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ABSTRACT

In December 2022, representatives adopted the Kunming-Montreal Global Biodiversity Framework (GBF). The overarching goal of the agreement is to halt biodiversity loss and restore natural ecosystems – and a much-cited target is the "30x30" target of protecting and restoring 30% of Earth by 2030. Salt marshes are highly productive coastal ecosystems relevant for both biodiversity and climate change mitigation but have experienced historical major losses and are among the habitats in need of protection and restoration. Currently, there is little knowledge about how salt marshes are valued from a societal perspective, which has important management implications. This is particularly the case in the Nordic region where awareness of these habitats is low. Using survey data from Norway, Sweden, Finland, Denmark, and Germany, this study contributes understanding how citizens value salt marshes by examining support for different management initiatives framed as contributing to the goal of either biodiversity protection or climate change mitigation. Generally, both respondents primed with information about the importance of salt marshes for biodiversity and for climate change mitigation were supportive of the management initiatives despite having little previous knowledge of salt marshes. For one initiative, respondents who were informed of the importance of salt marshes for biodiversity were slightly more likely to support the management initiative than those informed about the importance of salt marshes for climate change mitigation. Our study provides guidance for assessment of trade-offs from a human valuation perspective, thus supporting policy makers when considering arguments for salt marsh management within the context of the 30x30 targets for protected areas.

1. Introduction

Preserving biodiversity is now firmly understood as critical to solving the climate crisis (Pörtner et al., 2021, 2023), and as such, in recent years, we have seen an increase in biodiversity preservation efforts globally. Most notably, in December 2022, representatives adopted the Kunming-Montreal Global Biodiversity Framework (GBF).[1] The overarching goal of the agreement is to halt biodiversity loss and restore natural ecosystems, including a much-cited target – the "30x30" target of protecting and restoring 30% of Earth by 2030. The GBF exemplifies the growing global attention to biodiversity loss and climate change, and, for many, it provides hope for the preservation of vulnerable ecosystems like coastal wetlands across the globe. Coastal wetlands, like many other ecosystems, are facing two interlinked anthropogenically driven crises; the climate crisis caused by excessive emission of greenhouse gases (GHG) and the biodiversity crisis caused by habitat destruction due to multiple stressors. Coastal ecosystems are in dire need of sustainable management (Myers et al., 2019), and, fortunately,

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through the GBF, a focus on restoring and protecting natural ecosystems has been agreed upon, with concrete targets, national commitments, and deadlines.

The protection and restoration of coastal wetlands is a Nature-based Solution (NbS) benefitting climate change mitigation and biodiversity (Macreadie et al., 2021; Thorslund et al., 2017). NbS "*are inspired and* supported *by nature, they are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience; such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions. NBS must benefit biodiversity and* support *the delivery of a range of ecosystem services"* (European Commission & European Research Executive Agency, 2023). While NbS have great potential, it is important to highlight that achieving this potential depends on the parallel decarbonization of the global economy at unprecedented rates, and this potential is relatively small compared to reductions that can be made by rapidly phasing out fossil fuel use (Seddon et al., 2021). Nonetheless, the sustainable management, conservation, and restoration of coastal wetlands, among other ecosystems, is critical for the provision of the ecosystem services required for human security under a changing climate (IUCN, 2017).

Despite the importance of coastal wetlands, these ecosystems, nestled at the interface between land and sea, are often outside public consciousness (McKinley et al., 2020). In this study, we focus on salt marshes, a type of coastal wetland. How ecosystems are perceived by the public and key stakeholders can shape management practices and, as such, should be explored (Guan et al., 2022; Villamor et al., 2014; Wang et al., 2021). Limited comprehension of the ecological importance of salt marshes and the ecosystem services provided by salt marshes may affect public perception and valuation of these ecosystems, and in turn policy action plans and states' implementation of the 30x30 target of the GBF. Understanding how the public values these ecosystems is, therefore, a crucial step towards increasing support for their management and, thereby, their ability to act as a well-functioning NbS (Josephs and Humphries, 2018).

In this study, we examine how the public values salt marshes through assessing their willingness to support different initiatives framed as contributing to the goal of either biodiversity protection or climate change mitigation. We conducted the survey with respondents from Norway, Denmark, Finland, Sweden, and Germany. The purpose of the study is twofold: (1) to identify if respondents receiving a priming text about the importance of salt marshes for climate change mitigation are more willing to support initiatives to manage salt marshes than those receiving a text about the importance of salt marshes for biodiversity protection and (2) assess what factors influence respondent answers. Correspondingly, we address the following research questions in this study.

R1: Are respondents who receive the climate change priming more supportive of salt marsh management initiatives than those who receive the biodiversity priming?
R2: What factors influence support for salt marsh management?

We hypothesized that there would be a difference in response between respondents who received different priming texts. This was because findings from the Eurobarometer survey identified that Europeans are more likely to say that climate change is one of the most important environmental threats than the decline or extinction of species and habitats, or of natural ecosystems (forests fertile soils) (European Commission, 2020a). In the following sections, we first underscore the value of salt marsh habitats from an ecological standpoint and briefly discuss approaches to measuring their value before outlining the survey methods. We then report the results of the survey with respondents from Norway, Denmark, Sweden, Finland, and Germany.

1.1. Ecosystem services of salt marshes

Salt marshes are coastal wetlands that form the transition zones between land and sea in many regions. On a global scale, salt marshes are mainly found in temperate regions, whereas they are largely replaced by mangrove forests in the tropics and have relatively limited occurrence in the Arctic (Murray et al., 2022). Overall, salt marshes are confined to low-energy shorelines, and they are usually subjected to periodic flooding due to sea level fluctuations (Adam, 1990). With flooding, fine sediments are deposited on the surface of a salt marsh, leading to slow rise in their elevation.

Knowledge of the ecological functions and ecosystem services of salt marshes is well consolidated in macrotidal areas in temperate zones, such as the Atlantic shorelines. Due to greater variability in their appearance and definition, knowledge gaps persist regarding the exact distribution and the associated ecological functions and ecosystem services of salt marshes located along the Baltic Sea and other Nordic areas (Krause-Jensen et al., 2022; Ward, 2020). In Norway, for example, smaller salt marshes locally occur on the shorelines of fjords, where sediment deposition creates shallow areas for them to occur regardless of the steep and deep shores (Martini et al., 2019). At the Baltic coast of Finland and the eastern coast of Sweden, on the other hand, salinity is very low and tidal amplitude small (cm), and thus, these ecosystems are instead typically referred to as boreal coastal, seashore meadows or grasslands (e.g., Grace and Jutila, 1999; Jónsdóttir, 1991; Pätsch et al., 2019). Overall, the appearance and conservation of salt marshes differ greatly between the Nordic countries (Dijkema, 1990). Thus, we hypothesized that citizen support for salt marsh ecosystem services would also differ between the countries.

Salt marshes are largely recognized for their role in carbon sequestration (Mitsch et al., 2013) and biodiversity support (Gibbs, 2000). Salt marsh plants enhance sediment trapping, which is essential for contributing to climate mitigation as the deposition of fine particles enhances the long-term carbon burial. This carbon sequestration potential is one of the reasons that salt marsh habitats are promoted via conservation and restoration as a NbS to help mitigate climate change while also supporting other co-benefits such as coastal protection (Möller et al., 2014) and biodiversity maintenance, among others (Friess et al., 2020). However, these features also make them vulnerable to distinct climatic conditions, tidal amplitudes and flooding regimes. Their location at the land-sea interface underpins their ecological relevance in connecting terrestrial and aquatic systems and sustaining both aquatic and terrestrial food chains. These marsh areas also provide feeding and breeding grounds for migratory and resident bird species, while also creating recreational areas for bird watching and hunting (Friess et al., 2020). Furthermore, juveniles of commercially important fish species use salt marsh creeks and reed beds as nurseries, food, and shelter areas, hence supporting near-shore fisheries (Barbier, 2019; Boström et al., 2017; Niemi et al., 2023). In addition, they also promote refuge and food provision for a wide range of terrestrial fauna, such as insects (Rickert et al., 2014).

