SOCIAL PERCEPTIONS OF THE PRESENT AND FUTURE OF POND LANDSCAPES FROM INHABITANTS AND STAKEHOLDERS: RESULTS AND PERSPECTIVES IN EUROPE, TÜRKIYE AND URUGUAY

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ABSTRACT

Despite the crucial importance of pond landscapes for biodiversity conservation, they are less studied, especially in terms of their impacts on people and society. This paper presents the results of a survey carried out on the perceptions of inhabitants and stakeholders across 17 pond landscapes in six countries in Europe, as well as Türkiye and Uruguay. We collected 117 and 590 answers from stakeholders and local inhabitants, respectively, through questionnaires, including questions about their perceptions and preferences. Our results show that pondscapes are widely valued for their benefit to the quality of life and biodiversity. Three Nature's Contributions to People are considered important by both groups: 'creation and maintenance of habitats', 'physical and psychological experiences' and 'maintenance of options' (i.e. potential opportunities offered by nature to ensure resilience). Similar perceived threats related to 'climate change' and 'pollution' have been identified by stakeholders and inhabitants in all countries and have a direct impact on the maintenance of the most important contributions. The perceptions of potential solutions to identify threats are quite similar for most pondscapes, with conservation and maintenance actions being the most important for enhancing ecosystems and societal resilience to climate change and other societal challenges.

Keywords: nature-based solutions; nature's contributions to people; pond conservation and management; pondscape

Introduction

Ponds represent an estimated 304 million standing waterbodies of less than 10 hectares worldwide (Céréghnio et al. 2014). The number of ponds has fallen dramatically in many places. In Europe, the reasons (Hill et al. 2018) are related to land use change (Curado et al. 2011; Smith et al. 2022), urbanization (Brans et al. 2018) and climate change (Fahy et al. 2024). Additional anthropogenic pressures that affect biodiversity and ecosystem functioning (Stamenković et al. 2019) include pollution and the appearance of exotic and invasive species (Smith and Buckley 2020; Macedo et al. 2024). Ponds are environments that can make a significant contribution to aquatic biodiversity, for example, by harbouring 70% of the pool of freshwater species in European landscapes (Davies et al. 2008). They also make other contributions, such as the provision of water for livestock, pollination,

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carbon sequestration, fish production and recreational facilities (Oertli et al. 2023). Depending on the context, ponds can also contribute to cultural heritage (Delpero and Volpato 2022), flood regulation and tourist attractiveness (Turkelboom et al. 2021; Pereira-Lindoso et al. 2025). All the life that these ponds support makes a general contribution to human well-being (Jiang et al. 2023; Vasco et al. 2024). Over the last decade, pond landscapes, also known as pondscapes (Boothby 1997; Borthagaray et al. 2023), have gained traction in the field of pond science and management due to interest in thinking about them as networks and better integrating them with land uses. In a way, this concept overlaps with the other notion of waterscape (Karpouzoglou and Vij 2017), which invites us to think about the interplay of social and biophysical components of the landscapes.

In light of this perspective, better management of ponds at the pondscape level is increasingly promoted to achieve integrated management actions at the crossroads of water management, biodiversity conservation, and land planning (Hill et al. 2021; Cuenca-Cambronero et al. 2023). As mentioned by de Necker et al. (2024), it is essential to understand the opinions and knowledge of individuals on pondscapes when making any decisions regarding the conditions of these water bodies. In the face of growing societal demand for information and involvement, the identification of pond values provides the basis to prioritize the most important social and environmental issues for local actors (López-Rodríguez et al. 2015), improve their condition, fine-tune their management, and better integrate their management plans with regulatory and planning frameworks in many countries (Ryfisch et al. 2024).

Although largely focusing on Europe, ponds are spaces that have been studied in recent years by social science, whether concerning fishpond management (Popp et al. 2019; Lasner and Antje 2024; Zdeněk et al. 2025), their uses in relation to socio-economic interests (Blicharska et al. 2017; Vo et al. 2023; Bartrons et al. 2024), implementation of public policy (Ryfisch et al. 2023) and maximizing their ecosystem services (Jiang et al. 2023; Rey-Valette et al. 2024). Several studies show that pondscapes are highly valued by people, bringing psychological benefits (Zhang 2021), as well as cultural services (Oertli and Parris 2019). However, it is possible to collect some contrasting perceptions of pondscapes as spaces intended either exclusively for human use with anthropogenic pressures (Bouahim et al. 2014) or for uses oriented towards biodiversity conservation (Zamora-Marin et al. 2021). The social perception approach has also been mobilized recently to understand the contribution of ponds to well-being (Rey-Valette et al. 2022; Vanhöfen et al. 2025), the relationship of inhabitants with biodiversity (Vasco et al. 2024), their role in supporting local identities and water quality in urban environments (Mitroi et al. 2022). The social perception approach examines how individuals process information using their senses, experiences, and cognitive activity to make sense of what they understand and observe (Zebrowitz 1990). Perceptions are themselves influenced by knowledge of the environment and depend on social, economic and cultural context (Cauberghe et al. 2021). The analysis of perception can help take social and geographic perspectives into account (Castro et al. 2014; Quintas-Soriano et al. 2018) by proposing strategic ecological intervention measures. For example, meeting the specific needs of local actors can contribute to cultural heritage, pond restoration or biodiversity conservation, educational intervention, or preventing area degradation.

Cuenca-Cambronero et al. (2023) and Hill et al. (2021) identified research priorities for ponds and pondscapes that the social perceptions approach can strongly contribute to cover, such as climate change, water quality deterioration, biodiversity decline, and the delivery of environmental benefits. In this vein, we used two concepts, Nature-based Solutions (NbS) and Nature's Contributions to People (NCP), in order to assess perceptions of these challenges by linking them to the biophysical properties and functions of the pondscapes. The NCP concept (Díaz et al. 2018) represents nature's key positive and negative contributions to people and considers the socio-cultural dimension by identifying all links between society and nature. To interpret what nature is and understand its benefits for human societies, the NCP perspective emphasizes culture as one of the main factors in identifying bonds between society and nature (Pedersen et al. 2019). Specifying the relationship with nature is crucial to understanding the context-specific viewpoints and different knowledge systems (Pascual et al. 2017). The same NCP may be perceived as beneficial or detrimental depending on the cultural, socioeconomic, temporal, or spatial context. Within the NCP framework, nature contributes to the quality of life through material (e.g. food and feed), nonmaterial (e.g. recreational activities), and regulating processes (i.e. regulation of hazards), which are affected by natural or anthropogenic drivers. The concept of NbS (Nesshover et al. 2017) refers to measures based on or inspired by nature that are implemented to modify the functioning of environments and deliver specific outcomes to people while providing benefits to biodiversity and ecosystems. The NbS concept includes various forms, from creating, protecting, or restoring natural ecosystems to management measures. Therefore, NbS and restoration are not identical (Waylen et al. 2024). NbS is grounded on two logical follow-up ideas: (1) natural and artificial ecosystems must be managed to secure the production of a diverse range of services that impact the quality of life (Mell and Clement 2019); (2) this implies understanding and producing knowledge on socio-ecological processes and determining the most appropriate way of addressing environmental challenges.

In this study, using a survey, we explored social perceptions of different pondscapes in Europe, Türkiye and Uruguay to identify common patterns despite local varia-

tions and different respondents. The paper highlights the importance of studying several types of study sites in areas with different histories and uses to gather as many different perceptions as possible. It is thus important to fill a knowledge gap concerning the variability of perceptions according to the contexts of the study sites and the types of respondents. The study areas have never been studied from the perceptions point of view. Analysis of responses can provide important insights on eliciting motivation for pond management measures and the design of public policies.

This paper takes a global and comparative view by examining the responses of stakeholders and inhabitants. By stakeholder, we mean anyone who keeps abreast of pondscape news and is professionally, politically or associatively involved in its management. This framing allows us to draw up an exhaustive inventory of the existing expectations of inhabitants and stakeholders regarding current and potential future contributions. In doing so, we provide a step toward valuing the role of pondscapes for the quality of life, estimate the importance of certain challenges, assess the perceptions of different NCPs, and determine which NbS measures should be prioritized. It is likely that a large part of the perceptions could be in favor of the conservation of pondscapes. In light of the results, we discuss this hypothesis using the literature in order to identify ways of making a positive contribution to the management of these pondscapes.

Materials and Methods

Questionnaire content and dissemination

We distributed questionnaires in six European countries (Belgium, England, Denmark, Germany, Spain/Catalonia, Switzerland), Türkiye and Uruguay between 2021 and 2023. Questionnaires were developed with the specific purpose of assessing the inhabitants' and stakeholders' perception of pondscape offered by each different case study. Two different questionnaires were used for stakeholders and inhabitants. While both questionnaires largely contain the same questions for all pondscapes, they also include different questions relating to the profile of the inhabitants and stakeholders regarding their activities and their role in pondscape management. These specific questions were tailored to each type of respondent to better understand the relevance of their answers in relation to their profiles, were informative and had no connection to their social perceptions of pondscapes. In this article, through a comparative study, we present the results of the common questions asked of the two types of actors surveyed. Data from stakeholders and inhabitants have been analyzed to determine convergences and divergences between them. The questionnaires included several common questions covering topics such as: profile of the respondents, relation to nature and pondscape, the self-reported rating on the role of pondscapes on quality of life, visual perception of changes over time, perception about the environmental condition of the pondscape, perception of NCPs, perception of the most important threats and impact of threats to the pondscape in future and perception on the selected measures of NbS. Perceptions of the contribution of pondscapes to life quality may depend on familiarity and intensity of use, but also on connection and commitment to nature. Therefore, we have included these questions to understand the respondents' profiles. We selected closed questions, including questions concerning preferential choice (ranking) and rating. Several questions comprised close-ended dichotomous and multiple-choice questions to gain structured data on specific topics. A Likert rating scale was chosen to measure respondents' personal attitudes toward particular topics (Brown 2000). As interval data, we use the Likert scale where 1 is the lowest and 5 is the highest rating. The template of the common questions of the questionnaire is attached as Annex 1.

Templates of both questionnaires were written in each local language (Catalan, Danish, Dutch, English, French for Switzerland, German, Spanish for Uruguay, and Turkish). The translation of the questionnaire was standardized across countries, so that questions and answers were exactly the same. Only the unit of measurement varied (km-mile, hectare-acre) and was considered in calculating the results (Table S1). Before starting the questionnaire, a brief presentation of the research project was provided, along with a confidentiality statement and a guarantee of anonymity. Responses to the questionnaires were obtained via the internet and on-site during times spent on the pondscape.

The completed questionnaires were entered into a LimeSurvey database (http://www.limesurvey.org) that we developed for this study. Online questionnaires were collected via LimeSurvey and the paper were later entered to LimeSurvey by the authors.

Approach regarding the NCP and NbS framework

Díaz et al. (2018) proposed 18 different types of NCPs, of which not all are necessarily relevant to ponds. The list of 18 types of NCPs was therefore filtered according to their relevance for pondscapes and reduced to a final list of 11 NCPs (Table 1), selected to determine the contributions they provide and how they impact quality of life.

As suggested in the study by Gonzalez-Ollauri et al. (2023) on the selection of NbS concerning hydro-meteorological hazards, the list of NbS was also filtered according to their relevance for pondscapes. The NbS considered in the paper are:

- Pond creation (e.g. digging a pond in a place where there was formerly no waterbody);
- Pond restoration (e.g. digging a pond in a place where formerly a pond existed; regenerating a landfilled pond; undertaking important transformations on an existing pond that was functionally lost);

Table 1 List of the 11 types of NCPs selected in this survey based on IPBES (Díaz et al. 2018).

		Explanations
Regulation of environmental processes	Habitation creation and maintenance	Diverse habitats (shelter, nesting, breeding, refuge…) for numerous freshwater species such as aquatic plants, benthic invertebrates, amphibians, fish…
	Pollination	Favourable habitats for beneficial insects, such as wild bees and syrphid flies, due to the surrounding vegetation and the water supply in the pond landscape.
	Regulation of climate	Ponds can influence the microclimate by cooling or warming the surrounding air. Ponds also have the potential to sequester greenhouse gas and capture carbon through wetland vegetation.
	Regulation of water quantity, location and timing	A pond, being a water reservoir, can contain a certain level of stormwater and serve to reduce the amount of water delivered downstream.
	Regulation of water quality	Ponds can be important in purifying water against pollutants, by retaining them through algae, plants and other organisms present in the environment.
	Regulation of hazards and extreme events	Prevent flooding during heavy rainfall events.
Materials and assistance	Food and feed	Fishponds, livestock watering…
Non-materials	Physical and psychological experiences	Place open to the public and providing a great environment in which people can exercise and relax.
	Learning and inspiration	People can learn and be inspired by contact with nature. This space can also be used and studied for educational programmes.
	Supporting identities	Cultural heritage, local identity.
Other	Maintenance of options	Potential opportunities offered by nature to ensure resilience in the future. Pondscape's ability to keep options open for the future.

