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Ice and snow's contributions to people: What are they and how will they be affected by climate change? A case study in Oslomarka, Norway

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Abstract

Ice and snow provide many essential contributions to people and the planet, such as temperature regulation, socialising opportunities, and recreation. As an Arctic nation, Norway is one such place with an abundance of these contributions, but which are currently under threat from climate change. This study examines the contributions local people receive from nature through ice and snow and how beneficiaries expect these to be affected by climate change. Fieldwork was conducted in Oslo, Norway, and its peri-urban forest known as Oslomarka, where a sample of narratives from 132 informants among users of ice and snow was analysed.

The results indicate that beneficiaries from ice and snow see Oslomarka as a rich winter landscape that provides many intangible, or non-material contributions, including benefits to health, connection to nature, aesthetics, social bonds, transformative personal experiences, place identity, and freedom. Of these, health and connection to nature are the most highly valued. Furthermore, when considering the impacts from climate change on ice and snow in Oslomarka, users expect that the contributions of health and connection to nature will be impacted the most. Ultimately, users expect the effects of climate change on ice and snow to cause a considerable reduction in their own quality of life.

The findings of this study support a correlation in which climate change is threatening the same contributions that are not only present in Oslomarka, but that local people value the most.

Keywords: Norway, nature's contributions to people, non-material, snow, ice, climate change

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List of Figures and Tables

Figures

| | |
|----------------------------------------------------------------------------------------------|----|
| Figure 1: Norway with the Osloomarka boundaries encircled in red _____ | 8 |
| Figure 2: Cultural ecosystem services framework for recreational users of marine areas _____ | 14 |
| Figure 3: IPBES Conceptual Framework _____ | 15 |
| Figure 4: Selected sites for sampling in Osloomarka _____ | 20 |

Tables

| | |
|-------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Table 1: Sub-domains linked to their corresponding NCP domain, with keyword examples _____ | 17 |
| Table 2: Example of how narratives were coded using sub-domains and linked domains, and how duplicates were removed _____ | 24 |
| Table 3: Results for Task #1, #2, and #3 for the percentage of the sample that mentioned each sub-domain and the corresponding NCP domain _____ | 28 |
| Table 4: Results for Task #4 for average and median expected change in quality of life grouped by sampling site _____ | 29 |

List of Acronyms

| | |
|-------|-----------------------------------------------------------------------------------------|
| IPBES | <i>Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services</i> |
| ES | <i>Ecosystem services</i> |
| TEEB | <i>The Economics of Ecosystems and Biodiversity</i> |
| CES | <i>Cultural ecosystem services</i> |
| NCP | <i>Nature's contributions to people</i> |

Table of Contents

| | |
|--------------------------------------------------------------------------------------------|-----------|
| 1. Introduction | 1 |
| 2. Background and Case Study | 3 |
| 2.1. Background: Ice and snow in Norway | 3 |
| 2.1.1. Landscape and environment | 3 |
| 2.1.2. Climate | 3 |
| 2.1.3. Society and culture | 4 |
| 2.1.4. Economy | 6 |
| 2.1.5. Climate change | 6 |
| 2.2. Case study area: Oslomarka | 7 |
| 2.2.1. Site description..... | 7 |
| 2.2.2. Climate | 9 |
| 2.2.3. Recreational culture in Oslomarka | 9 |
| 2.2.4. Climate change | 10 |
| 2.2.5. Adaptations | 12 |
| 3. Analytical Framework | 13 |
| 3.1. Ecosystem services | 13 |
| 3.2. IPBES and nature’s contributions to people | 14 |
| 3.3. Nature’s non-material contributions to people | 15 |
| 3.4. Assessing nature’s non-material contributions to people | 18 |
| 4. Methods and Materials | 19 |
| 4.1. Data collection | 19 |
| 4.2. Experience maps | 21 |
| 4.3. Data analysis | 23 |
| 4.4. Limitations | 25 |
| 5. Results | 27 |
| 5.1. Ice and snow’s contributions to people in Oslomarka | 29 |
| 5.2. Highly valued contributions from ice and snow in Oslomarka | 29 |
| 5.3. Impacts from climate change on ice and snow’s contributions in Oslomarka | 30 |
| 6. Discussion | 31 |
| 6.1. Key findings | 31 |
| 6.2. Reflections and recommendations | 33 |
| 7. Conclusion | 35 |
| 8. References | 37 |
| Appendix | 49 |

1. Introduction

Human well-being, including economic and social prosperity, is intertwined with the ecosystems on Earth (MEA, 2003). The concept of ‘ecosystem services’ evolved in the 1980s from a need to understand how different ecosystems around the world provide benefits to people (de Groot et al., 2010; Costanza, 2016; Potschin & Haines-Young, 2016a). Ecosystem services provides a pivotal framework with which to assess the multitudinous benefits people receive from nature, the values people attribute to them, and how human well-being is affected by the loss of ecosystems and biodiversity (MEA, 2003).

More recently, the complementary concept of ‘nature’s contributions to people’ was developed and adopted by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). It builds upon and expands the mechanisms for understanding the complex relationships between humans and nature (Pascual et al., 2017; Kadykalo et al., 2019).

While human well-being is affected by the natural environment, human activity is degrading the ability of nature to sustain societies worldwide (MEA, 2003; Díaz et al., 2019) and pushing the natural limits of the planet past safe and sustainable levels (Rockström et al., 2009; Steffan et al., 2015). In recent decades, climate change has begun to impact not just ecological systems, but has challenged many established governance, legal, and economic systems around the globe (see Hulme, 2009; Vatn, 2015; Hulme, 2020). Without a change in direction, these impacts are expected to be but a fragment of the consequences that humanity will need to cope with for continuing to degrade and exploit nature in unsustainable ways (Maslin, 2014; Vatn, 2015).

Among other consequences, climate change is causing a rise in average yearly temperatures around the globe, which is affecting all types of ecosystems (Maslin, 2014; Locatelli, 2016). However, it is the ecosystems that comprise global ice and snow cover, or the ‘cryosphere’, that are particularly vulnerable (Barry, 2002; Maslin, 2014; Hayhoe, 2018; IPCC, 2019). Places heavily influenced by the cryosphere, namely the polar regions, are now warming at a faster rate than anywhere else on the planet (Ecochard, 2011; Markon, 2018; Belgrano, 2018).

The impacts of climate change on ice and snow will have significant biophysical consequences, in large part because they are linked to other segments of the global climate system (Barry, 2002; IPCC, 2019). Consequences from climate change on ice and snow are problematic because they threaten the many benefits and services the cryosphere provides for the planet,

such as through glaciers and permafrost which store methane (Euskirchen et al., 2013; Maslin, 2014; AMAP, 2017; Wadhams, 2017) or continental ice and snow which reflect sunlight and regulate temperature (Euskirchen et al., 2013; Maslin, 2014; NSDIC, 2020). Moreover, such biophysical impacts can lead to potentially huge economic losses (Whiteman et al., 2013; Maslin, 2014; IPCC, 2019).

Research has furthermore demonstrated that the cryosphere provides multiple contributions to people and society, such as through sustaining life and livelihoods (Barnett et al., 2005; Bury et al., 2011; Wang & Cao, 2015; Palomo, 2017), providing spiritual and aesthetic values (Gagné et al., 2014; Magnuson & Lathrop, 2014; Allison 2015), creating spaces for recreation and tourism (Englin & Moeltner, 2004; Agrawala, 2007; Wang et al., 2010) and promoting identity and culture (Orlove et al., 2008; Buckland, 2012; Gagné et al., 2014; Palomo, 2017).

Yet despite the vulnerability to climate change, and the potentially significant consequences to people, surprisingly little research has systematically assessed the connection between the contributions that local people receive from ice and snow and how these same contributions may be affected by climate change. This is especially the case for the Arctic region (Malinauskaite et al., 2019).

Using the forested region of Oslomarka, in South-Eastern Norway as a case study, we aim to address this knowledge gap, using three interlinked research questions:

- 1) *What contributions does nature provide to local users through ice and snow?*
- 2) *Which contributions are most highly valued by local users?*
- 3) *How do local users expect climate change to impact these contributions and how will these changes affect their quality of life?*

This thesis is organised in six main chapters. First, we introduce the role of ice and snow in Norway and the case study area. Next, we detail the conceptual and analytical frameworks employed in this study. Third, we explain the methodology used to collect the necessary data and our approach to analysing it. The results of the data analysis on ice and snow's contributions to people, and how climate change may impact these are then presented, followed by a discussion of the key findings and our reflections and recommendations. Finally, the thesis concludes with a brief summary and final comments.

2. Background and Case Study

2.1. Background: Ice and snow in Norway

2.1.1. Landscape and environment

Since the early Quaternary period¹, the cryosphere has profoundly impacted the Norwegian landscape, and the valleys, fjords, and lakes that are iconic to Norway were formed by such geological history (Mangerud et al., 2011). From the start of this period until present, the climate has fluctuated, causing some species to dwindle while others, like the Norwegian Spruce (*gran*), have thrived (Mangerud et al., 2011; Fjellstad, 2017). The presence of both permanent and seasonal ice and snow in the Norwegian landscape has thus shaped its flora and fauna. Evidence of adaptive strategies for the cold are found across nature, such as how snow insulates the ground and keeps the vegetation beneath healthy (NSDIC, 2020). Flora such as lichen and mushrooms can then withstand winter conditions, which is in turn crucial for fauna like reindeer to survive the winter months (Inga, 2007).

According to the Norwegian Biodiversity Centre, today there are around 44,000 species² in Norway (NEA, 2017). 2,355 species are threatened, including many that once prospered in cold environments, such as the polar bear, Arctic fox, and lynx (Aase & Aase, 2008; NEA, 2017). Some species, such as the boreal felt lichen, have disappeared altogether in Norway (NCC, n.d.), and others, like the great auk are now extinct (Lee, 2003). Today, Norway has claimed a special responsibility³ to protect species that are strongly dependant on Norway's actions and management, many of which are found in the Arctic region (NEA, 2017).

2.1.2. Climate

The present-day average for winter temperatures in Norway is -6,8°C. However, the winter season differs significantly from one part of the country to another (Visit Norway, n.d.-a, n.d.-b). Along the coast, winter is often characterised by mild conditions, with little or no ice and snow, and temperatures oscillating around 0°C (Visit Norway, n.d.-a, n.d.-b). Inland and places of higher altitude⁴ can experience colder winters, with plenty of ice and snow, and temperatures between -10 and -20°C (Visit Norway, n.d.-a, n.d.-b). Towards the North, communities can

¹ beginning approximately 2,75 million years ago

² although it is estimated to be closer to 55,000 species

³“ If 25 % or more of the European population of a species is found in Norway, it is defined as a species for which Norway has special responsibility. Not all species in this category are threatened or near-threatened- some of them have sizeable, healthy populations in Norway [...] Of the species in this category, 159 are also classified as threatened species” (NEA, 2017).

⁴ 700 meters above sea level and up

experience significantly colder winters, with persistent and even permanent ice and snow, where temperatures can reach -40°C , and where the polar night⁵ can last anywhere from a few days to several months (MET, n.d.; Visit Norway, n.d.-a, n.d.-b).

A comparison of large cities in Norway demonstrates the variations in winter between regions, where to the West, the city of Trondheim experiences on average 27 days⁶ of snowfall⁷ per year, while to the North, the city of Tromsø experiences on average 74 days⁸ of snowfall per year (Pedersen, 2013). With these variations in mind, winter conditions in Norway can span a significant part of the year, commonly from October/November to April/May (DNT, n.d.-a). In the Norwegian language (*bokmål*), the term *vinterhalvår* refers to this ‘half-year’ that most of the country experiences dark and/or cold winter conditions.

2.1.3. Society and culture

The last ice age, which ended around 14,000 years ago, was followed by a warmer interglacial period, where settlers migrated north from Europe and west across the Arctic and sub-Arctic (Stenersen & Libæk, 2007; Lamnidis et al., 2018). Around 500 BC, the climate cooled once again; communities adapted to the presence of ice and snow, and this helped shape Norwegian society and culture. At first, ice and snow were of practical importance, such as allowing for transportation by skis (Sælen & Ericson, 2013). However, ice and snow became culturally symbolic as part of the ‘Norwegian people’s soul’ (*folkesjel*) when the Swedish-Norwegian union dissolved in 1905 (NK, 2016; NTB, 2016). King Haakon VII and the new monarchy established polar achievements as an integral part of the strategy for Norwegian nation-building (Stenersen & Libæk, 2007; Mølster, 1996 in Sælen & Ericson, 2013; NK, 2016).

