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Research article

Diversity of perspectives in biodiversity conservation: A case study of port land use in Antwerp and Rotterdam☆

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ABSTRACT

Conflicts of interest often undermine conservation initiatives against biodiversity decline. Effective decision-making requires a deeper understanding of the positions, criteria, concerns, and perspectives of stakeholders. However, managing so many perspectives can be difficult, and if not done well, conflicts arise which make it difficult to achieve conservation goals. The purpose of this study is to demonstrate that identifying areas of consensus is a good starting point to generate more effective debates and address complex issues. To do this, we investigate the diversity of perspectives regarding biodiversity conservation schemes among stakeholders in the studied ports of Antwerp and Rotterdam. Using Q-methodology, a semi-quantitative technique that enables us to systematically study the subjective views of stakeholders involved in a topic, we identified and organized a range of shared perspectives into three groups, known as factors. A total of 20 participants sorted 45 statements according to their perceptions and objectives, from −4 'most disagreeable' to 4 'most agreeable'. Then, respondents explained their rankings in a post-sorting interview. Next, the data was analyzed quantitatively and qualitatively. The quantitative analysis was conducted in two parts:

(i) Dividing respondents into groups based on similar perspectives and (ii) coupling distinguishing statements with one of the factors characteristic of that viewpoint. Finally, in a qualitative analysis, we used the distinguishing statements and insights from interviews to create narratives and titles for the three factors: (1) Ports are key for our economic wealth, hence port development should continue, (2) Nature first, and (3) Multi-actor governance. Our findings confirm consensuses in three areas: policy, land use, and mitigation tactics. Interestingly, all narratives unanimously agreed on the importance of regulating port development and land use changes via legislation and environmental impact assessments. However, they debated the rigidity of legislation and whether offsetting port expansion (and associated land and resource use claims) should take place locally or internationally. We also found that decision-making mostly followed a human-centered perspective, where economic values were more relevant than intrinsic ones. These insights can serve as a baseline for stakeholders to form coalitions around areas of consensus to depolarize debates and avoid decision-making gridlocks.

1. Introduction

Biodiversity determines the resilience of social-ecological systems (i.e., the capacity for a system to withstand perturbations (Garmestani et al., 2019),) which ultimately sustain human well-being. However, anthropogenic effects have caused the rapid decline of biodiversity at local, national, and global levels. Habitat degradation resulting from land use changes is the primary source of global and local biodiversity loss (Brondizio et al., 2019). Land use includes the ways in which humans manage and alter the natural environment to serve as recreational, transportation, agricultural, residential, and commercial means (Foley et al., 2005). The need to provide food, water, and shelter to over 8 billion people globally has increased the rate humans are altering farmlands, wetlands and waterways (Foley et al., 2005; United Nations,

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2022). Hence, as land use decisions and interventions directly affect biodiversity and their habitats, there is an urgent need to adequately manage the trade-offs between immediate human needs and the integrity of natural ecosystems (Foley et al., 2005). However, despite increasing awareness and actions designed to reverse and restore biodiversity, overall progress to keep land use changes within the planetary boundaries is still weak (Rockström et al., 2009).

Most initiatives to combat biodiversity decline fail to significantly curb biodiversity loss due to conflicts between stakeholders, which hinder efforts to develop and implement collaborative management strategies (Young et al., 2013). Such conflicts among stakeholders surrounding biodiversity conservation management interventions are often a result of ineffective communication and deep-seated disagreements between decision-makers, scientists, commercial stakeholders, and the local community. In addition, these conflicts often result in opposition or gridlocks, stalling development projects and undermining effective conservation and restoration efforts, costing valuable time and resources (Redpath et al., 2013).

Implementing biodiversity conservation strategies (such as biodiversity offsetting projects) is not a 'one-size fits-all' especially since the benefits and burdens of the solutions are often unequally distributed over society in space and time (Lubell and Morrison, 2021). In complex problems, different stakeholders seldom have the same perspectives, since varying criteria and suitable solutions exist for each stakeholder (Ostrom and Cox, 2010; Reed et al., 2018). Though the exact breakdown of stakeholders depends on the individual situation, a fundamental division that often occurs between stakeholders is between those who make decisions and those who are affected *by* the decisions, such as those at the local community level (Speelman et al., 2014). Hence, decisions and interventions have varying effects (positive and negative) that weigh differently on specific stakeholders. The heterogeneous impacts on different stakeholders can potentially undermine the success and value of conservation interventions (Reed et al., 2018). To overcome this, all actors must acknowledge the complexity of the situation at hand, recognize problems as shared ones, and be willing to accept (some) trade-offs as inevitable and come to a consensus (Redpath et al., 2013; Vande Velde et al., 2019).

Successfully achieving biodiversity conservation targets requires an effective and sustainable management approach capable of dealing with problems related to changing environmental conditions, stakeholder preferences, the delegation of power, regulations enforcement, transparent community involvement, and natural resource management (Gillson et al., 2019; Arumugam et al., 2020; Young et al., 2013). Though conservation decisions are based partially on measurable improvements in selected biodiversity metrics (Bouwma et al., 2016; Vande Velde et al., 2019), many other elements contribute to conservation decision-making and determine the effectiveness of conservation measures in practice. The different motivations underlying nature conservation are ultimately derived from the plural values of nature (e.g., instrumental, intrinsic, and relational values (IPBES, 2021).

There are numerous efforts being made to better support biodiversity conservation decision-making processes, often in the form of decision support tools that serve to facilitate the ability to make decisions (Marakas, 2003). One way in particular to facilitate the process is to focus discussions on the shared values that stakeholders already have (Hugé et al., 2016). This can be achieved by first, gaining a deeper understanding of each stakeholder's position, criteria (wants and needs), interests, perspectives, followed by identifying overlapping values and objectives (consensus areas). As a result of this process, coalitions and collaboration are more likely to advance. Therefore, the decision making process can be facilitated by implementing a tool that enables management to identify the degree of overlap in stakeholder perceptions and expectations (by organizing stakeholder beliefs, values, and knowledge regarding biodiversity conservation) which is key for effective conservation management (Vande Velde et al., 2019; Massarella et al., 2021).

Amid coastal cities, port land use and development are space-intensive and inherently restricted in terms of alternatives (Schipper, 2019). Notably, ports provide economic benefits but not without environmental consequences (Felsenstein et al., 2014). Port development plays an essential role in global trade and connects people in many ways: settlement, work, transport, leisure, and culture (Felsenstein et al., 2014; Puig and Darbra, 2019). Conversely, ports also present biodiversity conservation problems associated with their developments due to environmental pollution, land degradation, and encroachment (Puig and Darbra, 2019). Although trends for global trade are increasing port investments and competition, port development faces many limitations from social, environmental, available-land, and economic pressures that constrain economic advancements (Schipper, 2019). Thus, adaptable conservation management and the ability to overcome conflicts are essential not only for the financial profitability of ports operations but also to ensure ports are interacting with their surroundings in a manner that is both environmentally sustainable and socially acceptable (Merk, 2013).

