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Future Trends in Angler Behavior Based on a Delphi Study in the Nordic Countries

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ABSTRACT

Recreational fisheries are dynamic social-ecological systems. Identification of anticipated future trends supports the design of policies and management to deliver outcomes for fisheries resources, users, and communities. To this end, we applied a forecasting method (i.e., Delphi survey) to recreational fisheries in five Nordic countries. The survey consisted of three rounds and included 20 diverse experts from each country. The study focused on expert perceptions of future trends in angler behaviors linked to specific angling activities (e.g., gear used, species targeted), and more general behavior (e.g., social media use, stewardship). Experts unanimously expected increases in fly fishing, stewardship, and use of angling-related technologies and social media platforms in the upcoming decade. Results can guide future research, management, and collaboration related to recreational fishing in the Nordic countries and beyond.

1 | Introduction

Recreational fishing is an important leisure activity globally that provides numerous benefits to anglers and society. Recreational fishing can also negatively impact fish stocks through selective mortality or habitat deterioration (Lewin et al. 2019). Thus, pertinent knowledge, policies, and management are needed to deliver the best outcomes for fish and fishers. Increasingly, recreational fisheries are viewed as social-ecological systems (SES) embedded within broader societal, economic, and political settings across multiple organizational scales and physical environments (e.g., Arlinghaus et al. 2017; Hunt, Sutton, and Arlinghaus 2013). These wider settings are constantly changing, thereby influencing components and interactions in recreational fisheries. For example, if social norms or environmental conditions change, angler behavior is expected to adapt, which in turn triggers other shifts in SES components and interactions. Such shifts might relate to preferred target species, rule compliance, technology adoption, participation in specific fisheries, catch orientation, and more. An interesting example is the debate concerning voluntary catch-and-release (Ratamäki and Salmi 2011), which in some countries or angling communities is common (Skov et al. 2022) because anglers view catch-and-release as an important management tool that protects fish stocks by preventing unnecessary harvesting, among other reasons (Blyth and Rönnbäck 2022). In other communities, catch-and-release is considered socially unethical because it causes suffering to individual fish without satisfying a primary need such as food or income (Øian et al. 2017).

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To deal with the dynamic nature of recreational fisheries and their inherent multi-stakeholder environment, scholars have called for adaptive co-management in recreational fisheries management (Hansen et al. 2015; Potts et al. 2020). This approach emphasizes continuous monitoring of the SES while applying experimental interventions so that collaborative learning takes place and changes in angler behavior can be identified swiftly and managed effectively. Despite advantages over traditional natural resource management, adaptive co-management has received criticism for being too reactive and slow to respond to changes by focusing primarily on back casting rather than anticipating the future (Wollenberg, Edmunds, and Buck 2000). In response to this criticism, techniques have been employed that facilitate forward casting to identify future opportunities and challenges in recreational fisheries management (Fenichel, Abbott, and Huang 2013; Fowler et al. 2023; Holder et al. 2020). Recognizing anticipated trends and associated uncertainty is crucial for the application of adaptive co-management, and subject area experts, scientists, and practitioners often have a key role in articulating them.

One forecasting technique to support adaptive co-management is a Delphi survey, which aims to gather information on a specific topic through consulting a group of experts via multiple, usually three, survey rounds. Specifically, the design of a Delphi survey steers toward expert group consensus on a topic (Belton et al. 2019; Hanna and Noble 2015; Hasson, Keeney, and McKenna 2000) to guide future decision-making (Barrios et al. 2021; Linstone and Turoff 1975). The Delphi method has been recognized as a useful tool to identify future challenges and opportunities related to a topic (Bañuls and Turoff 2011; Linstone and Turoff 2011; Revez et al. 2020), including recreational fisheries (Zuboy 1980).

Focusing on the Nordic countries of Denmark, Finland, Iceland, Norway, and Sweden, we used a Delphi approach to improve understanding of current trends in angler behavior and how these behaviors may develop over the coming decade. We specifically focused on recreational angling with rod and reel. The Nordic countries were similar in history, culture, governance, climate, and natural environments, so conditions and opportunities for recreational fisheries were similar. However, recreational fisheries also differed among these countries in target species, traditions, political context, and management strategies, so angler behavior differed. Despite the popularity of recreational fishing in Nordic countries, studies of angler behavior in this area were less common than in well-studied regions, such as North America (Arlinghaus et al. 2020). Moreover, we found no Nordic studies on current and future trends in angler behavior for recreational fisheries and its components and interactions. We sought to close this gap by broadly exploring trends in angler behavior, including choices concerning different angling techniques, target species, fishing environments, angler engagement in stewardship, technology use, catch orientation ("consumptive orientation"), and social interactions among anglers. Our results would hopefully be useful internationally by focusing on inter-country differences and similarities and connections between expected trends. In addition, we hope the implications of our results will be useful for guiding future research and management of recreational fisheries.

2 | Methods

2.1 | Study Area

The study focuses on five Nordic countries (Denmark, Finland, Iceland, Norway, and Sweden) that have relatively high levels of education and income and are classified as developed countries with a high human development index (UN Development Programme 2024). Across the region, participation in marine and freshwater recreational fisheries ranges 14%–41% of the adult population (Stensland et al. 2024), which is relatively high compared to the 10.5% average across 27 industrialized countries (Arlinghaus, Tillner, and Bork 2015). Fisheries in Nordic countries are managed under well-developed, knowledge-based organizations, although the operational structures of these organizations are unique in each nation. Access and ownership of marine fisheries are managed as public resources across all five countries, while freshwater fisheries are generally managed as part of private property rights, with exceptions in Finland, Norway, and Sweden. National fishing licenses are, with some exceptions, required for anglers of ages 18–65 in marine and freshwater in Denmark and Finland, and in freshwater for anadromous salmonids in Norway. Although some fish species are present and targeted in all five countries, the most commonly targeted species varies across the region for marine and freshwater fisheries (Stensland et al. 2024). Geographic factors drive species diversity and distribution, differences in numbers of rivers and lakes, length of coastlines, and physical characteristics that affect accessibility.

2.2 | Data Collection

Data were collected through a Delphi survey (Figure 1) of recreational fishing experts in each of the five Nordic countries. The study and survey design were a result of discussions among co-authors, with at least one author from each country. The authors utilized professional networks to identify 20 experts per country, aiming to include a representative of predefined expertise categories from each country while also accounting for age and gender diversity. Expertise categories included: *Landowners* (fishing rights holders), *angler organizations* (national associations and local clubs), *angling tourism* (fishing guides and suppliers of angling services), *gear industry* (suppliers of fishing gear and angling equipment), *media* (social media and magazines), *government* (public recreational fisheries managers), *research* (researchers involved in research relating to recreational angling), and experts that did not fit into any particular expertise categories (Appendix Table B1). Some experts filled double roles, such as being angling equipment suppliers and also involved in facilitating tourism. Experts were assigned to a category wherein most of their time was allocated. The number of experts in each category differed among countries due to how angling was organized and governed in each country. If an expert chose not to participate in the study (1–3 per country), another expert of the same category was recruited.