Many of the most revered Norwegians thus have accomplishments in relation to ice and snow, such as the polar explorers Roald Amundsen (1872-1928) and Fridtjof Nansen (1861-1930) (Aase, 2008). Accomplished winter athletes as well, like Marit Bjørgen and Petter Northug, among many others, are household names in Norway (NK, 2016).

⁵ where the sun is not visible for more than 24 hours

⁶ based on data from 1923-2012

⁷ note that days of snowfall differ from days with snow on the ground

⁸ based on data from 1920-2012

Artists and writers have also demonstrated that snow, ice, and winter are an important cultural part of Norwegian life. For example, Henrik Ibsen (1828-1906), the most famous Norwegian playwright, wrote poems that described winter landscapes and experiences such as in *'The Tear'* where a young boy was devastated that he could not go sledding and play in the snow. Bjørnstjerne Bjørnson (1832-1910), a famous Norwegian writer, called Norway 'the shining country of the ski slope' in his famous poem *'Norge, Norge!'*. Ice and snow are thus thought to have had significant influences on Norwegian identity, with local sayings like 'Norway is a winter country' and 'Norwegians are born with skis on their feet' (WWF, 2019a; NTB, 2016).

Finding meaningful ways of interacting with ice and snow may allow Norwegians to experience 'nearness to nature' in long, dark, and cold winter conditions. Nearness to nature is considered one of the most fundamental cultural values in Norway, and it describes the emphasis Norwegians place on connecting to nature (Aase, 2008; Sælen & Ericson, 2013). Nearness to nature manifests in many ways, such as through the importance placed on outdoor recreation (*friluftsliv*) (Aase, 2008). This encompasses a variety of experiences with nature in wintertime, such as 'feeling the pleasure of sweeping down a hill on a toboggan run, finding the rhythm of a ski track, or finding traces of animals that have walked here before you' (WWF, 2019a). Though not all cultural values are upheld, nearness to nature in winter is illustrated in the 55% of Norwegians who go skiing each year (Aase, 2008; Norsk Friluftsliv, 2015).

About 80% of the roughly 5,3 million population of Norway live in urban areas (NEA, 2020), and many of these cities are characterised as still having easy access to nature. In a Norwegian context, the concept of *bynært friluftsliv* refers to the important outdoor recreational opportunities that are easily accessible from a nearby city. Some people aim to escape the city entirely, such as to one of the nearly half a million cabins (*hytte*) across the nation (SSB, n.d.-a). Cabins represent an important part of Norwegian culture and are a way for many to disconnect from the city and reconnect to nature (Eriksen, 1996; Kildahl, 2013). There can be both summer and winter cabins, but the communities with the most cabins are located in mountainous areas with major skiing opportunities, such as Ringsaker and Trysil (SSB, n.d.-a).

While some scholars have argued that certain conditions, such as widespread city-living, makes it more difficult to advocate for the importance of nature (Potschin et al., 2016), in the context of Norway, despite cold and dark conditions or a city-lifestyle, Norwegians still find ways to experience their cultural value of 'nearness to nature' (Eriksen, 1996)

2.1.4. Economy

The high level of engagement that Norwegians have with ice and snow also translates economically, where four billion Norwegian kroner⁹ (NOK) is spent annually on equipment or clothing for winter activities (NK, 2016). Even indirect experiences can draw revenue, such as advertising at televised events like the skiing World Cup, which becomes significant when millions of Norwegians watch (NK, 2016).

Furthermore, winter sports, tourism, and resorts are an important source of income to local communities (NK, 2016; NTB, 2016). Based on overnight stays (e.g. hotels or resorts), over a quarter of international tourists visit Norway from November-April (SSB, n.d.-b) and localised activities such as glacier tourism bring up to 30,000 visitors each year (Furunes & Mykeltum, 2012). Natural landmarks like Jostedalbreen, which is the largest glacier in continental Europe (Visit Norway, n.d.-c), draw Norwegians and international tourists alike, and built landmarks, such as the Holmenkollen Ski Arena, draw over one million visitors every year (Aase & Aase, 2008). In total, winter activities also represent billions of Norwegian kroner in tourism (NK, 2016). There is thus a strong economic importance of winter, where people's livelihoods and incomes may be at stake if Norway loses winter 'as they know it' (NK, 2016).

2.1.5. Climate change

The consequences of climate change will have significant impact on the cryosphere in Norway over the next century. The Norwegian Environmental Agency (*Miljødirektoratet*) predicts that by 2100, Norway will on average experience an annual temperature increase of about 4,5°C, and a precipitation increase of 18% (Hanssen-Bauer et al., 2017).

By 2100, the number of snow days will thus be reduced across nearly the entire nation (Vikhamar-Schuler et al., 2006 in Sælen & Ericson, 2013; Hanssen-Bauer et al., 2017), except at some higher altitude areas which may experience an increase in total snow accumulation (Hanssen-Bauer et al., 2017). The largest reduction in the snow season will occur at places of lower altitude¹⁰ (Hanssen-Bauer et al., 2017). Forecasts show a trend of later accumulation of snow and earlier snowmelt (Dyrrdal and Vikhamar-Schuler, 2009 in Hanssen-Bauer et al., 2017), with an increase in periodic melts within a single season (NK, 2016).

⁹ approximately 400 million euros

¹⁰ 200 meters above sea level and below (SNL, 2018)

There will also be substantial glacier reduction: by one-third the area and volume for large glaciers, and nearly a complete disappearance for small glaciers (Hanssen-Bauer et al., 2017). Finally, lakes in Norway will experience a reduction in both freezing duration as well as thickness (Hanssen-Bauer et al., 2017).

There is growing concern in Norway about the impacts that climate change will have on the life and culture of local people (Messel, 2020). In one study by Norwegian Outdoor Life (*Norsk Friluftsliv*), of the 1,000 respondents, 50% were concerned about the future of skiing (Nordstrøm, 2019). Another study by the World Wildlife Fund asked Norwegians what they are most afraid of losing due to climate change. Of the 6,000 people who responded, ‘winter’ was ranked as the fifth greatest concern of the ten options, after i) intact nature, ii) silence, iii) free flowing water, and iv) starry skies (WWF, 2019b). The results of the World Wildlife Fund study argued that snow-covered trees and landscapes are important for the Norwegian identity, that they invite people to exercise and improve their health during winter, and that this is an important part of the quality of life for many people (WWF, 2019a).

It is clear that from the environment, to society and culture, to economy, many aspects of life in Norway may be affected from the impacts of climate change on ice and snow.

2.2. Case study area: Oslomarka

2.2.1. Site description

Our study area is Oslomarka (Figure 1), the peri-urban forest surrounding Oslo, Norway’s capital city. The greater metropolitan area of Oslo hosts over 1 million people (SSB, 2019), or nearly 20% of the nation’s total population. The total area of Oslomarka is approximately 1,700km² across the Oslo, Viken, and Innland counties (NEA, 2020). The elevation ranges from coastal areas below 100 meters above sea level to mountain peaks at just above 700 meters above sea level (NMA, 2010; NEA, 2020).

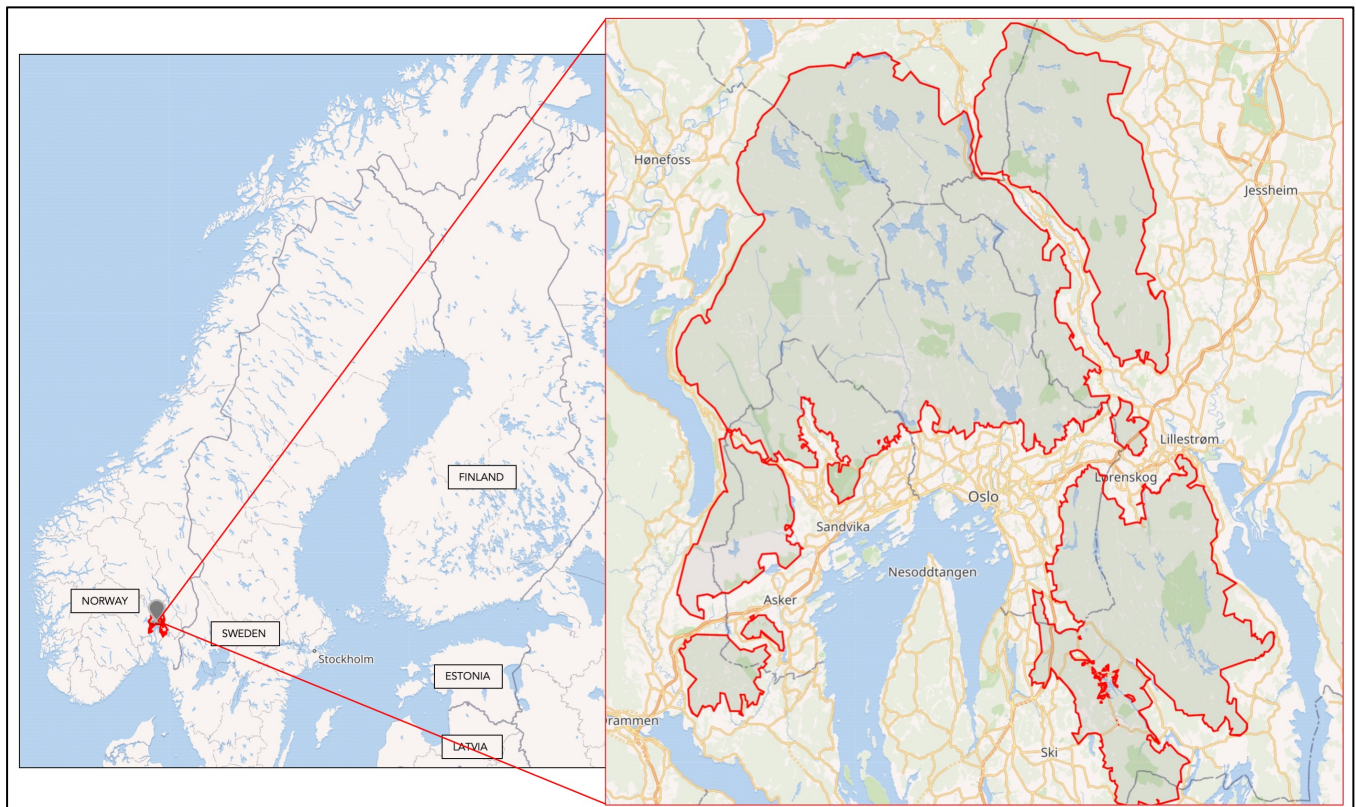
Approximately 20% of the total area in Oslomarka is protected for biodiversity purposes (Gundersen et al., 2015; Thorsnæs & Tvedt, 2017). Nevertheless, Oslomarka encompasses spaces where people permanently live and work, as well as routinely interact with nature, such as through recreation or visiting cabins (Christophersen & Svennson, 1984; Harlem et al., 2015; Regjeringen, 2015; NEA, 2020).

In 2009, the Act of Nature Areas in Oslo and Nearby Municipalities (*Markaloven*) defined the historically-contested borders of Oslomarka¹¹ and aimed to preserve the natural and cultural landscape within, as well as ensure that future generations will have access and opportunities to experience the nature there (Christophersen & Svennson, 1984; Markaloven, 2009:§1; Thorsnæs & Tvedt, 2017; NEA, 2020).

According to the Act of Nature Areas in Oslo and Nearby Municipalities, Oslomarka encompasses eleven smaller ‘wilderness areas’ (Markaloven, 2009:§2) (for a more detailed map of Oslomarka and a map of the approximate wilderness areas, see Appendix 1), each of which have numerous entry points from Oslo and surrounding areas (Sælen & Ericson, 2013). The forest is accessible via roads and on public transit anywhere between 5-40 kilometres from Oslo¹², making outdoor recreation easy to access and importantly, free of charge to use (Sælen & Ericson, 2013:427; Thorsnæs & Tvedt, 2017; Anchin, K., 2018).

Figure 1

Norway with the Oslomarka boundaries encircled in red (Adapted from Wikimedia-kart Kartdata, OpenStreetMaps).



¹¹ colloquially referred to as *Marka*

¹² from Oslo city centre (*sentrum*)

2.2.2. Climate

The average winter temperature in the city of Oslo itself is -5°C (Rommetveit, 2009 in Sælen & Ericson, 2013). The daytime temperature falls below zero degrees for 24 hours or more in Oslo on average around mid-November (Pedersen, 2013). In addition, the city of Oslo experiences an average of 31 days¹³ of snowfall per year, with snow on the ground as early as October¹⁴ (Pedersen, 2013). Though melting periods are common, on average the snow increases in depth on the ground until March¹⁵ (Pedersen, 2013). In Oslomarka as well, such as in the wilderness area of Nordmarka, the Norwegian Meteorological Institute (*Meteorologisk institutt*) estimates that there are on average 80 ski days¹⁶ per year (Dæhlen, 2020).