In efforts to minimize the (potential) adverse impact of port development and operations on biodiversity, some ports are now incorporating some form of biodiversity compensation and protection schemes into port development management (Port of Antwerp, 2019; Rotterdam Port Authority, 2021). As a result of such efforts, terrestrial and marine use conflicts can arise in these fast-changing, often highly bio-diverse coastal areas (Foley et al., 2005). Hence, ports are a prime embodiment of the tension between short term and long-term gains and economic development, and biodiversity conservation. This plurality of functions calls for considering the perspectives and knowledge of multiple stakeholders to address such complex and possibly continuous decision-making predicaments.

Given that value-laden decisions are inherent in land use and biodiversity conservation management decisions, there is an urgent need to acknowledge the diversity of stakeholders' perspectives and values to (1) uncover hidden consensus and disagreements and (2) identify differences and overlap in stakeholder objectives that could facilitate the decision-making process. This study aims to.

- Identify the diversity of stakeholder perspectives and objectives regarding biodiversity conservation management and land use in and around the Ports of Antwerp and Rotterdam
- Organize stakeholders based on shared perspectives and values
- Reflect on how grouping the diversity of perspectives and revealing consensus areas can help achieve conservation goals

2. The study area

The Port of Rotterdam is located on the western coast of the Netherlands (see Fig. 1). It is Europe's largest port, covering over 120 square kilometers (Rotterdam Port Authority, 2021). As the largest port in Europe, improving accessibility remains one of the most important objectives (Rotterdam Port Authority, 2021). Large infrastructure projects include the 177-m-long rail bridge across *Rozenburgsesluis*, the *Maasvlakte Plaza* expansion, and deepening the *Amazonehaven* on *Maasvlakte* from 16.65 to 17.45 m to allow larger ships to travel in and out (Rotterdam Port Authority, 2021).

The Port of Antwerp is located in the north of Belgium (see Fig. 1) and is Europe's second-largest port, covering over 70 square kilometers (Port of Antwerp, 2019; Rotterdam Port Authority, 2021). With increasing economic activities comes the need to increase the capacity of containers and structural solutions to target the mobility problems (Port of Antwerp, 2019). Long term investment plans in infrastructure and land use changes include developing zone *Saeftinghe*, dredging in the River Scheldt, initiation of the Extra Container Capacity Antwerp (ECA) project, rail development that involves placing a rail tunnel to connect the left and right bank, and continued dock renovations and investments (Port of Antwerp, 2019).

Fig. 1. (a) The Port of Rotterdam. Located on the Western Coast of the Netherlands (Rotterdam Port Authority, 2021). (b) The Port of Antwerp. Located in the North of Belgium. (Port of Antwerp, 2019). This map was created using ArcGIS® software by Esri. ArcGIS® and ArcMap™ are the intellectual property of Esri and are used herein under license. Copyright © Esri. All rights reserved. For more information about Esri® software, please visit www.esri.com.

2.1. Relevance to the study

The Ports of Antwerp and Rotterdam both have multidimensional environmental management problems: decision-makers must consider ecological and physical effects, economic costs and benefits, and logistic feasibility while working within a complex set of policies and regulations set by social and political pressures (Hommes et al., 2009). Hence, ecological issues (such as biodiversity degradation) are inherently linked to port development and operations which ultimately present challenges to management.

Currently, the traditional, top-down decision-making approach is still used most frequently to make changes regarding land use and development in these ports (Bouwma et al., 2016; Wiegmans et al., 2022). The port authorities oversee the port developmental decisions in collaboration with governmental agencies, which ultimately constrain the share of public participation in decision-making (van der Lugt et al., 2014). Separate offices oversee the environmental part of port management, where the environmental management department works together with the harbor master(s) to organize and direct all environmental aspects (Naumann et al., 2011; Darbra Roman et al., 2020).

The problem with a top-down decision-making approach is that it lacks transparency and interaction between stakeholders at all levels (Bouwma et al., 2016; Wiegmans et al., 2022). Evidence of the limitations of a top-down management approach can be identified when analyzing the narratives on nature conservation and land use: where both ports have notable histories of long-lasting controversies due to different preferred approaches to nature management (Bouwma et al., 2016). For example, regarding the Port of Antwerp, consider the decades-long dispute that began in the 1970s between the Flemish government's plan to demolish the village of Doel to expand the port. As a result of protests and local opposition, the Flemish government is now working on its ninth alternative for the expansion, costing valuable time, money, resources, and trust (Port of Antwerp, 2019). Regarding the Port of Rotterdam, reflect on the legal conflict that occurred in reference to extending *Maasvlakte*

II. In the 1970s, the project was canceled but then completed due to shifting societal narratives that supported the project and created a new nature reserve (Koppenol, 2014; Bouwma et al., 2016).

3. Q-methodology

The Q-methodology (from here on out, referred to as 'Q') is a flexible semi-quantitative technique used to gain insight into human thoughts and perspectives (Zabala, 2014; Lee, 2017; Zabala et al., 2018). In short, Q is a methodology in which respondents are asked to individually rank/sort statements according to their degree of agreement with these statements. The correlation between the individual Q-sorts subsequently allows the researcher to identify like-minded respondents who cluster together into factors (through factor analysis). A factor is a term used to describe the small set of sorted statements that differ from others and describe the perspectives of the respondents grouped in that factor (Zabala et al., 2018).

We chose the Q-methodology over other decision support tools because it has proven to be successful at enabling researchers to discover veiled viewpoints that revealed topics of consensus, which have facilitated depolarizing complex disagreements in the past (Lee, 2017; Zabala et al., 2018; Hugé et al., 2016). It is instrumental in conservation research to critically reflect on the values that subliminally influence

decisions and actions (Lee, 2017; Zabala et al., 2018). In addition, Q has several beneficial features that provide a quantitative way to investigate subjectivity regarding (port) land use and biodiversity conservation (Sandbrook et al., 2010; Zabala et al., 2018). In addition, its ability to group narratives and participants based on statistical significance is robust and objective which help to eliminate and identify areas of consensus or dissensus that may otherwise not be 'significant.' Lastly, the application of Q will enable us to surpass mere dichotomies (like anti or pro-port expansion), add nuance, and allow us to identify areas of consensus and dissensus among stakeholders and narratives (Benitez-Capistros et al., 2016). Hence, allowing us to identify areas of consensus that can directly feed into decision-making processes to aid in depolarizing conflicts and facilitate the successful implementation of biodiversity conservation management schemes.

