

Article

Study of Heathland Succession, Prescribed Burning, and Future Perspectives at Kringsjø, Norway

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Abstract: The coastal heathland of Western Europe, dominated by *Calluna vulgaris* L., was previously maintained by prescribed-burning and grazing to the extent that the *Calluna* became anthropogenically adapted to regular burning cycles. This 5000–6000-year-old land management practice was essential for local biodiversity and created a vegetation free from major wildland fires. In Norway, recent neglect has, however, caused accumulation of live and dead biomass. Invasion of juniper and Sitka spruce has resulted in limited biodiversity and increasing wildland fire fuels. At the Kringsjø cabin and sheep farm, Haugesund, an area of previous fire safe heathland has been restored through fire-agriculture. Kringsjø is located close to several important Viking Age sites and the Steinsfjellet viewpoint, a popular local tourist destination. The motivation for the present study is to analyse this facility and investigate possibilities for synergies between landscape management and tourism as a route to sustainable transitions. The present study compares restored heathland vegetation with unmanaged heathland at Kringsjø. The potential for activities is also analysed based on the proximity to the tourist attractions in the region. The Kringsjø area demonstrates different vegetation conditions depending on level of afforestation, *Calluna* heath maintenance, and grazing. Within a few minutes' walk, dense Sitka spruce communities with desert-like forest floor may be compared to native forest floors, *Calluna* dominated heathland, and grazing fields. It turns out that Kringsjø may become a showcase for resuming prescribed burning and grazing for fire-safe rich landscapes, while offering cultural and historical experiences for all age groups. Moreover, tourism may become a source of income required for supporting ongoing restoration initiatives. To start working on a common vision, preferably aligned with existing "Homeland of the Viking Kings" tourism approach, should be one of the first steps along this path.

Keywords: restoring heathland; prescribed burning; *Calluna Vulgaris*; succession; Sitka spruce; Old Norse Sheep; tourism

1. Introduction

In the 21st century, wildland fire incidents are becoming an increasingly severe threat globally [1] and fires in the Wildland–Urban Interface (WUI) pose a hazard to life and constructions [2,3]. Megafires dematerialise great masses of wood and release greenhouse gases to the atmosphere [1]. The megafires are intensified and the fire seasons prolonged, which create increasing challenges for fire management [4,5]. "Climate-fuelled megafires" have, therefore, gained global attention. Barriers to fire safe societies are recognised by stakeholders such as the EU [6]. The EU highlights the lack of landscape management as a barrier to reduce risk of intensified wildland fires [6]. Large wildland fires

may attack several populated areas at once, while possibly blocking escape routes, reducing chances for people to self-evacuate [7,8].

Improved fire suppression technologies and ramping up firefighting efforts have, in the last century, dominated the solutions of fire crisis management [9]. Nevertheless, technological advancements are near to insignificant in relation to the increasing threat of WUI fire disasters. Modern fire suppressive techniques delay and intensify wildland fire disasters, while age-old landscape and natural resource management prevented wildfires [10–12]. Fire-agricultural practices predate written history; for the past 5000–6000 years, *Calluna* dominated heathlands provided essential ecological services for people and the natural environment [10,13,14]. The symbiotic human–*Calluna* relationship is essential for the unique biodiversity found in coastal Western Europe [15–17].

During the past 50 years, previous *Calluna* dominated heathlands in coastal Norway have gradually been invaded by, e.g., juniper (*Juniperus communis* L.) and Sitka spruce (*Picea sitchensis* (Bong.) Carr.), which resulted in the accumulation of old and dead plants, i.e., potential fire fuel [18]. This successional development can, in part, be explained by changing agricultural and landscape management practices [19]. The modernisation of the agricultural sector decreased farmers' reliability on *Calluna* heathland. Forestry business was introduced to the Norwegian coast after WW2, for developmental benefits. Sitka spruce was planted extensionally [20]. Now, the Sitka spruce is blacklisted in Norway because of its degrading effect on biodiversity. Resuming heathlands reverses the trend of monotone composition [21,22].

In 1997, Kaland [20] estimated that solely 10 per cent of the original *Calluna* dominated heathland in Norway was retained [19]. At the time when *Calluna* dominated the coastal landscapes, the risk of severe wildland fires was close to absent [23]. Gradual build-up of natural biomass increased the risk of disastrous WUI fires [24]. In Flatanger and Frøya, Norway, communities have experienced the consequences of neglected heathlands and encroachment [25]. In January 2014, the fire brigades were fighting to manage developing fires because of accumulated WUI natural biomass, winter drought and strong winds. The Flatanger fire destroyed most structures in a single fire in Norway since 1923 [18,25]. These fires, resulted in an increased focus on possible devastating effects of severe burn depths, possible loss of the valuable seed layer, as well as possible soil combustion and soil erosion, as often experienced by fires in dry landscapes. However, due to the sub-zero temperatures, the soil contained sufficient ice to prevent soil combustion. Thus, the fire did not prevent the *Calluna* sprouting the following spring. Log et al. [18] concluded that similar fires during a dry period in the summer could have resulted in detrimental consequences regarding loss of the seed bank and soil erosion. Moreover, they argued that prescribed burning at regular intervals could mitigate such risks. In addition to the fire safety aspect, additional benefits from resuming heathlands in coastal Norway are increasingly recognised.

Farmers, fire fighters, scientists, government officials, and the tourism sector are recognising the positive attributes of prescribed burning [10]. Resuming millennium-old *Calluna* landscapes is favourable for biodiversity [26], carbon offset [27], local food production [28], cultural values [28,29], and tourism [30–32]. Summing up, heathland restoration might enhance synergies for sustainable transitions [33,34]. Heslinga et al. [35] highlight tourism as a way forward to enhance environmental biodiversity and local development.

Tourism relies on the specific nature, history, and culture that a country offers [36–38]. Tourists are engrossed by the Norwegian natural landscape of abundant lakes, fjords, distant mountains, and glaciers. In Norway, some civic burner groups have started maintaining the heather landscape by practicing mosaic burning and by keeping livestock [10]. The Old Norse Sheep [39], with massive horns, feed on the winter green *Calluna* and eat early successional trees and shrubs year-long. This sheep breed is commonly named Viking Sheep, even though the breed stems back to long before the Viking Age. Fire-agriculture enchases the values of the open cultural landscape. The uninterrupted views to the Atlantic Ocean, coastal islands, and sunsets in the West are of great aesthetic and monetary value, which is lost in areas covered by dense woods and degrading heathlands [10].

Viking villages, burial sites and Viking history is central to international and local tourism at Haugalandet, Norway [40], e.g., the Avaldsnes historical site and the Haraldshaugen National Monument. This monument was erected 1000 years after Harald the Fair-haired united Norway in the 872 Hafrsfjord battle. The Kringsjå cabin and sheep farm are located within a 15-min hike from the most conspicuous viewpoint in the region, i.e., at Steinsfjellet mountain summit (228 m AMSL) [41].

The purpose of the present study is to report on, and analyse, the re-established heathland area close to Kringsjå cabin and sheep farm. The changes from an open landscape to complete encroachment and the return to open landscape, are documented by photos. The possibilities for further developing the area as a showcase for successional development are investigated. The possibilities for reclaiming the ancient landscape are analysed through the Heslinga et al. [35] policy recommendations for synergetic interaction between tourism and landscape management. Section 2 presents the Steinsfjellet mountain, the Kringsjå cabin area, and associated activities. Section 3 presents the spatial successional development in the area. Section 4 analyses activities that can contribute to reclaim heather landscape through synergies between tourism and natural protection. Possible future development of the area is analysed based on local, as well as regional, perspectives aligned with ongoing activities. The Discussion highlights Kringsjå's relevance to sustainable transitions regionally and discusses the limitations of the present study. The major findings are presented in the Conclusions.

2. Haugesund, Karmøy, Steinsfjellet, and Kringsjå

2.1. Haugesund Region and Steinsfjellet Mountain Summit

Haugesund is a town municipality of 36,000 inhabitants located at the southern part of the Atlantic coast of Norway, at Haugalandet, in the northern part of Rogaland County [42]. The town is the economic centre of a region of about 100,000 inhabitants [42]. The region is rich in hydroelectric power production and industrial activities related to metal, oil, and gas production [43]. Shipping, fisheries, and fish farming are also important activities along with farming of, e.g., root fruits (potatoes, turnip, cabbage turnip, radish, etc.), vegetables, fruits, dairy and meat production [44]. There are numerous islands and fjords, and the hilly area is bordered by steep mountains and glaciers to the east. The area is generously supplied by the 1500 mm average annual precipitation giving life to numerous rivers and creeks [45]. It is one of the strong regions for tourism in Norway, especially from Germany and the Netherlands, and it is regularly visited by cruise ships [46]. The area experiences 100,000+ external visitors annually [45].