Assessing how citizens value these ecosystems is important from a

governance perspective (Costanza and Farber, 2002), as there are multiple threats to salt marshes. Coastal development (diking and urbanization) can decrease salt marsh area. Changes to these salt marsh ecosystems will impact their ability to not only take up and sequester CO_2, further accelerating effects of climate change (European Commission, 2020b; Simas et al., 2001), but also impact biodiversity. In addition, most of the Nordic salt marshes and coastal meadows are listed as endangered or vulnerable in the European Red List of Habitats (European Commission et al., 2016). Understanding how citizens value salt marshes' contribution to biodiversity protection and climate change mitigation is important when working to tailor management actions within a UN member state setting as they prepare to submit their national reporting plans for the Kunming-Montreal Global Biodiversity Framework.

1.2. Measuring value

Following the discussion of Costanza and Farber (2002), if value is defined as "contribution to a goal", then natural systems have value if they contribute to a goal. As Costanza and Farber (2002) state, a major goal of human interaction with natural ecosystems is the support of human welfare, and "this goal is the criteria against which human activity and the conditions of natural systems are often measured." We take this definition of value as a point of departure. While some scholars measure the value of ecosystem services in terms of monetary units (see, for example, Barbier et al., 2011; Breaux et al., 1995; Costanza et al., 2014), even Costanza et al. (2014) acknowledge that monetary estimates are not "… the only, or even the best way, to understand the value of ecosystem services", but rather one of many different approaches for measuring value. The IPBES embraces many different values (e.g., intrinsic, anthropocentric, etc.) (Pascual et al., 2017). Instead of focusing on monetary based 'willingness to pay' as a measure of value, in this study, we examine value through citizens 'willingness to support' different management initiatives framed as either positive for biodiversity protection or climate change mitigation. Both the initiatives framed as positive for biodiversity protection and those framed as positive for climate change mitigation are presented to respondents as supporting human welfare. 'Willingness to support' studies, can, in cases such as this, provide a better governance understanding by focusing on how citizens interact with policies instead of price hikes (e.g., Wan et al., 2015).

Table 1
The different panels. Respondents in the biodiversity panel also received information on biodiversity in scenarios 1, 2, and 3. Similarly, respondents in the climate change panel also received information on the climate in scenarios 1, 2, and 3. The scenarios are further specified in Table 2.

Panel	Main framing text
Biodiversity	Tidal salt marshes could potentially be important areas for biodiversity because they are a good habitat for birds, bees, butterflies and a variety of other species, both plants and animals. Often, there are rare, protected species in these marshes. Biodiversity is the backbone of life. It is as essential for humans as for environmental and climate protection. Biodiversity is vital in terms of protecting people's health and in sustaining our economy. However, biodiversity is declining at an alarming rate: according to scientists, around 200 species become extinct every day.
Climate change	Tidal salt marshes could potentially be important habitats when it comes to addressing climate change because they could store large amounts of CO_2 and removing CO_2 from the atmosphere will help to mitigate climate change. The latest data from leading scientists show unprecedented changes in the world's climate. According to the latest report of the Intergovernmental Panel on Climate Change (IPCC), global warming is causing increased, and in some cases irreversible, changes to rainfall patterns, oceans' currents and winds in all regions of the world.

2. Methods

2.1. Survey design

The study involved approximately one thousand respondents in each country, making the total sample size for all five countries 5045. In Norway, N = 1007, in Sweden N = 1006, in Denmark N = 1012, in Finland N = 1010, and in Germany N = 1010. The respondent profiles are detailed in Appendix Fig. 1. The respondents in each country were randomly assigned to one of the two following panels (with different priming). Respondents in the first panel were presented with a priming text that highlighted the importance of salt marshes for biodiversity and information about biodiversity. Respondents in the second panel were presented with a priming text highlighting the importance of salt marshes for climate change mitigation and information about climate change (Table 1). Respondents were split equally into each panel, with 50% receiving the biodiversity panel and 50% receiving the climate change panel. The statements on biodiversity and climate change mitigation (see Table 1) were based on text from the European Union's website (European Council, n.d.-a, n.d.-b). The statements were modified to increase similarity. They were chosen because they target citizens and succinctly describe climate change and biodiversity.

A workshop conducted in the BiodivERsA-funded NordSalt project with natural science researchers in each of the respective countries highlighted different ways citizens may be called on to support salt marsh management. Three scenarios were used. The scenarios tested respondents' willingness to support initiatives to manage salt marshes despite 1) a potential decrease to their house value (i.e., by letting reeds, common salt marsh plants, block their view), 2) a personal inconvenience, or 3) taxation (Table 2).

Following the scenarios, as shown in Table 2, respondents were asked a binary question to determine their willingness to support. The questions were binary because, in real life, respondents would have to choose to support or not to support the initiative.

The questionnaire was translated from English into Norwegian, Danish, Swedish, Finnish, and German. The translation of the questionnaire from English to each country's national language followed a set procedure inspired by Forsyth et al. (2007), which included

Table 2
Scenarios presented to the respondents and corresponding questions.

Scenario	Text
1	You own a house on the coast and there is a salt marsh in front of your house. There are tall reeds that grow in the marsh. The reeds block your view and, therefore, lower your house value. Cutting the reeds could potentially have a negative impact on **biodiversity/the climate**[a]. Would you keep the reeds or cut them down? - I would keep the reeds - I would cut them down
2	In the summer, you often swim in the sea. There is a salt marsh near where you usually swim. There's an initiative to conserve this salt marsh. This could potentially have a positive impact **on biodiversity/the climate**[a]. However, if the salt marsh is conserved, you cannot swim at your usual swimming spot and would have to walk 10 min more to get to another spot. Would you support this initiative? - Yes, I would support the initiative - No, I would not support the initiative
3	There is a dike (a type of physical barrier) in your town that is keeping the salt marsh from expanding inland with sea level rise. Would you support an initiative to remove this dike and let the salt marsh expand? This could potentially have a positive impact **on biodiversity/the climate**[a]. However, this will also mean that your taxes will increase slightly. Would you support this initiative? - Yes, I would support the initiative - No, I would not support the initiative

[a] Different treatment, see Table 1.

translation, review, initial adjudication, and final review and adjudication.

The survey was programmed by YouGov, an online polling company who fielded it via an online questionnaire in Norway, Denmark, Sweden, Finland, and Germany. All respondents were 18+ years of age. YouGov selected a representative sample based on age, gender, and geographical location. The survey was fielded in September 2022. Each programmed survey was reviewed by at least two people before fielding. The questionnaire translations were also reviewed by You Gov. Following standard procedure in Norway, we notified the Norwegian Agency for Shared Services in Education and Research regarding the processing of personal data. Approval was received prior to fielding, and before respondents filled out the questionnaire they were informed of their rights as well as the purpose of the study.

2.2. Data analysis

Respondents' willingness to support initiatives to manage salt marshes was compared using percent of responses split by panel (primed with information on climate change and biodiversity respectively). T-tests with a 95% confidence interval were used to statistically examine whether the mean responses were different between panels (with willingness to support coded as "1", and not willing to support coded as "0"). We assumed equal variances in stimulus groups and a normal distribution. As the study design was balanced and survey data were weighted to account for sociodemographic differences across groups, the samples were assumed to be independent. The data was weighted by YouGov based on gender, age, and geographic data.

In addition to questions about willingness to support, we asked respondents questions about their background knowledge on salt marshes, how much time they spend in nature, how worried they are about climate change and biodiversity loss, how much they value the environment, and whether they are aware of living within a 1-h drive of a salt marsh. Number of responses were split by panel to assess whether panels were overrepresented by respondents with more interest in the environment or concern about biodiversity loss or climate change. Chi-square tests were used to test for the independence of background variables (time spent in nature each week, concern about biodiversity loss, concern about climate change) and respondents' willingness to support in each scenario. We explored whether the amount of time respondents spent outside is independent of their willingness to support initiatives to manage salt marshes following the three scenarios presented. In addition, we explored whether respondents' willingness to support in each scenario is independent of respondents' concern about biodiversity loss/climate change (see Fig. 1).

Societal context (represented by respondents' country) was predicted to influence respondents' relationship to the environment. To test this hypothesis, ordinal regressions were used to analyse the influence of respondents' country of origin on their (1) perceived importance of climate change, (2) perceived importance of biodiversity loss, and (3) perceived overall importance of the environment. Ordinal regressions are used to predict ordinal response values where the ordering of values is important. For the questions "*How worried are you about climate change/the loss of biodiversity?",* the ordered levels were: "extremely worried" < "very worried" < "somewhat worried" < "not very worried" < "not worried at all". For the question "*Generally, how important is protecting the environment to you personally?",* the ordered levels were: "not important at all" < "not very important" < "somewhat important" < "very important" < "extremely important". The responses "not sure" were not included in these analyses as they were not possible to order.

