

# Chapter 10

## Multiple Use of Forests



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### Abstract

- Sustainable forest management approaches, regardless of whether they involve continuous cover forestry (CCF) or rotation forestry (RF), require a holistic landscape perspective that acknowledges the multiple interests, values, and uses that depend on the locally relevant economic, ecological, and socio-cultural circumstances. These must be considered alongside the use of forests and forest landscapes as a resource for rural development.
- Forests provide a wide range of goods and services. Those addressed here (i.e. tourism, recreation, health, grazing, non-timber forest products, and societal protection from natural hazards) are a subset of all of those potential services that are already considered to be of special significance for the Nordic region.
- Most recreational users consider variation in the forest landscape and long-distance views as visually attractive but think that clearcuttings and soil tilling are harmful.
- In general, CCF favours bilberries, while lingonberries and some mushrooms benefit from even-aged forestry.

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- Owing to the many and varied demands relating to forests and forest landscapes in Norway, Sweden, and Finland, CCF-supported multiple-use strategies and planning will need to consider stakeholder requirements more, now and in the future, than is currently the case.

**Keywords** Recreation · Nature-based tourism · Grazing · Non-timber forest products · Natural hazards

## 10.1 Introduction

In an international context, “multiple use” in terms of land use is often defined as the provision of a combination of different goods and services. This involves two general strategies. Multiple use can be based on either “integrated” or “differentiated” land use, defined by the spatial distribution of land use including forest management (Hoogstra-Klein et al. 2017). Integrated land use means that different benefits are produced simultaneously in the same area, normally as a compromise between the required uses, while differentiated land use means individual services are specifically targeted in individual areas, with each service optimised within the respective areas. CCF generally comes under the integrated strategy, while traditional clearcutting typically forms part of a differentiated strategy. Rather than a sharp division based on the extremes, there is often a gradation between integrated and differentiated land use.

In the Nordic countries, forests are used for more than one purpose. Multiple-use forest management aims at simultaneously producing several goods and services (Huuskonen et al. 2021) as well as values and functions (Solbär et al. 2019). In Norway, the term multiple use has been used since the 1970s. Today’s multiple use is regulated by the Forestry Act of 1989 (Lov om skogbruk 2005). In Sweden, the national forest programme defines multiple use as: “...that the forest is used for several different purposes (e.g. forestry, nature tourism, reindeer husbandry, nature conservation, wood processing, hunting, enjoyment, non-profit community networks, recreation, public health, arena for cultural expressions). The purposes may be commercial or non-commercial.” (Andersson et al. 2016, p. 13). In the Finnish Forest Strategy by 2035, multiple use is not emphasised as such, but the multi-purpose nature of forests is assumed to increase and the need to coordinate different forms of use will be emphasised in the future. It is also noted that forests are increasingly subject to usage restrictions and various conservation pressures (Kansallinen metsästrategia 2035 2022).

Multiple use is not a new phenomenon. In both Sweden and Norway, multiple use of forests in the form of, e.g., timber extraction for household needs and forest grazing for domestic animals was dominant until the rise of modern industrial forestry in the 1950s (Fritzbøger and Søndergaard 1995, Kardell and Bishop 2014). In Finland, extraction of wood for household construction and fuelwood, hunting, and the use of land for silvopasture, slash-and-burn agriculture, and tar production were

dominant forms of forest use before the emergence of modern forest industry (Tasanen 2015).

In line with the international trend toward sustainable forestry, initiatives in Sweden have been aimed at developing multifunctional forestry. The political goals have mainly focused on strengthening the goods and services that provide biological values of forests, while the ones seen as holding social values have not been prioritised in the same way (Beland-Lindahl et al. 2017). One explanation for this imbalance is that the social value of forests is a concept that lacks national consensus and a consistent definition (Sténs et al. 2016). Within the framework of the Swedish national forest programme, aspects such as employment, social policy, and rural development are now also included as important parts, which indicates a wider scope of what can be considered as services provided by forests. Multiple use is clearly a concept with a broad definition which many different actors can relate to, yet these actors can have quite different interpretations of what multiple use means (Hoogstra-Klein et al. 2017).

Multiple use of forests has been promoted for various reasons. In the Swedish forest policy (SOU 1992, p. 76), for instance: “the fact that almost all forest land in Sweden is used economically and the great importance of forestry for the social economy makes it necessary to combine different land use interests on the forest land, i.e., to apply multiple use.” Differentiated land use, on the other hand, means that the forest landscape becomes a mosaic where different benefits are produced in different areas, i.e., that the forest is zoned so that forest production is carried out in certain stands while other stands are set aside for nature conservation or other functions; this is often referred to as “triad” forest management (Himes et al. 2022). A spatial differentiation of different uses is a form of multiple use, as well as spatial integration of two or more uses (Hoogstra-Klein et al. 2017).

Integrated and differentiated land use can be seen as two extremes along a continuum, whereas in reality there is a range of different variants of mixed use between the two extremes (Ekvall and Bostedt 2009, Klemperer 1996). This sheds light on implications for forest management methods, as some stands can be managed with a focus on intensive timber production, while others are managed (or left for free development) to provide several other benefits. Such a zonal approach is easier to implement in large areas with a single owner. It can be challenging or even impossible to implement across multiple owners, as collaborations and possible sharing of revenues are required. This puts Norway, Sweden, and Finland in slightly different positions in terms of differentiated land use. In Norway, 12% of the forest area is publicly owned i.e., state, municipal or church (Ministry of Agriculture and Food 2011, p. 18), whereas in Finland and Sweden the corresponding figures are 32% and 28%, respectively (Finnish Forest Association 2019, Swedish Forest Industries 2023). Integrated approaches, which can more easily be considered within CCF systems, could have an advantage. Another variant is where there is a dominant benefit, e.g., timber production, while other benefits are produced in addition when possible. This, however, means that emphasis must be placed on one goal beforehand, and can thereby be understood as multiple use but with restrictions. A further variant is to diversify the production of different benefits in time rather than in space.