The Delphi study consisted of three survey rounds (open-ended, scoring, and consensus-seeking, Figure 1) between December 2019 and January 2022. Authors invited experts personally by email or telephone. When an expert accepted

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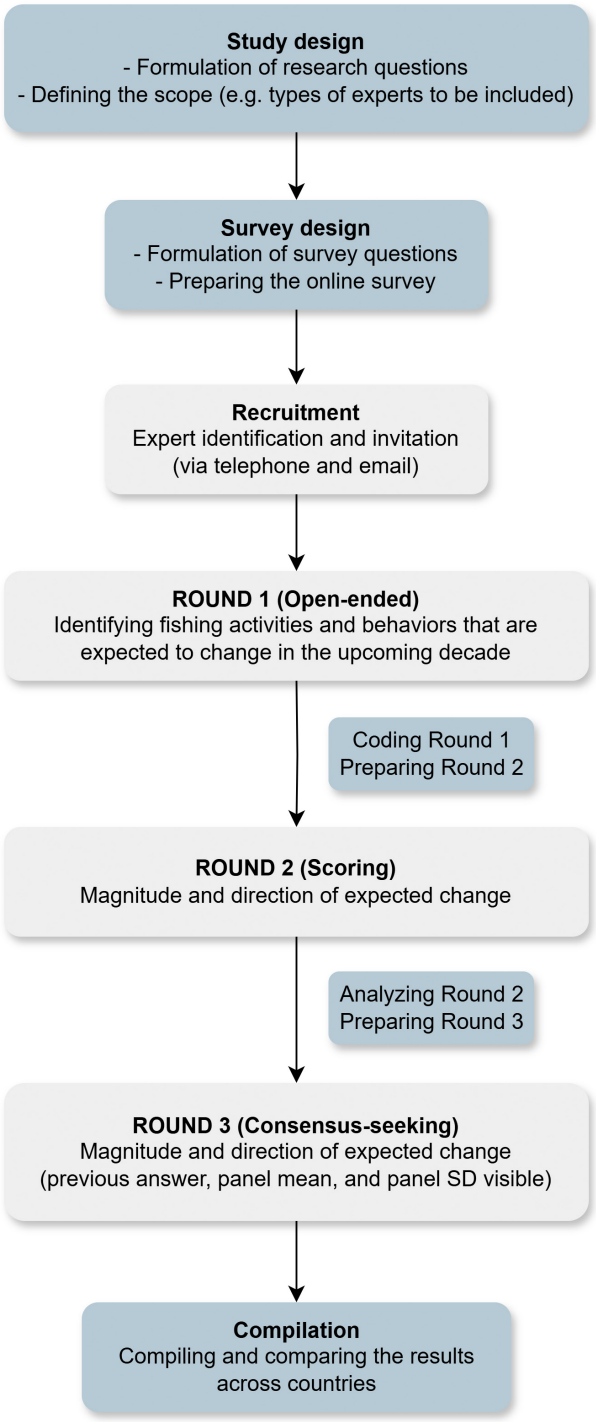

FIGURE 1 | Overview of the Delphi survey of recreational angling experts from Denmark, Finland, Iceland, Norway, and Sweden between December 2019 and January 2022. Dark gray boxes with solid lines indicate activities undertaken by all countries together. Light gray boxes indicate activities undertaken by each country separately.

the invitation, a personalized link to an online survey was sent by email. The first round (December 2019—February 2020) included a set of open-ended questions that asked experts about which angling activities (e.g., angling in specific types of waters, with a particular type of gear, or targeting specific species) they expected to increase or decrease in participation over the next 10 years (Appendix A). Open-ended questions from the first round were analyzed through qualitative content analysis (Bryman 2008) to identify angling activities of interest. Authors from all five countries ranked the ten activities that were mentioned most often by experts from their country, after which they collectively decided which activities should be included in the following rounds of the Delphi study. Some activities were country-specific, but most were common to all countries. In addition to changes in angling activities, most experts also mentioned expected future trends in other types of angler behavior, such as stewardship or use of social media. Because of the perceived relevance of these additional behaviors to recreational fishery management, they were included in the second and third rounds of the survey.

The second and third rounds of the survey were delayed due to the COVID-19 pandemic. In the second scoring round, February—May 2021, experts were presented with a list of angler behavior statements extracted from the first round (Appendix A). Based on their expertise, experts were asked to indicate the direction and magnitude of change they would expect in specific types of behaviors on a 7-point scale from strong decrease (more than 15% decrease) to strong increase (more than 15% increase) in the next 10 years in relation to the current situation. In the third consensus-seeking round, June 2021—January 2022, experts were presented with the same items as in the second round, including information about their own response in the second round and the mean, range, and standard deviation of all expert responses from their country for each statement. This final convergence round aimed to reach consensus by encouraging experts to reflect on their own answer in the previous round in the context of other answers, while allowing them to adjust their answer if answers by other experts justified a change (Barrios et al. 2021; Appendix A).

2.3 | Data Preparation and Presentation

Three overall behavioral themes were identified. The first theme included expected changes related to use of different types of gear, gathered under the theme *angling techniques* (e.g., fly-fishing, bait fishing). The second theme included expected changes in participation in specific *angling types*, defined as angling activities in a specific type of environment and/or targeting specific species, irrespective of angling gear. Angling types were subdivided into three categories: environment (e.g., street fishing), distinct groups of target species (e.g., coarse fish angling), or a combination of the two (e.g., coastal angling for sea trout). The third theme related to *additional behavioral aspects*, which included social interactions, catch orientation, stewardship, and social media and technology use. Some behaviors were similar among countries, while others were mentioned only by 1–4 countries. Only behaviors that were mentioned by at least three countries and for which items were worded similarly were included in the analysis (Appendix Tables B2–B4).

2.3.1 | Angling Techniques

Angling techniques mentioned by the experts in the first survey round were generally similar among countries. Six overall categories emerged: fly fishing, spin fishing, jig fishing, bait fishing, trolling, and ice fishing. Except for ice fishing, which

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was not mentioned in Iceland and Norway, all techniques were mentioned in all countries in round one and therefore included in the second and third rounds.

2.3.2 | Angling Types

Experts mentioned a diverse range of angling types in the first survey round. To allow for comparisons among countries, angling types were organized within specific categories based on target species or type of fishing environment. In some cases, country-specific angling types included both a specific environment and species or species group. In these cases, angling types were organized under an environment- or species-specific category, guided by professional judgment of the similarity to other angling types in a category.

2.3.2.1 | Angling Type—Fishing Environment. Environment-specific angling types were identified based on input from round one: put-and-take fishing in stocked lakes and remote angling in remote places in freshwater ecosystems; coastal angling from land and marine angling from boats in marine ecosystems; and street fishing in densely populated urban areas in freshwater or marine ecosystems (Table 1). No angling types were mentioned by all countries. For example, remote angling was not mentioned in Denmark, likely due to the relatively high population density compared to the other countries. In Finland, while remote angling exists, experts did not mention remote angling as a type of behavior anticipated to change in the next decade.

2.3.2.2 | Angling Type—Species (Groups). Angling types focused on a species or group of species (Table 2). No species were mentioned by Icelandic experts in round one, so Iceland was not represented in any species group. Coarse fish angling for species that typically were undesirable for eating (not including predatory species) and predator angling were both mentioned by experts from Denmark, Sweden, Finland, and Norway. However, for predator angling, the environment varied among countries, being specific for lakes in Denmark but including coastal angling in other countries.

2.3.2.3 | Angling Type—Other. Some angling types included angling that focused on a single or group of species in a particular environment (Table 3). For example, salmon or sea trout in rivers was explicitly mentioned as a combination of species and environment in all countries except Denmark, where most experts in the first survey round expected participation to increase in salmon fisheries and decrease or remain the same for sea trout angling. In addition, Danish experts often mentioned sea trout in combination with other salmonids, such as grayling and brown trout, but not with salmon. Hence, for Denmark, stream fisheries (sea trout, grayling, and brown trout) were included as a river environment category, and stream fishing for salmon was included here. Coastal angling for sea trout was its own category, as a common angling type in Norway, Denmark, and Sweden, but not in Iceland, which was likely why this angling type was not mentioned by Icelandic experts. The difference between Iceland and other Nordic countries became even more apparent by five angling types that were only mentioned in Iceland (Appendix B), likely due to unique geographical and ecological conditions in Iceland. Coastal sea trout angling was common in some parts of Finland (Natural Resources Institute Finland 2020), but was not mentioned by Finnish experts as a behavior that was expected to change.