To test the effect of sociodemographic variables (gender, level of education, country of origin, age of respondent, self-reported income) on respondents' willingness to support, we used multivariate, generalized linear models with binomial distributions. Sociodemographic variables were included in models as fixed effects. Chi-squared tests were used to test the independence of sociodemographic variables. We used tests of independence to avoid the inclusion of dependent variables and the complexity of interpreting results with multicollinearity. The initial full model included all variables that were independent (as determined by chi-squared tests, Appendix Table 2). Akaike's Information Criterion (AIC) values were used to determine variable inclusion, with non-significant variables being removed from models (Burnham, 2015). Selected models therefore only included sociodemographic variables that significantly influenced proportion of people willing to support initiatives to manage salt marshes.

All analyses were conducted in R (version 4.1.2; R Core Team, 2022). R scripts used to perform data analyses are available in a public GitHub repository (link available following publication). Ordinal regressions were fit using the "ordinal" package (Christensen, 2015).

3. Results

Most of the respondents (see Fig. 1) were willing to support initiatives to manage salt marshes in all three scenarios and across both treatment groups (Fig. 1). However, whether the management initiative was framed as important for biodiversity or for the climate had a significant effect only under one specific scenario; respondents primed with information about the importance of salt marshes for biodiversity were slightly more willing to keep reeds that block their view from their house (and thereby potentially lower their home value) than those presented with information about the importance of salt marshes for climate change mitigation (Fig. 1 panel a; scenario 1).

The results from the *t*-test provide support for the hypothesis that responses differed between panels; more respondents in the biodiversity panel were willing to support than the sample as a whole (*t*-test: df = 5043, *t*-value = 2.46, *p*-value = 0.01; t-threshold = 2). However, there was no significant difference between panels in respondents' willingness to support to keep salt marshes via effected recreational swimming area

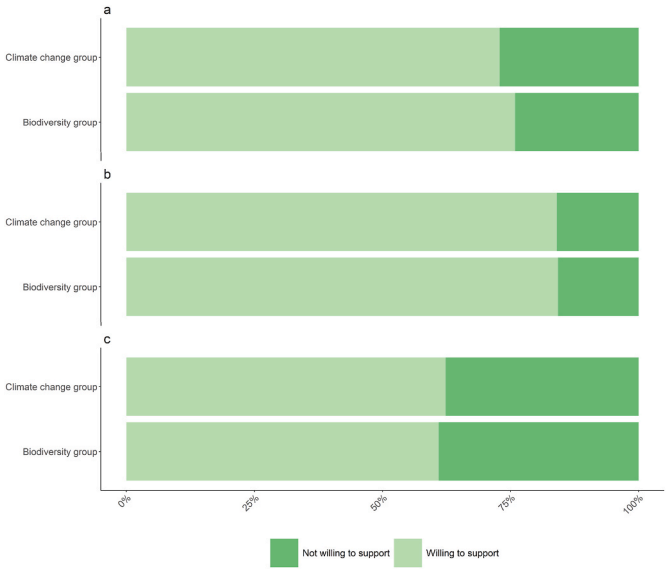

Fig. 1. Percent of responses to questions about respondents' willingness to support initiatives to manage salt marshes following priming about either the importance of salt marshes for retaining biodiversity or the importance of salt marshes for addressing climate change. Panel a shows response percentage for willingness to support an initiative despite a potential decrease in home value (scenario 1), panel b willingness to support an initiative despite decreased convenience for a recreational activity (scenario 2), and panel c shows willingness to support despite an increase in tax to pay for the removal of dikes (scenario 3). Weighted survey data were used to account for differences across demographic groups. Between panels, we detected a difference in the proportion of survey respondents willing to support the initiatives for scenario one (a), but not for scenario two (b) or three (c).

Table 3
Effects of respondents' sex, country of origin, and age on their response to the survey scenarios. Selected models are indicated with bold Akaike's Information Criterion values.

Scenario	Treatment group	Sex	Country	Age	AIC value
1	X		X	X	**5632.40**
	X	X	X	X	5632.20
			X	X	5636.60
		X	X	X	5636.50
			X		5648.10
				X	5732.00
2		X	X	X	**4354.70**
		X		X	4368.90
		X	X		4375.00
			X	X	4377.30
3		X	X		**6688.2**
		X	X	X	6694.60
		X			6699.40
			X		6707.40

(t-test: df = 5043, t-value = 0.22, p-value = 0.82, Fig. 1 panel b; scenario 2) or via increased taxes for removal of dikes (t-test: df = 5043, t-value = −0.99, p-value = 0.32, Fig. 1 panel c; scenario 3).

The exact percentages are presented in Table 3. From visual inspection, the number of responses to background questions regarding environmental knowledge and values did not reveal clear differences between the two panels (Fig. 2). Most respondents did not know what a salt marsh was before the survey was conducted (Fig. 2a), spent approximately 1–6 h in nature each week (Fig. 2b), were very or somewhat worried about the loss of biodiversity (Fig. 2c), were very or somewhat worried about climate change (Fig. 2d), report protecting the environment is somewhat important to them, and were not aware of a salt marsh being located in the proximity of where they lived (Fig. 2e). From tests of independence, we found respondents' willingness to support management initiatives across all three scenarios was dependent on their responses to questions on how much time they spent in nature, how much they worried about climate change, and how much they worried about biodiversity loss (see Appendix Table 1).

We found there was a relationship between the variables from tests of independence (see Appendix Table 2). Thus, full models that explained these relationships included the variables sex, country, and age (and excluded the two variables self-reported income and highest education level obtained). Models fit for scenario one also included stimulus group as a fixed effect due to differences in responses between groups detected by t-tests (also see Fig. 1). Models fit for scenarios two and three did not include the effect of priming, as we did not find support for the hypothesis that responses to these survey questions differed between panels.

Overall, the ordinal regressions indicated respondents' concern about climate change and biodiversity loss as well as the importance of the environment was significantly influenced by their societal context (represented by respondents' country of residence). For all models fit, Hessian numbers were <10000 indicating models were uniquely identifiable (Christensen, 2015). German survey respondents were the most worried about climate change, biodiversity loss, and placed the highest importance on the environment (see Appendix Table 3). German respondents were, however, no more likely to report previous knowledge about salt marshes, more time outside per week, or knowledge that they lived in the proximity of a salt marsh from visual inspections of counts of responses to questions split by country (Appendix Fig. 2). Nordic respondents were more similar in their responses to the questions about concerns about climate change (Finnish and Danish respondents did not respond significantly differently) and biodiversity loss (Norwegian and Danish did not respond significantly differently) as well as importance of nature (Swedish and Danish did not respond significantly differently) (See Appendix Table 2 for complete list of coefficients and significance levels).

The selected best model fit survey responses to scenario one was the full model which included the respondents' stimulus group, country, and age (Table 3). There was no significant effect of sex for explaining differences in responses to scenario one. The full model and model with stimulus group, country, and age (but not sex) were within two units of each other and therefore performed similarly (ΔAIC = 0.20). The model excluding sex was selected following the rules of parsimony. The selected model for survey responses to scenario two was the full model with differences in responses between sexes, respondent country, and