2.2.3. Recreational culture in Oslomarka

Activity in Oslomarka is varied, where some people may visit to ski for just a few hours after work, while others spend many days at cabins or out in the wilderness. Still others come to socialise on the weekends at landmarks, such as at the iconic *Holmenkollbakken*, which has the longest connected history of any ski hill in the world (Christophersen & Svennson, 1984).

The first race at Holmenkollen was in 1892, with a crowd of 12,000 people and the first 50km (*femmila*) ski race was ten years later in 1902 (Christophersen & Svennson, 1984). In subsequent years, the importance of winter activities to Oslo residents grew, and the 50km ski race event at Holmenkollen was even called the ‘second’ national holiday, as many Norwegians spent one of their fourteen vacation days a year attending the event (Christophersen & Svennson, 1984). The importance of ice and snow increased further when Norway hosted the 1952 Winter Olympics in Oslo, and between 100,000-150,000 people attended the ski-jump event at the newly built Holmenkollen Ski Arena (Christophersen & Svennson, 1984; Aase & Aase, 2008; Sollie, 2018).

Holmenkollen continues to be a landmark that has significance around the world, where it is considered ‘skiing’s mecca’ (Christophersen & Svennson, 1984). Locally as well, the Holmenkollen Ski Festival, which is a series of events that now includes the iconic 50km race, draw crowds of over 100,000 people each year (NTB, 2017).

¹³ based on data from 1937-2012

¹⁴ with 0,1cm of snow on average

¹⁵ with 21,2cm of snow on average

¹⁶ using a measure of at least 30cm of snow on the ground

While Holmenkollen is perhaps the most iconic landmark in Oslomarka, a wide range of other businesses and organisations are also in operation. For example, Oslomarka has lodges, called *stues*, spread across its landscape, which provide important food, drink, and socialising opportunities to locals (Bymiljøetaten, 2014; Harlem et al., 2015; Skiforeningen, n.d.).

Furthermore, the Norwegian Trekking Association, (*Den Norske Turistforening*) operates 31 cabins in the region that people can rent and spend the night at, even in remote parts of the forest that may only be accessible in winter by skiing¹⁷ (DNT, n.d.-b). Together with Oslo Municipality (*Oslo Kommune*), the Association of Skiing (*Skiforeningen*) maintains ski trails throughout the region to allow for easy access in wintertime (Thorsnæs & Tvedt, 2017).

The ability to access Oslomarka in winter conditions is described by the Norwegian anthropologist Thomas Hylland Eriksen, as “you can become a Norwegian, culturally speaking, by putting on a pair of skis and heading down the trail” and that Oslo residents visit Oslomarka, “to surround themselves with winter temperatures and snow for a few hours to confirm that they are Norwegian, despite all” (Eriksen, 1996).

2.2.4. Climate change

Oslomarka is a suitable case to study because climate change is already affecting the South-Eastern region of Norway: effects which are predicted to worsen. The impacts of both an increase in temperature and precipitation can already be observed in Southern Norway, where the snow-water equivalent¹⁸ has been decreasing since 1931 below elevations of 850 meters above sea level (Skaugen et al., 2012 in Hanssen-Bauer et al., 2017). For Eastern Norway, the Norwegian Environmental Agency estimates that by 2100, there will be between one and four months less snow each year (NK, 2016:). In fact, in the last 30 years alone, the city of Oslo has lost 21 days of winter¹⁹ (Dæhlen, 2020).

A loss of winter days can impact the ability of locals to engage in winter experiences like skiing. The amount of snow on the ground necessary for skiing ranges between 15-80cm,²⁰ though in Oslomarka skiing conditions are often measured at 25-30cm (Dæhlen, 2020; Løken, 2020). In

¹⁷ or hiking in summer

¹⁸ the amount of water contained in a pack snow, if melted

¹⁹ days with temperatures below zero

²⁰ depending on the unevenness of the terrain

this perspective, Oslomarka has already experienced on average four less ski days each decade since 1900 (NTB, 2016). In Nordmarka, the Norwegian Meteorological Institute estimates that by 2050, the number of ski days²¹ will be reduced from 80 to 50 days, and by 2100, reduced to 30 days (Dæhlen, 2020).

Moreover, the Norwegian Meteorological Institute (Rommetveit, 2009 in Sælen & Ericson, 2013) estimates that between the years 2070-2099, the winter temperatures in the Oslo area will shift from an average of -5°C to 0°C and this will cause less stable winter conditions. The temperature decrease is anticipated to result in either wetter snow in Oslo and Oslomarka, which is ‘poorly suited for skiing’, or even no snow at all (Sælen & Ericson, 2013).

Furthermore, the amount of ice and snow may fluctuate significantly from one winter season to the next. For example, the 2018-2019 season in Oslomarka was a snow-rich season (at 103 ski days²²), with ski trails amounting to 3,087 and 11,792 kilometres in just two of the eleven wilderness areas: Østmarka and Nordmarka, respectively (Løken, 2020). The following season (2019-2020) was one of the worst for winter conditions in Oslomarka since the late 19th century (at 42 days ski days²³), where the ski trails were just a fraction, with 113 and 2,195 kilometres of ski trails in Østmarka and Nordmarka, respectively (Løken, 2020). While future predictions estimate less ice and snow by the end of the century in Oslomarka on average, heightened unpredictability implies that next year very well may be a snow-rich season once again.

The volatility of ice and snow conditions may in turn impact local people, as shown in a 2013 study of wintertime forest users and skiing conditions in Oslomarka. The study found that the willingness to pay for trips to Oslomarka in good skiing conditions was considerably higher than conditions with bare ground (40% less) or wet snow (77% less) (Sælen & Ericson, 2013). Furthermore, the willingness to travel was up to 45km for good conditions, 23km for bare ground, and 0km for wet snow (Sælen & Ericson, 2013). The study found that fewer snow days and less desirable conditions in Oslomarka could produce considerable welfare loss for locals, and when similar studies were examined, their results suggested that skiing was highly important to Norwegians by comparison (Sælen & Ericson, 2013).

²¹ using a measure of at least 30cm of snow on the ground

²² using a measure of at least 25cm of snow on the ground

²³ using a measure of at least 25cm of snow on the ground

In fact, Oslo is the region in Norway where Norwegians are the most concerned about the future of skiing (Nordstrøm, 2019). A 2016 report from the Norwegian Climate Foundation (*Norsk Klimastiftelse*) argued that in Oslomarka, where over 200,000 people visit on any given winter weekend day with good conditions, poor conditions will have an enormous effect on many important aspects of people's lives (NK, 2016). It stated that the impacts of climate change on ice and snow are especially expected to affect health, but also national identity, as it risks people losing the feeling of belonging to something greater than themselves (NK, 2016).

2.2.5. Adaptations

While snow conditions in lower altitude areas, like some of those in Oslomarka, may be adversely affected, more mountainous regions and areas of higher altitudes may, for the time being, remain 'snow safe' (Hanssen-Bauer et al., 2017). The consequence is thus not a total loss of snow in Norway, but rather that certain areas, like Oslomarka, will be affected more than others. Outdoor recreation, which can be easily accessed from a city, may in turn become difficult to provide in wintertime, and it is then the people who have access to or can afford the ever-increasing prices of cabins in the ski communities further away who will secure ample opportunities to enjoy winter activities in nature (NK, 2016; Mikalsen, 2019).

To address this, cities like Oslo have adaptation approaches that are already underway, such as constructing indoor ski arenas and producing artificial snow (SINTEF, 2017; Nickel, 2020; Visit Oslo, 2020; Visit Norway, n.d.-d). The commodification of ice and snow have become a recent debate; where locals voice concerns over losing the ability to 'freely' and 'easily' access ski tracks and the winter landscape; that the use of indoor arenas is limited to people of wealthier economic backgrounds; and that artificial and indoor snow experiences do not provide the same desired connection with nature (Flatøy, 2019; Berglund, 2020; Fauche, 2020; Messel, 2020).

The predicted impacts of climate change on the winter landscape in South-Eastern Norway indicate that over time, fewer Norwegians may have the freedom to participate in winter activities like skiing and ice skating, that are truly in nature, and can uphold their cultural values (Berglund, 2020; Haugli & Brennevann, 2020; Messel, 2020).

There are thus many potential impacts that climate change creating a reduction in ice and snow will have on Oslomarka and the local people who use it, making it an important and highly relevant case for the purposes of this research.

3. Analytical Framework

3.1. Ecosystem services

The purpose of the ecosystem services (ES) framework is to generate a deeper understanding of the benefits that people obtain from functioning ecosystems²⁴, and how this in turn impacts human well-being (MEA, 2003; Costanza, 2016). Examples of ecosystem services include commodities like food and water, the regulation of soil erosion or flooding, and recreational benefits from natural spaces (Potschin & Haines-Young, 2016a; UKNEA, 2020).

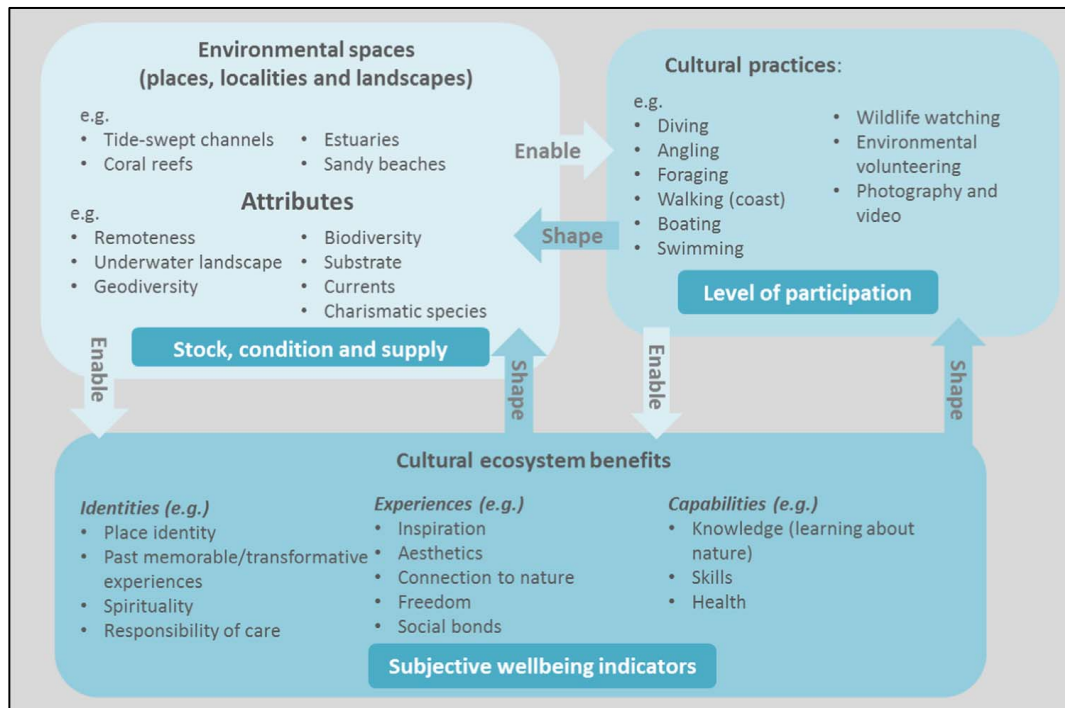
According to The Economics of Ecosystems and Biodiversity (TEEB), ES assessments have conventionally used two primary approaches: i) biophysical and ii) preference-based (Pascual et al., 2010) to capture the natural processes of ecosystems and their corresponding importance or value to people (Costanza, 2016; Gómez-Baggethun et al., 2016). Biophysical approaches determine the state and value of ecosystem services through measuring the ‘physical’ costs to maintain the environmental status and service, such as through energy or material flows (Pascual et al., 2010). Preference-based approaches often determine the state and value of ecosystem services through economic or monetary measurements, such as through human behaviour and subjective preferences (Pascual et al., 2010). Communicating nature’s benefits in biophysical and economic terms is done to allow for greater inclusion in decision-making, a better understanding of trade-offs, as well as to have an approach for lay-people to understand and protect these benefits (Kumar, 2010; Sukhdev, 2010; Díaz et al., 2015). Nevertheless, a growing body of literature has recognised the need to expand the available approaches to encompass those that can measure a variety of ways that humans benefit and derive meaning from their experiences with nature (Gómez-Baggethun et al., 2016; Arias-Arévalo, et al., 2018).

The focus of this thesis is on so-called ‘cultural ecosystem services’ (CES), the intangible or non-material benefits of the experiences and capabilities that emerge from people’s relationships with nature (Chan et al., 2011 in Chan & Satterfield, 2016). An example of a cultural ecosystem service is the mental health benefits a person receives from relaxing at the beach. To illustrate this further, Figure 2 demonstrates an example of a marine landscape (spaces) and its qualities (attributes), which give rise to cultural activities (practices), that in turn generate human well-being (benefits) through a variety of different factors like inspiration and health (Bryce et al., 2016).