TABLE 1 | Environment-specific angling-type categories were identified in a Delphi survey of recreational angling experts from Denmark, Finland, Iceland, Norway, and Sweden between December 2019 and January 2022.

Ecosystem	Category	Denmark	Finland	Iceland	Norway	Sweden
Freshwater	Put-and-take	X	X			X
	Remote angling			X	X	X
Marine	Coastal angling from land	X		X	X	X
	Marine angling from boat	X		X	X	X
Freshwater/Marine	Street fishing	X	X		X	X

Note: 'X' indicates which countries mentioned this category. See Appendix B for explicit item wordings per country.

TABLE 2 | Species-specific angling type categories identified in a Delphi survey of recreational angling experts from Denmark, Finland, Iceland, Norway, and Sweden between December 2019 and January 2022.

Ecosystem	Category	Denmark	Finland	Iceland	Norway	Sweden
Freshwater	Coarse fish angling	X	X		X	X
Freshwater/Marine	Predator angling	X	X		X	X

Note: 'X' indicates which countries mentioned this category. See Appendix B for explicit item wordings per country.

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TABLE 3 | Other angling type categories were identified in a Delphi survey of recreational angling experts from Denmark, Finland, Iceland, Norway, and Sweden between December 2019 and January 2022.

Ecosystem	Category	Denmark	Finland	Iceland	Norway	Sweden
Freshwater	Salmon/sea trout in rivers	X	X	X	X	X
Marine	Coastal angling for sea trout	X			X	X

Note: 'X' indicates which countries mentioned this category. See Appendix B for explicit item wordings per country.

2.3.3 | Additional Behavioral Aspects

In the first survey round, experts mentioned expected changes in angler behavior that did not relate to a specific technique, fishing environment, or target species. Such identified behaviors were relevant to explore across countries because of their global relevance to recreational fisheries research and management. Hence, with few exceptions, the list of additional behavioral aspects included in the second and third survey rounds was identical across countries.

Additional behavioral aspects were grouped into social interactions, catch orientation, stewardship, and social media and technology use. Social interactions included: angling with family; angling with friends; participating in angling competition; and being a member of a local angling club or national angling organization. For Denmark, the latter was split into member of a national angling organization and member of a local angling club. Catch orientation included voluntary catch-and-release and fishing for food. Stewardship contained four items related to angler intentions and behavior that contributed either directly or indirectly to responsible use of fisheries resources, including: active work to protect and restore fish and their habitat; boycotting companies and products that harm fish and habitats; trying to minimize negative impacts on fish and habitats when angling; and willingness to report angling trips and catches to improve general knowledge of fish stocks. Social media and technology use was showing and exploring interest in sport fishing on social media and using modern technology (e.g., apps, new equipment).

2.4 | Data Analysis

Results of the third survey round reflecting expected trends for each country were visually assessed and compared through violin plots created with ggplot2 in R (Wickham 2016). A decreasing trend was defined when at least half of all experts predicted a decrease by selecting one of three response categories indicating at least a minor decrease (and vice versa for an increasing trend). Moreover, a trend was strongly expected when > 75% of experts indicated a change in the same direction. For countries with an odd number of responses, the number of experts needed to meet 50% or 75% criteria were rounded up (Appendix Table B1). For example, Norway had 19 experts, so a strong expectation (75% of 19 = 14.52) would mean that at least 15 Norwegian experts expected a trend in a single direction. In some cases, a change could not be identified based on expert opinion, either because most experts did not expect a change or because experts expected trends in different directions.

In a few cases, multiple angling types from a given country were merged to fit into predefined angling type categories (Appendix Tables B2–B4). For example, marine angling from boat included both coastal and marine angling from a boat for Norway and Sweden, so the average score of these different activities was used as the value for the new category.

3 | Results

3.1 | Angling Techniques

Fly fishing was expected to increase in Iceland, Sweden, and Finland, and ice fishing was expected to decrease in countries where it was mentioned (strongly so in Denmark) (Figure 2). Bait fishing was expected to decline in Denmark, Iceland, and Norway and increase in Finland, with no clear trend in Sweden. Trolling was expected to decline in Finland, strongly in Iceland, with no clear trend in the other three countries. Spin fishing was strongly expected to increase in Sweden and decrease in Iceland, expected to increase in Denmark and Norway, and neither increase nor decrease in Finland. Jig fishing was expected to increase in Finland, Norway, and Sweden (strongly so in Finland), and neither increase nor decrease in Denmark nor Iceland.

3.2 | Angling Environments

Put-and-take angling was expected to increase in Sweden, strongly so in Denmark, and a decrease was strongly expected in Finland (Figure 3). Angling in remote places was strongly expected to increase in Iceland and Sweden, but neither increase nor decrease in Norway. Coastal angling from land (not for sea trout) was expected to increase in Iceland, strongly so in Denmark, but neither increase nor decrease in Norway and Sweden. Street fishing was expected to increase in Norway and strongly increase in Denmark, Finland, and Sweden. Marine angling from boats was expected to increase in Norway, strongly so in Iceland, but neither increase nor decrease in Sweden and Denmark.

3.3 | Angling for Target Species

Angling for coarse fish was expected to increase in Finland, but no increase or decrease was expected in Norway, Denmark, or Sweden (Figure 4). Predator angling was expected to increase in Norway, strongly so in Finland and Sweden, but no trend was expected in Denmark.

