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Workshop Report

Integrating local knowledge and data in marine spatial planning and management - challenges and opportunities in the North Atlantic Region

Nordregio

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1. Introduction

Since the mid-20th Century, there has been a rapid expansion of marine and maritime activities, including oil and gas exploration, electricity and telecommunication cables, sand and gravel extraction, aquaculture, seaweed farming, and marine renewables, as well as the creation of marine protected areas (MPAs). This expansion has, in part, been facilitated by the extension of state jurisdiction over the sea, where states have increasingly claimed control over areas of the continental shelf adjacent to their coasts. This is in stark contrast to the relatively limited use during the preceding millennium, where marine activities were largely confined to fisheries and seafaring.

The change in marine use and prioritisation, including conservation, can lead to conflict between new and existing users through competition for space and resources, as well as a range of environmental impacts [1,2,3,4,5]. These conflicts and impacts have generally been seen more acutely in coastal areas [6,7,8]. However, development is increasingly occurring further offshore, through emerging sectors such as floating offshore wind, and deep-sea drilling for oil and gas [9,10].

To help mediate conflicts, balance multiple objectives, and move towards more sustainable decision-making, marine spatial planning or maritime spatial planning (herein MSP), has emerged as a key management tool [4]. Within Europe, the first nations to develop MSPs in the mid-2000s were Belgium [11], Germany [12], and the Netherlands [13]. Within the EU the role-out of MSP became mandatory for member states through the EU Maritime Spatial Planning Directive 2014/89/EU (MSPD) in 2014. Subsequently, Sweden and Denmark adopted MSP in 2021 and 2022. While Norway has a multi-tiered marine planning approach, Iceland has opted to develop marine plans in areas where there is specific need. Iceland, Faroe Islands, Greenland and Norway are not bound by the EU Directive as non-member countries, and while the UK has left the EU it chose to retain the Directive requirement in legislation. In Scotland, pilot projects were also developed in 2006 [14], and Scotland adopted its first national marine plan in 2015.

MSP has been seen as a management tool that could align disparate governance structures, provide a ‘public’ forum, and deliver blue economic growth. However, translating theoretical MSP ideals into practice poses several challenges, including overcoming existing power imbalances, differences in values, interests and priorities between stakeholders, knowledge gaps, data accessibility and quality, disparate data types, and balancing competing needs [15,16,17,18,19,20,21].

To overcome some of these challenges for stakeholder and public participation are increasingly being recognised as a way to integrate local perspectives into marine planning. Thus, stakeholder and public participation in MSP are intended to respond to a range of objectives including improving understanding of the marine environment; resolving conflicts over use; incorporating social dimensions; and strengthening the acceptability of decisions in the

eyes of users and communities [22]. This can be achieved through participatory methods including consultation, where stakeholders and knowledge holders become sources of data for researchers, or through the co-production of knowledge where:

"iterative and collaborative processes involving diverse types of expertise, knowledge and actors to produce context-specific knowledge and pathways towards a sustainable future" [23].

The inclusion of stakeholder knowledge through participative methods emerged to challenge existing approaches which can exclude a range of knowledge types, particularly local and Indigenous knowledge [24,25]. Hence, despite attempts to establish participatory methods and integrate local voices in MSP, concern has been expressed by existing marine users and communities that traditional users are being pushed aside by new development activities [26], transitioning from *Mare Liberum* [27] to spaces subject to rigorous state control [28]. Indeed, despite efforts, Indigenous and local knowledge is rarely fully included in the whole MSP process, leading to a range of challenges including (but not limited to) enforcing rather than overcoming existing power imbalances, tokenistic inclusion, creating 'talking shops' that delay decisive action, creating consultation fatigue and may be compounded by the non-negotiable positions or actors with veto power [29].

The advancements of new technologies and digital transformation in a rapidly changing world has extended this gap further. Driven by the demand for more efficient processes, intensifying ocean resource use, the majority of today's MSP processes incorporate various types of digital tools to aid decision-making and assessments. Such digital tools are commonly explained to enhance MSP processes through their abilities to analyse vast data sets, use digital mapping tools, and create comprehensive intensity assessments. However, while a digital transformation may act as an enabler for MSP, a rapid digital transformation may cause the divide between who can participate in MSP process and decision-making to increase, especially due to differences in access to technical tools, resources, and expertise coupled with fundamental divergence in value systems and beliefs, and social considerations [30].

1.2 Introduction to workshop

This workshop will explore the role of local knowledge in MSP for a just green transition in times of digital transformation and climate change. It will seek to understand what we can learn from each other within the region, how cross-country exchange and collaboration can address challenges and take advantage of opportunities ahead. The workshop has been funded by the Nordic Council of Minsters, via the Nordic working group on fisheries (AG-Fisk), supporting a strong and dynamic North Atlantic region, and we welcome participation from Denmark, Faroe Islands, Greenland, Iceland, Norway, Scotland and Sweden.

