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Plans for urban green infrastructure in Scandinavia

Helena Nordh^{a*}  and Anton Stahl Olafsson^b 

^aDepartment of Public Health Science, The Norwegian University of Life Sciences, Faculty of Landscape and Society, Aas, Norway; ^bDepartment of Geosciences and Natural Resource Management, University of Copenhagen, Frederiksberg, Denmark

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Scandinavian countries are often mentioned as forerunners in sustainable urban development; here, green infrastructure (GI) planning has played an important role. However, little is known about the status of GI planning at a municipal level—this paper aims to provide such knowledge. In an analysis of GI plans or municipal master plans from 24 municipalities in Scandinavia, we explored the scope of the plans, the focus of the goals/strategies, the terminology, and the measures for access to green spaces. The results show that all the municipalities had strategies for GI, but only 60% had a GI plan or a similar “greenspace” document. Social values were the main focus of the plans, particularly recreation and access. GI was a concept more commonly used in practice compared with ecosystem services. The findings confirm a common Scandinavian approach to urban GI planning, which provides a relevant general frame for future globally strategic GI planning.

Keywords: ecosystem services; planning; document analysis; urban nature; green space planning

1. Introduction

There is a great body of literature concerned with the loss of urban green space caused by urbanization processes. Researchers from Scandinavia (see, for example, Lindholm 2017; Thorén and Saglie 2015; Slätmo, Nilsson, and Turunen 2019b) and elsewhere (Wang and Banzhaf 2018; Hansen *et al.* 2019) have suggested that strategic green infrastructure (GI) planning with a focus on multifunctional uses is one means to meet the challenge of pressure on urban green space. The interest in GI planning and the body of literature on the benefits of urban green spaces and their ecosystem services (ESS) have seen tremendous growth in recent years (Hegetschweiler *et al.* 2017; Seppelt *et al.* 2011). The European Commission has launched urban GI as a strategic focus area in Europe, highlighting the importance of GI planning. On a policy level, the Scandinavian countries are all concerned with protecting and developing urban GI (Slätmo, Nilsson, and Turunen 2019a; Ministry of the Environment 2012; The Norwegian Government 2017; Ministry of Environment 2014). But updated knowledge about *whether* GI is integrated in spatial planning on a local (municipal) level is

*Corresponding author. Email: helena.nordh@nmbu.no

sparse. There is also little known about differences across the Scandinavian countries and outside the capital “urban” regions. GI planning at a municipal level is influenced by national rules and guidelines as well as regional plans. Moreover, for several reasons related to, for example, priorities or land ownership (Slätmo, Nilsson, and Turunen 2019b), national policy documents may not be implemented on a local level. In this paper, we adopt a bottom-up approach and explore the status of GI planning in a strategic sample of nine large and 15 medium-sized municipalities in Scandinavia. With this in mind, we set out to provide an overview of the status of content on GI planning and take the first step toward launching a Scandinavian urban GI planning model.

1.1. Theoretical framework

The article is guided by theory from the fields of GI and ESS. One of the most cited definitions of GI was published by Benedict and McMahon (2012), according to whom, GI includes a “network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife” (p. 1). Thus, GI is generally conceived as multifunctional and encompasses a wide variety of benefits (European Commission 2012; Wang and Banzhaf 2018). GI benefits are commonly divided into ecological, social, and economic functions (Wang and Banzhaf 2018). Koc, Osmond, and Peters (2017) reviewed the GI literature and suggested that GI typologies be grouped into four main categories: tree canopy, green open spaces, green roofs, and vertical greenery systems. Researchers have acknowledged that in GI planning, it is important to focus on both the benefits of the separate parts, such as the typologies mentioned above, as well as the benefits of the network structure (Lindholm 2017). Multifunctionality and connectivity can be seen as core principles of GI, but GI planning is also about integrating different kinds of green spaces at different scales (for an overview of GI principles, see Pauleit *et al.* 2017). GI delivers ESS (Koc, Osmond, and Peters 2017; Andersson *et al.* 2014). These ESS are referred to as the benefits people gain from GI ecosystem functions and are divided into four categories: regulating, supporting, provisioning, and cultural (Millennium Ecosystem Assessment 2005; Hansen and Pauleit 2014). However, in urban planning discourse, others have addressed the reality that ESS are seldom strictly and conceptually applied, and there are discussions about their applicability to planning practice (Beery *et al.* 2016; Hansen *et al.* 2015). According to Gómez-Baggethun and Barton (2013), ESS are a broader concept incorporating all types of natural areas, including privately owned ones, while GI is a concept mainly used in planning and policy discourse, focusing primarily on the benefits of public green spaces. However, others claim that both concepts are commonly used intertwined in planning practice (Hansen *et al.* 2019). We also support the notion that GI planning incorporates other, non-public spaces. In this paper, we acknowledge that there are differences between ESS and GI benefits, but refer to others for a more thorough discussion of the differences (Hansen *et al.* 2019; Wang and Banzhaf 2018). Instead, our interest is in studying the degree to which the two concepts ESS and GI appear in the municipal green strategic plans under study. As this would indicate whether the terminology used by researchers has reached planning practice, which is also a topic of interest to others (Lindholm 2017; Di Marino and Lapintie 2018).