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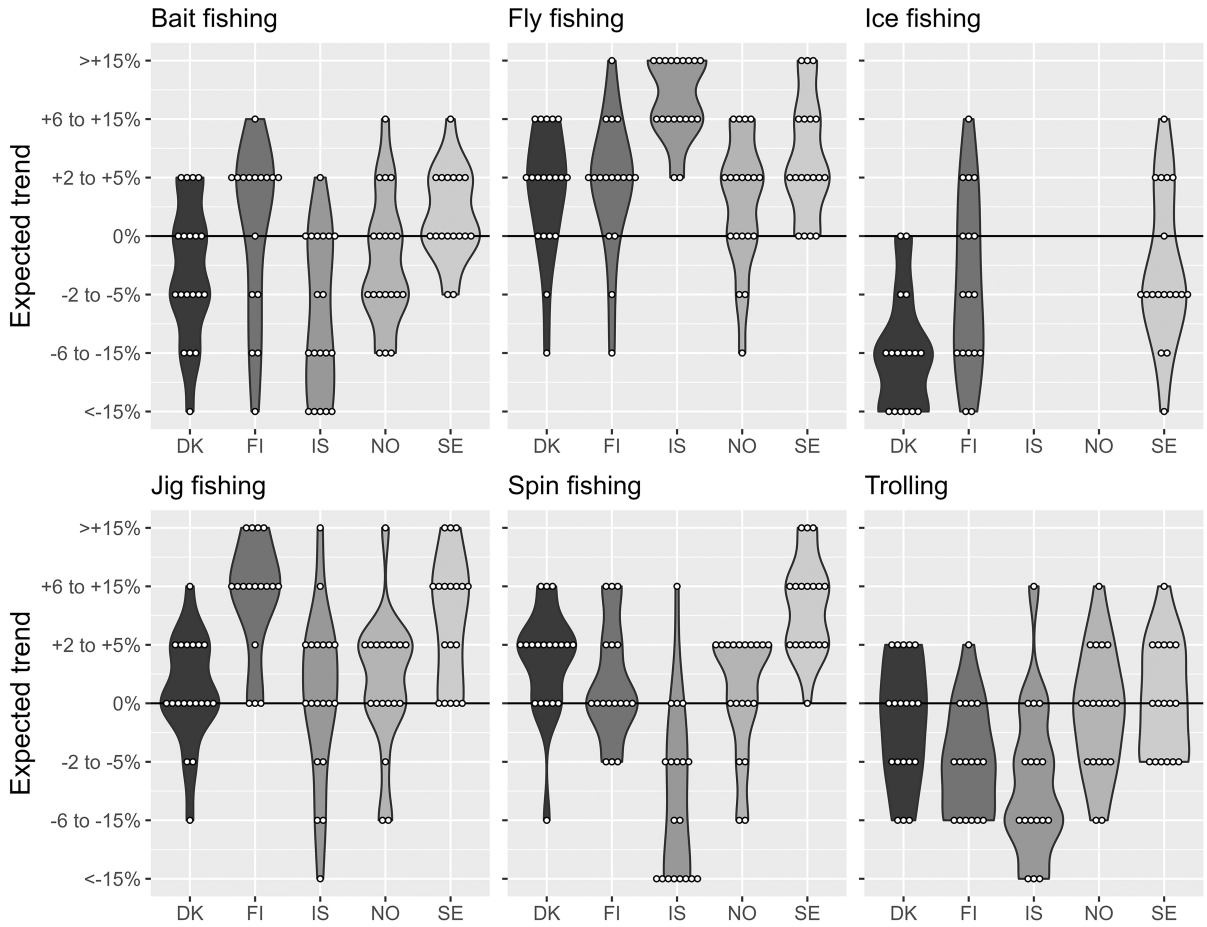

FIGURE 2 | Expected changes in the use of different fishing techniques identified in a Delphi survey of recreational angling experts from Denmark (DK), Finland (FI), Iceland (IS), Norway (NO), and Sweden (SE) between December 2019 and January 2022. Dots represent individual experts.

3.4 | Other Angling Types

River angling for salmon and sea trout was expected to increase in Denmark, Iceland, and Sweden, decrease in Norway, and neither increase nor decrease in Finland (Figure 5). Coastal angling for sea trout was expected to increase in Norway, strongly so in Denmark and Sweden. Seven angling types were mentioned only by experts from Denmark or Iceland, so were excluded from further analysis (i.e., not mentioned by at least three countries; Appendix Figure B5; Appendix C).

3.5 | Social Interactions

Angling with family was expected to increase in Sweden and Finland, strongly so in Iceland, but neither increase nor decrease in Norway and Denmark (Figure 6). Angling with friends was expected to increase in all countries, with strong expectations in Finland, except in Norway, where no clear trend was expected. Competition angling was expected to decline in Finland and Norway, but neither increase nor decrease in Iceland, Sweden, and Denmark. Membership in national angling associations was expected to increase in Denmark, but not to change for local angling clubs. Membership in local clubs and national associations was expected to increase in Sweden, strongly decrease in Finland, and neither increase nor decrease in Norway and Iceland.

3.6 | Catch Orientation

Catch-and-release (C&R) angling was strongly expected to increase in all five countries (Figure 7). Anglers who primarily fish for consumption were expected to decline in Denmark, Iceland, and Norway but to neither increase nor decrease in Finland and Sweden.

3.7 | Stewardship

Anglers boycotting harmful companies that could pose a threat to the natural fish population (such as fish farms), anglers who engage in habitat restoration, and anglers who will strive to have minimal negative impact on the environment while angling (e.g., by using lead-free fishing gear) were all strongly expected to increase (Figure 8). Anglers' willingness to report their fishing trips and catches was expected to increase in Finland and Norway, strongly expected to increase in Denmark and Sweden, but to neither increase nor decrease in Iceland.

3.8 | Social Media and Technology Use

Use of social media and other modern technologies was strongly expected to increase in all Nordic countries (Figure 9).

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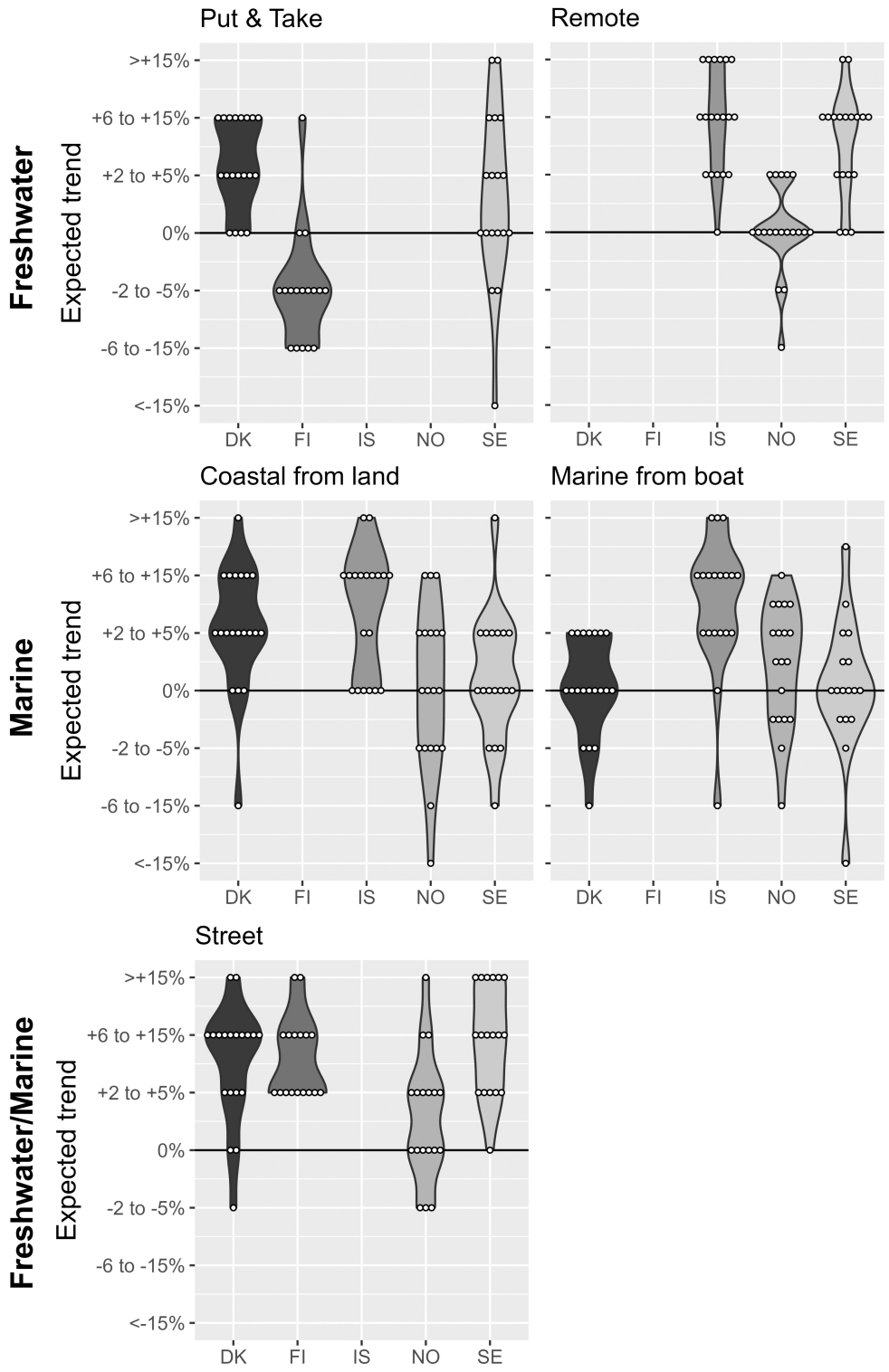

FIGURE 3 | Expected changes in angling in different environments identified in a Delphi survey of recreational angling experts from Denmark (DK), Finland (FI), Iceland (IS), Norway (NO), and Sweden (SE) between December 2019 and January 2022. Dots represent individual experts.