The workshop will explore best practices across the North Atlantic region, to address three key questions:

- **How has Indigenous, local or users knowledge been integrated into MSP and management processes in the North Atlantic region, and what challenges have countries in the region faced to integrate diverse knowledge types into these processes?**
- **What challenges and opportunities does the fast digital transformation pose for the inclusion of diverse local knowledge and data sources in MSP and management in the region?**
- **What opportunities can digital tools contribute to facilitate the integration of diverse local knowledge sources in MSP and management?**

2. Marine management and MSP in the North Atlantic Region

Denmark

Denmark adopted their first Law on MSP in 2016, the Danish Maritime Spatial Planning Act, encouraged by the EU MSPD. The Act establishes a framework for implementing a Maritime Spatial Plan for the Danish marine area and promotes sustainable development of: the maritime energy sector; maritime transport; fisheries and aquaculture; extraction of raw materials; preservation and protection of the environment; tourism and recreation. Following the Danish Maritime Spatial Planning Act, a comprehensive Maritime Spatial Plan was developed through a coordinated and collaborative process between the Danish Maritime Authority under the Ministry of Industry, Business and Financial Affairs, various other ministries (e.g., the Ministry of Environment, the Ministry of Climate and Energy, the Ministry of Food, Agriculture and Fisheries), stakeholders (e.g., fisheries, energy industries, transport), and interested parties. The Danish Maritime Spatial Plans were adopted in 2021 as the first legally binding plan/map for Danish waters.

The Danish Maritime Spatial Plan covers the entirety of the Danish Exclusive Economic Zone and territorial sea and therefore holds an essential role as a tool for enhancing collaboration between the many interests and actors in the Danish marine areas. To further ensure transparency of the content and development of the Danish Maritime Spatial Plan, it has been digitalised and made available to the public at https://havplan.dk.

Read more:

- Danish Maritime Authority. (n.d.). Maritime spatial plan.

Faroe Islands

Similar to the other island nations in the North Atlantic, the Faroe Islands have a long history as a seafaring country, depending on the oceans to support the livelihoods of the residing coastal communities. Today, marine resources still hold great significance for the country with the Faroe Islands having one of the largest fisheries and recently aquaculture per capita, with marine resources constituting 95 percent of Faroese exports of goods.

However, despite the growth of marine industries, the Faroe Islands have not yet developed a marine spatial plan for their coastal and marine areas. Instead, marine activities are regulated and managed through the distribution of licences e.g., fishing quotas and licences for fish farming. Thus, marine activities are evaluated and assessed on a case-by-case basis under the respective ministries responsible. Hence, while regulations on spatial use do exist, the Faroe Islands have not yet established an overarching marine spatial plan.

In addition to the licensing system, all marine activities are required to undergo an environmental impact assessment. However, this requirement does not apply to fisheries and aquaculture. Fisheries management is instead regulated according to the Faroese fisheries management regime which utilises area closures based on gear, season and effort.

Read more:

- The Government of the Faroe Islands. (n.d.). Oceans, Fisheries and Maritime Affairs. Retrieved November 20, 2024.
- Ministry of Foreign Affairs, Industry and Trade, Ministry of Fisheries, The Faroese Fish Producers Association, The Association of Faroese shipowners, & The Faroese Fish Sellers Association. (2018). Faroe Islands - Fishery Legislation and Administration. Faroese Seafood.

Greenland

MSP has not yet been developed within the waters around Greenland. As Greenland withdrew from the European Union in 1985, the instituted MSP legislation such as the Marine Spatial Planning Directive (2014/89/EU) does not directly apply. However, through its close connection to Denmark as an autonomous territory within the Kingdom of Denmark, Greenland has set out to apply an ecosystem-based approach to management, initiating the process with several pilot projects. These have been largely initiated due to the increasing environmental degradation and pressures from marine traffic, e.g., shipping and tourism. With increasing pressures on the environment and the Indigenous and local communities, the pilot projects attempt to identify areas of higher ecological significance for biodiversity, birds and wildlife, and marine ecosystems. Accordingly, plans for protected areas are given high priority.

Additionally, it is important to note that manpower and resources are relatively scarce in comparison to the vast area of Greenland. As such, questions remain about how to effectively implement larger coastal and marine management. Additionally, there is a need to understand what effects such plans would have on the livelihoods of the communities living along the Greenlandic coastlines.

Read more:

- Morf, A., Perus, J., Steingrímsson, S. A., Ekenger, M., Evans, S., Mayer, I., & Zhou, Q. (2014). Results 2nd Nordic Workshop on MSP. https://doi.org/10.6027/na2014-932
- Christensen, T., Falk, K., Boye, T., Ugarte, F, Boertmann, D., Mosbech, A. 2012. Identifikation af sårbare marine områder i den grønlandske/danske del af Arktis (Identification of Vulnerable Marine Areas in the Greenlandic/Danish Part of the Arctic.) Scientific report (43), Danish Centre for Environment and Energy, Århus University.
- Schütz, S. E. (2018). Marine Spatial Planning – Prospects for the Arctic. *Arctic Review on Law and Politics*, 9, 44–66. https://doi.org/10.23865/arctic.v9.899

Iceland

In Iceland, the first law on MSP was established in 2018, requiring the many fjords and coastal areas to undergo the process of developing coastal zone plans. As such, where the oceans in and around Iceland have been predominantly used for fisheries, growth in new industries such as aquaculture and tourism has given rise to the need for more complex planning and prioritisation of space. As a result, the fjords in the West and East were the first to undergo the process of developing coastal zone plans, followed by Skjalfandi Bay in the north of Iceland, with the Skipulagstofnun (National Planning Agency) as the lead organiser. In each location, a regional council was appointed with the intention of preparing the plans with the aid of the municipalities, various research institutes, and a consulting group consisting of local businesses and other actors. It is important to note that regulations of commercial fisheries are excluded from the Icelandic MSP Act.

