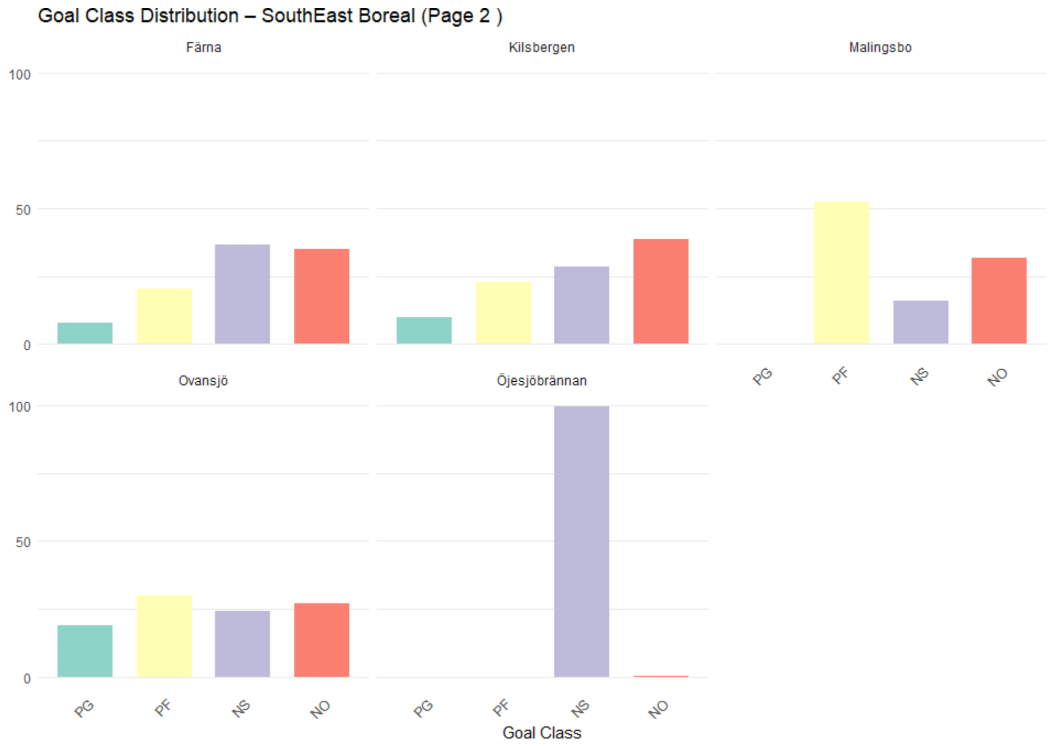


Figure 6. Goal Class Distribution within Ecoparks located in the SE boreal ecoregion.

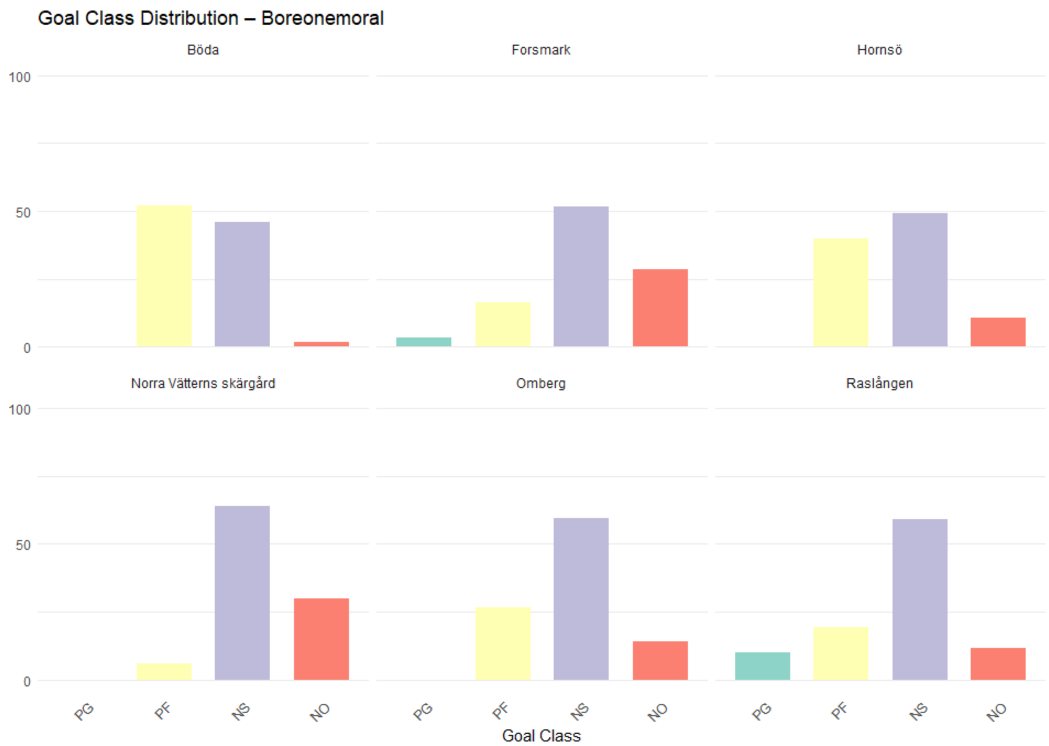


Figure 7. Goal Class Distribution within Ecoparks located in the BN ecoregion.

Figure 8 illustrates the overall difference in median forest stand size in the database. The ecoregions are marked by colour, Blue-NW boreal, Orange-SE boreal and Green-BN.

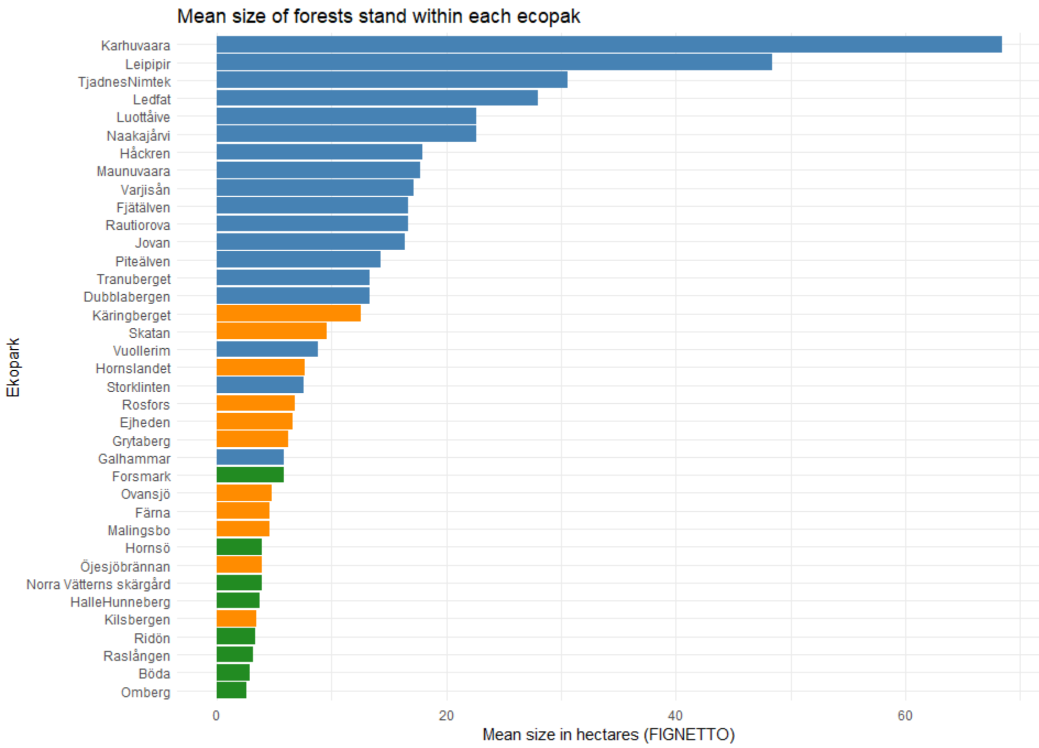


Figure 8. Mean size of forest stands in each Ecopark, expressed in hectares.

To examine if there is a significant size difference between forest stands in the ecoregions a Kruskal-Wallis test was performed. This indicated a significant deferens and a Dunn test, post hoc pairwise comparison to compare the difference. Figure 9 illustrates the difference in size of forest stands between the ecoregions and the P values between the different ecoregions. The results indicated that the mean forest stand in the NW boreal ecoregion is significantly larger than the mean forest stands of the BN and the SE boreal ecoregions. The results also indicate that the mean forest stands of the SE boreal ecoregion is significantly larger than the mean forest stand of the BN ecoregion.

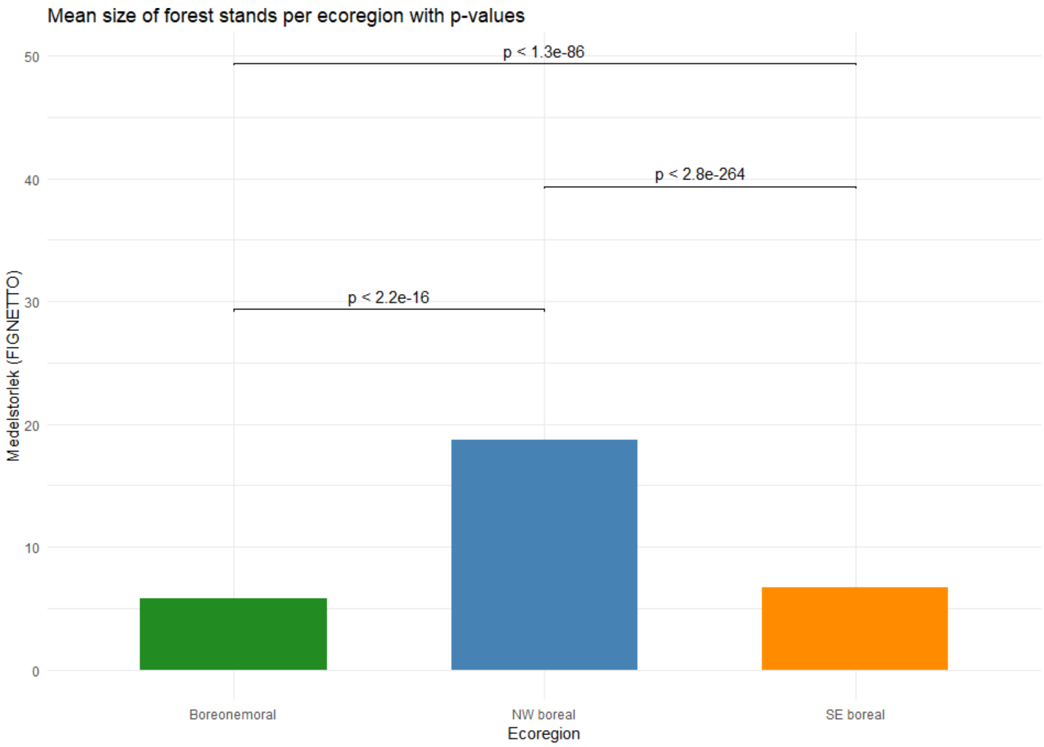


Figure 9. Median forest stand comparison between the ecoregions and the P values for the Dunn test.

Table 3. Z-values and P-values from the Dunns test

Comparing	Z-value	P-value
NW boreal-BN	54,16	<2,2e-16
NW boreal-SE boreal	34,73	<2,8e-264
BN-SE boreal	-19,78	<1,3e-86

The very low P-values displayed in table 3 indicate very large differences between the mean sizes of forest stands.