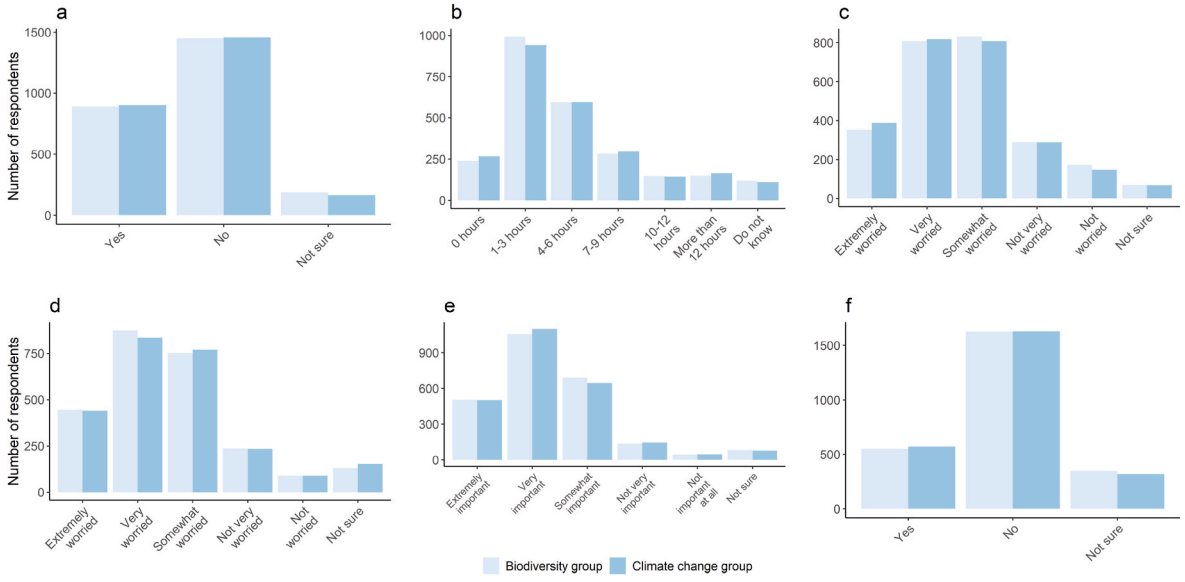

Fig. 2. Number of respondents' answers to the questions: "Before you read the above definition of a salt marsh, did you know what a salt marsh was?" (panel a), "In an average week, how many hours would you say you spend in nature (for example, in the woods, by the sea, etc.)?" (panel b), "How worried are you about climate change?" (panel c), "How worried are you about the loss of biodiversity?" (panel d), "Generally, how important is protecting the environment to you personally?" (panel e), and "Consider where you live. Are you aware of any salt marshes within a 1 h driving distance of where you live?" (panel f). Responses are split by panel (light blue for those primed with information about the importance of saltmarshes for retaining biodiversity, dark blue the group primed with importance of salt marshes for addressing climate change).

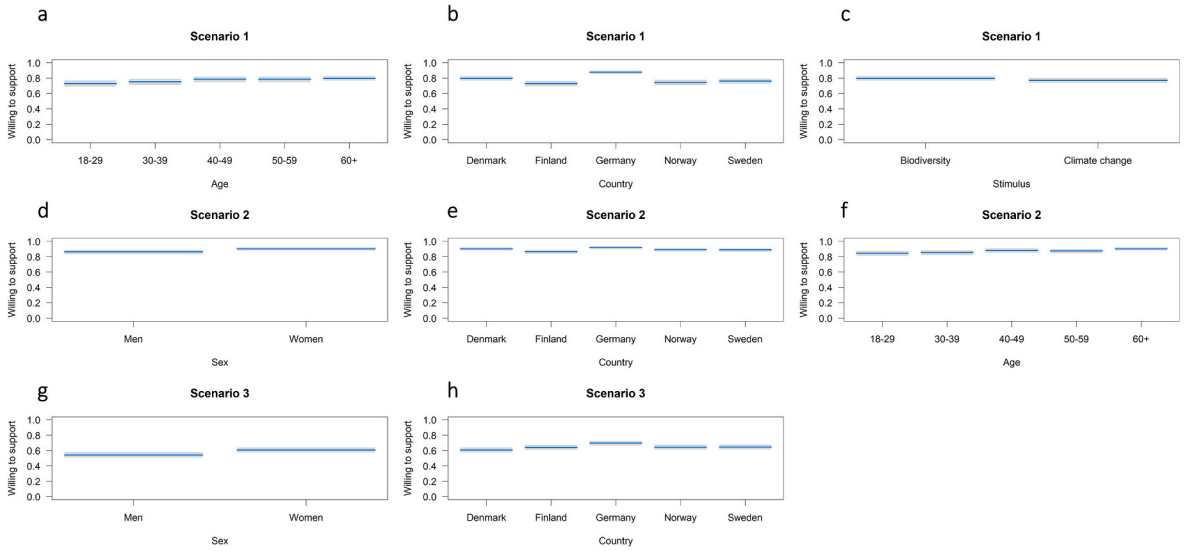

Fig. 3. Estimates from selected generalized linear models as proportions of respondents willing to support initiatives to manage salt marshes from selected models for each scenario presented in the survey. Blue lines represent model fitted values with the associated shaded areas representing fitted values' 95% confidence intervals.

age all detected. The removal of any variable led to worse model fit. The selected model fit survey responses to scenario three included survey respondent's sex and country. There was no significant difference detected in responses across age groups.

A higher proportion of older respondents (i.e., 60+ years of age), German respondents, and respondents receiving the biodiversity priming were willing to support the management initiative that could decrease their house value (scenario 1) (Fig. 3a–c). Female respondents, German respondents, and older respondents were more likely to support the initiative that led to changes in their recreational area (scenario 2) (Fig. 3d–f). Finally, a higher proportion of female respondents and German respondents were willing to support the initiative that led to higher taxes (scenario 3) (Fig. 3g–h).

4. Discussion

This study contributes to understanding how citizens value salt marshes by examining support for management initiatives framed as contributing to the goal of either biodiversity protection or climate change mitigation. It also examines the factors influencing respondent support. To our knowledge, this is the first study examining willingness to support salt marsh management initiatives in a Nordic context, thus complementing studies on coastal wetlands examining willingness to pay and willingness to support outside the Nordic context (Bauer et al., 2004; Johnston et al., 2005; Voltaire et al., 2017). Our results provide useful guidance for policy makers when considering arguments for the management of areas within their jurisdictions, such as salt marshes, as well as other coastal ecosystems, within the context of the 30x30 targets for protected areas of the Kunming-Montreal Global Biodiversity Framework. Understanding what types of management initiatives gain most public support and the factors associated with this support can help states reach their individual targets in the global framework. The Kunming-Montreal Global Biodiversity Framework will, in turn, help to improve management practices and the governance of vulnerable ecosystems.

Particularly when facing the challenging dilemma of having to consider global targets and legally binding agreements on both climate change and biodiversity protection measures, insights on public perceptions can be useful. Our results demonstrated that both respondents primed with information on the importance of salt marshes for biodiversity and those primed with information on the importance of salt marshes for climate change mitigation were, on average (>50%), willing to support all three initiatives to manage salt marshes. The general support for all initiatives either reflects that most people care about these habitats or that the costs – both indirect and direct monetary costs – are low enough that respondents can afford to be generally supportive. Future quantitative studies should investigate how response changes when the direct monetary costs are higher. Nonetheless, these results show that the public are supportive of initiatives to manage salt marshes, an important finding for policy makers.

Interestingly, respondents were generally supportive of the management initiatives even though most respondents did not know what a salt marsh was before starting the survey. Previous knowledge of salt marshes was low across all the five countries included in the study; the highest knowledge of salt marshes was in Finland, where 49% of Finnish respondents said they knew what a salt marsh (called coastal meadow in the Finnish translation) was before starting the survey. We originally hypothesized that, because the overall appearance and conservation of salt marshes differs largely between the Nordic countries (Dijkema, 1990), public knowledge would also differ between the Nordic countries. The terminology for naming these habitats is also diverse across these countries (Krause-Jensen et al., 2022), likely also contributing to a lack of recognition of salt marshes as a common ecosystem type. As mentioned, though, while knowledge differed in these regions, it still did not appear to affect support. The finding that respondents do not need to have previous knowledge of a salt marsh to support management initiatives will be important for managers and policy makers when it comes to gathering public support for the implementation of the 23 biodiversity targets, including that of 30x30 target. This finding is consistent with Manson et al. (2021) who found that respondents familiarity with marine reserves did not influence their public support for marine reserves. Rather, support was related to concern for the ecological integrity of the area positivity towards limiting some human uses of the ocean (Manson et al., 2021).