Once the coastal zoning plan for an area has been submitted it is open to the public and any interested parties can make comments which will be taken into consideration by the Regional Council. The development of MSP in Iceland is still relatively new, however with increasing activities in the oceans, the importance of planning and developing MSP for a sustainable future is becoming apparent.

Read more:

- Skipulagsstofnun. (n.d.). Marine planning. Ísland.is.
- Hafskipulag. (2022). *Skipulag haf- og strandsvæða í landsskipulagsstefnu*. Hafskipulagsstefna.
- Kokorsch, M., & Benediktsson, K. (2018). Prosper or perish? The development of Icelandic fishing villages after the privatisation of fishing rights. *MAST. Maritime Studies/Maritime Studies*, 17(1), 69–83. https://doi.org/10.1007/s40152-018-0089-5
- Wilke, M. (2023). Public participation in marine spatial planning in Iceland. *Frontiers in Marine Science,* 10. https://doi.org/10.3389/fmars.2023.1154645

Norway

The purpose of Norway's management plans is to ensure the sustainable use of marine resources while preserving the ecosystem. Each sector, including shipping, fisheries, and energy, is managed separately under specific legislation and ministries. Regional integrated management plans for the Barents Sea, Norwegian Sea, and North Sea (under development) aim to coordinate across sectors.

MSP in Norway is combined with a marine strategy into integrated marine management plans. At the largest scale a national marine plan exists: 'The integrated marine management plan. Barents Sea–Lofoten area, the Norwegian Sea and the North Sea and Skagerrak (2020)'. This plan aims to achieve holistic and ecosystem-based management for Norway's marine areas. It provides guidance for the public management of different marine sectors through more detailed, sector-specific management laws and processes.

At a more localised scale, Norway has two levels of local government: county and municipal. The country is divided into 19 counties (Regions). At local level it is further divided into municipalities. There are 275 coastal municipalities. The Planning and Building Act 2008 (PBA) regulates regional and municipal planning. County Councils and Municipal Councils have competence under the Planning and Building Act to adopt both municipal and county plans landward of the baseline and out to 1 nm.

Read more:

- Norway – MSPGLOBAL2030.
- Meld. St. 20 (2019–2020) - regjeringen.no.

Scotland

The UK established an integrated planning system for the UK's marine environment via the Marine and Coastal Access Act 2009. The four administrations in the UK (England, Scotland, Wales and Northern Ireland) developed separate marine planning processes and legislation, with the 2009 Act remaining the overarching legislation. Despite the same base legislation, England and Scotland have taken different approaches to MSP with Scotland choosing to legislate, via the Marine (Scotland) Act 2010, for a national marine plan with eleven subordinate regional marine plans. In Scotland, the National Marine Plan has been developed by the Scottish Government's Marine Directorate (previously known as Marine Scotland), while regional marine plans are developed by local 'delegates', also referred to as marine planning partnerships (MPP).

In Scotland, trials of MSP began with the Sustainable Marine Environment Initiative (SSMEI) which ran from 2006-2010 [14], followed by a pilot in the Pentland Firth which ran from 2012-2016 [31]. It was intended that the SSMEI pilots would both inform the development of the National Marine Plan, and uniquely to Scotland in the UK context, future regional (sub-national) marine plans.

Scotland adopted its first National Marine Plan in 2015 [32] and opted for a policy framework without the use of hard zoning, although sectoral plans for marine renewables were established which identified priority areas for development. Marine regions were formally defined in 2015 via the Scottish Marine Regions Order [33]. In 2016, the Scottish Government gave direction to the NAFC Marine Centre UHI (now UHI Shetland) and the Shetland Islands Council to form a MPP for the Shetland Marine Region, with a marine plan for the region subject to public consultation in 2019. The development of regional marine plans was intended to provide a pathway for local knowledge and values into MSP in Scotland. In 2022, the Scottish Government initiated the development of an updated National Marine Plan, 'NMP2'.

Read more:

- Scottish Government. (2015). Scotland's national marine plan.
- UHI Shetland- Shetland Islands Regional Marine Plan

Sweden

The Swedish Environmental Code (1998:808) and the Plan and Building Act (2010:900) constitute the legal basis for MSP in Sweden. The EU Maritime Spatial Planning Directive (2014/89/EU) has been incorporated into national legislation through the Marine Spatial Planning Ordinance (2015:400).

In 2002, under this legislation and in line with the EU MSP Directive, Sweden adopted three marine spatial plans, one for the Gulf of Bothnia, one for the Baltic Sea and one for the Skagerrak/Kattegat. The Swedish Agency for Marine and Water Management is responsible for drafting proposals for the plans including the consultation process, and submit these to the Government. The adopted plans are currently under revision, and the Agency is required to submit proposals for the revised plans to the government no later than January 21, 2025.