- Pond infrastructure and local management actions (e.g. removing some vegetation or tree shade; removing or introducing species; water management);
- Landscape management actions (protective status, changing land use around the landscape of ponds, enhancing the connectivity between ponds or the landscape of ponds).

Presentation of the studied pondscapes

The seventeen pondscapes where the questionnaires were distributed are shown in Table 2, along with their main characteristics. They have not been chosen to be representative of all European, Turkish or Uruguayan pondscapes but rather to represent a diversity of areas in terms of bioclimatic zone (Continental, Mediterranean, Subtropical, Arid context, Atlantic), surface area of the pondscapes (less than 1 km² to 30 km²) and pond age (from newly created ponds to naturally occurring ponds that have existed for thousands of years). The pondscapes are integrated into watersheds with a variety of land uses (arable, urban and suburban zone, grassland, pasture, nature reserve) and have different land tenure relationships. Pondscapes have all seen measures implemented in recent years to improve their condition. On the one hand, across all study areas, the creation of ponds has been the most implemented measure, followed by management actions, and then measures to restore ponds (Table 3). These features may directly affect the relationship of stakeholders and inhabitants to the pondscapes because the issues and challenges linked to them may be different. This selection of study sites with natural or artificial nature of a pond is explained by the context of each country. While in European countries, pondscapes tend to be located in recreational areas, dedicated to biodiversity or no intended purpose of use, the context in Uruguay and Türkiye is a little different. In Uruguay, man-made ponds are located in isolated areas and mostly dedicated to livestock watering and secondarily for low scale irrigation support to boost rural production. In Türkiye, the three pondscapes are close to a large lake and flats (Dolcerocca et al. 2024) with no officially identified use for the ponds, but which are currently used as nature areas, landfill sites, informal pleasure gardens with water pumping system.

Samples of respondents

In all countries combined, we collected 117 completed answers from stakeholders and 703 completed answers from the different inhabitants, of which 590 have visited the pondscapes at some point (Table 3). Given that these pondscapes are located in different countries, their management mode is not as institutionalized as other water bodies such as large lakes and rivers. There is no exclusive legal responsibility (uncertain status of ownership) for the ponds in some countries, which presents the challenge of identifying the stakeholders. This explains the limited number of responses from stakeholders.

There are large differences in the number of responses from inhabitants between the seventeen pondscapes studied. We identified four groups of pondscapes with a similar number of answers:

Table 2 Characteristics of the studied pondscapes.

Country	Name of the pondscape	Bioclimatic zone	Landscape and surrounding land use	Land tenure	Area (km²)	Number of ponds in the pondscape	Pond sizes (m²)	Activities in the pondscapes
Switzerland	**Bois de Jussy**	Continental	Rural with woodland and agriculture	Mostly public	7	25	100 to 4000	Wildlife watching Hiking
	Rhône Genevois		Suburban (agricultural, woodland, partly nature reserve)	/	16	40	50 to 20 000	Hiking Wildlife watching
Germany	**Schöneiche**	Continental	Suburban with agriculture	Mostly private	16	12	100 to 20000	Relaxation Wildlife watching
Türkiye	**Dikkuyruk**	Central-Anatolian arid-cold steppe climate	Peri-urban (wheat field, landfill, ornamental garden with water pumping system, near a lake)	Mostly private	0.58	4	4000 to 80000	Wildlife watching Hiking
	Gölbasi			Mostly public	0.26	23	100 to 10.000	Hiking Relaxation
	Imrahor			Private	2.51	12	225 to 57000	Informal uses
England /UK	**Pinkhill Meadows**	Atlantic	Rural and floodplain (Thames)	Private	0.1	50–60	20 to 3000	Wildlife watching Relaxation
	Water Friendly Farming		Rural with farmland	Mostly private	30	120	100 to 5000	Wildlife watching Relaxation
Catalonia /Spain	**Albera**	Mediterranean	Rural with agriculture	Mostly private	25	23	450 to 62000	Wildlife watching Hiking
	La Pletera		Suburban and coastal marshes	Public	0.6	20	100 to 3600	Wildlife watching Cycling
Belgium	**Gete Vallei**	Atlantic	Rural with grassland/ arable land	Mostly private	>10	41	100 to 150	Hiking Cycling
	Pikhakendonk		Rural with grassland	Mostly private	0.1	62	100 to 150	Hiking Relaxation
	Tommelen		Nature reserve near urban area	Public	0.12	144	100 to 150	Hiking Relaxation
Uruguay	**Sierra de los Caracoles**	Subtropical/ temperate humid	Rural with pastures and grasslands for grazing cattle	Private	>10	25	400 to 5000	Agriculture Education purpose
	La Pedrera				>10	18		Hiking Picnic
Denmark	**Lystrup**	Continental	Suburban	Mostly public	8–30	14+	100 to 1500	Wildlife watching Relaxation
	Fyn		Rural with pasture/ arable	Mostly private	8–250	30+	100 to 1500	Hiking Wildlife watching

- Three pondscapes with more than 80 responses: Rhône Genevois in Switzerland, Albera and La Pletera in Spain;
- Four pondscapes between 30 and 60 responses: Pinkhill Meadows, Schöneiche in Germany, Gölbasi in Türkiye, Bois de Jussy in Switzerland;
- Four pondscapes between 15 and 30 responses: Pikhakendonk and Tommelen in Belgium, Lystrup in Denmark, Water Friendly Farming in England;
- Six pondscapes between 2 and 12 responses: Fyn in Denmark, the Uruguayan pondscapes, Gete Vallei in Belgium, Imrahor and Dikkuyruk in Türkiye.

Given these discrepancies and the low number of responses per pondscape for the last group of six pondscapes, we will place less emphasis on their results when presenting comparisons between pondscapes but we will keep them for the figures including all pondscapes combined. However, it is important to explain the low number of responses due to the difficulty of collecting data on ponds. Many are not located in tourist or frequented areas. Population density in the immediate vicinity of some ponds (particularly in Uruguay, Turkey, and Funen, Denmark) is low, with some ponds having a small surface area. Other ponds are difficult to access (Uruguay, Funen, Denmark, Water Friendly Farming in England, Turkey), with some areas being geographically isolated. The temporary or permanent disappearance of ponds (in Spain and Germany) does not attract particu-

Table 3 NbS implementend of the studied pondscape in recent years.

Country	Name of the pondscape	Pond creation	Pond restoration	Pond infrastructure and local management actions (e.g. digging, vegetation clearing)
Switzerland	**Bois de Jussy**	X	X	X
	Rhône Genevois	X	X	X
Germany	**Schöneiche**	X		X
Türkiye	**Dikkuyruk**	X	X	
	Gölbasi	X	X	
	Imrahor		X	X
England/UK	**Pinkhill Meadows**	X		X
	Water Friendly Farming	X		X
Catalonia/Spain	**Albera**		X	X
	La Pletera	X	X	
Belgium	**Gete Vallei**	X	X	X
	Pikhakendonk	X	X	
	Tommelen		X	
Uruguay	**Sierra de los Caracoles**	X		X
	La Pedrera	X		X
Denmark	**Lystrup**	X		X
	Fyn	X	X	X

Table 4 Number of answers per respondent type (i.e., inhabitants and stakeholders) and pondscape.

Country	Pondscapes	Number of answers	
		Inhabitants	Stakeholders
Switzerland	**Bois de Jussy**	57	7
	Rhône Genevois	84	7
Germany	**Schöneiche**	44	5
Turkey	**Dikkuyruk**	8	8
	Gölbasi	41	9
	Imrahor	2	6
England	**Pinkhill Meadows**	32	11
	Water Friendly Farming	18	6
Spain	**Albera**	92	17
	La Pletera	118	9
Belgium	**Gete Vallei**	8	5
	Pikhakendonk	22	5
	Tommelen	23	7
Uruguay	**Sierra de los Caracoles**	12	4
	La Pedrera	4	3
Denmark	**Lystrup**	17	3
	Fyn	8	5

lar attention. As shown in Table S1 (supplementary data), the profile of stakeholders varies from one pondscape to another. The stakeholders see themselves mostly in the role of counselling, public authority and civil society. Regarding the profile of the inhabitants (supplementary data), some pondscapes attract a very local population on average with less than 5 kilometers away whereas half of the pondscapes in this study are visited by people who live more than 10 kilometers away. That distance explains why inhabitants do not visit the pondscapes more frequently.

Statistical analyses

All the graphical representations and statistical analyses were carried out with R and RStudio software (R Development Core Team 2025). Graphics have been made using the *ggplot2* package (Wickham 2016) or associated packages such as *ggradar* (for certain types of graphic representation, Fig. 1). All results based on these questionnaires are expressed with mean scores (from 0 to 5, and accompanied by standard deviations) or as percentages. These responses are presented by pondscapes, by type of respondents or for all respondents combined (main figures and supplementary data), according to the most readable and useful way of presenting them. Our aim was to analyze the data as a whole, comparatively by study site, but also by type of respondents. Where results vary between pondscapes, we also highlight comparisons between study sites. Hence, the results are presented at one or two levels of analysis: by pondscape and all pondscapes combined, to show both specific features and overall trends. Comparisons between the responses provided by inhabitants and stakeholders were carried out using t-tests. Differences between pondscapes were analyzed using ANOVA. For both types of tests, the alpha risk was

set at 5%. For the questions on threats and impacts, we have chosen to retain only the top-3 responses, to make it easier to read the results, but also to easily identify general trends and compare both between pondscapes and between types of respondents.

Results

Relation to pondscapes and the environmental condition of the pondscapes

We asked participants a series of questions to find out about their relationship with nature, the pondscape that concerns them and the importance of this same pondscape for their quality of life. We included a table in the supplemental data (S2).

Inhabitants and stakeholders gave both high scores to express their connection with nature (i.e. replies to the question: how would you describe your relationship with 'nature'?) with a mean of, respectively, 4.4 (± 0.8) and 4.7 (± 0.6) out of 5. The maximum average score was 5 for La Pedrera in Uruguay, and the minimum was 3.5 for the Imrahor pondscape in Türkiye (Fig. 1). Both respondent types also gave high marks to their relationship with the pondscapes (between 3 and 4.2 for inhabitants with a mean value of 3.8 (± 1.0) and between 3.2 and 4.6 for stakeholders, with a mean value of 4.0 (± 1.1) and quality of life (between 3.1 and 4.1 for inhabitants, with a mean value of 3.8 (± 1.1) and between 3 and 4.8 for stakeholders, with a mean value of 4.2 (± 1.0). We note that the given scores are higher for the relation with nature than for the relation with pondscapes (Fig. 1; t test, $t = 13.83$, $df = 1202.8$, $p < 0.001$). Stakeholders gave higher ratings than inhabitants for the connection to nature and the quality of life (t tests, respectively; $t = -4.94$, $df = 188.45$, $p < 0.001$ and $t = -3.41$, $df = 175.92$, $p < 0.001$). Despite a higher average score, this difference is not significant for the relationship with the pondscape ($t = -1.44$, $df = 156.02$, $p = 0.07$). This trend is reversed for the Uruguayan pondscapes, and to some extent in Türkiye ones. Despite the variability of the results obtained, the average scores given to these three questions are high (>3), regardless of the pondscape or type of respondents (Fig. 1).

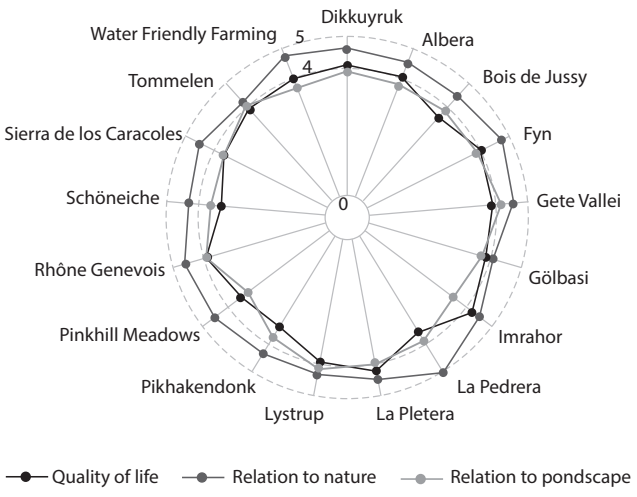

Fig. 1 Representation of the average scores given by the two types of respondents (inhabitants and stakeholders) on their relationship with nature (intermediate grey line), the pondscape (grey line) and the pondscape's contribution to their quality of life (black line), for each pondscape.

