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Policy analysis

Social and ecological connectivity: A Q-methodology investigation of coastal estuary perceptions in Oregon

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A B S T R A C T

Due to the severe loss of vegetated tidal wetlands, coastal communities are increasingly interested in estuary restoration. However, projects viewed as less successful by community members have created obstacles for practitioners, creating opposition and mistrust. To better understand differing estuarine restoration values between natural resource managers, coastal managers, and community members in three coastal bays, we created a Q-methdology study that aligned issue statements with concepts from an ecological conservation framework. We found four shared narratives among ten discourse groups: 1) restoration success depends on positive ecological outcomes while federal and state management is important; 2) ecological outcomes are the most important success metrics, but equality and social acceptance are top concerns; 3) economic prosperity and local community use determine success; and 4) equality and community resilience are the highest priority. The results demonstrate the importance of social connectivity in maintaining ecological connectivity. In other words, valuing social communities supports efforts for ecological restoration. Q-methodology can identify viewpoints for monitoring social perceptions of success and engaging multiple perspectives in estuarine restoration.

1. Introduction

Estuaries are important ecosystems for coastal health and coastal zone management (Zhang et al., 2024). Restoring estuarine habitats can mitigate the loss of fishery species and provide more marsh or seagrass habitat that acts as a “sponge” to reduce impacts from storm surges (Barbier et al., 2011; Duarte et al., 2013; Verutes et al., 2024). When functioning properly, the complex structure of estuaries and their biogenic habitats dampens tidal energy, traps sediment (Townend et al., 2011), and facilitates carbon storage (Callaway et al., 2012; Suwandhahannadi et al., 2024). Marshes and their channels also act as critical nurseries, feeding areas, and seasonal habitats for invertebrates, fish, and birds (Uhrin and Schellinger, 2011; Minello et al., 2003; Weller, 1994).

However, natural resource managers (NRMs) who may be responsible for habitats or wildlife in estuaries face a challenge. Landscapes that are managed solely for ecological benefit may not appeal to the people who live near them. The results of estuarine restoration activities, such as removing dikes, modifying tide gates, or removing invasive plants, can impact social life and human perceptions (Sherren et al., 2021). Construction to change a salt marsh' elevation, for example, may create an unvegetated landscape that may look bare (Shikuzawa et al., 2024). In contrast, a monoculture of an invasive weed may look more orderly and appealing than a more diverse natural assemblage. Or, the resulting project may look different and unfamiliar, perhaps with more mudflats and areas of low-lying succulent vegetation. These changes may shape whether or not the public will endorse future projects. Although community support for restoration can promote or thwart potential projects and the long-term success of completed ones, restoration success metrics rarely include human preferences (Miller and Hobbs, 2007). Until recently, NRMs have not been required to monitor public acceptance changes before, during, or after the restoration project (Nassauer, 1995; Howie et al., 2024).

The term ‘ecological connectivity’ is widely used in the biological sciences to describe diverse habitats that facilitate the temporal and spatial functions and processes that support organism life cycles (Sheaves, 2009). Social connectivity is a common term in social psychology and communication studies that refers to the subjective

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experience of belonging in human relationships and networks (Van Bel et al., 2009). In this paper, we propose that social connectivity is inherently a part of ecological connectivity - poor social connectivity (expressed as economic loss, political or interpersonal conflict, etc.) will impact the success of restoration to promote ecological connectivity. Similarly, poor ecological connectivity (expressed as biodiversity loss, increasing disasters, etc.) can disrupt social connectivity.

Therefore, it is important to measure stakeholders' estuarine values and to determine how best to measure them. For brevity, we use Worcester's (1997) metaphor to distinguish between opinions, attitudes, and values: "opinions: the ripples on the surface of the public's consciousness, shallow, and easily changed; attitudes: the currents below the surface, deeper and stronger; and values: the deep tides of public mood, slow to change, but powerful." Because Q-methodology allows researchers to identify nuance in perspectives, it is a suitable technique for uncovering values underlying opinions and attitudes.

We selected three US West Coast bays as case studies where significant restoration initiatives have occurred. The objectives of this study were to inform regional NRMs and to apply a conservation perspectives framework for understanding the kaleidoscope of coastal community perspectives. We ask: 1) What perceptions are important in evaluating estuarine conservation success? and 2) Do estuarine perceptions vary among the general public, NRMs, and managers who work on the coast that rely on estuarine success?

2. Methods

2.1. Case study selection

The US West Coast has lost 85 % of its vegetated tidal wetlands due to diking, draining, and similar conversion practices (Zedler and Kercher, 2005; Brophy et al., 2019). In response to the widescale biodiversity loss of coastal lands (Table 1), the State of Oregon established the Statewide Planning Goal 16 "to protect the long-term values, diversity, and benefits of estuaries and associated wetlands" (ODLDC, 2019). Of the estuaries designated for protection, we selected three that differ in the number of completed restoration projects and level of agency involvement in restoration (Table 2). The different management mandates of each bay have been set forth by their unique estuary plans. Alsea Bay is classified as a 'conservation management unit,' while Coos Bay and Yaquina Bay are classified as 'deep-draft development units' (ODLCD, n. d.). Project partners of this study identified two estuarine restoration projects in Alsea Bay, four in Coos Bay, and three in Yaquina Bay as important for ecological evaluation, motivating our study in these areas (Fig. 1).

Alsea Bay spans 2516 acres, providing habitat for overwintering waterfowl and other notable species (Table 2) (OWEB, 2021; ODFW, 2016). Although an unusual amount of high-elevation marsh is in excellent condition, the bay has been disrupted by dams, backfilling, tidegates, and erosion (Brophy, 1999). This area was once rated first in importance for coho salmon (*Oncorhynchus kisutch*) spawning but declined due to habitat loss and poor water quality created by pile and rock dikes installed in the 1960s and 1970s (Brophy, 1999). Over 2000 people live in the nearest city of Waldport whose median income for a family of four was $48,553 in 2020 compared to the US average of $70,784 (US Census Bureau, 2021a). Logging, fishing, agriculture, and tourism are the principal economies of this region and Alsea Bay is known for crabs and clams dependent on the estuary's nutrient-rich waters (OSU, 2023). However, Alsea Bay lacks commercial shipping unlike the other two sites in our study. As part of restoration efforts, the non-profit Western Rivers Conservancy purchased over 1500 acres along Drift Creek (upriver of Alsea Bay) for coho recovery. There have been four restoration projects implemented in this area between 1995 and 2020 (OWRI, 2020).

The 4329 acres of Yaquina Bay includes spruce tidal swamps, now rare due to historical land changes (Brophy, 1999; Brophy, 2007; OWEB, 2021) (Table 2). In the early 19th century, a large percentage of the spruce tidal swamp was converted to pasture for cattle grazing (Brophy, 2007). Over the years, the estuary lost at least 1400 acres of adjacent tidal marsh due to diking and fill activity to support commercial shipping and navigation (Brophy, 1999). The nearest city of Newport (population 10,256 in 2020) enjoyed the highest median income among the three sites ($52,897), although still under the national average (US Census, 2021c). In addition to two industrial ports, commercial and recreational fishing and clamming are major uses in Yaquina Bay, as is some lumber. Among the seven estuary restoration projects in this area between 1995 and 2020, the MidCoast Watersheds Council has lowered dikes, created tidal channels, and restored spruce swamp habitat along 55 acres of land owned by The Wetlands Conservancy (OWRI, 2020). The nearby Oregon State University' Hatfield Marine Science Center has provided education and outreach about estuaries since 1965.

Table 1
Examples of biodiversity loss affecting Oregon's estuaries.