In addition, there was little to no difference in response of those who received the biodiversity priming versus those who received the climate change priming. This was a surprising result, since we had expected that there would be a larger difference between panels. This expectation was based on the Eurobarometer survey, which found that Europeans are more likely to say that climate change is one of the most important environmental threats than the decline or extinction of species and habitats, or of natural ecosystems (forests fertile soils) (European Commission, 2020a). The priming did have significant effect under scenario one (see Fig. 1, panel a), but the difference was relatively small

with the biodiversity panel results showing 76% of respondents to be willing to support the initiative whereas only 73% of respondents in the climate change panel were similarly willing (see Appendix table 4). Surprisingly, given the results of the Eurobarometer survey, the biodiversity primed group was significantly less likely to cut down reeds, which was presented as having a positive impact on biodiversity. One hypothesis for this result is that people who were told of the value of plants in the biodiversity priming text are more likely to consider the value of the reeds themselves when deciding whether to keep or remove them. Another hypothesis is that it may be easier for respondents to conceptualize the consequences of cutting the reeds for local biodiversity (i.e., loss of birds, etc.) and harder for respondents to conceptualize the impact of cutting the reeds for global climate change (Weber, 2010, 2016). Future studies should investigate different types of biodiversity framing as well as how response changes when respondents are not primed with information about the importance of these habitats. Investigating citizens' perspectives on the different scenarios from a qualitative perspective could also add value to future studies. However, the current result that respondents were *not* more willing to support initiatives framed as important for climate change mitigation than those framed as important for biodiversity protection is interesting for policy makers, as they need to present management options to their constituents.

We presented three scenarios with direct or indirect costs to respondents. The scenarios with the least direct monetary cost gained the most public support. The scenario that received most support (scenario 2) targeted personal convenience. It was arguably the least burdensome on respondents as it would have had a non-monetary impact and likely only impact citizens at a specific time of the year (i.e., during summer swimming season). The first and third scenarios, on the other hand, which received the least support, targeted indirect (home value, scenario 1) and direct (taxation, scenario 3) monetary support. Direct monetary support to manage salt marshes appears to be difficult to attain based on these results. This is in line with willingness to pay studies on coastal erosion (Alves et al., 2015; Tourlioti et al., 2021), which found that respondents were largely unwilling to pay for coastal erosion protection via a fee. Tourlioti et al. (2021) suggest that the public to prefer volunteering activities and public awareness actions over direct monetary contribution. Taking this into consideration, when suggesting actions that require direct monetary contributions from citizens, policy makers should work on how to make these actions more appealing to constituents.

Age, gender, and country were factors that *did* in fact influence respondents' support for management initiatives, though to a minor extent (see Fig. 3). A slightly higher proportion of older people were willing to decrease their home value (scenario 1) or be personally inconvenienced (scenario 2) to support a management initiative. A slightly higher proportion of women than men were also willing to be personally inconvenienced (scenario 2) and to increase their taxes (scenario 3). This follows trends seen in the literature, where women are more likely to display environmentally friendly attitudes than men (Brough et al., 2016; Davidson and Freudenburg, 1996; Rice et al., 2020). Respondents in Germany stand out as slightly more supportive of management initiatives than those in other countries. German respondents were in fact also more worried about both climate change and biodiversity loss and placed the highest importance on the protecting the environment (see Fig. 3 and Appendix Fig. 2 c-e). For the purposes of political agenda setting, risk perception is critical, as increased concern in the public about a given topic can lead to higher influx of media attention, influencing the salience of a given topic, and thereby set the agenda for policy making (Brown and Deegan, 1998; McCombs and Shaw, 1972). We have also seen this in results from studies on support for initiatives associated with worry or concern for the climate (Pleeging et al., 2021), the environment (Davidovic et al., 2020; Royne et al., 2011), and plastics specifically (Tiller et al., 2022). National and regional differences are important to consider when working with specific management initiatives (see, for example Abe et al., 2022), but also when designing policy (Prystay et al., 2023; Thomas et al., 2022; Tonin and Lucaroni, 2017). Considering the contextual setting (e.g., country, age, gender) is especially important when working to increase citizen support for actions that require direct monetary contributions, which in this study received the least support from respondents.

5. Conclusion

Coastal ecosystems including salt marshes will play an important role as we tackle the interconnected, anthropogenic crises of biodiversity loss and climate change. This study has provided insight into citizens valuation of salt marshes by examining support for different management initiatives framed as contributing to the goal of either biodiversity protection or climate change mitigation. Understanding citizen support management initiatives, and the factors influencing support, can help to tailor management actions within a UN member state setting as they prepare to submit their national reporting plans for the Kunming-Montreal Global Biodiversity Framework, where many of the targets have a 2030 deadline for successful implementation. These decisions on biodiversity will increasingly be coupled with initiatives by the same states to report on progress on nationally determined contributions towards the effective implementation of the Paris Agreement – sometimes in stark contradiction with the former. As such, policy makers increasingly will have to take at times unpopular decisions regarding area use and protection and restoration of ecosystems to comply with global legally binding agreements and targets and, thus, insights on how their constituents will react to these can provide helpful insight.

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CRediT authorship contribution statement

Anne Gaspers: Writing – review & editing, Writing – original draft, Methodology. **Gary Banta:** Writing – review & editing, Funding acquisition, Writing – original draft. **Lara Veylit:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis. **Anu Vehmaa:** Writing – review & editing, Writing – original draft. **Marianna Lanari:** Writing – review & editing, Writing – original draft. **Cintia O. Quintana:** Writing – review & editing, Writing – original draft. **Kai Jensen:** Writing – review & editing, Writing – original draft. **Christoffer Boström:** Writing – review & editing, Writing – original draft. **Johan S. Eklöf:** Writing – review & editing, Writing – original draft. **Dorte Krause-Jensen:** Writing – review & editing. **Carmen Leiva-Dueñas:** Writing – review & editing. **Rachel Tiller:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ocecoaman.2024.107109.

Appendix 1

Appendix table 1
Results from tests of independence between answers to background questions on respondents and their responses to each of the scenarios on willingness to pay for salt marsh conservation. Chi-squared are reported followed by p-values. Statistically significant p-values (i.e., with an alpha threshold below 0.05) indicate that the two variables are not independent (significance code: *).

	Time spent outside	Concern about biodiversity	Concern about climate change
Response to scenario 1	45.93 (<0.01)*	437.57(<0.01)*	415.34(<0.01)*
Response to scenario 2	28.64(<0.01)*	474.43(<0.01)*	414.18(<0.01)*
Response to scenario 3	19.89(<0.01)*	441.2(<0.01)*	597.43(<0.01)*

Appendix table 2
Chi-squared tests of independence for sociodemographic variables. Chi-squared are reported followed by p-values. Statistically significant p-values (i.e., with an alpha threshold below 0.05) indicate that the two variables are not independent (significance code: *). Smaller than expected frequencies were detected between education level groups so the smallest number of variables were pooled logically (i.e., respondents with a doctorate were pooled with respondents with a masters, respondents who had not finished high school were grouped with the "other" category) before the chi-squared test was performed.

	Sex	Income	Age	Country
Income	63.88 (<0.01)*	–	–	–
Age	3.83 (0.43)	84.23 (<0.01)*	–	–
Country	0.60 (0.96)	176.09 (<0.01)*	20.43 (<0.20)	–
Education level	26.06 (<0.01)*	588.33 (<0.01)*	155.93 (<0.01)*	720.61 (<0.01)*

Appendix table 3
Results from the ordinal regressions fit to responses to the questions: "how worried are you about climate change?" (worry about climate change), "how worried are you about the loss of biodiversity?" (worry about biodiversity loss), "generally, how important is protecting the environment to you personally?" (importance of environment), with respondents' country of origin included as predictor (n = 5045). Results are shown in comparison to those from Danish respondents (top level factor).

Question	Predictor	Coefficient	Std. error	z-value	P-value	Significance
Worry about climate change	Finland	−0.08	0.83	−1.00	0.32	n.s.
	Germany	−0.73	0.09	−8.52	<0.01	***
	Norway	0.45	0.08	5.55	<0.01	***
	Sweden	0.24	0.08	2.85	<0.01	**
Worry about biodiversity loss	Finland	−0.54	0.08	−6.43	<0.01	***
	Germany	−1.08	0.09	−12.53	<0.01	***
	Norway	−0.02	0.08	−0.28	0.78	n.s.
	Sweden	−0.18	0.08	−2.09	0.04	*
Importance of environment	Finland	0.27	0.09	3.19	<0.01	**
	Germany	1.03	0.09	11.78	<0.01	***
	Norway	−0.30	0.08	−3.52	<0.01	***
	Sweden	0.15	0.09	1.80	0.07	.