To get an overview of the condition of pondscapes from the respondents' point of view, we asked them how they assess the environmental status of pondscapes (Fig. 2) and what changes they noticed over the last ten years. Across all the pondscapes, the inhabitants gave an average score of 3.6 (± 0.9), while the stakeholders gave a score of 3.4 (± 1.0), with a significant difference (t test, $t = 2.06$, $df = 138.01$, $p < 0.05$). Except for the Pinkhill pondscape in England, Albera in Spain, Bois de Jussy in Switzerland and Dikkuyruk in Türkiye, the inhabitants gave a higher score than the stakeholders about the environmental status of the pondscape (Fig. 2), contrary to the trend observed for the first questions. Concerning this environmental status, there were divergent perceptions between stakeholders and inhabitants in Gete Valei (± 0.9), Pink Hill, Gölbasi and Dikkuyruk (± 0.8), Lystrup, Pikhakendonk, Fyn, Rhône Genevois and the Uruguayan pondscapes (± 0.6). In contrast to the first three questions, there was a slightly greater variability between pondscapes, with a minimum mean score of 1.6 given by Schöneiche stakeholders in Germany (2.4 by inhabitants) (Fig. 2). Conversely, Pinkhill stakeholders gave the highest mean score of 4.7. Considering both types of respondents, the pondscape effect is significant (ANOVA, $df = 16$, $F = 14.11$, $p < 0.001$). Except for Schöneiche (Germany), environmental status appeared satisfactory from the respondents' point of view.

To further address the perception of each landscape's status, we asked respondents to select the main visual changes observed during the last decade. With multiple-choice questions, we have retained here the most selected answers according to the number of responses selected by respondents (Table 5). Some negative changes ('decrease of pondscape surface area', 'more frequent drying pond' and 'lower pond water level') were mainly selected by both types of respondents. Conversely, only one positive change, 'increase in the number of ponds', was selected. When combining all pondscapes and answers, the negative changes highlighted exceed the positive ones. The perceptions of the changes observed were similar for residents and stakeholders in Switzerland and Water Friendly Farming (England) with positive changes, Germany, Spain, Tommelen (Belgium) with negative changes.

Analysis conducted to understand perceptions of threats and their impacts

Perceptions of threats and their impacts on pondscapes are represented in Figures 3 and 4. The threat 'climate change' was selected in the top-3 in 13 out of 17 pond-

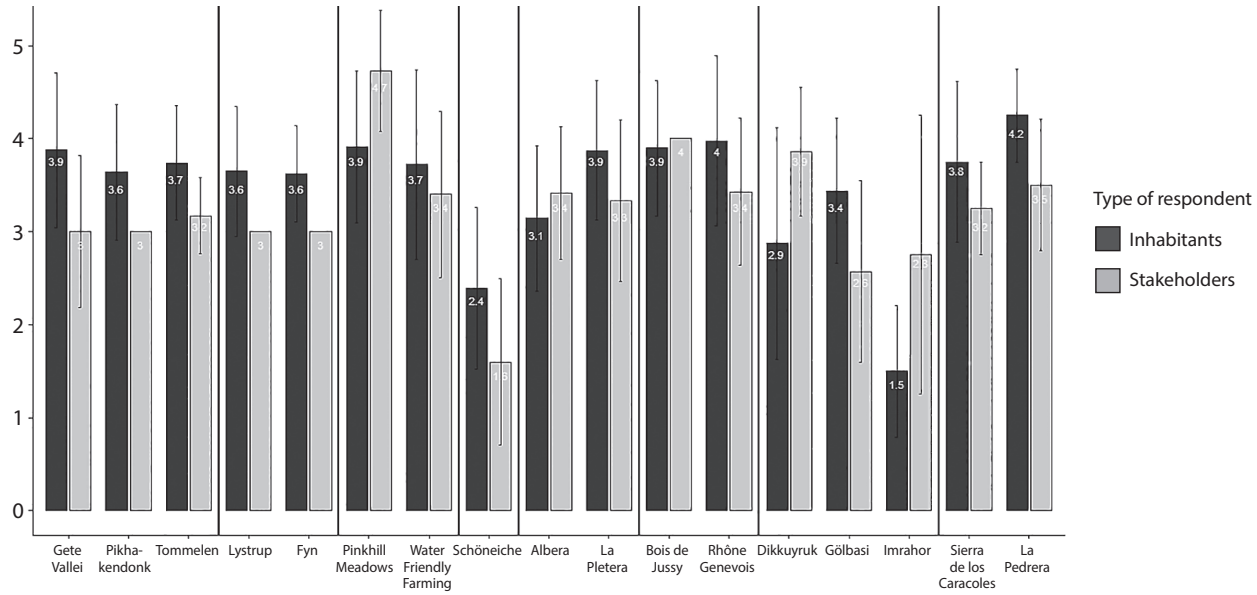

Fig. 2 The environmental status per pondscape according to the type of respondent (inhabitants in black and stakeholders in gray). The values represent the averages of the various responses obtained, and the bars represent the standard deviations.

Table 5 Comparison between inhabitants and stakeholders on the changes observed during the last decade (S = Stakeholder. I = Inhabitants). The term "citations" refers to responses that were quoted at least twice by respondents to ensure congruence between responses.

Country	Pondscape	Decrease of pondscape surface area	More frequent drying ponds	Increase in the number of ponds	Lower pond water level	Colonization of new plant species	Colonization of new plant species	Deterioriation of water quality	Improvement of water quality	Higher pond water level
Switzerland	Bois de Jussy			S & I		I	S & I			
	Rhône Verbois			S & I		S & I	I			
Germany	Schöneiche	S & I	S & I							
Turkiye	Dikkuyruk	S			I			S & I		
	Gölbasi	S			S			I		
	Imrahor	S & I						S & I	I	
England	Pinkhill M.			S		S	I			
	Water Friendly F.					S & I	S & I			
Spain	Albera	I	S & I		S & I					
Belgium	Gete Vallei		I	I				S	I	
	Pikhakendonk		S & I		S					I
	Tommelen	S & I	S & I				I			
Uruguay	Sierra de los C.			S		I	S			
	La Pedrera			I		I	I			
Denmark	Lystrup					I				
	Fyn	S			S	I				
Total number of citation		6S & 3I	4S & 5I	4S & 4I	4S & 2I	3S & 7I	3S & 6I	3S & 3I	2I	1I

scapes (global average for the 13 pondscapes in S1 in supplementary data: 4.1), followed by 'pollution' (9 out of 17 pondscapes), and 'tourism' (9 out of 17 pondscapes) according to inhabitants (Fig. 3). Their responses on impacts highlight that the 'impact on biodiversity' is the primary concern (selected 14 times out of 16 pondscapes with a global average available in Fig. S2 in supplementary data: 4.3). 'Impact on water quantity' (11 out of 16 pondscapes with a global average of 4) was selected as second, followed by 'impact on water quality' (selected 11 times out of 16 pondscapes with global average: 3.9). Interestingly, the data from stakeholders (Fig. 4) are fairly similar, with 'climate change' (15 out of 17 pondscapes, global average: 4.4) and 'pollution' (10 out of 17 pondscapes, global average: 3.8) chosen by the majority as the main threats (Figure 4). Concerning the impact of threats, stakeholders have given priority in top-3 to 'impact on biodiversity' (13 out of 17 pondscapes, global average:

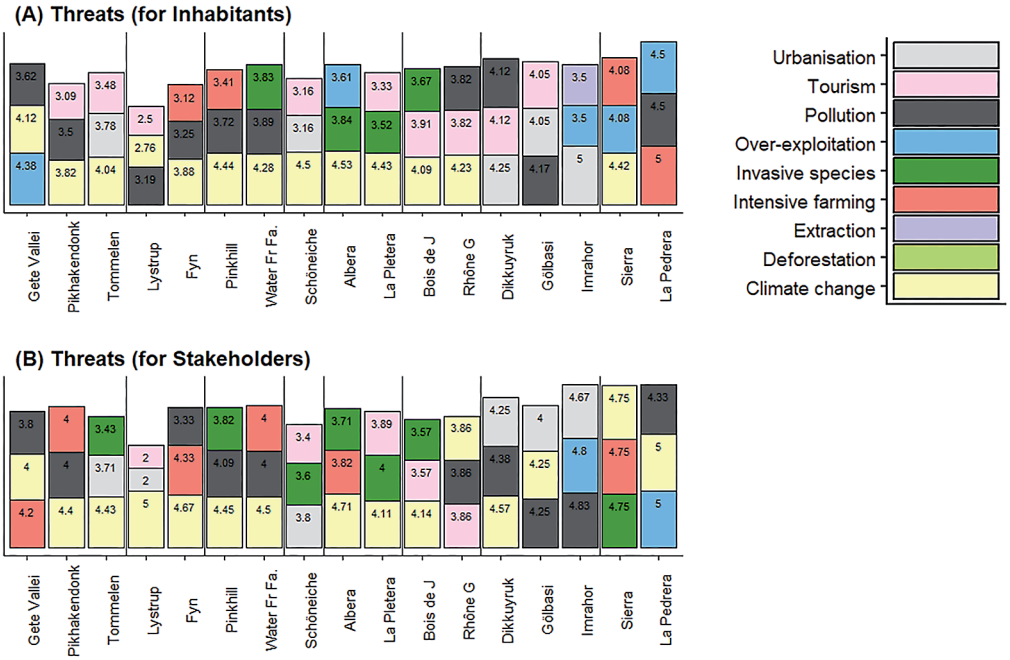

Fig. 3 Threats assessment in inhabitants' and stakeholders' responses per pondscape. Mean scores are given for the top three for each pondscape.

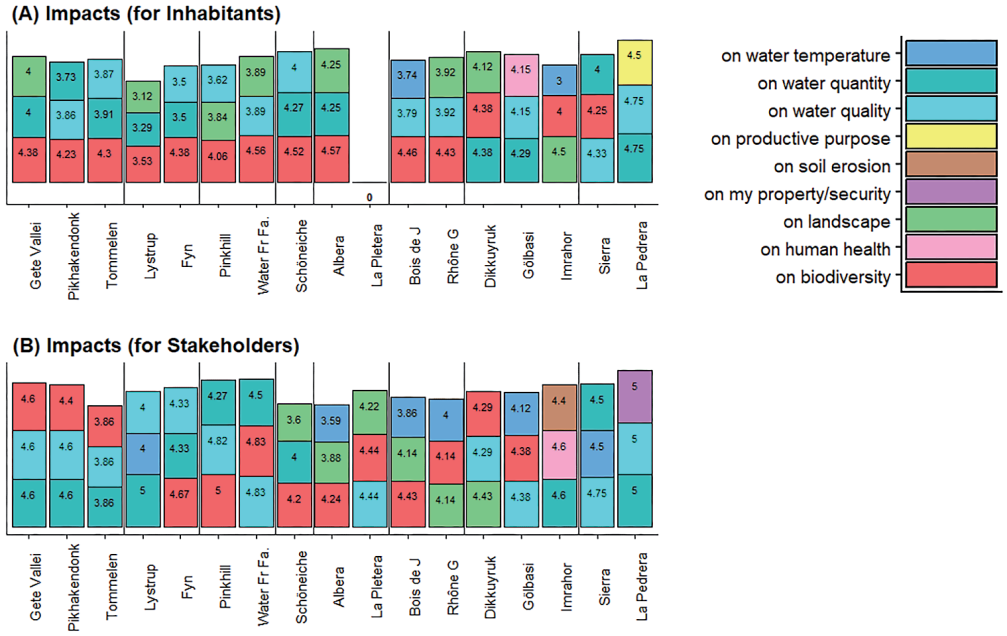

Fig. 4 Impacts of threat assessment in stakeholders' and inhabitants' responses per pondscape. Mean scores are given for the top three for each pondscape.

4.4), 'impact on water quality' (12 out of 17 pondscapes, global average: 4.4) and 'impact on water quantity' (11 out of 17 pondscapes, global average: 4.4). This means that the views are quite aligned between both samples.

About differences between pond landscapes, the Turkish and Uruguayan respondents selected slightly different answers compared to the other pondscapes, given their agricultural context. In particular, they perceived "overexploitation" and "urbanization" as significant threats (Fig. 3 and 4). We also observed that Turkish and Uruguayan pondscapes received the highest average scores on both questions when all responses to threats were combined. Conversely, Danish pondscapes received the lowest overall average score for all threats. The rest of the pondscapes scored in the mid-range.