Habitat or species	Amount of loss
Tidal forest swamps	95 % loss statewide (Brophy et al., 2019)
Tidal marsh	60 % loss statewide (Brophy et al., 2019)
Estuaries, bays, and harbors	99 % impaired for any use statewide (Kelderman et al., 2022)
Salmon	28 salmonids listed under the Endangered Species Act on the West Coast (NOAA Fisheries, 2024a) 1992–1994; 1995; 2005–2006; 2008–2009; 2010; 2015–2017; 2018–2020; 2021; 2022; 2023 Salmon disasters declared in Oregon by US Dept of Commerce (NOAA Fisheries, 2024b)
Streams	122,800 miles of impaired rivers and streams statewide (most miles in the US) (Kelderman et al., 2022)
Eelgrass	Near complete loss throughout much of South Slough despite prior large beds (Magel et al., 2023)
Native oysters	Considered functionally extinct in 2011 statewide, currently 1 % of historic levels in the Pacific Ocean (Beck et al., 2011)
Scallops	The highest concentrations were in 1963 statewide, but have not recovered since overharvesting in the 1980s

Table 2
Characteristics of the three study sites.

Bay	Area in acres[1]	#restoration projects 1995–2020[2]	Nearest town/2020 population/ median income (compared to $70,784 US average for family of 4)[3]	Principal industries[7]	Notable species[8]
Alsea	2516	4	Waldport/ pop. 2249/ $48,553[4]	Logging, fishing, agriculture, tourism	Clams, eagles, osprey, Great Blue Heron, Harbor seals, waterfowl
Yaquina	4329	7	Newport/ pop. 10,256/ $52,897[5]	Logging, fishing, agriculture, tourism	Eelgrass, shellfish, oysters, eagles, osprey
Coos	13348	10	Coos Bay/ pop. 15,985/ $48,233[6]	Logging, fishing, including shellfish	Oysters, clams, crabs, salmon; bird migration[8]

Note: [1]OWEB, 2021 [2]Oregon Watershed Restoration Inventory, 2020 [3]Current Population Survey 2021 [4]U.S. Census Bureau, 2021a [5]U.S. Census Bureau, 2021b [6]U.S. Census Bureau, 2021c [6]OSU, 2023 [7] ODFW, 2016 [8]Sounhein et al., 2021.

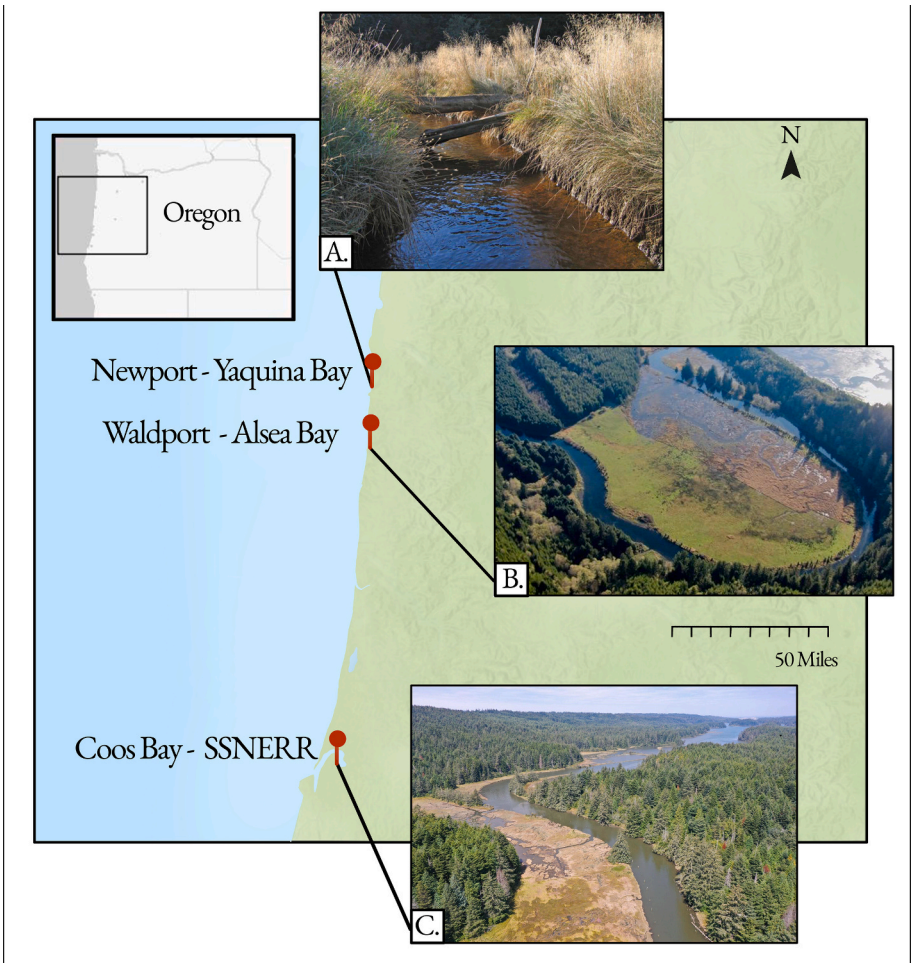

Fig. 1. A) Channel 4, Yaquina Bay, Oregon. Native grasses on banks during rising tides. Photo credit: Laura Brophy. B) Lower Drift Creek in Alsea Bay, Oregon. Meandering channels and brown vegetation are visible indications of the reintroduction of tidal influence. Photo credit: Paul Engelmeyer. C) Kunz Marsh in Coos Bay, Oregon. Dike excavated to raise the marsh's surface elevation, recruit vegetation, form tidal channels, and increase fish abundance and diversity in South Slough, NERRS Winchester Tidelands Restoration Project, Coos Bay, Oregon (Cornu, 2005). Photo credit: Jennifer Kirkland.

Coos Bay includes 13,348 acres and has had the most restoration projects between 1995 and 2020, mostly due to the South Slough Research Reserve established in 1974 as the first location in the National Estuarine Research Reserve System (NERRS) (OWEB, 2021) (Table 2). The South Slough Reserve includes over 2833 ha of upland conifer forest, freshwater streams, riparian corridors, and tidal estuary habitat for oysters, clams, crabs, and salmon (Sounhein et al., 2021). The NERR System now manages over 500,000 ha of natural area in the US coastal states, Great Lakes, and territories. The Reserves has a long history of environmental education, research, stewardship, and public outreach programs. The nearest city of Coos Bay is the largest of the three sites in this study with 15,985 people and a median household income of $48,233 (US Census, 2021b). Principle industries include logging, fishing (including shellfish) (OSU, 2023).

2.2. Stakeholder engagement

Because we prioritized stakeholder engagement to investigate hyperlocal restoration values scaled to the specific bays, we created an Advisory Group of community leaders to ensure cultural appropriateness (see Supplementary Material Table 1 for Advisory Group logic, selection criteria, and activities). We used the IAP2 (2013) stakeholder engagement levels (consult, inform, involve, collaborate, and engage) to ensure that the advisors could meaningfully engage through two-way interactions and partnerships. The Advisory Group consulted on the social metrics to be used. We informed end users, stakeholders, and the general public with outreach materials. The Advisory Group was directly involved in creating the Q-statements and collaborated with the South Slough Reserve to hold one of the workshops. Three Advisory Group members engaged with co-authoring this and other scientific publications and communication materials. The Advisory Group was created to limit implicit bias of the researchers facilitating the project by ensuring wide geographic representation; members selected were from groups not commonly called to leadership in (restoration projects, estuarine science), with the goal of further building trust between the public, practitioners, and researchers. This effort sought to strengthen connections with community partners and establish long-term relationships.