1.2. A historical introduction to green infrastructure (GI) planning in Scandinavia

The Scandinavian countries of Norway, Sweden, and Denmark have a joint historical background which has influenced, for example, culture, language, and traditions. The countries are similar democratic welfare states, but have different geographical, ecological, and land-use contexts. The countries also have many similarities related to planning practices. For example, in all countries, the municipalities ought to undertake a municipal master plan with strategies and measures for spatial development. However, in Denmark and Norway, the municipal master plan (only the spatial/map-based part in Norway) is juridically binding, while, in Sweden, the plan is viewed as a guiding document (Borges *et al.* 2017). There is an official body for intergovernmental cooperation—The Nordic Council of Ministers—that works with topics, such as sustainability, mobility, and GI (see <https://www.norden.org/en/nordic-council-ministers>). On a policy level, GI planning is addressed as highly important across the Scandinavian countries (Zinko *et al.* 2018). The significance of long-term planning and good governance is also acknowledged. In all the countries, national authorities have published, or are developing, guidelines for GI planning (National Board of Housing, Building and Planning 1999, 2007; The Norwegian Environment Agency 2014; Ministry of Environment and Food of Denmark 2017). According to these guidelines, GI should be monitored, protected, and developed, not least to identify any impact environmental changes may have on society. Across the Scandinavian capital regions, there has been a long tradition of protecting nature (forests) surrounding the cities (Zinko *et al.* 2018). The main aim has been to facilitate recreational purposes for city dwellers. Both Stockholm and Copenhagen have a built structure that is in the shape of a star, with strictly protected green wedges stretching from the surrounding nature all the way into the city centers. The green wedges cross several municipalities, which has resulted in cooperation regarding GI on a regional level (Region Stockholm 2008, 2012; Caspersen, Konijnendijk, and Olafsson 2006). Oslo is located by a fjord with a green belt (forest) surrounding the city. The green belt is protected by law and no (or very limited) development is allowed within this area (Ministry of Climate and Environment 2009).

A GI plan is an important document to protect and develop green spaces, thereby safeguarding the GI's delivery of all the benefits and services needed by communities to tackle multiple contemporary urban challenges, such as social cohesion, public health, biodiversity protection, and climate adaptation (Pauleit *et al.* 2019). As can be seen later in this paper, not all municipalities entitle the plan a 'GI' plan, even if they cover so-called core concepts of GI (Pauleit *et al.* 2017). Therefore, when we refer to GI plans in our study, we include all kinds of "greenspace" plans. Norwegian, Swedish, and Danish research shows that until the end of the 1990s, the values that received the most attention in GI plans were social values (Sandström 2002; Thorén and Opedal 1997; Vejre, Jensen, and Thorsen 2010), while ecological values were afforded much less attention. However, little is known about the current picture. In particular, there is a lack of knowledge on similarities and differences on a local (municipal) level. To determine whether the focus has shifted in GI planning in Scandinavia during the last 10–20 years, we explore the aim of current plans. Such information is valuable to practitioners working with GI planning. It is also important for the research community, who, among other things, facilitate practitioners through tools, concepts, and indicators of importance in GI planning. One such indicator that has been in focus in both research and practice is the distance/proximity to green space

from people's homes. In 2016, WHO published an overview on urban green space and health. This report showed that 300–500 meters to the nearest green space seems to be the distance applied in several European towns/countries (WHO 2016). Slätmo, Nilsson, and Turunen (2019b) also show that across European countries, there is an interest in planning tools calculating the amount of green space; they mention tools, such as green space factor and green-area-per-capita factor. These tools are particularly applied in the development stage aimed at integrating GI into the built structure. To follow up on this, our study looks particularly at any measures of access to green space in the plans in our study.

1.3. *Aim*

This study will develop a comprehensive overview of the status of municipal GI planning in Scandinavia (Norway, Sweden, and Denmark). Much of the international literature on GI planning explores differences across countries (Slätmo, Nilsson, and Turunen 2019b) or differences across larger cities (see, for example, Grădinaru and Hersperger 2019; Hansen *et al.* 2015; Pauleit *et al.* 2019). To contribute to the international research agenda, we explored GI planning on a local level, including both larger cities and medium-sized municipalities and towns in the Scandinavian region. In an analysis of 24 GI plans or municipal master plans, the following questions were considered: What is the scope of the plans? What GI functions are focused upon in the goals and strategies? To what extent is GI or ESS used as terminology in the plans under study? Finally, are there any measures for access to GI in the plans? The overall aim is to inspire practice and guide authorities when providing future support to municipalities. The findings will also add to the international body of research on links between research and practice in GI planning. Before introducing the method of the paper, we introduce GI planning in each of the three Scandinavian countries.

1.4. *A brief introduction to GI in Norway*

In 1992, Nyhuus and Thorén published the first report on GI planning in Norway (Nyhuus and Thorén 1992). Later, in 1997, Thorén and Opedal (1997) showed that only 10% of the municipalities in Norway had developed a GI plan. The Norwegian government encourages all municipalities to develop GI plans (The Norwegian Environment Agency 2014; The Norwegian Government 2017). However, the extent to which such plans are developed varies across municipalities. In 2018, Thorén *et al.* examined municipal plans for neighborhood walks (Thorén, Nordh, and Lund 2018). The authors of the current study gained the opportunity to further analyze the data from that study, which was based on questionnaire responses from planners-in-chief in 204 Norwegian municipalities (~48% of all municipalities). In their study, we noted that only 21% of the municipalities in the study had a GI plan or analysis. When Norway introduced a new planning and building act in 2008 (Ministry of Local Government and Modernisation 2008), GI was introduced as one of six topics that should be mapped in the municipal master plan. In the governmental guidelines describing the act (Ministry of Local Government and Modernisation 2009), GI is defined as follows:

Green infrastructure is a coherent, or almost coherent, area predominately vegetated, in or in proximity to a city or densely built up area. The aim [read GI] safeguards the

municipality's needs to protect the main structure of natural areas in and around cities and densely built areas, with green areas along rivers, a pattern of single green spaces and network of parks, large green spaces and play areas, paths, shortcuts and wedges connecting the larger natural areas and important coherent landscape characteristics and areas. The green infrastructure aims to connect the green spaces within the built up area with areas for outdoor recreation in the periphery.

Over the years, there have been several handbooks guiding GI planning in Norway (The Norwegian Environment Agency 2014; Thorén and Nyhuus 1994; Directorate for Nature Management 2003). In the latest guideline (The Norwegian Environment Agency 2014), it was suggested that there should be a small green space within 200 meters of each dwelling, and the maximum distance to the nearest green corridor or larger green area should be 500 meters. There are also suggestions regarding ways of categorizing various types of green space from a social/outdoor recreation point of view.