NCP assessment

The ranking of NCP made by inhabitants and stakeholders is proposed in Fig. 5. The data (Fig. S3, S4, S5, S6 in supplementary data) clearly show similar results

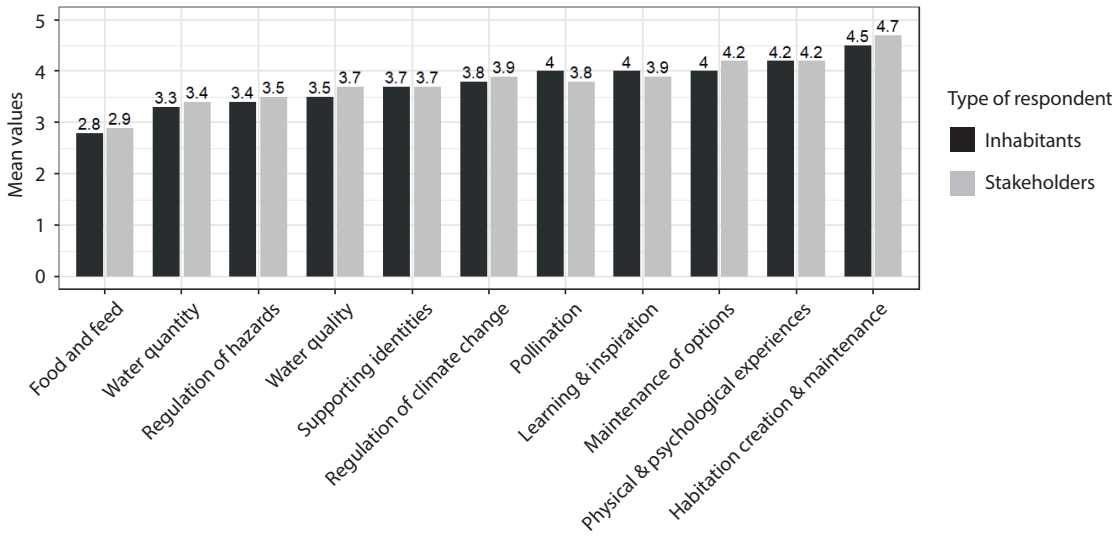

Fig. 5 Mean scores of NCPs assessment from all pondscapes combined, according to the type of respondent (stakeholders in black and inhabitants in grey).

with a clear top-three for a large part of the European pondscapes: 'creation and maintenance of habitats' relating to biodiversity (4.6), 'physical and psychological experiences' (4.2) and 'maintenance of options' as potential opportunities offered by nature to ensure resilience (4.1). The three contributions are important for both types of respondents. Similarly, a certain consensus emerges concerning NCPs that are perceived as more secondary such as 'learning and inspiration', 'regulation of climate' and 'regulation of water quality'. For all NCPs, the two types of respondents give almost identical average scores (t-tests for each, $p > 0.05$), with differences of no more than 0.2 (Fig. 5). This means that the NCP expectations are aligned between them despite some slight differences, resulting in homogeneous perceptions of the NCPs, shared between inhabitants and stakeholders.

Some perceptions of all NCPs are more noticeable than others among the sites studied. For example, we can mention Uruguay and Türkiye with the highest scores for 'food and feed' and 'regulation of water quantity' (supplementary data), although these two NCPs have the lowest scores all sites combined (2.9 and 3.4, respectively). The prioritization of the NCPs is the same between stakeholders and inhabitants.

NbS' assessment

We also compared the results from inhabitants and stakeholders about the perception of the NbS measures that should be implemented in the future (Table 6). Several pondscapes with a lack of data were not included. Analyzing by pondscape, there is often agreement on at least 2 types of NbS measures to be implemented for pondscapes among the 9 proposed, except for Bois de Jussy, Pinkhill, la Pedrera and Tommelen. Therefore, the views of both types of respondents on NbS are more or less aligned without being exactly the same. If we read this table by NbS measures, there are clearly four of them that were selected the most: 'restoration measures', 'maintenance of biodiversity', 'better/more environmental education', 'improving water quality'. On another level, compared to stakeholders, inhabitants chose distinctly the NbS measures 'limitation of certain uses' and 'better/more environmental education'.

Discussion and Perspectives

Pondscapes and quality of life: connecting people to nature

Our results demonstrate that stakeholders and inhabitants both show strong interest in pondscapes, with high mean scores. The stakeholders gave higher scores for the items "quality of life" or "connection to nature" than the inhabitants. The results on "relation to pondscape" show no significant difference between respondents. Except for Germany and England, this high link for stakeholders can be explained by their professional profiles with activities in management and public policy monitoring, and backgrounds focused on biology and ecology. Inhabitants visiting the pondscapes mostly once a month for activities (hiking, wildlife watching and relaxation) demonstrate a strong relationship with ponds thanks to nature exposure and connectedness. This can also be explained by the fact that all pondscapes have seen measures implemented in recent years to improve their conditions. This is consistent with studies on the same subject (Lumber et al. 2017; Rey-Valette et al. 2022; Vasco et al. 2024). These pondscapes are thus widely appreciated by respondents for their contribution to their quality of life, which has also been highlighted by other authors (Xie et al. 2021; McDougall et al. 2022; Vo et al. 2023). In addition to our survey, it would be interesting to find out whether this is linked to the aesthetic quality of the landscape (Hill et al. 2021), the presence of emblematic species (Oertli et al. 2005) and the *naturalness* of the vegetation and the *land-*

Table 6 Comparison between inhabitants and stakeholders on NbS measures (S = Stakeholder and I = Inhabitants). The term "citations" refers to responses that were quoted at least twice by respondents to ensure congruence between responses.

Country	Pondscape	Resto-ration measures	Mainte-nance of bio-diversity	Better/ more envi-ronmental education	Improving water quality	Limitation of certain uses	Creating new pond	Increasing water volume	Monitoring of ponds	Abandon-ment of certain uses
Switzer-land	Bois de Jussy	S	S & I	I			I			
	Rhône Verbois	S	S & I	S & I		I				
Germany	Schöneiche	S & I	S	S & I				S & I		
Turkiye	Dikkuyruk	I		S & I	S & I	I				S
	Gölbasi	I		S & I	S & I	I				S
England	Pinkhill M.		S & I	I			I		S	
	Water Friendly F.		S & I		S & I		S & I			
Spain	Albera	S & I	S	S & I		S & I				
Belgium	Gete Vallei	S & I	S & I		S & I					
	Pikhakendonk	S & I		I	S & I	S	S			
	Tommelen	I	S	I		I		S		
Uruguay	La Pedrera	I		S	I	S & I				
Denmark	Fyn	S	S & I		S & I		I			
Total number of citations		7S & 8I	9S & 6I	6S & 9I	6S & 7I	3S & 6I	2S & 4I	2S & 1I	2S	2S

scape structure (Szilassi et al. 2017; Hermes et al. 2018), or the right conditions for practising recreation activities. This would need to be correlated with other nearby green spaces to identify the specificity of the pondscapes in relation to other waterscapes in particular (Karpouzoglou and Vij 2017; Borthagaray et al. 2023).

Perceptions of changes, threats and environmental status

Based on the responses obtained and within the framework of pondscapes that have already undergone measures to improve their condition, positive changes such as the 'increase in the number of ponds' were perceived in seven pondscapes out of seventeen. These pondscapes most often concerned recently restored sites shown in Table 3, such as Bois de Jussy and Pinkhill Meadows. The effects of restoration have, therefore, been perceived and made visible and do not seem to have generated any form of resistance to restoration strategies (van Marwijk et al. 2012; Rajput et al. 2023), as evidenced by the high assessment awarded to the relationship with the pondscape and their contribution to quality of life. Given these positive post-restoration perceptions in certain pondscapes, the restoration frameworks applied seem to converge in socially acceptable and ecologically feasible (Petursdottir et al. 2013).

A wide consensus was found on a range of threats and impacts of threats with significant negative changes such as "more frequent drying of ponds", "lower pond water level", "degradation of water quality", and 'decrease of pondscape surface area' selected. An interpretation could be made to link these main negative changes observed in the majority of the pondscapes (9/16) with the main threats identified, namely 'climate change' and 'pollution', and the main impacts identified by respondents on 'biodiversity' and 'water quantity'. This perception of deterioration over the last ten years are in line with the threats mentioned by de Necker et al. (2024), including climate change and habitat degradation.

It is important to consider the links between social perceptions and the monitoring of pondscapes as the documentation of temporal changes by authorities, which does not exist to date for some of these pondscapes. This is why future research is needed to determine how the different respondent types perceive visible and invisible elements of the landscape's biogeophysical processes. Acceptance of the management of the pondscapes could be affected by not considering the habits (visual, auditory, practical) of the inhabitants. Similarly, it would be interesting to explore why "colonization of new plant species" and "degradation of water quality" were frequently cited as threats, in order to identify the causes from the respondents' point of view. A multitude of anthropogenic disturbances could affect pondscapes (Brönmark and Hansson 2002), and it is important to identify them for each study site so that they can be incorporated into management plans (Biggs et al. 2024). Making visible the types of change and their causes could be a useful decision-making tool in environmental education initiatives (Ardoin et al. 2020).

NCP and NbS assessment

Both stakeholders and inhabitants generally ranked the various proposed NCPs in the same order, suggesting that this is not necessarily dependent on the context of local uses. The NCPs 'habitat creation and maintenance' was considered a priority. This means that respondents

are very attached to the pondscapes because they can either derive a source of satisfaction as a place to connect with nature or alternatively enjoy leisure activities on pondscapes that have a fairly direct impact on their quality of life: contemplating nature, relaxation and hiking are important recreational activities for people (Schafft et al. 2021). Two other NCPs, 'physical and psychological experiences' and 'maintenance of options', were also perceived as important. NCP 'physical and psychological experiences' refers to the direct uses of humans with leisure activities (cycling and walking, picnic areas) with beneficial effects on physical and mental health (Lopez-Haro et al. 2024), particularly in urban areas (Vasco 2024). The NCP 'maintenance of options' is interesting and original and was not expected to be so important, especially for inhabitants. This highlights the importance of maintaining or improving the current situation to avoid losing potentially useful options for the future. This NCP makes it possible to link existing nature with future options for use and benefit. There is a convergence of social perceptions between stakeholders and residents revealing the acuteness of risks and impacts in the future with a felt need to think about the future and anticipate the management of pondscapes. The prominence given to this NCP testifies to the importance of intergenerational justice and the quality of life of future generations (Faith 2021).

While our results highlighted that the most selected NCPs are focused on biodiversity, the numerous non-material NCPs (Methorst et al. 2020; Hill et al. 2021) are consistent with the literature on the multifunctionality of ponds (Popp et al. 2019; Hambäck et al. 2023). It is important to study in greater depth how these various contributions can be combined. Two recent articles on ponds and pondscapes have contradictory results on this subject. According to the review from Necker et al. (2024), some European restoration projects have regrettably failed to take account of different contributions and services in the initial ecological objectives of the restoration. However, in their analysis, Bartrons et al. (2024) mention combinations of NCPs that have implemented NbS in ponds/pondscapes in 24 countries. According to this paper, the NCP 'creation of habitat for biodiversity' was combined with the NCPs 'learning and inspiration', 'regulation of water quantity' or 'physical and psychological experiences'. The integration of various objectives on the NbS measures is central to achieving the inter-relationship between biodiversity, aquatic ecosystem functioning and human activities, in knowing whether these objectives are compatible or contradictory. This brings us back to the scientific debates specific to ecosystem service bundles (Raudsepp-Hearne et al. 2010; Meacham et al. 2022), in terms of whether contributions can be cumulative, synergetic, antagonistic or neutral (Hambäck et al. 2023). The maintenance of the quality of the environment and of contributions provided by the environment (Streimikiene 2015) are ways of strengthening stakeholders' attention (Smyth et al. 2021) and public awareness (Sousa et al. 2016), in this case to pondscapes. Maintaining or improving the environmental condition of a pondscape is a milestone in fostering the commitment of inhabitants and stakeholders to preserve it. This preservation, in whatever form (creating, managing or restoring), is achieved by integrating various contributions such as visitor activities, the aesthetic quality of the landscape, the landscape or cultural identity of the site, or the presence of emblematic species.