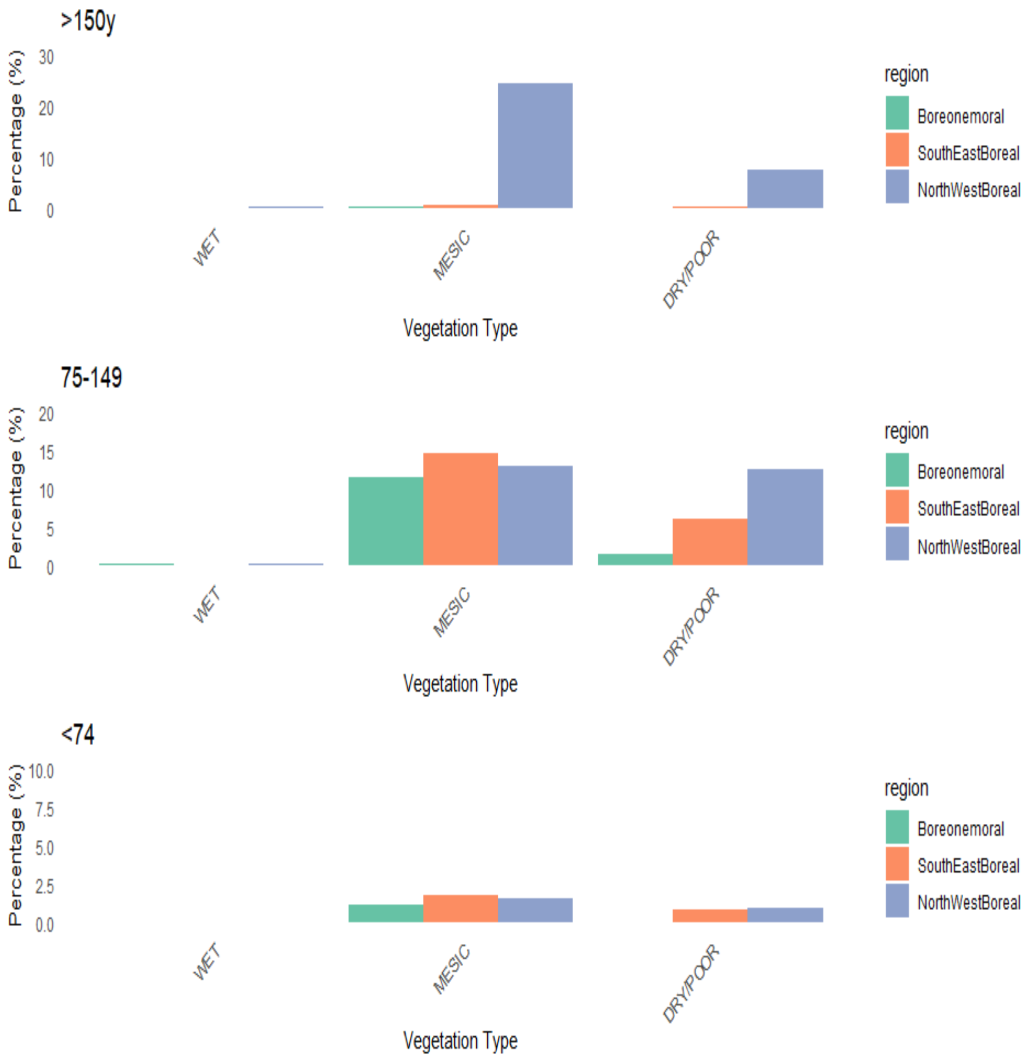


Figure 10. Vegetation type distribution per stand-age class expressed in percentage of all productive forest land. Note that the Y-axis scales are in descending order from 30-10% for the different age categories.

Figure 10 illustrates the overall proportions of forest land distributed across age and vegetation classes. This mimics the model for the natural distribution of vegetation and age categories presented by Berglund and Kuuluvainen.
Tables 4-6 illustrates the age and vegetation class distribution of the ecoparks in each ecoregion, in addition the existing data impediment data have been added, marked as Add wet and Add Dry/Poor. This data is not included in the GCS but relevant for the natural distribution of forest across vegetation and age categories.

Table 4. Age and vegetation class distribution within the NW boreal ecoregion.

Age class	Area %	Wet	Mesic	Dry/Poor
0-74	14,2%	0,00%	2,60%	11,60%
75-149	32,2%	0,50%	21,30%	10,40%
>150	53,6%	0,60%	40,40%	12,60%
Total	100%	1,10%	64,30%	34,60%
Adjusted %		13,47%	53,53%	32,99%

Table 5. Age and vegetation class distribution within the SE Boreal ecoregion.

Age class	Area %	Wet	Mesic	Dry/Poor
0-74	47,8%	0,00%	44,6%	3,20%
75-149	35,1%	0,30%	22,20%	12,60%
>150	18,6%	0,00%	3,60%	15,00%
Total	100%	0,30%	70,40%	30,80%
Adjusted %		7,67%	64,12%	28,21%

Table 6. Age and vegetation class distribution within the BN ecoregion.

Age class	Area %	Wet	Mesic	Dry/Poor
0-74	62,2%	0,00%	55,40%	6,8%
75-149	33,8%	1,40%	29,60%	2,80%
>150	4%	0,20%	2,80%	1,00%
Total	100%	1,6%	87,80%	10,60%
Adjusted %		6,06%	81,10%	12,84%

3.2 Assessment of management compared with the revised ASIO-model

Figure 11 illustrate the actual distribution of forest available for alternative forest management and the current management distribution compared to the revised ASIO-model. In this graph all forest stands with the NO classification have been removed as they are exempt from active management.

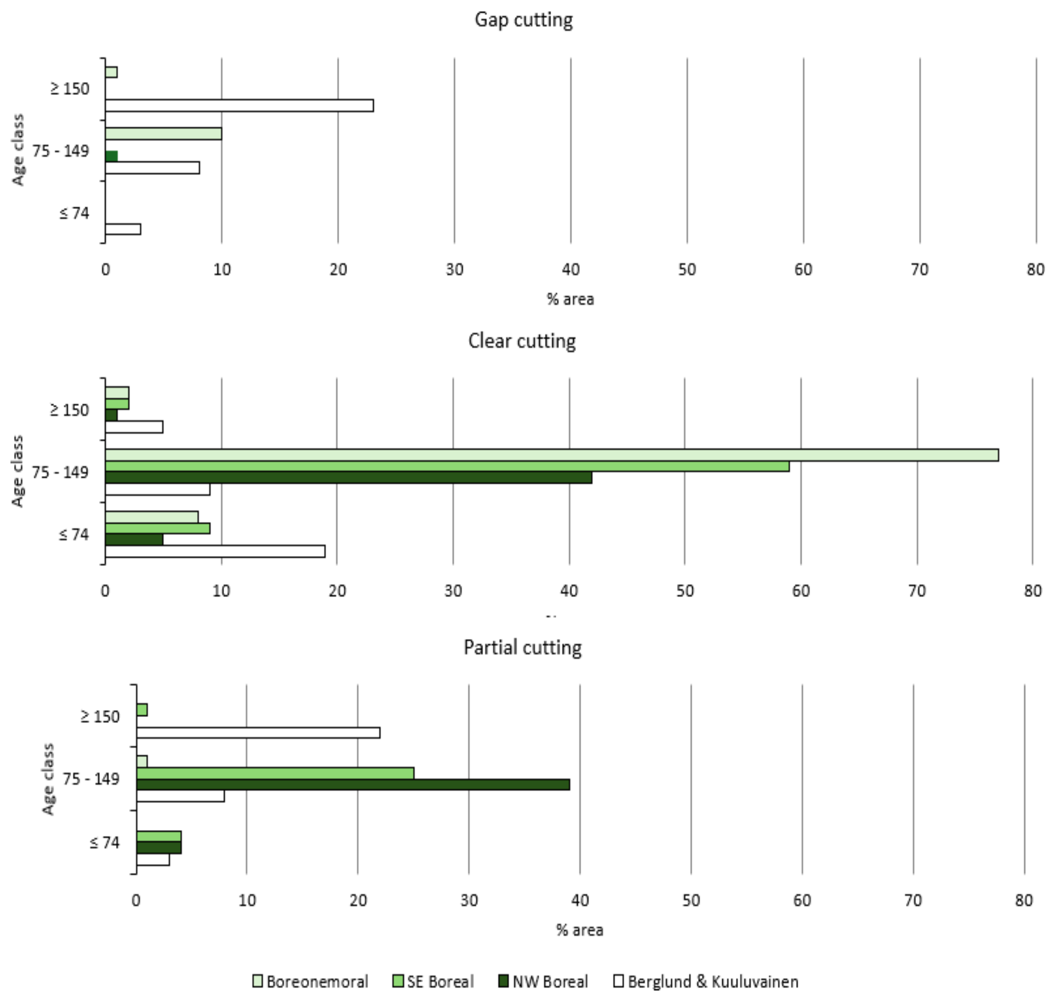


Figure 11. Percentage of forest land without the NO classified forest areas distributed across management actions.

Table 7 illustrates the distribution of goal classes across ecoregions. Because of the larger share of NO classified forest stands in the NW boreal ecoregion the analysis presented in figure 11 will exclude a significant part of the productive forest in the NW boreal ecoregion.

Table 7. Illustrates the distribution of the GC across the ecoregions and the large percentage of NO forest in the NW boreal ecoregion.

GC distribution %	NW Boreal ecoregion	SE Boreal ecoregion	BN ecoregion
NO	61%	20%	9%
PG	14%	20%	6%
PF	13%	26%	38%
NS	12%	34%	47%

3.3 Multiple-use assessment

In the assessment of noted multiple-use values in the Ecopark plans, recreational values occurred in 229 forest stands consisting of 1749 ha. These are predominantly distributed in the NW boreal, to a lesser extent in the BN ecoregions and to the least extent in the SE boreal ecoregion. Böda ecopark in the BN ecoregion represents an outlier with a substantial amount of recreational value, around 40% of the total noted recreational value in the BN ecoregion.

The recorded data for reindeer herding values in the SE Boreal and BN ecoregion indicates a few areas with very suitable conditions, because the value system is used in a binary way where areas are either determined to have no values or very high values. Out of the areas noted as suitable for reindeer herding in the BN ecoregion 99.9% are classed as 5. The same pattern can be seen in the SE boreal ecoregion, where all but two areas suitable for reindeer herding are classed as a 5. The parks in the NW boreal ecoregion, with substantial documented reindeer herding as a part of the profile of the parks, have more areas classed as 2 and 3.

Apart from the forestry plans the ecoparks also have written ecopark plans containing descriptions of the overall values, plan and profile for the Ecoparks. These folders for each park are meant to mediate the future strategy of the park and its many values as information but also to attract visitors. To summaries the written information found in the ecopark plans and the focus areas of each park, Table 8, as seen below, was created to illustrate the values mentioned and their frequency. Some values, such as fishing, hunting, and reindeer herding consideration, had their predetermined headings within the ecopark plan. Other values, such as the harvesting of wild mushrooms and berries, were frequently mentioned under the heading "recreational values." All parks had some recorded recreational value and some specific adaptations to attract visitors, such as hiking trails, snowmobile trails, or shelters for hikers. Because there were no large deviations and to avoid repetitiveness this category was excluded from the table. Positive answers were noted with green, negative answers were indicated with red. The ecoparks have been color coded based on what ecoregion they belong to. With blue numbers indicating the NW boreal ecoregion, orange indicating the SE boreal ecoregion and red indicating the BN ecoregion. The ecoparks are grouped from north to south in falling order.