An important issue for forest use across the Nordic countries is *allemannsretten* (Norway), *allemannsrätten* (Sweden), and *jokaisenoikeus* (Finland). These terms literally translate to “everyone’s rights” in English but are more accurately described as “the public right of access” (Norwegian Environment Agency 2023). The public right of access permits mostly unrestricted access to the outdoors (i.e., countryside, woodlands, coast, waterways, and mountains), irrespective of who owns the land. The exclusions are military zones, cultivated farmland and private gardens. This is an important privilege for the public throughout the Nordic countries, who value the importance of outdoor recreation.

The Nordic public right of access encompasses more than just unrestricted access; it also involves the gathering of specific forest resources, such as wild berries, mushrooms, and herbs. Hunting and fishing are not part of these rights, with slight variations in different Nordic countries. The access extends to almost all forest land, with certain restrictions in nature and cultural conservation areas. Even though the term “everyone’s right” became common only in the early twentieth century, the concept’s roots can be traced back to centuries-old customary rights. Behind these rights lay sparse settlement, the absence of large, private land ownership, and practices like a widespread hunting culture and slash-and-burn agriculture. The public right of access is regulated by formal written law only in Norway, while in Finland or Sweden it is based on customary law and integrated in some specific legislation (Tuulentie and Rantala 2013). It should also be noted that, in Sweden, different aspects of the public right of access are supported legally in the national public interests within Chaps. 3 and 4 of the Swedish Environmental Code (Svensson et al. 2020).

There have, however, been concerns regarding the Nordic public right of access and whether commercial activity on private land should be allowed without the landowner’s permission, or indeed without remunerating the landowners due to gains from that activity. This particular aspect of commercial use based on the public right of access is perceived to be a barrier for development of multiple use forestry. Many non-timber uses could generally have a more prominent role in the owners’ management choices if associated alternative and non-timber incomes could be provided to those owners, so that they are less reliant on timber sales. This has been an active debate in Sweden for the past two decades, where forest owners’ property rights can sometimes be considered as compromised by other commercial uses of forests in Sweden, such as berry picking by international businesses (Sténs and Sandström 2013), outdoor recreation, and tourism operations (Sténs et al. 2016). Despite this, the Swedish authorities have not made any attempt to limit or regulate the public right of access, indicating both the importance of this concept to the national psyche and the significant challenge of differentiating between commercial and recreational activity on the ground. Focusing on the Finnish case of whether free berry-picking was already an existing tradition alongside the public right of access, La Mela (2014) argues that the practice of berry picking only became open to everyone with the new economic expectations in the late nineteenth century, where having berries as an open resource would sustain the poor as well as be commercialised for the markets. In a survey of forest actors regarding their perceptions

of multiple-use forestry, the public right of access is seen as an important foundation for enabling forest owners to understand multiple forms of forest use and to both encourage and facilitate communications and agreements regarding land use (Zhang et al. 2022).

The concept of forest “ecosystem services” is more comprehensive than the concept of multiple use (Huuskonen et al. 2021). Forest ecosystems provide multiple services for many stakeholder groups, often with conflicting interests and thereby with limited capacity for sustainability in land use strategies and planning. Tradeoff models that evaluate both monetary and non-monetary measures have proven to be a useful way of reducing conflicts over ecosystem services (e.g. Pukkala 2011). Here, multiple use is understood as a part of ecosystem services that are related to cultural ecosystem services and non-timber forest use, and the relationship between these and timber production methods is considered.

The importance of forests as an environment for collecting non-timber forest products and for recreation and domestic tourism cannot be overemphasised. Furthermore, forests in Nordic countries are increasingly an operating environment for international tourism. The importance of protected areas and especially national parks as an attractive factor for tourism and outdoor recreation has grown, but non-protected forest areas are also important environments for various activities. National parks and other protected areas are often located far from large population centres, where adjacent forests have proven to be especially valuable recreation areas. In a similar way, since many outdoor activities take place in the vicinity of the home or place of leisure, forests close to populations centres are especially valuable. About two-thirds of domestic outdoor activities are directed to nearby recreation areas (Sievänen and Tyrväinen 2015).

From a philosophical perspective, Haila (2015) states that multiple use symbolises the forest environment as a public good, accessible to all citizens. Alongside the traditional multiple use interpretation, he also emphasises multisensory and spiritually deep forest relationships. Paying attention to multisensory and a deeper forest relationship has become increasingly important, both in research and in public debate. Recently, special attention has focused on the effects of forests on wellbeing and health (Simkin et al. 2021), and these effects are closely linked to the recreational and tourism use of forests.

In this chapter, we examine forest landscapes as areas for recreational and nature-based tourism use, as producers of berries, mushrooms and huntable game, as a basis for reindeer and sheep husbandry, and as bearers of aesthetic and cultural values. The issue of forestry in relation to avalanches, landslides and rockfalls is also addressed, with a particular focus on Norway. Where possible, we address the implication of CCF management vs. RF management. All these aspects must be considered when managing the forest resource on all forest land and on all forest impediments in the Nordic countries considered here.