The area has a rich historical tradition, especially from the Viking period [40]. The area was inhabited soon after the ice cap started melting 10,000 years ago, evidenced by 8000-year-old fragments of a 60-year-old man discovered at Bleivik, just north of Haugesund, in 1952 [47]. The process of prescribed burning for herbivore production commenced in the area 6000 years ago [48]. Gradually, larger areas were managed by prescribed burning. Fire-agriculture peaked during the Viking age about 1000 years ago [10]. This praxis continued until the mid-20th century. Then, gradually, modern and more productive sheep breeds were introduced, and the agricultural activities were increasingly industrialised. This process left the heathland unmanaged and prone to succession. Post-World War II, afforestation initiatives were introduced in the area and continued to the mid-1960s.

Due to the strategic location, Avaldsnes on the Karmøy island 4 km south of Haugesund, played an important role in the Viking Age by controlling the weather-shielded Karmsundet ship lane along the dangerous Atlantic coastline [49]. Avaldsnes includes a 750-year-old stone church still in regular use, a modern Viking Age museum and a Viking farm at Bukkøy (Norwegian: "male sheep island"), a 25-min hike from the history centre. The strait between Haugesund and Avaldsnes has given the name to Norway. Due to the rich Viking history, the area is marketed as the "Birthplace of Norway" and "Homeland of the Viking Kings". Indeed, Avaldsnes was the homestead of several Viking kings, including Harald Hårfagre (Harald the Fair-haired) who consolidated Norway to one kingdom in 872 by winning a major naval battle at Hafrsfjord. Historical sources describe his burial site to be just 2 km

north of the Haugesund town centre. In remembrance of this victory, Norway's National Monument, Haraldshaugen, was erected in 1872 on the location where King Hårfagre is believed to be buried. With 60,000 visitors annually, it is the most visited tourist attraction in Haugesund [50]. History and artefacts, as seen in Figure 1, demonstrate how well the Viking history is instituted in the area.



Figure 1. Reminders of the past; (a) the 750-year-old church at the former Avaldsnes king farm, and (b) the national monument of Norway erected in 1872, i.e., 1000 years after the Hafrsfjord battle.

The Steinsfjellet mountain is only a 15-min drive from the Haugesund town centre [51]. The summit offers unrestricted view of the area, from the Atlantic Ocean in the west to high mountains and the Folgefonna glacier to the east. It is a popular hiking and tourist destination, however, not developed beyond car parking and view compasses, naming conspicuous points of interest. The Steinsfjellet summit experiences 100,000+ visitors annually.

2.2. Kringsjå Mountain Cabin

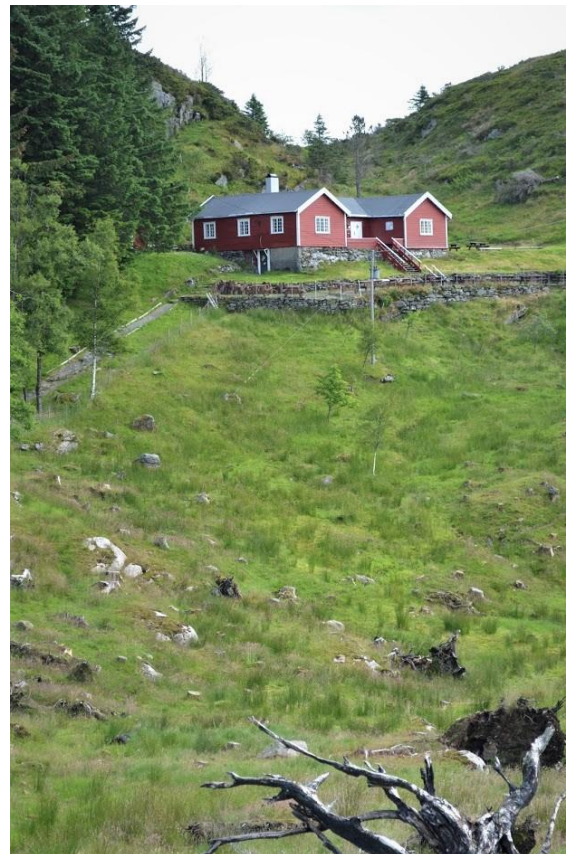
The original Kringsjå (Norwegian for “Look around”) mountain cabin was built in 1909, but unfortunately lost in fire in 1923 [52]. At that time, it was located in a well-maintained heathland; see Figure 2. The hut was located a 15-min hike from the Steinsfjellet summit.



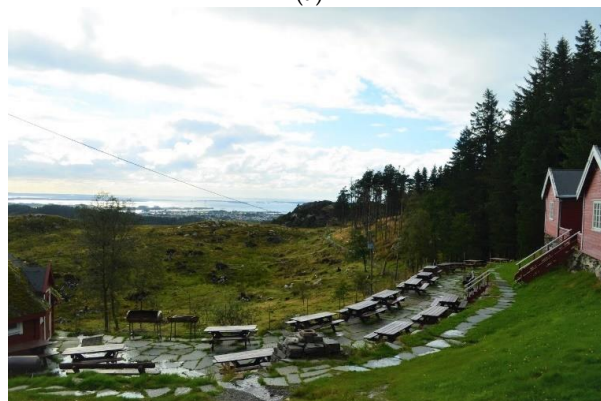
Figure 2. The Kringsjå cabin prior to the 1923 fire. (Courtesy of Kringsjås Venner. Reproduced with permission).

A new 200 m² cabin was erected in 1924, and it became frequently used by local hikers. However, in the 1980s, the cabin was in a poor condition, and due to the extreme succession, it was surrounded by forest. The spectacular view had disappeared. A major restoration effort was initiated in 1991. An ideal non-profit foundation based on voluntary work named Kringsjås Venner (Kringsjå's friends) was established and a cooperation and lease agreement with the owner, i.e., the International Organisation

of Good Templars (IOGT), was arranged. In addition to the restoration of the cabin and the access paths, Old Norse Sheep were introduced to graze the remaining fragments of the original heathlands. Formalised cooperation with a local vocational school, the Haugesund penal care, and people from the municipal labour market initiative “young elderly” was of great value. Kringsjås Venner also received support and help from, e.g., senior groups, municipality institutions supporting outdoor activities, etc. A separate toilet building and a wooden lavvu with about 60 seats were funded by the municipality outdoor council. Outdoor benches and picnic tables were arranged on the 400 m² slate-covered area, as seen in Figure 3.



(a)



(b)

Figure 3. Kringsjå cabin; (a) viewing east and (b) viewing west.

The Kringsjås cabin is open to the public every Sunday, supplying waffles and coffee to visitors. Twice a year they also arrange larger outdoor events including, e.g., horse riding, stick bread baking, etc. School classes, kindergartens, youth groups, scouts, and other organisations compliant to the IOGT

no-drug requirements regularly rent the facility, which has about 80 rental days a year. The outdoor area is freely accessible.

29 January 2016, the hurricane “Tor”, with a recorded wind strength of 48.9 m/s at Kråkenes lighthouse, peaking 61.7 m/s, hit the area. This hurricane deforested 10 hectares (0.1 km²) west of the cabin and thereby enabled the previous unrestricted coastal view. Thus, the cabin once again lives up to its name Kringsjø. These 10 hectares have recently been cleared and burned, and the heather is currently re-emerging.

The Kringsjø cabin, merely a 15-min hike from the Steinsfjellet summit and car park, is easily accessible for people of normal mobility. The path is, however, not accessible for, e.g., wheelchairs. Kringsjø is also accessible through longer hiking paths. This area experiences 100,000+ visitors annually. An estimated 30% of these find their way to the Kringsjø cabin.

2.3. Kringsjø Sheep Farm

Another 2-min hike from the Kringsjø cabin, there is a sheep farm consisting a main building, a 100 m² sheep shed and a small shed for demonstrating poultry production [53]; see Figure 4. The 130 m² main building includes a kitchen and a meeting hall housing 80 people. Numerous local stuffed wild birds and animals are on display. The farm buildings are owned by Kringsjø's Venner, while the land is owned by the Haugesund municipality. The slated outdoor area is supplied with picnic tables, a terrace and full-scale wooden toy sheep and dogs.



