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PPGIS-Mapping of Coastal-Marine Recreation: Participatory Tool for Increasing Ocean Literacy in Planning and Management?

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Abstract

Increased ocean literacy is needed not only in relation to formal education, the public, and industry, but also in policy, planning, and management of coastal and marine areas. While environmental data is often available, there is a need to also understand the human recreational uses, experiences, benefits, and problems linked to the ocean and integrating this into planning. This article discusses public participation geographical information system (PPGIS)-mapping as a potential participatory method in ocean literacy, focusing on knowledge exchange in the public-planning interface based on a Norwegian case study. The Oslo Fjord in Norway is impacted by environmental degradation, increasing urbanization, accessibility problems, and user conflicts, and the Norwegian Ministry of Environment is preparing a comprehensive plan for the fjord involving 26 municipalities with 1.7 million inhabitants. A lack of recreation data was identified, and a PPGIS survey was conducted. The results (12,445 responses) provide extensive quantitative and qualitative knowledge of recreational uses combined with spatial mapping. Participation in fjord-oriented recreation activities was high (71%) and provided health benefits, but 27% perceived problems related to accessibility, environment, or other users. In addition, mapping and open-ended questions provided detailed information on specific problems and user-generated suggestions on solutions. This study in coastal Norway helps to demonstrate how a PPGIS-mapping approach can be used as a tool for coastal and marine management and planning and how, more broadly, a public participation mapping approach can be used to increase ocean literacy among community members, planners, managers, and policy makers. We discuss how experience-based knowledge and mapping by recreationists may link to the 10 ocean literacy dimensions. Adding geospatial mapping data to the wider concept and field of ocean literacy research may provide new insights and understanding of ocean literacy dimensions and how social science may contribute to more sustainable ocean policy, planning, and management.

Keywords
coastal and marine recreation; coastal management; fjord; marine management; Norway; ocean literacy; PPGIS-mapping; recreation management; spatial planning

1. Introduction

The ocean is increasingly impacted by anthropogenic stressors, causing severe degradation of the marine ecosystems and reduction of the goods and services they provide for human well-being and prosperity (Shellock et al., 2024). Key impacts on the ocean often originate from land use, such as eutrophication, population growth, increasing urbanization, rising individual consumption, and climate change (Nash et al., 2017), and marine environmental decline is predicted to continue (Halpern et al., 2015, 2019; Jouffray et al., 2020). This will lead to a critical need for ocean management (Hobday & Cvitanovic, 2017; Salinger et al., 2016). Solutions to the ocean problems are connected to social values and societal environmental behavior (Gifford, 2014; Wynveen et al., 2015) and to social and marine governance (United Nations Environment Programme, 2021; Veríssimo, 2013). To ensure successful governance outcomes, increased ocean literacy (OL) is needed.

OL was initially defined as an "understanding of the Ocean's influence on humans and of our influence on the Ocean" (Cava, 2005, p. 5), along with seven essential principles to support the definition of ocean literacy, but is now viewed more as a process and an outcome resulting in a society that understands, values, and cares for the ocean (Glithero et al., 2024). Brennan et al. (2019) identify six dimensions of OL: knowledge, awareness, attitude, behavior, communication, and activism. McKinley et al. (2023), meanwhile, suggest four additional dimensions: emOceans (emotional connections to the sea), access and experience, adaptive capacity, and trust and transparency. Originating in formal education, the concept and approach of OL is radically evolving into a broader tool and approach for society, aimed at stimulating actions towards ocean sustainability (IOC-UNESCO, 2021). A review of the literature on OL and spatial planning reveals multiple debates and perspectives, which are outlined in Sections 1.1–1.8.

1.1. Policy Dimensions

The principles and fundamental concepts of OL are becoming central components of international frameworks and policy goals supporting ocean sustainability policy and societal behavior change (McKinley & Burdon, 2020). They are embedded in various European regulations, e.g., the Marine Framework Strategy Directive, Blue Growth Strategy, Marine Spatial Planning Directive, and the Common Fisheries Policy (Costa & Caldeira, 2018; Fernández Otero et al., 2019; French et al., 2015). In addition, OL is also a key pillar of the UN Decade of Ocean Science for Sustainable Development (Claudet et al., 2020; Ryabinin et al., 2019). The Framework for Action by the IOC-UNESCO (2020) has also recognized OL as a transformative mechanism for understanding and reshaping society-ocean relationships. Also, the Barcelona Statement (UNESCO, 2024) resulting from the UN Ocean Decade Conference in Barcelona in April 2024, identified OL as a key strategic mechanism for ensuring the success of the Ocean Decade and the UN highlighted the need to continue to expand efforts in OL to address all sectors of society including policy makers, resource managers, and industry (UNESCO, 2024). This makes OL highly relevant for decision-makers working on international Ocean policy initiatives (Claudet et al., 2020; Ryabinin et al., 2019), as well as for national, regional, and local policy directives and sustainable

use of marine areas, e.g., marine protected areas, marine spatial planning, marine conservation, and climate change (Kelly et al., 2022).

1.2. Uneven Knowledge Collection

The number of publications on OL is increasing, including different OL literature reviews (Cavas et al., 2023; Costa & Caldeira, 2018; Paredes-Coral et al., 2021; Salazar-Sepúlveda et al., 2023; Shellock et al., 2024). Shellock et al. (2024) find a geographical bias with a concentration of OL studies in the US, Canada, UK, Ireland, and Portugal, and only one from Norway. Surveys are the predominant data collection method with students/teachers as the primary target populations, and out of the 10 OL dimensions, knowledge, access, and experience were the most studied, while activism, trust, transparency, and emOceans have received limited focus (Shellock et al., 2024).

1.3. Diverse Knowledge Systems

It is important to adopt a governance approach that recognizes the multidisciplinary and cross-sectoral nature of OL and effective ocean and coastal management, which requires a holistic understanding of the social, cultural, and economic dimensions of human–ocean interactions (Shellock et al., 2024). By bringing together diverse perspectives and knowledge systems, OL can serve as a platform for fostering inclusive and participatory governance processes, ultimately contributing to more sustainable and equitable management of marine resources and ecosystems. In this study, we add experience-based knowledge by recreational users to the existing natural science data.

1.4. Collaborative Approaches

OL is a key tool to engage society and needs to be more efficiently and widely promoted to turn into actions (Claudet et al., 2020). Increasing OL amongst decision-makers can facilitate more useful discussions among researchers, practitioners, and decision-makers and inform the development and implementation of OL initiatives and strategies (Shellock et al., 2024). This indicates a need for greater collaboration among researchers, policymakers, and stakeholders to develop practical guidance on integrating OL into marine policy and management frameworks. This collaborative approach can help bridge the gap between scientific knowledge and governance, facilitating the translation of OL concepts into actionable strategies for sustainable ocean and coastal management. Furthermore, there is a need for a more inclusive and culturally sensitive approach to OL with collaborative efforts involving diverse stakeholders, including Indigenous communities and underrepresented groups. This can enhance the acceptance and effective implementation of OL initiatives, fostering greater participation and ownership among coastal communities in ocean and coastal management processes (Shellock et al., 2024).