Across countries, most opinions on NbS were quite similar for a majority of pondscapes with the same options of responses selected: 'restoration measures', 'maintenance of biodiversity', 'improving water quality' and 'better/more environmental education'. Views of both types of respondents on NbS were more or less aligned. This may be explained by the large number of suggested answers (12; detail in supplementary data), which may have dispersed the responses. Alongside the best way to integrate the different contributions, the same applies to the co-benefits to be implemented during an integrated approach to NbS planning (González-García et al. 2025). In facing the challenge of water quantity, respondents from the Belgian, German, Turkish and Uruguayan pondscapes have selected other options, such as "increasing water volume", "limitation of certain uses", and "abandonment of certain uses" with action both on the supply and demand of water. This refers to the causes of the deterioration of the pondscapes, which implies a limitation of activities (industrial, agricultural or touristic) to maintain or improve the situation or preserve water resources in the face of climate change. However, abandoning certain practices and uses, such as agriculture, is not always a panacea, as shown by Erös et al. (2020). Monitoring the dynamics of pondscapes requires close cooperation between those involved in habitat conservation and management, in order to develop strategies that encourage closer socio-ecological links and improve the impact of research on decision-making (Fisher et al. 2020). Another main research priority moving forward should be to better understand applying (Arnautu and Dagenais 2021) these results to the management and policy of pondscapes (Ryfisch et al. 2024). The broad-based knowledge exchange collaborations can assist local actors including particularly interested inhabitants, and actors at the meso-level (e.g. regional actors and civil society) and macro-level (e.g. legal and regulatory systems) that together shape management decisions in implementing NbS measures.

Limitations

This survey has limitations. Firstly, we did not obtain a similar number of responses for all pondscapes with a low number of responses linked to certain pondscapes in Türkiye, Belgium and Uruguay. Although the low number of responses can be justified by the characteristics of these pondscapes, a larger sample of responses would have been required to study more precisely certain variables (age, gender) in greater statistical depth. Therefore,

when comparing inhabitants-stakeholders, we thus paid more attention to pondscapes with the strongest response.

Secondly, we are unable to explain the reasons that led different respondent types to favor specific answers. While most responses often converge, the interpretation of the main differences between the population and stakeholders remains limited. As a result, the sum of individual points of view cannot be representative of the collective point of view, since this approach does not allow for the emergence of discussion and negotiation processes leading actors to change their perceptions through contact with others (Zerbe 2023). This approach is also biased towards the profile of respondents (S1 in supplementary data). For example, we sent the questionnaire to stakeholders, with the indication to share it with people likely to be able to respond. An initial orientation was therefore carried out. This way of dissemination may have led to more responses from existing small networks of actors and specific epistemological communities in pond management, perhaps to the exclusion of other actors with fewer institutional links but with potentially greater expertise (Arango-Quiroga et al. 2023).

With the face-to-face surveys and the sign boards dedicated to inhabitants, the respondents likely included people already interested in ponds and pondscapes, as we targeted respondents who live near/within or use the pondscapes. Social networks, which could have broadened the spectrum of respondents, were not used, as none corresponded to the perimeter of these pondscapes. It should also be stressed that the representativity of the inhabitant sample was not an issue in terms of gender, income, geographical location or age group.

All the pondscapes studied exhibit a diversity of uses (biodiversity and recreation, and sometimes agricultural and informal uses linked to a lack of management and maintenance) and land-use contexts (urban, peri-urban, agricultural). These mixed-use ponds not allow for the deduction of specific perceptions for each use due to the multifunctionality provided by the ponds. Selecting study sites with very different and less multifunctional uses would allow us to determine whether potentially different perceptions would facilitate or reinforce the synergies or antagonisms of management objectives. This would lead to specific strategies for prioritizing or not multifunctionality at the pond landscape scale in order to consider the synergies between NCPs.

Conclusion

Our survey describes and compares perceptions within and across pondscapes and explores to what extent perceptions vary between stakeholders and inhabitants. The examination of perceptions on a variety of topics (biodiversity, nature conservation, environmental condition, environmental change, threats assessment) gives interesting insights into the role of these small water bodies and their importance. Overall, with regard to the questions asked, the perceptions of stakeholders and inhabitants are fairly similar (threats and impacts, NCPs), but may also differ (quality of life, relationship with nature, environmental status), with high scores given by both types of respondents nonetheless. A central conclusion of our study is that pondscapes are widely valued by inhabitants and stakeholders in all pondscapes in all studied countries, and that this largely stems from the benefits that the pondscapes provide for the quality of life. Biodiversity was overall highly valued, and the importance for the conservation and protection of pondscapes was strongly acknowledged. Social, cultural, and recreational activities were also perceived as beneficial and promoting well-being and integration into the community. Respondents also rated the 'maintenance of options' NCP particularly highly, referring to long-term management to ensure resilience. Stakeholders and inhabitants identified 'climate change' and 'pollution' as the most important threats in the investigated pondscapes. Regarding the various ways of addressing the problems identified, the perceptions on NbS are quite similar for a large majority of pondscapes. The most frequently selected NBS were "restoration", "maintenance of biodiversity" and "better/more environmental education".

In light of this, by analyzing perceptions in several pondscapes, we gain insight into ways of understanding and acting upon pondscapes as Nature-based Solutions. These results are not necessarily representative of the European and South American context, but they illustrate how attachment to ponds, geospatial changes over time, and the issues surrounding NCPs inform management projects. Future actions should aim to ensure that these pondscapes continue to play a key role in biodiversity conservation and improving people's quality of life through recreational activities. Our social data can be used to analyse synergies and trade-offs in future policies and management of pondscapes, provided that broad-based knowledge exchange collaborations and educational and dissemination campaigns are put in place.

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Data availability

The dataset on pondscape features is available in the Zenodo repository (DOI: 10.5281/zenodo.14017011).

Any additional raw data used in the manuscript are available from the corresponding author upon reasonable request.

Consent to participate

We conducted this survey in accordance with ethical standards, and informed consent was obtained from all respondents. Participants were adults whom we asked exclusively in relation to pondscapes and not on sensitive subjects (e.g. health, sexual orientation, politics, etc.). The questionnaire explained the objectives of the study, the scientific context and required the consent of the respondents. All the data gathered during the survey will be only used for the research purposes and will be stored and used in line with GDPR. Any results will be presented only in aggregated form, so it will not be possible to identify particular participants.

REFERENCES

Arango-Quiroga J, Kinol A, Kuhl L (2023) Examining knowledge and epistemic justice in the design of nature-based solutions for water management. PLOS Clim 2: e0000194. doi: 10.1371/journal.pclm.0000194.

Ardoin NM, Bowers AW, Gaillard E (2020) Environmental education outcomes for conservation: A systematic review. Biol Conserv 241: 108224. doi: 10.1016/j.biocon.2019.108224.

Arnautu D, Dagenais C (2021) Use and effectiveness of policy briefs as a knowledge transfer tool: a scoping review. Humanit Soc Sci Commun 8: 211. doi: 10.1057/s41599-021-00885-9.

Bartrons M, Trochine C, Blicharska M, Oertli B, Lago M, Brucet S (2024) Unlocking the potential of ponds and pondscapes as nature-based solutions for climate resilience and beyond: Hundred evidences. J Environ Manage 359: 120992. doi: 10.1016/j.jenvman.2024.120992.

Biggs J, Hoyle S, Matos I, Oertli B, Teixeira J (2024) Using ponds and pondscapes as nature-based solutions: Guidance for policy makers on the use of ponds and pondscapes as nature-based solutions for climate change mitigation and adaptation. EU Horizon 2020 Ponderful project. doi: 10.5281/zenodo.13847395.

Blicharska M, Andersson J, Bergsten J, Bjelke U, Hilding-Rydevik T, Thomsson M, Osth J, Johansson F (2017) Is there a relationship between socio-economic factors and biodiversity in urban ponds? A study in the city of Stockholm. Urban Ecosyst 20: 1209–1220. doi: 10.1007/s11252-017-0673-2.

Boothby J (1997) Pond conservation: towards a delineation of pondscape. Aquat Conserv: Mar Freshw Ecosyst 7: 127–132. doi: 10.1002/(SICI)1099-0755(199706)7:2<127::AID-AQC224>3.0.CO;2-6.

Borthagaray AI, Cunillera-Montcusí D, Bou J, Biggs J (2023) Pondscape or waterscape? The effect on the diversity of dispersal along different freshwater ecosystems. Hydrobiologia 850: 3211–3223. doi: 10.1007/s10750-022-05123-0.

Bouahim S, Rhazi L, Amami B, Waterkeyn A, Rhazi M, Saber E-R, Zouahri A, Van den Broeck M, Muller S, Brendonck L, Grillas P (2014) Unravelling the impact of anthropogenic pressure on plant communities in Mediterranean temporary ponds. Mar Freshw Res 65: 918–929. doi: 10.1071/MF13194.

Brans KI, Engelen JMT, Souffreau C, De Meester L (2018) Urban hot-tubs: Local urbanization has profound effects on average and extreme temperatures in ponds. Landsc Urban Plan 176: 22–29. doi: 10.1016/j.landurbplan.2018.03.013.

Brown JD (2000) What issues affect Likert-scale questionnaire formats? JALT Test Eval 4: 27–33.

Brönmark C, Hansson LA (2022) Environmental issues in lakes and ponds: current state and perspectives. Environ Conserv 29: 290–307. doi: 10.1017/S0376892902000218.

Castro AJ, Verburg PH, Martín-López B, Garcia-Llorente M, Cabello J, Vaughn C, López E (2014) Ecosystem service trade-offs from supply to social demand: A landscape-scale spatial analysis. Landscape Urban Planning 132: 102–110. doi: 10.1016/j.landurbplan.2014.08.009.

Cauberghe V, Vazquez-Casaubon E, Van de Sompel D (2021) Perceptions of water as commodity or uniqueness? The role of water value, scarcity concern and moral obligation on conservation behavior. J Environ Manage 292: 112677. doi: 10.1016/j.jenvman.2021.112677.

Céréghino R, Boix D, Cauchie HM, Martens K, Oertli B (2014) The ecological role of ponds in a changing world. Hydrobiologia 723: 1–6. doi: 10.1007/s10750-013-1719-y.

Cuenca-Cambronero M, Blicharska M, Perrin J-A, Davidson TA, Oertli B, Lago M, Beklioglu M, Meerhoff M, Arim M, Teixeira J, De Meester L, Biggs J, Robin J, Martin B, Greaves HM, Sayer CD, Lemmens P, Boix D, Mehner T, Bartronss M, Brucet S (2023) Challenges and opportunities in the use of ponds and pondscapes as Nature-based Solutions. Hydrobiologia 850: 3257–3271. doi: 10.1007/s10750-023-05149-y.

Curado N, Hartel T, Arntzen JW (2011) Amphibian pond loss as a function of landscape change – A case study over three decades in an agricultural area of northern France. Biol Conserv 144: 1610–1618. doi: 10.1016/j.biocon.2011.02.011.

Davies B, Biggs J, Williams P, Whitfield M, Nicolet P, Sear D, Bray S, Maund S (2008) Comparative biodiversity of aquatic habitats in the European agricultural landscape. Agric Ecosyst Environ 125: 1–8. doi: 10.1016/j.agee.2007.10.006.

Delpero A, Volpato G (2022) Integrated pond aquaculture and regional identity: ethnobiology of the golden humped tench of Poirino highlands, Northwest Italy. J Ethnobiol Ethnomed 18: 31. doi: 10.1186/s13002-022-00529-5.

Díaz S, Pascual U, Stenseke M, Martin-Lopez B, Watson RT, Molnar Z, Hill R, Chan KMA, Baste IA, Brauman KA (2018) Assessing nature's contributions to people. Recognizing culture, and diverse sources of knowledge, can improve assessments. Science 359: 270–272. doi: 10.1126/science.aap8826.

Dolcerocca A, Başoğlu Acet D, Beklioğlu M, Perrin JA (2024) Restoration Project for a Degraded Urban Ecosystem in Gölbaşı Flats, Ankara. A Precarious Equilibrium. Ri-Vista. Res Landsc Archit 22: 70–83. doi: 10.36253/rv-15622.

Erős N, Maloș CV, Horváth C, Hartel T (2020) Temporary pond loss as a result of pasture abandonment: exploring the social-ecological drivers and consequences for amphibians. J Nat Conserv 55: 125836. doi: 10.1016/j.jnc.2020.125836.

Fahy JC, Demierre E, Oertli B (2024). Long-term monitoring of water temperature and macroinvertebrates highlights climate change threat to alpine ponds in protected areas. Biol Conserv 290: 110461. doi: 10.1016/j.biocon.2024.110461.

Faith DP (2021) Valuation and Appreciation of Biodiversity: The "Maintenance of Options" Provided by the Variety of Life. Front Ecol Evol 9. doi: 10.3389/fevo.2021.635670.

Fisher JRB, Wood SA, Bradford MA, Kelsey TR (2020) Improving scientific impact: How to practice science that influences

environmental policy and management. Conserv Sci Pract. 2: e0210. doi: 10.1111/csp2.210.

González-García A, Palomo I, Codemo A, Rodeghiero M, Dubo T, Vallet A, Lavorel S (2025) Co-benefits of nature-based solutions exceed the cost of implementation. Cell Rep Sustain 2: 100336. doi: 10.1016/j.crsus.2025.100336.