2.3. Q-methodology

Q-methodology is a mixed-method technique that identifies social phenomena from individual opinions, providing statistical credence to subjective observations. We applied this technique to investigate the values and perspectives of coastal residents and managers that depend on estuarine functions in the three selected bays. Q-methodology has been used in several environmental sustainability and conservation studies (for systematic reviews, see Zabala et al., 2018; Sneegas et al., 2021; for marine-specific studies, see Pike et al., 2015; Hagan and Williams, 2016; Bueno and Schiavetti, 2019). Q-methodology can be more appropriate to use than surveys when researchers want to

investigate the relative relationship between constructs (rather than a respondent marking "Strongly Agree" for all issue statements, for example) (Ho, 2017). It can also be more appropriate than random surveying, where practitioners need intimate information from a specific population. Participants in Q-methodology are given all of the issue statements together to prioritize them in relation to each other. Therefore, Q-methodology can unveil the values behind the opinions or attitudes to construct whole narratives rather than responses to specific issues (Zabala et al., 2018). It cannot reveal all possible perspectives among a generalized population. Still, it can illuminate minority or seemingly self-conflicting viewpoints across issues otherwise lost in survey analysis (Klooster et al., 2008). The standard Q-method process follows the following steps: defining the concourse, selecting the P-set, Q-sorting, analysis, and interpretation (Webler et al., 2009), as described below.

2.4. Four-step Q-statement development process

Q-methodology data are collected through a Q-sort, a forced ranking (i.e., sorting) exercise of Q-statements. Q-statements are developed using a "concourse," a comprehensive list of themes that could be included in the study. The creation of Q-statements is an involved process that must be clearly documented. We took the following steps to develop and test our Q-statements (Fig. 2). In the first step, our Advisory Group helped build the concourse based on prior challenges and specific values of interest inherent in the anticipated participants. For example, a story circulated that a mosquito infestation followed a past restoration project. Even though it was unclear whether the estuarine changes correlated with increased mosquito breeding, the managers were concerned that the public blamed the project. Another emerging local issue was the public's level of acceptance or opposition to beaver reintroduction. Mangers also heard that some residents thought the newly restored areas looked "ugly" or that the projects' machinery was too noisy. The Advisory Group also wanted to learn about the public's views on the local economy's connection to ecology, such as habitat and water quality effects on clams, crabs, oysters, agriculture, and tourism. These conversations revealed strong discursive elements, including a sense of place, economic benefits, physical health and well-being, promotion of democratic participation, benefits to the local community, etc. (for the full list of the Advisory Group social variable interests, see Supplementary Table 2). In step 2, we reviewed the social science literature on public perceptions and values of salt marsh and coastal restoration to learn how social scientists measure these variables (Supplementary Materials Table 3). We found studies that used a variety of qualitative research and mixed methods such as Q-methodology, surveys, interviews, and social media studies. From these, we identified 18 that published the measured indicators of restoration perception. These studies revealed 13 ways in which the public weighs the costs and benefits of restoration: for aesthetic reasons, biological diversity, economic impacts, health and well-being, rights and access, education, natural resources, decision-making responsibility, ecological safety, sense of place, spirituality and connection to nature, and social cohesion (Supplementary Materials Table 3). We also had a research interest in the extent institutional trust played in estuarine restoration perspectives and the three areas of environmental justice: distributive justice (equity), procedural justice (stakeholder involvement in decision-making), and recognition justice (reflecting on the inherent dignity of groups who have been denied power in dominant society).

Our topics fit the classic conservation framework proposed in Bennett (2016). Q-methodology relies on small, site-specific samples that cannot be scaled up; this limitation was mitigated by utilizing (similar, near-identical, identical) frameworks in several adjacent but socio-economically distinct bays. While many restoration studies construct frameworks around ecosystem services (for example, Matzek and Wilson, 2021), we selected the Bennett (2016) framework because it includes governance domains important to our study involving decision-makers and constituents (for definitions, see Supplementary Materials Table 4).

In step 3 we organized the Q-statement elements into the theoretical themes. Each statement was aligned with Bennett's (2016) conservation framework but reflected our specific context:

- Ecological outcomes (impacts on ecosystem quality and productivity) (Table 3)
- Social/human impacts (aesthetics, sense of place, the intrinsic value of nature, human health, social relations). We included both communal impacts and personal impacts. (Table 4)
- Legitimacy (policies, rules, accountability, transparency, fairness in decision-making) (Table 5)
- Acceptability (the appropriateness of restoration projects, decisions, and actions) (Table 6)

In step 4, the Advisory Group then met to discuss the content and wording of each of the 48 pre-Q-statements (Supplementary Table 5). Through these deliberations, we consolidated and refined the wording to create a 34-statement grid that would allow us to collect the information we needed while being manageable for the respondents to sort (Supplementary Material Fig. 1). Our priority was to design an instrument that would prompt participants to identify gaps they could expound upon during the workshop discussions. The final Q-statements are listed in Tables 3–6 in which ten Q-statements were categorized as ecological outcomes, ten as social/human impacts, five as legitimacy, and nine as acceptability.

2.5. Participant selection: Selecting the P-set

In Q-methodology, samples are called the P-set, which are purposefully selected to reflect the types of perceptions that may be available in a community. In our case, we wanted to explore the estuarine restoration perceptions that individuals have based on their level of knowledge about the sites. Therefore, we recruited natural resource managers (NRM), coastal managers (CM), and residents (R).

NRMs are end users (e.g., restoration managers) who produce information about the sites. To attain a mix of NRM perspectives, we contacted participants who worked for agencies at the federal, Tribal, state, and local levels.

CMs are employees who work in agencies that receive technical reports directly from NRMs. To attain a mix of CM viewpoints, we invited

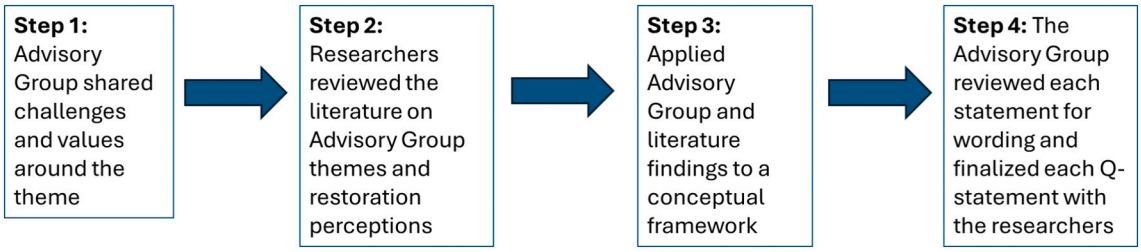

Fig. 2. Flowchart describing the four steps used to operationalize estuary restoration values and perceptions into locally-responsive Q-statements.

Table 3
Rankings for the "ecological outcome" values for each of the ten factor groups (NRM1, NRM2, CM1, CM2, CM3, R1, R2, R3, R4, R5). Data are displayed on a scale of −4 (least important) to 0 (neutral) to 4 (most important). Distinguishing statements are marked where $*p < 0.05$ and $**p < 0.01$. Compared to all other factors, differentiating *Z*-scores for statements are marked ▶higher or ◀lower.