1.5. Community Involvement and Integration of Public Perceptions

Community involvement is a key factor, but while organized stakeholder groups are included in formal policy consultation, the opinion of individual citizens rarely enters the process of policy formation (Potts et al., 2016). It is important to include the collective choices made by individuals about the resources they use, the places they visit, and the orientation of environmental behaviors, as this guides the interactions with and pressures

on marine environments (McKinley & Fletcher, 2010; Mee, 2012). The integration of public perceptions of the marine environment into policy processes is highlighted in several studies (Ahtiainen et al., 2013; Gelcich et al., 2014; Jefferson et al., 2014). Studies of recreation and public awareness in countries surrounding the Baltic Sea found national differences in the level of concern among residents and highlight the importance of cultural and recreational values (Ahtiainen et al., 2013). In a cross-national study of residents in 10 European countries, Potts et al. (2016) found differences in scientific and public perspectives on the key factors affecting the marine environment and a need for developing ocean citizen initiatives and wider social engagement beyond the limited stakeholder approach including a deeper understanding and incorporation of social complexities into marine planning where communities are actively engaged in the decisions that affect them.

1.6. Public Awareness

An extensive comparative study of surveys on public perceptions of marine threats and protection finds that citizens from around the world have a clear understanding that the ocean is threatened and most support marine protected areas (Lotze et al., 2018). This information is relevant to marine managers, policy makers, conservation practitioners, and educators because it contributes to improvements in marine management and conservation programs. There is, however, still a need for increased OL, including awareness of the marine environment to change individual behaviors and regional, national increased OL and international stewardship and governance (Lotze et al., 2018). Public awareness research is a valuable contribution to raising awareness and promoting a more bottom-up approach to enhance the protection and sustainable management of the ocean.

1.7. OL Research as a Tool in Policy and Planning

OL research is an important policy tool and there is a need to test approaches and develop recommendations to support the use of OL as a practical policy tool, feeding directly into decision-making with a focus on better understanding the science–policy–society interface (McRuer et al., 2025). A more holistic approach with increased integration of local community priorities is needed, including data and documentation on public perceptions of ocean issues as part of policy and planning. Lack of user involvement and failure to incorporate diverse understandings of human–ocean relationships in marine planning may cause failure (e.g., failed marine protected areas), inadequate protections, and a lack of shared commitment to implementation (Rife et al., 2013; Turnbull et al., 2021).

1.8. Recreationists as Key Informants

Coastal and marine recreation includes direct engagement with the ocean (Kaae et al., 2018). Recreationists can offer experience-based insights into the complex interactions between human activities and marine ecosystems, thereby providing planners with more comprehensive understandings to facilitate the design of targeted policies, support conservation strategies, and foster public engagement at an early stage (McRuer et al., 2025). We perceive coastal and marine recreationists as an important group in OL as they use the marine environment to gain a range of benefits (mental and physical health, experiences, socialization, etc.), and due to frequent visits, recreationists may perceive problems not detected by planning and management.

1.9. Objective

The objective of this article is to assess public participation geographical information system (PPGIS)-mapping as a potential participatory method in OL research, focusing on knowledge exchange in the public-planning interface. Based on a Norwegian case study in the Oslo Fjord, residents' coastal and marine recreational uses, knowledge, and perceptions of their local fjord were documented, contributing to increasing OL in planning and management.

The article starts off introducing the present knowledge gaps of coastal and marine recreation data in relation to planning of the coastal and marine areas in Oslo Fjord and then presents key results of a coastal and marine recreation PPGIS-survey in the fjord. This is followed up by a discussion on how the data and mapping of coastal and marine recreation may contribute to the different dimensions of OL and the potentials and limitations of further integration of spatial data into OL research.

2. Methods

The project was carried out in 2022–2023, involving the Transport Economic Institute (project coordination), the Norwegian Sports University (qualitative interviews), and the University of Copenhagen (PPGIS-survey of resident population) based on experience from a similar mapping in Denmark (Kaae et al., 2018). This article is based on the results from the PPGIS-survey (Kaae & Olafsson, 2024), while the qualitative studies (Gurholt & Lund, 2024) are reported in other papers and a summary report (Flotve et al., 2024) combines the project's results.

The data collection of coastal and marine recreation of the Oslo Fjord used a PPGIS method, which combines a survey with spatial mapping using the Maptionnaire software (https://www.maptionnaire.com). The survey was developed by the University of Copenhagen in cooperation with the overall project group and it was pre-tested. Permission for the survey was granted by the University. The questionnaire included initial questions, consent to use the results for research purposes, and questions to sort recreational users of the Oslo Fjord from non-recreational users. The recreationists mapped their recreation sites and for each point, a range of questions were answered about activity, motives, seasonality, etc. The non-recreationists joined the recreationists in answering questions on satisfaction of recreational needs, and those with unfulfilled needs were asked questions on barriers. Finally, supplementary sociodemographic variables were included. Open-ended responses provide a wealth of qualitative information.

Data collection was conducted by a professional survey company (Norstat), which monthly distributed a link to the survey during 1 year (June 2022 through May 2023) to a representative sample of the adult population (18 years and above) in their panel. Respondents receive points for participating in different surveys. Norstat provided a number of basic socio-demographic variables of the respondents, while supplementary background variables were included in the survey. We received 14,162 fully or partially completed surveys, but we removed duplicates and surveys without consent to use the results for research purposes, as well as questionnaires with fewer than five responses. The final sample of 12,445 respondents includes both participants in coastal and marine recreational activities at the Oslo Fjord and a segment that did not use the Oslo Fjord, either because they used other recreation areas or did not participate in recreation activities. The survey is representative of the adult population (18 years and older) in the 26 municipalities bordering the Oslo Fjord by gender, age group, and municipality.

3. The Oslo Fjord Case Area and Planning Challenges

The Oslo Fjord in Norway is long and narrow in Southern Norway, involving 26 municipalities with 1.7 million inhabitants, and with the capital, Oslo, in the inner part. The fjord suffers from a range of environmental degradation (e.g., poor water quality, lack of fish, and invasive species), increasing urbanization, accessibility problems, and user conflicts. As a response, the Norwegian Ministry of Environment is preparing a comprehensive plan to reduce the problems and conflicts in the Oslo Fjord.

While natural science data on a range of ecosystem services are available and monitored over time, Chen et al. (2019) identified a lack of knowledge on the recreational uses and user conflicts in the fjord. Several reports on the environmental and economic aspects of the fjord exist, but recreation data and mapping of the many coastal and marine recreational uses of the Oslo Fjord were needed (Klima- og miljødepartementet, 2021). Some recreation data exists on specific coastal sites (Stokke & Hage, 2021), as well as for protected areas and national parks in the Oslo Fjord (Haukeland & Stokke, 2021; Meyer & Strandli, 2021), but comparable and spatial data for the entire fjord were missing. Consequently, the Norwegian Ministry of the Environment commissioned a study on outdoor recreational use of the Oslofjord including the coastal zone. The aim was (a) mapping of the coastal and marine recreational uses throughout the year of the Oslofjord, (b) Mapping of what enhances and limits the recreational use by different groups in the population, and (c) mapping of conflicts among recreation groups and in relation to other users of the fjord.

3.1. Integration of Coastal and Marine Recreation in the Current Comprehensive Plan of the Oslo Fjord

In the process of establishing a comprehensive plan for the Oslo Fjord, the Norwegian Ministry of Environment, as the planning authority, already has access to a range of well-documented biological and commercial sector data. The lack of knowledge and spatial data on the recreational uses of the Oslo Fjord (Chen et al., 2019; Klima- og miljødepartementet, 2021) was a challenge. These data-needs motivated the commissioning of the present study in the densely populated region with many competing uses.

The study focused on providing key information on coastal and marine recreation to the planning process, and we see some potential in the methodological approach and integration of local resident perspectives and experience-based knowledge that may be relevant to OL studies and to bridging some of the gaps between the theoretical and applied knowledge in spatial planning. Shellock et al. (2024, p. 10) highlight the application of OL in decision-making processes and identify:

> A need for greater collaboration between researchers, policymakers, and stakeholders to develop practical guidance on integrating OL into marine policy and management frameworks. This collaborative approach can help bridge the gap between scientific knowledge and governance, facilitating the translation of OL concepts into actionable strategies for sustainable Ocean and coastal management.