1.5. A brief introduction to GI in Sweden

GI as a concept was introduced in Sweden at the beginning of 1990 (Region Stockholm 2008). Since then, the National Board of Housing, Building and Planning has published several handbooks or guidance documents of relevance to GI planning (National Board of Housing, Building and Planning 1999, 2007, 2010). In 2012, they also presented the status of GI planning to the Swedish municipalities (National Board of Housing, Building and Planning 2012). Herein, they showed that 47 municipalities (22.5%) had a GI plan or a similar document. On the web page of the National Board of Housing, Building and Planning (2019), there is data from 2018 on the number of municipalities with a GI plan. On this web page, we can see that 82 municipalities (39%) state that they have a GI plan or similar document, and an additional 38 (18%) have such a plan for some parts of the municipality. In Sweden, several municipalities choose to have a nature management plan instead of a GI plan (National Board of Housing, Building and Planning 2012), and in some they have both types of plan. After reading several nature management plans, our impression is that the plans are not as focused on urban nature as the GI plan. Moreover, ecological functions, rather than social functions, appear to be the focus of the nature management plans. As early as 1999, the Parliament of Sweden had launched 16 environmental goals aiming to guide municipalities and companies toward a more sustainable future (Ministry of the Environment 2012). ESS are part of these goals.

1.6. A brief introduction to GI in Denmark

In Denmark, there is a long history of regional large-scale GI planning around the larger cities. The most cited of these is the green structure around Copenhagen, which consists of clearly defined and strictly protected green "wedges" and green "rings" that are enforced in the "Fingerplan" dating back to the 1930s and 1940s (Caspersen, Konijnendijk, and Olafsson 2006). Up until a local government reform in 2007, GI strategic planning was divided between municipalities and the former regional counties with different foci. Municipalities worked only with the built-up urban areas and focused on more detailed urban green structures plans and green space plans (e.g. Busck *et al.* 2009). While the regional counties worked only with countryside planning with a focus on, e.g. ecological corridors and regional green structure plans (e.g.

Jongman 1995). After the local government reform, the regional spatial planning level was abolished, and planning of both urban and rural areas was now undertaken by larger agglomerated municipalities providing new opportunities for coherent GI planning. However, there are currently no formal governmental urban GI guidelines in Denmark; therefore indicating a lack of an official GI definition. Nevertheless, official national governmental reports emphasize the urban GI concept (for example, the Ministry of Environment 2014), and the planning act, as well as a series of national guidelines supporting current GI planning in Danish municipalities. The foci of the various guidelines include climate adaptation, urban fringe afforestation, connectivity for biodiversity, and outdoor recreation. For climate adaptation, all municipalities must carry out a flood risk assessment and climate adaptation plan that is supported by a national guideline that emphasizes the critical role of blue and green infrastructures, such as sustainable drainage systems (Danish Business Authority 2019). For urban fringe afforestation, all municipalities must designate afforestation areas, and land-owners receive payment for urban afforestation to achieve multiple society benefits, such as outdoor recreation, climate mitigation, ground water protection and biodiversity improvement (Ministry of Environment and Food of Denmark 2015). Furthermore, a specific guideline requires all municipalities to designate and conserve a connected green network of existing and potential nature areas for biodiversity improvement—the so-called Green Denmark Map (Ministry of Environment and Food of Denmark 2017). Finally, the national planning act includes measures to designate outdoor recreation areas, and a national outdoor recreation policy spotlights urban recreation as well as various aims and their associated social benefits.

2. Method

2.1. Choice of municipalities

Before we decided on the criteria for choosing which municipalities to include in the analysis, we scanned plans from several municipalities of differing sizes. This process confirmed that there were also GI plans (empirical material) available outside the larger cities. Based on population data retrieved from Sweden (Statistics Sweden 2018), Norway (Statistics Norway 2019), and Denmark (Statistics Denmark 2019), we chose the three largest municipalities and the five municipalities with just under 55,000 inhabitants in each of the Scandinavian countries (see Table 1 and Figure 1). Hence, the larger cities represent an urban focus, whereas the medium-sized municipalities indicate the ways in which GI planning is implemented outside the metropolitan regions in medium-sized towns. (Data collection was undertaken between June 2019 and September 2019.) Sweden, and in particular Norway, have a high number of municipalities, a substantial proportion of which have very few inhabitants. With such a skewed population, it seemed wise to choose strategically, rather than choose based on a random sample, which would have resulted in municipalities of a much smaller size. From a Scandinavian perspective, 55,000 inhabitants is a medium-sized municipality, and there are a relatively high number of municipalities of this size, which strengthened the relevance of the choice of municipalities. We expected municipalities of this size to have a municipal center with certain features, shops, services, and housing. Since most of these municipalities are under pressure of densification, we also expected similar needs for plans and strategies on means to protect and develop the GI in the built-up area. All plans were retrieved from the official websites of the municipalities.

Table 1. An overview of the plans in the study.