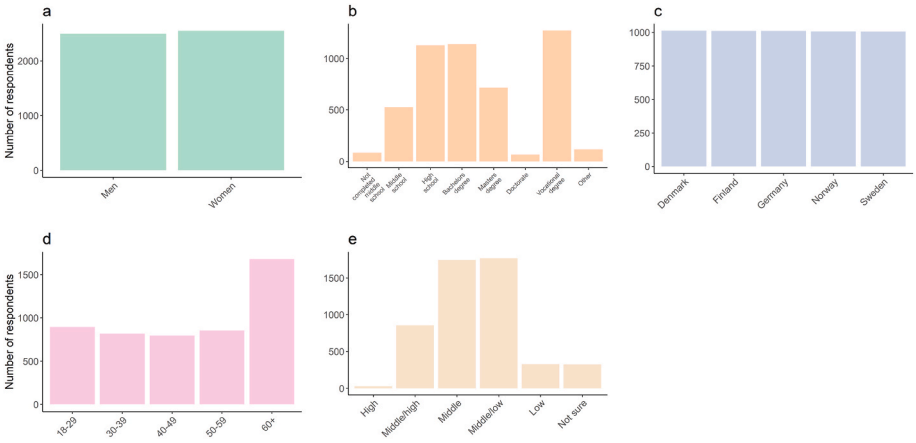
Appendix table 4
Percent of responses to questions about respondents' willingness to support initiatives to manage salt marshes following priming about either the importance of salt marshes for retaining biodiversity or the importance of salt marshes for addressing climate change.

Panel	Group	Willingness to support	Percent
A	Biodiversity group	Not willing to support	24
		Willing to support	76
	Climate change group	Not willing to support	27
		Willing to support	73

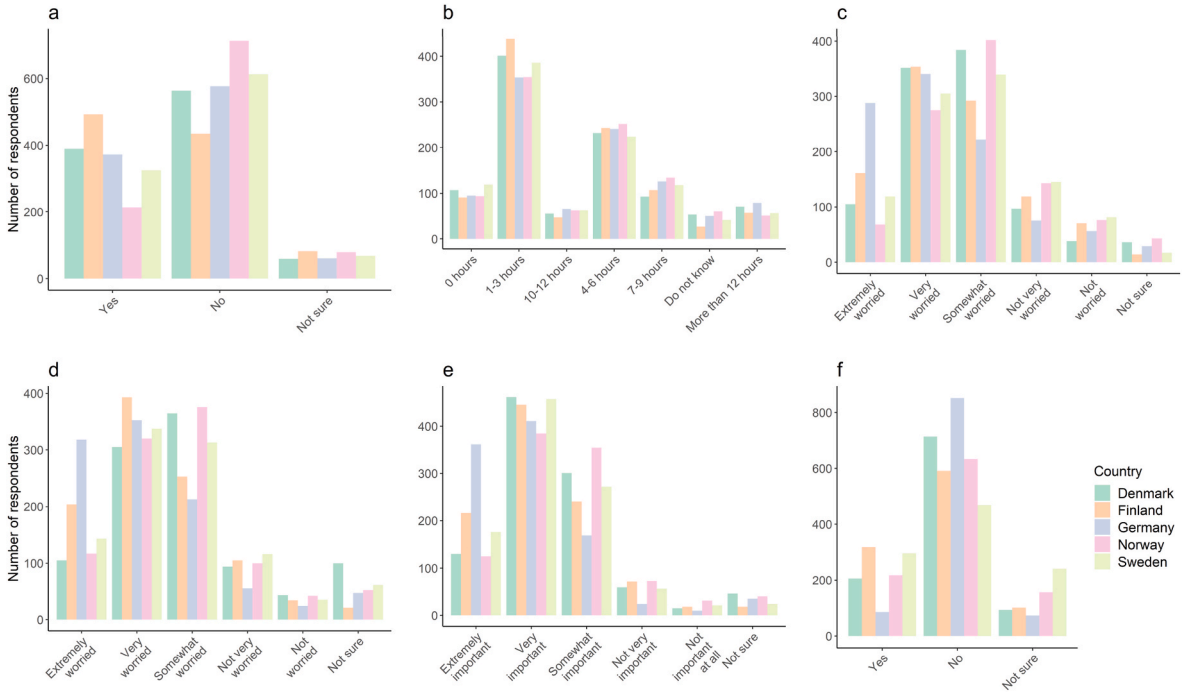
(*continued on next page*)

Appendix table 4 (*continued*)

Panel	Group	Willingness to support	Percent
A	Biodiversity group	Not willing to support	16
		Willing to support	84
	Climate change group	Not willing to support	16
		Willing to support	84
C	Biodiversity group	Not willing to support	39
		Willing to support	61
	Climate change group	Not willing to support	38
		Willing to support	62



Appendix Fig. 1. Depicting raw counts of number of survey respondents grouped by sociodemographic variable. Panel "a" shows the number of male and female respondents, "b" shows respondents' highest education level completed, "c" the country respondents live in, "d" respondents' age, and "e" self-reported income level (for their country). Note the y-axis scale varies across panels. .



Appendix Fig. 2. Count of responses to the questions "Before you read the above definition of a salt marsh, did you know what a salt marsh was?" (panel a), "in an average week, how many hours would you say you spend in nature (for example, in the woods, by the sea, etc.)?" (panel b), "how worried are you about climate change?" (panel c), "how worried are you about the loss of biodiversity?" (panel d), "generally, how important is protecting the environment to you personally?" (panel e), and "consider where you live. Are you aware of any salt marshes within a 1 h driving distance of where you live?" (panel f). Distributions of number of respondents are split by county.

References

Abe, H., Mitsui, S., Yamano, H., 2022. Conservation of the coral community and local stakeholders' perceptions of climate change impacts: examples and gap analysis in three Japanese national parks. Ocean Coast Manag. 218, 106042 https://doi.org/10.1016/j.ocecoaman.2022.106042.

Adam, P., 1990. Saltmarsh Ecology. Cambridge University Press.

Alves, B., Rigall-I-Torrent, R., Ballester, R., Benavente, J., Ferreira, Ó., 2015. Coastal erosion perception and willingness to pay for beach management (Cadiz, Spain). J. Coast Conserv. 19 (3), 269–280. https://doi.org/10.1007/s11852-015-0388-6.

Barbier, E.B., 2019. Chapter 27—the value of coastal wetland ecosystem services. In: Perillo, G.M.E., Wolanski, E., Cahoon, D.R., Hopkinson, C.S. (Eds.), Coastal Wetlands, second ed. Elsevier, pp. 947–964. https://doi.org/10.1016/B978-0-444-63893-9.00027-7.

Barbier, E.B., Hacker, S.D., Kennedy, C., Koch, E.W., Stier, A.C., Silliman, B.R., 2011. The value of estuarine and coastal ecosystem services. Ecol. Monogr. 81 (2), 169–193. https://doi.org/10.1890/10-1510.1.

Bauer, D.M., Cyr, N.E., Swallow, S.K., 2004. Public preferences for compensatory mitigation of salt marsh losses: a contingent choice of alternatives. Conserv. Biol. 18 (2), 401–411. https://doi.org/10.1111/j.1523-1739.2004.00367.x.

Boström, C., Pittman, S.J., Simenstad, C., 2017. Ecological consequences of seagrass and salt-marsh seascape patterning on marine fauna. In: Pittman, S.J. (Ed.), Seascape Ecology. John Wiley & Sons, pp. 27–56.

Breaux, A., Farber, S., Day, J., 1995. Using natural coastal wetlands systems for wastewater treatment: an economic benefit analysis. J. Environ. Manag. 44 (3), 285–291.

Brough, A.R., Wilkie, J.E.B., Ma, J., Isaac, M.S., Gal, D., 2016. Is eco-friendly unmanly? The green-feminine stereotype and its effect on sustainable consumption. J. Consum. Res. 43 (4), 567–582. https://doi.org/10.1093/jcr/ucw044.

Brown, N., Deegan, C., 1998. The public disclosure of environmental performance information—a dual test of media agenda setting theory and legitimacy theory. Account. Bus. Res. 29 (1), 21–41. https://doi.org/10.1080/00014788.1998.9729564.

Burnham, K.P., 2015. Multimodel Inference: Understanding AIC Relative Variable Importance Values. Colorado State University. https://sites.warnercnr.colostate.edu/kenburnham/wp-content/uploads/sites/25/2016/08/VARIMP.pdf.

Christensen, R.H.B., 2015. Ordinal—Regression Models for Ordinal Data. R Package Version 2015 6.28. http://www.cran.r-project.org/package=ordinal/.