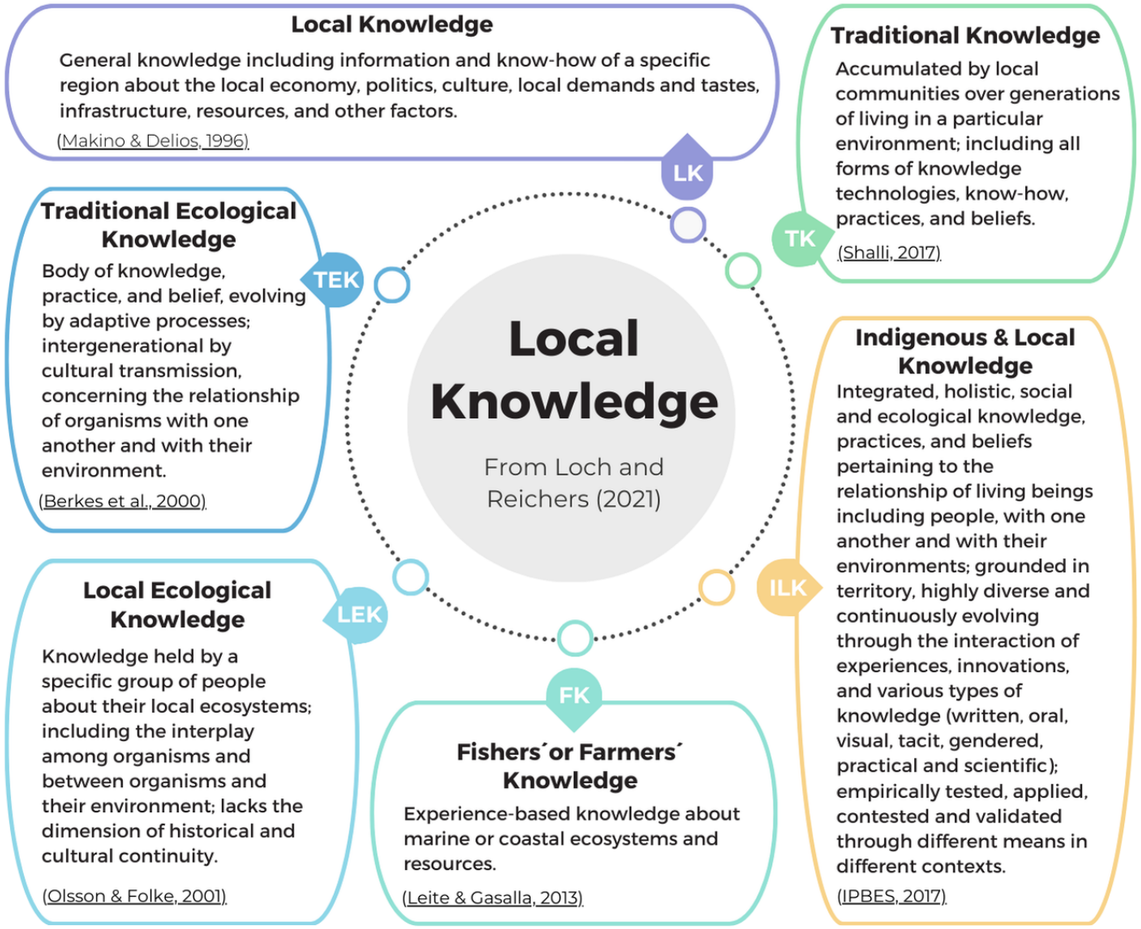
National marine plans are complemented by comprehensive plans for inland territorial waters developed by municipalities, under the Planning and Building Act (2010:900). In the area of territorial waters where national and municipal plans overlap, both plans apply, while the MSP alone applies in the outer- most marine area , and the comprehensive plan alone applies in the coastal area.

The Swedish planning approach requires important consideration of the interaction between MSPs and comprehensive municipality plans in order for the connection between sea and land to function well. Comprehensive municipality plans are significant for indicating local and regional considerations and claims which may be relevant to marine spatial planning.

Read more:

- Swedish Agency for Marine and Water Management. (2019, March 22). Marine spatial plans.

3. Towards understanding Indigenous & local knowledge



Local Knowledge (LK) is diverse. There is therefore not a singular definition which explains what is understood as LK, instead it may vary greatly in meaning between countries and contexts [34,35]. In general terms, LK is often described as the wisdom, skills, and understandings that people living in a specific community have developed over time through direct interaction with the environment around them [36]. LK is therefore explained to include spatially specific information of the local context such as for example, the culture, local demands and needs, politics and functions of the economy.

While the existing literature on LK often define it in terms of Indigenous communities, it is important to note that LK also encompasses local communities that do not fall under Indigenous

legal frameworks. Thus, communities that do not identify as Indigenous or assert certain rights are still recognised as LK holders. In a Nordic context, the term LK therefore includes both Indigenous peoples (e.g., Sami and Inuit communities) but also local communities (e.g., local fishermen, local citizens) who possess specific knowledge of the local environment and practices.

To add to the complexity, over the years, LK has been divided into several different subcategories, reflecting the fact that LK is viewed differently across fields of research, countries, and communities themselves. Frequently used terms are Indigenous and Local Knowledge (ILK), Traditional Ecological Knowledge (TEK), Local Ecological Knowledge (LEK), Fishers' Knowledge (FK), and Traditional Knowledge (TK) [37]. While they all possess the same characteristic of generational and cultural transmission, variation is seen in terms of what knowledge is transmitted. For instance, fisher's and farmer's knowledge show a transfer of experienced-based knowledge, LEK and TEK focuses specifically on local ecosystems and ecological knowledge, and ILK takes a holistic approach, encompassing all practices, beliefs and knowledge. Although, existing literature tend to view LK through an Indigenous lens, recommendation by the United Nations (UN) and UNESCO suggest that LK should be referred to as Indigenous and Local Knowledge [37]. This is recommended as ILK acknowledges the heterogeneous nature of LK by including both Indigenous peoples and local communities that share many characteristics yet separate the groups according to rights and laws. Hence, the term reinforces that Indigenous peoples are recognised and granted rights according to the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) yet broadens the scope to include local communities that are not recognised as Indigenous [37,38].