The Norwegian Ministry is presently working on the comprehensive plan for the Oslo Fjord and the recreation data and mapping are in the process of being integrated into the planning process. Results of the study are published in an extensive Nordic language report and have been presented to planners, stakeholder groups, and the public on several occasions. Several local planning authorities have shown great

interest in the data and mapping covering their county or municipality for their planning and management. We see relevant application of PPGIS-mapping as a potential participatory method in OL, focusing on knowledge exchange in the public-planning interface.

4. Selected Results

The results provide a wealth of quantitative and qualitative data on recreational uses combined with geolocated and scalable spatial mapping. For detailed descriptions and maps, see Kaae and Olafsson (2024). Here, selected results will be presented with a focus on the experience-based mapping by recreationists of different problems to be addressed in planning and management.

Results show that the Oslo Fjord is a popular recreation site: 71% participated in fjord-oriented recreation activities annually, 67% participated in land-based coastal outdoor recreation activities, and 53% in marine outdoor recreation activities. As only non-motorized and non-competitive activities are perceived as outdoor recreation in Norway, the study does not include activities by the 31% who sailed with ferries to recreation areas, the 28% who sailed in motorboats or used jet skis, or the 7% who participated in water sports or competitive activities. A different definition of outdoor recreation may be used in other countries.

Data was collected on the different activities, motives, number of visits, organization of visit, seasonality, perceived health benefits, fulfilment of recreational need, and overall satisfaction with visiting the fjord, as well as a range of socio-demographic variables. Furthermore, non-participants and participants with unfulfilled recreation needs were asked questions on barriers to participation.

4.1. Mapping

The mapping involved mapping of coastal and marine recreation activities and mapping of perceived problems with access, environment, and other users.

As seen below, both coastal recreation activities (Figure 1) and marine recreational activities (Figure 2) are concentrated in the inner parts of the Oslo Fjord, where the capital, Oslo, is located.

For the coastal recreation activities, the most popular is walking under three hours (29%); stays with a focus on quietness, reflection, looking at the view, and experiencing nature (12%); bathing/winter bathing (11%); stays with a focus on sunbathing, picnic, BBQ, etc. (9%); dog walking (7%); and walking over three hours (6%); 3% participate in nature studies (photography and drawing/painting), 2% are fishing from land, while 1.3% participate in beach clean-up (plastic, invasive Pacific oysters, etc.). Many open responses mention the decline in water quality, lack of fish, etc. The most popular marine recreation activities are bathing/swimming from boat (47%), paddling/rowing (kayak, canoe, SUP, rowboat, etc.; 13%), fishing from boat (12%), ice-bathing/winter bathing (9%), sailing (non-motorized; 9%), nature studies from boat (5%), and clean-up of the fjord environment (2%). Seasonality differences show that most marine activities take place during the summer, while land-based activities are less influenced by weather conditions and take place throughout the year.

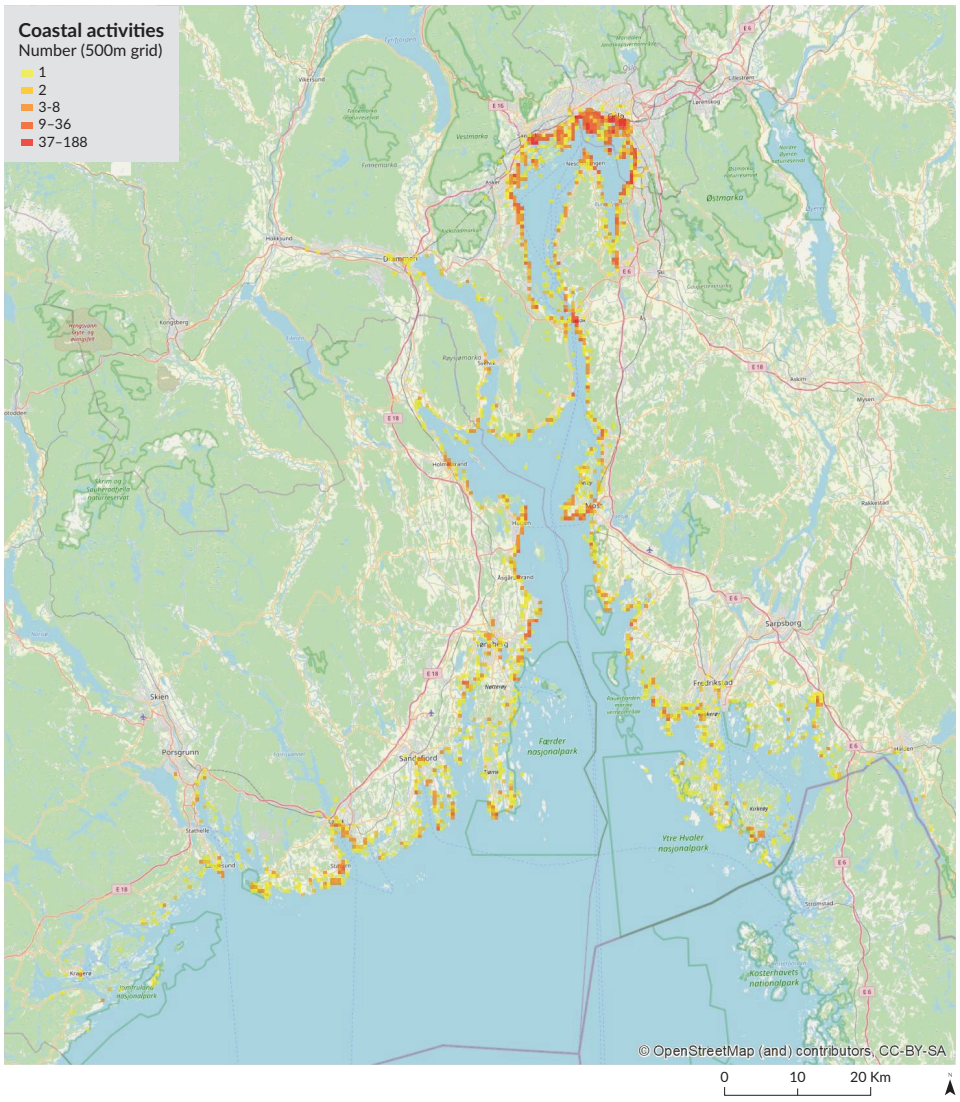

Figure 1. Coastal recreation activities (4.933 respondents mapped 6.713 points with 15.124 recreation activities).

Both recreationists and non-participants in recreation were asked to state their level of fulfillment of recreation needs. Many had their recreational needs fulfilled by either participating (27%) or not participating (11%) in coastal and marine recreation in the Oslo Fjord, while just below half (48%) had some level of unfulfilled needs for participating as much as they would like to, and 14% did not answer. The group with unfulfilled recreation needs was asked questions on barriers following the framework of Crawford et al. (1991). While some barriers related to the supply-side (e.g., amount and quality of recreation facilities) may be addressed in planning, many of the barriers were linked to the personal life situation of respondents and constraints of intra-personal, interpersonal, or structural constraints, which can be difficult to address in planning. Many constraints were linked to limited time, family obligations, and health problems. Also, 14% had either permanent or temporary reductions in functions that call for facilitating access for all through universal design.

Participation in coastal and marine outdoor recreation in the Oslo Fjord was higher among respondents with higher education, persons with higher household income, and in families with children in the household.