4 | Discussion

The results of this Delphi study on recreational angling in the Nordic countries offer insights into the decade that lies ahead of us through the eyes of a suite of experts that, in one way or another, work in or engage with the recreational fisheries sector every day. More specifically, our study presents the experts' expectations regarding future shifts in angler behavior with respect to angling techniques, environments, and target species. For many of the angling-related behaviors examined in this study, there were considerable differences between the expectations of the Nordic experts, both within and across countries (see Appendix B for a full list of behaviors mentioned in each country). As such, our results indicate that, while there

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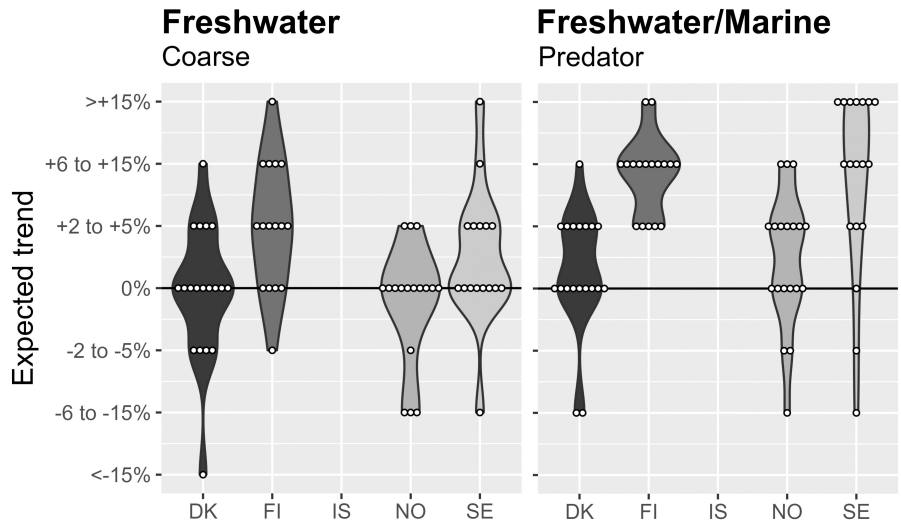

FIGURE 4 | Expected changes in angling for specific target species identified in a Delphi survey of recreational angling experts from Denmark (DK), Finland (FI), Iceland (IS), Norway (NO), and Sweden (SE) between December 2019 and January 2022. Dots represent individual experts.

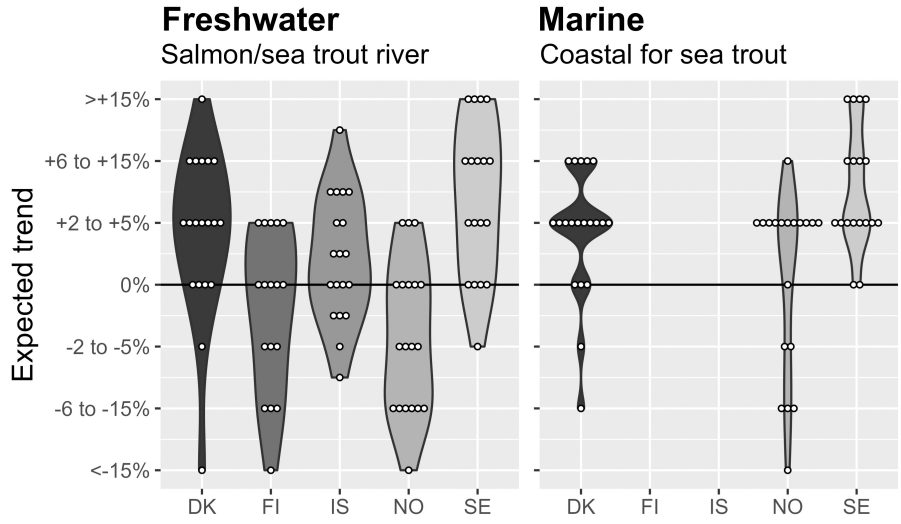

FIGURE 5 | Expected changes in other angling types identified in a Delphi survey of recreational angling experts from Denmark (DK), Finland (FI), Iceland (IS), Norway (NO), and Sweden (SE) between December 2019 and January 2022. Dots represent individual experts.

are numerous avenues for Nordic collaboration and knowledge exchange, each country also has their own fish to fry and may need to prioritize certain issues according to their national context.

4.1 | Stewardship

The unanimous expectation of increased stewardship intentions and actions to protect or restore aquatic ecosystems and associated angling opportunities we found was consistent with increasing interest in promoting stewardship as an important strategy toward achieving sustainable outcomes in recreational fisheries (Cooke et al. 2019; Elmer et al. 2017; Shephard, List, and Arlinghaus 2023) and in many other SES (e.g., Chapin III et al. 2011; Steffen et al. 2011; Folke et al. 2016). Several Nordic experts in our study recognized this potential by mentioning that angling participation can be a strong motivation to voluntarily engage in habitat restoration activities, especially in sparsely populated Nordic countries with many remote fishing areas (e.g., Iceland and Sweden), where protection through rule enforcement is often not possible. We conclude that global momentum is currently strong for reshaping the way humans interact with ecosystems, and angler stewardship can play an important role in this, which is consistent with the UN General Assembly declaration that 2021–2030 will be the "UN Decade on Ecosystem Restoration" (UN General Assembly 2019).

Anglers can contribute to healthy fisheries through logging their fishing trips and reporting their catches, for example, through formal trip reporting (e.g., Gundelund et al. 2021) or by sharing catches on social media (e.g., Giovos et al. 2018). Researchers and managers are increasingly aware of the usefulness of such angler citizen science (e.g., Arlinghaus et al. 2019) and increased uptake of recreational trip and catch reports in fisheries research and management (e.g., Bergström et al. 2022; Gundelund et al. 2022; Harris, Johnston, and Yeoh 2021). Moreover, the