Table 8. Illustrating specific ecosystem services mentioned in the Ecopark plans and the frequency they are mentioned.

	Name	CV	RV	SV	HV	FV	BV
1	Naakajärvi						
2	Maunuvaara						
3	Karhuvaara						
4	Leipipir						
5	Rautiorova						
6	Vuollerim						
7	Luottåive						
8	Storklinten						
9	Varjisån						
10	Piteälven						
11	Tjades-Nimtek						
12	Dubblabergen						
13	Ledfat						
14	Jovan						
15	Håckren						
16	Galhammar						
17	Tranuberget						
18	Fjätälven						
19	Rosfors						
20	Skatan						
21	Käringberget						
22	Hornslandet						
23	Grytaberg						
24	Ejheden						
25	Ovansjö						
26	Öjesjöbrännan						
27	Malingsbo						
28	Färna						
29	Kilsbergen						
30	Forsmark						
31	RidöSundbyholm						
32	Norra Vätterns						
33	Halle Hunneberg						
34	Omberg						
35	Böda						
36	Hornsö						
37	Raslången						

[1]

[1] The abbreviations used in the table denotes the following values CV- cultural values, RV-recreational values, SV-sami values, HV-hunting values, FV-fishing values and BV- berry and mushroom values.

As seen in Table 8, Sami reindeer herding was mentioned in 19 out of the total 37 plans. However, reindeer herding is not performed in the ecoparks located in the BN ecoregion. The reindeer herding is mentioned in 19 of the 29 parks located in the NW and SE Boreal ecoregions where possible reindeer herding areas may be found. Hunting was mentioned in all the Ecopark plans, and it is the most widely spread, specifically mentioned recreational activity documented in the plans. Berry and mushroom harvest were mentioned in 20 of the 37 plans.

Figure 12. Map displaying Sweden and the extent of the national interests of Sweden according to the Swedish environmental code paragraph 3-4. The pink areas show nature reserves, the green areas illustrate reindeer herding areas, the dots illustrate reported biodiversity values, the purple area illustrates the national interest of unbroken mountain range. The small blue spots show the ecoparks.

Figure 12 illustrates and overview of the NIs used in the analysis and the distribution across Sweden. The analysis will display a selection of the ecoparks and the interaction of different national interests within the ecoparks.

Figure 12 also illustrates the distribution of goal classes within areas at the intersection of areas marked as national interests (NI) within the ecoparks. The overlapping area amounts to 139 912 hectares of productive forest land out of the approximately 175 000 hectares of productive forest land within the ecoparks.

Figure 13 and illustrates the distribution of NI surrounding Jovan, Skatan and Kärringberget ecoparks located in Västerbotten county. Most of the illustrated NI are tied to Reindeer herding areas and the long thin herding corridors between suitable gracing grounds. Figure 14 is a zoomed in view of Jovan ecopark marked by the red square in figure 13.

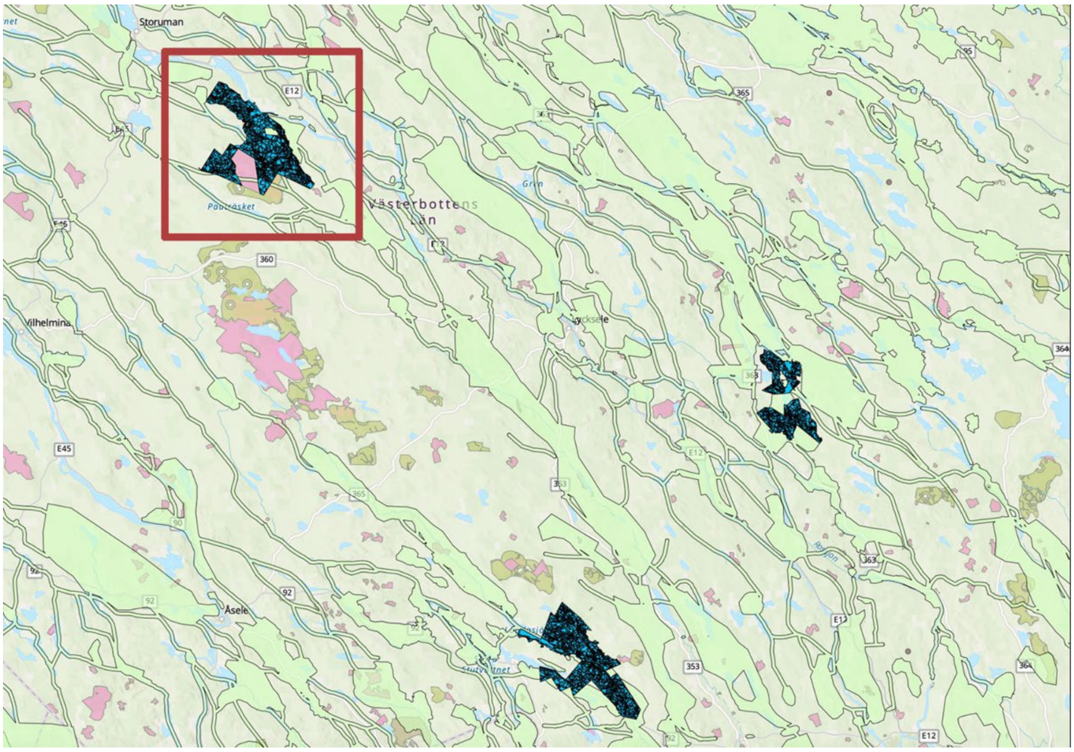


Figure 13 The NI present in and around the three ecoparks Jovan, Skatan and Kärringberget, blue coloured areas, located in Västerbotten county. The green colour indicate reindeer herding values, the pink indicates nature reserves, and the yellow areas indicate areas designated for wind power. The red square highlights Jovan ecopark further illustrated in Figure 14.

The area in and around Jovan ecopark is affected by a large are of reindeer gracing and reindeer corridors between gracing areas. Jovan is also affected by a nature reserve and an area with wind power stations.

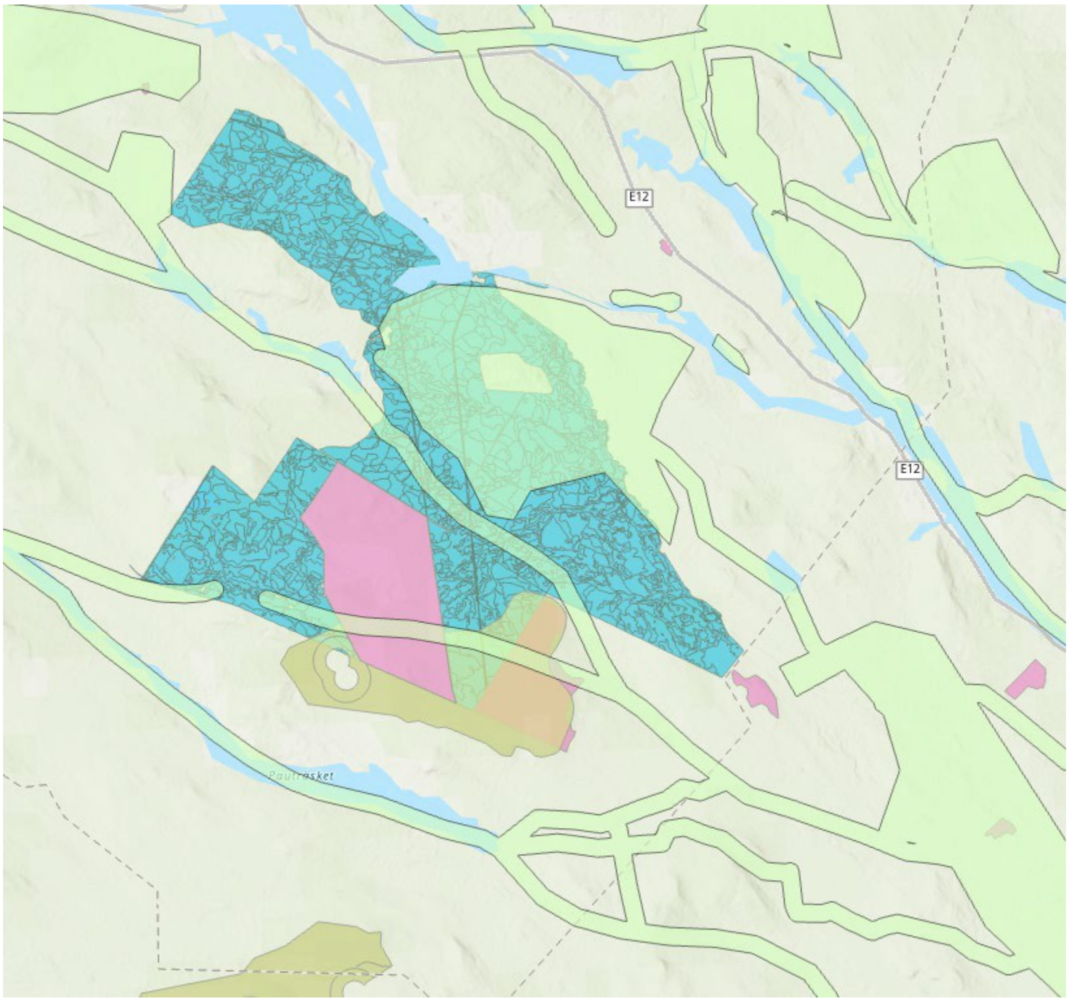


Figure 14. Map displaying the NI layer and the ecoparks Jovan, blue areas, located in Västerbotten county in northern Sweden. The green areas are reindeer herding areas , the pink coloured areas are nature reserves and the yellow area is areas with wind power.

Figure 15 illustrates the Tranuberget and Fjätälven ecoparks. They are both located in Dalarna County and are the two parks furthest south within the NW boreal ecoregion. A large portion of the NI surrounding the ecoparks are tied to reindeer herding, both migration routes (elongated polygons) and core areas. Other NI are the nature reserves bordering the ecopark illustrated in pink. The purple colored area in the surrounding landscape is tied to the NI of unexploited continuous mountains in Sweden.