Gonzalez-Ollauri A, Mickovski SB, Anderson CC, Debele S, Emmanuel R, Kumar P, Loupis M, Ommer J, Pfeiffer J, Panga D, Pilla F, Sannigrahi S, Toth E, Ukonmaanaho L, Zieher T (2023) A nature-based solution selection framework: Criteria and processes for addressing hydro-meteorological hazards at open-air laboratories across Europe. J Environ Manage 331: 117183. doi: 10.1016/j.jenvman.2022.117183.

Hambäck PA, Dawson L, Geranmayeh P, Jarsjö J, Kačergytė I, Peacock M, Collentine D, Destouni G, Futter M, Hugelius G, Hedman S, Jonsson S, Klatt BK, Lindström A, Nilsson JE, Pärt T, Schneider LD, Strand JA, Urrutia-Cordero P, Åhlén D, Åhlén I, Blicharska M (2023) Tradeoffs and synergies in wetland multifunctionality: A scaling issue. Sci Total Environ 862: 160746. doi: 10.1016/j.scitotenv.2022.160746.

Hermes J, Albert C, von Haaren C (2018) Assessing the aesthetic quality of landscapes in Germany. Ecosyst Serv 31: 296–307. doi: 10.1016/j.ecoser.2018.02.015.

Hill MJ, Greaves HM, Sayer CD, Hassall C, Milin M, Milner VS, Marazzi L, Hall R, Harper LR, Thornhill I, Walton R, Biggs J, Ewald N, Law A, Willby N, White JC, Briers RA, Mathers KL, Jeffries MJ, Wood PJ (2021) Pond ecology and conservation: research priorities and knowledge gaps. Ecosphere 12: e03853. doi: 10.1002/ecs2.3853.

Hill MJ, Hassall C, Oertli B (2018) New policy directions for global pond conservation. Conserv Lett 11: e12447. doi: 10.1111/conl.12447.

Jiang Q, Wang Z, Yu K, Dou Y, Fu H, Liang X (2023) The influence of urbanization on local perception of the effect of traditional landscapes on human wellbeing: A case study of a pondscape in Chongqing, China. Ecosyst Serv 60: 101521. doi: 10.1016/.ecoser.2023.101521.

Karpouzoglou T, Vij S (2017) Waterscape: a perspective for understanding the contested geography of water. WIREs Water 4: e1210. doi: 10.1002/wat2.1210.

Lasner T, Antje G (2024) Aquaculture as a dysfunctional system of action; Why does fish farming stagnate in Germany? Mar Policy 170: 106405. doi: 10.1016/j.marpol.2024.106405.

Lopez-Haro J, Gómez-Chávez LFJ, Pelayo-Zavalza AR, Gómez-Varela JF (2024) Association between Active Use of Urban Green Spaces and Well-Being in Adults Aged 18–65 Years: A Systematic Review. J Health Pollut 27: 1–4. doi: 10.1289/JHP1040.

López-Rodríguez M, Castro J, Cabello J, Jorreto S, Castro H (2015) Science–policy interface approach for dealing with water environmental problems. Environ Sci Policy 50: 1–14. doi: 10.1016/j.envsci.2015.01.013.

Lumber R, Richardson M, Sheffield D (2017) Beyond knowing nature: Contact, emotion, compassion, meaning, and beauty are pathways to nature connection. PLoS ONE 12: e0177186. doi: 10.1371/journal.pone.0177186.

Macedo RL, Haubrock PJ, Klippel G, Fernandez RD, Leroy B, Angulo E, Carneiro L, Musseau CL, Rocha O, Cuthbert RB (2024) The economic costs of invasive aquatic plants: A global perspective on ecology and management gaps. Sci Total Environ 908: 168217. doi: 10.1016/j.scitotenv.2023.168217.

van Marwijk RBM, Elands BHM, Kampen JK, Terlouw S, Pitt DG, Opdam PFM (2012) Public perceptions of the attractiveness of restored nature. Restor Ecol 20: 773–780. doi: 10.1111/j.1526-100X.2011.00813.x.

McDougall CW, Hanley N, Quilliam RS, Oliver DM (2022) Blue space exposure, health and well-being: Does freshwater type matter? Landsc Urban Plan 224: 104446. doi: 10.1016/j.landurbplan.2022.104446.

Meacham M, Norström AV, Peterson GD, Andersson E, Bennett EM, Biggs R, Queiroz C (2022) Advancing research on ecosystem service bundles for comparative assessments and synthesis. Ecosyst People 18: 99–111. doi: 10.1080/26395916.2022.2032356.

Mell I, Clement S (2019) Rethinking Urban Nature: The Rise and Value of Nature-Based Solutions (NbS) in Europe. Fábos Conf Landscape Greenway Plan 6. doi: 10.7275/0n91-xq04.

Methorst J, Arbieu U, Bonn A, Böhning-Gaese K, Müller T (2020) Non-material contributions of wildlife to human well-being: a systematic review. Environ Res Lett 15: 093005. doi: 10.1088/1748-9326/ab9927.

Mitroi V, Maleval V, Deroubaix JF, Vinçon-Leite B, Humbert JF (2022) What urban lakes and ponds quality is about? Conciliating water quality and ecological indicators with users' perceptions and expectations about urban lakes and ponds quality in urban areas. J Environ Policy Plann 24: 701–718. doi: 10.1080/1523908X.2022.2037413.

Necker (de) L, Florencio M, Vanschoenwinkel B, Rhazi L, Goldyn B (2024) Lessons from pond creation and restoration projects in Europe. Restor Ecol 33: e14342. doi: 10.1111/rec.14342.

Nesshover C, Assmuth T, Irvine KN, Rusch GM, Waylen KA, Delbaere B, Haase D, Jones-Walters L et al. (2017) The science, policy and practice of nature-based solutions: an interdisciplinary perspective. Sci Total Environ 579: 1215–1227. doi: 10.1016/j.scitotenv.2016.11.106.

Oertli B, Biggs J, Céréghino R, Grillas P, Joly P (2005) Conservation and monitoring of pond biodiversity: introduction. Aquat Conserv: Mar Freshw Ecosyst 15: 535–540. doi: 10.1002/aqc.752.

Oertli B, Decrey M, Demierre E, Fahy JC, Gallinelli P, Vasco F, Ilg N (2023) Ornamental ponds as Nature-based Solutions to implement in cities. Sci Total Environ 888: 164300. doi: 10.1016/j.scitotenv.2023.164300.

Oertli B, Parris KM (2019) Review: Toward management of urban ponds for freshwater biodiversity. Ecosphere 10: e02810. doi: 10.1002/ecs2.2810.

Pascual U, Balvanera P, Díaz S, Pataki G, Roth E, Stenseke M, Watson RT et al. (2017) Valuing nature's contributions to people: the IPBES approach. Curr Opin Environ Sustain 26–27: 7–16. doi: 10.1016/j.cosust.2016.12.006.

Pedersen E, Weisner SEB, Johansson M (2019) Wetland areas' direct contributions to residents' well-being entitle them to high cultural ecosystem values. Sci Total Environ 646: 1315–1326. doi: 10.1016/j.scitotenv.2018.07.236.

Pereira-Lindoso D, Boix D, Ribas A, Bou J, Quintana XD (2025) Deurbanizing for conservation and adapting: framing ecological restoration as a Nature-based Solution in the La Pletera salt marsh, Catalonia (Spain). Front Water 6: 1462412. doi: 10.3389/frwa.2024.1462412.

Petursdottir T, Aradottir AL, Benediktsson K (2013) An Evaluation of the Short-Term Progress of Restoration Combining Ecological Assessment and Public Perception. Restor Ecol 21: 75–85. doi: 10.1111/j.1526-100X.2011.00855.x.

Popp J, Békefi E, Duleba S, Oláh J (2019) Multifunctionality of pond fish farms in the opinion of the farm managers: the case of Hungary. Rev Aquac 11: 830–847. doi: 10.1111/raq.12260.

Quintas-Soriano C, Brandt J, Running K, Baxter CV, Gibson DM, Narducci J, Castro AJ (2018) Social-Ecological Systems Influ-

ence Ecosystem Service Perception: a Programme on Ecosystem Change and Society (PECS) Analysis. Ecol Soc 23: 3. doi: 10.5751/ES-10226-230303.

Rajput S, Kumari A, Rajput VD, Mandzhieva SS, Minkina T, Arora S, Kaur R (2023) Current scenario, services, concerns, and restoration perspectives of ponds in India. Sains Tanah J Soil Sci Agroclimatol 20: 19–31. doi: 10.20961/stjssa.v20i1.64190.

Raudsepp-Hearne C, Peterson GD, Bennett EM (2010) Ecosystem service bundles for analyzing tradeoffs in diverse landscapes. Proc Natl Acad Sci U.S.A. 107: 5242–5247. doi: 10.1073/pnas.0907284107.

Rey-Valette H, Blayac T, Salles JM (2022) Evaluating the contribution of nature to well-being: The case of ecosystem services related to fish-farming ponds in France. Ecol Econ 191: 107217. doi: 10.1016/j.ecolecon.2021.107217.

Rey-Valette H, Salles JM, Blayac T (2024) Perceptions of ecosystem services and bonds with nature: the case of fish-farming ponds in France. Ecol Econ 217: 108049. doi: 10.1016/j.ecolecon.2023.108049.

Ryfisch S, Başoğlu D, Benejam Vidal L, Biggs J, Boissezon A, Boix D, Brucet Balmaña S, Dolcerocca A, Hansen K, Lago M, Lemmens P, Lindoso D, Llausas Pascual A, McDonald H, Meerhoff M, Mehner T, Perrin JA, de Quintana F, Rasmusse M, Maria Ribas Palom A, Sander Johansson L, Blicharska M (2024) Policies and practices impacting the implementation of Nature-Based Solutions: A comparative study of ponds and pondscapes in eight countries. J Environ Plan Manag 69: 1146–1176. doi: 10.1080/09640568.2024.2418966.

Ryfisch S, Seeger I, McDonald H, Lago M, Blicharska M (2023) Opportunities and limitations for Nature-Based Solutions in EU policies – Assessed with a focus on ponds and pondscapes, Land Use Policy 135: 106957. doi: 10.1016/j.landusepol.2023.106957.

Schafft M, Wegner B, Meyer N, Wolter C, Arlinghaus R (2021) Ecological impacts of water-based recreational activities on freshwater ecosystems: a global meta-analysis. Proc R Soc B 288: 20211623. doi: 10.1098/rspb.2021.1623.

Smith T, Buckley P (2020) Biological Flora of the British Isles: Crassula helmsii. J Ecol 108: 797–813. doi: 10.1111/1365-2745.13336.

Smith LP, Clarke LE, Weldon L, Robson HJ (2022) An evidence-based study mapping the decline in freshwater ponds in the Severn Vale catchment in the UK between 1900 and 2019. Hydrobiologia 849: 4637–4649. doi: 10.1007/s10750-022-05000-w.

Smyth RL, Fatima U, Segarra M, Borre L, Zilio MI, Reid B, Pincetl S, Astorga A, Huamantinco Cisneros MA, Conde D, Harmon T, Hoyos N, Escobar J, Lozoya JP, Perillo GME, Piccolo MC, Rusak JA, Velez MI (2021) Engaging stakeholders across a socio-environmentally diverse network of water research sites in North and South America. Environ Dev 38: 100582. doi: 10.1016/j.envdev.2020.100582.

Sousa E, Quintino V, Palhas J, Rodrigues AM, Teixeira J (2016) Can Environmental Education Actions Change Public Attitudes? An Example Using the Pond Habitat and Associated Biodiversity. PLoS ONE 11: e0154440. doi: 10.1371/journal.pone.0154440.

Stamenković O, Stojković Piperac M, Milošević D (2019) Anthropogenic pressure explains variations in the biodiversity of pond communities along environmental gradients: a case study in south-eastern Serbia. Hydrobiologia 838: 65–83. doi: 10.1007/s10750-019-03978-4.

Streimikiene D (2015) Environmental indicators for the assessment of quality of life. Intellect Econ 9: 67–79. doi: 10.1016/j.intele.2015.10.001.

Szilassi, P, Bata T, Szabó S, Czúcz B, Molnár Z, Mezősi G (2017) The link between landscape pattern and vegetation naturalness on a regional scale. Ecol Indic 81: 252–259. doi: 10.1016/j.ecolind.2017.06.003.

Turkelboom F, Demeyer R, Vranken L, De Becker P, Raymaekers F, De Smet L (2021) How does a nature-based solution for flood control compare to a technical solution? Case study evidence from Belgium. Ambio 50: 1431–1445. doi: 10.1007/s13280-021-01548-4.