Ecological Outcome Values	Natural Resource Manager Factors		Coastal Manager Factors			Resident Factors				
Q-statement	NRM1	NRM2	CM1	CM2	CM3	R1	R2	R3	R4	R5
Enhancing water quality.	4	3	3	2	4	4	4	2	2	3
Increasing ecological function in general.	3*◀	4*▶	4	3	3	4	1	2	4	-2**◀
Increasing habitat for fish and wildlife.	4	4	4	3	3	2	4	4	4	2
Increasing native vegetation.	2	1	2**▶	0	0	2	1	2	2	0
Minimizing the impacts of sea-level rise.	−1**◀	3**▶	2	0**◀	2	−1	0	-1	3**▶	1
Places that attract beavers.	2	1	1	−3**◀	0*	0	−3	0	1	−3
Places that attract birds.	0	2	2*▶	−2	1	0	−1**▶	4	2	−2
Reducing coastal erosion.	−2	0	2	1	1	−1	2	1	3	1
Reducing flooding along the coast.	−1	−1	1	1	1	−1	2	−1	3	2
Reducing the amount of pollution in water bodies.	2	3	3	2	3	3	3	3	2	3

Table 4
Rankings for the "social/human impact" values for each of the ten factor groups (NRM1, NRM2, CM1, CM2, CM3, R1, R2, R3, R4, R5). Data are displayed on a scale of −4 (least important) to 0 (neutral) to 4 (most important). Distinguishing statements are marked where $*p < 0.05$ and $**p < 0.01$. Compared to all other factors, differentiating *Z*-scores for statements are marked ▶higher or ◀lower.

Social/Human Impact Values	Natural Resource Manager Factors		Coastal Manager Factors			Resident Factors				
Q-statement	NRM1	NRM2	CM1	CM2	CM3	R1	R2	R3	R4	R5
An aesthetically pleasing environment.	1**▶	−2**◀	−1*	−3**◀	1*▶	−2	−2	0	0	1
An outdoor place to go to for my mental well-being.	1*▶	0*◀	−1	−2	−2	0	−3◀	1	0	2
Everyone benefits from natural places equally.	0**◀	2**▶	0	−1	4**▶	1	0	1	−1	4**▶
Generating long-term jobs.	1	0	−2	3**▶	−1	0	2	−2	0	0
Generating money for my community.	−1	−1	−3**◀	2	1	0	2	−1	−2	0
Having a mosquito-free environment.	−3	−4	−3	−2	−3	−4	−4	−2*	0**▶	−4
Increasing my community's resilience.	0	1	−1**◀	2	2	1	1	−1	−2	4**▶
Increasing storm protection for the community.	0	1	0	0	0	1	1	0	1	0
Outdoor sites for physical well-being, exercise, or recreation.	1	0	0	−1	0	−1	−1	2	1	2
Reducing flood damages to my property.	−3**◀	−1**▶	−2	0**▶	−2	−3	3**▶	0**	−3	−4

Table 5
Rankings for the "legitimacy" values for each of the ten factor groups (NRM1, NRM2, CM1, CM2, CM3, R1, R2, R3, R4, R5). Data are displayed on a scale of −4 (least important) to 0 (neutral) to 4 (most important). Distinguishing statements are marked where $*p < 0.05$ and $**p < 0.01$. Compared to all other factors, differentiating Z-scores for statements are marked ▶higher or ◀lower.

Legitimacy Values	Natural Resource Manager Factors		Coastal Manager Factors			Resident Factors				
Q-statement	NRM1	NRM2	CM1	CM2	CM3	R1	R2	R3	R4	R5
Involving the community in decision-making.	−1**◀	1**▶	−2*◀	−1*	2**▶	1	0	1	−1	−1
My local government's management of the ecosystem.	−1	−1	−1	4**▶	−2	0*▶	−1	−3	−2	−2
The federal government's management of the ecosystem	2**▶	−1**◀	0	1*▶	−1	2	−2	−3	1	−1
The state government's management of the ecosystem.	1**▶	0**◀	1**	4**▶	−3**◀	1	−2	−4◀	0	0
What the majority of my community votes for.	−4	−3	−4	−4	−1**▶	−2	0	−4	−4	−1

Table 6
Rankings for the "acceptability" values for each of the ten factor groups (NRM1, NRM2, CM1, CM2, CM3, R1, R2, R3, R4, R5). Data are displayed on a scale of −4 (least important) to 0 (neutral) to 4 (most important). Distinguishing statements are marked where $*p < 0.05$ and $**p < 0.01$. Compared to all other factors, differentiating Z-scores for statements are marked ▶higher or ◀lower.

Acceptability Values	Natural Resource Manager Factors		Coastal Manager Factors			Resident Factors				
Q-statement	NRM1	NRM2	CM1	CM2	CM3	R1	R2	R3	R4	R5
Attracting tourists to the area.	−2	−2	−4	−1*▶	−2	−1	−1	0	−3*◀	−1
Being able to catch native fish in local water bodies.	3**▶	−3**◀	0	0	2**▶	−2	1	0	−1	1
Being able to harvest local clams.	−2	−2	0**▶	−2	−4	−2	0	−2	−2	−1
Being able to harvest local oysters.	−2*▶	−3*◀	−2	−3	−1	−3	3**▶	−3	−4	−2
Projects that don't require heavy machinery.	−3	−2	−1	−4*◀	−3	−3	−4	−2	−1	−3
Promoting the historical & cultural values of the area.	0**◀	2**▶	1	1	−4**◀	2	0	3	−1	3
Recognizing the original Indigenous caretakers.	0**◀	2**▶	1	−1	−1	3	−2	3	−3	0
Reconnecting tidal channels.	3**▶	0**◀	3*▶	1	0	3	−1	1	1	−3
Reducing waterlogging of crops.	−4	−4	−3**◀	0	0	−4	−3	−1	0	1

participants involved in city and county planning, port management, and government agencies in adjacent fields.

Rs are individuals who live in the area and receive information through publicly available media and/or by personally visiting the sites. We contacted landowners, seafood businesses, estuary volunteers, and other community members to attain a mix of R viewpoints.

We emailed and called 299 contacts and were able to reach 110. Of these, 66 declined, and 44 accepted. Unfortunately, the COVID-19 pandemic prevented many from attending, which affected the racial diversity of the sample. Nevertheless, we attracted participants in each geographic area across each of our three categories (NRM, CM, and R). Due to the small populations and managers in these areas and the need to limit our in-person numbers because to the pandemic, this sample consists of people who are highly interested in estuarine restoration – they live, work, or volunteer on or near this land. While the sample will not elicit generalizable results, it can highlight subtle differences that may go unnoticed in large-scale surveys (Brown, 1996; Watts and Stenner, 2012).

2.6. Data collection: Q-sorting

Participants ranked the Q-sort statements at each study site in August 2021 on a scale from −4 (less important) to +4 (most important) (Supplementary Materials Fig. 2). Each participant was given an envelope of unsorted Q-statements so the prompts were received in random order (Supplementary Materials Fig. 3). After participants completed the Q-sort, they were randomly assigned to small groups with a trained facilitator to aid self-reflection and respectful dialogue (Supplementary Materials Table 12). This study has been reviewed by the Institutional Review Board at Portland State University 207,109–18 and the University of California-Davis 1,688,293–1. Human subjects ethics forms and information are available in the Supplementary Materials Tables 6–11).

2.7. Analysis and interpretation

The rankings participants gave to the Q-statements were analyzed using the web application Ken-Q Version 2.0.1. Each participant's Q-sort was correlated with the sortings of the other participants in their factor group to create a composite Q-sort that expresses the "structure and form" of the narratives, representing them as *social* perspectives (as opposed to personal opinions) (Brown, 1986:58). Then, a principal component analysis was performed on this matrix to identify statistically significant similarities. Factors with eigenvalues greater than one (Saigal et al., 2005), with at least two Q-sorts loading (Raadgever et al., 2008; Seyni et al., 2018), and total explained variance (Zabala et al., 2018) were selected for rotation using the varimax method. Participant loadings were auto-flagged at $p < 0.05$, suggesting that the factors represent distinct viewpoints. The results produced *Z*-score rankings for each statement. Using the composite and weighted Z-scores from the participants who defined each factor, the software visualized a composite Q-sort showing each factor's rankings. Distinguishing statements were found by comparing absolute differences between Z-scores.

