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What locals want: citizen preferences and priorities for the Tagliamento River

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Abstract

Sustainable river management frameworks are based on the connection between citizens and nature. So far, though, the relationship between rivers and local populations has played a marginal role in river management. Here, we present a blueprint questionnaire to characterize the perception of cultural ecosystem services (CES) by locals, and how preferences change across the river landscape. We investigate how locals value the river and whether their preferences are affected by characteristics such as place of residence, age, frequency of visits and relation to the river. The questionnaire was filled in by more than 4000 respondents, demonstrating huge interest and willingness to contribute to the project. A striking 85% of respondents identify a spiritual value of the river, suggesting a strong emotional connection. River conservation is the main priority for most respondents across the different groups. The map of favorite places shows that most of the river is appreciated by locals, with a high preference for the landscape of the braided middle course. The most valued area of the river, located in the middle course, faces threats due to dam construction projects, which would modify the natural course of the river and likely impact the favorite places of the locals. Our study highlights discrepancies between management choices and citizens´ values and priorities, and shows the need for including river values and CES in river management and their potential role for tackling conflicts. More generally, this work points out that any river intervention should be pondered carefully accounting for its environmental impact also in terms of loss of river values.

1. Introduction

A big challenge today is to promote both the well-being of nature and humankind. Traditionally, human society has been increasingly modifying and disrupting ecosystems, often in favor of economic interest or risk management (e.g. flood protection). In Europe, the last free-flowing rivers are threatened by artificial infrastructure (Grill *et al* 2019), often following energy production and risk reduction priorities, with severe implications for the rivers' ecological status (Lovett 2014, Grizzetti *et al* 2017, Tickner *et al* 2017, Strassburg *et al* 2020).

Besides their ecological value, rivers also provide important benefits to people. They provide places for recreation (Rabe *et al* 2018), improve the health and wellbeing of people living near them (Völker and Kistemann 2011, Nutsford *et al* 2016), and have a high aesthetic value, which is often related to their ecological value (Junker and Buchecker 2008). In addition, many rivers have an important spiritual value to indigenous communities (Klubnikin *et al* 2000, Harmsworth *et al* 2016) and are an important element of local identities (Du Bray *et al* 2019). These types of values and benefits, including recreation, sense of place, heritage and inspiration, which can

be described using frameworks such as nature's contributions to people or cultural ecosystem services (CES), are often not considered in environmental assessments (Satz *et al* 2013, Small *et al* 2017) and land use management (Brown and Fagerholm 2015). In part, this is because river values, defined here as CES and connection to places, are difficult to quantify (Fish *et al* 2016b, Ryfield *et al* 2019) and assessing them requires the involvement of a wide range of beneficiaries.

Involving and engaging citizens in river management is of uttermost importance (Maidl and Buchecker 2015, Global Water Partnership *et al* 2016, UN 2017, Euler and Heldt 2018, Allen *et al* 2019), and participatory processes are key to support social learning (Mostert *et al* 2007, Muro and Jeffrey 2008, Borowski-Maaser *et al* 2021, Nikkels *et al* 2021). However, in practice, participation is still marginal and often does not impact river management choices (Wehn *et al* 2015, Verbrugge *et al* 2017), and lack of stakeholder involvement is the main cause of failure for many river restoration projects (Heldt *et al* 2016). The relationship between rivers and local populations plays a marginal role in river management, in part because most participatory approaches involve stakeholders but do not include all profiles of citizens, and often do not deal with cultural and social aspects (Santoro *et al* 2019). Although approaches such as participatory mapping are increasingly used in Europe, e.g. Zoderer *et al* (2016), Garcia *et al* (2021), Brown *et al* (2020), the locals' perception of rivers and the CES they provide is mostly unknown (Arias-Arévalo *et al* 2017, Mould *et al* 2020, Liguori *et al* 2021).