City/ municipality	Number of inhabitants ¹	Type of plan	Name of plan	Year of approval	Number of pages
Norway					
Oslo	681,071	Municipal master plan and Municipal sector plan	Vår by, vår framtid Kommuneplan for Oslo 2018 and Kommunedelplan for torg og møteplasser Kommunedelplan for blågrønn infrastruktur i Bergen (2012–2020) (Grøntmiljøplanen)	2018 and 2009	90 and 46
Bergen	281,190	GI plan	Plan for friluftsliv og grønne områder	2010	62
Trondheim	196,159	GI plan	Kommuneplan 2015–2022 Samfunnsdelen	2017	56
Skien	54,645	Municipal master plan	Grønnstrukturplan for Bodø	2016	47
Bodø	52,024	GI plan	kommune - Planbeskrivelse	2017	44
Ålesund	47,998	Municipal master plan	Kommuneplan Samfunnsdel 2015–2027	2015	48
Larvik	47,107	<i>New municipal master plan in pipeline (no available plan)</i>			
Tønsberg	45,976	Municipal master plan	Kommuneplanens samfunnsdel 2014–2026 Tønsberg kommune	2019	27
Sweden					
Stockholm	935,619	GI plan	Grönare Stockholm. Riktlinjer för planering, genomförande och förvaltning av stadens parker och naturområden	2017	44
Göteborg	556,640	GI plan	Göteborg Grönstrategi för en tät och grön stad	2014	86
Malmö	328,494	Municipal master plan <i>New GI plan in pipeline</i>	Översiktsplan för Malmö planstrategi	2018	76
Borlänge	52,224	Municipal sector plan <i>New nature protection plan in pipeline</i>	Fördjupad översiktsplan för Borlänge tätort	2018	(online version)
Hässleholm	52,121	GI plan	Grönplan för park—och naturområden i Hässleholms tätort	2002	75
Sundbyberg	50,564	GI plan	Grönplan Sundbyberg	2011	59
Sigtuna	48,130	Municipal master plan			
Tyresö	48,004	GI plan	Grönplan 2009	2009	42

(Continued)

Table 1. (*Continued*).

City/ municipality	Number of inhabitants ¹	Type of plan	Name of plan	Year of approval	Number of pages
Denmark					
Copenhagen	613,288	GI plan <i>New GI plan in pipeline</i>	Urban nature in Copenhagen Strategy 2015–2025	2015	40
Aarhus	340,421	Park plan <i>New GI plan in pipeline</i>	Parkprogram for Århus. Taet på mennesker 2010–2019	2010	16
Odense	202,348	GI plan	Handleplan for Danmarks Grønneste Storby 2018	2018	77
Faaborg-Midtfyn	51,809	Municipal master plan <i>New GI plan in pipeline</i>	Kommuneplan 2019	2019	(online version)
Fredericia	51,427	Municipal master plan	Kommuneplan 2017–2029 for Trekantområdet og Fredericia kommune	2017	(online version)
Hillerød	50,998	GI plan	Grøn Strukturplan—En rekreativ plan for Hillerød Kommune 2012	2012	12
Høje-Taastrup	50,686	GI plan	Grønt Atlas Høje-Taastrup Kommune	2006	47
Greve	50,267	GI plan	Landskabsanalyse og grøn blå struktur Greve kommune, Solrød kommune	2011	109

Note: A few specifications related to our sample: Borlänge municipality had a joint municipal master plan with Falun municipality; therefore, we chose to analyze the municipal sector plan for the center of Borlänge. Oslo had a municipal sector plan for squares and meeting places that partly covered GI; therefore, we added this plan to the analysis.

¹Retrieved from: Statistics Denmark 2019, Statistics Norway 2019 and Statistics Sweden 2018.

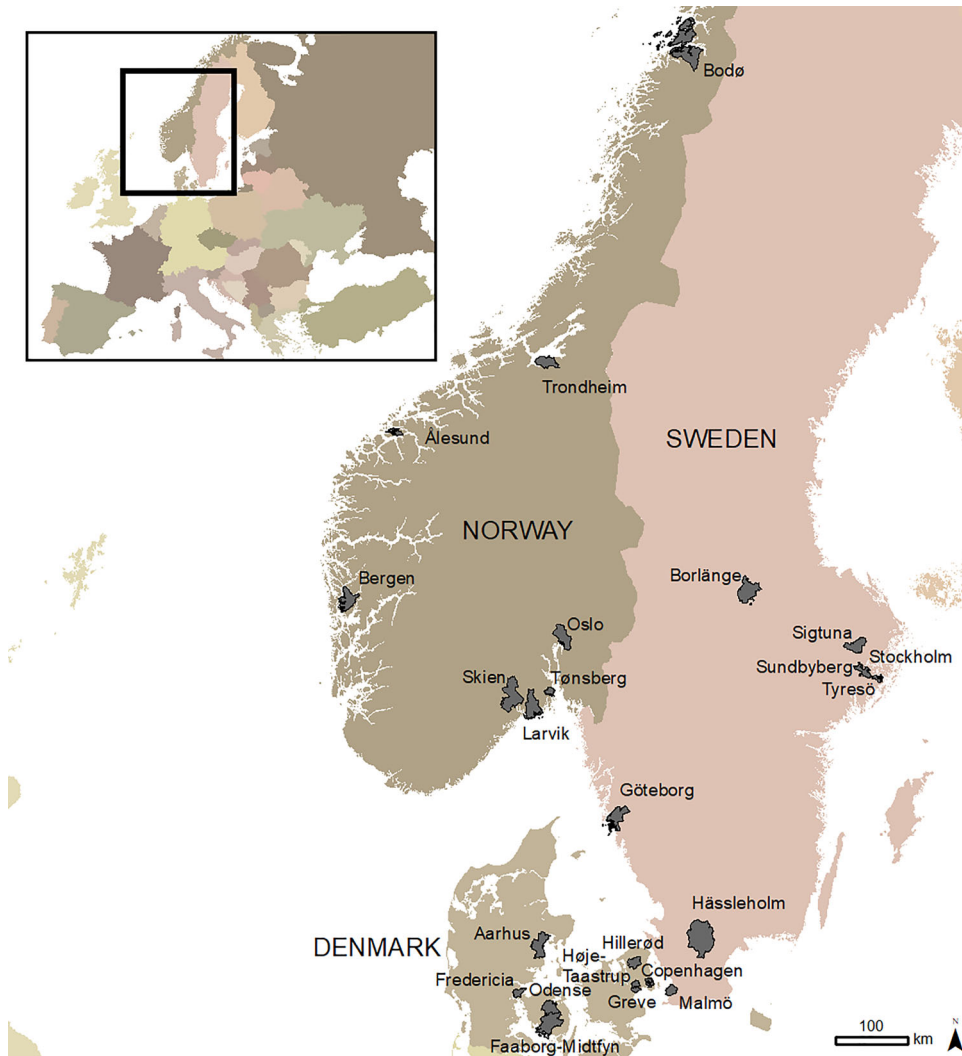


Figure 1. The 24 municipalities under investigation in Sweden, Norway and Denmark.