Vanhöfen J, Härtel T, Reichert G, Randler C (2025) The relationship between perception and landscape characteristics of recreational places with human mental well-being. Sci Rep 15: 4245. doi: 10.1038/s41598-025-88414-5.

Vasco F, Perrin JA, Oertli B (2024) Urban pondscape connecting people with nature and biodiversity in a medium-sized European city (Geneva, Switzerland). Urban Ecosyst 27: 1117–1137. doi: 10.1007/s11252-023-01493-y.

Vo HT, Vrachioli M, Frick F, Sauer J, Brucet S, Benejam Vidal L, Mehner T, Lemmens P, Oertli B, Boissezon A, Beklioğlu M, Dolcerocca A, Meerhoff M (2023) Socio-economic or environmental benefits from pondscapes? Deriving stakeholder preferences using analytic hierarchy process and compositional data analysis. J Environ Manage 342: 118298. doi: 10.1016/j.jenvman.2023.118298.

Waylen KA, Wilkinson ME, Blackstock KL, Bourke M (2024) Nature-based solutions and restoration are intertwined but not identical: Highlighting implications for societies and ecosystems. Nat-Based Solut 5: 100116. doi: 10.1016/j.nbsj.2024.100116.

Wickham H (ed) (2016) Ggplot2: elegant graphics for data analysis. Springer, Cham. doi: 10.1007/978-3-319-24277-4.

Xie Q, Lee C, Lu Z, Yuan X (2021) Interactions with artificial water features: A scoping review of health-related outcomes. Landsc Urban Plan 215: 104191. doi: 10.1016/j.landurbplan.2021.104191.

Zamora-Marín JM, Ilg C, Demierre E, Bonnet N, Wezel A, Robin J, Vallod D, Calvo JF, Oliva-Paterna FJ, Oertli B (2021) Contribution of artificial waterbodies to biodiversity: A glass half empty or half full? Sci Total Environ 753: 141987. doi: 10.1016/j.scitotenv.2020.141987.

Zebrowitz LA (1990) Social perception. Thomson Brooks/Cole Publishing Co.

Zerbe S (2023) Actors and Stakeholders and Their Role in Ecosystem Restoration: Conflict Resolution and Acceptance Through Participation. In: S Zerbe (ed) Restoration of Ecosystems – Bridging Nature and Humans. Springer Spektrum, Berlin, Heidelberg. 10.1007/978-3-662-65658-7_22.

Zhang X, Zhang Y, Zhai J, Wu Y, Mao A (2021) Waterscapes for Promoting Mental Health in the General Population. Int J Environ Res Public Health 18: 11792. doi: 10.3390/ijerph182211792.

Zdeněk R, Lososová J, Mráz J (2025) Long-term trends in the economic viability of pond aquaculture in Central Europe – The example of Czechia. Aquaculture 598: 742069. doi: 10.1016/j.aquaculture.2024.742069.

Annex 1 (template of the common questions asked to the inhabitants and stakeholders)

How would you describe your relationship with 'nature'?
Please select a score from 1 to 5, where 1 means 'very weak' and 5 means 'very strong'.

How would you describe your relationship with pondscapes?
Please select a score from 1 to 5, where 1 means "very weak" and 5 means "very strong".

Are pondscapes important for your quality of life?
Please respond using the five-point scale, where 1 means "not important at all" and 5 means "very important".

Have you observed significant changes in this pondscape during the last ten years?
- Yes
- No

And, if so, which one(s)?
Check any that apply
- Colonisation of new animal species
- extinction of local animal species
- colonisation of new plant species
- extinction of local plant species
- increase of bad odours
- decrease of bad odours
- increase of pondscape surface area
- decrease of pondscape surface area
- increase in the number of ponds
- decrease in the number of ponds
- more rubbish
- less rubbish
- higher pond water level
- lower pond water level
- improvement of water quality
- deterioration of water quality
- more frequent drying of ponds
- less frequent drying of ponds
- other:

In your opinion, what are the contributions provided by this pondscape?
Please rank the following contributions on a scale from 1 to 5, where 1 means "not important at all" and 5 means "very important".

	1	2	3	4	5
Food and feed (productivity of food: fish, waterfowl, livestock)					
habitat creation and maintenance (preservation of desired species, for biodiversity conservation)					
pollination (diversity of plants to be pollinated)					
regulation of water quality (water purification)					
regulation of water quantity (reservoir of irrigation, water supply)					
regulation of hazards (flooding regulation, fire protection)					
regulation of climate (carbon storage, maintaining an acceptable temperature)					
physical and psychological experience (calm, freshness, sociability, activities)					
learning and inspiration (aesthetic, art, education, science)					
supporting identities (cultural heritage, local identity)					
maintenance of options (potential opportunities offered by nature to ensure resilience in the future)					

In your opinion, what is the environmental condition of this pondscape?
Please respond using the five-point scale, where 1 means "very bad" and 5 means "very good".

What do you perceive are the most important threats to this pondscape in future?
Please, rank the following threats on a scale from 1 to 5, where 1 means "not important at all" and 5 means "very important".

	1	2	3	4	5
Climate change					
Deforestation					
extraction of materials (gravel, sediment, sand…)					
intensive farming (trampling by cattle for example)					
invasive species					
over-exploitation (water abstraction, irrigation)					
Pollution					
tourism (rubbish, damage to vegetation by trampling, disturbance of wildlife)					
Urbanization					

For you, what are the impacts of these threats in future?
Please, rank the following impacts on a scale from 1 to 5, where 1 means "minor impact" and 5 means "major impact".

	1	2	3	4	5
impact on the productive purpose					
impact on human health					
impact on water quantity					
impact on water quality					
impact on biodiversity					
impact on water temperature					
impact on soil erosion					
impact on the landscape					
impact on my property/my security (nuisance species and flooding for example)					

In order to mitigate these threats and impacts, what changes would you propose to improving the environmental state of the most visited pondscape?
Tick the following propositions on a scale of 1 to 5, where 1 means "not at all important" and 5 means "very important".
- better/more environmental education
- creating new ponds
- increasing biodiversity (species, populations, or on a genetic level)
- improving water quality
- increasing the volume of water
- limitation of certain uses
- abandonment of certain uses
- restoration measures
- maintenance of biodiversity
- monitoring of ponds
- developing public ownership
- developing environmental regulation

Supplementary data

Table S1 Dominant profile of stakeholders and inhabitants per pondscape.

Pondscapes	Stakeholders			Inhabitants	
	Dominant area education	Prominent role	Sense of professional responsibility (1–5)	Most selected visit frequency	Mean distance from their home (km)
Bois de Jussy	Biology	Consultancy	3.2	Once a month	7.4
Rhône Genevois	Biology	Consultancy	3.8	Once a month	7.2
Schöneiche	Administration	Local authority	2.6	Once a month	2.4
Dikkuyruk	Engineering	Civil society	4.0	Once a week	12.0
Gölbasi	Engineering	Civil society	4.1	Once a week	9.7
Imrahor	Engineering	National authority	4.3	/	15.0
Pinkhill Meadows	Ecology	Civil society	3.0	Once a month	12.5
Water Friendly Far.	Ecology	National authority	3.0	Once a week	9.6
Albera	Biology	Regional authority	3.1	Once every six months	17.6
La Pletera	Biology	Research / Local authority / Regional authority	2.5	Once every six months	19.2
Gete Vallei	Ecology	Civil society	3.6	Once a month	9.3
Pikhakendonk	Ecology	Research	3.4	Once a month	4.2
Tommelen	Ecology	Civil society	3.0	Once a month	3.8
Sierra de los Car.	Agronomy	Research	3.5	Once a month	18.7
La Pedrera	Ecology	Research	4.6	/	18.8
Lystrup	Biology	National authority	3.6	Once a day	2.2
Fyn	Biology	National authority	4.0	Once every six months	23.1

Table S2 Mean scores obtained by respondent types for their relations to nature, to the pondscape and quality of life. The values are presented by pondscapes, by country, and also for all data obtained.

Country	Pondscapes	Relation to nature		Relation to pondscape		How important are the pondscapes for your quality of life?	
		Inhabitants	Stakeholders	Inhabitants	Stakeholders	Inhabitants	Stakeholders
Switzerland	Bois de Jussy	4.4	4.8	3.8	4.2	3.5	4.2
	Rhône Genevois	4.5	4.8	3.9	4.2	3.8	4.2
Germany	Schöneiche	4.2	4.8	3.6	3.6	3.2	4.2
Turkey	Dikkuyruk	4.5	4.6	4.2	3.6	3.8	4.3
	Gölbasi	3.9	4.6	3. 8	3.3	3.7	4.2
	Imrahor	3.5	4.6	3.0	3.4	3.5	4.5
England	Pinkhill Meadows	4.4	4.7	3.0	3.9	3.1	4.3
	Water Friendly Farming	4.7	5.0	3.3	4.5	3.7	4.3
Spain	Albera	4.5	4.5	3.8	3.9	4.0	4.0
	La Pletera	4.1	/	3.9	/	4.1	/
Belgium	Gete Vallei	4.3	4.8	3.8	4.6	3.8	4.2
	Pikhakendonk	4.2	4.6	3.5	4.4	3.2	4.0
	Tommelen	4.0	4.5	3.9	4.2	3.8	4.1
Uruguay	Sierra de los Caracoles	4.5	4.5	3.8	3.2	3.9	3.0
	La Pedrera	5.0	5.0	3.7	4.0	4.0	3.0
Denmark	Lystrup	4.1	5.0	4.1	4.3	3.8	4.6
	Fyn	4.6	5.0	3.7	4.2	3.5	4.8
Average		4.4	4.7	3.6	3.9	3.6	4.1

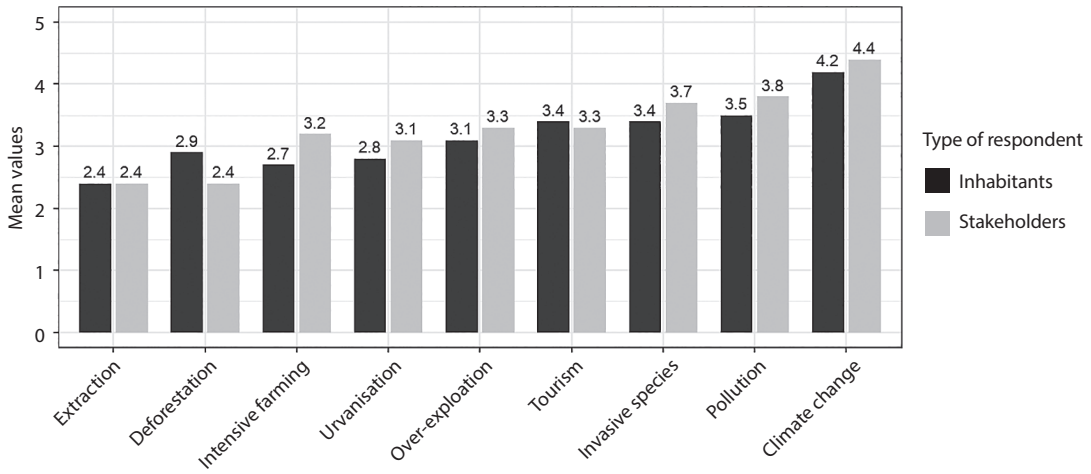

Fig. S1 Assessment of threats with mean scores given by both respondent types (inhabitants in black and stakeholders in grey), with all pondscapes combined.

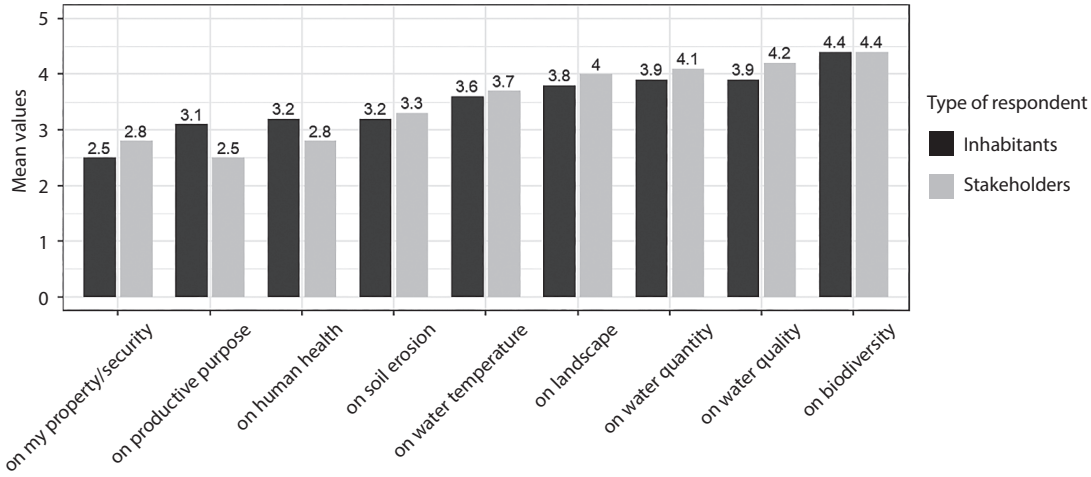

Fig. S2 Assessment of impacts of threats with mean scores given by both respondent types (inhabitants in black and stakeholders in grey), with all pondscapes combined.