## 10.2 Nature-Based Tourism and Recreation

For nature-based tourism, such as hiking, protected areas and especially national parks are popular destinations. In addition, many nature tourism activities take place in managed and non-protected forest areas. In a Swedish study, forests were recognised as a vital attribute for all kinds of nature-based tourism settings (Margaryan 2018). Landscape and accessibility are recognised as the most important forest factors for tourists and recreational users. Studies from Norway, Sweden and Finland show that a common preference among forests users was a forest stand with relatively large trees at an advanced stage of stand development, but also with the sense of accessibility and the provision of a view (Gundersen and Frivold 2008, Karjalainen and Store 2015, Silvennoinen 2017). Clearcuts have been seen as negative for tourists' "wilderness" experience, and preferably there should be minimal traces of forest harvesting, including stumps and residues in their preferred destinations (Edwards et al. 2012, Karjalainen and Store 2015). In addition, the condition of the understorey vegetation, in terms of greenness and uniformity of coverage, is highly valued (Karjalainen and Store 2015).

The value of forest nature for tourism and recreation can be increased by modifying forest management practices, for instance by making clearcuts smaller, which is a feature of all types of CCF and some kinds of RF. A variety of forest structures is also popular: the view that opens after a stretch of dense forest pleases people, and water bodies, wide landscapes and distant views are appreciated (Miina et al. 2020). A study has shown that Finnish people generally prefer pine and birch forests, with spruce forests as the least popular and, again, that relatively open forests are preferred for recreational use (Silvennoinen 2017).

In the far north, the landscape changes dramatically with the seasons, most markedly with the presence or absence of snow. The winter landscape is especially important for tourism in Finnish Lapland, with the main season for tourism in the north occurring between November to March (Lapland Tourism Strategy 2019). Efforts have been made to develop summer tourism for decades, but summer seems to be a less attractive season in most parts of Finnish Lapland. In a study of the preferences of international tourists, it was found that the differences relating to the seasons are greatest in forest regeneration areas, where snow covers the traces of forest harvesting (Tyrväinen et al. 2017). Tourists considered even-aged forests, advanced thinning stands, and mature stands to be suitable environments in both summer and winter (Tyrväinen et al. 2017). Therefore, clearcutting has no detrimental effect on winter tourism, but does impact summer tourism.

The nature of forestry operations along the routes and landscapes are particularly important. Ahtikoski et al. (2011) tried to calculate whether the increase in tourists on the routes between the major tourist centres of Levi and Ylläs in Finnish Lapland could compensate for the possible losses in timber revenue if harvesting operations along the routes were restricted. The result was that large-scale tourism with its multiplier effects compensated for those possible losses in timber revenue. Konu and Tyrväinen (2020) focused on key forest sites from a tourism point of view when

studying the possibilities of assigning values to landscapes for recreation. They examined the outdoor trails and the views from scenic spots in mature forest stands which, according to the management recommendations, should be regenerated by clearcuts. The goal has been that not only professional tourism providers, but also self-guided tourists, cabin owners and local residents, would benefit from the preservation of diverse nature areas. According to Konu and Tyrväinen (2020), extending tourism income to local forest owners could also help reduce conflicts between the tourism and forest sectors.

A survey of Finnish Lapland's nature-based tourism companies (Kosenius et al. 2013) showed that these companies set stricter environmental and recreational requirements for the management of the state's productive forests than for the management of private forests. More than 90% of respondents felt that the routes and structures located in the state's productive forests promoted tourism, and that the needs of nature-based tourism companies should be better provided for by the operations of Metsähallitus, the Finnish administrator of state-owned land and water. About 65% of respondents felt that wider protection zones should be left along watercourses than at present, and clearcutting should be completely stopped in the state's productive forests. Among forestry measures, the avoidance of soil treatment and clearcutting was considered particularly important for nature-based tourism.

## 10.3 Non-timber Forest Products

### 10.3.1 *Berry and Mushroom Picking*

Non-timber forest products (NTFPs; e.g., wild berries, mushrooms, herbs, plants, craft material, game meat) are an important and widely used ecosystem service provided by forests. The direct monetary value of NTFPs compared to timber varies by country, but even in the most timber production-oriented boreal forests, it is difficult to overestimate their cultural value. For example, more than 3 million Finns—64% of the population—pick berries, mushrooms, and wild herbs every year (LVVI 2020). It is estimated that approximately 20–30% of Sweden's population (age 18–74) pick berries, and close to 40% pick mushrooms at some point during the year (Andersson 2018). Estimates for the Norwegian population are not available, but these are undoubtedly very popular activities. According Nordström et al. (2020), the majority of forest owners in Swedish rural areas state that they are completely or partially self-sufficient in terms of mushrooms, berries, and game meat. Even though wild berries for commercial purposes are primarily picked by foreign labour, wild berries are also a source of additional income for domestic pickers, especially in the direct sales market (Vaara 2015). However, domestic berry picking is mostly for recreational and household use in the Nordic countries. The most important wild berries are bilberry (*Vaccinium myrtillus*) and lingonberry (*Vaccinium vitis-idaea*).

Bilberries are found throughout the Nordic countries in grove-like and dry forests, heaths and fell forests. The clearcuts and soil tilling associated with RF damage the bilberry root system. Since bilberry does not tolerate the dry and hot environment often prevailing in clearcut areas, it does not usually return to the forest until after the first thinning in RF. In Finland, bilberry coverage decreased between the 1950s and 1990s from 18% to 8%, due to the transition to RF and the accompanying change in forest structure (Salemaa 2000a). However, since 1995, bilberry coverage appears to have increased (Mäkipää 2022).