We had an inclusive approach to GI plans, thereby including greenspace plans and even park plans if no overarching level of GI plan existed. If the plans were not found online, we contacted the municipalities to confirm that no such plans existed. In the absence of GI plans, we analyzed the goals and strategies for GI as presented in the municipal master plans. Larvik municipality did not have a GI plan or an available municipal master plan due to revisions at the time of our data collection. Therefore, Larvik was not included in the analysis. This resulted in 23 available plans.

2.2. Analysis of plans

Inspired by Grădinaru and Hersperger (2019) and Hansen *et al.* (2015), we developed a protocol for the analysis of plans. The choice of overall variables in the protocol responds to the aim of the study. The information retrieved from the plans was:

GENERAL INFORMATION AND SCOPE OF PLANS

- Name of municipality
- Number of inhabitants
- Type of plan
- Name of plan
- Year of approval
- Number of pages

AIMS OF PLANS

- Overall aim of plan
- Aims/strategies of the GI

TERMINOLOGY USED

- Focus on and use of ESS
- Use of GI

MEASURES OF ACCESS

- Recommendations of minimum distance to green spaces or minimum amount of green space per inhabitant
- Analysis of access to green spaces

Sections of text in the GI plans or municipal master plans that corresponded with any of the above mentioned bullet points were marked, copied and pasted into a table of analyses. Each category was separately analyzed and synthesized. We noticed that not all municipalities had a separate chapter in which they presented the goal/strategies of the plan, or the aim of the GI. Therefore, we analyzed all sentences in which the municipalities described that they *will*, *must*, *aim to do* anything about the GI. The aim and strategies were analyzed using a qualitative text condensation approach (Malterud 2012). The text was first read with a bird's eye view to gaining an overview of the content of the goal/strategies. The text was re-read several times and words indicating any goals/strategies were marked with colored pens. These words/units were later grouped into categories/topics as presented in Figure 2. To examine for any differences across the size of municipalities, we grouped the municipalities into two categories: large and medium-sized municipalities. We then analyzed the proportion of large and medium-sized municipalities covering each topic. Patterns relative to the size of municipalities and nations were noted, and findings presented in figures, tables, or descriptive quotes located in the Results section.

3. Results

3.1. Number and scope of GI plans

Of the 24 municipalities, 14 had a separate GI plan (see Table 1). At the time of writing, a further three municipalities (Malmö, Aarhus and Faaborg-Midtfyn) were developing GI plans. It was more common to find GI plans in Denmark and Sweden than in Norway, at least among the medium-sized municipalities. Nevertheless, in contrast, many of the Norwegian municipalities had a strong focus on GI in the municipal master plans (see, for example, Oslo and Skien). All the large municipalities (except Oslo)

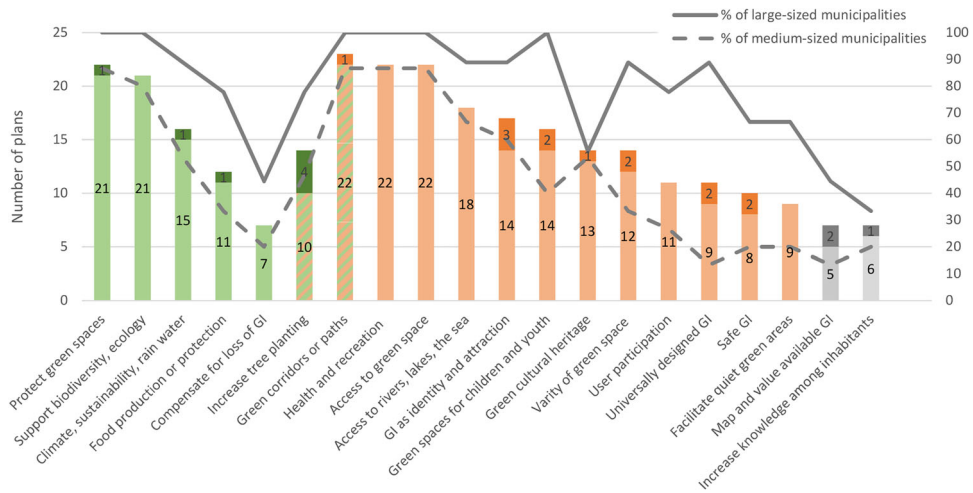


Figure 2. The goals/strategies in focus across municipalities in the study. The bars are divided into categories of ecological (green) and social (orange) functions. The two gray columns are related to planning and dissemination. Two of the categories (tree planting and green corridors) were described in terms of both ecological and social functions; these bars are marked with stripes. The dark colors on the top of the bars are the number of plans in which the goals/aims were partly addressed. As an example, two municipalities described that, in general, it was important with a variety of green spaces, but they did not explicitly say that they aimed to increase the variety of green spaces. The y-axis on the right, shows the percentage of plans in relation to size of municipality.

had a GI plan. Oslo municipality had instead merged the new municipal master plan with the previous GI plan from 2010 (Oslo Municipality 2010).

The length of the GI plans varied from 12 to 109 pages. There was no difference in the mean number of pages when comparing the large municipalities ($M=55$ pages) with the medium-sized municipalities ($M=54$ pages); what differed was the content. The GI plans from the large municipalities were strategic documents, focused on overall goals and strategies for the GI. These plans did not cover an analysis (maps) of existing green spaces qualities or types (except for Trondheim); for such details, some (i.e. Stockholm and Göteborg) referred to other plans, such as park plans or nature management plans, or requested such information for the future. All GI plans from the medium-sized municipalities in Denmark and Sweden described existing qualities of green spaces. Geographical areas within the municipalities were presented, as well as concrete goals or actions with the areas and the GI were addressed. Some medium-sized municipalities, particularly those in Sweden (Tyresö, Sundbyberg, and Hässleholm), had GI plans that were more of a management plan with concrete actions related to certain green spaces.