(a)



(b)

Figure 4. Old Norse Sheep at Kringsjø mountain farm, Haugesund, Norway, including the main building (left), the poultry shed (centre), and sheep shed (right) (a) and the view of Haugesund from the farm, including Norwegian Wild Sheep (b).

Previously, the land closest to the sheep farm was harvested from peat. This was a common practice at the west coast of Norway, where people utilised peat for heating, due to limited availability of trees in the area. Today, this activity has ceased, and it is prohibited by Norwegian law due to environmental concerns [54].

2.4. Activities at the Kringsjå Cabin and Sheep Farm

Kringsjå cabin and sheep farm are operated by Kringsjås Venner and Kringsjås Samdrift (from now on referred to as Kringsjå, if not otherwise specified). Kringsjå Samdrift is an ecological co-operation within Old Norse Sheep husbandry. The two institutions provide a recreational space for locals and a possible destination for tourists. Kringsjå is a popular hiking spot, not least due to the beautiful view and the Norwegian Wild Sheep.

Much of the work associated with the operation of the facility and maintenance of hiking paths near the Kringsjå cabin and the sheep farm is carried out in collaboration with Kringsjås Venner, social services (such as the Norwegian Labour and Welfare Administration (NAV), local work training centres (ABR), and Sandeid prison) and volunteers. In this way, Kringsjå provides work opportunities for vulnerable groups (people with autism, previous criminals, and drug addicts).

Since the early 1990s, Kringsjå Samdrift has cultivated the fields and mountain sides for Wild Sheep husbandry [41]. Prior to the pasture restoration program that started in 2002, the surrounding area was encroached by dense and hardly penetrable prostrate juniper communities. Junipers and other successional and invasive trees, such as the Sitka spruce, were cut and burned as part of the process. Gradually, 200 hectares (2.0 km²) have been cleared by prescribed burning and sheep grazing (including 100 hectares (1.0 km²) accidentally burned in a wildfire resulting from loss of control during prescribed burning). Some of this heathland is fenced off and inhabited by Old Norse Sheep owned by different farmers engaged in traditional meat production and landscape management. During that time, Kringsjå was a meeting point for prescribed burner civic groups and farmers from the region, gathering to discuss and collaborate in activities such as husbandry, prescribed burning, and cultivation. In 2010, Lundberg [41] reported that Kringsjå Samdrift stood out as an enthusiastic and dedicated part of the collaboration.

3. Successional Development at Steinsfjellet

3.1. The *Calluna* Dominated Heathland Maintenance Cycle

The cultural landscape in coastal Norway, characterised by *Calluna* dominated heather vegetation, provides good conditions for a multiplicity of plant, animal, insect, amphibians, and reptile species. Human activities, i.e., husbandry, tree logging, and prescribed burning are essential for the vegetation composition [55]. Winters along the coast are mild with little snow; *Calluna* is ever-green, and a great resource for year-round grazing. It grows on the thin soil layers that characterise the Norwegian coast [20]. Well-managed *Calluna* dominated vegetation intensifies the growth of organic soil, which is assumed to bind CO₂ with similar efficiency as marshland [27].

The *Calluna* life cycle can be described in four stages 1. Pioneer, 2. Mature, 3. Degrading, and 4. Dying [23,56,57]. In the absence of regular burning, *Calluna* develops into stage 4—characterised by infertility, dryness, and death. *Calluna* dominated vegetation, the species that depend on it and livestock that feed from it thrive in a mosaic landscape that is burned in a cyclic pattern [58]. Controlled mosaic burning leaves refuge for insects, birds, and reptiles. When small areas are burned in patches, and the grazing pressure is right, the *Calluna* provides stages with different ecological services. The pioneer stage is favourable in summer; the vegetational compositing provides conditions for a multiplicity of herbs and grass to thrive, which in turn provides a quality food source for animals. Meanwhile, the maturing stage provides fodder in winter in case of snow. Lastly, when the *Calluna* reaches the degrading and dying stages, it is favourable to burn the plant to ashes—for the *Phoenix* to be reborn. The *Calluna* sprouting is dual; either it sprouts from the roots or from seeds. The *Calluna* populations

from traditionally burnt Norwegian coastal heathlands are adapted to regular burning cycles to the extent that significantly increased germination probabilities are experienced in response to smoke treatment [17].

3.2. The Current Vegetation at Steinsfjellet

The ecological composition near Kringsjå is dominated by semi-natural *Calluna* heather landscape, natural swampland, and planted Sitka forests expanding into the area from the south, west, and north [41]. During a period of eight years from 2002, approximately 60 hectares of land was burned and re-cultivated as Class A *Calluna* heather landscape (pioneer and mature). However, areas untouched by fire for the past 50 years are classified as Class B. Such *Calluna* is dry, old, and partly overgrown by dense juniper fields, posing as dangerous fire traps.

Landscape management (prescribed burning, tree and juniper clearing, and husbandry) undertaken by Kringsjås Venner and Kringsjå Samdrift enhanced natural biodiversity and WUI fire safety in the area. It is recognised that prescribed burning itself, especially when the heathland has been left unmanaged for several decades, may represent a fire risk, also at Kringsjå. In the regional context, learning processes for safe prescribed burning and requirements regarding cooperation with the local fire brigades are analysed by Metallinou [10].

Several species that previously experienced a reduction in numbers are, according to Lundberg [41], increasingly prevalent due to the reintroduction of Class A *Calluna*. These species include hares, lizards, vipers, frogs, toads, and birds, such as Steinskveit (*Oenanthe Oenanthe*), Heipiplerke (*Anthus pratensis*), Orrfugl (*Lyrurus tetrrix*), and Bergirisk (*Linaria flavirostris*). Nevertheless, the area's biodiversity is still threatened by degrading and dying *Calluna* and increasing numbers of juniper and Sitka. Build-up of dead and live biomass reshapes the ancient *Calluna* dominated vegetation and pose as fire fuel [9,59]. Moreover, intensified climate change challenges the robustness of the natural environment and creates uncertainty. New scenarios for fire safety are emerging simultaneously with transforming *Calluna* dominated landscapes [10,60]. In turn, changing biodiversity is affected by intensified weather conditions (droughts and floods) [9,61,62]. The alteration of climate and biodiversity changes the conditions that we live in (e.g., increasing the fire disaster risk).

Kringsjå may pose as a showcase for the successional development of *Calluna* dominated heather landscape in correlation to surrounding flora and fauna. The vegetation near Kringsjå projects the development of managed versus unmanaged *Calluna* heathlands.

3.3. Successional Development in Unmanaged Versus Managed Areas at Steinsfjellet

The view from Steinsfjellet is a combination of oceanic, city, coastline, surrounding mountains, heathland, and developing Sitka forest, as seen in Figure 5.



Figure 5. View from the Steinsfjellet summit; (a) viewing west, and (b) viewing south-west.

The main hiking path to Kringsjø starts at the Steinsfjellet summit. The first 100 m passes through the Sitka forest shown in Figure 6. A combination of traditional Norwegian forest and planted Sitka forest surrounds the track. The Sitka forest at Steinsfjellet demonstrates a species-poor basin [41]. As seen in Figure 6, the forest floor resembles a desert. This is different than the floor in the native local forests, which contain an abundance of species, including the harvested bilberry (*Vaccinium myrtillus*), also named European blueberry.