3.1. Research design: an outline

This study was conducted sequentially according to these six steps (see Fig. 2); (1) Define the concourse, (2) Develop the Q-sample, (3) Data collection: Q-sorting, (4) Data collection: Post-sorting interviews, (5) Quantitative analysis: Factor analysis identification of distinguishable statements) and (6) Qualitative analysis: Interpretation of data into narratives.

3.1.1. Concourse and Q-sample

First, the concourse (the complete set of possible opinions of a subject from all viewpoints) was collected by extracting statements from conducting a literature review (n = 56). Literature (see Supplementary Table S3) was found using the following keywords: *biodiversity*, *conservation harbors*, *stakeholder perception harbors*, *conservation decision making*, *Rotterdam Port*, *Antwerp Port*, *value pluralism*, *plural valuation of diversity in ports*, *decision-making and land use change ports*, *port land use change*, and *development* (see Supplementary Table S2). After the literature review, the set of statements (n = 120) was compiled and reduced to a final representative selection of statements called the Q-sample (n = 45).

3.1.2. Q-participants

The aim was to collect the most diverse range of opinions possible (Zabala et al., 2018). A total of twenty Q-participants (n = 20) were selected using a combination of key stakeholder identification through literature, a stakeholder analysis, and application of the snowball method (Baltar and Brunet, 2012). Once stakeholders agreed to participate in the study, they were given a personalized user code attached to their resulting Q-sort distribution (n = 20) to keep their identity anonymous.

To ensure a diverse set of views was incorporated into the study, we contacted stakeholders in accordance with the pre-defined scale: international, national, regional, local on-site, local off-site (see Table 3). This scale was finalized using Reed et al. (2009)' s recommendations to differentiate between stakeholders' power and interests. Choosing as many different stakeholder types spread across the various scales provided us with the most diverse range of opinions as possible. Meaning, because stakeholders at different scales have different criteria when it comes to port development, it is likely that their objectives and how they perceive different policies and decisions differ. Hence, we were able to incorporate as many different viewpoints and perspectives in the study (Raum, 2018) (see Table 2).

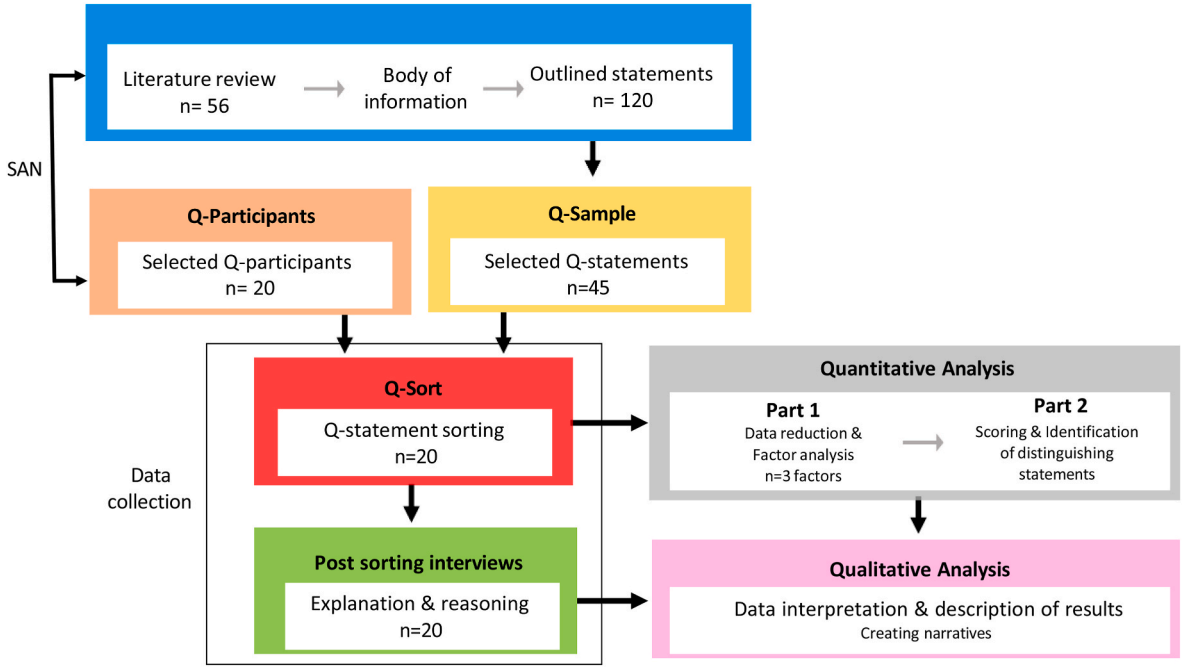

Fig. 2. Visual diagram illustrating the Q-methodology (Zabala et al., 2018). From the top left to bottom right: A stakeholder analysis (SAN) was used to identify key stakeholders (Q-participants) relevant to the ports and further identify the diversity of possible perspectives and establish the body of information (concourse). Using keywords, a total of 56 pieces of literature were reviewed and used to gather and outline 120 possible statements. Next the statements were combined and reduced from 120 to 45 controversial statements (Q-sample). Then, the participants were asked to sort and rank the Q-samples in order of their most disagreeable to most agreeable statements (Q-sorting) (see Fig. 3). After the Q-sorting, the semi-structured post-sorting interviews took place (n = 20). During the interviews, participants were asked to explain their reasoning, ideas, and opinions behind their final statement scheme. The data from the Q-sorting was then used in the quantitative analysis which took place in two parts. In part 1, three factors were retained and the 20 participants were divided into the one of the three factors that best aligned with their perspectives. In part 2, the statements were divided into 1 of the 3 factors according to how best they aligned with the viewpoints of the relevant participants. Finally, the qualitative analysis used insights from the post-sorting interviews to give the factors names and narratives. These narratives were then compared amongst each other to determine the areas and topics of consensus and analyzed further in the discussion.

Table 1
Eight factors were extracted using a principal component analysis (PCA) to reduce the dimensionality of the large set of variables into smaller ones. Note '*' indicates Eigenvalue >1.0 (Kaiser-Guttman Criterion).The five factors that meet the core criteria for retention are indicated in the shaded areas.

Factor number	1	2	3	4	5	6	7	8
Eigenvalue	6.905*	2.257*	1.724*	1.379*	1.129*	0.990	0.864	0.802
% Explained variance	34.526	11.283	8.618	6.897	5.644	4.951	4.321	4.011
Cumulative variance	34.526	45.809	54.427	61.324	66.968	71.919	76.240	80.250
Standard Error	**0.224**	0.224	0.224	0.224	0.224	0.223	0.223	0.223

3.1.3. Data collection: Q-sort post-sorting interviews

Data was collected using the online application Q-method Software (Lutfallah and Buchanan, 2019). The twenty Q-participants followed specific instructions, in which they filled in their demographic information (sex, level, sector, working area, affiliation) and sorted the statements into a forced normal distribution Q-sort (the array of scores for all statements per respondent). According to their own feelings, perceptions, and experiences, each statement was placed in the matrix from

−4 '*most disagreeable*' to 0 '*neutral or unknown*' to 4 '*most agreeable.*' Directly following the sorting was a qualitative semi-structured interview, in which respondents were asked to explain their reasoning, reactions, and thoughts to the statements that they most agreed or disagreed with (see Fig. 3).