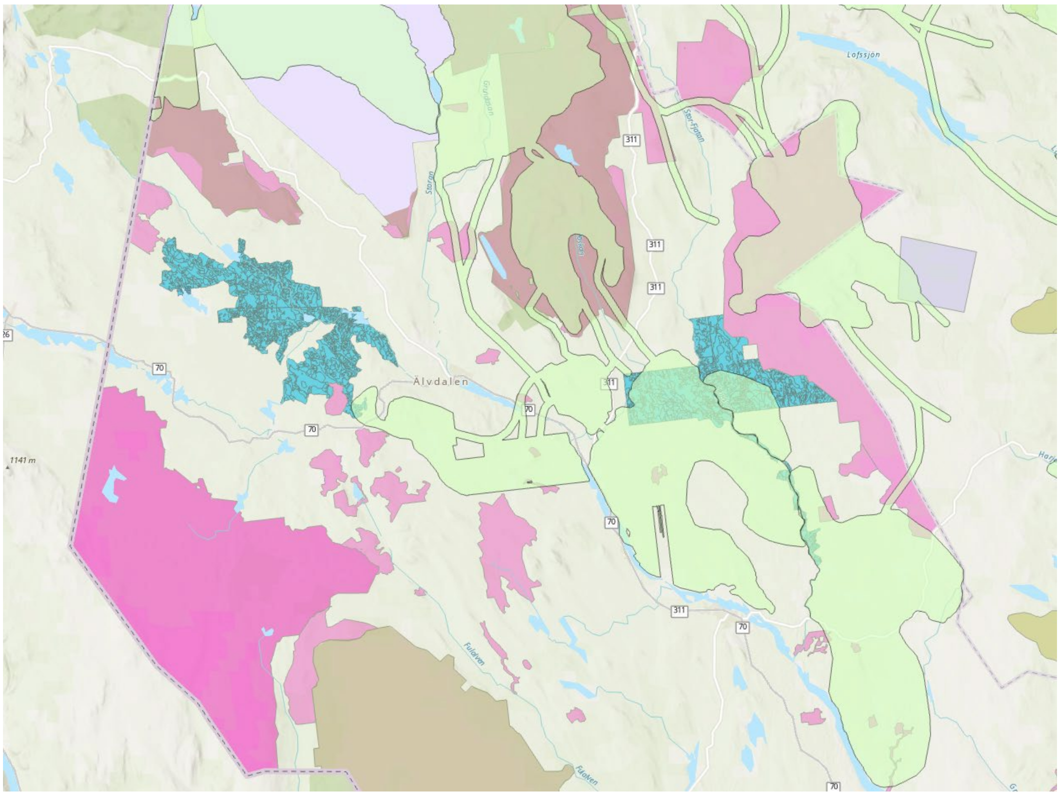


Figure 15. Map displaying the Tranuberget and Fjätälven ecoparks, blue areas, located in Dalarna County. The green coloured areas are tied to reindeer herding, the pink coloured areas are nature reserves, the yellow-coloured areas are tied to wind power, and the purple coloured areas are tied to the national interest of continues mountains in Sweden.

Figure 16 illustrates the distribution of NI surrounding Ridö-Sundbyholms archipelago located in Västmanland County. The ecopark is located within a nature reserve and the surrounding NI is the nature reserve. The ecopark consists of around 70 small islands and is located in the BN ecoregion. The Ridö-Sundbyholms archipelago is one of a few ecoparks being considered to become new national parks.

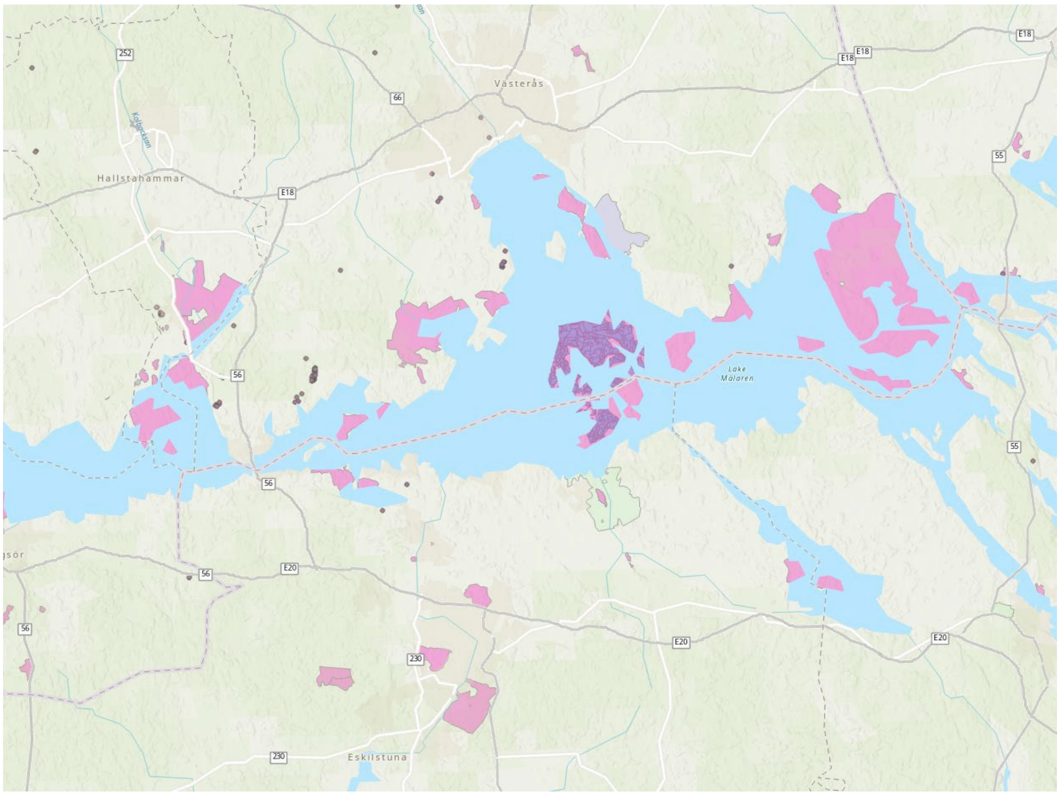


Figure 16. Map displaying the NI surrounding the ecopark Ridö-Sundbyholms archipelago located in Västmanland county. The pink coloured areas indicate nature reserves.

Figure 17 illustrates the GC distribution within the intersect of the ecoparks and documented NI expressed as % of forest land. Within the intersect the most common GC is the NO category. The production forest classes, PG and PF, amounts to around 30% of the total forest land within the intersect.

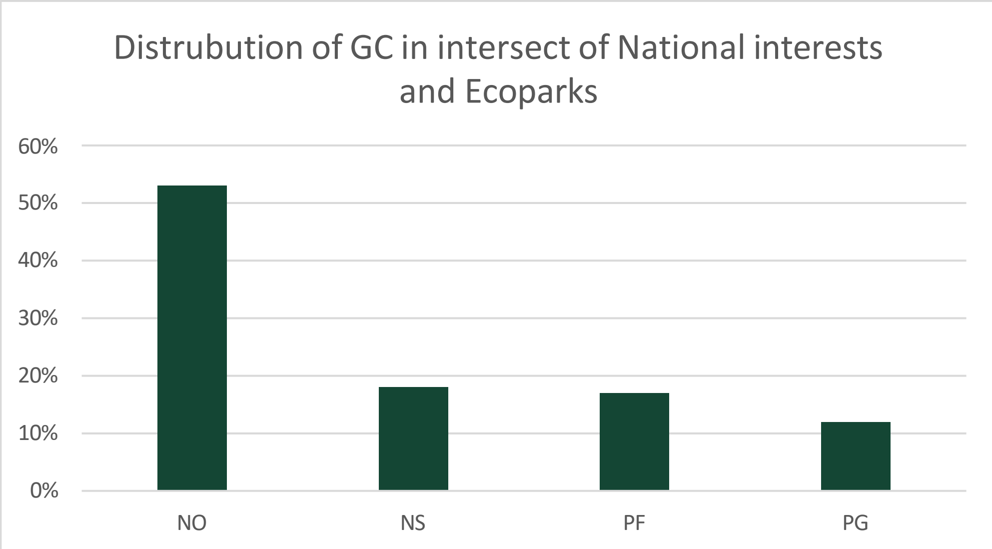


Figure 17. Graph illustrating the GC distribution within the intersection of Ecoparks and National interests.

Figure 18 illustrates the distribution of the different NIs found in the intersection of ecoparks and NI. The bars represent nature reserves, national voluntary offsets, reindeer herding areas of special importance wind power and areas of interest for mineral exploits. The most common NI are reindeer herding rights, nature reserves, and wind power-affected areas.

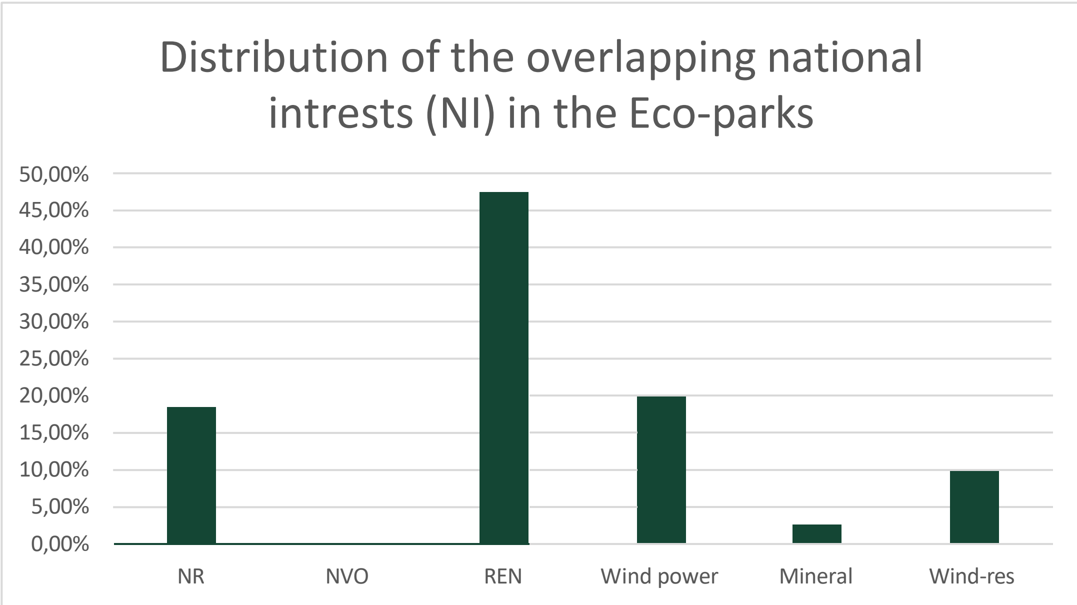


Figure 18. Graph illustrating the distribution of national interests within the Ecoparks. . The bars represent Nature reserves (NR), National voluntary offsets (NVO), Reindeer herding areas of special importance (REN), areas of national intresst for wind power (Wind power), areas of interest for mineral exploits (Mineral), and wind power in close proximity to residential areas (Wind-res).

Figure 19 displays the GC distribution within productive land affected by reindeer herding. Sveaskog has previously used the NO category frequently in these areas, as illustrated by the GCS. Recently, new management strategies to increase the abundance of ground lichens might change this. The new strategies might include reclassifying areas as NS/PF to manage them more actively to benefit the reindeer herding areas.

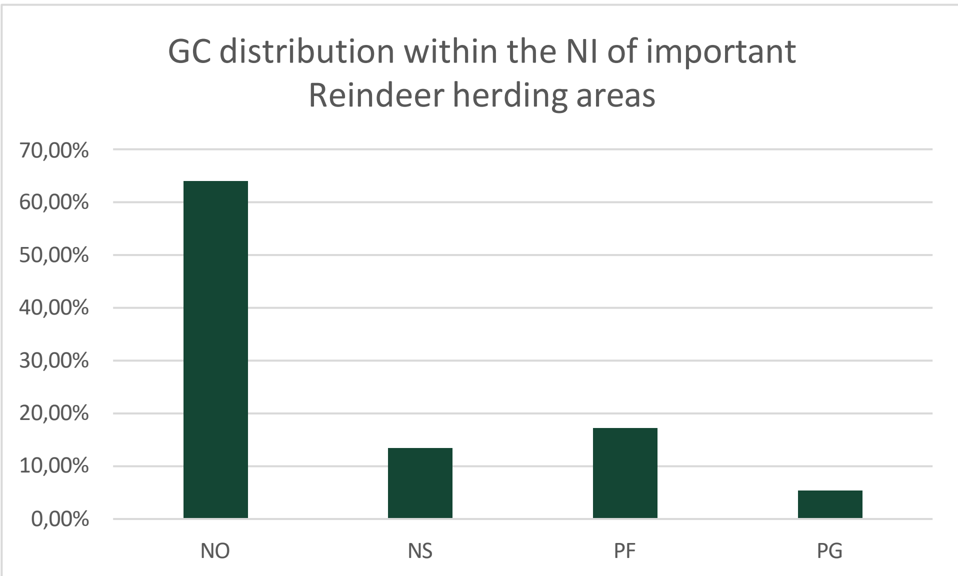


Figure 19. The distribution of goal classes within the most common National interest within the Ecoparks, reindeer herding areas.