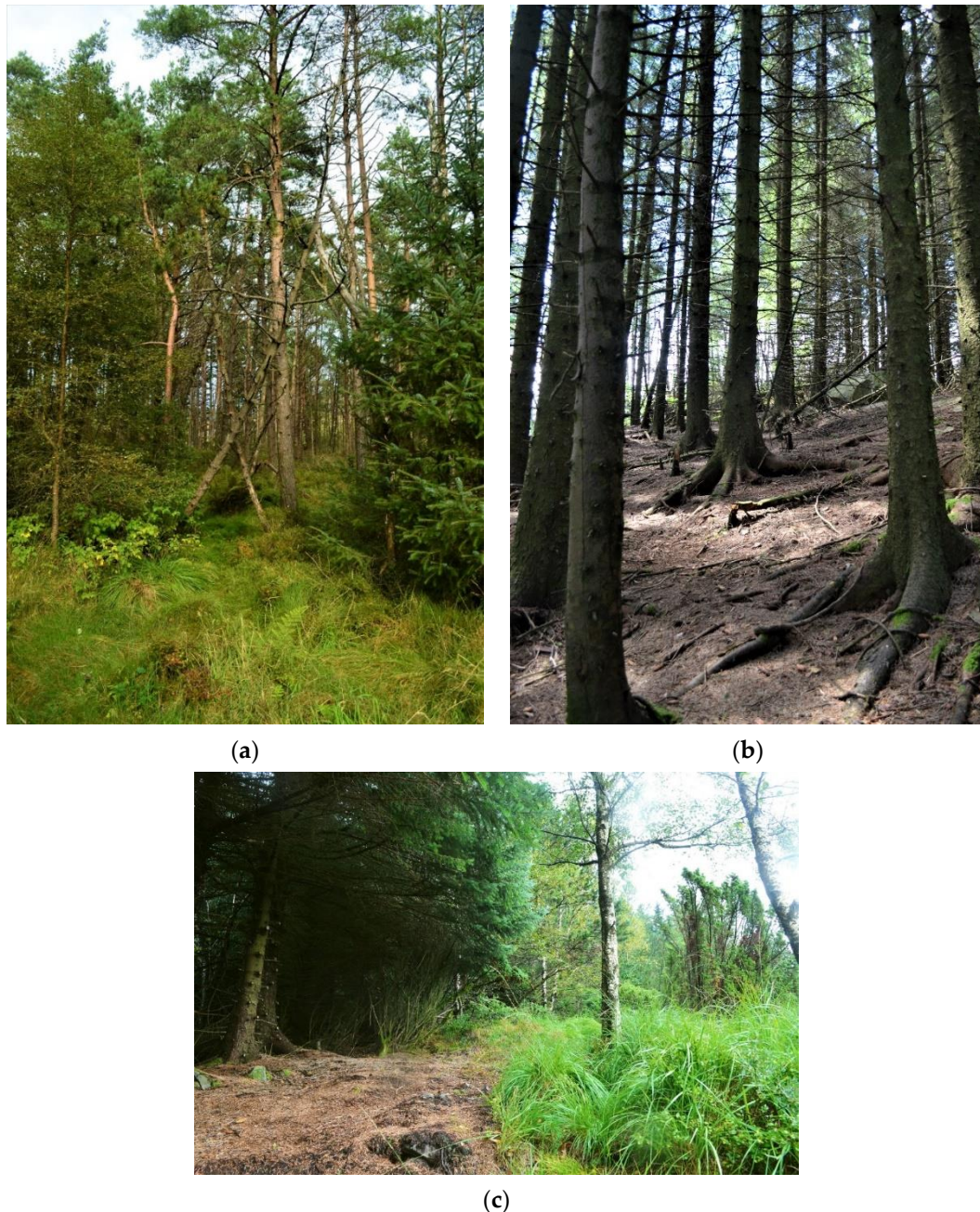


Figure 6. Illustrating the contrast between native Scots pine and birch forest (a) and Sitka spruce forest (b). Both photos are taken on the path from Steinsfjellet summit within a 1-min hike towards the Kringsjø cabin, respectively facing east (a) and west (b). The forest basin transition at the edge between Sitka forest and natural Norwegian forest (c).

It is quite clear that the biodiversity is severely restricted due to limited light in such a dense Sitka forest. This confirms the warnings issued by Saure et al. [63] who analysed loss of biodiversity under

single Sitka trees invading *Calluna* dominated heathlands. The reduced biodiversity in dense Sitka forests, as seen in Figure 6b, is indeed quite extreme. Saure et al. [63] recommend controlling spread of Sitka, and Øyen et al. [64] advise collection of data to show the effect on biodiversity in Sitka forest over a longer period.

In Norway, spruce, Scots pine, yew, and juniper are the native conifers [63]. The most common non-native conifer introduced in NW Europe are the Douglas-fir (*Pseudotsuga menziesii* L.) and the Sitka spruce [64], originating from the Pacific North West. In addition to timber production, the tree species contribute to ecosystem services such as carbon sequestration, providing shelter, soil stabilisation, habitats, and recreational activities. In the Haugesund area, Sitka spruce was introduced in the 1950s, to rebuild the country after World War II. Due to limited local expertise regarding three plantations, the Sitka forests were left unmanaged and the trees are currently generally unfit as building material. The strong winds are challenging for the tree growth and the elastic quality of the timber, and the thin soil composition in the area cripples quality wood. Sitka does not need much sunlight to thrive and is highly competitive [20]. At 5–20 years old, Sitka produces high quantity of seeds. Along the west coast of Norway, it spreads on average 4.4 m/year [22]. Currently, three per cent of the forest on the Norwegian coast is covered by Sitka [22]. The potential for further invasive Sitka spread in heathlands has become acknowledged in the Norwegian scientific community [63,64]. Because of Sitka's detrimental effect on the Norwegian biodiversity, it was blacklisted in 2012.

The exit of the Sitka forest consists of a mix of bilberries, juniper shrubs, *Calluna*, and other flora, as seen in Figure 7. The change from a Sitka forest floor to open landscape with much light is quite abrupt.



Figure 7. Spread of Sitka at different successional levels (a). Sitka forest spread south of the Steinsfjellet mountain peak (to the left) and maintained heathland in the foreground (b).

One of the early successional species found in unmanaged heathlands in south west Norway is the juniper [65]. Particularly, steep south facing slopes get covered by impenetrable juniper communities, which replace the *Calluna* due to limited access to nutrients and sunlight. Since dense juniper communities are extremely combustible [65], they represent a danger to the prescribed burners [10]. It is also hard work to cut and remove these stingy plants prior to burning. Leaving them uncut after burning attracts negative attention and may turn the public against heathland restoration projects [66]. Due to their thermal thickness within the timescale of a prescribed burn and their resinous stems and branches, “scorched juniper corpses” (as seen in Figure 8) may survive decades before decomposing. Thus, juniper leftovers can be present long after burning.

The view from the path, exiting the dense Sitka forest facing south, shows an area deforested by the hurricane Tor, January 29th, 2016, cleaned and burned the following years, as seen in Figure 9a. Continuing on the path seen in Figure 9a, one can see the effects of hurricane Tor close-up, as seen in

Figure 9b,c. The most conspicuous species are bilberry and *Calluna* plants. In addition, *Potentilla erecta*, as seen in Figure 10, thrives in areas that has undergone prescribed burning.



Figure 8. Pioneer stage *Calluna* growing amidst burned juniper remains (a) and juniper remains of significant size (b).



Figure 9. Landscape on the west side of the Kringsjø cabin. Naturally spread Sitka forest (a), area uprooted by hurricane Tor in 2016, cleaned and burned (b) and representative close-up of vital 4-year-old pioneer phase *Calluna* and a 1-year-old Sitka spruce (c).



Figure 10. The yellow flower *Potentilla erecta* is a common species in Norwegian *Calluna* dominated heathlands.

The path continues past Kringsjø mountain cabin and sheep farm. At a lookout 1 min from the sheep farm, the accumulation of biomass in terms of juniper and Sitka that threatens the neighbouring community in case of WUI fires is clearly seen, as shown in Figure 11. Davies et al. [67,68] highlight the reduced fire disaster risk in well-maintained *Calluna* dominated heathland.



Figure 11. Representative south-facing slopes covered by 3–4 m tall junipers and Sitka.

3.4. Ancient Heathland Habitat Reclaiming Process

If unmanaged, the *Calluna* will gradually degrade and die, as seen in Figure 12. It becomes increasingly vulnerable to drought and cold weather. A case study from Scotland [59] demonstrates that old *Calluna* is vulnerable to winter drought in periods with frost and no snow cover and emphasises the die-back of *Calluna* because of climatic variability.

Calluna is a source of fodder for grazing animals. However, too high grazing pressure leads to destruction for the *Calluna*. In addition, sheep dung fertilisation is high in nitrogen, which prevents the growth of *Calluna* [23,56]. This is present at Kringsjø, but also evident at the nearby islands of Røvær and Feøy. At these islands, *Calluna* is absent in the area with livestock and degrading in unmanaged areas, as seen in Figure 13. The County Governor [69] offers a planning scheme for farmers regarding a healthy level of grazing to enhance the symbiosis between *Calluna* vegetation, sheep, and people.



Figure 12. Partly degenerated *Calluna*.