4. Results

4.1. Quantitative data analysis

The statistical analysis was conducted sequentially in two parts: (1) Applying a multivariate data reduction technique and factor retention and (2) Scoring and identifying distinguishing statements of consensus. All data analyses were performed with the *method* package in R studio (Zabala, 2014, R Team, 2020) and Q-method Software (Lutfallah and Buchanan, 2019) and PQ method (Schmolck, 2014).

4.1.1. Part 1: application of a multivariate data reduction technique and factor retention

First, the entire data set of Q-sorts (n = 20) was used to configure a 20-20 Pearson Correlation matrix, illustrating the relationship between the participants according to their Q-sorts. Next, significant factors were extracted using a principal component analysis (PCA) to reduce the dimensionality of the large set of variables into smaller ones (see Table 1) to find repeated patterns that reflected a similarity of opinions and perspectives for a given statement (Zabala et al., 2018).

Since it is best to explain the most variance in the study with as few factors as possible, the preliminary rule "6 Q-sorts to 1 factor" was followed (Watts and Stenner, 2005), which considers factors significant if the cross -product of its two highest loading scores are higher than twice the standard error (SE). Thus, factors were retained if they were deemed significant (Brown, 1996; Mullen et al., 2022). The resulting standard error was 0.30 and calculated as follows, where x represents the standard error of the study and n represents the total number of statements in the Q-set:

$$\sigma x = 2 \cdot [1 \div [sqr[n]]] \quad (1)$$

$$\sigma x = 2 \cdot [1 \div [sqr[45]]$$

$$\sigma x = 2 \cdot [1 \div 6.708]$$

$$\sigma x = 2 \cdot 0,\ 15$$

$$\sigma x = 0{,}30$$

Humphrey's Rule (*Eigenvalue* > 1.0) was then applied to the extracted factors by multiplying the two highest loadings (per each factor) by the standard error as previously calculated (see Supplementary Table S1). The factors that did not meet the core criteria for retention to rotation were dropped prior to rotation (Brown, 1996; Mullen et al., 2022).

4.1.2. Part 2: scoring and identifying distinguishing statements of consensus

As a result of the PCA, a total of 8 factors were extracted (see Table 1) with the significant factors shaded in grey. To determine which factors to retain for the factor rotation, the Kaiser-Guttman Criterion was applied and showed that 5 factors had eigenvalues >1. Factors 1, 2, and 3 satisfied the application of Humphrey's Rule and met the core criteria for retention to rotation (see Supplementary Table S1). Although it is possible that the participants could have been arranged into a total of five factors, the application of Humphrey's Rule allowed two factors to be removed as they did not have sufficient explanatory power. Meaning, factors 4 and 5 did not exceed SE of 0.30 and were therefore dropped before factor rotation and not included as narratives.

To maximize the variance of each factor loading, factors were rotated using the Varimax method (Akhtar-Danesh, 2017; Watts and Stenner, 2005). The rotated factors produced a weighted average of each Q-sort, where Q-sort significant factor loading's (*loadings* ≥ 0.30, *all* $p < 0.05$), were considered characteristic or of that viewpoint and the factor with the highest weight for each Q-sort was 'flagged' and used to generate the factor arrays (see Supplementary Table S4).

Lastly, significance was indicated using the z-scores and the Q-sort value (i.e., average rank during sorting). Significance meant the statements were characteristic of the respondents grouped with that factor. These distinguishing factors were then used in combination with insights from the post-sorting interviews to interpret the data.

After factor rotation, all 20 Q-sorts loaded significantly onto one or more factors. However, the Q-sorts were loaded onto just one factor to ensure that each factor contained at least 3 Q-sorts. Meaning, only the factor with the highest weight for each Q-sort was 'flagged' and used to generate the factor arrays. Significance was determined when comparing them. Statements with significantly different z-scores were defined as 'distinguishing' statements for that factor. If there was no significant difference between the factors, then the statement was indicative of a *statement of consensus.*

4.2. Qualitative analysis

Insights and quotes taken from the post-sorting interviews were used in combination with the statements to make final interpretations of each factor into narratives, from here on out referred to only as narratives (N). The three factors were also given titles that summarize the perspectives of the associated stakeholders: Narrative 1: *Ports are key for our economic wealth hence port development should continue*, Narrative 2: *Nature first*, and Narrative 3: *Multi-actor governance*.

4.3. Factor interpretation and description of narratives

Quantitative results from the Q analysis (i.e., z-scores and rankings) were combined with the qualitative data from the post-sorting interviews (i.e., insights and quotes) to make final interpretations of each Q-factor to generate three different narratives (see Table 3).

Table 2
List of Q Statements (S) constituting the Q sort presented to the respondents, QSV (Q-Sort value), and Z (Z-Score value) associated with each factor. The QSV estimated the average representative perspective (ranking) of the statement. Note '*' Statement significance at $p < 0.05$ level.