3.2. Aims and strategies of the plans

Many municipalities described the GI plan as a tool for policy and planning, as well as a source of information to the public. The GI plans did not have any legal status, but they provided the municipalities with material for other legally binding municipal plans.

As we can see in Figure 2, both ecological and social functions were addressed as goals/strategies across the Scandinavian plans. When we compared the number of goals/strategies applied in the large municipalities with those of a medium size, we

noticed that a higher proportion of the large municipalities covered each of the topics. Assessing national differences between the three countries, we found few differences. However, the three large-sized Swedish municipalities differed from the other large-size municipalities. When combined, they covered a higher number of topics ($N=54$) as compared with Denmark ($N=45$) and Norway ($N=44$).

The five most frequently mentioned topics in the goals/strategies across the GI plans were health and recreation among inhabitants, people's access to green spaces, the importance of green corridors (mainly for social purposes, partly for ecological), the protection of green space, and support of biodiversity or ecology. These topics were addressed in all large municipalities and in around 80–90% of the medium-sized municipalities. In a quote from Malmö's municipal master plan, most of these goals/strategies are covered in a few sentences:

The parks, nature and water environments of Malmö must be protected and increased, and their recreational and biological qualities improved. There should be powerful restrictions if one wants to use green and blue spaces for other purposes. The access to the cities blue-green network must be improved, extended and connected. The structure should be tightened and connected, resulting in a fine grained network. (Malmö Municipal plan, 35)

Some of the larger municipalities had ambitious aims with their GI—for example, Odense and Oslo positioned themselves at the forefront of GI planning from national and international perspectives, respectively. According to their GI plan, Odense wants to create “the greenest city in Denmark” (also the title of the plan), despite the ongoing densification of the city:

During the transformation of Odense to a more compact city, there is a battle for the space. However, we choose to see the transformation as a possibility to safeguard and develop Odense's special green profile. This is to create the greenest city of Denmark. (Odense GI plan, 5)

Similarly, Oslo's self-image as a leading environmentally friendly city in Europe includes protection of and care for GI:

Oslo is Europe's leading environmentally friendly city, the city takes care of its biodiversity, cultural heritage and identity.

The inhabitants experience a liveable city with few cars, many activities and attractive qualities, such as coherent green spaces and rivers in the built area between the fjord and Marka [the forest], where the coast, the fjord and the isles are cared for. (Oslo municipal master plan, 17)

Although there was a strong focus on protection, surprisingly few municipalities mentioned land to compensate for the loss of green space as part of their goals. We would have expected that at least the large municipalities had a greater focus on this, but only around 45% of them mentioned compensation for loss of green space as a goal. Perhaps this finding would have been different if we had focused purely on municipal master plans rather than GI plans.

As we can see in [Figure 1](#), several of our municipalities are located by the sea. People's access to water (the sea, rivers, and lakes) was also frequently mentioned in

the goals and strategies. This is a quote from the GI plan of the Copenhagen municipality, in which they state that they aim to:

... secure access to water and water experiences and securing clean water in lakes, streams and the sea with a varied wildlife and vegetation. (Copenhagen GI plan, 7)

Very often, the municipalities mentioned the handling of rainwater as a means to both address climate change and increase people's access to water, as well as being an attractive quality in the urban landscape. Below is a quote from the Trondheim GI plan about strategies for handling rainwater:

It is a pressing need to take care of the increased precipitation. In this context, it is important to facilitate natural water flows, such as streams and green corridors in-between buildings. (Trondheim GI plan, 18)

In approximately half of the plans, the municipalities described the green spaces as assets contributing to a municipal green identity. Some also alluded to GI as being part of the cultural heritage. Here is an example from the GI plan of Göteborg:

The green cultural heritage strengthens the identity of Göteborg and brings a quality to the city. It is therefore important to safeguard the historical character when densifying the city. (Göteborg GI plan, 29)

Green cultural heritage was the only topic in which we observed a similar pattern when comparing the large and medium-sized municipalities. About 50% of both groups of municipalities covered the topic. The largest differences between large and medium-sized municipalities were found in three topics: green spaces for children and youth, variety of green space, and universal design. For example, goals/strategies related to green spaces for children and youth were addressed in all large municipalities but only in 40% of the medium-sized ones. Green spaces designed for all, "universal design," was mentioned in 90% of the large municipalities but only 13% of the medium-sized municipalities. Six municipalities stated goals to increase knowledge about GI among their inhabitants; the municipality of Odense even had a quantitative measure, suggesting that a minimum of 80% of the inhabitants should know about the importance of city nature.

In Denmark, strategies for nature protection, planting new forests, and increasing the number of urban trees were major concerns. A quote from the municipal master plan from Faborg-Midtfyn reveals the extent to which protection of nature is prioritized:

The nature values must be developed, and the inhabitant's possibilities for experiences and access to nature must increase. The most important areas should be developed and if possible be connected. However, the use of nature should not destroy valuable nature areas. (Faborg-Midtfyn municipal master plan, online version)

3.3. Terminology used

Ecosystems (ES) or ESS were mentioned in 13 of the 23 plans (see [Table 2](#)). Municipalities, such as Stockholm, Göteborg, and Borlänge, were at the forefront of applying the concept to their plans. ES or ESS were more actively used in Sweden in

Table 2. Analysis of terminology and access.