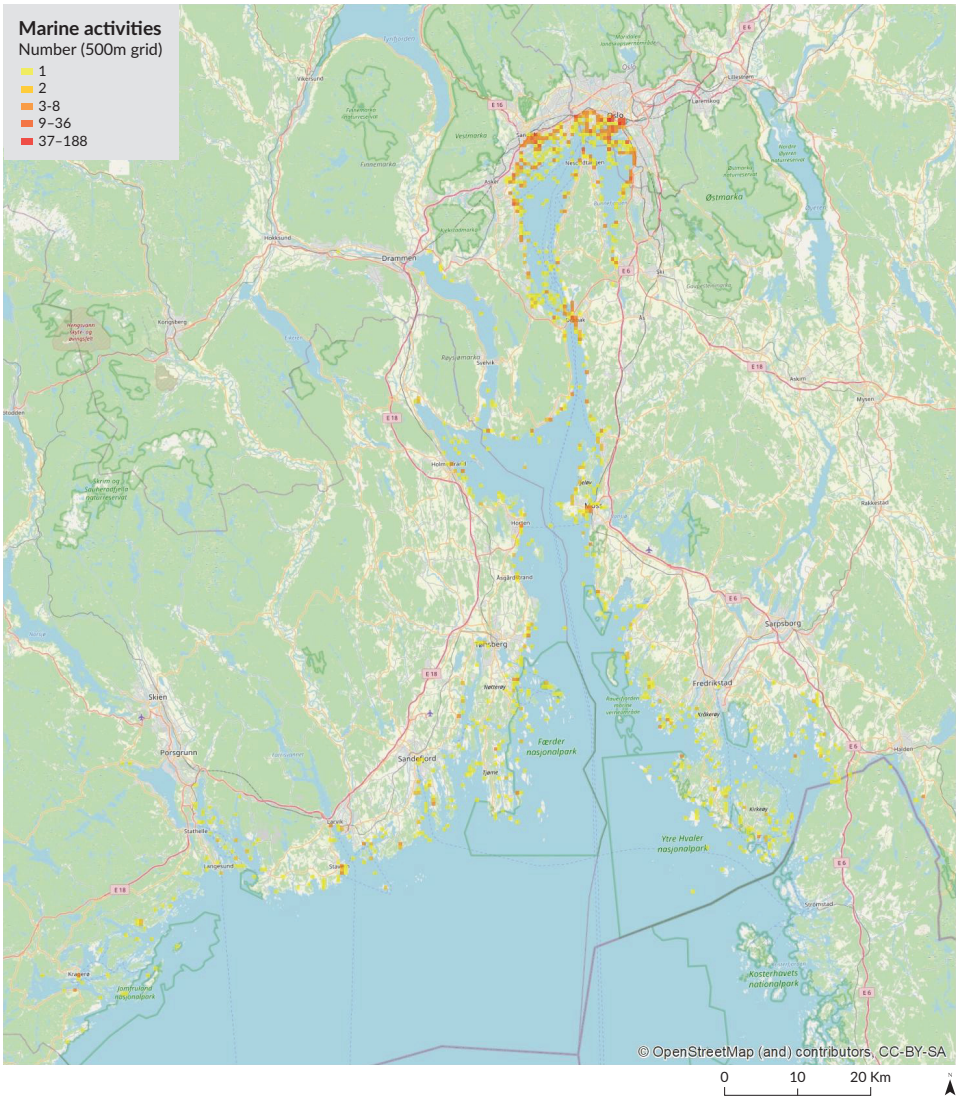

Figure 2. Marine recreation activities (1.711 respondents mapped 1.913 points with 2.375 recreation activities).

No gender difference was found in the overall participation in recreation, but differences emerged in specific recreation activities—for example, more men participated in motorized water sports. Participation was lower among the oldest age group and in non-Western ethnic groups.

Most of the recreationists reported self-perceived benefits from their fjord-oriented recreation activities on their psychological wellbeing and mood (82%), overall life quality (68%), their physical health condition (58%), and their social life (51%). Open-ended statements expressed many experiences of these benefits and emotional bonds with the fjord.

4.2. Problem Mapping

To inform planning, the study also included mapping of perceived problems in the fjord. Among the recreationists who mapped recreation activities in the Oslo fjord, 27% mapped areas where they perceive

problems. This includes 757 points where they perceived accessibility problems, 593 points with perceived environmental problems, and 345 points with perceived problems with other users. These are further described in Sections 4.2.1–4.2.4, and illustrated by the mapping.

4.2.1. Access Problems

The problem mapping shows that residents perceive problems related to accessibility both in the inner urban part of the fjord but also in many coastal areas along the less populated parts of the fjord (Figure 3). For each point, respondents could indicate further details of different access problems and the magnitude of the problems. As seen in Figure 4, most access problems are linked to trails being closed off, people being unsure if they are allowed to trespass, and attempts at privatization. About a third avoid visiting these areas, hereby indicating displacement of those perceiving the most access problems.

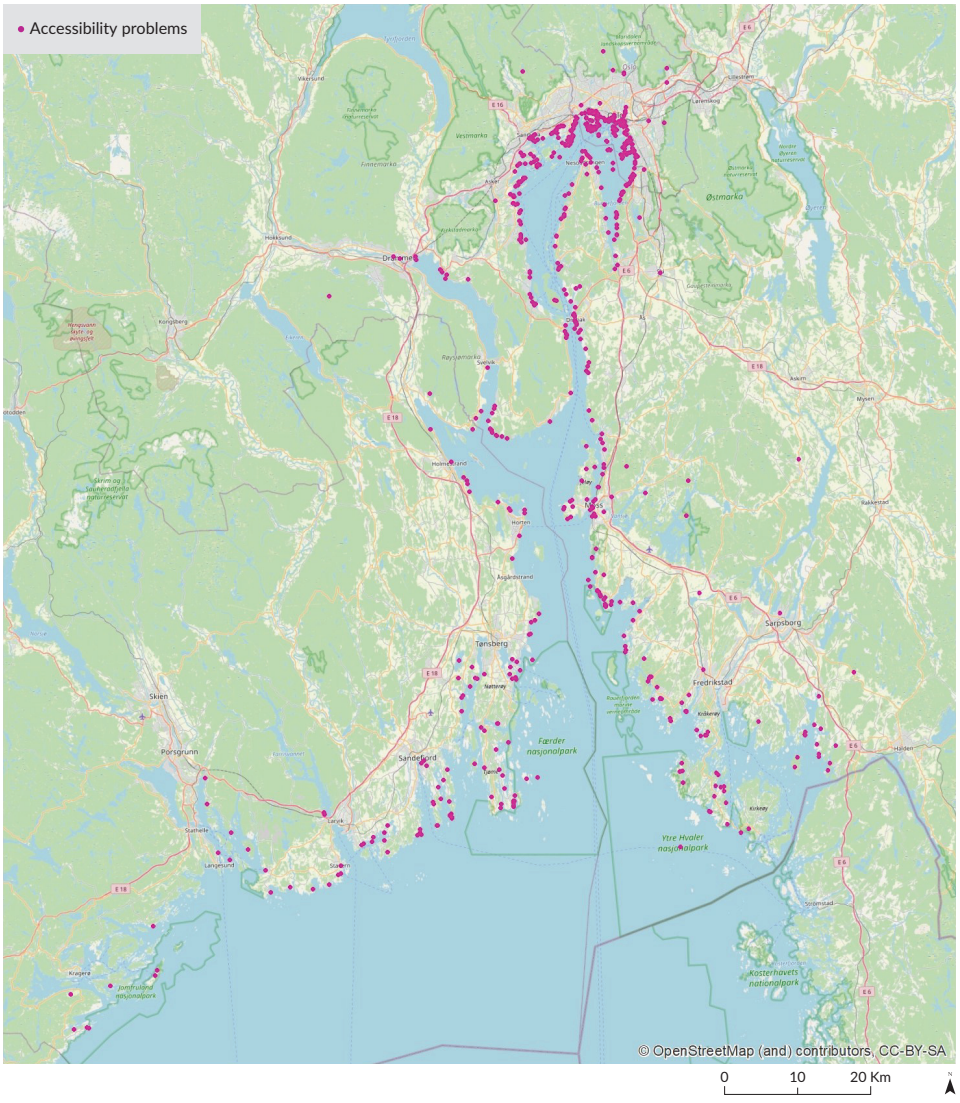

Figure 3. Mapping of problems with access to the fjord perceived by recreationists in the Oslo Fjord (757 sites mapped).