Statement (s)		Factor					
		1		2		3	
		QSV	Z	QSV	Z	QSV	Z
S1	Harbor development should be aesthetically appealing.	1	0.522	1	0.518	−3	−1.321*
S2	Harbors are important to my country's culture.	1	0.905	0	0.052*	2	0.917
S3	A port's capacity to handle increasing ship trade is important.	3	1.142*	0	0.320	1	0.205
S4	Harbors are vital to my country's economy and therefore must continue to expand.	1	0.559	−2	−0.964*	0	0.101
S5	Marine transport activities inevitably cause the destruction of *some* shoreline habitats	1	0.525	0	−0.213*	2	0.676
S6	Marine transport activities inevitably lead to water pollution.	0	−0.248	1	0.595	1	0.242
S7	Disturbances to biodiversity are acceptable if the species is not indicated as endangered on the national "Red List."	0	−0.086*	−2	−1.189	−1	−0.682
S8	Nature offsetting (restoring or creating nature in alternative locations) makes habitat destruction for harbor development acceptable.	3	1.547	−1	−0.689*	3	1.360
S9	All environmental damage caused by port development should be offset by creating new nature.	3	1.404	1	0.611*	3	1.836
S10	Offsetting projects as a mitigation method (to harbor development)are not acceptable because they allow pre-existing nature to be destroyed.	−3	−1.253	0	−0.011*	−2	−0.918
S11	The government should subsidize nature-offsetting projects.	1	0.648*	−2	−1.072*	0	−0.133*
S12	I am in favor of giving back part of the port to nature (restoration).	−1	−0.386*	4	1.701*	1	0.612*
S13	Harbor development is climate-friendly, as it leads to more maritime transport, which emits less carbon than air or road transport.	−1	−0.504	−1	−0.740	2	0.778*
S14	The economic benefits of ports outweigh the negative effects on surrounding waters.	−1	−0.486	−3	−1.291*	−1	−0.238
S15	The port's contribution to economic growth makes it acceptable to sacrifice -some- biodiversity.	0	0.147*	−4	−1.734	−4	−1.601
S16	Harbor expansion should happen without restrictions in order to get the most profits possible.	−4	−2.2018	−4	−2.072	−2	−1.024*
S17	All local residents benefit from harbor activities.	0	−0.143	−1	−0.543	−3	−1.187*
S18	I am anti-port expansion, even if it lowers economic growth.	−3	−1.356	−1	−0.256*	−3	−1.420
S19	I am conscious of my personal environmental footprint (i.e., consumption habits)	4	1.856	3	1.621	0	−0.105*
S20	Better environmental conditions give more profit in the long term (i.e., less water pollution yields more fish).	4	1.935	3	1.674	2	0.886*
S21	Because better environmental conditions are profitable, more regulations should be placed to limit negative effects.	0	−0.228	1	0.417*	−1	−0.371
S22	Biodiversity should be valued independently from the benefits it provides humans (i.e., food, clean water, climate, recreation, etc.).	1	0.509	2	0.685	3	0.987
S23	Putting a price on nature ultimately reduces my feelings of responsibility to protect biodiversity.	−2	−1.007	−2	−1.128	0	−0.202*
S24	Unless one is sure there will be NO negative effects on a site's biodiversity, development should NOT be approved (precautionary principle).	−2	−0.994*	2	0.635*	3	1.737*
S25	It is unacceptable that native biodiversity is declining due to harbor expansion.	3	1.142*	4	1.883*	−1	−0.472*
S26	Stricter laws are needed to protect wildlife surrounding the harbor.	−3	−1.155*	1	0.527	0	−0.035
S27	Stricter implementation of EU nature protection measures (i.e., based on the EU Bird and/or Habitat Directive) is needed.	−1	−0.546*	2	1.132*	4	2.619*
S28	All expansion activities in the harbor should stop immediately.	−4	−2.011*	−1	−0.380	−1	−0.678
S29	Habitat destruction via port expansion is acceptable as long as the site is not listed on the existing Natura 2000 sites.	−2	−0.816	−2	−1.218	−2	−0.989
S30	It is acceptable to develop onto land that is not listed as an "environmentally sensitive area."	2	1.117	2	0.650	2	0.790
S31	It is acceptable that harbor expansion results in irreversible habitat destruction.	0	−0.245	−3	−1.253*	0	−0.037
S32	Policymakers only agree to protect the environment to avoid legal consequences.	−1	−0.550*	2	0.820*	−3	−1.125*
S33	Policymakers only agree to protect the environment to avoid social consequences.	−1	−0.506	−1	−0.573	−1	−0.607
S34	The "polluter pays" principle should be extended from the original polluters (harbors) to the intermediate users (industries).	2	1.320*	1	0.569*	4	2.173*
S35	The "polluter pays" principle should be extended from the original polluters (harbors) to the final uses (consumers).	0	0.298	0	0.205	1	0.329
S36	Commercial actors (those who do business with the port, i.e., shippers) always consider the alternatives to physical expansion (i.e., relocation to other regions in the country).	2	0.942*	−3	−1.403*	0	−0.099*
S37	Private companies are responsible for ALL local environmental damages related to port expansion (as they are the ones that require more space).	−1	−0.697	−1	−0.368	−4	−1.563*
S38	Port authorities do not have enough knowledge of the impact land use change has on biodiversity to make informed decisions.	−2	−0.699	1	0.486*	−2	−1.060
S39	Port authorities do not consider the consequences of land use change on biodiversity when making decisions.	−2	−1.029	0	0.116*	−2	−1.091
S40	Port authorities take responsibility for all mistakes.	1	0.313	−3	−1.321*	1	0.207
S41	Port authorities only conduct Environmental Impact Assessments (EIA) as a formality (part of the protocol).	0	−0.217	0	0.094	0	−0.007
S42	Resident's participation in the port's decision to develop and expand is a right.	2	1.108	3	1.484	−1	−0.423*
S43	The guidelines set for conducting Environmental Impact Assessments (EIA) are needed to be effective.	2	0.906	3	1.384	0	−0.104*
S44	Environmental Impact Assessments allow authorities to achieve the social support they need for project approval without actually doing anything.	−3	−1.202*	0	0.040	1	0.441
S45	Environmental assessment tools are seen as a nuisance in port planning projects.	0	−0.189	0	0.205	1	0.646

4.3.1. Narrative 1: Ports are key for our economic wealth hence port development should continue

Adherents of Narrative 1 (N1) focus on the continuation of port development to meet the demand for increasing ship trade and to support the local and national economy (S3, S18, S28): "*Terminals are fully booked. We really need an expansion of the harbor otherwise it's a problem for the future*" (P6). For this reason, they do not support giving back part of the port to restore nature and habitat (S12). As most of the land within the port is not environmentally suitable to support large amounts of biodiversity, regardless: *"When we [Rotterdam Port] have an area marked for port development during planning, which most of the time it is not qualified for a high level of a nature habitat"* (P1).

Supporters of Narrative 1 acknowledge that port development inevitably causes the destruction and modification of the shorelines (S5): *"There will always be a negative effect on the surrounding waters. But these impacts are way less than alternatives such as air transport"* (P10).

Table 3
Summary of the three narratives by distinguishing statements and stakeholder characteristics. (Int. = international).