3. Results

Overall, 44 NRMs, CMs, and Rs participated: 17 in Alsea Bay, 12 in Yaquina Bay, and 15 in Coos Bay. Of the 44 participants in the sessions, three participants submitted incomplete Q-sorts, leaving 41 completed Q-sorts. However, all of the participants' post-Q-sort comments were used to develop the discussion and conclusion. Analyzing the P-set as a whole (P-set = 41), we identified multiple perspectives in which the highest explained variance was due to the perspective that valued ecological outcomes the most. However, that analysis did not provide the clearest distinction between NRMs, CMs, and Rs. When we separated the P-set into the three groups we purposefully sampled – NRM (P-set =9), CM (P-set =15), and R (P-set =17) – the results elicited richer information, which we report below.

We first defined the factors for each stakeholder group, which were used to create common narratives across the entire P-set discussed in section 3.1. Two factors (NRM1 and NRM2) were found to be the best solution for the NRM Q-sorts, cumulatively explaining 71 % of the variance. Three factors (CM1, CM2, CM3) were found to be the best solution for the CM Q-sorts, with 63 % cumulative explained variance. Five factors (R1, R2, R3, R4, and R5) were found to be the optimal solution for the R Q-sorts, with a cumulative total of 74 % explained variance. To compare the ten resulting factors, we display each factor's Q-statement rankings by framework category in Table 3 (ecological outcomes), Table 4 (social/human impacts), Table 5 (legitimacy), and Table 6 (acceptability). Negative rankings do not necessarily mean that participants opposed those Q-statements but that the other statements were a higher priority for them. Negative rankings should be read as "less important" rather than "unimportant."

Across the board, we found high agreement about the importance of ecological outcomes (Table 3). Indeed, the statements "enhancing water quality," "increasing ecological function," and "increasing habitat for fish and wildlife" were the highest ranked for most factors. Factors also relatively agreed that social/human impacts were ranked in the middle (Table 4). A prime example of this was "increasing storm protection for my community," which focused on safety benefits to society and was ranked 0 or 1 by all factors. Legitimacy values (Table 5) were more controversial, with factors rating federal, state, and local government management across the spectrum. However, all factors were in relative agreement that "what my community votes for" was not of great concern. The factors were generally in agreement that attracting tourists and reducing waterlogging were not high success values on their lists, nor would heavy machinery or mosquitos deter acceptance (Table 6). Looking more closely at each category's statements, we can construct distinct social narratives.

3.1. Combining similar factors to understand commonalities

Four main narratives were identified as a result of the 41 Q-sorts. They are described below as 1) restoration success depends on positive ecological outcomes while federal and state management is important; 2) ecological outcomes are the most important, but equality and social acceptance are top concerns; 3) economic prosperity and local community determine success, and 4) equality and community resilience are the highest priority (Table 7).

3.1.1. Narrative 1: Restoration success depends on positive ecological outcomes, while federal and state management is important (NRM1, CM1, R1, R4)

Four factors formed a narrative that reflects an eco-centric approach to estuarine restoration. Among these factors, federal and state management of the ecosystem were rated higher than the local government, community involvement, or what their community votes for. Two resident factors, along with natural resource and coastal managers, share this narrative. Not only were ecological outcomes ranked very highly, but the most important acceptable management outcomes were also related to environmental goals. With rare exceptions, social impacts were ranked less important or neutral.

In the post-Q-sort sessions, participants associated with NRM1 (natural resource managers) touched on the importance of considering social values but ultimately prioritized ecological success and restoration potential (Table 7). Some residents discussed their involvement in environmental restoration efforts while expressing concern about the challenges of property interference, pollution reduction, and climate change adaptation, highlighting the necessity for diverse species, community buy-in, and restored ecological function. The consensus was on the positive effects of marsh restoration on various wildlife habitats and water quality, and this group ultimately prioritizes actions that support

Table 7
Illustrative quotes from participants associated with each narrative.

	Narrative 1: Restoration success depends on positive ecological outcomes, while federal and state management is important (NR1, CM1, R1, R4).	Narrative 2: Ecological outcomes are the most important, but equality and social acceptance are too (NR2, R3).	Narrative 3: Economic prosperity and local community determine success (CM2, R2).	Narrative 4: Equality and community resilience are the highest priority (CM3, R5).
NRM	"When it came down to talking about one of the most important values, for me, was increasing habitat for native fish and other aquatic species. But there were others, like reconnecting tidal wetlands… they're all interlinked."	"We have a [federally funded] project that we're having [a local organization] lead because of anti-government sentiments in the area. I do think the public cares about it."	n/a	n/a
CM	"Sand's being pushed into the estuaries. It's really the symmetry that has changed. Getting the sands moving in and not getting flushed out, it's become a different estuary."	n/a	"It's very difficult right now to get that type of a policy change to where people can buy into it and move forward, and I think that has huge possibilities of how you can work the margins on this thing and get more done for less dollars."	"I do feel here there is more effort to try and get all the parties involved early on."
R	"Nature is my number one priority. I can't stand when the environment is pitted against jobs because every single thing that we have, the earth provides for us."	"More educational outreach works. I don't know how many people I've interacted with over the years who just don't have a clue. And it's not that they don't care. They just don't understand, it's never been presented to them."	"I'm more afraid of the federal government than the state or any of the other ones when it comes to projects because they're harder to make any adaptations."	"The reason I put 'increase in my community resilience' is because I feel like communication is a big factor in all of this."

the overall health and functionality of the ecosystem.

3.1.2. Narrative 2: Ecological outcomes are the most important, but so are equality and social acceptance (NRM2, R3)

The second narrative was similar to the first in that ecological outcomes were highly important, but social equality was also very important to these factors. However, some notable differences existed. In the post-Q-sort discussion, participants associated with NRM2 discussed the economic, social, and environmental benefits and challenges of restoration projects and the importance of addressing cultural values and species in restoration efforts (Table 7). Participants associated with R3 focused on local ecosystems and were concerned about the industrial impacts on natural habitats. They expressed their personal experiences and emphasized the importance of community engagement and diverse perspectives in environmental stewardship.

3.1.3. Narrative 3: Economic prosperity and local community determine success (CM2, R2)

Two points that stood out for factors CM2 and R2 were prioritizing the local economy. Personal property and personal use of the estuary were also important to R2. CM2 ranked the local and state management of the ecosystem higher than the federal government, whereas R2 ranked the local government higher than the others but still relatively lower.

In the post-Q-sort discussions, participants associated with CM2 emphasized the need for public input, addressing misinformation, managing resources responsibly, and the financial implications of estuary restoration. There was some frustration around government bureaucracy and disjointed agency efforts toward common goals. Relationships with Tribes and the broader community were also highlighted as crucial for successful environmental management.

3.1.4. Narrative 4: Equality and community resilience are the highest priority (CM3, R5)

A fourth narrative differed from the others in that equality ranked highest among both factors that shared this narrative. CM3 ranked community involvement higher than any other factor, while R5 ranked community resilience higher than any other. The two factors sharing this narrative agreed that governmental management at any level ranked low-to-middle. Project acceptance ranked very low except for catching native fish in local water bodies for CM3 and promoting historical and cultural values for R5.

4. Discussion

The first question we set out to answer with this study was "What perceptions are important in evaluating estuarine conservation success?" Although ecological outcomes were highly ranked among all groups, a significant portion of the participants wanted to understand the social benefits to determine estuarine restoration success. While monitoring social benefits has grown, it has received less attention than monitoring ecological indicators of estuarine restoration (Wagner et al., 2008; Jefferson et al., 2021). Some research has studied the social impacts of estuarine restoration on sustaining biodiversity, protecting water quality, and supporting clean air, water, and soil (Curado et al., 2014; Sherren et al., 2016; Petrakis et al., 2020; Sauer et al., 2022; Schaich, 2009; Roca and Villares, 2012; Bennett, 2016; McKinley et al., 2020a). There is a significant gap in the knowledge about how social goals relate to ecological values and, specifically, what competing interests might mean for estuarine restoration outcomes.