3.4 Semi structured interview

To get a small assessment of the possible need for an alternative GCS for alternative management I contacted a referral webpage for entrepreneurs in non-clear-cut forest planning. I was referred to two persons working with alternative forest management and planning and emailed a set of questions such as.

How do your close to nature forest plans differ from the common forestry plans used in Swedish forest management?
Do you use any type of other system for goal classification?
In what way do you communicate the content of a forestry plan to the forest owner?

The following statements are the personal opinions of the forest planners and may not be the overall philosophy of Plockhugget as a company. All my emails and their entire response is including in the appendix.
The interviewed forest planers stated that the current goal classification system is adapted to traditional rotational forestry and less suitable for alternative management. Even the idea of dividing the forest into manageable stands was less suitable for continuous cover forestry as the data such as age, height and volume is an estimated mean for the stand. For single tree selection in an uneven aged forest this is not relevant as large and small trees are located all over the stands. The management methods require more thorough measurements and is more time consuming. Presently most of the forest they work with are affected by historic rotational forestry and therefore the forest has not regressed far from an even aged dynamic. Its therefore possible to use the same forest planning tools as for rotational forestry. They expressed a future need for more adaptable and nuanced forestry planning tools. They were more focused on expanding the maturity classification system within Swedish forestry. This classification system is primarily used for classifying what the next forest management action should be such as clear-cut, thinning, precommercial thinning.

4. Discussion

4.1 The distribution of GC within the Sveaskogs Ecoparks

The comparison between the Ecoparks and the NI indicates that the GCS does not represent the multifunctional values found within the Ecoparks. As illustrated in figure 5-7, there is high distribution of NO in the NW boreal region and low in the Boreonemoral region. This mimics the distribution of older forests with high biodiversity values in Sweden and the location of the Scandinavian green belt (Svensson et al., 2020). The lack of older forest areas with high biodiversity values in the SE boreal and BN ecoregions makes it difficult to straight forward use the NO classification. This creates a need to use NS and PF to promote biodiversity values to reach the biodiversity demands of a green forestry plan. Figure 8-9 illustrates that apart from the differences in usage of different GC the sizes of a forest stand differ between the different ecoregions. Not only are there more NO classified forest in the NW boreal ecoregion and a higher distribution of NO forest compared to the other ecoregions. The forest stands are substantially larger further north. This could be an indicator of a more heterogenous landscape in the south and fewer differences for larger areas in the north.

The interview and email correspondence with forest planners in alternative management highlighted the need for more adaptable forest management tools. In personal communication with representatives at Sveaskog they expressed a similar notion. Because of the internal policy regarding NO/NS categorized forests the company is not permitted to remove trees from these areas. As shown in figure 19 more than 60% of the ecopark areas within the NI of reindeer herding is NO classified. To preserve these areas as suitable for reindeer herding Sveaskog and the Sami people would like to remove ingrowth of spruce, because it can negatively affect the ground lichens. This is not permitted in NO/NS stands. This highlights the potential benefit of a multiple use forest GC. The Nature conservation ambition of the company prohibits an active restoration that would benefit the reindeer herding, the preservation of the pine dominated heathland and potentially produce spruce lumber and pulpwood. The Swedish forestry company SCA have a similar concern regarding their wind-power parks. Because land designated for wind power is primarily used for wind power, the land is considered to be non-forest land. SCAs ambition of providing green energy for their factory's created a new problem. The reclassification of large areas of land from forest to non-forest is problematic as it in paper looks like extensive deforestation, even though the forest surrounding the turbines is still there. With a more adaptable classification system this could potentially be avoided.

Multifunctional values

The Multifunctional values in the Ecopark plans are represented in comments organized in specific categories for values such as recreational values, reindeer herding values, and cultural values. These categories are not consistently used between different ecoparks and within the same ecopark plan. The suggested treatments or management suggestions in the plan are listed as comments in the columns of the data sheets in the plans. The comments are organized in specific categories such as recreational values, reindeer herding values, and cultural values. The usage indicated a lack of consensus on how to evaluate and the criteria for evaluating certain values. This might be due to differences in the subjective evaluation of these values. Swedish forestry plans are primarily used to plan for economic and biodiversity values. The lack of experience in documentation and evaluation of other values could be the cause of the inconsistencies and incorrect documentation.

Representation of reindeer herding values

The reindeer herding value system also seems to be used with more nuance in the NW ecozone, with values ranging from 1-5. The recorded data for reindeer herding values in southern Sweden indicates that the scale of 1-5 have been used in a binary way. This could be attributed to inexperience in assessing these values in the south of Sweden or the data might have been recorded arbitrary because it would be of no real value in the forest planning. Of the areas suitable for reindeer herding in the ecoparks in the BN ecoregion 99.9% are classed as 5, the highest grade. The same pattern can be seen in the SE ecoregion, where all but two areas suitable for reindeer herding are classed as a 5. The parks in the NW boreal ecoregion, with documented reindeer herding as a part of the profile of the parks, have more areas classed as 2 and 3 illustrating a more nuanced use of the system.

Representation of recreational values

Recreational values, according to the data in the plans, are distributed with a large majority of recreational values in the NW boreal and BN ecoregions and fewer recreational values in the SE boreal ecoregion. The forest stands with recreational values are larger in the NW ecoregion and smaller further south. There is also an outlier in the form of the Böda ecopark in the BN ecoregion. Böda has a significant amount of recreational value, around 40% of the total recorded recreational value in the BN ecoregion. This would indicate a larger area of recreational values in the single ecopark, Böda, than in all the ecoparks in the entire SE ecoregion. This may be interpreted as a lack of consistency in the documentation of recreational values. The system for documenting recreational values has very little data consisting of 1749 hectares of forest land documented as suitable for recreational activities. The lack of documentation of recreational values can be due to the Swedish right to roam, making all land available for recreational activities. The argument would be that marking all areas suitable for recreational activities would be unnecessary. However, because most of the Ecoparks are specifically designed with the goal of promoting recreational activities and there are significant investments from Sveaskog to create hiking trails, bike trails, areas for horseback riding, and fishing areas, this is not represented in the GCS. A better representation could provide clearer data to showcase the multiple values within the Ecoparks. It could also provide valuable test sites for forestry management with recreational goals and forest planning for recreation. The recorded values apart from production values and biodiversity are inconsistent represented within the forest plan data due to the lack of consistency in the recording of the data. This can be attributed to several factors, the subjective evaluations of forest data done in the field by the creators of the forestry plan, a lack of guidelines on how different categories for values within the forestry plans should be used, and non-intuitive or complicated systems for data recording.

Written Park folders

As seen in Table 7, several ecosystem services such as Sami reindeer herding, hunting, berry harvest and recreational activities are mentioned in the written park folders. Hunting was the most frequent mentioned other usage of forest land in the ecoparks. Berry and mushroom harvest were mentioned in 20 of the 37 plans. The reasoning for berry harvest is mentioned less then hunting might be due to the economic incentive for Sveaskog in promoting hunting, both in form of lease hunting and the economic gain from limiting gracing damage in forestry. Some type of hunting is conducted in all of the Sveaskog ecoparks by local hunters leasing areas or by ecotourism companies such as hunting guides leasing areas for arranging hunting trips for tourists Because berry harvest falls within the Swedish right to roam most Swedes will assume the right to harvest and forage is implied on all land and there is no reason to include this. This distribution of documented recreational land usage is not reflected in the forest data and GCS of the ecoparks. Reindeer herding is mentioned in the written folders of most of the parks located in the NW and SE Boreal ecoregions where possible reindeer herding areas may be found. Its however not mentioned in all the written park folders, the reason to exclude mentioning reindeer herding values in some parks is not clarified in the folder information or on Sveaskogs website.

Limitations

The category NSBESKRIVN, Nature Conservation Create description, is used to describe the type of nature conservation management that is to be used in the NS forest stands. However, in some parks, management suggestions, such as pre-commercial thinning and thinning's for PF forest stands, have been recorded in the NSBESKRIVN category. These suggested management effects in production forests should not be included in the nature conservation actions. This might be due to the term nature care, Naturvård, being used as a term for all types of forest management actions apart from clearcutting. The PF category does not have a fixed amount of nature consideration like the mandated 10% of PG. Because the PF GC have this span of 15-50% of the forest stand being left for nature consideration the creator of the forestry plan might have a need to precisive the amount of the PF that is to be left for consideration. In contact with Sveaskog representatives they remarked that the main management method for nature restoration in NS areas is the removal of spruce to promote pine and broadleaf species. The instructions for NS management prohibits the removal of the spruce logs, they may be thinned out but left as dead wood in the stand. Sveaskog could use these spruces for quality lumber/pulp and thereby reduce costs for the nature restoration operation. According to the Sveaskog representative, it is not currently according to their strategy to use the PF category when the main goal of the management action is restoration.

4.2 How can a revised version of the goal classification system be constructed to reflect the multifunctional values and interests in the forest landscape in Sweden.

The modern forestry in Sweden relies on the distinction between production forest and forest left for nature conservation. The repeated clearcutting of boreal forests have a documented effect on species richness and the changes in biodiversity is likely to have an effect on the functionality of the forest ecosystem (Fagerli Lunde et al., 2025). The passive conservation efforts made in Swedish forestry is not enough to reach agreed national and global targets for biodiversity (Angelstam et al., 2020). The current Swedish forest left for conservation lack ecosystem connectivity or “green infrastructure” (Svensson et al., 2023, Angelstam et al., 2020). This further illustrates the need not only for restoration but for pre restoration with future conditions in mind and active management is needed to ensure provisions of ecosystem services(Svensson et al., 2023). Clear cutting forest regimes and ideas behind the GCS does not mimicking natural fire disturbance regimes in boreal forests (Berglund and Kuuluvainen, 2021, Fagerli Lunde et al., 2025). The current age and vegetation class distribution illustrated in figure 4-6 can be seen as a result of the current forest management system. Most of the forest in the southern ecoregions, BN and SE boreal, are located in the young to middle age categories with a small percentage of older forests(>150yrs). The higher percentage of older forest in the NW Boreal ecoregions reflects the higher amount of NO classed forest stands. Table 8 and figure 10 further illustrates the large distribution of NO classified forest in the NW boreal ecoregion and the lack of older forest stand when disregarding the NO stands that are already exempt from active management. The PG, PF and NS classified forest stands within the ecoregions further reflects the effects of the current management system.