Narrative	Key statement	Stakeholder characteristics			
		Participant #	Scale	Sector	Agency/Institution
1. Ports are key for our economic wealth hence port development should continue	3, 7, 11,12, 15, 24, 25, 26, 27, 28, 32, 34, 36, 44	P1	Local on-site	Port Authority	Rotterdam Port Authority
		P2	Regional	Government	Flemish Land Agency
		P3	Local Off-site	Resident	The European Chemical Industry Council (CEFIC)
		P4	Local on-site	Government	Municipality Beveren
		P5	National	Policy maker	Rotterdam Port Authority
		P6	Local on-site	Private	Voka National
		P7	Regional	Government	European Grouping for Territorial Cooperation (EGTC)
		P8	Int.	NGO	International Association of Ports and Harbors (IPAH)
		P9	Local on-site	Government	Scheldt Left Bank Agency (MLSO)
		P10	Regional	Government	Departments of Mobility and Public Works (DMOW)
2. Nature first	2, 4, 5, 8, 9, 10, 11, 12, 14, 18, 21, 24, 25, 27, 31, 32, 34, 36, 38, 39, 40	P11	Local on-site	Government	Antwerp City Council
		P12	Regional	Government	Flemish Land Agency
		P13	National	NGO	World Wildlife Fund (WWF)
		P14	National	NGO	Natuurpunt
		P15	Local Off-site	Scientist	University Antwerp
		P16	Local Off-site	Scientist	Institute Nature- forest research (INBO)
3. Multi-actor governance	1, 11, 12, 13, 16, 17, 19, 20, 23, 24, 25, 27, 32, 34, 36, 37, 42	P17	Local on-site	Private	Environmental Consultancy
		P18	Local on-site	Port Authority	Antwerp Port Authority
		P19	Local on-site	Government	Antwerp City Council
		P20	National	Farmers Union	Boerenbond in Flanders

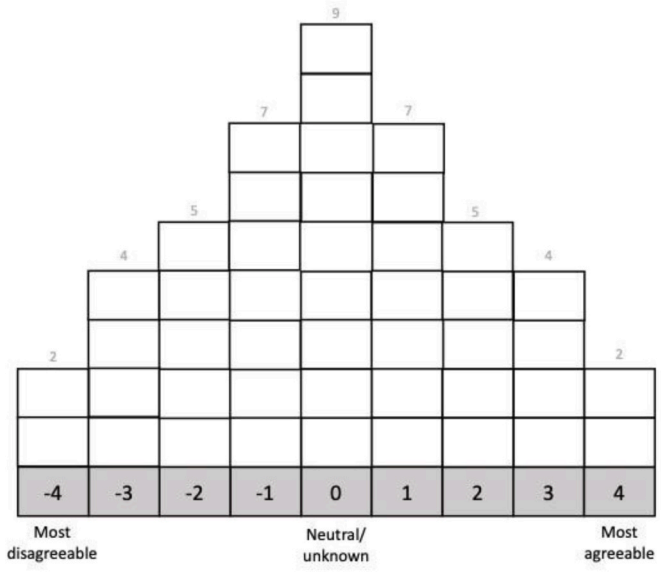

Fig. 3. The pyramidal quasi-normal distribution used to sort and rank the Q-sample (45 statements) in order from *most agreeable* (4) to *neutral/unknown* (0) to *most disagreeable* (−4). The numbers above each column indicate the total number of statements that participants needed to place onto each rank (Zabala et al., 2018).

Hence why it is acceptable if development is approved even if there are confirmed adverse effects as a result (S24). They also believe that all environmental damage should be offset by creating new nature (S9, S10): *"When you disturb biodiversity, you have to compensate for it … and it gets very expensive"* (P1). Hence why, habitat destruction for harbor development is acceptable (S8). In some cases, they also agree the government should subsidize offsetting projects to aid in restoring nature (S11).

Adherents of Narrative 1 also believe that there is already a surplus of laws and regulations for environmental protection (S27): *"There are so many laws, which are already some of the strictest in EU legislation"* (P6). Since there is already a strict implementation of EU nature protection measures, they do not support stricter enforcement: *"I am not sure if it would make much more of a difference if they [EU laws] are implemented stricter. Authorities know what must be done and the reasoning behind it. So, if you have a stricter framework, I don't think it will make a difference. It could even be counterproductive"* (P2).

It was also noted that there is a need for systemic change, in which education and awareness are used as tools to address conservation and land use conflicts: *"We need a fundamental change in the way they develop the areas. Creating more awareness among businesses to produce more resilient nature and biodiversity could potentially create optimal conditions for us [residents]"* (P3).

Contrary to adherents of Narrative 2, those whose Q-sorts aligned best with Narrative 1 perceive port authorities to have all the required knowledge to make informed decisions (S38). It's also thought that port authorities want to minimize the amount of adverse effects on the environment because it is the right thing to do, regardless of the pressure of legal consequences and social support (S32, S44): *"I believe not everything done in accordance with policy is a tactical way of avoiding legal consequences. Of course there is a social aspect, but they also do things for the sake of nature's well-being"* (P8).

4.3.2. Narrative 2: Nature first

Adherents of Narrative 2 (N2) focus on environmental aspects surrounding the port and favor giving back part of the port to restore nature and give back habitats for biodiversity (S12, S14): *"I think in general we [people in general] have been damaging so much nature, restoration is one of the most important activities we can do"* (P15).

Contrary to N1, those whose Q-sorts are best aligned with N2 believe that it is unacceptable that native biodiversity is declining due to harbor development, even when considering the port's contribution to

economic development (S25): *"When making decisions regarding biodiversity, it is wrong to think about economic expansion. Harbor activities are important, but they should be contained within the planetary boundaries"* (P11). It is with the same reasoning that Narrative 2 supporters believe biodiversity should be valued independently from the benefits it provides humans (i.e., clean is hard to put in Euros" (P14). However, they acknowledge that sometimes it [economic valuation of nature] is necessary to get policymakers to care: water, food, climate regulation, recreation activities) (S22): *"I think that putting a price on nature is risky business. Nature has an intrinsic value, which "When you put an ecosystem service on it [biodiversity], the value becomes more tangible. When everything has a price, then you can compare harbor expansion with the loss of nature and air pollution if you have a method of standardization"* (P11).

Adherents of N2 also think development should not be approved unless it is certain biodiversity will remain unaffected (S24). In all cases, it is unacceptable that harbor expansion results in irreversible habitat destruction (S31). In addition to the guidelines set for conducting EIAs (Environmental Impact Assessment) (S43), it is believed that stricter laws protecting harbor wildlife and stricter implementation of the EU nature protection measures are needed to limit adverse effects (S27): *"It is our responsibility to protect future generations. Which is why I am glad we have strong legislation to leverage for the environment. Otherwise, it's overruled by economic greed"* (P13).

Contrary to both Narratives 2 and 3, supporters of N2 think policymakers agree to protect the environment to avoid legal consequences. Meaning that without the pressure of fines and sanctions, decisions made for the sake of protecting nature and biodiversity would not be prioritized (S32): "*Today, their beliefs [those with the positions of power] are not in favor of the environment. Economic growth is the most important factor to them*" (P11). They also believe port authorities do not have all the knowledge of the impact land use change has on biodiversity required to make informed decisions (S38): "*I think there is a problem in the education system in general. They [port authorities] know the basics but not the details. It is not that people don't care, it's just that they don't know*" (P13). Even in the case they do have the knowledge of the ramifications of land use change occurring on-site, "*they don't think about consequences up to* 100 km *in the area. you need specialists to work this out*" (P16).