	GI as a concept present in the plan	ES or ESS as a concept present in the plan	Analysis of access to green space	Recommended distance to green space
Oslo	Yes	No	No	No
Bergen	Yes	Yes	Yes	Yes
Trondheim	Yes	Yes	Yes	Yes
Skien	Yes	No	No	No
Bodø	Yes	No	Yes	Yes
Ålesund	No	No	No	No
Larvik	–	–	–	–
Tønsberg	Yes	No	No	No
Stockholm	Yes	Yes	No (but in the park plans)	Yes
Göteborg	Yes	Yes	Yes	Yes
Malmö	Yes	Yes	No	No
Borlänge	Yes	Yes	No	Yes
Hässleholm	Yes	Yes	No	Yes
Sundbyberg	No	Yes	No	No
Sigtuna	Yes	Yes	No	No
Tyresø	Yes	Yes	No	No
Copenhagen	Yes	Yes	No	No
Aarhus*	No	No	No	No
Odense	Yes	Yes	No	Yes
Faborg-Midtfyn	No	No	No	No
Fredericia	No	Yes	No	No
Hillerød	Yes	No	No	No
Høje-Taastrup	Yes	No	No	No
Greve	Yes	No	No	No
SUM of Yes:	18	13	4 (5)	8

Note: Green color means that the municipality has a GI plan.

*Park plan.

comparison to the other Scandinavian countries. A quote from the Stockholm GI plan illustrates their active approach to the use of ESS:

The concept of ecosystem services should be used actively as a tool in urban development and be integrated in economical evaluations in relation to exploitation and management. (Stockholm GI plan, 21)

Green structure or infrastructure was a much more commonly used term; it appeared in 18 of the 23 plans. Few of the plans clearly defined what they had included in GI. Examples of typologies used that were synonymous with GI were: green, green spaces, green areas, urban nature, green wedges, parks, and nature.

3.4. Measures of access

Increasing access to green spaces was a topic that was in focus in most of the goals/strategies across municipalities (see Table 2). Therefore, we find it surprising that an analysis of access was not included by more municipalities. All of the Norwegian municipalities with a GI plan and one Swedish municipality (Göteborg) presented

visual analyses (maps) of areas with a lack of green spaces. Geographical buffer distances of 200 meters (in Norway) or 300 meters (in Sweden) around parks/green spaces were used to show areas with a lack of green spaces. Eight of the municipalities also had guidelines for distance to parks/green spaces. These were 200–300 meters to smaller green spaces and 500–1,000 meters to outdoor recreation areas of approximately two hectares. In Stockholm and Göteborg, they also operated with recommendations regarding the qualities and/or functions that these recreational areas should have. It is notable that only one municipality in Denmark, Odense, had a recommendation of distance to green spaces. Nevertheless, analyses, maps, and recommendations of distances to differently sized green spaces are a part of the ongoing strategy work in both Aarhus and Copenhagen in Denmark. Borlänge, in Sweden, even presented ambitious recommendations for distance to parks in their municipal master plan; below is a quote from the plan:

- Aim at maximum 300 meters to the nearest green space from dwellings, nurseries, schools, and work places.
 - Neighborhood parks—target value: approximately 2 ha and distance 300 m.
 - Local district parks—target value: approximately 8 ha and 1,200 m from dwellings.
- (Borlänge municipal sector plan, online version)

4. Discussion

This review of GI plans and municipal master plans from Scandinavia shows that national policies about the importance of GI are implemented on a local level. Both ecological and social functions were addressed in the plans, which is a result that is also found internationally (Grădinaru and Hersperger 2019; Hansen *et al.* 2019). However, in accordance with Sandström (2002), Thorén and Opedal (1997), and Vejre, Jensen, and Thorsen (2010), we observed a stronger focus on (a higher number of) social functions, with a particular interest in human health and recreation, as well as access to green space. This shows that after twenty years, the focus in GI plans has not changed much. For future studies, we think it is important to qualitatively explore the reasons behind *why* social functions dominate the goals/strategies for GI on a municipal level. Furthermore, to explore potential challenges with implementing GI on a local, municipal, level (c.f. Khoshkar, Balfors, and Wärnbäck 2018; Slätmo, Nilsson, and Turunen 2019b).

The focus on the accessibility and measure of green space access in Scandinavian GI planning is similar to both the research and planning foci in many other regions of the world (O'Brien *et al.* 2017). However, for the future, it would be relevant for GI planning to work beyond simply universal distance-based measures, and also focus on potential differences in green space access between different user groups, such as marginalized user groups, e.g. children, the elderly, or migrants, who might have different or special requirements related to green space accessibility. Such an analysis would improve the basis for social and environmental justice considerations in GI planning practice (e.g. Kabisch and Haase 2014; Rutt and Gulsrud 2016). Interestingly, green spaces for children and youth, the variety of green space, and universally designed GI were the three topics in which we found most differences when comparing large and medium-sized municipalities. All these topics are in a way related to peoples' various needs. Both children and youth, as well as universal design, cover

aspects of equal rights and participation in the planning process. The results underpin the need for particularly the medium-sized municipalities to apply a more inclusive planning approach regarding the GI.

A focus on the different functions (or ESS) of green spaces could also be relevant to include in future accessibility measures, i.e. functionally oriented accessibility indicators (Ekkel and de Vries 2017). In a review of literature on the built environment and health among children and youth, Nordbø *et al.* (2018) demonstrates that studies using green and open space measures mostly apply the distance and proportion of green space, yet focus little on type or quality. To add to the literature on access to green space, we suggest future studies pay particular attention to the quality of green spaces (see, for example, Edwards *et al.* 2015; Nordh and Østby 2013; Weimann *et al.* 2017). Such information would also be of extreme relevance for practice.

Interestingly, almost all municipalities were concerned with increasing or developing the green wedges connecting the cities/towns with the surrounding landscape; a result that is in line with the core concepts of GI planning (Pauleit *et al.* 2017). Green wedges are important for both wildlife and humans, but, again, in most plans, the main purpose of the green wedges was to facilitate outdoor recreation. Our analysis also revealed that all the goals/strategies we found in the plans were covered to a larger extent in the plans by the large municipalities as compared with the medium-sized municipalities. Nonetheless, the result is not surprising, and confirms the strong focus on multifunctional GI planning within large city regions that we find in the research literature (Hansen *et al.* 2019; Grădinaru and Hersperger 2019).