²⁴ or natural capital

Figure 2

Cultural ecosystem services framework for recreational users of marine areas [as adapted from: UK NEA Follow-on CES framework in Church et al., 2014] (Source: Bryce et al., 2016).



While biophysical and economic measurements or quantification approaches have traditionally dominated the field, it is increasingly understood that CES are a crucial contribution to human well-being, with some scholars arguing that they may even hold the key to sustainable human-nature relationships (Chan et al., 2011 in Chan & Satterfield, 2016).

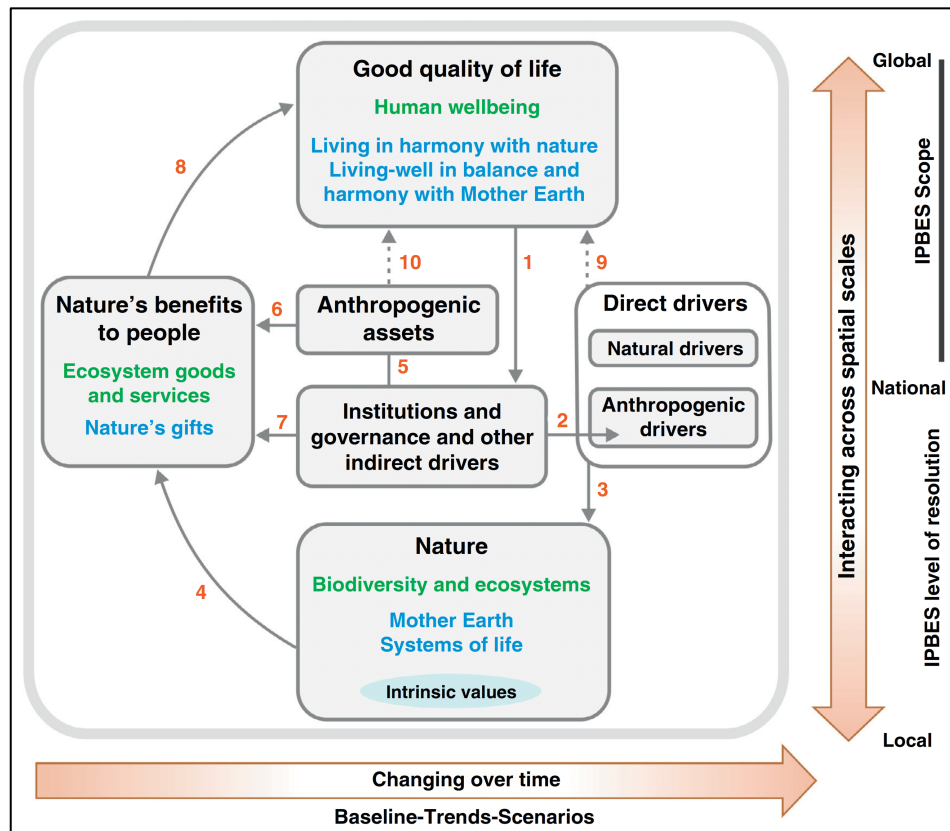
3.2. IPBES and nature’s contributions to people

In recent years, the field of ecosystem services has evolved towards new frameworks which encourage more inclusive language and approaches, the acknowledgement of a wider range of values and broader valuation methods, as well as the consideration of more diverse worldviews, like incorporating indigenous and local knowledge (Díaz et al., 2015; Christie et al., 2019; Kadykalo et al., 2019).

A key actor in this evolution is IPBES, who expanded upon ES with an adapted framework (Figure 3). The aim of IPBES is to improve current conservation practices and promote the sustainable use of nature to generate long-term human well-being (Díaz et al., 2015; Potschin & Haines-Young, 2016b). While in many ways it builds upon the ES framework, there is somewhat of a divergence in the concept very of ecosystem services, which was absorbed into ‘nature’s contributions to people’ (NCP) (Kadykalo et al., 2019).

Figure 3

IPBES Conceptual Framework (Source: Díaz et al., 2015).



While still seeking to understand and describe the complex relationships between people and nature, NCP allows for a perspective of both positive and negative experiences from nature, rather than just benefits, and are thus defined as “all the positive contributions, or benefits, and occasionally negative contributions, losses or detriments, that people obtain from nature” (Pascual et al., 2017).

NCP are divided into three main categories, which are not necessarily mutually exclusive: i) ‘Regulation of Environmental Processes’: such as habitat creation and regulation of air quality or climate; ii) ‘Materials and Assistance’: such as energy and food; and iii) ‘Non-Material’: such as through learning and inspiration (Díaz et al., 2019). There is also a fourth ‘meta’-category called ‘Maintenance of Options’, which encompasses the maintenance of all the above categories for future use and generations (Díaz et al., 2018; Díaz et al., 2019).

3.3. Nature’s non-material contributions to people

This study focuses on the third category, non-material contributions to people, which correspond closely to CES. Non-material NCP are described as the intangible elements of

nature which “underpins all dimensions of human health and contribute to non-material aspects of quality of life- inspiration and learning, physical and psychological experiences, and supporting identities- that are central to quality of life and cultural integrity, even if their aggregated value is difficult to quantify” (Díaz et al., 2019:3).

Nature’s non-material contributions are thus divided into three sub-categories, called domains: i) ‘Learning and Inspiration’; ii) ‘Physical and Psychological Experiences’; and iii) ‘Supporting Identities’. Each of these domains cover different aspects of “nature’s contributions to people’s subjective or psychological quality of life, individually and collectively” (Díaz et al., 2019:40). This closely corresponds to the ES approaches which also divide CES into three domains: capabilities, experiences, and identities (see Church et al., 2014; Bryce et al., 2016; Fish et al., 2016).

According to Díaz et al. (2018), ‘Learning and Inspiration’ entails opportunities for developing capabilities which allow people and communities to prosper through gaining knowledge, developing skills, and through generating inspiration. ‘Physical and Psychological Experiences’ entails opportunities for both mental and physical activities such as those that generate health and happiness, aesthetic enjoyment, as well as the social experiences produced by nature. Finally, ‘Supporting Identities’ entails the basis for spiritual, religious, and otherwise significant individual or collective experiences, such as through creating memories, a sense of place, cultural belonging, and spiritual connection (Díaz et al., 2018).

These three domains are broad, in that they cover a wide range of very diverse contributions (Díaz et al., 2018). With the aim of providing a deeper analytical framework to understand the diverse experiences possible in Oslomarka, this study has used the descriptions of the three domains from Díaz et al. (2018) above, alongside indicators from Bryce et al. (2016) (Figure 2) to divide the domains further into ‘sub-domains’ (Table 1).

This combined approach was done for two reasons. First, while ES is more likely to be used in quantitative research, and NCP in qualitative (Pires et al., 2020), Bryce et al. (2016) recognised that the quantitative CES subjective well-being indicators they developed could be adapted to the qualitative exploration of local socio-cultural contexts (Bryce et al., 2016). Second, scholars are increasingly acknowledging that rather than emphasising the conflicts and differences between ES and NCP, it may be possible to use them complementarily (Pires et al., 2020).

Table 1

Sub-domains linked to their corresponding NCP domains, with keyword examples (Source: own elaboration of CES indicators from Bryce et al. (2016) using NCP descriptions from Díaz et al. (2018)).

| NCP Domain | Sub-Domain | Sample Keywords |
|-----------------------------------------------|-------------------------------------|-----------------------------------------------------------------------------|
| Learning and Inspiration | Inspiration | <i>vision, ideas, clarity, art, collecting thoughts, motivation</i> |
| | Knowledge | <i>learning, storytelling, sharing information, gaining knowledge</i> |
| | Skills | <i>challenge, mastery, accomplishment, abilities, discipline</i> |
| Physical and Psychological Experiences | Health | <i>recreation, feelings, emotions, moods, activities, exercise</i> |
| | Aesthetics | <i>silence, beauty, sounds, sights, observations</i> |
| | Connection to Nature | <i>nature, nature experiences, conditions of nature</i> |
| | Responsibility to Care | <i>protection or concern for nature, concern for future generations</i> |
| | Freedom | <i>access, opportunities, fortune, appreciation, privilege, possibility</i> |
| | Social Bonds | <i>other people, shared experiences, relationships, community</i> |
| Supporting Identities | Place Identity | <i>Norwegian culture, icons, landmarks, language, and traditions</i> |
| | Transformative Personal Experiences | <i>nostalgia, drastic changes, special meaning, memories</i> |
| | Spirituality | <i>connection, escape, meditation, harmony, religion, existence</i> |

Thus for the analytical framework of this study, the three domains of the non-material category of NCP are divided further into sub-domains as follows: the domain ‘Learning and Inspiration’ entails the opportunities for developing capabilities that allow people to prosper, through creating inspiration (‘Inspiration’); gaining of knowledge (‘Knowledge’); and developing skills (‘Skills’). The domain ‘Physical and Psychological Experiences’ entails experiences such as activities to pursue health and happiness (‘Health’); aesthetic enjoyment from nature (‘Aesthetics’); experience and engagement with nature (‘Connection to Nature’); the concern for the quality of nature or ability of future generations to experience it (‘Responsibility to Care’); one’s ability to access nature and partake in desired experiences (‘Freedom’); and the ability to engage with others and have social experiences (‘Social Bonds’). The domain ‘Supporting Identities’ entails opportunities that form the basis of a sense of place and cultural belonging (‘Place Identity’); meaningful or transformative experiences, such as through the creating of memories (‘Transformative Personal Experiences’); and spiritual connections, or religious experiences (‘Spirituality’).

3.4. Assessing nature's non-material contributions to people

To assess the presence and value of non-material NCP, a variety of approaches can be used. This is because, from principles to preferences, value can be understood in many ways (Kenter, 2016; Pascual et al., 2017). For this study, value is defined as the subjective worth, meaning, or importance of something (Díaz et al., 2014 in Gómez-Baggethun et al., 2016). To uncover value, any technique used needs to make three important considerations. First, determining value in regard to nature is, in itself, a contested action, especially when doing so through economic or monetary measures (Díaz et al 2015), as this is considered by some scholars as a driving force of unsustainable policies that are leading to nature's degradation (Vatn, 2015).

Second, assessments of value are imbued with philosophical underpinnings, and are influenced by how people understand the world. For example, Pascual et al. (2017) argue that understanding the diverse contributions present in nature requires techniques that acknowledge a variety of worldviews and allow people to express in unconventional ways how they ascribe value to nature and nature's impacts on their quality of life (Pascual et al., 2017; Chan et al., 2012 in Christie et al., 2019). Value pluralism is a solution which presents opportunities to cross different knowledge systems, bridge academic disciplines, and mobilise transdisciplinary collaboration (Pascual et al., 2017; Chan et al., 2012 in Christie et al., 2019).

Third, is that assessments which aim to elicit value can be highly sensitive to the method researchers use to determine it: the valuation approach that is chosen impacts the values that are subsequently highlighted (Kenter, 2016; Jacobs et al., 2018). Díaz et al. (2015) argue that approaches used for valuation need to fit with the value system that the stakeholders involved actually have, in that it must be able to accurately reflect plural values, interests, preferences, perceptions, ideas, and needs for the future (Díaz et al, 2015). Plural valuation thus increases the types of values that can be assessed, which necessarily means incorporating new methods of assessment (Kenter, 2016; Arias-Arévalo, et al., 2018).

An increasingly viable approach to uncovering plural values is so-called socio-cultural valuation, or non-monetary and deliberative approaches (de Groot et al., 2010; Kenter, 2016; Jacobs et al., 2012 in Christie et al., 2019). An example of socio-cultural techniques that are widely used are interpretive methods. Interpretive methods represent a group of assessment and valuation approaches such as media analysis, historical study, ethnographic or participant observation, and other discourse or text analyses (Kenter, 2016).

In the context of non-material NCP (and CES), interpretive methods fit well because they can uncover how people relate to their environments, and attribute meaning to different places (Kenter, 2016). Furthermore, NCP are increasingly understood as not merely present in nature, but as being co-created through people's relationships with nature (Fish et al., 2016; Díaz et al., 2019). Thus, to study these complex and dynamic relationships, and learn how people value them, this study explores the 'human experience' of nature.

Interpretive methods are considered advantageous for this kind of research because they can assess narratives, which explore the 'human experience' through a representation of it (such as a text or photo) (Salkind, 2010; Chan & Satterfield, 2016; Kenter, 2016), and thus a narrative-based approach was chosen for this study. Moreover, narratives can be an effective tool to integrate knowledge across different cultural perspectives, such as bridging indigenous and local knowledge with scientific information (Satterfield, 2001 in Pascual, 2017). The means by which narratives were collected for this study are elaborated on in the next chapter.