4.3.3. Narrative 3: multi-actor governance

Adherents of Narrative 3 (N3) focus on enforcement, regulations, and cooperation to safeguard biodiversity and habitats surrounding the harbor. For instance, they believe a stricter implementation of the EU nature protection measures is greatly needed (S27): "*Legislation and enforcement are two different things. Enforcement here [in Flanders] is a sham. If there was stricter enforcement of the law through the governmental agencies, then project developers would be much more careful to find a solution and integrate alternatives found in the EIAs*" (P18). However, supporters of N3 mostly disagree that more laws protecting nature are needed (S26): "They already have a surplus of legislation protecting nature. It creates a big imbalance. Natura 2000 is *"holy"*, but the rest of the issues are forgotten about (P20). Regarding the local community, those whose Q sorts aligned with N3 strongly disagree that all local residents benefit from port development (S17). Although the harbor contributes to economic growth and jobs, there are many downfalls, such as taking over agricultural land: "farmers lose double time with the nature compensation and port development" (P18). A recurrent topic was the Port Authorities use money to solve one farmer's problem, but that just passes the problem into someone else's hands: *"Land that's taken from farmers in the port area needs to be compensated for land somewhere else. But there's no more land to be given. So, someone is always losing!"* (P20). Hence why cooperation and transparency throughout the development and decision-making is one of the most important aspects. Supporters of multi-actor governance (N3) are also in favor of extending the polluter pays principle from the original polluters (harbors) to the intermediate users (industries) and in some cases, extending down to the final consumers (S34, S35): *"Pollution is an environmental cost of society. So, the cost of polluting should be included in the cost of transporting and buying the product"* (P19). Narrative 3 supporters also agree EIAs are seen as a nuisance in port planning projects-costing developers valuable time, money, and resources (S45). Hence why they believe EIAs are only conducted to allow authorities to achieve social support without considering the alternatives suggested (S44): *"They [Port authorities] are still complaining of the regulations and try to go behind the rules one way or another"* (P19). Contrary to adherents of Narrative 1 and 2, supporters of Narrative 3 do not feel that their responsibility to protect biodiversity is affected by putting a price on nature (S23). This is because *"there needs to be a way to get policymakers and those making decisions to care and prioritize environmental well-being. Therefore, we tie it to an economic/monetary value"* (P20).

4.4. Consensus and dissensus statements

The analysis of the results also indicated that there are seven statements of consensus and four statements of dissensus across all three narratives (see Table 4).

Three statements of consensus (S22, S29, S30) generated the strongest consensus to the high-end of the rankings (average $>\pm 2$). Topics of consensus include policy, land use, and mitigation tactics. Participants agreed that biodiversity should be valued independently from the benefits it provides humans (S22). They also acknowledged that there needs to be a way to leverage it against other discussion topics in decision-making. Supporters of all three narratives also all agreed that it is acceptable to develop onto land that is not listed as an "environmentally sensitive area" (S30). The reasoning is that most of the time, development occurs on land that is not otherwise suitable to support vast amounts of biodiversity. On the other hand, it was unanimously agreed across all narratives that it is *not* acceptable to destroy habitats via port expansion, even if the site is not listed on the existing Natura 2000 sites (S29). Respondents acknowledged that port expansion inevitably will destroy some habitats, and therefore there must be actions taken to mitigate and offset these impacts. But destruction, in all cases, is not acceptable. The five remaining statements (S6, S33, S35, S41) were considered not relevant as they generated average rankings close to 0, indicating reactions to statements were either neutral or unknown (average $<\pm 2$).

Four statements (S11, S27, S32, S35) generated the strongest dissensus across all three narratives, meaning these statements were the most controversial among the participants. Topics of controversy include offsetting policy, economic factors of biodiversity conservation, principles of land use, and stakeholder responsibility for port development. There were different views about the government subsidizing nature offsetting projects (S11). Adherents of Narratives 1 and 3 agreed that because the port's contribution to economic development helps on a national level, government support in offsetting projects would benefit on a national scale. On the contrary, supporters of Narrative 2 disagreed stating that polluters should be solely responsible for the financial burden of offsetting projects. Statement 27, "stricter implementation of EU nature protection measures is needed", was one of the most controversial. Those grouped in Narratives 2 and 3 agreed that although there are a lot of regulations in place, implementation of laws and consequences of not abiding by these rules is greatly lacking. Stakeholders in Narrative 1 disagreed because they said the rules are too rigid and can sometimes be counterproductive, which is why flexibility is more beneficial both to nature and the port. In addition, supporters of Narratives 1 and 3 disagreed that policymakers only agree to protect the environment to avoid legal consequences (S32) because they believe there is also a factor of protecting nature for the sake of nature at play. Whereas adherents of Narrative 2 agreed because they believe that without legal consequences, policymakers would not consider environmental aspects above financial gain. Lastly, supporters of Narrative 1 agreed that Commercial actors (those who do business with the port, i.e., shippers) always consider the alternatives to physical expansion (S36)

Table 4
Summary of the most consensual and controversial statements when compared across all three narratives (significance level, $p < 0.05$) and the corresponding category and sub-category of the statement (see Supplementary Table S2). Statements were ranked from −4 (most disagreeable) to 0 (neutral/unknown), up to 4 (most agreeable).Note '*' indicates the average >±2.

Category	Sub- category	Forming statement	Agreed ranking	Disagreed ranking	Consensus (CN)/Dissensus (DS)
Environmental pressures	Pollution	S6	0, 1		CN
Offsetting	Policy	S11		−2, 0,1	DS
Biodiversity conservation	Value pluralism	S22	1, 2, 3*		CN
	Economic	S27		−1, 2, 4	DS
Land use	Environmental	S29	−2*		CN
Policy		S30	2*		CN
Principles	Land use	S32		−3, −1, 2	DS
		S33	−1		CN
Mitigation tactics	Stakeholder responsibility	S35	0,1		CN
Port development	Stakeholder responsibility	S36		−3, 0, 2	DS
Management	System tools	S41	0		CN
System tools		S45			CN

because those working in this sector said alternatives are always considered because expansion is expensive. However, adherents of factor 2 disagreed and claimed that shortcuts are taken when considering alternatives, and the most lucrative option almost always wins (i.e., expansion).

5. Discussion

Making effective and well-informed decisions for biodiversity conservation is complex. This complexity stems from the fact that stakeholders tend to have different visions of reconciling economic development and biodiversity conservation. One way to reduce this complexity is to recognize and make visible the diversity of values people assign to nature. Our research is based on the notion that revealing areas of consensus among different narratives and identifying the underlying reasoning behind preferred pathways of biodiversity conservation is a good starting point to generate more effective debates on biodiversity conservation. Out of these different views and perspectives (dissensus), new acceptable strategies (consensus) can emerge. By applying Q-methodology, we identify areas of (unexpected) consensus among diverse stakeholders, which can facilitate decision-making.