Given their importance for people's wellbeing, as well as the potential trade-offs and conflicts between CES and other ecosystem services, there is a need to better include CES in assessments and river management projects. Integrating CES in decision-making requires innovative methods that translate concepts like 'environmental spaces' and 'cultural practices' to evidence-based information (Fish *et al* 2016a). Assessments of CES can be done through indicator-based approaches (Casado-Arzuaga *et al* 2014, Thiele *et al* 2019) or social media data (Richards and Friess 2015, Oteros-Rozas *et al* 2018) that provide spatially explicit information about CES, or using more qualitative approaches, such as questionnaires or interviews to inform on perceived CES (Martín-lópez *et al* 2014). Questionnaires can grasp intangible values, and help pointing their importance and the need to better include them in ES assessment/river management projects. Questionnaires are particularly appropriate to assess CES, as they can combine both qualitative (open-ended questions) and quantitative information (ranking questions), allowing for an integrated assessment (Jaligot *et al* 2019). Participatory mapping is a useful approach to elicit spatially explicit information about people's perceptions (Verbrugge and van

Den Born 2018, Jaligot *et al* 2019, Fagerholm *et al* 2021). While questionnaires and participatory mapping are increasingly used in ES research and urban planning, they have not often been used to assess links between river values and land/river management at the river basin scale.

To fill these gaps, we assess links between river values and management as seen by all the locals of the river. We assess how locals value the Tagliamento River (TR) in Italy, one of the last free-flowing rivers in Western Europe. Despite being morphologically well preserved, the TR is at the center of a decadal long dispute regarding river management and ecological conservation, in particular in relation to future infrastructural plans (Brusarosco *et al* 2010, Osti 2019, Scaini *et al* 2021a). We assess CES throughout the whole basin by assessing locals' perception of river values as well as their opinion on river management options, and use favorite places and landscapes as a way to identify areas of interest and perceived value. In addition, we test if and how perception is affected by people's characteristics such as place of residence, age, knowledge of the river and relation to the river.

2. Materials and methods

2.1. The questionnaire
The questionnaire, in Italian and English, was prepared using the software Questionpro and was available online between 23 November 2020 and 5 January 2021. To reach a comprehensive picture of the different relationships, values and opinions of people, the questionnaire was shared widely, where the only condition for participation was some knowledge of the TR (Scaini *et al* 2021b).

The questionnaire includes questions regarding the respondents' perception of the role and importance of the TR in terms of CES (contact with nature, identity, spirituality, conservation), river management and development, and risks (table 1). In addition, respondents are asked to pinpoint on a map their favorite locations, identifying important areas for place attachment and recreation. The questionnaire is comprised of 12 questions, aiming at assessing three main categories:

- CES—The first two questions, Q1 and Q2, relate to the CES and other uses of the river, where the participants were asked about their agreement with statements describing the CES (see SI available online at stacks.iop.org/ERL/17/025008/mmedia) using a 5-step likert scale. A free-text follow up question allowed participants to expand on their opinion related to the CES: 'Would you like to say something more about your opinion?' (Q3).
- River management—Participants were asked to prioritize management options (Q4) to understand

Table 1. List of questions included in the questionnaire, including question ID used throughout the article. The questions used for the groupings are shown in italic. More detailed information available in the SI.