Regardless of the diversity of the definitions and views of LK, one of the main challenges today is recognising the value of LK in a world dominated by scientific approaches and technocratic processes. Therefore a challenge exists to make sure LK is respected and integrated, especially in global discussions about climate change, conservation, and economic development [39]. Understanding how diverse communities interact with their environment is highlighted as important due to its ability to offer valuable insights for solving global issues. Yet, despite the increasing recognition of its importance in MSP processes, existing literature highlights that local communities report that their knowledge is often overlooked or undervalued in favour of scientific "expert" opinions [40]. One of the main factors contributing to this perception of misrepresentation is the uncertainty regarding what LK entails and the lack of a shared understanding of local values. There is therefore a need to develop a deeper understanding for how LK is viewed and acknowledged across different countries and contexts. Similarly, recognising the heterogeneity and evolving nature of LK may aid the process of incorporating it into MSP processes.

Within the workshop we will be hearing examples from across the North Atlantic region of the challenges and opportunities of incorporating Indigenous and local knowledge into marine decision making. The session will explore how local knowledge and values are collected, analysed and incorporated, and what challenges countries in the region have faced with the integration of diverse local knowledge into these processes.

In this workshop we therefore pose the questions:

- **How do the way we define and view local knowledge across the different countries affect the ability to identify and integrate valuable local knowledge into MSP and management processes?**
- **What type of local knowledge can be difficult to integrate into MSP and why?**
- **Do the countries see any particular type of local knowledge or values that is often missing?**

4. MSP and marine management in a digital era

A digital transformation is reshaping business, policy and everyday lives, with new opportunities presenting themselves with the development of technological tools and innovations [41]. While novel in MSP, the emergence of tools for decision-making, spatial planning, forecasting, and processing data have changed the way we look at our current planning processes. Traditional methods such as mapping with the use of pen and paper have quickly been replaced or combined with geographical information systems (GIS), where isolated data on environmental conditions are combined in cumulative impact analyses, and in today's highly innovative society, Artificial Intelligence (AI) has appeared as the newest tool in the planning toolbox [42,43]. As such, we find ourselves in the middle of a digital transformation and a race for data.

Driven by an effort to enhance efficiency, digital transformation is predominantly a term used within the spheres of business, economics, and information systems, where it is often defined as:

"transformation concerned with the changes digital technologies can bring about in a company's business model, … products or organisational structures" [44].

The concept of digital transformation alludes to being a market-driven approach, spurred by increasing demand in a capitalistic economic structure. As such, one may wonder what relevance understanding digital transformation has in the contexts marine management. With an increasing demand for ocean resources, the very same mechanisms that push businesses to digitalise their processes act within governments, institutions, and planning agencies. As a result, MSP processes are increasingly relying on various digital tools to increase efficiency and analyse larger quantities of data. Consequently, quality, accessibility, and the usage of data determine the structure and development of MSP [45]. Indeed, as MSP is rolled out globally the need for baseline data collection relevant to marine planning needs and objectives has become apparent, as has the large number and types of data relevant to MSP. These data normally include environmental and biological variables, economic activities, and social and cultural uses. However, while academics present various ways of how such data can be utilised, few practical examples exist within published literature. This may be largely contributed to the fact that practical examples are seldom published, resulting in a gap between theory and practice. Consequently, one may ask how we can bridge this gap to enable the integration of vast data and methods in marine management. At an EU level there is ongoing work to ensure data harmonisation between member states[1].

Within the workshop we will be facilitating a discussion of what an increasing digitalised process means for the field of MSP and marine management and how this affects the integration of diverse local knowledge. We will further hear examples of what technologies are currently used within the field of planning and facilitate a discussion about the future barriers and opportunities of integrating data and local knowledge in a digital world.

In this workshop we therefore pose the questions:

- **What challenges and opportunities does the ongoing fast digital transformation pose for the inclusion of diverse local knowledge and data sources in MSP and management in the Region?**
- **What opportunities can digital tools contribute to facilitate the integration of diverse local knowledge sources in MSP and management?**
- **What digital tools are mainly used today?**
- **What developments are seen (both positive and negative) in the field?**

4.1 Current uses of digital tools in MSP and marine management

4.1.1 Mapping

To support this workshop, a comprehensive literature review was undertaken to explore the effects of digital transformation in MSP and marine management, with the aim to identify current practices and usage of digital tools. The resulting literature demonstrates a widespread use of various digital tools in the North Atlantic region and globally. Out of the articles analysed in this research, nearly all employed some form of digital tools, with a large portion focusing on mapping through the use of geographical information systems (GIS). GIS tools were applied to both primary and secondary data, synthesising and analysing diverse datasets to create comprehensive overviews of the intended area [43]. Studies based primarily on pre-existing datasets often layered information on environmental conditions and species distribution [46], tourist densities and human activities [47], infrastructure locations, and fisheries routes [35]. These data were used to inform MSP processes including identifying space for renewable energies and new maritime industries.