4. Methods and Materials

Using a context-specific (or place-based) approach, where contributions for a particular place are bundled together (Potschin & Haines-Young, 2016b; Kadykalo et al., 2019), this study examines which non-material NCP local people receive through ice and snow in Oslomarka, which are highly valued, and how climate change is expected to impact the contributions and the user's associated well-being.

4.1. Data collection

In order to collect the background data on ice and snow in Norway found in Chapter 2, a desk-based cultural history study was conducted, which used existing literature such as academic literature, creative writing, industry reports, and other relevant and reliable sources for historical analysis (Kenter, 2016). This analysis was supplemented by a media analysis, which used a review of newspaper articles from the last few decades in Norway and abroad (Kenter, 2016).

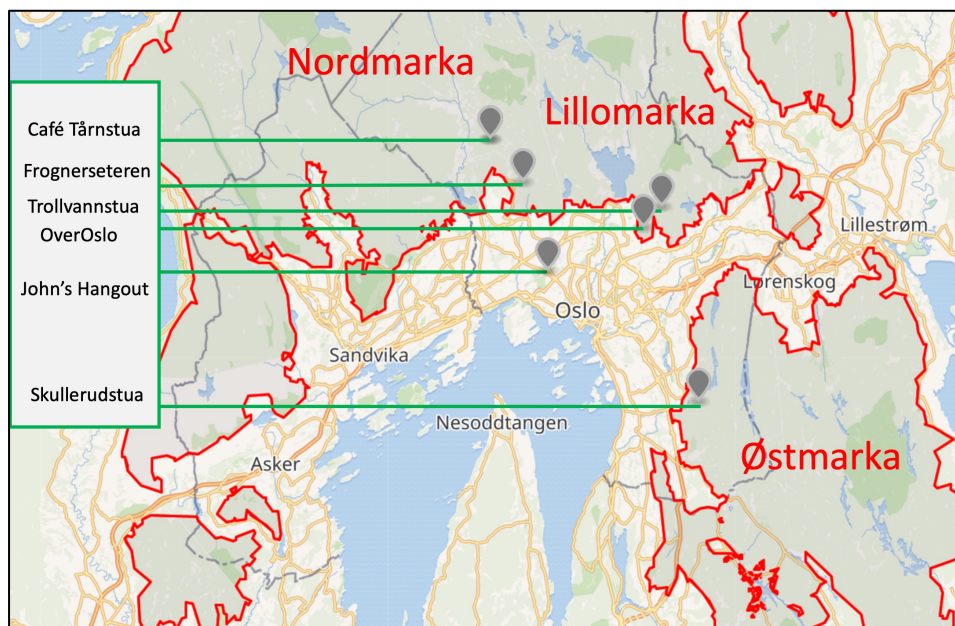
To answer our research questions, primary data was collected, and sampling was conducted among 132 informants in the Oslomarka area (including one site in the city of Oslo) of Norway during February and March 2020. Purposive sampling was used, as it allows for the strategic focus on a specific homogeneous characteristic (in this case being a 'user' of ice and snow) of

the population (Bryman, 2016). The criteria for participation was that people (henceforth referred to as ‘users’) must have experienced ice and/or snow within Oslomarka. A minimum degree of use was not established, meaning that regular, occasional, infrequent, or first-time users could participate. Furthermore, any kind of ‘experience’ within Oslomarka with ice and snow present was considered valid, whether it was direct interaction (e.g. out skiing) or indirect (e.g. inside at a lodge).

Six sampling sites in and near the study area were selected based on location, ability to access, space available, and permission granted (Figure 4). Three wilderness areas in Oslomarka, and one site in Oslo were chosen to maximise diversity of participants and variability in environmental factors (e.g. natural and artificial snow). Due to the public health crisis caused by the coronavirus pandemic in 2020, the sixth sample site in Østmarka could not be accessed.

Figure 4

Selected sites for sampling in Oslomarka (Adapted from: Wikimedia-kart Kartdata, OpenStreetMaps).



In total, a sample of 133 individuals was collected. The sample size for each of the sampling sites was as follows: Café Tårnstua ($n=8$), Frognerseteren ($n=22$), Trollvannstua ($n=11$), and OverOslo ($n=71$), located in Oslomarka, and John's Hangout ($n=20$), located in Oslo. The variation in sample size was primarily due to some sites being more conducive than others (e.g. easier to find participants or more space for participants to engage). Each prospective participant had the procedure and purpose of the study explained to them, and their oral consent was asked for before they could participate (NESH, 2016).

4.2. Experience maps

With the aim of using a socio-cultural valuation approach, and specifically the interpretive technique of narrative, this study employs a methodology for obtaining people's narratives called 'Experience mapping', that to our knowledge, has not been used before in the field of ecosystem services. It comes from the field of design and specifically from the 'user-centred' problem-solving process of 'design-thinking' (see Ferreira et al., 2015).

One method in design-thinking is a form of experience mapping called 'Empathy mapping'. Empathy mapping is a 'user-centred' approach in that it aims to understand the 'user's' perspective. Researchers who use this approach thus need a 'mindset capable of empathising' with their subjects (Brown, 2009 in Katoppoa & Sudradjatb, 2015:121). The Empathy map itself is a physical 'mind map', in that it functions as a tool to learn more about a person (actual or imagined) through their perspectives of given conditions. By uncovering what the person does, says, hears, sees, thinks, feels, gains, and pains in a given situation or experience (general or specific), researchers are able to identify problems through new angles and explore new perspectives and insight towards solutions (Ferreira et al., 2015).

We believe that such a tool is suitable for the field of ecosystem services, in that it can function to elicit the narratives necessary for identifying and valuing NCP. However, the map itself needed to be modified somewhat to answer our research questions using the IPBES Conceptual Framework and the non-material NCP domains and sub-domains of our analytical framework. The final product was a physical A3 paper that contained a modified map, henceforth referred to as 'Experience Maps' or 'Maps' to distinguish from the original Empathy Map. Experience Maps were made available to participants in both English and Norwegian (see Appendix 2)

Rather than using an oral interview or survey, the motivation for using this method was to test if it could allow for deep insight into the participant's experience, as well as flexibility for participants to describe their experience on their own time and in their own language or way. It was additionally aimed at making our study more accessible to a wider range of participants in order to promote a variety of local perspectives and encourage people of diverse backgrounds, educations, and ages to participate.

Ultimately, our primary data was collected at the five sampling sites in Oslo and Osloomarka through the use of these Experience Maps to elicit a user's narrative. Since the users themselves

described from their own perspective their experience of ice and snow, each completed Experience Map is a personal narrative and representation of the user's experience with nature.

The Experience Map is organised in four parts, each one including a task for participants. Task #1 (Experience Descriptions) is aimed at allowing users to describe their experience. Users were thus asked to respond to the prompt: 'When enjoying the ice and snow in Oslomarka, I...' according to certain conditions (do, say, hear, see, think, feel, gain, and pain) through drawings, words, or other descriptions that shared their subjective experience of the situation and place. Additional sub-questions were added for clarity under each condition. For example, one might not normally 'enjoy' pain, so this was clarified through the sub-questions, 'What do I feel is negative about these experiences or place? What are my frustrations about it?'

Task #2 (Highly Valued Experiences) is aimed at determining which experiences or parts of the experience are valuable. Users were thus asked to circle items from Task #1 that were of strong importance or highly valued to them. Task #3 (Experiences Impacted by Climate Change) is aimed at uncovering which experiences users expect to be impacted by climate change, and how. Users were thus given a climate scenario of: 'The Norwegian Environmental Agency estimates that within the next 80 years, Oslomarka will have between 1 and 4 fewer months of snow, and rainfall may increase up to 18%' and asked to describe which experiences listed (or not) in Task #1 they expect to be affected and in which ways.

Finally, Task #4 (Expected Quality of Life Change) is aimed at allowing the user to put the impacts that climate change may have on ice and snow into a broader personal context in relation to their quality of life. Participants were thus asked to rank on a qualitative Likert scale how they feel having less ice and snow in Oslomarka might affect their quality of life overall. Beginning on the left-hand side, -5 signified a significant decrease in quality of life. The scale then counted in integers to the right-hand side up to 0, signifying no affect in quality of life, and then up to +5, signifying a significant increase in quality of life.

The wording on the maps was carefully selected. Because it is considered to be a politically laden concept, references to 'climate change' were removed in order to avoid perceived bias based on political views. Technical terms like 'ecosystem services' and 'nature's contributions to people' were also avoided to prevent confusion and to let informants express their experiences in their own terms.

4.3. Data analysis

The subsequent data analysis of the Maps involved three main steps: i) transcription, ii) coding, and iii) evaluation. The first step was to transcribe the user's narratives on the physical Maps into the Excel program. The precise wording was copied from the original Map (including original language) and a separation was made between each determined thought, statement, or sentence (henceforth referred to as 'narrative themes' or 'themes'). This was done interpretively by the researchers. As only 21 of the 133 individual narratives were written in English, it was necessary to also translate the original Norwegian wording to English, to make transparent precisely how concepts or words were understood. One user, who had written that they did not understand the tasks, was removed from the sample, making the final size of the sample $n=132$.

The second step was coding. Every narrative was coded using sub-domains, each of which had a corresponding domain, as shown in Table 1. Coding was done interpretively, based on the descriptions in Díaz et al. (2018) (for the full Codebook with descriptions, main keywords, and interpretations, see Appendix 3). For example, if a user wrote 'ice skating', this would be coded with the sub-domain of 'health'. The corresponding domain of 'physical and psychological experiences' was automatically linked whenever 'health' was selected. The link from sub-domain to domain was determined *a priori* and interpretively, also based on the descriptions in Díaz et al. (2018).

While the sub-domains themselves are mutually exclusive, in that they each represent distinct and separate factors, some themes were coded with more than one sub-domain. For example, if the user had written 'ice skating with friends in Sognsvann'²⁵, this would be coded with 'health-physical and psychological experiences' (for the theme of: ice skating), 'social bonds- physical and psychological experiences' (for the theme of: friends), and 'place identity- supporting identities' (for the theme of: Sognsvann). An illustration of this narrative example and sample coding approach is shown on the next page in Table 2.

The final step was then to evaluate the coded narratives through calculation. An important factor that is relevant for all coded tasks (#1, #2, and #3), was that any single mention of a sub-domain marked its presence and further duplicates were removed. It was therefore not the total number of *times* a sub-domain was mentioned per narrative but whether or not it was *present* in the

²⁵ an iconic lake in Osloomarka

narrative (e.g. existence, not amount). Using the example from Table 2, the narrative ‘ice skating and relaxing with friends in Sognsvann’ would only count health once, as being present at all, and not twice, as the number of times actually mentioned.

Table 2

Example of how narratives were coded using sub-domains and linked domains, and how duplicates were removed.

| Original Narrative | Theme | Sub-Domain | Domain |
|-------------------------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>‘ice skating’</i> | <i>ice skating-</i> | Health- | Physical and Psychological Experiences |
| <i>‘ice skating with friends’</i> | <i>ice skating- with friends-</i> | Health- Social Bonds- | Physical and Psychological Experiences Physical and Psychological Experiences |
| <i>‘ice skating with friends at Sognsvann’</i> | <i>ice skating- with friends- at Sognsvann-</i> | Health- Social Bonds- Place identity- | Physical and Psychological Experiences Physical and Psychological Experiences Supporting Identities |
| <i>‘ice skating and relaxing with friends at Sognsvann’</i> | <i>ice skating- and relaxing- with friends- at Sognsvann-</i> | Health- Health- Social Bonds- Place identity- | Physical and Psychological Experiences Physical and Psychological Experiences Physical and Psychological Experiences Supporting Identities |

This was done the same when evaluating the domain. From the example above in Table 2, for the narrative ‘ice skating with friends’, while the two sub-domains of ‘Health’ and ‘Social Bonds’ are both present, only one ‘physical and psychological experiences’ would be counted, since any additional ‘physical and psychological experiences’ would be removed as a duplicate using our approach to evaluation (this is shown with strike-throughs for all statements in Table 2). The consequences for this and the limitations it poses are expanded on in Chapter 4.4. Ultimately, for the evaluation of all coded data (#1, #2, and #3), it was the percentage of sub-domains and overarching domains present in the sample that was calculated.

With this in mind, Experience Map’s Task #1 (Experience Descriptions), from the combined do, say, hear, see, think, feel, gain, and pain sections, was evaluated by calculating the percentage of each sub-domain and domain present in the sample ($n=132$). For example, 89 maps identified the sub-domain of ‘Place Identity’ at least once, representing 67% of the sample. To assess the corresponding domain however, 123 maps identified at least one of the

three sub-domains within the ‘Supporting Identities’ domain (‘Place Identity’, ‘Transformative Personal Experiences’, or ‘Spirituality’) representing 93% of the sample.