Legitimacy and acceptability issues may have ranked lower for certain groups because of mixed emotions about how well agencies at different institutional levels are doing. Other studies have argued that the level of trust people have in policymakers to be dependable, competent, effective, or work with integrity is also important (Guimarães, 2010; Smith and Bond, 2018). A comment we received from a participant about disjointed efforts highlights participant values for better professional-community dynamics (e.g., coordination among agencies, permitters, funders, coastal planners) that might result in more effective restoration projects. Recent studies provide evidence of the connection between how the public feels about agencies and how they

perceive the restoration projects they implement (Sherren et al., 2016; Roca and Villares, 2012; Bennett, 2016; McKinley et al., 2020b). Furthermore, research on participatory governance demonstrates how the roles and relationships people have in decision-making influence their perception of restoration success. Studies like these have found a link between stakeholder involvement in decision-making and positive impacts on restoration success (Pueyo-Ros et al., 2019).

The second research question we asked was, "Do estuarine perceptions vary among the general public, natural resource managers, and managers who work on the coast that rely on estuarine success?" Although we found that natural resource and coastal managers shared core values with residents, there were important nuances, and participants were acutely aware of differences. R perspectives might differ from CMs and NRMs because the public learns about sites through informal means, such as outdoor education or observing nature, which may lead them to understand nature in different ways than NRMs and scientists (Schaich, 2009: Pike et al., 2015, Chen et al., 2020: Petrakis et al., 2020). Indeed, previous studies have shown that people's sense of place develops through direct experience with the natural and social worlds (Masterson et al., 2017). People's place dependency due to their economic livelihoods such as fishing, farming, and tourism may also influence differing perceptions (Schaich, 2009; Roca and Villares, 2012; Bacher et al., 2014; Bennett, 2016; Sherren et al., 2016; Rendón et al., 2019; Chen et al., 2020; McKinley et al., 2020a; Petrakis et al., 2020; Sauer et al., 2022). Understanding different perceptions might help natural resource managers create targeted messages that may appeal to a wide range of people. Although some restoration messages focus on how much money will be saved over the long-term, Sherren et al. (2016) found that only focusing on cost savings in messages will likely result in low public buy-in. Managers can choose to focus on one perspective or emphasize cross-cutting characteristics, such as the importance of ecological outcomes, coastal safety, and benefits to communities. Focusing on these values may help natural resource managers reach their target audiences.

Indeed, this demonstrates the value of Q-sort-derived methods in forcing arbitrary ranking of values, in comparison to Likert scale based surveys in which all statements (values) can be assigned to a single bin (Most Valuable).

5. Conclusion

Just as an estuary mixes salt and freshwater, coastal communities combine to form a variety of perspectives. Our work addressed a social value assessment of estuarine restoration progress to track both social and environmental objectives. While other studies focusing on natural resource manager viewpoints have provided insight into strategy and policy preferences (Smith and Houser, 2022), our study contributes by comparing natural resource managers with other managers and the general public to observe how environmental and social connections influence perspectives. We found that ecological outcomes were ranked as the most important values for evaluating estuarine conservation success but not at the expense of social outcomes, governance legitimacy, or management acceptability. In all of the four narratives we found, ecological connectivity was tied to social connectivity in the form of federal-state-local relationships, the promotion of social equality and democratic processes, and social resilience. The qualitative data additionally emphasized that people living and working in coastal areas were concerned about the potential impacts of restoration on their communities as well as wildlife and habitat. To further strengthen social connectivity in estuarine restoration, social priority studies using Q-methodology could be useful in the initial planning stages and in post-project evaluation.

Using a conservation perspectives framework to guide the research design, this study used a Q-methodology technique to reveal multiple perspectives in three Oregon bays. The conservation framework was useful for reducing the concourse to the final number of Q-statements and highlighting what distinguished each discourse from the others. Although we expected natural resource managers, coastal managers, and the general public to disagree, we found surprising commonalities and connections between them. Q-sorts were able to draw out the differences between stakeholders in the region, while the post-Q-sort discussions provided a space for structured and respectful conversation. This finding adds a richer dimension to other estuarine restoration evaluations that have focused solely on ecological outcomes. Restoration impacts people's lives and occur in a "messy" and complex political, social, and cultural space.

The findings raise unresolved questions for future research, including whether perceptions are generalizable across the western United States or other coastal communities. The small sample size required for Q-methodology is a limitation for answering questions of generalizability. Another limitation of the study is the purposive sampling method and the potential for researchers to bias the sample through recruitment. An additional limitation was that data collection occurred during the COVID-19 pandemic which may have deterred participants from attending. Despite our efforts to recruit diverse viewpoints for our sample, we missed important perspectives. This is a significant limitation and reflects the need for greater engagement in the region and in restoration in general. Nonetheless, our participants have much to offer in the conversation on estuarine restoration. They have a significant amount at stake—they work, volunteer, and live on or near these lands and waters. In addition, we were able to follow up on this research with a larger sample survey study in Tomales Bay, CA, US. We found similar prioritization of ecosystem functioning and sea-level rise resilience by community members. Still, discussion groups with more diversity might find significant differences between sociodemographic groups that encounter varying degrees of pollution and degradation due to colonialism and racial segregation in the United States.

Our study was also constrained by the number of Q-statements that could be included in the Q-sort. We described our process in the Methods section and Supplementary Material to be transparent about the Advisory Group's priorities, social constructs from the extant literature, and important context-specific place variables. The Q-sorts were designed to cover the conservation framework domains while prompting further conversation in the post-Q-sort discussions. Future studies could add Q-statements relevant to their specific communities, including enjoying restoration sites for their intrinsic value as sources of inspiration, spirituality, and connection to nature. Furthermore, future research should determine how we move from identifying key indicators to how we can monitor them, including individual benefits and community access, resilience, and justice.

CRediT authorship contribution statement

Melissa Haeffner: Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Shersten Finley:** Writing – review & editing, Methodology, Investigation, Data curation, Conceptualization. **Catherine de Rivera:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Edwin Grosholz:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Julie Anne Gonzalez:** Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Investigation, Funding acquisition. **Vanessa Robertson-Rojas:** Writing – review & editing, Methodology, Investigation, Formal analysis, Data curation. **Shon Schooler:** Writing – review & editing, Resources, Project administration, Methodology, Investigation, Conceptualization. **Sabra Comet:** Writing – review & editing, Resources, Project administration, Methodology, Investigation. **Paul Engelmeyer:** Writing – review & editing, Resources,

Project administration, Methodology, Investigation, Conceptualization.

Ethical approval

This study has been reviewed by the Institutional Review Board at Portland State University 207109-18 and the University of California-Davis 1688293-1.

Author contributions

CdR, EG and SS conceptualized the study. CdR, EG, MH, JG, VRR, SS secured funding. MH led the social science research design. MH, CdR, JG, VR, SF, SC collected the data. MH analyzed the data, and developed and framed the manuscript. All authors edited and approved the manuscript.

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Declaration of competing interest

No potential conflict of interest was reported by the authors.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.biocon.2025.111277.

Data availability

Data will be made available on request.