Upon analyzing the results, it is apparent that the three IPBES (2021) value categories (*Intrinsic values*, *Instrumental values*, *Relational values*) are partly reflected in the narratives identified in our case study and describe the relationship between stakeholders and nature. Further, as indicated by our results, each narrative does prioritize a different value category, reflecting their viewpoint about the balance between biodiversity and nature protection and port development. Linking each narrative with a particular IPBES value category is useful because the IPBES (2021) assessment report provides guidelines for designing and implementing valuation methods and processes into nature decision-making and policy.

Adherents of Narrative 1 prioritize nature's 'instrumental values' as most environmental decisions are based on an economic valuation that considers costs and their direct benefits to humans. This monetary valuation at the forefront of policy leaves supporters of N2 to question if the importance of environmental protection would remain without legal and social consequences. Adherents of Narrative 2 prioritize nature for its 'intrinsic values'.

There is a dominant focus on species conservation and protected area management to ensure natural habitats stay intact and capable of supporting biodiversity. Notably, supporters of N2 are in favor of giving back part of the ports' areas for nature restoration and disagree that ports should continue to expand due to their contributions to national economic development. Adherents of Narrative 3 prioritize the 'relational values' of nature as a multi-layered approach where the function, adaptability, and resilience nature provides humans are highly valued (IPBES, 2021). Decision-makers recognize that the ports are a shared human-nature environment in this category.

The results also revealed that the human-centered perspective on biodiversity is dominant, meaning that most respondents prefer to make decisions based on economic valuations of nature rather than intrinsic ones. Notably, no narrative questions the importance of regulating port development and land use changes with legislation protecting nature and guidelines set for conducting environmental impact assessments. Instead, the debate focused on the rigidity and focus of legislation and whether off setting port expansion should occur locally or internationally. Some stakeholders believe there are already too many regulations protecting nature and the environment. So many that the focus on protecting other key issues such as air quality and the local community's health (those living near the roads where the import and export goods are transported) are forgotten. Some respondents also acknowledge that actual enforcement of the legislation is the most significant problem. So, before adding new laws, existing ones need to be fully enforced if we want to safeguard natural habitats and biodiversity. Though all stakeholders believe offsetting is a non-negotiable, the disagreement about where the offsetting and restoration should occur is debated. This is likely due to the stakeholders prioritizing different ecosystem services and the intensity at which port activities affect these Zelenski et al. (2015). For instance, if a local community member values cleaner air for recreation purposes, they prefer offsetting to happen locally. Whereas private and commercial companies value economic gain over cleaner air. Hence, there is no problem if offsetting occurs internationally, so long as their carbon footprint is compensated. Nonetheless, all narratives agree that better environmental conditions yield more reward (e.g., climate regulation, monetary and recreation) so minimizing adverse effects while conducting harbor activities is important.

5.1. Limitations of the Q-methodology

While the use of Q-methodology has enabled us to reveal three areas of consensus among a wide range of stakeholders, each with different perspectives and objectives, the method in itself is a constraint in the sense that the distribution of statements into the pyramidal distribution is fixed (Brown, 1996; Zabala, 2014; Zabala et al., 2018). Meaning, that if stakeholders were given more freedom to rank statements outside of the distribution, they likely would have had different results. Also, the statistical interpretation of the results is quite constrained to the Q-sort, rather than giving us space to interpret or critique the issues themselves (such as the usefulness of environmental offsetting or the added value of working towards achieving both economic and environmental goals concurrently). These critiques were only partially incorporated into the study during the stakeholder interviews and factor interpretation. Due to this, there could be a large aspect of the bigger picture missing from the discussion, which is why we suggest supporting this study with further work in the conclusion.

In addition, the Q-methodology involves personal interviews and asks participants for their subjective views on potentially sensitive

issues, which brings with it some disadvantages (Brown, 1996; Zabala, 2014; Zabala et al., 2018): (1) The Q-methodology is an intellectually challenging and lengthy process that requires respondents to be knowledgeable of the topic and requires a great deal of patience and time from the participants and interviewer (Kampen and Tamás, 2014; Zabala, 2014; Zabala et al., 2018). (2) There are potential sources of bias, such as the willingness of participants to agree to participate in the study (i.e., if they know the results will be used to support something that they are in favor of (Webler et al., 2009),) or the individuals interpretation of the statements themselves. Differences in backgrounds, political ideology, and educations are some biases to consider that influence the way Q-set statements are sorted and ranked during the survey Further, there are potential biases that should be considered during the interview process such as differences between the participants and the interviewer in age, gender, culture, and language, all of which influence the way interview questions are answered and interpreted (Webler et al., 2009).

6. Conclusion

This study confirms that diverse perspectives and values range across many individuals (linked to many sectors) in the Ports of Antwerp and Rotterdam. The existence of polarized views on land use and biodiversity conservation in the ports of Antwerp and Rotterdam is just one example of how complex environmental decision-making can be. The combination of a century-old top-down management system in the ports and the urgent need to combat the global decline in biodiversity provided us with an interesting case. While further research is needed on the long-term impact of such decision-making tools on achieving biodiversity conservation targets, this study provides new insights that can be used to advance future biodiversity conservation management strategies. Which, when given adequate resources, can be successful in finding common ground (consensus areas) in situations where many stakeholders must work together to protect the integrity of the shared human-nature environment.

Although conservation decision-making must be supported by objective, normative, and quantitative foundations (Babcicky, 2013), the effectiveness of such decisions to be rigidly followed at the local level is a more subjective matter (Zelenski et al., 2015). Hence, the use of decision-support tools can help to organize and simplify complex information to help environmental managers during the decision-making process (Grêt-Regamey et al., 2017). The Q-methodology is an effective management tool because it provides a systematic structure aimed at gaining a better understanding of people's perceptions about an issue, by combining statistical analysis and qualitative interpretation (Zabala, 2014; Brown, 1996).

It is also important to acknowledge that these results are merely representative of the current situation in Antwerp and Rotterdam: every port has a different set of stakeholders, environmental circumstances, guiding principles, and legislation that influence the way in which interviewees complete the Q-sort and respond during the interview. Therefore, we suggest further research to expand this research and repeat this study annually to map how narratives and stakeholders change over time. Furthermore, to add an element of transparency and community engagement in the decision-making process, future research can expand on this study to determine which of the three narratives is most representative of the population by distributing surveys to the community to identify which of the three narratives they best align with. This study can also be enhanced by coupling it with an in-depth review on the usefulness of environmental offsetting or the added value of working towards achieving both economic and environmental goals concurrently.

Credit author statement

Ashlynn Marie-Ann Broussard preformed writing-original draft, conceptualizations and formal analysis. Farid Dahdouh-Guebas preformed writing-review and editing. Jean Hugé preformed supervision, writing-reviewing and editing and conceptualizations.

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Data availability

The data that has been used is confidential.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvman.2023.117937.

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