ID	Question	Statements
Q1	How much do you agree with the following statements?	The TR allows me to be in contact with nature; The TR is a source of inspiration; The TR takes me back to my childhood; The TR is a place I feel connected to; The TR has a spiritual/symbolic meaning to me; The TR is an important part of my culture and tradition
Q2	How much do you agree with the following statements?	The TR offers opportunities for recreation and socialization; The TR offers opportunities for tourism; The TR offers opportunities for learning from nature; The TR offers opportunities for conducting research; The TR offers opportunities for agricultural/industrial development
Q3	Would you like to add something more about your opinion?	
Q4	How would you divide funds to improve the Tagliamento? Drag these options to the right rectangle, in order of importance	River works to defend against floods; River promotion (events, guided tours); Recreation (e.g. cycle paths); Education and research activities; Ecosystem and landscape conservation; Infrastructure/Energy production
Q5	What river features or types of management would you support and which ones not?	Recreation activities (ex. cycling routes); Recreation activities (ex. car racing); Natural reserves; Hydroelectric power generation; Extraction of gravel or sand; Cultivated fields near the river; Natural vegetation in the river; Bridges and roads; Use of chemicals near the river
Q6	Click on the map to indicate up to 5 favorite places on the TR!	
Q7	Would you like to explain why you chose these points?	
Q8	Which TR landscape do you like the most?	Two photos for each basin morphology
Q9	*How old are you?*	*18–30; 31–50; 51–70; > 71*
Q10	*Where do you live?*	*TR—mountain basin; TR—upper basin; TR—middle basin; TR—lower basin; In another municipality in Friuli Venezia Giulia; In another municipality in Veneto; In other regions of Italy Abroad*
Q11	*How often do you visit the TR?*	*Almost every day; Once a week; Once a month; Once a year; I have been there once; Other*
Q12	*Which of these groups do you belong to? Think about the relationship you have with the TR and choose more than one option if you deem it necessary!*	*Artist/writer; Tourist; Researcher/scholar; Production activity linked to the TR; Teacher/environmental educator; Activities such as kayaking, swimming, walking, biking; Activities with motorcycles, cars; Local technician; Local administrator; Politician; Student; Activities such as hunting, fishing; Member of an environmental association; Other*

their river management priorities in relation to current management plans. The management options of Q4 are quite general. A more specific question was asked to hear the participant´s opinion about specific river features or types of management they would or would not support (Q5).

- Favorite places and landscapes—Participants were asked to indicate up to 5 favorite places on the TR (Q6), with the underlying assumption that people would choose their favorite places based on their attributed value. The question was organized so that participants would 'click' on the OpenStreetMap basemap (available at openstreetmap.org) of

the TR landscape—no zoom or change of background options were available. A free-text follow-up question allowed participants to explain their choices (Q7). An additional question was posed to ask which photo of the Tagliamento landscape participants liked the most (Q8). The TR basin was divided into three main parts: upper, middle and lower, based on geomorphological settings and on slope (Paronuzzi 2005). The upper basin is dominated by steep channels in mountainous areas with forested vegetation. The middle basin is largely comprised of a highly dynamic channel which is braided through a wide (1 km) gravel bed. In the

lower basin the river is a single, meandering channel. For this task, one choice was given among a total of 6 photos, e.g. 2 for the upper, 2 for the middle, and 2 for the lower course.

Close-ended questions to profile the participants were also included, in particular asking age (Q9), place of residence (Q10), and frequency of visits to the TR (Q11). In addition, participants' relation to the river was assessed through a multiple option question, where participants were asked to identify with groups based on their activities or use of the river (such as recreation, fishing, environmental activism, administration; see SI for all groups) (Q12).
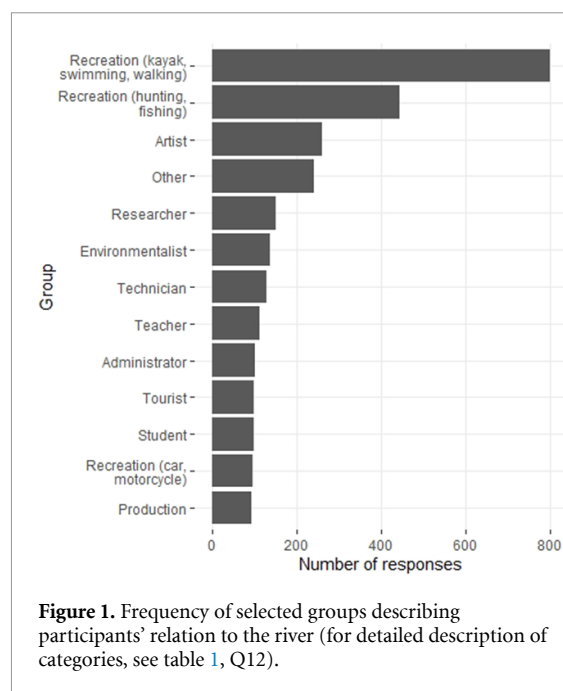
The online questionnaire was shared widely with different types of stakeholders (table SI2), including locals, NGOs and other interest groups (e.g. civil associations, teachers and educators, public and private water managers), and public administration members (e.g. technicians, practitioners).