This distribution of older and younger forest stands among ecoparks on a national scale mimics the disproportional national distribution of protected and functional forest land concentrated to the north and sub alpine ecoregion and the lack of ecoregional representation discussed in Angelstam et al., (2020).
The vegetation type distribution further reflects the effects the potential negative effects of the ASIO model for forest disturbance presented by Berglund and Kuuluvainen (2021). The low share of forest within the vegetation types as Wet and Dry/Poor reflects that these should be exempt from clear-cut forestry according to the ASIO model for natural fire disturbance (Berglund and Kuuluvainen, 2021).

It's in the economic interest of the forest owner or manager to classify more vegetation as Mesic or historically to change the vegetation type with methods such as trenching. The current GCS have the distinction between production forest and nature conservation, in the production forest the ruling paradigm have been clear-cuts. Because clear-cuts should be applicable on 90% of land according to the interpretation of the ASIO model (Berglund and Kuuluvainen, 2021). This have led to low productive or logistically difficult to access Wet and Dry/Poor areas are classified as impediments. The higher productive Wet or Dry/Poor areas have been classified as Mesic and suitable for clearcutting.

The current GCS fails to reflect the multifunctional values such as recreation, reindeer herding, hunting and active forest restoration. The current GCS can be viewed as a blunt tool when focusing on other values than biodiversity and economic values, and when used for alternative forest planning, as demonstrated in the ecopark database. A revised GCS could potentially give a better overview of the multiple values in the forest, while at the same time facilitating the use of alternative forest management. The future needed increase of alternative management is illustrated both in the Eu nature restoration, the Swedish forest service rapport on the future potential of CCF in Sweden and in the public opinion. The revised GCS could also potentially give better data of the major economic investments done by Sveaskog to promote recreational values, hunting, carbon sequestration, reindeer herding, and other values in the ecoparks.

Berglund and Kuuluvainens revised model suggest a distribution of approximately 1/3 of the productive forest land managed with clear-cuts, 1/3 left for nature conservation, and 1/3 to be managed using alternative management methods such as CCF. This is also similar to the idea of triad landscape functioning zoning as a suggested solution to balance social, ecological, and economic values in the forest landscape(Blattert et al., 2023). A similar approach for more sustainable forest management was also published in the Inquire of the management of forests owned by the Swedish church (Enander, 2024). The revised GCS could potentially utilize the different management and conservation methods to maximize the common good in line with multifunctional forest management. The revised GCS would hopefully also promote synergy effects between restoration, alternative management and clear-cut forestry. This is also in line with the recommendation for CCF in Sweden by the Swedish forest service. The potential negative effects of a system with the intention to decreasing the number of clear-cuts on a landscape level is a potential lower economic yield for the forest owner.

Because the ecoparks already are voluntary set asides with the intention of alternative forest management to promote biodiversity and recreational values the economic effects are of lesser importance for the management in the ecoparks. It could be argued that the economic investment in setting the land aside could be further used to its full potential with a system that further illustrates the work done to promote other values within the ecoparks. The use of the ecoparks as research subjects is also mentioned in the ecopark plans and aim. It could therefore be beneficial to implement the suggested revised GCS from this thesis in the Sveaskog ecoparks to further develop the system.

The Revised GCS

The revised GCS is based on the revised model for natural disturbance by (Berglund and Kuuluvainen, 2021) presented in figure 3. This thesis suggests that the current production classes PG/PF and the nature conservation classes NO/NS could be complemented with a multifunctionality class, or mångbruksklass in Swedish, and a set of sub-classes for the specific focus area of the forest stand. The system could potentially allow for more nuances in forest planning and help visualize the multitude of values in Swedish forestry both for the public but also for a more intuitive insight in the forest for the forest owner.

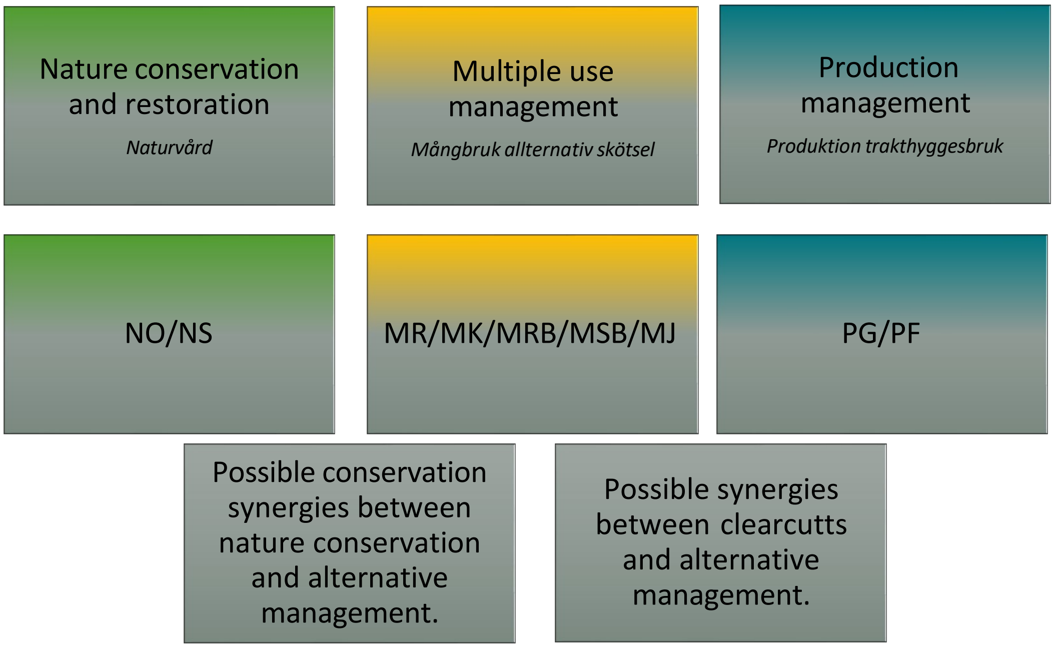


Figure 20. Illustration of goal class distribution within the revised goal classification system and the potential to promote synergies.

The system would utilize the previous categories of NO/NS and PG/PF illustrated in table 2. A third category named Multiple use, M(Mångbruk), would be added with additional subcategory's such as multiple use reindeer MR (Mångbruk Ren), multiple use hunting MJ (Mångbruk Jakt), and multiple use wind power MV (Mångbruk Vindkraft). The forest land will be divided on a landscape level into 3 thirds according to Berglund and Kuuluvainen (2020). The majority of the PG/PF goal class would be located in the Mesic vegetation category and in the 0-74yrs and 75-149yrs age categories. Most of the alternative management or multiple use forestry would be done in form of partial cuttings on the Dry/Poor soils and gap cutting on part of the Wet soil types. The 30 % of nature conservation would be conducted in older stands on Wet and Dry/poor soils. One underlining idea with the system is to promote conservation synergies between nature conservation and alternative management while enabling more active restoration strategies.

Alternative forest management regimes such as single tree selection or CCF have been highly debated within Swedish forestry(Ekholm et al., 2023). The ruling consensus within Swedish forestry have been that the methods have only been done in stands dominated by Norway spruce, *Picea abies,* in the boreal ecosystem(Lundqvist, 2017). Because single tree selection systems or gap cutting only have been performed on specifically multi layered spruce dominated stands it has been viewed as insignificant compared to rotational forestry within the context of Swedish silviculture (ibid). The main critique of such management regimes has been the lack of adaption to the disturbance regimes and ecological conditions of the boreal forest and the potential loss of economic revenue (Lundqvist, 2017). However the literature of comparative studies between specific alternative forest management and clearcutting is inconclusive but suggest a lower economic yield from alternative management (Ekholm et al., 2023). A conclusion to be drawn from the entire debate is the need for more research and that there is no silver bullet for forest management, no management system has all the answers.

Multiple use forest planning could potentially mitigate the negative aspects of different management approaches by utilizing different management regimes as different tools in a toolkit with the correct tool for the conditions presented in each forest stand while simultaneously consider the landscape perspective.

As the general attitude to alternative management is closely tied to negative connotations to historic mismanagement of forests this thesis suggests that the revised GCS could be used as a voluntary complement or more specific tool for forest owners with an interest in multiple use forestry but also as a more effective planning tool for forest workers. The implementation of the system would therefore be within the current Swedish forest policy of Freedom under responsibility. Instead of using non intuitive and unstructured comments within the excel data of the forestry plan. The revised GCS could potentially clearer illustrate the values within the forest to the forest owner. This would also impose a clearer systematization, ensuring correct data recording. This would hopefully lessen the occurrence of non-useable data from the forestry plans due to human error.

Landscape application
This study suggests a trial implementation of the revised GCS could be done in all Sveaskogs ecoparks. The data distribution of age and GC across the different ecoregions indicate high amounts of old growth NO classified forests in the NW boreal ecoregion compared to the SE boreal and BN ecoregions. This could indicate less need for alternative management in the NW ecoregion and a larger need in the SE and BN ecoregion to promote more old growth forest. The NO forest of the NW boreal ecoregion are by their classification exempt from active management. The new revised GCS is primarily based on disturbance models for Boreal Forest. This thesis therefore suggest that a possible implementation of the revised system can be done in all ecoparks in all ecoregions. But the focus area of implementation should be focused on parks in the SE boreal ecoregion.

Potential further application
Implementation of the forest planning system within the ecoparks could be used for educational purposes for private forest owners. The ability for the forest sectors show their ability to adapt, learn, and reform to the broad society and other stakeholder groups can be seen as a key to the success of the LÖWE forest program or "German Model of forestry" (Borrass et al., 2017). The strength of the Swedish policy model of "freedom under responsibility", relies in its ability to address new sustainability challenges and introduce new management approaches(Lindahl et al., 2017). The Swedish forestry model's greatest weakness lies in weak mechanisms for implementing policy's and making choices between conflicting goals(ibid). This have in recent years resulted in a large number of alternative management approaches but relatively small-scale implementations. The presentation of the revised GCS as an alternative tool incapsulating most management systems for forest management would fall within the Swedish forest policy and could potentially capture some of the current growing "Zeitgeist" of interest in alternative forest management. The revised forest management model could further respond to the critique Swedish forestry have received and integrate broader societal, ecological and economic trends. The revised system would with minor changes be applicable for forest planning in the entire boreal forest biome. The implementation of the revised GCS in the ecopark concept could illustrate a sustainable multifunctional forestry approach for state owned forests. Based on forest planning with a landscape perspective and voluntary set asides. The approach of combining multiple management methods for maximum common good while taking inspiration from Swedish and German forest policy could showcase new strategies for implementing forest policies among private forest owners.

4.3 Conclusions

The current goal classification system for Swedish forestry does not reflect the multifunctional forestry potential or the nature conservation ambition of the ecoparks. By using documented areas of national interests in Sweden as a proxy for multiple values, it was established that there were documented multiple values in 139 912 hectares of the total 175 000 hectares of productive forest land in the ecoparks. These national interests are not represented in the forest planning. The nature conservation ambition and profiles of the parks presented in the written park folder indicate multifunctional values and land usage. This is not represented in the goal classification system.

The goal class distribution within the ecoparks divided by ecoregion indicate a lack of old growth forest further south and larger areas of old forest with high biodiversity values in the northwest boreal ecoregion. This mimics the disproportional national distribution of protected and functional forest land concentrated to the north and sub alpine ecoregion and the lack of ecoregional representation.
A developed goal classification system based on models for natural disturbance dynamics of boreal forest was developed in the thesis. By incorporating several management systems into a multifunctional forestry goal classification system while implementing a landscape perspective the goal classification system could further reflect the multifunctional values of the forest. Sveaskog could further illustrate the multiple values that they are already promoting in their voluntary set asides and more actively support important values such as reindeer herding. The revised goal classification system could potentially also be utilized by alternative management of privately owned forest. Because the current goal classification system is based on rotational forestry the system is less suited for alternative management. The revised system could therefore be implemented in small scale on a voluntary basis alongside the current system.