Task #2 (Highly Valued Experiences) was also evaluated by calculating the percentage of informants mentioning each sub-domain and domain ($n=89$). However, Task #2 was evaluated using a different sample size due to the fact that many users did not select valuable experiences. The reason why users did not make selections is unknown. It could be interpreted as a consideration that nothing was of value, everything was of value, or nothing was more valuable than others (Sukhdev, 2010). To avoid making assumptions, only those who made selections were considered in the analysis ($n=89$). For example, for Task #2, 24 maps selected the sub-domain of ‘Place Identity’ at least once, representing 27% of the sample. To assess the corresponding domain however, 52 maps selected at least one of the three sub-domains within the ‘Supporting Identities’ domain (‘Place Identity’, ‘Transformative Personal Experiences’, or ‘Spirituality’), representing 58% of the sample.

Task #3 (Experiences Impacted by Climate Change) was also evaluated by calculating the percentage of each sub-domain and domain present in the total sample ($n=132$). For example, For Task #3, 60 maps described the sub-domain of ‘Place Identity’ at least once, representing 45% of the sample. To assess the corresponding domain however, 91 maps described at least one of the three sub-domains within the ‘Supporting Identities’ domain (‘Place Identity’, ‘Transformative Personal Experiences’, or ‘Spirituality’), representing 69% of the sample.

Finally, Task #4 (Expected Quality of Life Change) was evaluated by calculating the average and median numbers selected on the Likert scale of -5 to +5 for the sample ($n=132$). The average and median numbers were calculated both for the total sample, and per site. The average and median were assessed per site only to indicate potential discrepancies in the data, and to make transparent the differences between sites in relation to the total sample.

4.4. Limitations

There are several important limitations that were identified in the methodology used for this study. First, the use of a new methodology has presented certain advantages and disadvantages in the context of our study. It has allowed the researchers to overcome the initial language barriers that may have been present when working in languages other than their native ones. It also allowed the researchers to gain data from multiple people at one time. Disadvantages

primarily included the physical nature of the Maps. In winter conditions especially, sample sites were required to be at an indoor establishment that was willing to allow for the approach of their clientele, as well as sufficient table-top space for participants to fill them out. This means there is a possible bias in the sample. For example, users who frequently visit Oslomarka for only an hour or so after work, and then return home without stopping in such an establishment, would not have been consulted; or more direct users, who would be out experiencing the ice and snow and not in the establishment, would not be consulted though their family member in the lodge who is waiting would be.

Additionally, in data collection, Task #1 was phrased as: ‘When enjoying the ice and snow in Oslomarka, I...’ in order to elicit narratives not just of direct, but also indirect use. In hindsight however, we observed that this should have been phrased as “when experiencing” as it is less value-laden and prone to positive-experience bias.

In data analysis, when transcribing and translating between languages, deciphering handwriting and interpreting drawings, some nuances of the narrative may have been lost. Determining separate narrative themes also required interpretation by the researchers, and the interpretations have likely impacted the data results. To address this, we recognised that while the number of times a sub-domain is mentioned in the total sample can be an indicator of salience/importance, we chose a data analysis method that examined instead the existence/presence of the sub-domain. As Task #2 (Highly Valued Experiences) was explicitly created to address salience, analysing the presence of sub-domains and domains was primarily done to reduce the sensitivity of the data set to the individual demarcations between different themes done by the researchers. Moreover, it could not be demonstrated that more writing on the Maps even indicated saliency.

For example, if a participant listed ten activities coded as ‘Health’, and another user listed one activity coded as ‘Spirituality’, if counting the total times instead of presence, ‘Health’ would overshadow ‘Spirituality’ significantly. However, given the contexts at sampling sites, where some participants had more time and some were more enthusiastic to participate, the researchers could not substantiate a claim that the ten health codes in the example would be more salient than the single ‘Spirituality’. Thus, analysing the presence of domains and sub-domains also reduced the likelihood that a participant writing more would have a ‘greater voice’ than one writing less, and the risk of introducing a bias where sub-domains were weighted based on the descriptiveness of a user’s narrative rather than actual salience.

In addition, it is important to highlight that our study was context-specific, and as such, results cannot necessarily be extrapolated to other locations (Kadykalo et al., 2019).

Finally, while the researchers made an effort to approach a wide range of genders and ages, and select sites that spanned across the region, the Experience Maps alone did not collect socio-economic data on these factors or others (income, background, education, etc.). Without this information, it is impossible to know the true representativeness of the sample or provide additional insight on the participants.

5. Results

The results of the study are shown on the next pages in Table 3 and Table 4.

Table 3

Results for Task #1, #2, and #3 for the percentage of the sample that mentioned each sub-domain and the corresponding NCP domain.




| NCP Domain | Sub-Domain | Task #1: Experience Descriptions (n=132) | Task #2: Highly Valued Experiences (n=89) | Task #3: Experiences Impacted by Climate Change (n=132) |
|-------------------------------------------------------------------------------------|-------------------------------------|---------------------------------------------|----------------------------------------------|---------------------------------------------------------------|
| Learning and Inspiration | | 72% | 33% | 14% |
|  | Inspiration | 47% | 22% | 5% |
| | Knowledge | 9% | 1% | 2% |
| | Skills | 49% | 17% | 11% |
| Physical and Psychological Experiences | | 100% | 98% | 97% |
|  | Health | 100% | 90% | 92% |
| | Aesthetics | 92% | 44% | 29% |
| | Connection to Nature | 98% | 60% | 78% |
| | Responsibility to Care | 27% | 8% | 30% |
| | Freedom | 50% | 22% | 40% |
| | Social Bonds | 83% | 30% | 13% |
| Supporting Identities | | 93% | 58% | 69% |
|  | Place Identity | 67% | 27% | 45% |
| | Transformative Personal Experiences | 83% | 38% | 44% |
| | Spirituality | 43% | 22% | 9% |

Table 4

Results for Task #4 for the average and median expected change in quality of life grouped by sampling site.

| Sample Site (<i>n</i>) | Task #4: Expected Quality of Life Change (average) | Task #4: Expected Quality of Life Change (median) |
|--------------------------------|----------------------------------------------------|---------------------------------------------------|
| Total (<i>n</i>=132) | -2,75 | -3 |
| Café Tårnstua (<i>n</i> =8) | -2,62 | -3 |
| Frognerseteren (<i>n</i> =22) | -2,43 | -3 |
| Trollvannstua (<i>n</i> =11) | -2,27 | -2 |
| OverOslo (<i>n</i> =71) | -2,89 | -3 |
| John's Hangout (<i>n</i> =20) | -2,93 | -3 |

5.1. Ice and snow's contributions to people in Oslomarka

In relation to the first research question: *What contributions does nature provide to local users through ice and snow?* Task #1 (Experience Descriptions) revealed that all three NCP domains are present in Oslomarka as identified by over half of the users in the sample: 'Learning and Inspiration' (mentioned by 72% of informants), 'Physical and Psychological Experiences' (by 100%), and 'Supporting Identities' (by 93%). Furthermore, seven of the twelve sub-domains were identified by at least half of the sample: 'Health' (100%), 'Connection to Nature' (98%), 'Aesthetics' (92%), 'Social Bonds' (83%), 'Transformative Personal Experiences' (83%), 'Place Identity' (67%), and 'Freedom' (50%). Importantly, the findings in Table 3 are characterised by a variation between sub-domains. For example, the sub-domains comprising 'Physical and Psychological Experiences' demonstrated a high degree of variation, in that 100% of users identified the 'Health' sub-domain, then 50% of users identified the 'Freedom' sub-domain, but only 27% of users identified the 'Responsibility to Care' sub-domain.

5.2. Highly valued contributions from ice and snow in Oslomarka

Regarding the second research question: *Which contributions are most highly valued by local users?* While all the NCP domains were identified as present in Oslomarka, Task #2 (Highly

Valued Experiences) revealed that just two domains were selected by at least half of users as highly valued: 'Physical and Psychological Experiences' (by 98%) and 'Supporting Identities' (by 58%). Moreover, only two of the twelve sub-domains were selected by half or more of users: 'Health' (90%) and 'Connection to Nature' (60%). The results indicate that users were more selective when valuing themes than identifying them. In addition, the Task #2 (Highly Valued Experiences) results are also characterised by variation between sub-domains.

Three important considerations should be given to the results for Task #2. First, only 67% of the informants selected valuable themes and the reduced sample size risks it being less representative. Second, because the selections were made by circling themes from Task #1, users could not include additional themes if they were not already on the Map. Finally, given that participants made selections by circling and not ranking, it is impossible to know the subjective thresholds users had for determining what was of value or not; if the same user circled one theme that was of more value than another they circled; or how one user's value selections compared to other users.

5.3. Impacts from climate change on ice and snow's contributions in Oslomarka

To answer the third and final research question: *How do local users expect climate change to impact these contributions and how will these changes affect their quality of life?* Task #3 (Experiences Impacted by Climate Change) revealed that at least half of the users in the sample expect that two of the three NCP domains will be impacted by climate change: 'Physical and Psychological Experiences' (by 97%) and 'Supporting Identities' (by 69%). Two sub-domains are expected by at least half of users to be impacted: 'Health' (92%) and 'Connection to Nature' (78%). In addition, Task #3 is also characterised by a high degree of variation between sub-domains.

Furthermore, Task #4 (Expected Quality of Life Change) revealed that users perceive that the impacts of climate change on ice and snow will cause a considerable reduction in their quality of life: with an average of -2,75 and a median of -3. The findings in Table 4 demonstrate that for Task #4, while the sample sizes varied significantly between sites, the average and median rankings exhibit a low degree of variation. For example, the John's Hangout ($n=20$) site has the highest average of -2,93, while the Trollvanstua ($n=11$) was lowest at -2,27. Trollvanstua ($n=11$) was also the only site that deviated from a median of -3, with a median -2.

6. Discussion

6.1. Key findings

There are several key findings from our study. For Task #1 (Experience Descriptions), over half of the sample of users identified seven of the twelve sub-domains, corresponding to all three NCP domains. The results indicate that users see Oslomarka as a plentiful winter landscape, where ice and snow provide a very wide range of non-material contributions.

The seven identified contributions identified by the informants are consistent with previous research that characterises Oslomarka as a place with a high degree of interaction and meaning (Christophersen & Svennson, 1984; Sælen & Ericson, 2013; NK, 2016; Nordstrøm, 2019; WWF, 2019b). For example, ‘Health’ was mentioned by the highest percentage of the sample across all tasks, with many users listing activities like skiing, ice skating, and sledding, as well as emotions like calm, relaxation, and joy. Our results for Oslomarka lend support to the research from the World Wildlife Fund’s national survey and the Climate Foundation’s report, both of which argued that winter landscapes contribute to people’s health (NK, 2016; WWF, 2019a).

Moreover, our results lend support to the claim that the cultural value of nearness to nature still applies in the cold and dark winter months, with the ‘Connection to Nature’ sub-domain consistently mentioned by the second highest percentage of the sample across all tasks. ‘Connection to Nature’ was often mentioned alongside the sub-domain ‘Aesthetics’ with rich descriptions of beautiful snow-covered landscapes and of a stillness broken only by the falling of snow from trees, the chirping of birds, or the snow crunching underfoot. In fact, though the World Wildlife Fund’s survey respondents ranked ‘winter’ as the aspect of Norwegian life that they are the fifth most afraid of losing due to climate change (WWF, 2019b), the many narrative descriptions from our study (e.g. the ‘Aesthetic’ and ‘Connection to Nature’ sub-domains) also portrayed the four aspects in their study ranked before winter; intact nature, silence, free-flowing water, and starry skies (WWF, 2019b). This suggests that the contributions identified from the World Wildlife Fund’s survey are also present in wintertime in Oslomarka.

Additionally, the sub-domain ‘Transformative Personal Experiences’, which included descriptions of perfect moments, new experiences, and childhood memories, was also mentioned by a high percentage of users. This was often in connection to the ‘Social Bonds’ sub-domain, with descriptions of families around the campfire grilling hotdogs, family

traditions such as at Christmas or Easter time, or attending cultural events with friends. This is supported by other studies indicating a high level of engagement by Norwegians at events like the Holmenkollen Ski Festival (Christophersen & Svennson, 1984; NTB, 2017).