Lingonberry can also be found all over the region, mostly in bright and dry forests, but coverage has also decreased since the 1950s. Again, clearcuts damage lingonberry plants, albeit less than bilberries, and lingonberries recover from damage faster (Salemaa 2000b). Lingonberry tolerates drought better than bilberry and the best fruit production is in areas where tree canopies do not shade the growth, so the most productive lingonberry growth is often in clearings or under seed trees and in seedling stands (Turtiainen et al. 2013) (Fig. 10.1).

There is little empirical research regarding the effects of CCF methods on berry yields. However, bilberry probably benefits from CCF systems where the forest canopy remains intact and there is no extensive soil tilling, and machines are restricted to a permanent trail network. In CCF, spruce-dominant forests for example are kept to a basal area of 10–22 m<sup>2</sup>/ha (Tapio 2019). According to coverage models, the coverage of bilberry increases up to basal areas of 26 m<sup>2</sup>/ha (Turtiainen et al. 2016). However, the optimal basal area for berry yield is 14 m<sup>2</sup>/ha, because in denser stands bilberry has poor yields despite good coverage (Miina et al. 2009). Based on the models, bilberry would seem to thrive well in CCF areas of spruce forests in both peat and mineral soils (Miina et al. 2020), and produce five times higher bilberry yields compared to RF. In contrast, the effect of silvicultural system had only a minor effect in pine forests (Pukkala et al. 2011).

Unlike bilberry, lingonberry does not thrive in shady habitats, so the best berry yields occur after regeneration and final fellings under RF. Eventually however, under RF, there will be a reduction in surface area coverage and productivity as the forest grows and less light is available (Turtiainen et al. 2013). Nonetheless,



**Fig. 10.1** Lingonberry benefits from the availability of light in young stands at the seedling stage and may produce good yields in such forests (Photos: Erkki Oksanen / Luke)

according to models, RF is better than the CCF in terms of lingonberry yields (Peura et al. 2018).

At the end of the nineteenth century, mushrooms were still only occasionally eaten in most part of the Nordic region. However, attitudes changed during the twentieth century, and mushroom picking is now a popular outdoor activity and can even provide supplementary income (Svanberg and Lindh 2019). The most popular mushrooms are chanterelles (*Cantharellus tubaeformis*, *C. cibarius*), false morels (*Gyromitra esculenta*), black trumpets (*Craterellus cornucopioides*), lactarius mushrooms (*Lactarius trivialis*, *L. rufus*, *L. torminosus*), and pinewood king boletes (*Boletus pinophilus*, Turtiainen and Salo 2015, Svanberg and Løvaas 2023). In clearcuts, yields of all mushrooms except false morels drop significantly for several years. However, yields rebound in young forests (Miina et al. 2020) and, for example, the best *Boletus edulis* yields are obtained from 20–40-year-old spruce forests before the first thinning (Tahvanainen et al. 2016). Models applied in Nordic conditions have shown that, in terms of mushroom yields, RF is a better option than CCF (Peura et al. 2018). It is also noteworthy that the optimal stand management schedules for commercially marketed mushrooms are very similar to that of timber (Tahvanainen et al. 2018).

### 10.3.2 Forestry and Game Management

How the needs of wild animals, in particular moose (*Alces alces*, or the European elk), should be considered in forestry is a topic that has been actively discussed for over half a century. In Fennoscandia, moose hunting in forest environments plays an important role, both financially and in terms of the number of participants. Moose hunting is practiced by approximately 60,000 Norwegian hunters (Statistics Norway 2023), 250,000 Swedish hunters (Jagareförbundet.se), and some 110,000 Finnish hunters (Artell et al. 2020). It has been estimated that the total value of moose hunting for the 2019–2020 hunting season is NOK 1.1 billion (Pedersen et al. 2020), and the consumer surplus from moose hunting in Finland is EUR 260 million (Artell et al. 2020).

Moose eat many plant or tree species that are found in early successional stages following clearcuts, so moose have benefited from intensified forestry management since the beginning of the twentieth century (Lavsund et al. 2003, Bjørneraas et al. 2011). The relationship between forestry and the moose is ambiguous—on one hand, higher densities of moose can increase the economic value of forest property for hunting (Engelman et al. 2018); on the other, moose foraging in forest stands (mainly Scots pine used as winter habitats) can cause severe economic damage for the forest owner. For decades, non-industrial private forest owners have been advised on how to prevent damaging browsing of moose in forest estates and, particularly in Finland, how to manage forest patches to promote grouse (i.e., *Tetrao urogallus* or capercaillie, *Tetrao tetrix* or black grouse, *Tetrastes bonasia* or hazel grouse) habitats (Herrero et al. 2020). Management is increasingly emphasised in

research literature as game-oriented, grouse-oriented, or grouse-friendly forest management (Haakana et al. 2020, Haara et al. 2021, Ikonen et al. 2023), and emphasises forestry practices where forest patches vary in tree age and species and have an unmodified canopy layer. This is therefore likely to benefit from CCF and mixed-species forest management.