The usage of secondary data is frequent, with recent MSP initiatives often utilising pre-existing datasets in combination with social values and qualitative data. In an effort to apply ecosystem-based management and inclusion of local voices in planning, recent MSP literature advocates for using GIS to map human dimensions and social values [43]. This approach often involves a series of workshops with Indigenous peoples and local communities to conduct participatory mapping (PGIS) or conduct interviews where the collected data are converted to a digital map at a later stage [48,49]. These approaches help to capture the unique cultural values of a local place, values that are often communicated in an intangible and holistic manner [49].

1 What's next on Maritime Spatial Planning? - European Commission

Methods such as participatory mapping can help to build trust, enhancing the acceptance of plans, and enabling a co-creation of MSP plans and processes [50]. An example of technologies used for participatory mapping is SeaSketch, a digital tool that allows groups to map simultaneously, creating a space for joint mapping [49]. Although participatory mapping can be conducted with the use of pen and paper, it can also utilise GIS enabled technologies, giving rise to participatory geographic information systems (PGIS). PGIS thus enables an inclusive decision-making process and local participation in resource management and spatial planning [51]. Through this democratisation of spatial planning, the usage of participatory approaches involving the Indigenous and local communities allows for the creation of data in otherwise data scarce areas. Where secondary data has not yet been collected, social data and values are essential for understanding the local environment.

Mapping processes provide the opportunity for all or multiple stakeholders to be consulted as data/ knowledge holders but also to co-create the scope of data collection, determining relevant data types for the area and how data should be presented. This digitalisation can reveal when there is lack of knowledge or evidence representing local communities and uses. Whilst conceptualising justice is complex and multifaceted, MSP provides an opportunity for community and local uses to be better represented. The provision of community relevant environmental, economic and community data for inclusion within the decision-making process can assist in the representation of stakeholders within the plan making process, facilitating increased recognitional and procedural justice [52,53] and informing distributive justice.

To further ensure accessibility of data and facilitate mapping processes, the creation of online data portals to hold data has become increasingly common, and marine planning needs are often pivotal in driving national data collection programmes [54]. Examples of data portals within the North Atlantic region include Scotland, where the national data platform is called ‘National Marine Planning Interactive (NMPI)’, and Landmælinga Ìslands – the National Land survey database in Iceland.

4.1.2 Decision support systems

Marine management and MSP have increasingly looked to digitalisation and decision support systems (DSS) to negotiate the complex and competing demands placed on marine space. This digitalisation includes data mapping which provides an opportunity for a range of activities, users and uses to be considered early in the decision-making processes, including their consideration in more detailed strategic spatial guidance. DSS are regarded as important intermediaries to assist in management plan development in an objective, efficient, and fast manner [52]. Output data becomes information when it is relevant and utilised by decision-makers [56] and should assist problem solving and decision-making [57]. While a marine plan itself might be considered a DSS, the use of computerised models has the potential to assist the planning and management process where decision-making is complex.

Globally the development of MSP has led to a proliferation of DSS, with assessments of tools indicating over 100 are available for the North Sea alone [58]. However, DSS are frequently unsuccessful in terms of uptake in decision-making [59]. The development of DSS and their application in management to inform complex issues can be hindered by a range of factors, even where challenges may be considered quantitative in nature. This includes the suitability of DSS to resolve the specific management issue, data requirements (including data sparsity), time and costs for development and maintenance, complexity of the system and uncertainty of the output or the limited involvement of the end users in the development phase of the model [60,18,61,62].

Decision support tools have frequently been criticised for failing to consider policy in their development [62]. Learning between marine areas therefore frequently generates knowledge, which is transferable, but not necessarily directly reproducible in other regions. This contributes to the challenge of utilising a DSS developed in one region or area to another.

The use of DSS is evident in marine planning process in the North Atlantic region, including marine renewables and ecosystem-based planning tools. We hope to explore the use of these tools in MSP within the workshop.

4.1.3 Artificial Intelligence

While the use of Artificial Intelligence (AI) in MSP is novel, new AI technologies are slowly being developed for planning purposes. Due to their ability to understand complex functions, collect and analyse various datasets, and identify patterns to support informed decision-making, AI technologies are identified as presenting new opportunities within planning [42]. Novel studies such as those presented by Spalding et al. (2023) [47] allude towards its potential, where machine learning is used to model and map ecosystem values significant to tourism. In this study, user-generated content (UGC) e.g., reviews on Tripadvisor, are combined with local datasets and participatory mapping data collected through a workshop. The combination of big data and local knowledge then led to the development of use-intensity maps, showing how nature influences tourism in the planning area, spanning from ocean activities to coastal recreational use. This may be one of the few examples of AI technologies being used in planning currently. However, as a significant portion of marine planning relies on data, it can be argued that AI technologies may hold vast opportunities in the future. Thus, while AI technologies are in their infancy, a discussion about how AI and new technologies may affect the planning field is needed.

4.1.4 Digitalisation challenges

A digital transformation poses many challenges for LK. For example, where rigid regulatory processes exist and the methods developed to digitise, map and use data have to align with norms of legal and regulatory systems, stakeholders can find they often have minimal agency over how data is used. In this way, MSP might be classified as “planner centred”, with

participation that is focused on outcomes in contrast to ‘‘people-centred’’ participation, which builds capacity and empowers stakeholders to define and meet their own need [63]. If collection and representation of knowledge and data do not comply with existing norms including data collection or representation methods, there is the risk that data gathered may not be included within decision-making processes [22].