The sub-domain 'Place Identity' was also identified by a high percentage of the sample. This is logical given the prevalence of important built landmarks in the region like Holmenkollen Ski Arena, and natural landmarks like well-known lakes and wilderness areas (see Christophersen & Svennson, 1984). In addition, the proximity to Oslo meant an important dichotomy was often described, where users can switch between city-life and nature-experiences. 'Place Identity' was also the most closely linked sub-domain to national identity or Norwegian culture, which confirmed the claim that Oslo residents could surround themselves with "snow for a few hours to confirm that they are Norwegian" (Eriksen, 1996). This was often connected to the sub-domain 'Freedom', with descriptions of gratitude at the ability to freely and easily access Oslomarka from Oslo and surrounding areas.

In regard to Task #2 (Highly Valued Experiences) and Task #3 (Experiences Impacted by Climate Change), it is interesting that they were so similar: it is the same two domains 'Physical and Psychological Experiences' and 'Supporting Identities' and sub-domains of 'Health' and 'Connection to Nature', which are both highly valued by users and expected to be impacted by climate change. What is significant about this finding is that it suggests a correlation where users perceive that their ability to enjoy the many contributions from nature, and in particular the most highly valued contributions, will be affected by climate change. This confirms results from other studies which have suggested that climate change is threatening the valuable contributions from nature that people receive from ice and snow in Oslomarka and Norway in general (Sælen & Ericson, 2013; NK, 2016; Nordstrøm, 2019; WWF, 2019b).

Importantly, in combination with the findings from Task #4 (Expected Quality of Life Change), such a correlation is not a mere observation: the effects of climate change are also expected to have negative consequences for the local people who will experience them. Our results further support the claim in the World Wildlife Fund's national survey that winter landscapes contributed to people's overall quality of life (WWF, 2019a), as our results show that users expect the impacts of climate change on ice and snow to produce a clear and considerable reduction in their quality of life.

6.2. Reflections and recommendations

In Chapter 2, we identified that climate change is predicted to have biophysical consequences on the ice and snow in Oslomarka, and through our study, we have provided another perspective on these consequences, with findings of socio-cultural impacts as well. We have thus found that having multiple, or plural perspectives, provides a holistic picture of local impacts and may indeed be a necessary one if decision makers are to sustainably protect the vital contributions that ecosystems provide to people and the planet (Fish, 2011 in Bryce et al., 2016). Moreover, this study was conducted through the complementary use of indicators from CES, adapted as sub-domains to support NCP domains. Our research indicates that it is not only possible to bridge CES and NCP (Pires et al., 2020), but it deepened the study by allowing us a closer examination of the non-material NCP category and the broad domains within (Díaz et al., 2018).

Furthermore, we found the use of an interpretive, narrative-based approach, paired with a methodology adapted from a different discipline to be, though not without challenges, a compelling technique to elicit non-material NCP in Oslomarka, and an interesting approach to bridging disciplines to incorporate the plural values of local people (Pascual et al., 2017). In addition, we received very positive feedback from nearly all respondents, who felt the Maps were fun to fill out and sparked interesting discussions and debates. We experienced the use of the Maps as an enriching methodological process, in which we could both gain and give information. Nevertheless, there are several important reflections we have made.

First, the results for Task #1 (Experience Descriptions) were closely linked to which aspect of the experience was being described. For example, the sub-domain ‘Spirituality’ was identified by 4% and 2% of users for the (combined) sections of ‘Do & Say’, and ‘Hear & See’, respectively, but by 39% for ‘Think, Feel, Gain, & Pain’. Additionally, the sub-domain ‘Health’, which was identified by only 19% for the ‘Hear & See’ sections, but by 99% and 95% for the ‘Do & Say’, and ‘Think, Feel, Gain, & Pain’ sections, respectively. Except for ‘Knowledge’, strong variations such as these were visible across every sub-domain. This indicated that a user’s mentioning of different sub-domains was strongly dependant on which aspect of the experience they were reflecting upon.

This follows a logical progression, as illustrated with the ‘Aesthetics’ sub-domain, which was identified by 83% of users for the ‘Hear & See’ sections, which allows participants to reflect in a highly sensory way. In contrast, the ‘Do & Say’ sections lend themselves to a physical

(external) reflection, and ‘Think, Feel, Gain, & Pain’ lend themselves to a mental (internal) reflection, and both were identified by only 36% of users for ‘Aesthetics’. As described above, the ‘Health’ sub-domain demonstrates this as well, but in reverse.

In one way, this may affirm the process of the Experience Map as being used to gauge a wide range of aspects of the experience. In Chapter 3, we acknowledged that the method used for valuation should fit with the value system of the stakeholders who are involved- that it needs to be able to reflect their preferences and perceptions (Díaz et al, 2015). However, we also acknowledged that assessments of value are very sensitive to which method researchers use to elicit it (Kenter, 2016). Thus in another way, such section-specific reflections on the Experience Maps may instead refute its process: e.g. when a participant is describing their experience under the ‘Hear & See’ sections, the Experience Map may not just *allow* participants to reflect in a highly sensory way, but *require* them to in order to complete the task.

While the Experience Map methodology functioned independently in this study, it may be possible to address the concerns above through integration with other methods. It is thus recommended that a follow-up study, ideally using a wider sample as well, be conducted in the same study area of Osloomarka using a quantitative method to see if it would corroborate our findings. Alternatively, another study could be conducted entirely, using a mixed methods approach.

We also recommend that research using the Maps be carried out in other environmental contexts (e.g. coastal, wetlands) and regions (e.g. other parts of Norway or other countries), either alone or integrated with other methods, to determine their limitations. This will aid in determining the extent to which the Experience Maps may function as a useful tool for the field of ecosystem services on a more regular basis.

Furthermore, in our study, the wording for all tasks on the Experience Map prompted users to primarily consider their *own* perspective, though not explicitly disabling the perspective of future generations and other people. Still, the sub-domain corresponding to future generations, ‘Responsibility to Care’, was nevertheless described by 30% of users for Task #3 (Experiences Impacted by Climate Change). Due to the lack of prompting, this sub-domain was included for analysis within the ‘Physical and Psychological Experiences’ domain.

However, in addition to the non-material NCP category used in this study, IPBES also has a meta-category of NCP, ‘Maintenance of Options’, which addresses the ability of future generations to experience nature’s contributions (Díaz et al., 2018; Díaz et al., 2019). It is thus recommended that a second follow-up study be carried out where this meta-category is separated: users should be explicitly prompted to consider future generations and the wider community/culture perspective as *separate* from their own for all of the tasks. Findings from an explicit study with dual perspectives such as this may reveal different results for the people who experience and value ‘Responsibility to Care’ as well as other sub-domains in Oslomarka.

Finally, it is important to note that this study has been exploratory rather than prescriptive. However, the concepts of ES and NCP seek not only to assess, but also build on such information, in order to incorporate scientific knowledge into policy making (Díaz et al., 2015) and improve the conservation of nature and biodiversity. As this study is context-specific, the findings themselves cannot be extrapolated to other locations. Nevertheless, given that our results support other research from Norway, which suggest that the valuable contributions from ice and snow are being threatened by climate change, a third follow-up study is recommended.

Specifically, it is recommended that current and predicted climate policies in Norway, as well as internationally, be assessed to determine if their outcomes can be expected to protect the important contributions Norwegians receive from ice and snow. If not, specific pathways could be charted to address this, for example, using a mix of quantitative modelling of climate scenarios alongside qualitative scenario and well-being assessments, such as those employed in this study. Such insight may provide a clearer understanding of if the current Norwegian legislation, such as the Act of Nature Areas in Oslo and Nearby Municipalities, will indeed protect the contributions local people receive from ice and snow, both for this generation and for future generations to come (Markaloven, 2009:§1).

7. Conclusion

The cryosphere provides vital contributions to both people and planet, but the ecosystems the cryosphere includes are now being threatened by climate change. As an Arctic nation, Norway’s landscape, nature, and people have been historically shaped by ice and snow, but the future of ice and snow, and the associated contributions to people, is now uncertain. Our study has aimed to address a knowledge gap in the connection between the contributions that people receive

from ice and snow and how climate change may affect these contributions as well as the associated well-being that people may gain from them.

Our research has provided insight into what changes are predicted for the cryosphere due to climate change in the peri-urban forest of Oslomarka, in the South-Eastern region of Norway, and how local users expect to be subsequently impacted. We uncovered that users of ice and snow see Oslomarka as a rich winter landscape, where ice and snow provide a wide range of contributions to people through learning and inspiration, physical and psychological experiences, and supporting identities. Using in-depth criteria to understand experiences more thoroughly, we found that nature's contributions to people through ice and snow are in the form of health, connection to nature, aesthetics, social bonds, transformative personal experiences, place identity, and freedom. Of these contributions present from ice and snow in Oslomarka, the contributions that are most highly valued are physical and psychological experiences and supporting identities, and specifically those in the form of health and connection to nature.

Moreover, users expect the impacts of climate change on ice and snow to affect contributions to physical and psychological experiences and supporting identities, and expect contributions in the form of health and connection to nature to be impacted most. In terms of how these changes will affect the local people's quality of life, on scale of -5 (significantly decrease it) to 5 (significantly increase it) the average was a decrease of -2,75, indicating that climate change is expected to cause a considerable reduction in the quality of life for users.

Our findings are significant because they suggest a correlation in which it is the same contributions from ice and snow that users identify, highly value, and additionally describe as being threatened by climate change, and that these changes are expected to reduce the average user's quality of life considerably. Our results for the Oslomarka region support other research across Norway which argues that ice and snow provide important opportunities for locals to improve their health and be near to nature during the dark and cold conditions of wintertime.

Given that users perceive some winter contributions as both valuable and at risk of being negatively affected by climate change, we have made several recommendations. Most notably, we encourage a follow-up study in the form of a policy review, in which the outcomes of current and expected climate policies in Norway and internationally are assessed to learn if such experiences will be preserved, or if new policies need to be negotiated before it is too late.

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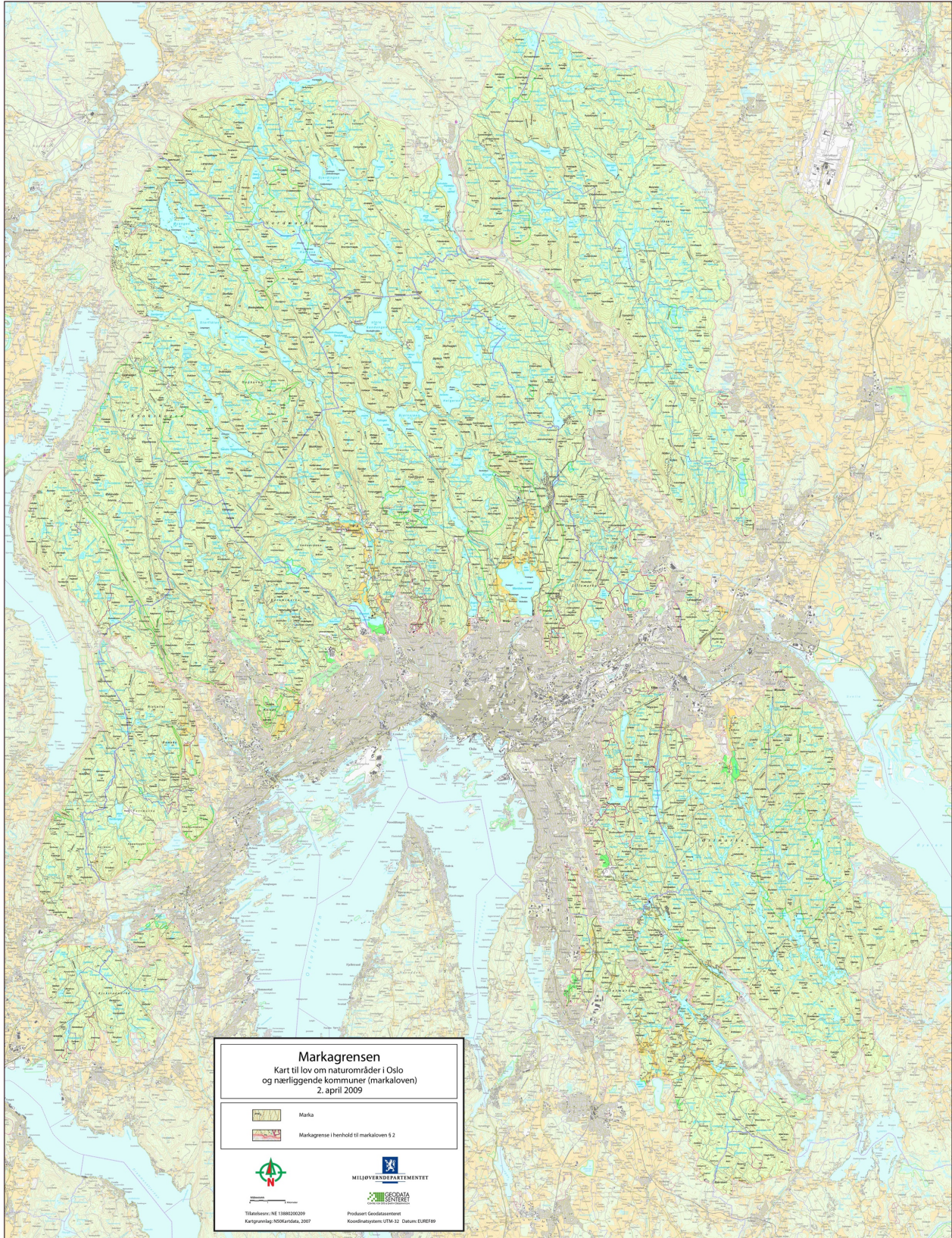
NOTE: All icons in this article are from Flaticon.com

Appendix

Appendix 1. Oslomarka maps

Oslomarka external borders

Oslomarka borders as defined by Act of Nature Areas in Oslo and Nearby Municipalities (Source: Lovdata Foundation)



Oslomarka wilderness areas

Oslomarka (approximate) wilderness area locations (Source: Anchin, 2018)



Appendix 2. Experience map

English (front)

Instructions: Read and complete each of the four tasks (two per side). You can always ^{1/2} return to a previous task to add or make changes and you can be as vague or detailed as you like.