However, the relationship between forestry practices and hunting not only comes down to the fact that certain types of game animals are most likely to be found in specific forest environments, but equally that some types of forestry practices maintain forests and canopy layers as a more pleasant place to walk. For example, a notable segment of hunting tourists in Finland appreciates forest landscapes in their hunting grounds that they regard as representing “wilderness”, peaceful and not modified by intensive human land use (e.g. Pellikka et al. 2018). An example of the cultural value of wilderness areas and compatible forestry practices for hunters is the recurrence of a wilderness context in fictional hunting literature (in Finland: Varis 2003).

Hunters also evaluate and accept different forestry activities from the perspective of other roles. Some are trained foresters and are more positive to harvesting than the general public (e.g., Gundersen and Frivold 2008). Nearly half of Finnish hunters are non-industrial private forest owners (Toivonen 2009), and have multiple ownership goals, including ones related to income and economic security provided by forestry (Kouhia and Pellikka 2021). For these owners, providing a means to balance income with continual hunting opportunities would likely be a win-win situation, and CCF management might be a suitable prospect for them.

## 10.4 Grazing

In Norway, Sweden and Finland, forests are essential for reindeer husbandry and, to some extent, for livestock grazing, which makes such forest a contemporary cultural landscape (Nordström et al. 2020). This long-term cultural use of the forests is central to the landscape we see today, as the cultural use of the land has a special and unique historical basis. It has been used for multiple purposes for several thousand years. It is therefore of great importance in terms of natural and cultural values, in addition to the biological cultural heritage. This is often forgotten, but these cultural values should be considered in forest management practices.

### 10.4.1 Reindeer Grazing

Lichen-rich forests are a crucial resource in reindeer (*Rangifer tarandus*) herding systems. During the winter, reindeer primarily feed on lichens (Kivinen et al. 2010), although wintertime fodder feeding in fences is becoming more and more common. Forests rich in pendulous lichen are important grazing areas, especially during

periods of reduced availability of ground pasture (including ground lichen) during snowy and/or icy conditions. Clearcuttings remove the lichen-bearing, old-growth trees. Forest management considering reindeer herding should take measures aiming at, e.g., promoting uneven-aged forest structure, retaining old-growth trees, avoiding leaving logging residue on the most terricolous lichen-rich sites, minimal soil preparation, and the use of natural regeneration (Turunen et al. 2020). Many of these are components of CCF management. However, CCF selection harvesting may have the same effect on the availability of lichen-bearing trees as clearcutting unless there is a separate a specific harvesting instruction to retain these trees.

### **10.4.2 Livestock Grazing**

In Norway, nearly 2 million sheep graze on open hillsides and in forests for at least 3 months during the summer (Maurtvedt 1989). About 260,000 cattle graze on cultivated land or rangeland pastures for 5 weeks or more. The number of beef cattle is increasing at the expense of dairy cattle, hence the greater use of woodland pastures for cattle (ssb.no). In Finland and Sweden, livestock silvopasture is less important.

Sheep and cattle prefer the grasses of forest pastures (Wam et al. 2022). In coniferous forests, the decisive factor for good pasture is availability of light in the understorey layer and nitrogen in the soil. Therefore, clearcutting areas and the subsequent young forests are the most suitable grazing forests (Rekdal and Angeloff 2021), so CCF may not be the most optimal forest management method for livestock grazing. On the other hand, forest with greater cover offers shelter from weather and possible predators (Herfindal et al. 2017). More studies are needed to establish the optimal spatial structure mix of open and closed canopies for livestock. Some of the group felling methods within CCF could facilitate this.

It is well known that livestock grazing reduces regrowth of deciduous trees and herbaceous plants after clearcuttings (e.g., Belsky and Blumenthal 1997, Östlund et al. 1997). With respect to commercial forestry this is considered positive because it reduces competition for nutrients, water, and light in favour of the desired conifer seedlings (e.g., Zimmerman and Neuenschwander 1984, Prolux and Mazumder 1998). However, in CCF forests, if the density of livestock becomes too high, particularly of heavy cattle breeds, trampling and bedding, in addition to grazing, may lead to tree damage, erosion and soil packing (e.g., Fleischner 1994, Hester et al. 2000), potentially limiting the natural regeneration and tree recruitment desired in CCF systems. This was demonstrated in a Norwegian study (Hjeljord et al. 2014). Within fenced, clearcut areas with young spruce regeneration, the proportion of damage to the replanted trees was found to be positively related to cattle use in the area, but not so for sheep. On the most intensively used areas 80% of the young trees were damaged. Furthermore, the density of deciduous trees was five times lower inside the livestock fence than outside. It was concluded that livestock grazing may reduce resource competition in favour of spruce, whereas the current animal density clearly reduced forest regeneration in the study area. Intensive grazing is therefore

likely to pose problems for CCF if the aim is to increase the variation in tree species and to rely predominantly on natural regeneration.

Interest is growing in using plant resources in the forest for grazing livestock (Larsson and Rekdal 2000). With higher animal densities, the risk of conflicts will increase, both within the livestock husbandry and between grazing interests and other uses of forests. Knowledge of the grazing value of different vegetation types provides a better basis for managing grazing resources within a multifaceted exploitation of forests. Larsson and Rekdal (2000) summarised the grazing value of eight forest vegetation types in south-eastern Norway; lichen forests had the poorest grazing value and tall herb forest the best.

CCF managed in a way that secures a variety of tree species, different stand ages and stand densities—including some small, felled spots—will provide vegetation types of good grazing value, but also a diverse habitat securing shelter and good resting areas for the grazing livestock. However, intensive grazing is likely to pose problems for CCF if the aim is to increase the variation in tree species and to rely predominantly on natural regeneration.