References

Bacher, K., Gordoa, A., Mikkelsen, E., 2014. Stakeholders' perceptions of marine fish farming in Catalonia (Spain): a Q-methodology approach. Aquaculture 424, 78–85.
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.
Bennett, N.J., 2016. Using perceptions as evidence to improve conservation and environmental management. Conserv. Biol. 30 (3), 582–592.
Bennett, N.J., Roth, R., Klain, S.C., Chan, K., Christie, P., Clark, D.A., Cullman, G., Curran, D., Durbin, T.J., Epstein, G., Greenberg, A., 2017. Conservation social science: understanding and integrating human dimensions to improve conservation. Biol. Conserv. 205, 93–108.
Brophy, L.S., 1999. Final Report: Yaquina and Alsea River Basins Estuarine Wetland Site Prioritization Project (September). Green Point Consulting, Corvallis, OR, Prepared for MidCoast Watersheds Council, Newport, OR, p. 71.
Brophy, L.S. 2007. Vegetation Monitoring and Mapping at Tidal Wetland Restoration and Reference Sites: Siletz Bay National Wildlife Refuge and Yaquina River Estuary. Prepared for Confederated Tribes of Siletz Indians, Siletz, OR. Green Point Consulting, Corvallis, OR. 47pp.
Brophy, L.S., Greene, C.M., Hare, V.C., Holycross, B., Lanier, A., Heady, W.N., O'Connor, K., Imaki, H., Haddad, T., Dana, R., 2019. Insights into estuary habitat loss in the western United States using a new method for mapping maximum extent of tidal wetlands. PLoS One 14 (8), e0218558.
Brown, S.R., 1986. Q Technique and Method: Principles and Procedures. Advances and applications in research methods, New tools for social scientists, pp. 57–76.
Brown, S.R., 1996. A primer on Q-methodology. Qual. Health Res. 6 (4), 561–567.
Bueno, P.F., Schiavetti, A., 2019. The influence of fisherman scale in the resilience of socio-ecological systems: an analysis using Q methodology. Ocean Coast. Manag. 169, 214–224.
Callaway, J.C., Borgnis, E.L., Turner, R.E., Milan, C.S., 2012. Carbon sequestration and sediment accretion in San Francisco Bay tidal wetlands. Estuar. Coasts 35, 1163–1181.
Chen, Y., Caesemaecker, C., Rahman, H.T., Sherren, K., 2020. Comparing cultural ecosystem service delivery in dykelands and marshes using Instagram: A case of the Cornwallis (Jijuktu'kwejk) River. Nova Scotia, Canada. Ocean Coast. Manag 193, 105254.
Curado, G., Manzano-Arrondo, V., Figueroa, E., Castillo, J.M., 2014. Public perceptions and uses of natural and restored salt marshes. Landsc. Res. 39 (6), 668–679.
Duarte, C.M., Losada, I.J., Hendriks, I.E., Mazarrasa, I., Marbà, N., 2013. The role of coastal plant communities for climate change mitigation and adaptation. Nat. Clim. Chang. 3 (11), 961–968.
Guimarães, M.H.M.E., 2010. The use of Q-methodology to obtain stakeholder discourses on the future development of ria Formosa coastal zone, south of Portugal. Revista portuguesa de estudos regionais 23, 5–19.
Hagan, K., Williams, W., 2016. Oceans of discourses: utilizing Q methodology for analyzing perceptions on marine biodiversity conservation in the Kogelberg biosphere reserve. South Africa. Frontiers in Marine Science 3, 188.
Ho, G.W.K., 2017. Examining perceptions and attitudes: a review of Likert-type scales versus Q-methodology. West. J. Nurs. Res. 39 (5), 674–689. https://doi.org/10.1177/0193945916661302.
Howie, A.H., Reeves, S.E., Gillies, C.L., Bishop, M.J., 2024. Integration of social data into restoration suitability modelling for oyster reefs. Ecol. Indic. 158, 111531.
International Association for Public Participation (IAP2), 2013. https://icma.org/sites/default/files/305432_IAP2%20Spectrum%20of%20Public%20Participation.pdf. (Accessed 29 July 2020).
Jefferson, R., McKinley, E., Griffin, H., Nimmo, A., Fletcher, S., 2021. Public perceptions of the ocean: lessons for marine conservation from a global research review. Front. Mar. Sci. 8, 1705.
Kelderman, K., Phillips, A., Peloton, T., Schaeffer, E., MacGillis-Falcon, P., Bernhardt, C., March 17, 2022. The clean water act at 50: promises half kept at the half-century mark. Environmental Integrity Project 1, 1–72. https://environmentalintegrity.org/wp-content/uploads/2022/03/CWA-report-3.23.22-FINAL.pdf (Accessed 29 July 2024).
Klooster, P.M.T., Visser, M., De Jong, M.D., 2008. Comparing two image research instruments: the Q-sort method versus the Likert attitude questionnaire. Food Qual. Prefer. 19 (5), 511–518.
Magel, C.L., Hacker, S.D., Chan, F., Helms, A.R., 2023. Eelgrass and macroalgae loss in an Oregon estuary: consequences for ocean acidification and hypoxia. Ocean-Land-Atmosphere Research 2, 0023.
Masterson, V.A., Stedman, R.C., Enqvist, J., Tengö, M., Giusti, M., Wahl, D., Svedin, U., 2017. The contribution of sense of place to social-ecological systems research: a review and research agenda. Ecol. Soc. 22 (1).
Matzek, V., Wilson, K.A., 2021. Public support for restoration: does including ecosystem services as a goal engage a different set of values and attitudes than biodiversity protection alone? PLoS One 16 (1), e0245074.
McKinley, E., Pages, J.F., Alexander, M., Burdon, D., Martino, S., 2020a. Uses and management of saltmarshes: a global survey. Estuar. Coast. Shelf Sci. 243, 106840.
McKinley, E., Pages, J.F., Ballinger, R.C., Beaumont, N., 2020b. Forgotten landscapes: public attitudes and perceptions of coastal saltmarshes. Ocean Coast. Manag. 187, 105117.
Miller, J.R., Hobbs, R.J., 2007. Habitat restoration—do we know what We're doing? Restor. Ecol. 15, 382–390.
Minello, T., Able, K., Weinstein, M., Hays, C., 2003. Salt marshes as nurseries for nekton: testing hypotheses on density, growth and survival through meta-analysis. Mar. Ecol. Prog. Ser. 246, 39–59.
Nassauer, J.I., 1995. Messy ecosystems, orderly frames. Landsc. J. 14 (2), 161–170.
NOAA (National Oceanic and Atmospheric Administration) Fisheries, 2024a. Species Status. https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/oregon-coast-coho-salmon (Accessed 11 September 2024).
NOAA (National Oceanic and Atmospheric Administration) Fisheries, 2024b. Fishery Resource Disaster Determinations. https://www.fisheries.noaa.gov/national/funding-financial-services/fishery-resource-disaster-determinations#131-oregon-ocean-commercial-salmon-fisheries-2023 (Accessed 11 September 2024).
ODFW (Oregon Department of Fish and Wildlife), 2016. Oregon Conservation Strategy. Salem, Oregon.
ODLDC (Oregon Department of Land Conservation and Development), July 2019. Oregon statewide planning goals and guidelines, vol. 1, pp. 1–112. https://www.oregon.gov/lcd/Publications/compilation_of_statewide_planning_goals_July2019.pdf (Accessed 17 January 2025).