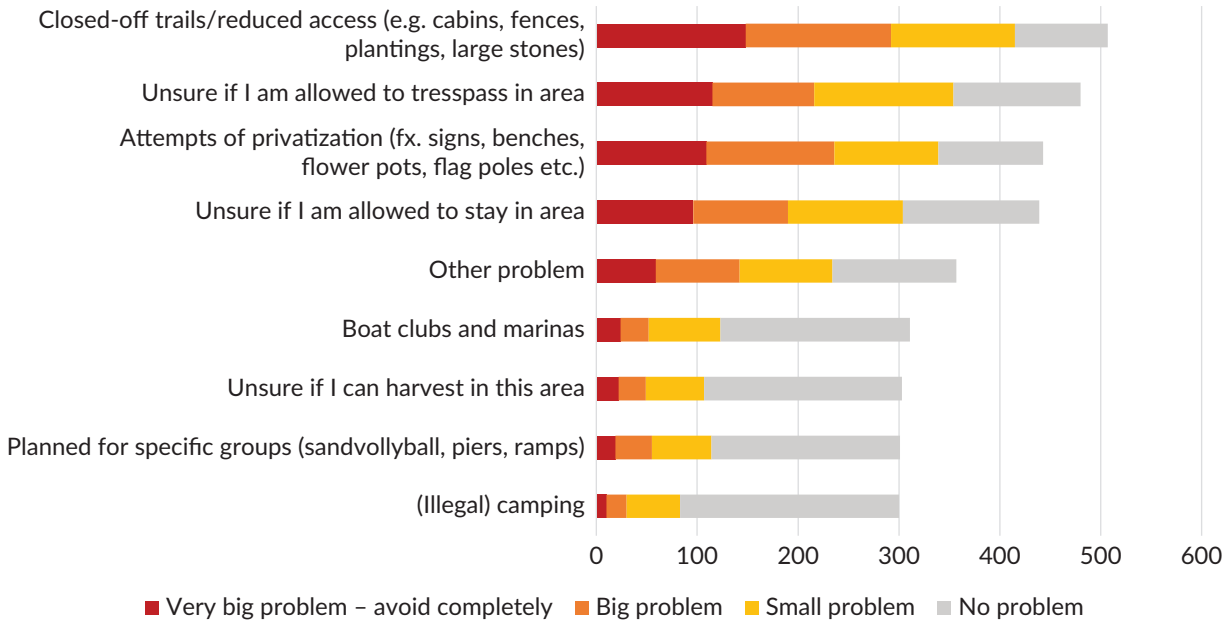

Figure 4. Perceived problems of access. Note: 620 residents mapped 757 points, representing 3,441 accessibility problems.

4.2.2. Perceived Environmental Problems

The "problem mapping" shows that residents also perceive environmental problems in the fjord. As seen in Figure 5, there is a wide distribution of perceived environmental problems both in the inner part of the fjord and along the shores. For each point, respondents could indicate further details of different environmental problems and the magnitude of the problems. Key problems are linked to the water quality, litter, and noise (Figure 6).

4.2.3. Problems With Other Users

The mapping (Figure 7) shows that many problems with other users are perceived in the inner part of the fjord. For each point, respondents could indicate further details of different problems with other users and the magnitude of the perceived problems. This corresponds well with crowding being the most experienced problem with other users (Figure 8), followed by noise from other users, large groups occupying areas, and noise from motorized boats and jetskies. A smaller part completely avoids the mapped areas, which indicates displacement.

4.2.4. Detailed Mapping

The GIS data is scalable, and the maps show the island Jeløy with examples of open-ended questions with detailed information on specific problems and user-generated suggestions on solutions (Figure 9a, b, c, and d). The mapped points provide key information for local planning and management.

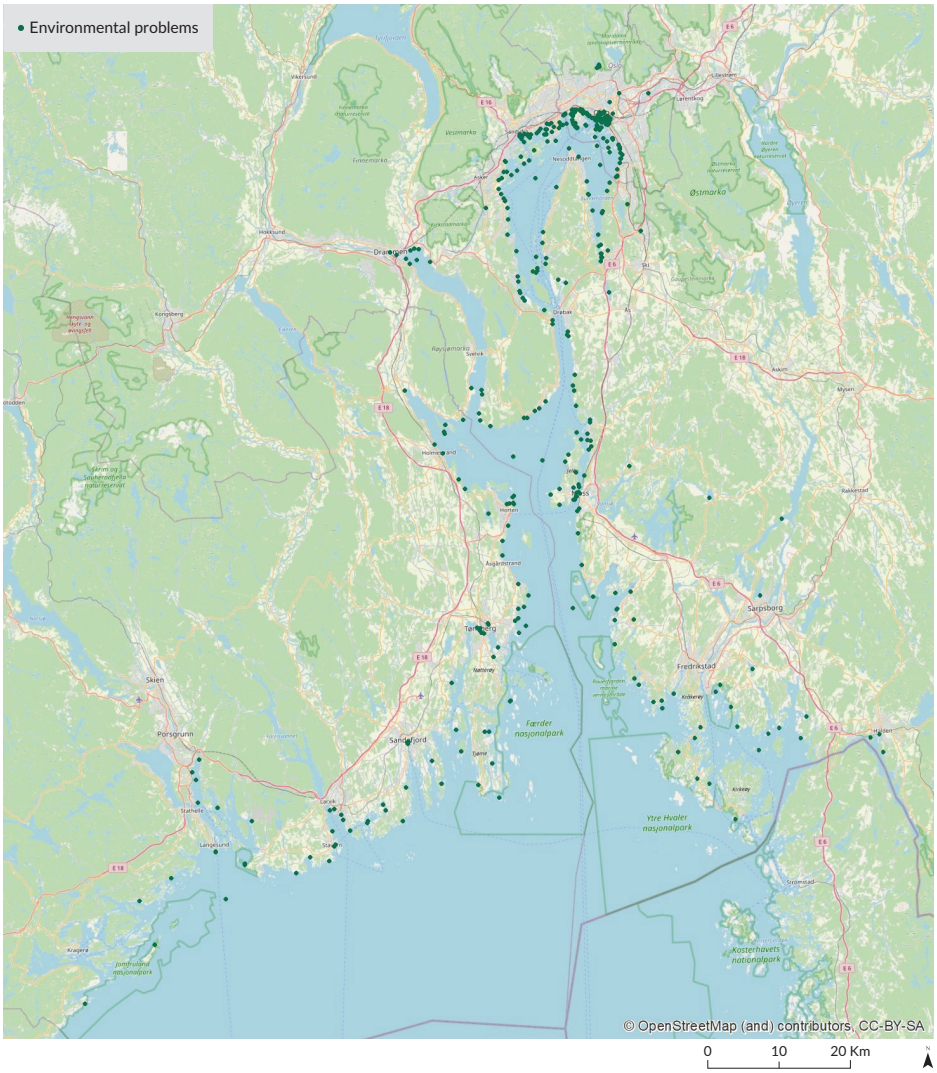

Figure 5. Mapping of environmental problems perceived by recreationists in the Oslo Fjord (593 mapped points).