Task #1. Consider your experience of enjoying snow and ice in Oslomarka. List your thoughts corresponding to the eight factors of experience in the sections below. This can be in the form of key words, sentences, drawings, etc. or you may choose to answer or find inspiration from the provided questions in each section.

1. Do **2. Say**

What activities do I engage in?
What is my attitude towards these activities?

3. Hear **4. See**

What do I hear around me? What do I see around me?

5. Think **6. Feel**

What does this place or these activities mean to me?
What emotions do I feel when I am here?
What connection do I feel or how does it inspire me?

7. Gain **8. Pain**

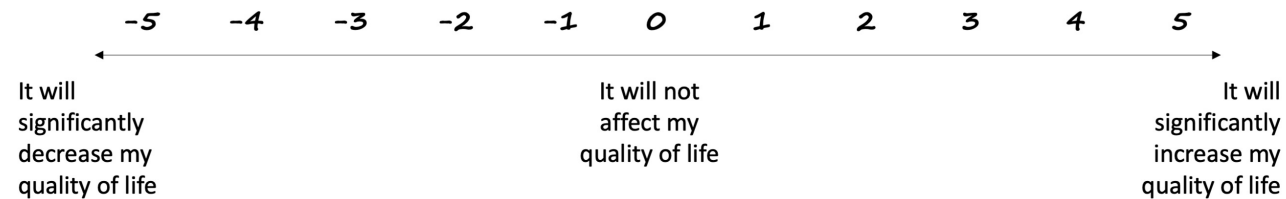
How do I feel I benefit from these activities or this place? What do I feel is negative about these activities or this place?
What are my hopes or dreams about it? What are my fears or frustrations about it?

Task #2. Circle items from Task #1 that you feel are of strong importance or are highly valued to you.




Task #3. The Norwegian Environmental Agency estimates that within the next 80 years, Oslomarka will have between 1 and 4 fewer months of snow, and rainfall may increase up to 18%. In the space below, express (such as a list, description, drawing, etc.) which of the items from Task #1 you think will be affected by less snow and how. You can also add and discuss new thoughts here if you would like.

Task #4. Considering the above possibilities, on the following scale, circle one number that represents how you feel having less snow and ice in Oslomarka might affect your quality of life overall.





Bruksanvisning: Les og svar på alle fire oppgavene (to per side). Du kan alltid gå tilbake til forrige^{1/2} oppgave for å legge til eller å gjøre endringer. Du kan være så vag eller detaljert som du selv ønsker.

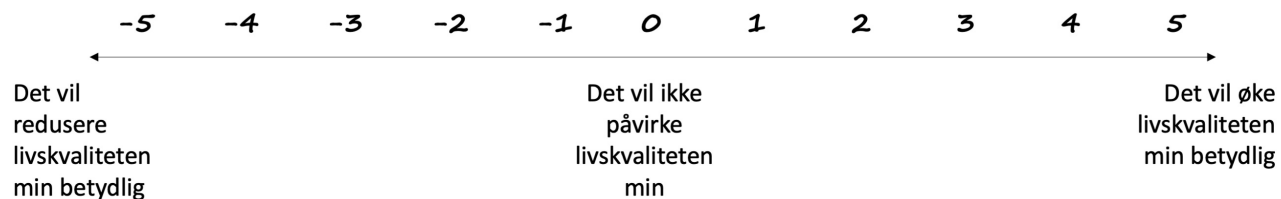
 **Oppgave #1.** Tenk på opplevelser der du nyter snø og is i Oslomarka. Skriv ned tankene dine i de tilhørende åtte opplevelseskategorier i seksjonene nedenfor. Dette kan være i form av stikkord, setninger, tegninger, etc., eller du kan velge å svare på eller finne inspirasjon fra de oppgitte spørsmålene i hver seksjon.



Oppgave #2. Ring rundt ting fra Oppgave #1, som du føler er av sterk betydning eller er høyt verdsatt for deg. 




 **Oppgave #3.** Miljødirektoratet anslår at vi innen de neste 80 årene vil få mellom 1 og 4 færre måneder med snø i Oslomarka, og nedbøren kan øke med opptil 18%. I feltet nedenfor, uttrykk (f.eks en liste, beskrivelse, tegning, etc) hvilke av elementene fra oppgave #1 du tror vil bli påvirket av mindre snø og hvordan. Du kan også legge til og diskutere nye tanker om du vil.

Oppgave #4. Med tanke på mulighetene ovenfor, på følgende skala, sett ring rundt det sifferet som representerer hvordan du føler at mindre snø og is i Oslomarka kan påvirke livskvaliteten din generelt. 





Appendix 3. Codebook

Descriptions

| NCP Domain | Descriptions (Source: Díaz et al 2018) | Sub-Domains |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Learning and Inspiration | | |
|  | <p><i>“Provision, by landscapes, seascapes, habitats or organisms, of opportunities for the development of the capabilities that allow humans to prosper through education, acquisition of knowledge and development of skills for well-being, information, and inspiration for art and technological design (e.g. biomimicry)”</i></p> | <p>Inspiration Knowledge Skills</p> |
| Physical and Psychological Experiences | | |
|  | <p><i>“Provision, by landscapes, seascapes, habitats or organisms, of opportunities for physically and psychologically beneficial activities, healing, relaxation, recreation, leisure, tourism and aesthetic enjoyment based on the close contact with nature (e.g. hiking, recreational hunting and fishing, birdwatching, snorkelling, diving, gardening)”</i></p> | <p>Health Aesthetics Connection to Nature Responsibility to Care Freedom Social Bonds</p> |
| Supporting Identities | | |
|  | <p><i>“Landscapes, seascapes, habitats or organisms being the basis for religious, spiritual, and social-cohesion experiences Provisioning of opportunities by nature for people to develop a sense of place, belonging, rootedness or connectedness, associated with different entities of the living world (e. g. cultural, sacred and heritage landscapes, sounds, scents and sights associated with childhood experiences, iconic animals, trees or flowers). Basis for narratives, rituals and celebrations provided by landscapes, seascapes, habitats, species or organisms. Source of satisfaction derived from knowing that a particular landscape, seascape, habitat or species exists.”</i></p> | <p>Place Identity Transformative Personal Experiences Spirituality</p> |

Keywords

| NCP Domain | Sub-Domain | Main Keywords |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Learning and Inspiration | | |
|  | Inspiration | <i>general reflections on life/self, internal silences, broadening the mind, letting the mind wander, freeing the mind/clearing one's head, collecting thoughts, calm mind, inspired, motivations, art, music, rhythm, movies, dreams or daydreaming, ideas/making plans, problem-solving, engaged/interested in a topic, vision, general clarity</i> |
| | Knowledge | <i>knowing something/how to do something, learning, knowledge, specific knowledge/technique, stories, storytelling, passing on or sharing knowledge, knowledge required</i> |
| | Skills | <i>challenge, achievement, skills, mastery, accomplishment, overcoming fears or inadequacies, discipline, confidence, specific improvements, adrenalin, exhaustion, good or bad form/technique, pride, specific abilities, self-esteem, displays of confidence, encouragement, losing, winning, self-efficacy, capabilities</i> |
| Physical and Psychological Experiences | | |
|  | Health | <i>psychological, general emotions (joy, sadness), general experiences, taking a trip/journey recreation, exercising, fitness, fun, expressions, relaxing, general peacefulness/calm, general break (from city, school, normal life), health/shape, variation in activities, satisfactions/dissatisfactions, anxieties, energy, physical, general feelings (cold, active), general activities (cross country/alpine skiing, walking, ice skating, sledding, , snowboarding)</i> |
| | Aesthetics | <i>beauty, silence, stillness, nature sounds, noise, scenery, specific objects, general descriptions, serene, observations, observing an occurrence, light or dark, colours, view, visual preferences, aesthetic appreciation, textures, charms or unique describing factors, aesthetics, surroundings, senses (taste, touch, etc.)</i> |
| | Connection to Nature | <i>wildlife, trees, outdoors, birds, nature, connected to nature, snow, rain, seasons, winter, water, feeling of nature (wind), conditions/weather, sun, animal tracks, nature experiences, non-specific places/landmarks (stream, creeks, sky, clouds) abundance or lack of nature, temperatures, snow-covered, environment, vegetation, natural</i> |
| | Responsibility to Care | <i>need for nature, protection, repercussion/consequences of damage/neglect/degradation (local or global), saving nature, future generations, nature belonging to everyone, concern for place/nature (local or global), untouched nature, admiration, everlasting, stability, resource uses</i> |
| | Freedom | <i>ability, access, free, freedom, opportunity, ability to fulfil desires, chances to do something, possibility, privilege, loss in access/ability, fortunate, lucky, grateful, pay for access, forced decision/inability to affect choices, experience luxuries, appreciation for another's actions, loss of tourism/business/economy</i> |
| Social Bonds | <i>social, other people doing something, sharing, family, friends, talking, multiple people, kids, children doing something, general community, together, others, relationships, descriptions of others, expectations off/from others, groups, discussions, social events/sports, observing an event (with people), crowds, types of people, thoughts</i> | |

Supporting Identities



| | |
|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Place Identity | <i>city, mountains, fjords, forest, wetlands, wilderness areas, lakes, fields, rivers, lodge, cafes, local businesses, cabins, Oslo, Oslomarka, Marka, other specific/recognisable landmarks/places, Norway, Norwegian culture/icons, Norwegian language, Norwegian traditions/experiences, local sayings, Norwegian identity, country/nation, belonging, home, distances between places</i> |
| Transformative Personal Experiences | <i>memories, nostalgia, childhood, child-like experiences, timelines, future/past, items of special meaning, dreams or hopes one has, being in one's element, something of true value (not as utility), special descriptions, altered state of mind, deep/extreme/full/true/meaningful/perfect/unique/new experiences/feelings, of significant value/importance/benefit/meaning, to take an experience with oneself/lasting experiences, drastic effects or changes, changes to how one imagines something, general tradition, transformations, feelings of emergence, renewal or born again</i> |
| Spirituality | <i>escape/leave normal life (more than a break), reset, general connectedness, being at peace/centred/present in the here and now/moment, mindfulness, spiritual, harmony, meditation, consciousness/awareness (beyond clarity), religious, existence, true self, to be alive, pulse, soul, calming the soul, good for the soul, finding peace, significant unwinding/disconnection, reality, intrinsic actions (nature, objects), solitude, deep aloneness/insight, oneness, deep unity/togetherness, purity, pureness, mystical, spiritual, mysterious, philosophy, philosophical</i> |

Notes

Rule: Distinctions are often made between themes that are specific versus general (as indicated in 9.3.2.). See additional notes below.

- *Distinction A) Nature: general wilderness observations (connection to nature); specific regions or identifiable areas (place identity).*
- *Distinction B) Silence: External experience of silence or quiet (aesthetics); internal quiet through not speaking or thinking (inspiration).*
- *Distinction C) Descriptions of nature: for health aspects like air freshness (health), for aesthetics like colour, texture (aesthetics); for natural like snow on trees (connection to nature is repeated).*
- *Distinction D) Disappearance: for ability or access, such as being forced to drive or inability to do an activity (freedom); for nature itself or nature experiences (connection to nature); if concern for others (responsibility to care).*
- *Distinction E) Vague descriptions: e.g. 'nice': context shall be considered, if 'it' is used, as in a thing (aesthetics), if 'this' is used, as in experience (health), or general observations (inspiration).*
- *Distinction F) Peace: for calm/relaxation (health); for external (aesthetics); for internal (spirituality).*



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