So, whilst MSP and digitalisation has a clear potential to bring a greater range of uses and values to the fore, there is a risk of amplifying real or perceived injustices, where closely held values are difficult or impossible to represent in static maps, processes fail to adequately engage all parties during mapping and policy development; or processes fail to consider existing power imbalances [53]. This could be particularly problematic if these data and policies are used to develop decision support tools.

To avoid exacerbating this risk of creating injustices, transparency throughout the planning process is essential. Evidently, as the data and tools used will influence the outcome of the planning process, clarity on what data has been used and how it was collected will determine the acceptability of plans. Who was involved in the planning process will also have greater significance as the divide between who has the access, skills and resources required to partake in the process may grow.

5. Workshop Programme

Day 1 – Monday 20 January 2025

11.30 – 12.00 Welcome & light refreshments

12.00 – 12.10 Introduction to the meeting: Matthias Kokorsch

Part 1 – Marine Spatial Planning in the Nordic Region

12.10 – 12.30 Key note: David Goldsborough

12.30 – 14.00 Country presentations by:

- Lewis Hurley
- Kari Grundig
- Hans Ellefsen
- Magnús Jóhannesson
- Kristen Ounanian

14.00 – 14.30 Coffee break

Part 2 – Local knowledge in marine management and planning

14.30 – 16.00 Presentations by:

- Helle Torp Christensen
- Kathryn Fradera
- Catherine Chambers
- Masaana Egede

16.00 – 17.00 Panel discussion

Day 2 – Tuesday 21 January 2025

Session 3 – Digital tools in marine management and planning

08.45 – 09.00 Introduction by Rebecca Eriksson

09.00 – 09.45 Presentations by

- Evert Flier
- Smári Mccarthy
- Jonas Bjärnstedt

09.45 – 10.15 Coffee break

10.15 – 11.20 Discussions in break out groups

11.20 – 11.40 Open discussion & summary from groups

6. Workshop Summary

What role does local knowledge have in marine management and planning in times of digital transformation and climate change? How can we learn from each other and foster cross-country collaboration within the North Atlantic region to address the challenges and opportunities ahead? This was the focus of the workshop Integrating Local Knowledge and Data in Marine Spatial Planning and Management – Challenges and Opportunities in the North Atlantic Region, held in Victoria Quays, Edinburgh. By bringing together a diverse group of participants from across the North Atlantic, the two-day workshop aimed to explore how rapid digital transformation affects marine management and planning processes and how the increasing use of digital tools influences the integration of local knowledge and data. Divided into three sessions, the workshop included examples from Scotland, Sweden, Iceland, Norway, Denmark, Greenland, and the Faroe Islands, illustrating different approaches to integrating diverse information into marine management and marine spatial planning.

The first session discussed the status quo of marine management and planning in the North Atlantic region, highlighting current challenges the countries have faced in integrating various information, and the influence of policy objectives and institutional barriers. A key focus was the influence of governance scale on planning effectiveness, particularly how different levels shape the balance between national and local priorities. Differences in scale were also seen to affect the availability of time and resources, directly influencing the extent to which stakeholders and communities can be meaningfully engaged in management and planning processes. As a result, local knowledge integration was seen as limited, often reduced to public participation where communities act as consultants rather than partners. The reasons identified for this were several, including short planning timeframes and consultation schedules, and the need for more detailed guidelines to support identifying and involving local communities and stakeholders. These challenges highlight that, while local knowledge was seen as crucial for creating sustainable, inclusive, and equitable planning, uncertainty remains on how to properly integrate it into marine management and planning processes.

In response to the identified institutional barriers, the remaining discussions focused on how a rapid digital transformation and increasing reliance on digital tools can facilitate or hinder the integration of local knowledge in marine management and planning processes. These conversations highlighted emerging opportunities, such as the use of geospatial technologies, data-sharing platforms, and Artificial Intelligence (AI) to enhance processes. The growing use of digital tools in marine management and planning was identified as a way to speed up workflows and incorporate a broader range of data types. Digital tools could further support planners, stakeholders, and local communities in multiple tasks, e.g., translation between different languages and industry jargon, stakeholder engagement, streamlining of repetitive tasks, creating adaptive planning processes, and developing feedback loops.

While technological solutions offer opportunities for marine management and planning processes, over-reliance on digital tools and data-driven approaches may lead to sub-optimal outcomes that could be unjust to certain communities and sectors. This was particularly emphasised in the case of communities that have historically been overlooked or have experienced injustices in management and planning processes, often in favour of Western scientific approaches. With this in mind, questions arose about whom current management and planning processes are for and whether local knowledge should and could be converted into digital formats to fit digitalised processes, or if this may exacerbate power imbalances and disparities. As current practices of integrating local knowledge were explained to mainly utilise mapping tools to “translate” local knowledge into digital formats, ambiguity remained as to whether digitalising it will affect its use, for example through loss of context, detail, and value. This becomes critical as local knowledge is understood as an intrinsic part of communities’ identities, reflecting their values, social structures, practices, and beliefs. Hence, although digitalising local knowledge was seen as important for documentation, preservation purposes, and ensuring that local perspectives are accounted for, digitalising it was seen to be, to an extent, a question of justice and equity.