Costanza, R., Farber, S., 2002. Introduction to the special issue on the dynamics and value of ecosystem services: integrating economic and ecological perspectives. Ecol. Econ. 41 (3), 367–373. https://doi.org/10.1016/S0921-8009(02)00087-3.

Costanza, R., de Groot, R., Sutton, P., van der Ploeg, S., Anderson, S.J., Kubiszewski, I., Farber, S., Turner, R.K., 2014. Changes in the global value of ecosystem services. Global Environ. Change 26, 152–158. https://doi.org/10.1016/j.gloenvcha.2014.04.002.

Davidovic, D., Harring, N., Jagers, S.C., 2020. The contingent effects of environmental concern and ideology: institutional context and people's willingness to pay environmental taxes. Environ. Polit. 29 (4), 674–696. https://doi.org/10.1080/09644016.2019.1606882.

Davidson, D.J., Freudenburg, W.R., 1996. Gender and environmental risk concerns: a review and analysis of available research. Environ. Behav. 28 (3), 302–339. https://doi.org/10.1177/0013916596283003.

Dijkema, K.S., 1990. Salt and brackish marshes around the Baltic Sea and adjacent parts of the North Sea: their vegetation and management. Biol. Conserv. 51 (3), 191–209. https://doi.org/10.1016/0006-3207(90)90151-E.

European Commission, Directorate-General for Environment, Tsiripidis, I., Piernik, A., Janssen, J., et al., 2016. European red list of habitats. Part 2, Terrestrial and freshwater habitats. Publications Office. https://data.europa.eu/doi/10.2779/091372.

European Commission & European Research Executive Agency, 2023. Nature-based Solutions – EU-Funded Nbs Research Projects Tackle the Climate and Biodiversity Crisis. Publications Office of the European Union. https://doi.org/10.2848/879543.

European Commission, 2020a. Attitudes of Europeans towards the environment—summary—en. https://europa.eu/eurobarometer/surveys/detail/2257.

European Commission, 2020b. COMMUNICATION from the commission to the EUROPEAN parliament, the council, the EUROPEAN economic and social committee and the committee of the regions eu biodiversity strategy for 2030. https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1590574123338&uri=CELEX%3A52020DC0380.

European Council. (n.d.-a). Biodiversity: how the EU protects nature. Retrieved 9 May 2023, from. https://www.consilium.europa.eu/en/policies/biodiversity/.

European Council. (n.d.-b). Climate change: what the EU is doing. Retrieved 9 May 2023, from. https://www.consilium.europa.eu/en/policies/climate-change/.

Forsyth, B.H., Kudela, M.S., Levin, K., Lawrence, D., Willis, G.B., 2007. Methods for translating an English-language survey questionnaire on tobacco use into Mandarin, Cantonese, Korean, and Vietnamese. Field Methods 19 (3), 264–283. https://doi.org/10.1177/1525822X07302105.

Friess, D.A., Yando, E.S., Alemu, J.B., Wong, L.-W., Soto, S.D., Bhatia, N., 2020. Ecosystem services and disservices of mangrove forests and salt marshes. In: Oceanography and Marine Biology. Taylor & Francis. https://library.oapen.org/handle/20.500.12657/43146.

Gibbs, J.P., 2000. Wetland loss and biodiversity conservation. Conserv. Biol. 14 (1), 314–317. https://doi.org/10.1046/j.1523-1739.2000.98608.x.

Grace, J.B., Jutila, H., 1999. The relationship between species density and community biomass in grazed and ungrazed coastal meadows. Oikos 85 (3), 398–408. https://doi.org/10.2307/3546689. JSTOR.

Guan, Y., Bai, J., Tian, X., Wang, X., Wang, C., Zhang, Y., Chen, B., Liu, G., 2022. Social network analysis and application for ecosystem service perceptions by stakeholders for coastal wetland conservation. J. Clean. Prod. 371, 133596 https://doi.org/10.1016/j.jclepro.2022.133596.

IUCN, 2017. the ocean and climate change. https://www.iucn.org/sites/default/files/2022-07/the_ocean_and_climate_change_issues_brief-v2.pdf.

Johnston, R.J., Opaluch, J.J., Magnusson, G., Mazzotta, M.J., 2005. Who are resource nonusers and what can they tell us about nonuse values? Decomposing user and nonuser willingness to pay for coastal wetland restoration. Water Resour. Res. 41 (7) https://doi.org/10.1029/2004WR003766.

Jónsdóttir, G.A., 1991. Tiller demography in seashore populations of Agrostis stolonifera, Festuca rubra and Poa irrigata. J. Veg. Sci. 2 (1), 89–94. https://doi.org/10.2307/3235900.

Josephs, L.I., Humphries, A.T., 2018. Identifying social factors that undermine support for nature-based coastal management. J. Environ. Manag. 212, 32–38. https://doi.org/10.1016/j.jenvman.2018.01.085.

Krause-Jensen, D., Gundersen, H., Björk, M., Gullström, M., Dahl, M., Asplund, M.E., Boström, C., Holmer, M., Banta, G.T., Graversen, A.E.L., 2022. Nordic blue carbon ecosystems: status and outlook. Front. Mar. Sci. 9. https://doi.org/10.3389/fmars.2022.847544.

Macreadie, P.I., Costa, M.D.P., Atwood, T.B., Friess, D.A., Kelleway, J.J., Kennedy, H., Lovelock, C.E., Serrano, O., Duarte, C.M., 2021. Blue carbon as a natural climate solution. Nat. Rev. Earth Environ. 2 (12), 826–839. https://doi.org/10.1038/s43017-021-00224-1.

Manson, P., Nielsen-Pincus, M., Granek, E.F., Swearingen, T.C., 2021. Public perceptions of ocean health and marine protection: drivers of support for Oregon's marine reserves. Ocean Coast Manag. 201, 105480 https://doi.org/10.1016/j.ocecoaman.2020.105480.

Martini, I.P., Morrison, R.I.G., Abraham, K.F., Sergienko, L.A., Jefferies, R.L., 2019. Chapter 4—northern polar coastal wetlands: development, structure, and land use. In: Perillo, G.M.E., Wolanski, E., Cahoon, D.R., Hopkinson, C.S. (Eds.), Coastal Wetlands, second ed. Elsevier, pp. 153–186. https://doi.org/10.1016/B978-0-444-63893-9.00004-6.

McCombs, M.E., Shaw, D.L., 1972. The agenda-setting function of mass media. Publ. Opin. Q. 36 (2), 176–187.

McKinley, E., Pagès, J.F., Ballinger, R.C., Beaumont, N., 2020. Forgotten landscapes: public attitudes and perceptions of coastal saltmarshes. Ocean Coast Manag. 187, 105117 https://doi.org/10.1016/j.ocecoaman.2020.105117.

Mitsch, W.J., Bernal, B., Nahlik, A.M., Mander, Ü., Zhang, L., Anderson, C.J., Jørgensen, S.E., Brix, H., 2013. Wetlands, carbon, and climate change. Landsc. Ecol. 28, 583–597. https://doi.org/10.1007/s10980-012-9758-8.

Möller, I., Kudella, M., Rupprecht, F., Spencer, T., Paul, M., van Wesenbeeck, B.K., Wolters, G., Jensen, K., Bouma, T.J., Miranda-Lange, M., Schimmels, S., 2014. Wave attenuation over coastal salt marshes under storm surge conditions. Nat. Geosci. 7 (10), 727–731. https://doi.org/10.1038/ngeo2251.

Murray, N.J., Worthington, T.A., Bunting, P., Duce, S., Hagger, V., Lovelock, C.E., Lucas, R., Saunders, M.I., Sheaves, M., Spalding, M., 2022. High-resolution mapping of losses and gains of Earth's tidal wetlands. Science 376 (6594), 744–749. http://doi.org/10.1126/science.abm9583.

Myers, M.R., Barnard, P.L., Beighley, E., Cayan, D.R., Dugan, J.E., Feng, D., Hubbard, D. M., Iacobellis, S.F., Melack, J.M., Page, H.M., 2019. A multidisciplinary coastal vulnerability assessment for local government focused on ecosystems, Santa Barbara area, California. Ocean Coast Manag. 182, 104921 https://doi.org/10.1016/j.ocecoaman.2019.104921.