References

ANGELSTAM, P., MANTON, M., GREEN, M., JONSSON, B.-G., MIKUSIŃSKI, G., SVENSSON, J. & MARIA SABATINI, F. 2020. Sweden does not meet agreed national and international forest biodiversity targets: A call for adaptive landscape planning. *Landscape and Urban Planning,* 202**,** 103838.

ANGELSTAM, P. K. 1998. Maintaining and restoring biodiversity in European boreal forests by developing natural disturbance regimes. *Journal of Vegetation Science,* 9**,** 593-602.

APPELQVIST, C., SOLLANDER, E., NORMAN, J., FORSBERG, O. AND LUNDMARK, T. 2021. 2021. Hyggesfritt skogbruk. Skogsstyrelsens definition. Skogsstyrelsen.

APPELSTRAND, M. 2012. Developments in Swedish forest policy and administration – from a "policy of restriction" toward a "policy of cooperation". *Scandinavian Journal of Forest Research,* 27**,** 186-199.

BAŞKENT, E. 2018. A review of the development of the multiple use forest management planning concept. *International Forestry Review,* 20**,** 296-313.

BERGLUND, H. & KUULUVAINEN, T. 2021. Representative boreal forest habitats in northern Europe, and a revised model for ecosystem management and biodiversity conservation. *Ambio,* 50**,** 1003-1017.

BERGMAN, P. & GUSTAFSSON, L. 2020. Ecoparks–Forest landscapes in Sweden with emphasis on biodiversity conservation and recreation. *Krumm, F.; Schuck, A***,** 369-378.

BINGHAM, A. J. 2023. From Data Management to Actionable Findings: A Five-Phase Process of Qualitative Data Analysis. *International Journal of Qualitative Methods,* 22**,** 16094069231183620.

BJÄRSTIG, T. & KVASTEGÅRD, E. 2016. Forest social values in a Swedish rural context: The private forest owners' perspective. *Forest Policy and Economics,* 65**,** 17-24.

BLATTERT, C., EYVINDSON, K., MÖNKKÖNEN, M., RAATIKAINEN, K. J., TRIVIÑO, M. & DUFLOT, R. 2023. Enhancing multifunctionality in European boreal forests: The potential role of Triad landscape functional zoning. *Journal of Environmental Management,* 348**,** 119250.

BORRASS, L., KLEINSCHMIT, D. & WINKEL, G. 2017. The "German model" of integrative multifunctional forest management—Analysing the emergence and political evolution of a forest management concept. *Forest Policy and Economics,* 77**,** 16-23.

BUBNICKI, J. W., ANGELSTAM, P., MIKUSIŃSKI, G., SVENSSON, J. & JONSSON, B. G. 2024. The conservation value of forests can be predicted at the scale of 1 hectare. *Communications Earth & Environment,* 5**,** 196.

COMMISSION, E. 2020. EU Biodiversity Strategy for 2030 – Bringing nature back into our lives. Brussels: Publications Office of the European Union.

COOKSEY, R. W. 2020. Descriptive Statistics for Summarising Data. *In:* COOKSEY, R. W. (ed.) *Illustrating Statistical Procedures: Finding Meaning in Quantitative Data.* Singapore: Springer Singapore.

DREVER, C. R., PETERSON, G., MESSIER, C., BERGERON, Y. & FLANNIGAN, M. 2006. Can forest management based on natural disturbances maintain ecological resilience? *Canadian Journal of Forest Research,* 36**,** 2285-2299.

EGGERS, J., ROOS, U., LIND, T. & SANDSTRÖM, P. 2024. Adapted forest management to improve the potential for reindeer husbandry in Northern Sweden. *Ambio,* 53**,** 46-62.

EKHOLM, A., LUNDQVIST, L., PETTER AXELSSON, E., EGNELL, G., HJÄLTÉN, J., LUNDMARK, T. & SJÖGREN, J. 2023. Long-term yield and biodiversity in stands managed with the selection system and the rotation forestry system: A qualitative review. *Forest Ecology and Management,* 537**,** 120920.

ENANDER, K.-G. 2007. Skogsbruk på samhällets villkor. *Skogsskötsel och skogspolitik under,* 150.

ERDOZAIN, M., ALBERDI, I., ASZALÓS, R., BOLLMANN, K., DETSIS, V., DIACI, J., ĐODAN, M., EFTHIMIOU, G., GALHIDY, L., HAASE, M., HOFFMANN, J., JAYMOND, D., JOHANN, E., JØRGENSEN, H., KRUMM, F., KUULUVAINEN, T., LACHAT, T., LAPIN, K., LINDNER, M. & MIGUEL, S. D. 2024. The Evolution of Forest Restoration in Europe: A Synthesis for a Step Forward Based on National Expert Knowledge. *Current Forestry Reports,* 11**,** 19.

ERIKSSON, M. & TOLLEFSEN, A. 2018. The production of the rural landscape and its labour: The development of supply chain capitalism in the Swedish berry industry. *Bulletin of Geography. Socio-economic Series,* 40**,** 68-81.

ESSEEN, P.-A., EHNSTRÖM, B., ERICSON, L. & SJÖBERG, K. 1997. Boreal forests. *Ecological bulletins***,** 16-47.

EUROPEAN UNION 1992. Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora. Brussels: Official Journal of the European Communities.

FAGERLI LUNDE, L., BIRKEMOE, T., SVERDRUP-THYGESON, A., ASPLUND, J., HALVORSEN, R., KJØNAAS, O. J., NORDÉN, J., MAURICE, S., SKREDE, I., NYBAKKEN, L. & KAUSERUD, H. 2025. Towards repeated clear-cutting of boreal forests - a tipping point for biodiversity? *Biological reviews of the Cambridge Philosophical Society*.

FRIDÉN, A., D'AMATO, D., EKSTRÖM, H., ILIEV, B., NEBASIFU, A., MAY, W., THOMSEN, M. & DROSTE, N. 2024. Mapping two centuries of forest governance in Nordic countries: An open access database. *Forest Policy and Economics,* 160**,** 103142.

FRIES, C., CARLSSON, M., DAHLIN, B., LÄMÅS, T. & SALLNÄS, O. 2011. A review of conceptual landscape planning models for multiobjective forestry in Sweden. *Canadian Journal of Forest Research,* 28**,** 159-167.

GAUTHIER, S., KUULUVAINEN, T., MACDONALD, S. E., SHOROHOVA, E., SHVIDENKO, A., BÉLISLE, A.-C., VAILLANCOURT, M.-A., LEDUC, A., GROSBOIS, G., BERGERON, Y., MORIN, H. & GIRONA, M. M. 2023. Ecosystem Management of the Boreal Forest in the Era of

Global Change. *In:* GIRONA, M. M., MORIN, H., GAUTHIER, S. & BERGERON, Y. (eds.) *Boreal Forests in the Face of Climate Change: Sustainable Management.* Cham: Springer International Publishing.

GIRONA, M. M., AAKALA, T., AQUILUÉ, N., BÉLISLE, A.-C., CHASTE, E., DANNEYROLLES, V., DÍAZ-YÁÑEZ, O., D'ORANGEVILLE, L., GROSBOIS, G., HESTER, A., KIM, S., KULHA, N., MARTIN, M., MOUSSAOUI, L., PAPPAS, C., PORTIER, J., TEITELBAUM, S., TREMBLAY, J.-P., SVENSSON, J., VERSLUIJS, M., WALLGREN, M., WANG, J. & GAUTHIER, S. 2023. Challenges for the Sustainable Management of the Boreal Forest Under Climate Change. *In:* GIRONA, M. M., MORIN, H., GAUTHIER, S. & BERGERON, Y. (eds.) *Boreal Forests in the Face of Climate Change: Sustainable Management.* Cham: Springer International Publishing.

GUNNARSDOTTER, Y. 2005. *Från Arbetsgemenskap till Fritidsgemenskap: Den svenska landsbygdens omvandling ur Locknevis perspektiv*.

HANSKI, I. 2011. Habitat Loss, the Dynamics of Biodiversity, and a Perspective on Conservation. *AMBIO,* 40**,** 248-255.

HARRIS, L. D. 1984. *The fragmented forest : island biogeography theory and the preservation of biotic diversity,* Chicago, University of Chicago Press.

HÖRNSTEN, L. 2000. Outdoor recreation in Swedish forests : implications for society and forestry. *Acta Universitatis Agriculturae Sueciae,* 169.

KALLNER, A. 2018. Formulas. *In:* KALLNER, A. (ed.) *Laboratory Statistics (Second Edition).* Elsevier.

KIVINEN, S., BERG, A., MOEN, J., ÖSTLUND, L. & OLOFSSON, J. 2012. Forest Fragmentation and Landscape Transformation in a Reindeer Husbandry Area in Sweden. *Environmental Management,* 49**,** 295-304.

KUULUVAINEN, T. 1994. Gap disturbance, ground microtopography, and the regeneration dynamics of boreal coniferous forests in Finland: a review. *Annales Zoologici Fennici,* 31**,** 35-51.

LINDAHL, K. B., STÉNS, A., SANDSTRÖM, C., JOHANSSON, J., LIDSKOG, R., RANIUS, T. & ROBERGE, J.-M. 2017. The Swedish forestry model: More of everything? *Forest Policy and Economics,* 77**,** 44-55.

LUNDMARK, L. 1982. *Uppbörd, utarmning, utveckling: det samiska fångstsamhällets övergång till rennomadism i Lule lappmark*, Arkiv för studier i arbetarrörelsens historia.

LUNDQVIST, L. 2017. Tamm Review: Selection system reduces long-term volume growth in Fennoscandic uneven-aged Norway spruce forests. *Forest Ecology and Management,* 391**,** 362-375.

NABHANI, A., MARDANEH, E. & SJØLIE, H. K. 2024. Multi-objective optimization of forest ecosystem services under uncertainty. *Ecological Modelling,* 494**,** 110777.

NATURVÅRDSVERKET. 2025. *Ekosystemtjänster* [Online]. Available: https://www.naturvardsverket.se/amnesomraden/mark-och-vattenanvandning/ekosystemtjanster/ [Accessed 8/4 2025 2025].

NEUMANN, W., LEVERS, C., WIDEMO, F., SINGH, N. J., CROMSIGT, J. P. G. M. & KUEMMERLE, T. 2022. Hunting as land use: Understanding the spatial associations among hunting, agriculture, and forestry. *Ecology and Society,* 27.

NORDSTRÖM, E.-M., BJÄRSTIG, THERESE., ZHANG, JASMIN. 2020. Mångbruk av skog- om att utveckla skogens mervärden. *2020:5.* Umeå: SLU, Future Forests

NORDSTRÖM, E.-M., DOLLING, A., SKÄRBÄCK, E., STOLTZ, J., GRAHN, P. & LUNDELL, Y. 2015. Forests for wood production and stress recovery: trade-offs in long-term forest management planning. *European Journal of Forest Research,* 134**,** 755-767.

NOSS, R. F. 1983. A Regional Landscape Approach to Maintain Diversity. *BioScience,* 33**,** 700-706.