Figure 13. *Calluna* at Røvær island are either absent because of too heavy grazing and nutrient composition from husbandry (a) or in its degrading stages (b).

Livestock is observed nibbling at *Calluna* at Kringsjø as it is part of their dietary composition. Nevertheless, the climate at the coast provides almost year-long access to the sheep's favourite dietary component, grass. In areas where the wild sheep are residing, there are few *Calluna* plants. The sheep fertiliser stimulates growth of grasses and limits *Calluna* growth. Nevertheless, *Calluna* is prevalent in the area where sheep are grazing less frequently, as seen in Figure 14. Sheep seldom dwell in areas dominated by junipers or juniper remains. To prevent the spread of invasive Sitka and further juniper spread, the juniper remains have been removed at Kringsjø. This has increased sheep mobility in the area. Moreover, the biological composition developed into grass-dominated patches that provide habitat for sheep.

In the south facing slopes from Kringsjø cabin and sheep farm, where sheep do not graze, and fire has been absent for decades, Sitka and juniper, that strangle *Calluna*, dominate, as seen in Figure 11. The absence of prescribed fire is ironically increasing the WUI fire risk.



Figure 14. Pioneer phase (4-year-old) *Calluna* is present at Kringsjø where sheep occasionally graze.

3.5. Prescribed Burning

To limit the risk of uncontrolled wildfire, prescribed burning during wintertime is a valuable activity with minimal impact on animal life [10,55,58]. Prescribed burners learn techniques (i.e., in relation to weather, wind, typography, and relevant equipment) to manage the fire to prevent wildfire incidents and handle issues regarding personal safety.

Today, new prescribed burners need to learn the age-old technique from scratch, since this traditional knowledge was lost for decades in several regions. Additionally, the significant accumulation of highly combustible biomass renders the prescribed burning significantly more complicated and dangerous [10]. They face challenging conditions compared to the well-managed heathland 60–70 years ago when one/two people would be sufficient for safe burning. Today, a team of approximately eight people come together to manage organised burning. Such teams need theoretical and practical training. To do this in a location like Kringsjø, where previously burned patches act as barriers for safe practice, may be very beneficial.

From biological, aesthetical and fire safety perspectives, protection of heather landscapes is justified [20]. Nevertheless, resources and engagement depend on economic revenue, public awareness, and possible synergetic interaction. Heslinga et al. [35] highlight that one route towards landscape management and conservation, is tourism.

4. Stimulating Synergies between Tourism and Landscape

An objective of the study is to identify possible synergies between tourism and landscape management. The proximity of Kringsjø to Steinsfjellet viewpoint, which already attracts tourists, opens up possible opportunities for increased activities and to restore age-old fire safe *Calluna* dominated “Viking” landscapes. The Kringsjø cabin and sheep farm may represent a location for increasing awareness about, and reintroducing, ancient heather landscapes through village tourism [70]. At Kringsjø, tourists can experience and learn about historic landscape management and sheep husbandry.

There are, however, monetary costs associated with maintaining paths, mountain cabin, sheep farm, and *Calluna* heathland. The government contributes funding directed to areas of high quality *Calluna* heathlands [69]. These funds are relatively small. Therefore, facilitation of other income-generating activities is necessary to support Kringsjø, which in turn aids reclaiming the original heathland to develop a more fire safe landscape.

Heslinga et al. [35] highlights tourism as valuable, insofar it encourages contextual sustainable development (SD). Tourism and nature protection initiatives are not isolated from the greater societal context; they depend on public and official awareness, acceptance, and support [71,72]. Following that argument, Heslinga et al. [35] identified eight policy recommendations for stimulating synergies

between tourism and landscape: understanding the historical institutional context of the region; strive for integrated policy aimed at synergetic interactions; gain an overview of all stakeholders; include all stakeholders; develop a shared story; co-create a vision for the future; allow for flexibility in the local implementation; and dare to experiment. In the following sections, these eight policy recommendations are utilised to analyse the Kringsjå activities and possible future developments.

4.1. Understanding the Historical Institutional Context of the Region

The local political atmosphere and public discourse create obstacles and opportunities for tourism [35,73]. The historical institutional context is complicated, and difficult to establish. Nevertheless, content analysis [10,40,41,74,75], and unstructured interviews with key stakeholders (i.e., one regional politician, one representative from the regional agricultural office, two members of the community environmental protection office, one local tourist official, one representative from the Avaldsnes project, participants from Kringsjå, two local-prescribed burners, and members of the WUI research team) provided insight into the opportunities and challenges for tourism in Haugesund.

It turns out that tourism has been relatively absent from regional objectives until the 1980s, and the sector is still underdeveloped. At Haugalandet, commercial actors have a strong position while the government holds a discrete role. The regional development has, until recent years, mainly been enhanced by commercial actors, such as rich shipowners [40]. The government has been almost absent in facilitating local tourist activities, let alone environmental protection initiatives. A potential regional “path dependency” is the tendency of the government to overemphasise economic revenue, thus underplay socio-environmental innovation necessary for sustainable transition [76].

Heslinga et al. [35] underpins the detrimental effects of a single focus on economic development, often at the expense of the local environment, and with few social benefits. A single focus on economic revenue might disable the tourist attraction’s “dignity”. Lack of toilet facilities at the National Monument and little political will to improve infrastructure are unfortunately evidence of the minimal engagement in the local tourism scene of Haugesund. Evidently, “Tourism” is situated as a subcategory under commerce in Haugesund Municipal political framework. (Meanwhile, other municipalities place Tourism as a category under infrastructure and culture, e.g., the neighbouring Karmøy municipality.) Arguably, Haugesund municipality might overemphasise commercial actors’ ability to enforce regional development, and thus underplay the importance of a broader network of stakeholders and objectives. Nevertheless, synergetic initiatives provide opportunities for a different path [77].

4.2. Strive for Integrated Policy Aimed at Synergetic Interactions

Development initiatives should integrate social and environmental objectives, since people are dependent on the environment and benefit from protecting it [35,78]. Heslinga et al. [35] highlight that “for people to support nature protection, they need to know what is being protected and why, and ideally, they need to personally experience the area”, i.e., people need to be informed and included. Kringsjå is inclusive and their activities are based on synergies between society and the environment.

Rusten et al. [70] highlight that village tourism based on natural and cultural resources enhanced commercial sales, experiences, and services, such as health and education in Hordaland, Norway. They underline that the success for village tourism in Hordaland was an outcome of the level of synergetic interactions between environmental activities and tourism. Nevertheless, Haugalandet’s “institutional conditioning” [76] challenges the necessary steps for further development at Kringsjå. The commercial path dependency in the area includes segmented politics and paternalistic decision-making (that has become synonymous with Norwegian governance [79]), which is unfavourable to regional socio-environmental innovation. The problematisation of segmentation is visible at Kringsjå. For example, the traffic connecting to Steinsfjellet summit car parking passes through local neighbourhoods. This is problematic because increased traffic through the neighbourhood might be unpopular and the traffic hazardous for the residents. A potential consequence may be reduced public support for Kringsjå with negative impact on the heathland restoration initiative.

Alternative strategies are possible, such as developing natural trails or building a gondola, which might have less carbon footprint than shuttle buses and car traffic.

4.3. Gain an Overview of All Stakeholders

Mapping stakeholders' interest provides insight regarding who is willing and able to contribute, and how, depending on the objectives [35,80]. Stakeholder analysis [80] and understanding levels of co-creation [81] might help Kringsjå develop strategic activities that are more likely to get support.

Kringsjå's activities may benefit from interaction with a broad set of stakeholders, such as the tourist sector, local population, land-owners, local government, academia, civic burner groups, and the natural environment. The stakeholders' interests include land ownership, biological diversity, climate friendly solutions, local food production, local (tourism) development, fire safety, public opinion, social inclusion, economic revenue, and more. Nevertheless, stakeholder analysis cannot alone address how civic organisations and the government are shaping and contributing to regional development. Therefore, further analysis is necessary to understand how to integrate synergetic interactions. These can include network analysis aiming to understand the levels of co-creation, and how stakeholders ought to situate themselves.