Niemi, N., Hansen, J.P., Eklöf, J.S., Eriksson, B.K., Andersson, H.C., Bergström, U., Östman, Ö., 2023. Influence of reed beds (Phragmites australis) and submerged vegetation on pike (Esox lucius). Fish. Res. 261, 106621 https://doi.org/10.1016/j.fishres.2023.106621.

Pascual, U., Balvanera, P., Díaz, S., Pataki, G., Roth, E., Stenseke, M., Watson, R.T., Başak Dessane, E., Islar, M., Kelemen, E., Maris, V., Quaas, M., Subramanian, S.M., Wittmer, H., Adlan, A., Ahn, S., Al-Hafedh, Y.S., Amankwah, E., Asah, S.T., et al., 2017. Valuing nature's contributions to people: the IPBES approach. Open Issue, Part II, 26–27 7–16. https://doi.org/10.1016/j.cosust.2016.12.006.

Pätsch, R., Schaminée, J.H.J., Janssen, J.A.M., Hennekens, S.M., Bruchmann, I., Jutila, H., Meisert, A., Bergmeier, E., 2019. Between land and sea? A classification of saline and brackish grasslands of the Baltic Sea coast. Phytocoenologia 49 (4), 319–348. https://doi.org/10.1127/phyto/2019/0339.

Pleeging, E., van Exel, J., Burger, M.J., Stavropoulos, S., 2021. Hope for the future and willingness to pay for sustainable energy. Ecol. Econ. 181, 106900 https://doi.org/10.1016/j.ecolecon.2020.106900.

Pörtner, H.O., Scholes, R.J., Agard, J., Archer, E., Arneth, A., Bai, X., Barnes, D., Burrows, M., Chan, L., Cheung, W.L., Diamond, S., Donatti, C., Duarte, C., Eisenhauer, N., Foden, W., Gasalla, M.A., Handa, C., Hickler, T., Hoegh-Guldberg, O., Ichii, K., Jacob, U., Insarov, G., Kiessling, W., Leadley, P., Leemans, R., Levin, L., Lim, M., Maharaj, S., Managi, S., Marquet, P.A., McElwee, P., Midgley, G., Oberdorff, T., Obura, D., Osman, E., Pandit, R., Pascual, U., Pires, A.P.F., Popp, A., Reyes García, V., Sankaran, M., Settele, J., Shin, Y.J., Sintayehu, D.W., Smith, P., Steiner, N., Strassburg, B., Sukumar, R., Trisos, C., Val, A.L., Wu, J., Aldrian, E., Parmesan, C., Pichs-Madruga, R., Roberts, D.C., Rogers, A.D., Díaz, S., Fischer, M., Hashimoto, S., Lavorel, S., Wu, N., Ngo, H.T., O, H., 2021. IPBES-IPCC co-sponsored workshop report on biodiversity and climate change. IPBES and IPCC. https://www.ipbes.net/sites/default/files/2021-06/20210609_workshop_report_embargo_3pm_CEST_10_june_0.pdf.

Pörtner, H.O., Scholes, R.J., Arneth, A., Barnes, D.K.A., Burrows, M.T., Diamond, S.E., Duarte, C.M., Kiessling, W., Leadley, P., Managi, S., McElwee, P., Midgley, G., Ngo, H.T., Obura, D., Pascual, U., Sankaran, M., Shin, Y.J., Val, A.L., 2023. Overcoming the coupled climate and biodiversity crises and their societal impacts. Science 380 (6642), eabl4881. https://doi.org/10.1126/science.abl4881.

Prystay, T.S., Neis, B., Sullivan, S.M., Le Bris, A., 2023. Coastal community perceptions of eelgrass in Atlantic Canada: considerations for management. Ocean Coast Manag. 239, 106600 https://doi.org/10.1016/j.ocecoaman.2023.106600.

Rice, C., Ragbir, N.K., Rice, S., Barcia, G., 2020. Willingness to pay for sustainable aviation depends on ticket price, greenhouse gas reductions and gender. Technol. Soc. 60, 101224 https://doi.org/10.1016/j.techsoc.2019.101224.

Rickert, C., Fichtner, A., van Klink, R., Bakker, J.P., 2014. α- and β-diversity in moth communities in salt marshes is driven by grazing management. AGRIS 146 (11). https://agris.fao.org/agris-search/search.do?recordID=US201400179335.

Royne, M.B., Levy, M., Martinez, J., 2011. The public health implications of consumers' environmental concern and their willingness to pay for an eco-friendly product. J. Consum. Aff. 45 (2), 329–343. https://doi.org/10.1111/j.1745-6606.2011.01205.x.

Seddon, N., Smith, A., Smith, P., Key, I., Chausson, A., Girardin, C., House, J., Srivastava, S., Turner, B., 2021. Getting the message right on nature-based solutions to climate change. Global Change Biol. 27 (8), 1518–1546. https://doi.org/10.1111/gcb.15513.

Simas, T., Nunes, J., Ferreira, J., 2001. Effects of global climate change on coastal salt marshes. Ecol. Model. 139 (1), 1–15. https://doi.org/10.1016/S0304-3800(01)00226-5.

Thomas, M., Roberts, E., Pidgeon, N., Henwood, K., 2022. This funny place': uncovering the ambiguity of saltmarshes using a multimodal approach. People and. Nature 4 (3), 804–815. https://doi.org/10.1002/pan3.10318.

Thorslund, J., Jarsjo, J., Jaramillo, F., Jawitz, J.W., Manzoni, S., Basu, N.B., Chalov, S.R., Cohen, M.J., Creed, I.F., Goldenberg, R., Hylin, A., Kalantari, Z., Koussis, A.D., Lyon, S.W., Mazi, K., Mard, J., Persson, K., Pietro, J., Prieto, C., et al., 2017. Wetlands as large-scale nature-based solutions: status and challenges for research, engineering and management. Ecological Engineering of Sustainable Landscapes 108, 489–497. https://doi.org/10.1016/j.ecoleng.2017.07.012.

Tiller, R., Booth, A.M., Cowan, E., 2022. Risk perception and risk realities in forming legally binding agreements: the governance of plastics. Environ. Sci. Pol. 134, 67–74. https://doi.org/10.1016/j.envsci.2022.04.002.

Tonin, S., Lucaroni, G., 2017. Understanding social knowledge, attitudes and perceptions towards marine biodiversity: the case of tegnùe in Italy. Ocean Coast Manag. 140, 68–78. https://doi.org/10.1016/j.ocecoaman.2017.02.019.

Tourlioti, P.N., Portman, M.E., Tzoraki, O., Pantelakis, I., 2021. Interacting with the coast: residents' knowledge and perceptions about coastal erosion (Mytilene, Lesvos Island, Greece). Ocean Coast Manag. 210, 105705 https://doi.org/10.1016/j.ocecoaman.2021.105705.

Villamor, G.B., Palomo, I., Santiago, C.A.L., Oteros-Rozas, E., Hill, J., 2014. Assessing stakeholders' perceptions and values towards social-ecological systems using participatory methods. Ecological Processes 3 (1), 22. https://doi.org/10.1186/s13717-014-0022-9.

Voltaire, L., Donfouet, H.P.P., Pirrone, C., Larzillière, A., 2017. Respondent uncertainty and ordering effect on willingness to pay for salt marsh conservation in the brest roadstead (France). Ecol. Econ. 137, 47–55. https://doi.org/10.1016/j.ecolecon.2017.02.029.

Wan, C., Shen, G.Q., Yu, A., 2015. Key determinants of willingness to support policy measures on recycling: a case study in Hong Kong. Environ. Sci. Pol. 54, 409–418. https://doi.org/10.1016/j.envsci.2015.06.023.

Wang, N., Li, J.-M., Xu, Z.-H., 2021. Public preference for the ecological restoration of coastal wetlands in Jiaozhou Bay in China based on a choice experiment. Mar. Pol. 128, 104487 https://doi.org/10.1016/j.marpol.2021.104487.

Ward, R.D., 2020. Carbon sequestration and storage in Norwegian Arctic coastal wetlands: impacts of climate change. Sci. Total Environ. 748, 141343 https://doi.org/10.1016/j.scitotenv.2020.141343.

Weber, E.U., 2010. What shapes perceptions of climate change? WIREs Climate Change 1 (3), 332–342. https://doi.org/10.1002/wcc.41.

Weber, E.U., 2016. What shapes perceptions of climate change? New research since 2010. WIREs Climate Change 7 (1), 125–134. https://doi.org/10.1002/wcc.377.