ODLCD (Oregon Department of Land Conservation and Development), n.d. Oregon Coastal Management Program. Statewide Planning Goal 16. https://www.oregon.gov/lcd/OCMP/Pages/Estuary-Planning.aspx (Accessed May 28, 2025).
OSU (Oregon State University), 2023. Oregon Coastal Atlas. Corvallis, Oregon. Retrieved August 28, 2023. https://www.coastalatlas.net/.
OWEB (Oregon Watershed Enhancement Board). 2021. Oregon Watershed Restoration Inventory. Salem, Oregon. Retrieved May 23, 2021, from https://tools.oregonexplorer.info/OE_HtmlViewer/Index.html?viewer=owrt.
OWRI (Oregon Watershed Restoration Inventory), 2020. Oregon's Statewide Investments in Completed Restoration Projects (1995–2020). Accessed June 16, 2022. https://www.oregon.gov/oweb/data-reporting/Pages/owri.aspx.
Petrakis, R.E., Norman, L.M., Lysaght, O., Sherrouse, B.C., Semmens, D., Bagstad, K.J., K. and R. Pritzlaff., 2020. Mapping perceived social values to support a respondent-defined restoration economy: case study in southeastern Arizona, USA. Air, Soil and Water Research 13, 1178622120913318.
Pike, K., Wright, P., Wink, B., Fletcher, S., 2015. The assessment of cultural ecosystem services in the marine environment using Q methodology. J. Coast. Conserv. 19 (5), 667–675.
Pueyo-Ros, J., Ribas, A., Fraguell, R.M., 2019. A cultural approach to wetlands restoration to assess its public acceptance. Restor. Ecol. 27 (3), 626–637.
Raadgever, G.T., Mostert, E., Van De Giesen, N.C., 2008. Identification of stakeholder perspectives on future flood management in the Rhine basin using Q methodology. Hydrol. Earth Syst. Sci. 12 (4), 1097–1109.
Rendón, O.R., Garbutt, A., Skov, M., Möller, I., Alexander, M., Ballinger, R., Wyles, K., Smith, G., McKinley, E., Griffin, J., Thomas, M., Davidson, K., Pagés, J., Read, S., Beaumont, N., 2019. A framework linking ecosystem services and human well-being: saltmarsh as a case study. People and nature 1 (4), 486–496.
Roca, E., Villares, M., 2012. Public perceptions of managed realignment strategies: the case study of the Ebro Delta in the Mediterranean basin. Ocean Coast. Manag. 60, 38–47.
Saigal, S., Borgoyary, M., Lal, P., 2005. Incorporating Stakeholder Perceptions in Participatory Forest Management in India. Winrock International, Little Rock, AR, USA.
Sauer, I., Roca, E., Villares, M., 2022. Beach users' perceptions of coastal regeneration projects as an adaptation strategy in the western Mediterranean. J. Hosp. Tour. Res. 46 (3), 418–441.
Schaich, H., 2009. Local residents' perceptions of floodplain restoration measures in Luxembourg's Syr Valley. Landsc. Urban Plan. 93 (1), 20–30.
Seyni, S., Moula, N., Hamadou, I., Issa, M., Issa, S., Hamani, M., Antoine-Moussiaux, N., 2018. Q method to map the diversity of stakeholder viewpoints along agricultural innovation systems: a case study on cattle genetic improvement in Niger. Archives Animal Breeding 61, 143–151.
Sheaves, M., 2009. Consequences of ecological connectivity: the coastal ecosystem mosaic. Mar. Ecol. Prog. Ser. 391, 107–115.
Sherren, K., Loik, L., Debner, J.A., 2016. Climate adaptation in 'new world' cultural landscapes: the case of bay of Fundy agricultural dykelands (Nova Scotia, Canada). Land Use Policy 51, 267–280.
Sherren, K., Ellis, K., Guimond, J.A., Kurylyk, B., LeRoux, N., Lundholm, J., Mallory, M. L., van Proosdij, D., Walker, A.K., Bowron, T.M., Brazner, J., Kellman, L., Turner II, B.L., Wells, E., 2021. Understanding multifunctional bay of Fundy dykelands and tidal wetlands using ecosystem services—a baseline. FACETS 6, 1446–1473. https://doi.org/10.1139/facets-2020-0073.
Shikuzawa, J., Watson, E.B., Tanner, K., Wilburn, B., Fork, S.K., Larson, S., Wasson, K., 2024. Ecosystem functions of plant diversity: comparisons from a large-scale marsh restoration experiment in California, USA. Ecosphere 15 (1), e4742.
Smith, A., Houser, C., 2022. Perspectives on Great Lakes coastal management: a case study of the point Pelee foreland. Canada. *Ocean & Coastal Management* 228, 106329.
Smith, J., Bond, A., 2018. Delivering more inclusive public participation in coastal flood management: a case study in Suffolk, UK. Ocean Coast. Manag. 161, 147–155.
Sneegas, G., Beckner, S., Brannstrom, C., Jepson, W., Lee, K., Seghezzo, L., 2021. Using Q-methodology in environmental sustainability research: a bibliometric analysis and systematic review. Ecol. Econ. 180, 106864.
Sounhein, B., Lewis, M., Weeber, M., 2021. Western Oregon adult Coho Salmon, 2020 spawning survey data report. Oregon plan for salmon and watersheds. Monitoring report no. OPSW-ODFW-2021-3.
Suwandhahannadi, W.K., Wickramasinghe, D., Dahanayaka, D.D.G.L., Le De, L., 2024. Blue carbon storage in a tropical coastal estuary: insights for conservation priorities. Sci. Total Environ. 906, 167733.
Townend, I., Fletcher, C., Knappen, M., Rossington, K., 2011. A review of salt marsh dynamics: a review of salt marsh dynamics. Water Environ. J. 25, 477–488.
U.S. Census Bureau, 2021a. American Community Survey 5-Year Estimates. Retrieved from *Census Reporter Profile page for Waldport*, OR. http://censusreporter.org/profiles/16000US4178000-waldport-or/.
U.S. Census Bureau, 2021b. American Community Survey 5-Year Estimates. Retrieved from *Census Reporter Profile page for Newport*, OR (http://censusreporter.org/profiles/16000US4152450-newport-or/).
U.S. Census Bureau, 2021c. American Community Survey 5-Year Estimates. Retrieved from *Census Reporter Profile page for Coos Bay*, OR. http://censusreporter.org/profiles/16000US4115250-coos-bay-or/.
Uhrin, A.V., Schellinger, J., 2011. Marine debris impacts to a tidal fringing-marsh in North Carolina. Mar. Pollut. Bull. 62, 2605–2610.
Van Bel, Smolders, K.C., IJsselsteijn, W.A., De Kort, 2009. Social connectedness: Concept and measurement. In: Intelligent environments, vol. 2009. IOS Press, pp. 67–74.
Verutes, G.M., Yang, P.F., Eastman, S.F., Doughty, C.L., Adgie, T.E., Dietz, K., Dix, N.G., North, A., Guannel, G., Chapman, S.K., 2024. Using vulnerability assessment to characterize coastal protection benefits provided by estuarine habitats of a dynamic intracoastal waterway. PeerJ 12, e16738.
Wagner, K.I., Gallagher, S.K., Hayes, M., Lawrence, B.A., Zedler, J.B., 2008. Wetland restoration in the new millennium: do research efforts match opportunities? Restor. Ecol. 16 (3), 367–372.
Watts, S., Stenner, P., 2012. Doing Q Methodological Research. SAGE Publications, Inc.. https://uk.sagepub.com/en-gb/eur/doing-q-methodological-research/book234368
Webler, T., Danielson, S., Tuler, S., 2009. Using Q Method to Reveal Social Perspectives in Environmental Research. Social and Environmental Research Institute, Greenfield MA. Downloaded from: http://www.seri-us.org/sites/default/files/Qprimer.pdf.
Weller, M.W., 1994. Bird-habitat relationships in a Texas estuarine marsh during summer. Wetlands 14, 293–300.
Zabala, A., Sandbrook, C., Mukherjee, N., 2018. When and how to use Qmethodology to understand perspectives in conservation research. Conserv. Biol. 32 (5), 1185–1194.
Zedler, J.B., Kercher, S., 2005. Wetland resources: status, trends, ecosystem services, and restorability. Annu. Rev. Environ. Resour. 30, 39–74.
Zhang, H., Tang, D., He, J., Yang, X., Feng, Z., Fu, Y., Ma, S., 2024. Assessment of heavy metal contamination in the surface sediments, seawater and organisms of the Pearl River estuary, South China Sea. Sci. Total Environ. 950, 175266.