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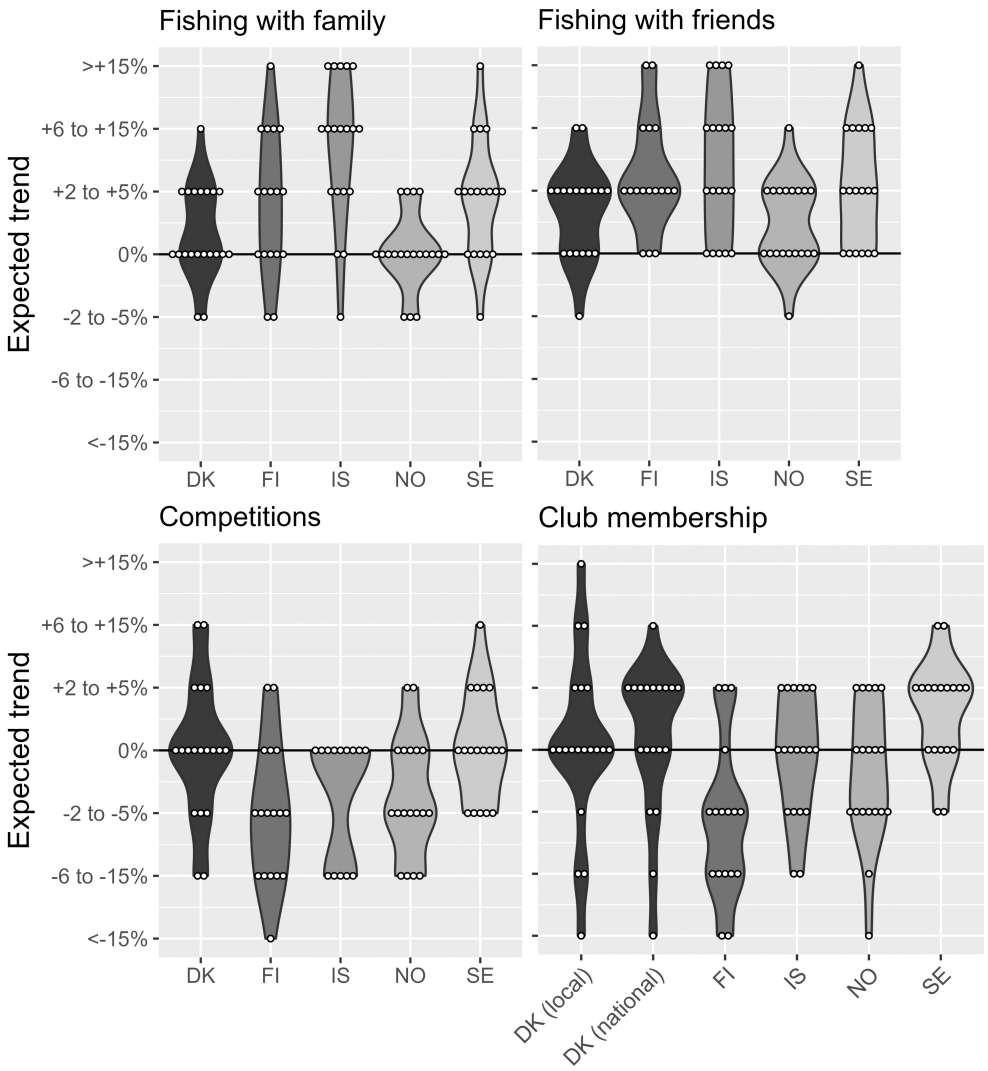

FIGURE 6 | Expected changes in angling-related social interactions identified in a Delphi survey of recreational angling experts from Denmark (DK), Finland (FI), Iceland (IS), Norway (NO), and Sweden (SE) between December 2019 and January 2022. Dots represent individual experts.

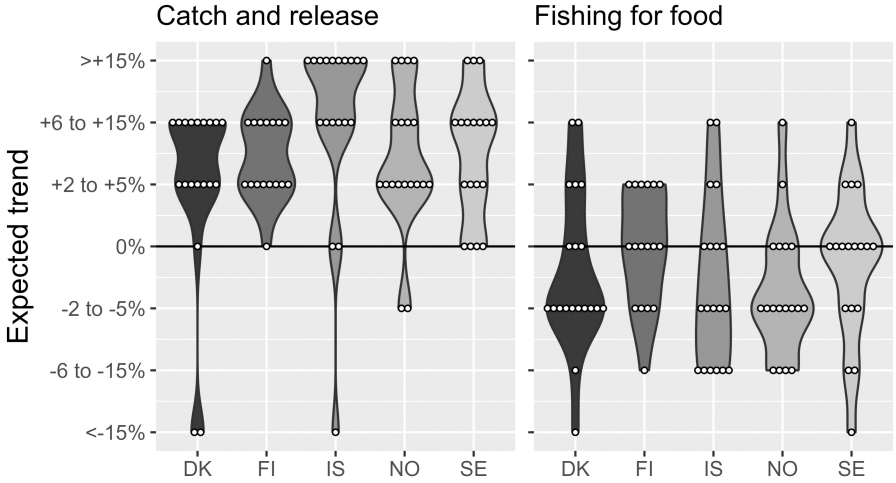

FIGURE 7 | Expected changes in catch orientations identified in a Delphi survey of recreational angling experts from Denmark (DK), Finland (FI), Iceland (IS), Norway (NO), and Sweden (SE) between December 2019 and January 2022. Dots represent individual experts.

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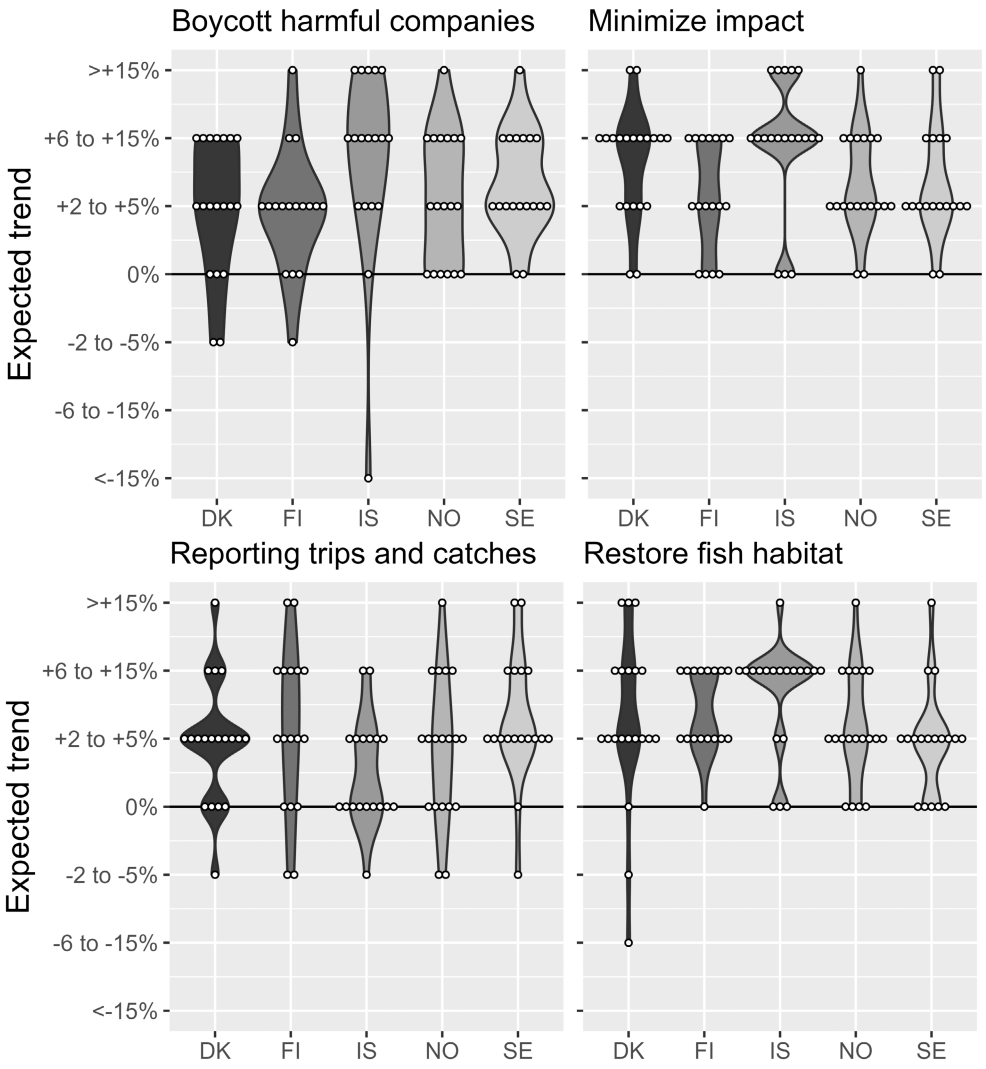

FIGURE 8 | Expected changes in stewardship actions identified in a Delphi survey of recreational angling experts from Denmark (DK), Finland (FI), Iceland (IS), Norway (NO), and Sweden (SE) between December 2019 and January 2022. Dots represent individual experts.