Similar to observations made by Grădinaru and Hersperger (2019), not all municipalities actively used the concept GI. Instead, the municipalities used varied terminology, such as green spaces, greenery, urban nature, and urban parks of different sizes. Researchers have requested a joint definition of the typologies included in the GI concept (Koc, Osmond, and Peters 2017). Such a joint understanding would increase the transparency and comparability of GI planning across municipalities, as well as countries. The presence of GI as a concept in planning documents depends not only on knowledge among practitioners, but also on cooperation among various disciplines, and at the various scales under which the municipalities work (Di Marino and Lapintie 2018). We found that national guidelines have an impact on the choice of terminology. In Norway, GI is one of six topics that must be mapped in the municipal master plan. As a result, all Norwegian municipalities in our analysis used the concept GI in their plans. In Denmark, the authorities aim to launch a national “green map” in the coming years; this will most likely standardize both terminology and methodology.

Despite the strong focus on GI in national policy documents and municipal strategies across Scandinavia, the number of GI plans is relatively limited. In our study, three of the eight Norwegian municipalities we analyzed had a GI plan. This may seem surprising, since the Norwegian authority encourages municipalities to make such plans, and GI must be mapped as part of the municipal master plan. In Denmark and Sweden, all large municipalities and about 50% of the medium-sized municipalities in our analysis had a separate GI plan. The number of GI plans in our sample is higher than that found in data on national surveys from Sweden (National Board of Housing, Building and Planning 2019) and Norway (extended analysis of data from Thorén, Nordh, and Lund 2018). While these national studies cover most municipalities, including rural ones, our focus has been on large and medium-sized municipalities.

4.1. A Scandinavian discourse

Based on the findings of the study, we allow ourselves to talk about a Scandinavian GI planning discourse. There are many similarities in GI planning across the Scandinavian countries. These similarities relate to the percentage of municipalities with a GI plan, the scope of those plans in relation to municipality size and the recommended distances to the nearest green space. Assessing the focus within the GI goals/strategies, we found that the large municipalities in Sweden cover the highest number of goals. Furthermore, ESS appear in all of the Swedish plans, while in Denmark, it is only found in the GI plans of Copenhagen and Odense; in Norway, it is only found in the GI plans of Trondheim and Bergen. Moreover, countries differ in their classification of green spaces. In Sweden, several municipalities divide the green spaces into local parks, neighborhood nature, and nature areas. In Norway, the handbook of The Norwegian Environment Agency (2014) defines four types of GI areas: nature areas, nature walks, open spaces, and parks. In Denmark, the focus is on green wedges and protection of the open landscape, rather than individual green spaces. The focus on green wedges and corridors corresponds well with the international literature on GI (see, for example, Benedict and McMahon 2012; Pauleit *et al.* 2019). There is also a discussion on afforestation and urban forests in Denmark, which is not present in the plans from the other Scandinavian countries. This difference is well-documented (Nielsen *et al.* 2017), and the particular Danish focus on urban afforestation corresponds to strong protection of urban forest and ambitious national aims about an increase in forest cover. Across all our cases, we notice a focus on GI within or around built-up areas; hence, one could define it is an urban focus, even if the medium-sized municipalities may not be urban from an international perspective.

In our study, Norway had the fewest GI plans; nevertheless, all municipalities must map GI as part of their municipal master plan. Other studies comparing GI planning across countries concluded that GI planning varies due to differences in planning practices (Mell *et al.* 2017), responsibility, or landownership (Slåtmo, Nilsson, and Turunen 2019b). The Scandinavian countries have many similarities in planning practices (Borges *et al.* 2017), which offers a unique possibility for cooperation and discussion around a Scandinavian urban GI planning model, which could also be of interest outside Scandinavia. Therefore, we encourage the authorities to work on this further.

4.2. Limitations and suggestions for future studies

We chose to include three large and five medium-sized municipalities from each country. The number of municipalities is a limitation of the study. It is possible that we would have obtained different results if we had chosen other municipalities. However, we experienced data saturation after reading a number of plans from each country. This may reflect the fact that there is a Scandinavian discourse for GI planning at a municipal level. In both Norway and Sweden, there are handbooks to guide work with the GI plan (The Norwegian Environment Agency 2014; National Board of Housing, Building and Planning 1999, 2007, 2010), and this also renders the GI planning process more mainstream. As stated above, the percentage of GI plans was a little higher in our sample compared with similar reported numbers of municipal GI plans at a national level. Several of the medium-sized municipalities from Sweden and Denmark in our sample are in the capital regions, which might also explain the higher number of GI plans compared with national data. It is likely that these municipalities differ

from other more rural medium-sized municipalities, not least because the capital regions of Stockholm and Copenhagen work with GI on a regional level, in addition to the municipal level. In the process of choosing cases, we briefly scanned plans from several municipalities. Our experience is that smaller municipalities and rural municipalities seldom have a GI plan. In future studies, we suggest that particular attention is paid to smaller, more rural municipalities.

The study is based on a review of plans. Hence, our focus has been on the plans, not the planning process. To gain a deeper understanding of the approaches municipalities use for GI planning, we suggest a future qualitative study based on interviews with practitioners as well as stakeholders involved in GI governance, policy- and plan-making.

5. Concluding remarks

This research on the status of GI planning in Scandinavia shows that there is a Scandinavian discourse for urban GI planning. GI is a topic prioritized in national policy documents, as well as implemented in strategies on a local (municipal) level, including both large cities and medium-sized towns. However, the numbers of GI plans are limited; moreover, the format and terminology used varies across municipalities. In the future, we hope to see an increased focus on ESS in GI plans. We also encourage municipalities to more intentionally emphasize ecological functions, as well as apply functionally oriented accessibility indicators and measures on the quality of green space. With this comparative study, we hope to initiate a greater understanding of GI planning across and outside the Scandinavian countries, as well as possibly inspire practitioners to seek best practice examples from Scandinavia.

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No potential conflict of interest was reported by the author(s).

ORCID

Helena Nordh  <http://orcid.org/0000-0003-3668-008X>

Anton Stahl Olafsson  <http://orcid.org/0000-0002-7940-8126>

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