Small-scale organisations seldom work in isolation from other stakeholders [36]. Network-building, trust, and collaboration are essential for co-creativity [81,82]. Increased co-creativity enhances the region's social capital. The government has an essential role in providing the framework for well-established collaboration. Eimhjellen and Loga [81] argued that co-creation between the government and local stakeholders is necessary for enhanced development of social and volunteer organisations. Voluntarism is embedded in the Norwegian culture, where much socialisation is organised [83]. The Norwegian society is on the move toward participation and activity-based local environmental protection [10], culture, and identity [84–86]. Henceforth, novel agendas and organisational forms might emerge [87]. Future planning and policy creation for synergic interactions may enable multi-levelled governance, that integrates parts from civic, private, and public sectors. Co-creation can conceptually be organised in three levels of collaboration, in brief terms: first, bottom-up initiation, supplemented with government support; next, government initiation, but with a great deal of civil society present in decision-making and carrying out the activity; and, lastly, government initiation and facilitation of activities for the public [81]. From an organisational perspective, the Kringsjå activity is driven by bottom-up co-creativity, initiated, and carried out by the members of the associated organisations. Kringsjås Venner is the initiator and operator of the activities at Kringsjå. The role of collaborative stakeholders, such as the municipality, is to engage, facilitate, support, and co-create the project through contributions, such as coverage, awareness building, shaping public opinion, monetary contribution, practical and knowledge expertise, on-site developments, network building, and more.

4.4. Include All Stakeholders

It is essential to involve affected stakeholders in tourism-landscape initiatives to prevent conflict, provide essential information, and develop a shared vision. By involving all stakeholders in decision-making or dialogue, public support, and chances for innovation might increase [35].

At Kringsjå, the staff insists that synergies ought to be the fundament for the initiated activities. By including a multiplicity of stakeholders, Kringsjå may facilitate competency building, innovation, and education. One example is seven 10 m × 10 m pilot research fields in the vicinity that demonstrate the local successional development. These fields provided educational value for local schools visiting Kringsjå. This initiative received positive feedback. Additionally, a recent WUI fire research meeting was organised at the sheep farm. Moreover, government officials, environmental institute representatives and tourist officials visited Kringsjå during the past months to learn about ongoing and possible activities. Additionally, Kringsjå collaborates with local prescribed burners [10]. This group consists of farmers, firefighters, and academics that work together to maintain the cultural landscape. This may represent a first step towards improved integration with academia, civic groups, local tourism, and the

government. The inclusion of such stakeholders, at least, is a start towards developing dignified activities. Kringsjå's network may contribute to the development of a new access road, upgraded water, and toilet infrastructure, and construction of small cabins that will be accessible for visitors during the daytime.

The insight from different stakeholders may highlight opportunities and potential threats for further developments. For example, tourist officials and the Kringsjå staff mention challenges, such as "too many" people walking in nature and the lack of modern toilet facilities. In a recent dialogue, local tourist actors recommend Kringsjå to avoid "entertainment" tourism solely for, e.g., cruise ship tourists, but rather offer "slow tourism" and dignified activities to provide people the opportunity to "connect" with nature and learn about the local history.

4.5. Develop a Shared Story

Co-creating a shared story is helpful in facilitating participatory action, enabling an open dialogue, and overcoming misunderstandings. A shared story enables a direction for the activities and minimises side-tracking motivated by individual stakeholders. Open and clear communication between the stakeholders is essential for the creation of sustainable collaboration [35].

Kringsjå may introduce a multiplicity of activities and involve stakeholders in the matrix of local development. Nevertheless, Kringsjå's ambition evolves around heathland restoration. Together, stakeholders with different backgrounds can shape a dynamic storyline that facilitates heathland restoration.

Culture, history, and the environment shape locals' identity, and create a basis for "meaningful" collaboration [35]. Haugalandet, the homeland of the Viking kings, attracts tourists to Viking sites. Moreover, the Viking history is incorporated with the identity of the residents. Through promoting Viking tourism at Kringsjå, the facility can contribute to regional objectives, which is to be a compatible region in relation to the larger cities of Stavanger and Bergen, i.e., respectively within a 2- and 3-h drive from Haugesund [74]. The staff at Kringsjå have previously guided German cruise ship tourists and presented the regional Viking history. The tourists enjoyed learning about the Vikings, fed the (Viking) sheep, and experienced the beautiful view.

Guttormsen [40] warns that the Viking branding may make minority groups feel excluded since the Viking culture has, unfortunately, been glorified by white supremacy groups. The Kringsjå area does, however, pose an opportunity to create a storyline that fits most social groups, e.g., in shared activities with NAV (Norwegian Labour and Welfare Administration), ABR (Work Training Centre), and Sandeid prison. Moreover, the site is frequently used by low-income families, retirees, and immigrants. The Viking history can also remind today's society about ecological caretaking, historic international orientation, trade, and cultural exchange.

4.6. Co-Create a Vision for the Future

Co-creating a shared vision for the future is helpful in setting the main direction for participatory action, enable focus on long-term goals and visualising the way forward [35].

Haugesund municipality strives to make the city viable, sustainable, and lively to attract citizens and commerce [74]. It is beneficial for Kringsjå to align their objectives with the broader regional goals for the mutual benefits for the involved parties. This will increase Kringsjå's chances to get governmental support. After all, Kringsjå contributes to the health and wellbeing of the citizens of Haugalandet and the local environment. Furthermore, creating an environment in line with the needs and wishes of the children, may be a very valuable approach for sustainable activities. The young generations should be invited to provide input to the vision [78,88]. This should not be difficult as a significant fraction of the visitors at the Kringsjå cabin and sheep farm are children and youth.

4.7. Allow for Flexibility in the Local Implementation

Heslinga et al. [35] highlight the challenge of bureaucracy and regulations in creating novel activities. Specific to Haugesund municipality, the commercial path dependency has enabled a void left by the government and filled by other stakeholders. Questions can be raised on whether the government backseat role is a barrier or an opportunity in this regard. Governmental involvement can either increase or stagger the quality of the activities as they go through the bureaucratic mill.

Other related sites on the west coast of Norway have overcome challenges posed by the lack of government involvement, e.g., the Avaldsnes Project, Karmøy [49] and the Heathland Centre at Lygra (HCL) [89], a 4-h drive to the north. The Avaldsnes Project and the HCL can be defined as “dignified” sites that take care of and convoy invaluable information about the Norwegian history and local endemic biodiversity, respectively.

The Avaldsnes Project goes beyond single-minded commercial interests and focuses on cultural contribution, historical scientific research, and nature protection. The project is recognised by Rogaland county as an up-most important historical and ecological site. Therefore, every decision of development is evaluated by the Directorate of Cultural Heritage (DCH). This is an opportunity for the site to maintain its “dignity”, because every decision is scrutinised by the national authority. However, the DCH’s involvement prolongs the timeframe of initiatives as they go through the bureaucratic mill.

The HCL combines a heathland restoration project, a tourist attraction, a site for scientific research, farming practices, and environmental protection. The HCL is situated on an island, Lygra, which is also the home of a mediaeval village, local food production, and diverse activities for visitors (tracking, museum, and guided tours). The initiation of HCL was independent of direct support from the government when established. The centre was initiated by entrepreneurs and scientists. A University of Bergen professor and co-workers were central in scientific studies that attracted attention to the semi-natural aspects of *Calluna* dominated heathland, and for acknowledging this landscape type as “endangered”. They paved the way for Nordhordland heathland’s recognition nationally and internationally. Today, the area is part of the recognised Nordhordland UNESCO Biosphere.

Both the Avaldsnes Project and the HCL are robust and dignified tourist attractions, with focus on professionalism and quality. These initiatives exemplify that the potential for a dignified scheme at Kringsjå is possible, independent of direct initial governmental support.

Lack of local authority’s engagement in maintaining heather landscapes enables a vacuum, which is currently filled by other local stakeholders, such as Kringsjås Venner, sheep farmers, prescribed burners, scientists, and local schools. It is questionable whether these passionate people can pave the way for sustainable activities, and overcome challenges related to “land ownership”, infrastructure, marketing, economic viability, public support, and awareness building, without further support. However, rather than thinking too big, it may be valuable to identify those stakeholders that benefit the most from increased activities, align forces and move towards a vision in a synergetic manner.

4.8. Dare to Experiment

An experimental approach to overcome limitations regarding stalemate decision making is recommended by Heslinga et al. [35]. They claim that experimentation provides opportunities for “thinking creatively, trialling options, reflecting on them, and re-design”. Integrating experimentation in initiation, facilitation and continuation of synergetic activities helps navigate a complex scene. Nevertheless, limiting factors of an experimental approach are that parameters of efficiency and success are relatively unknown.