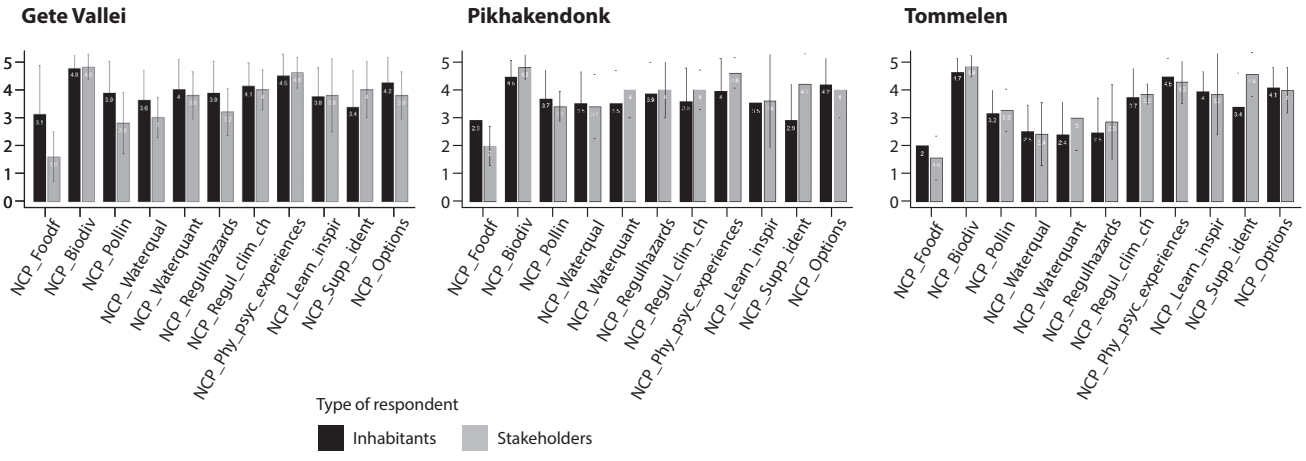

Fig. S3 NCP assessment for inhabitants (in black) and stakeholders (in grey) in the Belgium pondscapes.

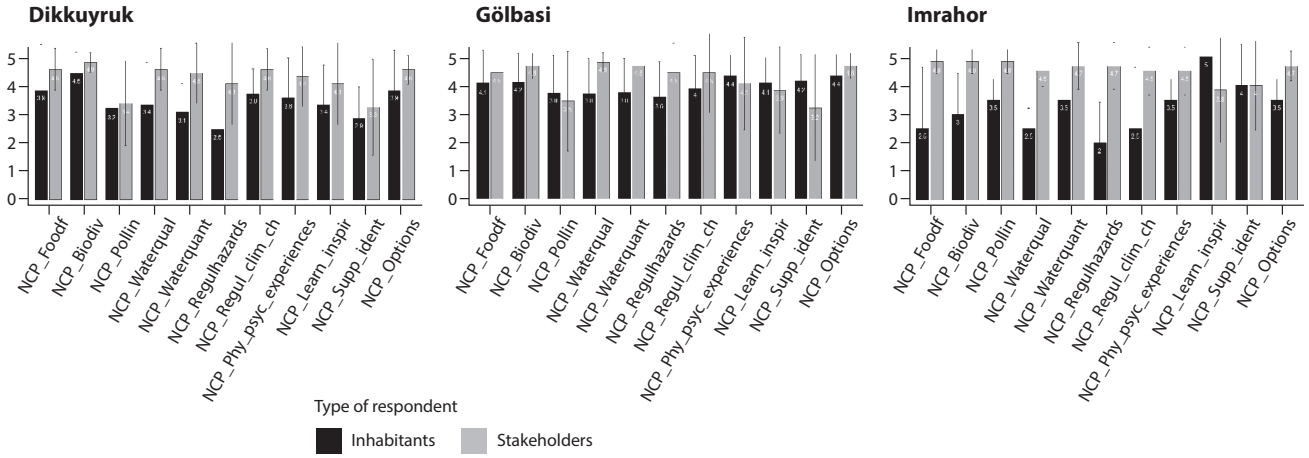

Fig. S4 NCP assessment for inhabitants (in black) and stakeholders (in grey) in the Turkish pondscapes.

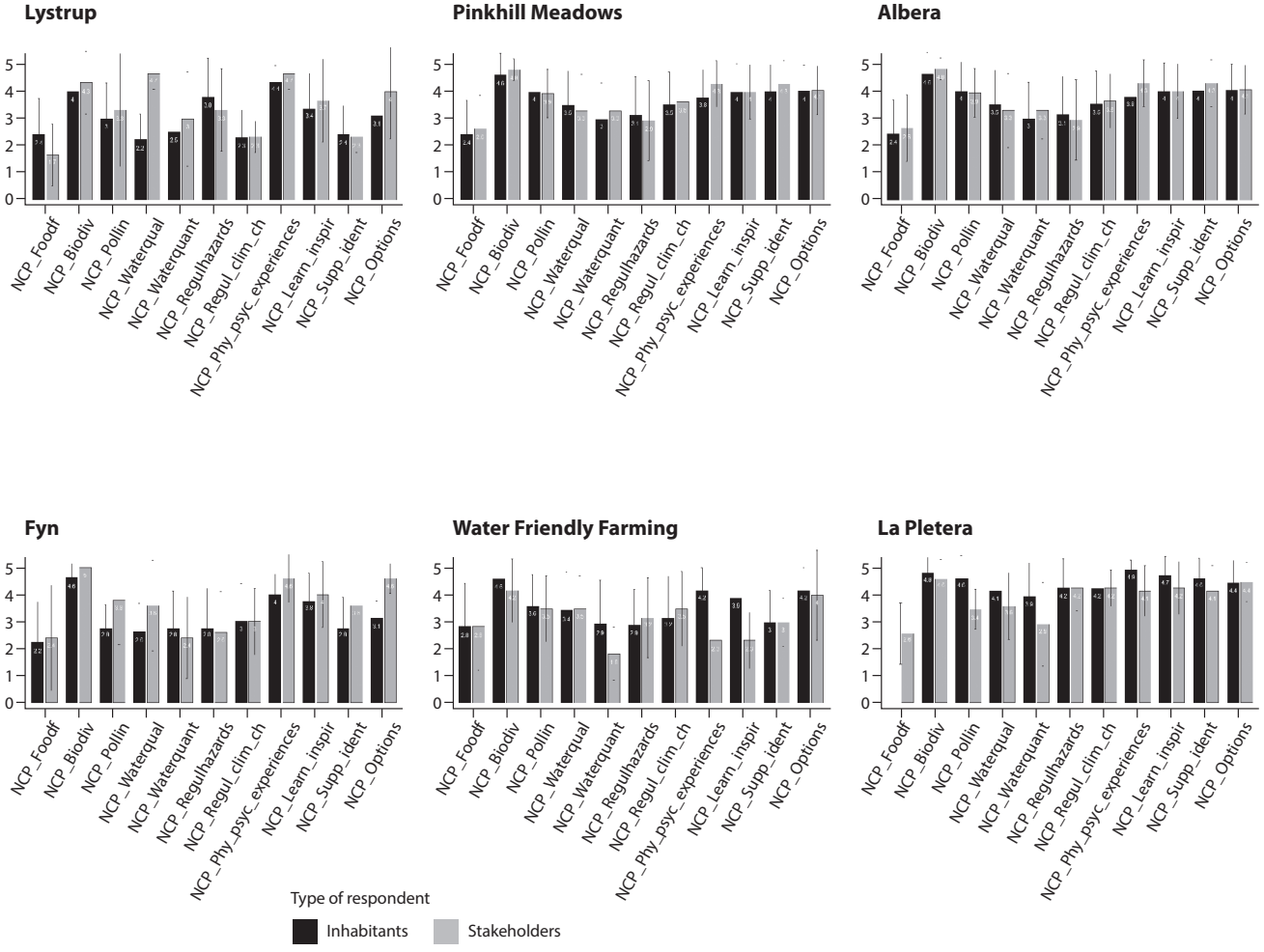

Fig. S5 NCP assessment for inhabitants (in black) and stakeholders (in grey) in the English, Danish and Spanish pondscapes.

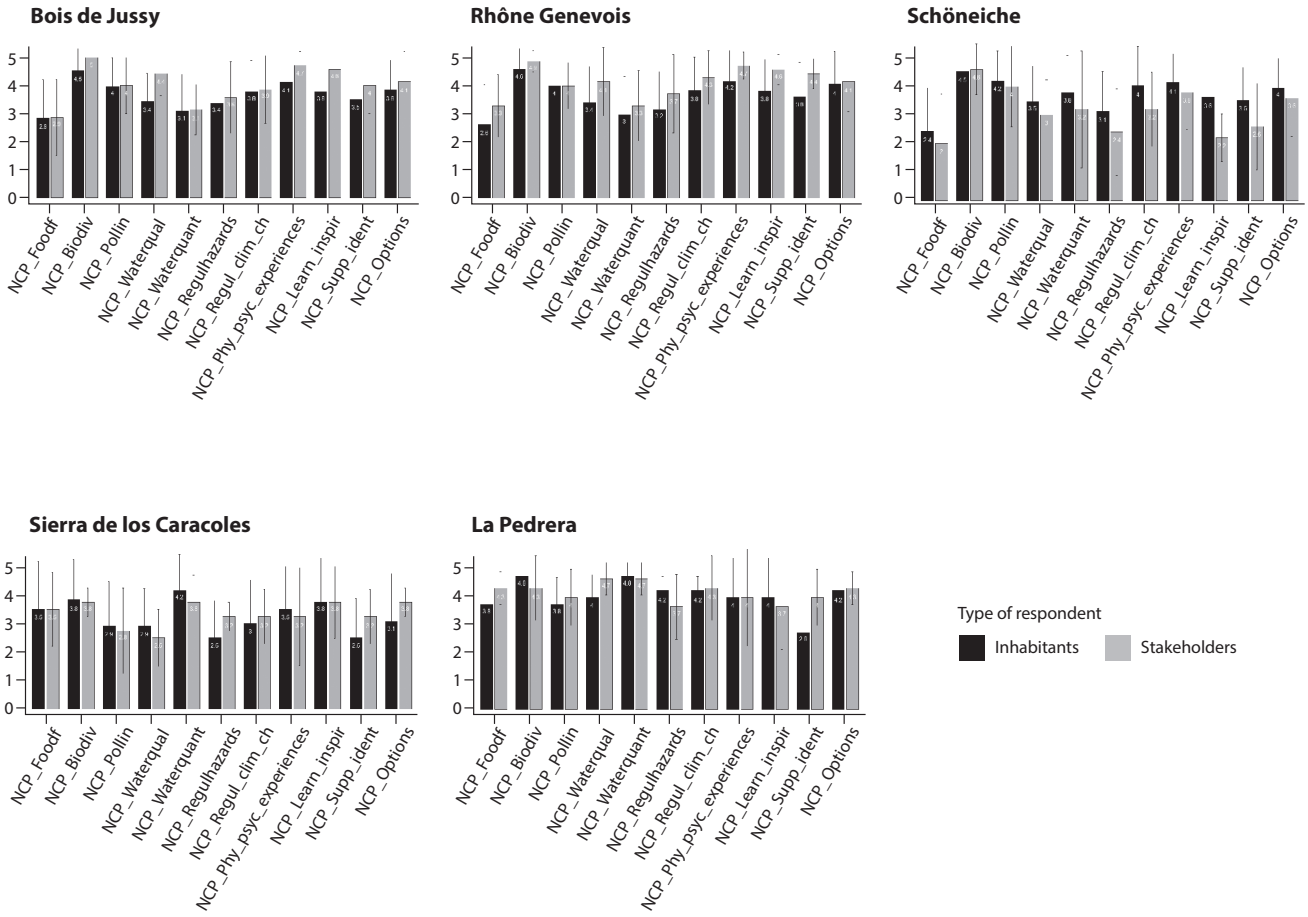

Fig. S6 NCP assessment for inhabitants (in black) and stakeholders (in grey) in the Uruguayan, Swiss and German pondscapes.