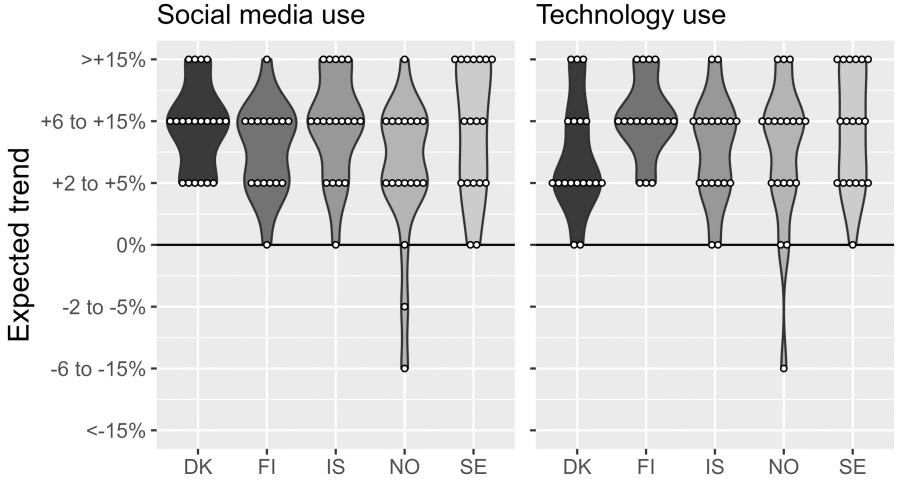

FIGURE 9 | Expected changes in social media and technology use identified in a Delphi survey of recreational angling experts from Denmark (DK), Finland (FI), Iceland (IS), Norway (NO), and Sweden (SE) between December 2019 and January 2022. Dots represent individual experts.

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importance of citizen science has been recognized on a global level through the 2022 Kunming-Montréal Global Biodiversity Framework, which highlighted that community-based monitoring systems and citizen science should play an important role in biodiversity monitoring (UN Convention on Biological Diversity 2022). Similarly, we found that most Nordic experts expected anglers' willingness to report their trips to increase in coming years, as in a Swedish study that found many anglers expressed a positive attitude toward catch reporting (van den Heuvel et al. 2020). However, to turn positive attitudes and willingness into angler behavior, trip reporting programs should be used to facilitate this behavior and ensure collection of valuable information. A pan-European program for trip and catch reporting could promote data sharing and collaboration among countries, but country-specific programs would be most likely due to high costs of developing and maintaining a pan-European program for highly diverse fisheries, contexts, and languages (Skov et al. 2021). Nordic countries are currently at different levels of development in creating national catch reporting programs, which provides opportunities for mutual learning and co-creation.

Voluntary C&R was expected to increase in the Nordic countries in our study. This practice has become more common in many fisheries throughout the world (Brownscombe et al. 2014; Lyach and Čech 2018; Skov et al. 2022) and can protect fish stocks if carefully used in suitable fisheries (Adams 2017). In addition to the stock protection argument for C&R, several experts mentioned potential changes in anglers' motivations to fish (e.g., from catch consumption to nature connectedness) that could drive C&R practices, but studies to support such a motivational trend are, to our knowledge, unavailable. At present, consumption of recreationally caught fish is higher in Nordic countries than in other countries (Cooke et al. 2018), and voluntary C&R is relatively new (Stensland, Aas, and Mehmetoglu 2013). Nevertheless, keeping and consuming catch is increasingly being perceived as problematic or unsustainable, especially by younger generations of anglers (Kagervall et al. 2014), which will make up a larger proportion of the future angler population. In contrast, some Finnish experts expected that self-caught fish would become more appreciated as ethical, local, and healthy food, and some of the Danish experts mentioned that the increase in C&R could result in a conflict with animal welfare organizations over the ethical implications of catching fish purely for leisure purposes rather than for nutrition. Such contrasting findings highlight the previously identified difficulty of capturing trends in consumption of recreationally caught fish on a national scale, as in our Delphi survey, due to the importance of local cultural and socio-economic drivers (Cooke et al. 2018). Angler populations, even at a local scale, are diverse in catch orientation, and individual angler attitudes and behaviors vary depending on target species and social norms, among others (Beardmore et al. 2011).

Potentially related to the expected increase in stewardship and C&R is the expected increase we found in fly fishing in Nordic countries. Fly fishing is an important part of several recreational fisheries in Nordic countries today, including coastal sea trout (Blicharska and Rönnbäck 2018; Skov et al. 2022) and salmon in streams (Aas, Andersen, and Stensland 2021). Experts from Denmark and Finland mentioned that anglers are attracted to fly fishing because they are motivated by the perceived sustainability and esthetics of fly fishing. Links between fly fishing and stewardship have not been studied explicitly, but recreation specialization, which is often higher among fly fishermen (Bryan 1977), is related to willingness to pay for conservation (Oh and Ditton 2008), and fly fishing preference is related to catch and release intentions (Kagervall et al. 2014). Moreover, most specialized trout anglers were most supportive of restrictive regulations, many of whom used fly fishing gear (Hutt and Bettoli 2007). Therefore, fly fishing, responsible resource use, and potential sustainable outcomes are likely related. In addition, our results suggest various switching behaviors away from unsustainable angling practices that could be a reflection of anglers' responses to ecological change. Anglers often adapt their behavior based on stock status and policies (Abbott and Fenichel 2013), which may explain the decrease expected in some countries for practices often considered less sustainable, such as bait fishing or targeting vulnerable species. Several Norwegian and Swedish experts expected a decrease in anglers targeting vulnerable species such as Atlantic salmon due to poor stock status and subsequent heavy restrictions, which in their opinion could explain the expected increased interest in other types of fisheries thought to be more resilient (e.g., predator fisheries or coarse fisheries). However, substitution results may be temporary, as explained by other Swedish experts who expected an increase in salmon and sea trout fishing now that the rehabilitation of these stocks in Sweden caused numbers to increase again. More research on recreation specialization development, substitution behavior, and the relationships between different angling techniques and stewardship is needed to get a better understanding of how managers can utilize the potential stewardship momentum that the Delphi experts foresee.

4.2 | New Technologies for Angling and Communication

Use of social media and angling-related technologies was expected to increase in Nordic countries in our study, consistent with other studies that emphasized the importance of angler apps and social media in understanding harvest patterns (e.g., Giovos et al. 2018; Lennox et al. 2022; Roos and Longo 2021; Sbragaglia et al. 2022) and angler characteristics (e.g., Gundelund et al. 2022; Vitale et al. 2021). Many reporting platforms developed as smartphone applications facilitate real-time logging of angling trips and catches and also provide information about potential sites to visit and support interactions among anglers (Venturelli, Hyder, and Skov 2017). Moreover, over the last few decades, social media has changed the way humans interact and therefore also how recreational anglers interact, by allowing the information about fishing spots or gear choices, as well as promoting and debating opinions and political issues (Cooke et al. 2021). Many experts in our study specifically mentioned how social media will become a main channel for practical and promotional information exchange between anglers and between anglers and managers, which has the potential to increase stewardship through facilitating (online) advocacy of best practices and other forms of citizen science and knowledge exchange (Allison et al. 2023). However, social media also poses many challenges to the distribution of information about

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environmental issues and best practices, among which are the creation of one-sided discourses and echo chambers that can spread misinformation (Cutler et al. 2022; Williams et al. 2015). Collaboration between researchers and managers could focus on planning social media strategies and interventions that utilize the potential of social media as a platform for positive behavioral change and information sharing (Allison et al. 2023), such as active engagement of researchers in online discussions and other forms of online scientific outreach (Bik et al. 2015).