Yapeng’s [36] study of Minor Historic Centres (MHC) in Italy experienced a continuation of innovation based on reinvention of their socio-environmental conditioning. Heritage-based and network-driven civic engagement were essential for effective revitalisation of the MHCs. The development contributed to community empowerment through tourism by promoting contextual heritage, such as landscape, historic buildings, and agricultural products. The respective MHC has an experimental and inclusive approach; since the 2004 refugee crisis, the reinvention of the MHC included

multicultural activities, which have further attracted tourists. Moreover, cooperation between the hosts and refugees has led to reclaiming abandoned farmland. Still, the MHC concept has encountered barriers. Yapeng [36] pinpoints the challenge of civic initiatives in a world where communities are increasingly governing themselves—consequently the MHC lack resources to take opportunities for enhanced economic return and in response to external changes.

Kringsjå's activities are agile, an outcome of the organisation's experimental approach and many collaborating partners. A pitfall of this is that their activities depend on the engagement of others. Nevertheless, the experimental approach provides multiple pathways to enhance opportunities and overcome obstacles. Experimentation may aid Kringsjå manoeuvre in an ever-changing complex context.

4.9. Takeaways

Summing up, Heslinga et al.'s [35] analytical tool was used to analyse opportunities and obstacles for Kringsjå to offer nature-based tourist experiences. A bullet point summary of the findings is given in Appendix A. In dialogue with respective stakeholders, several of these ideas have emerged for enhanced synergies between tourism and environmental protection. One example of this is that the information provided in Section 3. "Successional Development at Steinsfjellet", might be integrated in an education trail. Such a trail may exhibit heathland restoration—which can be used to educate visitors regarding the endemic *Calluna* heathlands, and invasive Sitka forests in correlation to the UN's SDGs (Sustainability Development Goals) and EU's circular economy framework [90,91]. This is an inexpensive initiative. Through engaging local pupils, they can help make education trail information posters that visualise the younger generation's vision for the future.

Another idea for Kringsjå is to integrate a living lab approach based on participatory involvement, open innovation, co-creation, experimental activities, and network building [92–96]. Participation engagement is at the forefront of this strategy. A Kringsjå living lab may become a foregoer for development in other nature areas in Haugesund, e.g., such as at the Vibrandsøy island (which is highlighted by officials as an important natural site). A synergetic living lab approach may encourage institutional shifts towards sustainability at Haugalandet, and further provide means for *Calluna* heathland management at Kringsjå.

5. Discussion

The present study is based on a pragmatic outlook on tourism, fire safety, co-creation, and nature protection. Kringsjå was chosen for the present study because of their experience with prescribed burning, the proximity to the urban interface and their focus on landscape management reducing WUI fire risk. In close vicinity of the cabin and sheep farm, there are very good examples of spreading Sitka spruce and invasive junipers and well-maintained heathlands; this may be regarded as an asset for educational purposes. It should be noted that the prostrate forms of junipers may be regarded as a weed in Norway [97], while the juniper is recognised as threatened in the UK [98]. The proximity of Kringsjå to local tourist destinations may represent a possibility for increased number of visitors.

The international focus on SD encourages local slow-paced tourism, which generally has less carbon footprint than long-distance tourism. In 2020, the Covid-19 pandemic considerably influenced tourism. Norway was less impacted by the pandemic than most other European countries. The Norwegians who could not travel abroad could, however, freely travel within the country, and thus re-discovered local vacation possibilities. This resulted in a significantly lower carbon footprint than through normal vacation activities and may pave the way for future sustainable tourism. This may fit well with the current activities at Kringsjå.

Heslinga et al. [35] provided a conceptual tool that has been helpful in mapping obstacles and opportunities for synergies between tourism and landscape at Kringsjå, which is situated in a complex and ever-changing context with stakeholders at the forefront of the local development. The study presents an investigation of the interactions between different stakeholders and a narrow grasp of the local-global political discourse/institutional conditioning. The rationality of the current study was to

suggest, analyse, and recommend synergetic developments. The focus on tourism as a path to SD, may distort other imagined pathways towards heathland restoration, such as agroecology-based food production and a Kringsjå education centre. Nevertheless, the study contributes to innovative-based thinking in relation to small-scale initiatives, that can benefit society and the environment.

Synergetic interaction between nature protection and tourism are central to the present study. The framework suggested by Heslinga et al. [35] and the experiences presented by Yapeng [36] were used for analysing the Kringsjå case and have helped improve the vision for the future for the Kringsjå program. Heslinga et al.'s [35] eight policy recommendations for stimulating synergies between tourism and landscape present a pragmatic and analytical tool. In the present study, the recommendations were used as a checklist for co-creation. They also provided insight in the importance of co-creation, which may be especially important today, as we are currently encountering resource scarcity, climatic change, and environmental stresses. The global trends visualise the shortfalls of global/national politics and international trade, often based on neoliberal ideologies and unable to provide environmentally sound and socially inclusive programs and policies. At Haugalandet, this trend is materialised in a "commercial path dependency".

The commercial path dependency at Haugalandet currently restricts synergetic interactions. However, there are several pathways towards a sustainable transition. Yapeng [36] highlights "place-based knowledge, collective vision, and collaborative strategy" as important factors for local adaptations to global challenges. A Kringsjå living lab can provide a stepping-stone for civic groups, society, local government, and private organisations to engage in environmental protection. Collaboration with Kringsjå entails access to invaluable knowledge and experience regarding the endemic environment and WUI fire risk mitigation techniques. Scholars, activists, and international institutions, e.g., UN and EU, highlight SDGs as a way forward to create paths for socio-environmental justice [99]. However, this route is difficult to address under the prevailing economic system. Programs, initiatives, and policies are often imagined within the same economic system (capitalism), and there may be a lack of imagination regarding sustainable transitions in other economic systems [100]. A path for Kringsjå should include community specific needs, e.g., WUI fire safety as examined in the present study.

Synergetic interactions can create new forms of governance. Kringsjå's inclusive approach concretises what "co-creation" might entail. For example, taking part in co-creative activity is synonymous with including society in shaping their local context. A transit towards co-creative activity is essential for enhancing activities that strengthen the community's wellbeing and robustness [81]. Along this path, co-creation may favourably increase social capital, contribute to the regional culture, and is fruitful for democratic, inclusive, and relevant SD. An overview of involved, or potentially involved, stakeholders and their situatedness in relation to each other, provides insight in objectives and the direction of proposed activities [35]. Moreover, the government may benefit from analysing their positioning with the civic society engaging in co-creativity. Indulging in civic engagement may provide opportunities to learn about public opinion, especially in the case of Norway, where much of the socialisation is organised. Kringsjå demonstrates that the local population aims at taking care of the open heather landscape.

Small-scale organisations, such as Kringsjå, may be valuable for the government as living labs, to learn, experiment and adapt to socio-environmental dynamics. It is difficult to foresee what co-creativity might bring, besides innovation. Innovation is unforeseen, experimental, dynamic, and bound to occasionally fail. For that reason, innovation might not be affordable to the government, which relies on public support and time-bound regulations. The officials may indeed benefit from cherry-picking, and subsequently decide to support sustainable successes without risking high losses. This may represent an interesting opportunity for the Kringsjå cabin and sheep farm. After all, small-scale organisations are usually more innovative than well-established bureaucratic entities [96].

Co-creation and social innovation might create dynamic governance. Interaction of tourism and natural protection may contribute to form regional objectives and directions [35]. Moreover, from a

governmental perspective, flexibility implies trust in the civil society. The government may position themselves closer to civil society through co-creation. The present study recommends the government to create a department that welcomes, recognises, connects network, provides information (about for example the EU eco-design for tourism [91]) and, otherwise, supports civil society organisations' needs through bottom-up socio-environmental innovation. This can contribute to the governmental understanding of innovation and entrepreneurs from a more nuanced approach than merely an "economic revenue" commercialisation. In addition, co-creation may also speed up social response mechanisms to a rapidly changing global environment and climate.