## 10.5 Health and Wellbeing

The role of forests and nature for health and wellbeing is becoming increasingly important (Nordström et al. 2020). The connection between forests and health is mainly made in relation to recreation and outdoor life, but some of the forest owners (mainly well-educated female forest owners) also highlight more innovative areas of use regarding social values, such as developing and adapting their forest to be a place of recovery and rehabilitation for people with stress and fatigue symptoms (Björstig and Sténs 2018, see also Nordh et al. 2009). These types of forests used for “forest therapy” purposes have clear potential to be enhanced by CCF management, both in improving accessibility on maintained roads and trails, and in aesthetic terms by creating a more varied and naturalised forest structure. Most of these forest owners also emphasise the role of the forest in allowing experiences of solitude and silence, and that visitors often have a spiritual and/or religious experience when in the forest (Björstig and Kvastegård 2016). An increasingly common example of the use for health and wellbeing is “forest bathing”, a relaxation and/or therapeutic practice that engages all the five senses with the forest environment (Furuyashiki et al. 2019).

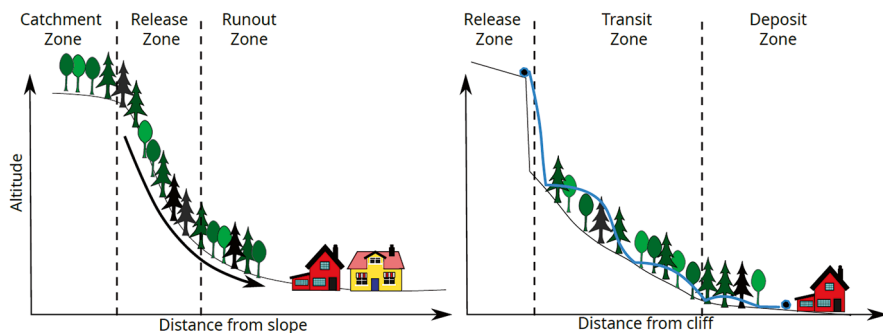
The demography of managing forests for health and wellbeing is important to consider. In the Nordic region it is primarily female forest owners who are interested in developing and adapting their management methods to make their forest a place for recovery and treatment for people suffering from depression and/or stress-related symptoms (Nordström et al. 2020). This result can be linked to, and is in line with, previous research on female forest entrepreneurs (e.g., Appelstrand 2015, Lidestav 1998, Lidestav 2010) as well as research on rehabilitation forests and the forest as a place for wellbeing and health (Sonntag-Öström et al. 2011, 2015).

According to the report by Nordström et al. (2020) the main question with this use concerns how these services can be commercialised so that additional jobs can be created, and how it contributes to sustainable rural development. Examples of guided activities include forest bathing, mindfulness spas in the forest, and health retreats with forest walks. Further non-commercial values relating to health are also prized by female forest owners, such as using herbal plants for alternative medical treatment, or a natural diet.

Studies are needed to explicitly examine the links between female forest owners and their attitudes and knowledge regarding CCF management methods. The above examples support the hypothesis that female forest owners tend to think and act “greener” (Umaerus et al. 2013, 2019), and therefore they might be more willing to choose CCF over RF, to focus on “softer” values of forest such as recreational, social, and environmental values, which are often interconnected (Hertog et al. 2022). However, for some uses relating to health and wellbeing or a “greener experience”, any forest harvesting might be less desirable than having a completely natural forest, where management is restricted to creating access. In this case, techniques relating to conversion to CCF could still be highly beneficial in creating suitable areas from existing even-aged forests.

## 10.6 Societal Protection from Gravitational Hazards

Forests provide the most naturally aesthetic and cost-effective way to mitigate against gravitational hazards in and near steep terrain. The precise nature of gravitational hazards varies by location and by season, but in general those in which forest management has a significant role are snow avalanches, shallow landslides and rockfalls. In the context of these natural hazards, the definition of steep is terrain that is more than 25 degrees, which is the minimum angle at which movement of material (i.e. mass) down slopes will occur. The areas affected, or risk zones, include the slopes themselves and the “runout” or “deposit” zones (Fig. 10.2). The events can vary massively in terms of speed, scale, and consequences. In the worst cases, there can be catastrophic loss of life and massive damage to societal infrastructure, but serious consequences can equally be a degradation of land and natural environments. The protection of society and societal assets from gravitational hazards in mountainous and fjordic landscapes is therefore a significant non-timber forest product. This use of forests for protection has been relatively less publicised in the Nordic countries, compared to the European Alps for example. Consequently, it is not well understood and is probably taken for granted by the public. However, this use as protection is increasingly recognised by national governments and actors outside the forest industries. Legislation about using forests for protection is being considered in Norway (Nordrum et al. 2022), although many uncertainties remain about how this will be achieved in practice.