POMMERENING, A. 2024. *Continuous cover forestry : theories, concepts, and implementation,* Hoboken, NJ, John Wiley & Sons, Incorporated.

SCHIMMEL, J. & GRANSTRÖM, A. 2011. Fuel succession and fire behavior in Swedish boreal forests. *Canadian Journal of Forest Research,* 27**,** 1207-1216.

SKOGSSTYRELSEN 2019a. Statistik om formellt skyddad skogsmark, firvilliga avsättningar, hänsynsytor samt improduktiv skogsmark. skogsstyrelsen Jönköping.

SKOGSSTYRELSEN 2023a. Förutsättningar för hyggesfritt
skogsbruk och definition av naturnära
skogsbruk i Sverige.

SKOGSSTYRELSEN 2023b. Miljöhänsyn som ska tas enligt skogsvårdslagen.

SKOGSVÅRDSLAGEN (1979:429). Skogsvårdslagen. *In:* RSL, L.-O. I. (ed.) *1979:429.*

STRENGBOM, J., AXELSSON, E. P., LUNDMARK, T. & NORDIN, A. 2018. Trade-offs in the multi-use potential of managed boreal forests. *Journal of Applied Ecology,* 55**,** 958-966.

SVEASKOG. 2023. *Våra Ekoparker* [Online]. [Accessed 18 oktober 2024].

SVENSSON, J., BUBNICKI, J. W., JONSSON, B. G., ANDERSSON, J. & MIKUSIŃSKI, G. 2020. Conservation significance of intact forest landscapes in the Scandinavian Mountains Green Belt. *Landscape Ecology,* 35**,** 2113-2131.

SVENSSON, J., MIKUSIŃSKI, G., BUBNICKI, J. W., ANDERSSON, J. & JONSSON, B. G. 2023. Boreal Forest Landscape Restoration in the Face of Extensive Forest Fragmentation and Loss. *In:* GIRONA, M. M., MORIN, H., GAUTHIER, S. & BERGERON, Y. (eds.) *Boreal Forests in the Face of Climate Change: Sustainable Management.* Cham: Springer International Publishing.

TILMAN, D., CLARK, M., WILLIAMS, D. R., KIMMEL, K., POLASKY, S. & PACKER, C. 2017. Future threats to biodiversity and pathways to their prevention. *Nature,* 546**,** 73-81.

ZACKRISSON, O. 1977. Influence of Forest Fires on the North Swedish Boreal Forest. *Oikos,* 29**,** 22-32.

ÖSTLUND, L., ZACKRISSON, O. & AXELSSON, A. L. 1997. The history and transformation of a Scandinavian boreal forest landscape since the 19th century. *Canadian Journal of Forest Research,* 27**,** 1198-1206.

Popular science summary

This thesis aims to evaluate if the current planning methods for forest planning and management reflects the many values or the nature conservation ambition that the forest of the Sveaskog ecoparks provides. Sveaskog is a state-owned forest company and the largest forest owner with 4.1 million hectares of forest land. The Sveaskog ecoparks are 37 large scale voluntary set asides distributed all over Sweden. This thesis will utilize data collected and combined from the forestry plans of the ecoparks. The data will then be compared to documented national interests of Sweden, thereby using the national interests as a proxy for multiple value potential in the ecoparks. The analysis suggests that these national interests are not effectively represented in forest management plans, despite the ecoparks' publicly communicated profiles emphasizing multifunctional values and land use. To address this lack of representation, a revised goal classification system was developed, based on natural disturbance dynamics in boreal forests. This framework allows Sveaskog to more transparently represent the diverse values already present in its voluntary set-asides and could also be adapted for use in alternative forest management on private lands. The previous goal classification system was adapted to the usage of rotational forestry as the primary management. Because of this the previous system was not suited for alternative management approaches. The revised system utilizes a broad range of management models to maximize the common good. In this way the revised system is a more flexible tool for alternative forest management planning and further illustrates the multiple values of forests.

Appendix 1

Answers and mail correspondence from Alternative Forest management planers in Swedish.

Hej
Jag heter Carl Rising och studerar vid Jägmästarprogrammet i Umeå. Just nu skriver jag mitt examensarbete angående ett alternativt målklassningssystem för multifunktionellt skogsbruk eller mångbruk, där jag utgår från data från Sveaskogs ekoparker. Jag har en del frågor angående era naturnära skogsbruksplaner eftersom det är lite inom samma område som jag skriver om men det finns en begränsad mängd vetenskaplig litteratur kring specifikt målklassningssystem i skogsbruksplaner.

Jag undrade lite kring hur de naturnära skogsbruksplaner ni tillhandahåller skiljer sig från en "vanlig" grön skogsbruksplan certifierad av pefc eller fsc?

Använder ni ett någon speciell målklassning för exempelvis skog där ett delmål är restaurering kombinerat med andra värden så som rekreation osv?

Hur förmedlar ni innehållet i planen till markägaren och har ni många kunder som inte bor nära sin egen skog?

Förstår helt om ni inte har möjlighet att besvara alla dessa frågor men är tacksam emot de svar ni kan ge eller era tankar och filosofi när det kommer till skogsskötsel.
Mvh Carl Rising

Svar till Carl Rising:

För att kunna svara på din fråga behöver vi börja med att kika något på grundförutsättningarna för de olika skötselsystemen.

I trakthyggesbruk finns ett "slutdatum" där alla träd i ett bestånd ska avverkas samtidigt (föryngringsavverkning) och åtgärderna som föreslås i en traditionell skogsbruksplan syftar som regel till att tidigarelägga detta datum (tex röjning för att öka medelstam inför gallring och som regel låggallring för att öka medelstammen inför kommande föryngringsavverkning). I hyggesfritt skogsbruk saknas ett sådant "slutdatum" och fokus ligger mer på att låta ung och äldre skog växa parallellt på samma yta (skiktad skog/kontinuitetsskogsbruk).

Skogsbruksplanerna och programmen som dessa skapas i är idag inte anpassade för hyggesfria metoder i form av kontinuitetsskogsbruk/naturnära. De utgår från att skogen ska delas in i bestånd (avdelningar) där bl a ålder, höjd, diameter, grundyta och volym ska anges. Dessa utgör medeltal för hela avdelningen och fungerar bra i homogena skogar med ungefär samma ålder, såsom det ser ut när skogen sköts enligt trakthyggesbruket, men kommer på sikt inte att säga så mycket i flerskiktade och olikåldriga skogar.

Om skogen är mycket olikåldrig och skiktad får vi genast problem med att hitta medelvärden som vi har nytta av. Det vi kan göra i dagens planer är att lägga in ett eller flera skikt utöver själva ”huvudskiktet” i en avdelning och ange medelvärden per skikt, men det är svårt att uppskatta detta med dagens mätmetoder och det blir som regel mer och mer arbetskrävande desto mer ”naturlig” skogen blir om vi ska förhålla oss till detta.

Skogarna som vi idag jobbar med är nästan undantagslöst påverkade av trakthyggesbrukets skötsel. Därför fungerar det hjälpligt just nu att skapa skogsbruksplaner med dagens planprogram och att vi använder oss i stora drag av dagens planstandard med medeltal för volym/ha, grundyta, ålder m.m. per avdelning. När vi gör certifieringsanpassade planer för Plockhuggets standard har vi bl a högre naturvårdsavsättning än vad som krävs för PEFC/FSC och andra åtgärdsförslag än inom trakthyggesbruket, ofta med beskrivande kommentarer. På sikt kommer skogarna som sköts med naturnära skogsbruk att utvecklas mer fritt och vi kommer behöva andra parametrar i planerna för att beskriva detta. Men kommande ”planperiod” är de allra flesta skogar fortfarande så pass formade efter trakthyggesbruket så vi kan nyttja de befintliga planläggningsstandarderna och systemen i stor utsträckning.

Vi använder idag samma huggningsklasser som i traditionella planer, förutom att vi tagit bort klasserna S1 och S2 eftersom vi inte ser skogar som ”mogna för slutavverkning”. Bestånd som ligger över LSÅ klassar vi som G2 (om det inte naturvårdsområden).

Huggningsklasserna som idag används är anpassade till homogena skogar och det finns ingen huggningsklass som på ett bra sätt fångar upp exempelvis ”dimensionsspridningen”, ”utvecklingsstadiet som skogen befinner sig i ur ett ekologiskt perspektiv”, ”beräknad inväxning i övre eller undre skiktet/år, ”vilket håll är utvecklingen på väg – utvecklas skogen i avdelningen mot en mer skiktad eller homogen skog just nu” eller ”åldersvariationen”. På det viset är dagens huggningsklasser ett trubbigt verktyg och förutsätter i princip att allt som inte är naturvård/hänsynskrävande ska föryngringsavverkas vid en given tidpunkt.

- -

Tankar kring huggningsklasser:
Det kommer uppstå ett behov av att skapa nya huggningsklasser. I trakthyggesbruk är vi nu inne i klasserna G2-S2, medan vi hyggesfritt skogsbruk i dagsläget blir tvungna att välja G2 som huggningsklass. Detta kan på ett sätt bli fel då det <u>inte</u> är gallring vi håller på med utan hyggesfritt skogsbruk. Den stora

skillnaden är att vi inte har några givna tillfällen för åtgärder som man kan hitta i en gallringsmall utan måste verifiera åtgärder på annat sätt.
Själv föreslår jag en åtgärd om beståndet har en tillräcklig volym över §10 som motiverar ett uttag, annars får det stå på tillväxt en tid till.
Detta sätt att verifiera en åtgärd samt med målet att skapa en föryngring redan i ung mogen skog, anser jag är anledningen till att det blir fel att kalla det för gallring -G2. Det skulle som förslag kunna heta H1 under LSÅ och H2 över LSÅ. H2 kan användas så länge som ett bestånds virkesvolym överstiger §10. Och H3 när virkesvolymen i det härskande skiktet understiger §10 fram till det att den plantskog som finns under kan räknas som en R1.
I huggningsklassen H3 gör man luckor om nästa generations skog inte har börjat etablera sig. Om luckhuggning inte fungerar för att få till en föryngring, blir det till slut en K1:a med åtgärdsförslag som markberedning och eventuell plantering. Tanken är att aldrig komma under §5 kurvan. Sedan blir det följden: K2- R1- R2- H1- H2- H3 och K1 igen. I flerskiktade bestånd kommer huggningsklassen alltid vara H2.

Vad det gäller målklasser tycker vi att de fyra vanliga målklasserna (PG, PF, NS, NO) är fullt tillräckliga på fastigheter där skogsägaren har som mål att producera virke. För kommuner med mycket rekreationsanpassat brukande finns även R och RF i dagens planer.

Publishing and archiving

Approved students' theses at SLU are published electronically. As a student, you have the copyright to your own work and need to approve the electronic publishing. If you check the box for **YES**, the full text (pdf file) and metadata will be visible and searchable online. If you check the box for **NO**, only the metadata and the abstract will be visible and searchable online. Nevertheless, when the document is uploaded it will still be archived as a digital file. If you are more than one author, the checked box will be applied to all authors. You will find a link to SLU's publishing agreement here:

- https://libanswers.slu.se/en/faq/228318.

☒ YES, I/we hereby give permission to publish the present thesis in accordance with the SLU agreement regarding the transfer of the right to publish a work.

☐ NO, I/we do not give permission to publish the present work. The work will still be archived and its metadata and abstract will be visible and searchable.