Experimental activities can contribute to reinventing and integrating synergetic solutions. This is seen in the study by Yapeng [36], where integration of refugees became a solution for enhanced tourism in southern Italy. At Haugalandet, social services may collaborate with the park service and provide increased work opportunities in environmental conservation at, e.g., Vibrandøy and Kringsjø (two recognised environmental sites of importance in Haugesund). Kringsjø has already engaged social services in such activities. There is an increasingly aging population in volunteer organisations, who might engage in mentor programs for struggling youth and adults interested in work opportunities in nature. Experimental activities at Kringsjø may include introducing other animals, such as, e.g., Scottish highland cattle, which are supposed to be quite close to the cattle in Norway one millennia ago. These are adapted to quite similar climate conditions as in the South Western Norway lowlands. Highland cattle have indeed recently been successfully introduced in Norway [101] and may be spotted in mixed farmland and *Calluna* dominated heath at a few local farms. Based on their prominence, including long horns, they may strengthen the regional Viking history already supported by, e.g., the Old Norse Sheep.

To keep the activities running, and hopefully expand the process of reclaiming more of the original heathland, income generating activities are necessary. The most realistic initiatives are either supported by officials, provided through funds, or are low-cost. Considering the low profile of public actors in tourism development, it is likely that a gradual development of the Kringsjø program is the best way forward. This was the solution for the Avaldsnes project and the HCL, both of which initiatives became successes with time. Since the Kringsjø facility is already a destination point, with a beautiful view, animals, facilities for picnics, barbeques, and a social hub, it would be favourable to develop this facility, rather than to develop random spots elsewhere. For further development at Kringsjø, it is important to note that civic engagement is vital for environmental protection. Thus, the government should aim at having a supportive role [35].

Developing an "educational nature trail", integrating Viking tourism and/or making Kringsjø a prescribed burning living lab would be very beneficial for integrating tourism, environmental education, vegetation management and fire safety, at a minimal cost. The prescribed burning and sheep grazing initiated at Kringsjø seems to be an interesting example of how the previous heathland may be revitalised. To stimulate such activities elsewhere may be very important both with respect to landscape management of the red-listed nature type [102], as well as coping with the general increasing fire risk associated with abandoned heathlands [9].

An "education trail" with displays and research fields is expected to create space for visitors to engage and learn about nature conservation, history of local agriculture and fire-safe landscapes, supporting the SDGs. Kringsjø's agile approach may provide an open-innovative setting for facilitating tourist activities in line with the EU Eco-design, possibly realised through co-creative efforts [91]. Fire agriculture supports the "phoenix" lifecycle of the anthropogenically adapted *Calluna*, which benefits local biodiversity, stores carbon, promotes local food production, protects the soil from devastating fires, and provides recreation possibilities in open landscapes with diverse wildlife [18]. In turn, heather maintenance has a positive effect on minimising accidental release of massive greenhouse gasses and toxins into the atmosphere from disastrous WUI fires. Well-managed heathlands also reduce the spread of invasive Sitka. At Kringsjø, the historical and cultural relevance and traditional

knowledge regarding heathland management can remind society about ecological caretaking and pose as a counter-industrial approach to food production.

Maintaining heather landscapes enhances community resilience. The heather landscape increases local food production, thus making communities less dependent on food import and reducing transport emissions. In addition, the heather landscape supports the native biodiversity. In well-managed heath in the Haugesund region, there are usually areas where the terrain is much steeper than seen in, e.g., classical Danish heaths and Scottish Highland heaths. In such steep terrain, local farmers often leave the area to native forest, trees and junipers, which are not considered as a threat to the well-managed heathland. Such small patches of more fire-prone vegetation do not represent a severe fire risk when surrounded by well-maintained heath. Furthermore, these patches are valuable for the wildlife and represent a variation in the landscape that may be considered aesthetic, especially regarding upright junipers. People rely on their environment, which provides a multiplicity of services (air, water, CO₂ storage, food supply, etc.). In the time and age of climate change and resource scarcity, it is essential to maintain a resilient environment able to cope with ongoing changes. The 6000-year-old *Calluna* heathland has stood the test of time in a symbiotic relationship with people, animals, and vegetation, and may serve as a showcase of circular agriculture.

To start working on a common vision, as suggested by Heslinga et al. [35], should be one of the first steps along this path at Kringsjå. To remind the actors about the historical Viking landscape and husbandry may aid the development of this vision.

6. Conclusions

The Kringsjå area demonstrates different vegetation conditions depending on the level of afforestation of Sitka spruce and invasion of spreading Sitka and juniper. The reintroduced *Calluna* heathland offers a contrast to dense Sitka and juniper communities. The results of heath management by lodging, prescribed burning and grazing can be seen within a few minutes' walk from desert-like forest floor in dense Sitka communities. The proximity of Kringsjå to local tourist destinations represents a possibility for an increased number of visitors. Restored historic Viking landscape and grazing Old Norse Sheep may become valuable for demonstrating sustainable food production and well-functioning biodiversity. Tourism may become a source of income required for supporting ongoing heathland restoration initiatives. Kringsjå may become a showcase for resuming prescribed burning and grazing for fire-safe biodiverse landscapes, while offering cultural and historical experiences for all age groups. To start working on a common vision, preferably aligned with the existing "Homeland of the Viking Kings" tourism approach, should be one of the first steps along this path.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Obstacles and opportunities for synergies between landscape and tourism at Kringsjå, Haugesund.
Obstacles for synergetic tourism:

- Commercial path dependency (single focus on economic revenue, discrete role of government, strong commercial actors, segmented politics, and paternalistic decision making)
- Limited regional focus on tourism (regional underdeveloped infrastructure, culture, nature-based tourism)
- Entertainment tourism might negatively affect tourist attractions' dignity (and might harm the environment)
- Viking tourism might exclude culturally diverse group sense of belonging because of historical emphasis on Scandinavian ethnicity.
- External changes (such as decreasing number of tourists due to pandemic)

Opportunities for synergetic tourism:

- Increased global, national, and local support towards SDGs and circular economy and increased attention to synergetic initiatives (e.g., between tourism and landscape).
- The Norwegian society is trending towards participation and activity-based local environmental protection, culture, and identity.
- Tourism (help stakeholders organise and present their regional heritage).
- Regional Viking tourism (remind today's society about ecological caretaking, historic international orientation, trade, cultural exchange).
- Slow tourism to provide people the opportunity to "connect" with nature and learn about local history.

Organisational obstacles:

- Government involvement: Might delay and complicate activities (due to regulations, stalemate decision-making, and bureaucracy).
- Lack of government involvement might limit opportunities (in terms of awareness, acceptance, and support); e.g., relatively small funds provided by the government to contribute to areas of quality *Calluna* heathlands.
- Limiting infrastructure: Traffic, and toilet facility.
- Monetary costs associated with maintaining paths, mountain cabin, sheep farm, and *Calluna* heathland.
- Complexities of co-creation (potential conflict; side-tracking; multiplicity of objectives; competition; efficiency/success rate unknown (unforeseen); land ownership; dependability on others etc.).
- Economic viability of experiment-based activity (uncertainty of economic sustainability).

Organisational opportunities:

- Contribute to regional objectives (Circular economy and "city viable, sustainable, and lively to attract citizens and commerce").
- Nature-based tourism: Attract tourists because of the beautiful vicinity, and husbandry (Wild Norwegian Sheep).
- Expertise in *Calluna* heathland maintenance (collaboration with local prescribed burner groups might foster further experimentation and a dynamic site for environmental tourism).
- Learning points from other successful tourist initiatives (such as Avaldsnes, HCL, village tourism in Hordaland, and MHC in Italy).
- Previous experience with tourism (specific learning points: The tourist enjoyed learning about the local Viking history, fed the (Viking) sheep, and experienced the beautiful view).
- Socio-environmental objectives (aiming to provide benefits to the society).
- Inclusive approach (across social groups, ages, and cultures).
- Broad Stakeholder involvement (collaborate with volunteers; social service; WUI researchers; prescribe burners; academia) (impact: coverage, awareness building, popular opinion, monetary contribution, practical and knowledge expertise, on-site development, network-building).

- Continues network building with local government, tourist officials, media and environmental intuitions that have visited Kringsjå the past months to learn about the ongoing activities.
- Agile approach: Innovative and experimental (e.g., pilot research fields demonstrating local successional development. Provided as educational value for local schools).
- Implementation of a Kringsjå Living Lab. A living lab might shape a dynamic storyline that facilitates activities that provide “learning value” to society; potentially taking care of and conveying information about heathland restoration. Co-creating a Living Lab might enable small-scale developments paving pathways to synergetic interactions (facilitate participatory action, enabling an open dialogue, overcoming misunderstandings/disagreement, shared objectives, outlining direction of activity).

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