We found that jig fishing and predator fishing were expected to increase in Nordic countries, perhaps related to increased use of social media that can provide a positive feedback loop for constantly emerging technology adoption of new angling technologies and innovations (Cooke et al. 2021). New technologies can increase angling efficiency (catch per unit effort, CPUE) of existing target species or access to previously inaccessible stocks or species, which may potentially increase fishing pressure on these stocks or species (Detmer et al. 2020). Predator species are an important part of the food chain in freshwater ecosystems, and increased fishing pressure on predators due to technological innovations and social media attention could negatively affect target species populations through trophic cascade (e.g., Bergström et al. 2022). Following and anticipating technological developments in the recreational fishing sector is an important focus area for research and proactive management to prevent overfishing.

Despite (or perhaps as a result of) the expected increase in the use of social media, more traditional forms of social interaction between anglers via membership in angling clubs and associations were expected to decrease. Danish experts in our study mentioned that fishing clubs were under pressure from social media, which have taken over some of the services that fishing clubs traditionally provided, such as sharing information about fishing spots or gear. Arlinghaus et al. (2019) suggested a policy reform for recreational fishing that highlights the importance of more and better organization of anglers. Among other things, such organization could help build social capital and give managers easier access to involve anglers in co-management. However, how to promote angler organization is unclear, and according to our survey, increased traditional angler organization were not expected in most Nordic countries. As such, angling club membership might decline, as in other leisure clubs (e.g., Sotiriadou, Wicker, and Quick 2014 on Australian cycling clubs). In anticipation of a shift away from traditional club membership toward online organization through social media, managers could utilize the power of social media to facilitate online communities dedicated to angler organization (Brownscombe et al. 2019).

4.3 | Climatic and Demographic Change

Across countries, there was a strong agreement that climate change, specifically warmer winters, will cause a decrease in ice fishing, which is in line with lake ice predictions for the Northern Hemisphere (Filazzola et al. 2024). Several Swedish experts mentioned that they expected the decrease in ice fishing to be most profound in the southern parts of the country, and the experts from Denmark, the most southern of the Nordic countries, correspondingly displayed the strongest expectations of a decrease. With similar changes in climate being expected throughout the Nordic region, international knowledge exchange related to climate change effects on recreational fishing practices (including but not exclusive to ice fishing; e.g., Mackenzie et al. 2007) could be useful to address the social-ecological implications of these changes throughout the region.

Street fishing (urban fishing) in rivers, ponds, channels, harbors, and piers in densely populated urban areas was expected to increase in most Nordic countries in our study, perhaps because of increased urbanization, and consistent with increased street fishing that is sometimes promoted to curb urbanization-induced declines in recreational fishing participation (Balsman and Shoup 2008; Schramm and Edwards 1994). To some extent, the expected increase in street fishing may also be connected to the expected diversification in recreational fishing participants, as in other studies that found high interest in street fishing among minority groups (Joosse et al. 2021; Valdez et al. 2019). Several Nordic experts in our study mentioned street fishing as an accessible, modern type of angling with its own subculture that appeals especially to young people in urban areas. High diversity of the street fisher population, together with unique fishing preferences, compared to anglers fishing in more rural locations (Arlinghaus and Mehner 2004), demand a tailored management approach, which could be a topic of collaboration among Nordic countries.

Our study showed an expected increase in angling with friends and family in all Nordic countries except Norway, perhaps as a result of the decrease in average household size and increase in one-person households (e.g., Fokkema and Liefbroer 2008), which can influence outdoor recreation participation (Tangeland, Aas, and Odden 2013). Along these lines, some Danish experts mentioned increases in specific fisheries that attract families more than others because of higher accessibility and catch rates than other fisheries, including put-and-take fisheries for rainbow trout, coastal fishing for mackerel or garfish, and fishing from piers and harbors.

4.4 | Study Limitations

Angler populations are highly diverse in demographic and psychological attributes (Hunt et al. 2021). However, we did not account for potential effects of age, gender, and ethnicity on participation in angling techniques, types, or behaviors in this study. For a discussion of demographic trends in recreational angling in Nordic countries, we refer to a related study (Stensland et al. 2024). In our study, experts generally expected behavioral changes due to the emergence of a new generation of anglers with different wants and needs for stewardship action, technology use, and social organization. Additional research into potential relationships between angler diversification and behavioral trends could be useful to guide future management of recreational fisheries in a way that acknowledges and better serves this diversity to provide improved management outcomes.

A potential bias in forecasting methods, such as the Delphi approach we used, is that the survey might measure a desired outcome rather than an expected outcome based on experience and expertise (Lin, Goodwin, and Song 2014). We minimized the effect of desirability bias by aiming to create

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a heterogeneous expert panel of people with different relationships to recreational fishing, yet all with high expertise, as suggested by Winkler and Moser (2016). Regardless of the potential desirability bias, outcomes of our Delphi study reflected expert perceptions of the future, which will influence decisions they make as stakeholders in recreational fisheries.

The Covid-19 pandemic that started shortly after the first survey round may have affected results of our Delphi study by causing a sudden increase in outdoor recreation in response to legal limitations on social interaction indoors, as in many European countries (Fagerholm, Eilola, and Arki 2021; Hansen et al. 2023; Jūrmalis, Lībiete, and Bārdule 2022). In contrast, a stay-at-home mandate strongly reduced outdoor recreation in the US (Rice et al. 2020). These developments may have influenced the magnitude of change expected by experts in the second and third rounds. For example, the upward trend in social media use and downward trend in fishing competition participation may have been amplified by restrictions on meeting with other anglers or visiting new sites in person. Effects of the pandemic on future outdoor recreation in the post-pandemic world are unclear (e.g., Rice et al. 2022). Evidence from recreational angling license sales suggested that participation effects were temporary (Britton et al. 2023), while data from a fishfinder device suggested sustained increased effort (Audzijonyte et al. 2023).

5 | Conclusions

Expected increases in angler stewardship and the use of new technologies and social media in all Nordic countries uncovered a shared vision of how angler behavior will change in the coming years. Many of these trends particularly concerned young, new anglers entering recreational fisheries, which provides insight into the potential behavior of the next generation of anglers. While the next generation likely constitutes a behaviorally diverse group of anglers, experts in our study expected them to share an increased interest in stewardship and to use many new angling methods. Moreover, young anglers were expected to build social connections outside traditional organizations, use social media to increase awareness of ecological issues and best angling practices, and coordinate habitat restoration activities. To utilize the expected potential for increased interest in stewardship action, managers would need to move away from "business as usual" and find new ways of connecting to anglers, in addition to existing fishing clubs and angling associations. For example, management bodies could actively participate in online communities and platforms (e.g., Danylchuk et al. 2018) and create angler apps to aid fisheries monitoring while also providing a tool to educate anglers and potentially motivate them to engage in stewardship (Skov et al. 2021). Collaboration among Nordic countries in joint research and other forms of knowledge exchange could provide new pathways to implement and test novel management strategies that address future trends across nations.

Ethics Statement

Informed consent was gathered where applicable.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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