In light of this, accelerating digital transformation in marine management and planning highlights the need to address data ownership, quality, accessibility, and harmonisation. This becomes increasingly important as AI evolves, necessitating stronger control mechanisms to ensure responsible and ethical use. Within these discussions, AI presented both risks and opportunities. In one respect, AI was seen as an augmenter with the ability to expand the gap between data-driven scientific processes and local knowledge. Effectively using digital tools and AI therefore requires an awareness of their functions and strengthening of technical skills. Alternatively, digital tools and AI solutions could be designed to fit their intended users, requiring lower technical skills. Additionally, ensuring responsible and transparent use of digital tools and AI necessitates a controlled environment, strategies for ensuring data quality, and fostering harmonisation across datasets and systems. Grounding planning in the local environment was also seen as essential, where processes prioritise local needs, conditions, and existing data, and develop planning that suits these conditions. Building on this foundation, digital tools and AI can help overcome barriers, reduce time and resource constraints, and accelerate planning by integrating diverse data sources and enabling dynamic, feedback-driven processes. In doing so, these technologies support more inclusive and holistic marine management that considers both spatial and temporal dimensions.

7. Workshop team

Kerstin Bly Joyce

I am a research advisor at Nordregio, a Nordic research institute established by the Nordic Council of Ministers. Currently, I work on several projects related to marine and maritime spatial planning in the Nordic region and Europe. My background is in environmental economics and policy design, focusing on water and marine management. I am particularly interested in integrating diverse values into evidence-based policy and understanding actors' interests to contribute to designing sustainable, fair, and inclusive policy processes. In this project, I am particularly interested in the challenges and opportunities of integrating diverse knowledge and values in relation to stakeholder involvement on equal terms within countries' marine and maritime spatial planning.

Matthias Kokorsch

I am the academic director of the Master's program 'Coastal Communities and Regional Development'. My research interests include community resilience, regional development, particularly in sparsely populated regions, structural changes of old-industrial areas, and resource management in combination with aspects of justice and decision-making processes. In this project I am particularly interested in the aspect of knowledge integration and whether AI is a curse or a blessing in this regard.

Rachel Shucksmith

I am a researcher at the University of Highlands and Islands Shetland. I lead the delivery on Shetland Islands Regional Marine Plan in partnership with the local authority, Shetland Islands Council. My research seeks to address marine management and governance challenges through applied interdisciplinary projects, addressing real world challenges. Through place-based research I seek to explore how management and governance processes can be adapted to facilitate decision-making which is inclusive of different values and knowledge types, to achieve sustainable outcomes.

Myriam Chilvers

I am a research fellow at Nordregio, a Nordic research institute established by the Nordic Council of Ministers. I am a political scientist specialised in local democratic governance and citizen participation. My interests lie in developing timely research and tools that support civil servants and politicians to practically understand and address complex problems democratically. Currently, I work with Kerstin on several projects related to marine and maritime spatial planning in the Nordic region and Europe.

Rebecca Eriksson

I am a research assistant and a Master's student at the University Center of the Westfjords, pursuing an interdisciplinary program in Coastal Communities and Regional Development. Currently, I am writing my Master´s thesis aiming to explore how diverse knowledge systems are influenced by the development of digital tools and artificial intelligence, and how these technologies can be utilised to support the inclusion of local voices in marine planning processes. I am therefore particularly interested in human-technology interactions, justice, equity, and the challenges and opportunities faced by coastal communities and marine life. I am very excited to meet you all!

Tabea Jacob

As a research assistant and Master's student at the University Centre of the Westfjords in Ísafjörður, Iceland, I am enrolled in the interdisciplinary program focused on Coastal and Marine Management. My research pursuits encompass fisheries management, ocean governance, the Blue Economy, and the critical aspects of social justice and equity for local communities. Through my Master's Thesis, I aim to explore social justice challenges faced by small-scale fishing communities in Greenland, specifically on integrating local knowledge and the cooperation between politics and communities in decision-making processes.

8. Attendee affiliation

Project Team	Affiliation
Matthias Kokorsch	University Centre of the Westfjords, Iceland
Rachel Shucksmith	University of Highlands and Islands, Scotland
Kerstin Bly Joyce	Nordregio, Sweden
Myriam Chilvers	Nordregio, Sweden
Rebecca Eriksson	Nordregio/University Centre of the Westfjords, Sweden/Iceland
Tabea Jacob	University Centre of the Westfjords, Iceland

Participants	Affiliation
David Goldsborough	Van Hall Larenstein University of Applied Sciences, Netherlands
Lewis Hurley	Government of Scotland
Kari Grundig	Norwegian Directorate of Fisheries
Hans Ellefsen	University of the Faroe Islands
Mangús Jóhannesson	Regional Councils for Austfirðir and Vestfirðir, Iceland
Kirsten Ounanian	Centre for Blue Governance, Aalborg University, Denmark
Róisín Kennelly	University of Oxford/ University of Faroe Isands
Maria Wilke	Scottish Association for Marine Science
Helle Torp Christensen	DTU Aqua National Institute of Aquatic Resources, Denmark
Kathryn Fradera	University of Glasgow, Scotland
Cathrine Chambers	University Centre of the Westfjords/Stefansson Arctic Institute, Iceland
Masaana Edege	Media Catch/Mediehuset Sermitsiaq, Greenland
Evert Flier	Norwegian Mapping Authority
Smári McCarthy	Ecosophy, Iceland
Jonas Bjärstedt	Swedish Agency for Marine and Water Management

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