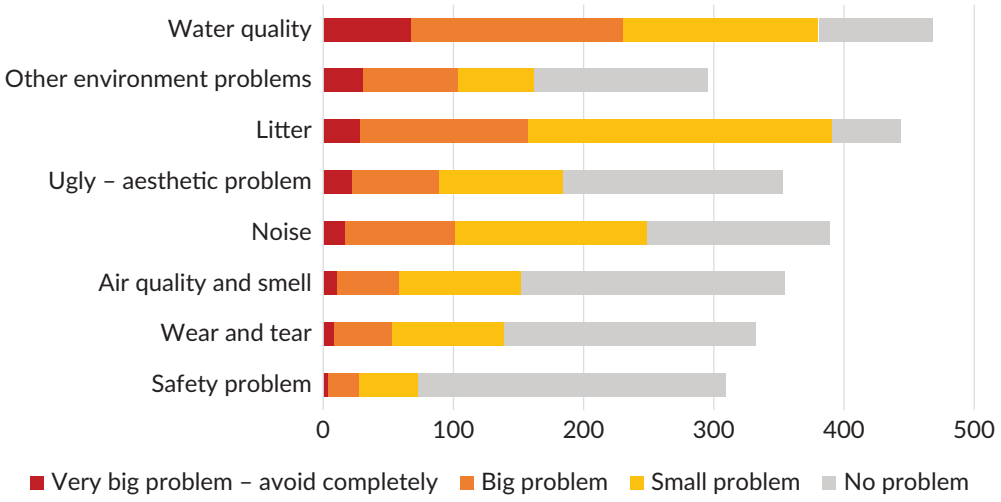

Figure 6. Perceived environmental problems. Note: 536 residents have mapped 593 points, representing 1728 problems.

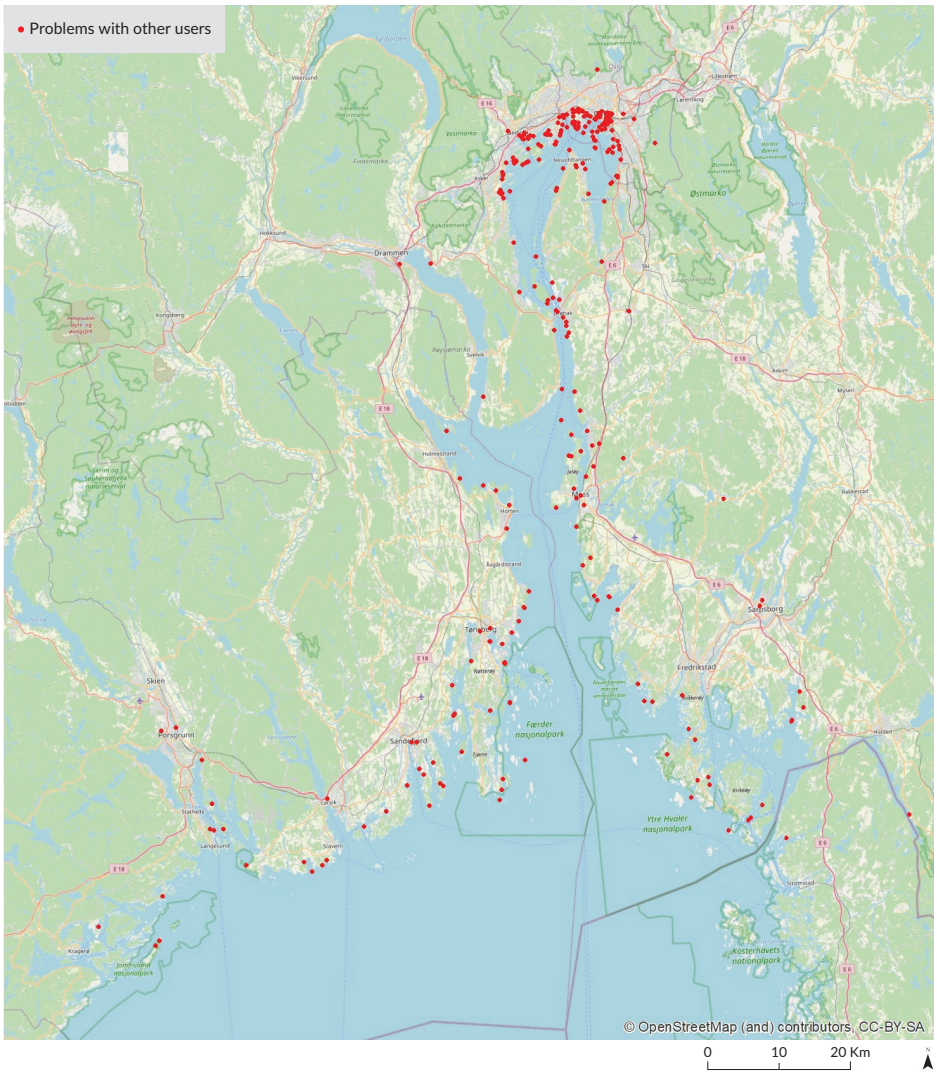

Figure 7. Mapping of perceived problems with other users (345 mapped points).

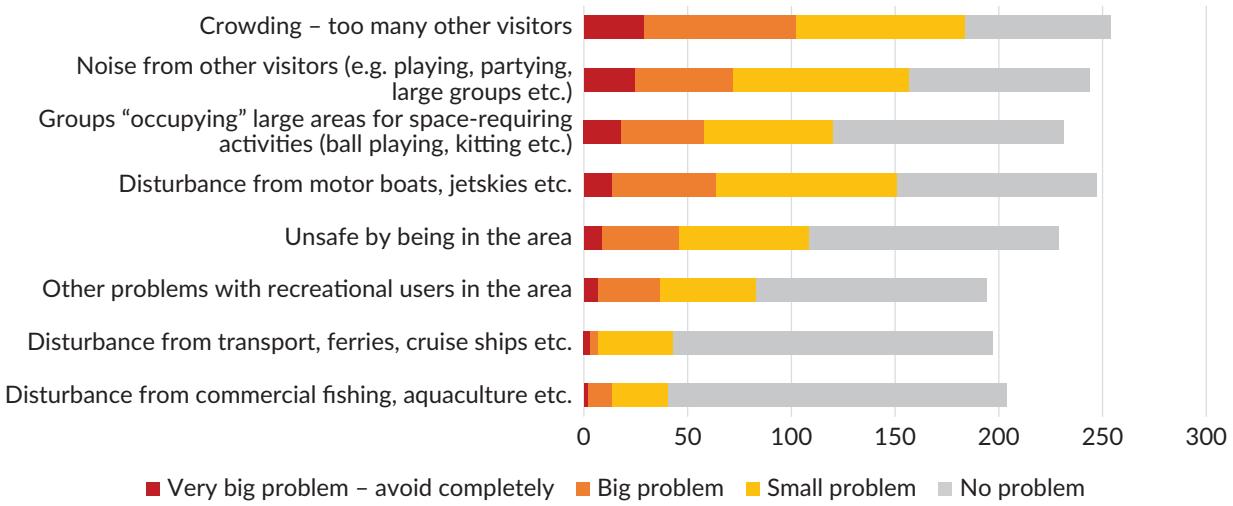

Figure 8. Perceived problems with other users. Note: 299 respondents mapped 345 points, representing 1800 problems.