**Fig. 10.2** **Left** – Forest structure in the release zone for snow avalanches and landslides affects the extent of the runout zone and, in many cases, the scale and velocity of the movement event. Sufficient forest cover can minimise the risk. For landslides forest management in the catchment area above a prone slope will also affect slope hydrology. **Right** (after Dorre et al. 2007): trees can catch large rocks and either prevent them travelling further downslope or substantially reduce their velocity, thereby reducing the risk to society. Removing all trees (e.g. through clearfelling) effectively removes most of the protection. Partial cutting to retain a sufficient forest structure to provide protection, and to create or maintain a stable forest over time, could bring many benefits to areas at risk

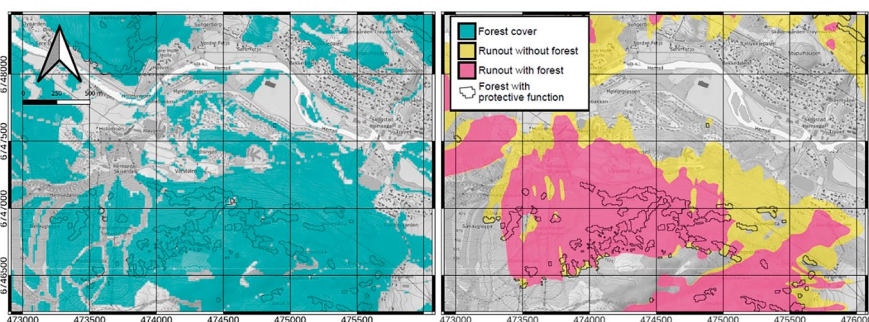
### 10.6.1 *The Mechanisms of Protection and the Impacts of Forest Management*

Forest management does not normally directly cause snow avalanches or rockfall, but it is one of the factors commonly associated with shallow landslides. This is because clearcutting forests contribute to a large and sudden change in slope hydrology (Rice 1977, Sidle 2005), and because of reduced mechanical stabilisation of the slope by tree roots (Rice 1977). Forest roads and wheel ruts resulting from mechanised harvesting can drastically alter drainage channels on a given slope (Fig. 10.3). It is important to consider that forests above slopes also contribute to the slope hydrology, even if they are seemingly not in steep terrain.

On slopes prone to avalanches, the protective function of trees is primarily achieved by intercepting snowfall in their branches, which later falls to the ground gradually. This prevents the formation and subsequent overloading of weak layers that are usually the cause of avalanches (Schneebeili and Bebi 2004). To a lesser extent trees also mechanically stabilise the slope (Teich et al. 2012, 2014). The forest can therefore be considered as providing a similar function to engineered structures such as avalanche fences and barriers. Given the prevalence of winter recreation in the Nordic countries, this protective function brings a significant societal benefit (Fig. 10.4). Trees provide a mechanical barrier during rockfalls, with the strength requirements of the trees depending on the sizes and weight of the rocks that are likely to fall (Dorre et al. 2007).



**Fig. 10.3** Left excavator roads without drainage commonly used in Norwegian clearcuts on slopes contribute to water channelling and flow accumulation in new parts of the slopes. Right (Photo Paul McLean, NIBIO). Wheel tracks left by heavy forwarders used in clearcutting can channel water and accelerate erosion downslope. While these channels are frequently repaired by excavators following forest operations, such repairs primarily serve an aesthetic purpose as significant soil compaction has taken place. CCF does not promote temporary machine access for large volumes of wood, therefore the potential to prevent some of these problems is significant (Photo Stephan Hoffman, NIBIO)



**Fig. 10.4** An example of protection forest in Hemsedal, a popular alpine skiing resort in Norway. The forest provides some protection from avalanches for the many recreational activities in the area, including protection for both tourist and permanent accommodation. Without the forest, the risk zones would be larger, and the avalanches would be triggered more easily. However, a substantial portion of these forests are currently managed under RF, where eventual clearfelling will remove the protection for several decades until the next forest has regrown. Some CCF systems could help maintain or even enhance the protection. (Background map ©Kartverket, forest information produced from NIBIO’s forest resource map SR16, avalanche risk zones are produced using NAKSIN 4, NVE 2023)

### 10.6.2 The Implications of CCF in Protection Forests

Certain forest structures are required to provide protection against these gravitational hazards (Table 10.1, derived from Nordrum et al. 2022). One of the main requirements is continually maintaining a minimum forest cover, which aligns clearly with the definition of continuous cover. The practice of clearcutting in protection forests results in a “protection gap” (Wohlgemuth et al. 2017) until the forest

**Table 10.1** The effect of forest structure can be quantifiably linked to protection from gravitational hazards for snow avalanches (Issler et al. 2020) and rockfall (Berger and Dorren 2007) for Norwegian conditions, but this is not yet possible for landslides. While each slope is different some simple thresholds can be defined to guide forest management. CCF systems, and particularly selection systems, can promote and maintain these forest structures irrespective of whether timber is extracted

Natural hazard	Most important elements of forest structure	Continual canopy required (% of surface area)	Maximum gap size (diameter or side length) (m)	Comments
Avalanche	Species, canopy coverage	50	30 m	Spruce intercepts most of the snow
Landslides	Species, canopy coverage	60	Unknown	Deep rooting species are better, conifers intercept more water year-round.
Rockfall	Tree size and forest density	NA	40 m	A minimum 400 trees/ha is proposed, with a DBH of 20 cm

is regenerated and the protection restored, thereby temporarily increasing the risk to society. On the other hand, many of the systems considered under CCF (see Chap. 2) already promote creating and maintaining forest structures that are consistent with the requirements for protection (Table 10.1). This strongly favours using CCF in protection forests, particularly in place of clearcutting even-aged forests. However, steep terrain is challenging for forest operations if timber production is to remain an objective. The challenges relate to both cost and technical difficulty, and already apply to clearcutting. More complex silvicultural choices will increase both relative difficulty and cost (McLean and Hoffmann *in press*). This potential for extra costs poses problems in the Nordic region due to the fragmented and highly privatised forest ownership. The problems are the question about who pays and the requirement for cooperation between multiple owners around risk zones. To resolve this, other economic aspects, such as considering the value of protection, or the costs of alternative technical provision of that protection (Moos and Dorren 2022), need to be taken into consideration.