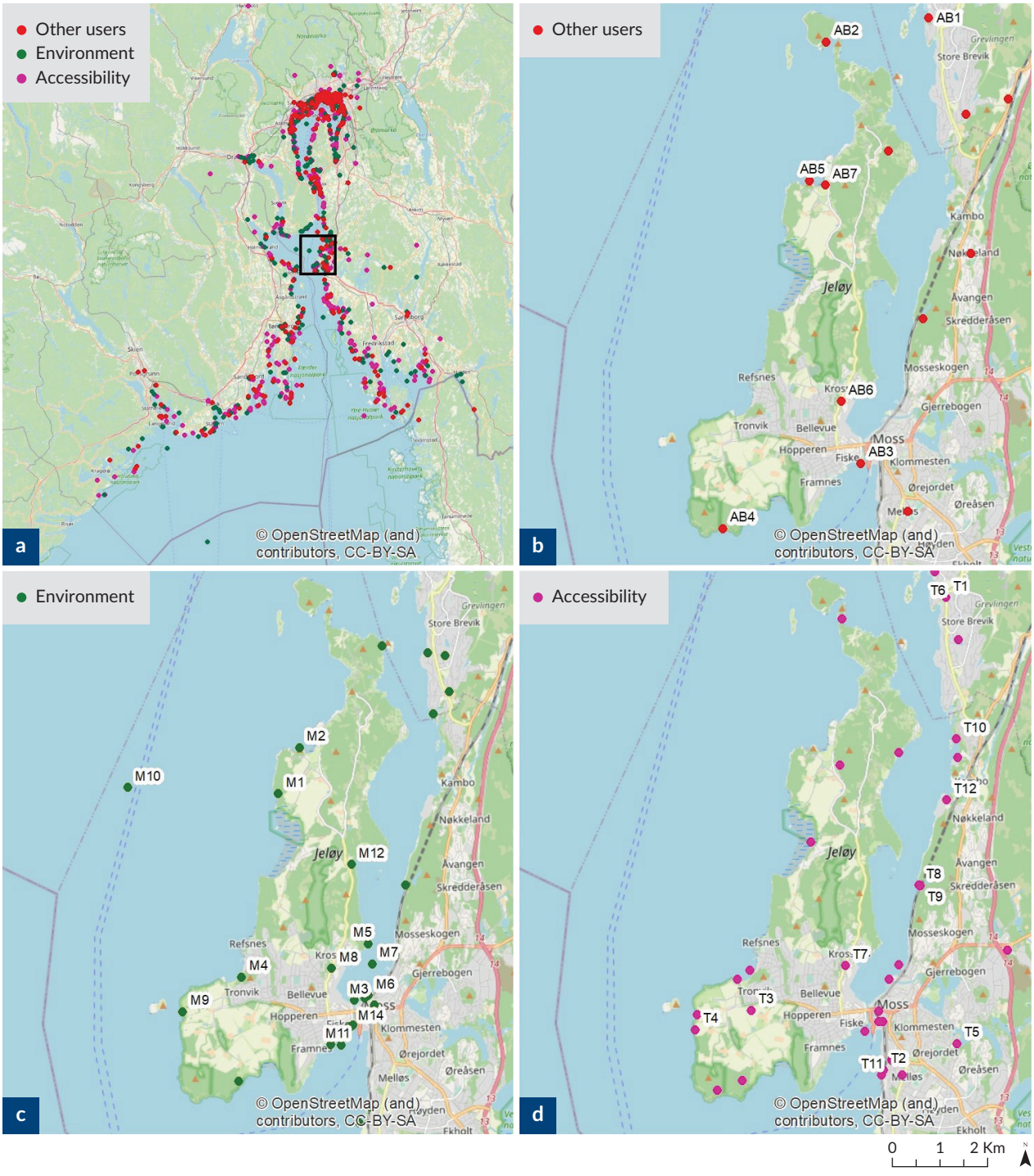

Figure 9. (a) Perceived problems in the Oslo Fjord; (b) perceived problems with other users at Jeløy; (c) perceived environmental problems at Jeløy; and (d) perceived access problems at Jeløy.

5. Discussion

5.1. How the Study Contributes to the 10 OL Dimensions Among Residents, Planners, and Managers

The project aimed at collecting data on resident recreational uses of the Oslo Fjord for planning purposes. However, as recreationists are frequent and engaged users of the Oslo Fjord, we see their use patterns, experience-based knowledge, and perceptions of problems as highly relevant to OL. By filling in the questionnaire, the respondents needed to reflect on their use of the coastal and marine environment, but also got the opportunity to share their experiences, perceptions, concerns, and suggestions with the planning authorities. The response process may increase the awareness dimension of OL among respondents.

While surveys are the most used method in OL research (Shellock et al., 2024), PPGIS-mapping adds an additional level of spatial knowledge generated by public participation, and the method may have wider application as a tool in OL research—not only in relation to planning and management.

Table 1 is a summary of how we see the study contributes to the 10 dimensions of OL (Brennan et al., 2019; McKinley et al., 2023) in the public-planning interface. Some of the 10 OL dimensions are more involved than others in this exchange process, for example, knowledge, access, experiences, (recreational) behavior, and communication, while expressions in the open-ended responses contribute to the emOcean dimension. The OL dimensions of attitude, awareness, and behavior change in general are more indirectly reflected but could be included more explicitly in future studies. The tool provides detailed mapping and data of high trust and transparency and results with high capacity for being adapted into planning and management. The adaptability also applies to the flexibility of the tool and the potential for including questions covering all 10 OL dimensions in future studies.

Table 1. Summary of the exchange within each of the 10 dimensions of OL between residents and planners and managers and the possible implications for the planning process for the Oslo Fjord.

Dimensions of OL	Residents provide	Planners and managers receive	Implications for planning
Knowledge	Sharing experience-based knowledge on recreational uses and perceptions of the Oslo Fjord	New experience-based knowledge on socio-cultural aspects added to environmental science-based knowledge	Potential for inclusion of social dimensions into planning
Access and Experience	Many problems of access identified—physical access and access to knowledge. There is a distance-decay function in visitation and consequently in experiences of the Fjord Non-user barriers to participation were identified	PPGIS-mapped perceived problems of access, environmental problems, and user conflicts Descriptions and user-generated suggestions on improvements	Opportunity to locate and reduce access barriers and improve experiences by more connected trails and upgrade of facilities, better public transport, and more parking Universal design of trails and facilities to increase access for all. Information campaigns

Table 1. (Cont.) Summary of the exchange within each of the 10 dimensions of OL between residents and planners and managers and the possible implications for the planning process for the Oslo Fjord.

Dimensions of OL	Residents provide	Planners and managers receive	Implications for planning
Attitude	Overall satisfaction with the visit was included as was self-selected displacement Some socio-cultural differences in use in relation to ethnicity, education level, income level, children in household, and age but not gender	Increased focus on the inclusion of all groups by planners and managers Focus on low satisfaction and displacement (who, where, and why)	Attention to factors causing low satisfaction and displacement Social programs for inclusion
EmOceans	Many expressions of emotional bonds with the Fjord (long qualitative statements in open-ended responses) Positive praise of fjord experiences and memories of good times Mourning of loss of marine life, fishing opportunities, and decline in other recreational qualities	Increased understanding of the personal and emotional importance of the Oslo Fjord to people's lives	Sites or aspects of high emotional importance to people may be considered/restored in the comprehensive plan
Awareness	Residents' awareness of the many problems of the Fjord (especially with access and water quality) have been identified Perceived health benefits identified	Heightened awareness in planning and management of resident perceptions of benefits and problems	Increase awareness in the comprehensive plan of "problem areas" for recreation, including areas people have stopped visiting due to problems (displacement)
Communication	The survey itself may be viewed as a communication tool to increase dialogue between residents and planners Representative of a broader segment than specific interest groups	Results are communicated in reports (free download), presented online, at several national and international conferences, in newspapers, and in radio interviews	Continued communication of recreational perspectives in the comprehensive planning process and public consultation
Behavior	Mapping and data on recreational behavior such as activities, motives, seasonality, group structure, etc No direct effect on the behavior of residents at this point, but potentially after planning initiatives	Spatial patterns of different recreational behaviors and a nuanced understanding of the different recreational user groups	GIS-based mapping of recreational use patterns can be combined with environmental data and maps of other uses (e.g., commercial fishing, shipping, etc.)

Table 1. (Cont.) Summary of the exchange within each of the 10 dimensions of OL between residents and planners and managers and the possible implications for the planning process for the Oslo Fjord.

Dimensions of OL	Residents provide	Planners and managers receive	Implications for planning
Activism	Few examples identified, but some landowners try to prevent recreational access by illegal signs, fences, etc.	Sites with experienced problems of recreational access are mapped and can be addressed in planning The type and magnitude of the access problem are described for each mapped site	Planners and managers can address the problem sites in the comprehensive planning process
Trust and transparency	The representative and large sample (12,445 responses) of the adult population in 26 municipalities makes the results trustworthy The method and results are transparent	A solid and trustworthy dataset is a prerequisite for inclusion in planning and the GIS data makes spatial analyses possible The voices of the general public, rather than specific interest groups	All data, including GIS data, has been delivered to the Norwegian Ministry of the Environment for integration into planning—open access by request
Adaptive capacity	The survey instrument can be adapted to diverse topics and knowledge needed from residents or from other groups	The integration of the extracted knowledge into planning and management depends on the planning regime and engagement by planners and managers at different levels	Adaptation of coastal and marine recreation data and problem-mapping into the comprehensive plan is likely, as the Ministry initiated the project

The article addresses the geographical and linguistic imbalances in OL literature as it provides insight into the results of an otherwise "grey literature" in non-English language. Likely, many similar studies could add to the growing body of OL literature. But in planning, many data collections are of an applied nature and disseminated in local language reports to planning and management agencies with limited interest in funding academic publications.

In the Ocean Decade, the role of OL is increasing as a tool for society engagement and community involvement (Claudet et al., 2020; UNESCO, 2024). OL is an evolving concept, and we introduce the geospatial mapping of social perspectives of the Ocean as a relevant tool in relation to integrating OL into a spatial planning and management context and to supplementing the predominant scientific knowledge with social perspectives on the ocean. By involving a large population sample, it also functions as a tool for community engagement beyond the select stakeholder groups and provides a wider societal involvement.

The study adds experience-based knowledge of recreational users to the existing natural science data and contributes to a broader knowledge base. This may support a more collaborative approach to help bridge the gap between scientific knowledge and governance and facilitate the translation of OL concepts into actionable strategies for sustainable ocean and coastal planning and management. The involvement of a wider community may also enhance the acceptance and effective implementation of OL initiatives by fostering greater participation and ownership among coastal communities in ocean and coastal management

processes (Shellock et al., 2024). Increased integration of local community priorities by including data and documentation on public perceptions of ocean issues is an important part of a more holistic approach to policy and planning. We perceive coastal and marine recreationists as an important user group and key informants in OL, as they frequently use the coastal and marine areas and may experience different problems not detected by planning and management.

5.2. Potentials for Further Integration of the PPGIS Results Into Planning

Data and mapping on resident recreational uses of coastal and marine areas may have further potential for being part of planning and analyses. Experiences from a nationwide PPGIS-mapping in Denmark (Kaae et al., 2018) showed a wide range of applications. At the national level, spatial data was used to compare the distribution of recreation in relation to waterbirds at different seasons (Laursen et al., 2021), recreation data was used alongside natural science data in an extensive modelling of ecosystem components and pressures for all Danish waters in the ECOMAR-project (Andersen et al., 2020a, 2020b) and in analyses of the compliance with different directives (Andersen et al., 2023). The recreational data was delivered to the Danish planning authorities responsible for the maritime spatial planning (Olafsson & Kaae, 2019), but it is only a service layer in the plan. At the regional level, the data were integrated into multisectoral projects on maritime spatial planning in Øresund (Riemann, 2019) and Kattegat (Riemann et al., 2020). At the local level, the recreational data was used in local national parks planning (Olafsson et al., 2016) and in the assessment of recreational uses in the western part of the Limfjord when planning a new watersports center (Kaae & Olafsson, 2020).

In Norway, the Oslo Fjord recreation data may, in similar ways, be used in new projects beyond the comprehensive plan. Knowledge and data diffusion into projects on environmental accounting (MAREA project) is ongoing and in integrated environmental assessment and synthesis (AquaSYNC, ongoing). Several local and regional planning authorities are interested in extracting data and maps covering their areas of planning.

In future studies, we see the potential for including more OL-related dimensions such as knowledge of the sea, nature connectedness, place attachment to coastal/marine sites of special emotional meaning, etc. The method may also be applied in more OL-focused studies of populations or groups. Adding a mapping component to the survey instrument has the advantage of providing spatial GIS-mapping of social science data, such as experience-based knowledge, activities, etc, which makes it compatible with other data layers in spatial planning, including natural science data on the environment.

Drawbacks are the need for a license for a PPGIS program and the potentially high cost of data collection (e.g., through a professional data collection company) to obtain a representative sample of the population. GDPR rules may make data collection difficult, e.g., through recreation organizations. While open-ended questions provide a wealth of information, it is very time-consuming to analyze thousands of responses and more quantitative measurements may be included. A large sample is needed to get reliable spatial mapping in the least populated areas, in particular when there is an uneven distribution of the population, as in the Oslo Fjord.

6. Conclusion

A large part of the population participates in coastal and marine outdoor recreation and thus gets in close contact with the coastal and marine environment and perceives both benefits and problems. Their experience-based knowledge provides valuable insights, complementing the science-based data in policy, planning, and management of the Oslo Fjord. This article illustrates how this may contribute to the 10 OL dimensions and knowledge exchange in the public planning interface.

The public participation mapping approach is a highly relevant tool providing new knowledge for planning and increasing the OL level among planners, managers, and policy makers in the Oslo Fjord case area and likely also among the residents who must reflect on their relations with the Oslo Fjord, describe their activities, benefits, and perceived problems.

The project provides both quantitative and qualitative data on many of the 10 OL dimensions. It reflects new insight into the perceived health benefits as well as experienced problems with access, environment, and other users, detailed descriptions, and user-generated suggestions for improvements—highly relevant for planning. Adding geospatial mapping data to OL surveys and the wider concept and field of OL research may provide new insights and understanding of OL dimensions and how social science may contribute to more sustainable ocean policy, planning, and management.

Overall, this study in coastal Norway helps to demonstrate how the PPGIS-mapping approach can be used as a tool for coastal and marine management and planning and how, more broadly, PPGIS-mapping can be used to increase OL among community members, planners, managers, and policy makers.

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Conflict of Interests

In this article, editorial decisions were undertaken by Emma McKinley (Cardiff University, UK), Benedict McAteer (Queen's University Belfast, UK), and Brice Trouillet (Nantes Université, France).

Data Availability

A link to the report in Danish language on the PPGIS study of outdoor recreation activities in the Oslo Fjord, including the coastal zone, can be found here: https://www.miljodirektoratet.no/publikasjoner/2024/mai-2024/ppgis-undersogelse-af-udendors-fritidsaktiviteter-i-oslofjorden-inkl.-strandzonen

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