Currently there is no such framework within the Nordic region. However, it is highly likely on an economic basis alone that the value of protection will be greater than any short-term financial gain from clearcutting. Likewise, the value of protection will likely warrant more expensive timber extraction if this is desired. However, it should be noted that the extraction of wood is not essential for protection, and forest structures can be produced and maintained by felling the trees even if the felled timber is left in place. In fact, if felled timber is left perpendicular to slopes this can provide additional mechanical protection from mass movement in an eco-engineering solution (e.g. Berger et al. 2013) and could have strong synergies with objectives for biodiversity in terms of habitat provision (see Chap. 11). In summary, CCF could provide the means to both provide protection from gravitational hazards and produce timber, but the silvicultural options may not be so varied, and any

economic benefits (see Chap. 8) will not be as easy to estimate compared to flat terrain with easy access.

## 10.7 Summary with Recommendations

All forestlands in Norway, Sweden, and Finland, through tradition and legal recognition, inherently provide many uses beyond wood biomass production. When managing Nordic forests for multiple use, all the functions of the forest should be considered. The important functions considered here are:

- Supply of renewable raw materials
- Habitat for plants and animals
- Venue for outdoor life
- Bearer of aesthetic and cultural values
- Protection from natural hazards
- The source of nutrition for reindeer and other grazing livestock
- Producer of berries, mushrooms and huntable game

The weighting given to the various functions in any area depends on the natural conditions in the landscape, the needs of local stakeholders and rightsholders (e.g., indigenous peoples), the local population density, and the forest site quality (SOU 1992, p. 76). Ultimately however, management decisions are driven by the individual owner's management objectives. Whether to consider RF or CCF will therefore come down to evaluating the relative pros and cons of each, which are considered within this chapter are summarised below (Fig. 10.5).

In terms of tourism and recreational use, it is somewhat indisputable that during the thaw and summer periods heavy tillage and clearcutting do not attract tourists. However, during the snowy season, these features are less of a hindrance. When summer tourism in the north is to be developed, it is essential to avoid clearcuts and logging residues in important tourist areas. Koivula et al. (2020) state that forest management with continuous cover and different age structure preserves the attractiveness of forests for recreational and tourist use better than clearcut logging.

So far, the preservation of landscapes or other intangible nature values for tourism has not received wide attention in forest policy or land use planning (Tyrväinen et al. 2020). In discussions about the use of forests, conflicts often arise between different forms of use, such as forestry, nature conservation and recreation (Sténs et al. 2016, Svensson et al. 2023, Stoessel et al. 2022). The challenges for future research are to improve understanding of the synergies between multiple use and forestry, and the issues of conflict and their location. Spatially-integrated multiple-use planning solutions are needed, as well as a development of forest management approaches that allow spatiotemporally simultaneous provisioning of other values than wood biomass production and a flexible management choice of priority value(s). Participatory GIS methods, for example, could be used more in



**Fig. 10.5** The infographic shows how CCF favours most recreational uses while RF is suitable for at different stages. The situation also varies according to the season, as e.g. the cross-country skiing experience does not suffer from clearcuts whereas for false morels clearcuts are almost necessary

positioning. Wider use of participatory methods would also bring more understanding of the needs of different user groups.

Wild berries and mushrooms can produce good yields in both periodic and continuous cover silviculture, depending on the species. Based on the modelling, it seems that bilberry benefits more from CCF than RF, while lingonberries and most mushrooms produce better yields under RF. However, certain CCF systems can produce gaps with the right kind of conditions for lingonberries and mushrooms, so this should not be seen as an obstacle to implementation. Currently, there is little empirical information on the effects of CCF on berry and mushroom yields, so monitoring programmes should be set up in CCF areas. In addition to monitoring of berry and mushroom yield, pollinator monitoring should be set up in the same areas, as the success of pollination is the most important individual factor affecting wild berry yields. Further, as with hunting, picking berries and mushrooms is equally about exercise in nature and recreation. When promoting the picking of these natural products, the visual attractiveness of forests must also be taken into account, which is usually better in forests under CCF management than in clearcuts.

There can be no question that clearcutting systems are less effective in protecting from natural hazards than maintaining a continual forest cover, because clearcutting involves periodic, total removal of the protection. In areas where protection is critical, it is questionable whether timber harvesting is really sustainable (e.g. where significant erosion damage is caused in the process) and in the best interests of society. Nonetheless, there are large areas of even-aged, planted forests that are providing this protection, so converting these to multilayered forests with more self-sustaining structures using CCF techniques to avoid future protection gaps is a logical thing to do. Here, CCF techniques may also permit the steady production of timber if that remains an objective in these areas. RF techniques that exclude clearcutting can possibly also be used in areas requiring protection, as long as they can be designed to continually provide enough forest cover to prevent the relevant hazard or hazards. This would involve maximum gap sizes and sufficient overstorey

retention until the next generation, or understory, has grown sufficiently to replace the same protective function as that provided by the overstorey.

A transition towards increased multiple use forest management in Norway, Sweden and Finland requires full acknowledgement of the multiple values, services and goods associated with the forest ecosystem. CCF for multiple use is far from a simplified and normative forest management system that can be applied systematically across the forest landscape. However, it may facilitate the delivery of a better balance of the multiple uses when applied correctly in the correct places.

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