2.2. Analysis of responses

For the analysis of responses to individual questions, all responses were used, including participants who did not finish the questionnaire (more details in SI). The Pearson chi-square test of independence was used to test for differences among the participants' responses and opinions based on their age (Q9), place of residence (Q10), frequency of visits (Q11) and relation to the river (Q12). For each group, we tested whether their responses were significantly different from participants that did not identify with this group. Only the groups 'Environmentalist', 'Local technician', 'Production activity' showed significant differences with the rest of the participants and are discussed in the manuscript. Only significant differences between the classes are discussed in the manuscript. In order to achieve a statistical sample to perform the chi-square test, the place of residence categories for the tributaries and the upper basin, as well as the categories for municipalities not along the river (Friuli Venezia Giulia, Veneto, other regions in Italy) and residents living abroad were aggregated.

The free-text comments were used to map the most recurring words through word clouds as well as to apply the method described in Scaini *et al* (2021b). The categorization of free-text was performed through the use of tags. The free-text results were analyzed with tags associated with the use of certain words, as well through a manual screening.

The software Questionpro has a built-in functionality called 'heatmap', used for Q6. The output provides a qualitative image showing the amount of clicks based on a 5-step color scale. Clicking is a simple action that can be done by most users, something important here given that responses validity depends on the capacity to work with spatial attributes (Jaligot *et al* 2019).

Figure 1. Frequency of selected groups describing participants' relation to the river (for detailed description of categories, see table 1, Q12).
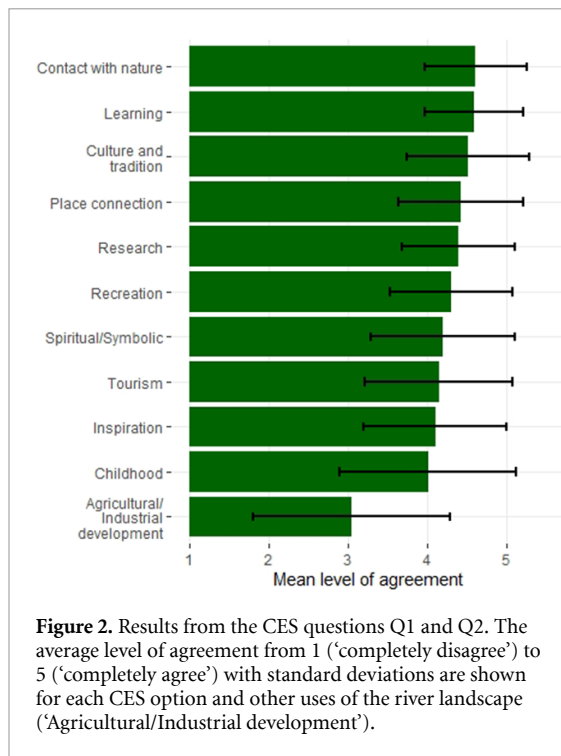
2.3. Mapping drivers of preference

A georeferenced, quantitative version of the map of favorite places (Q6) was created following the approach described in SI and compared to other spatial proxies that could be used to map CES. For this purpose, global land use maps (Buchhorn *et al* 2019), the InVEST approach to map recreation (Adamowicz *et al* 2011), the Park4Night database (a participatory mapping project to identify areas where it is possible to spend the night camping or by recreational vehicles), total and rural touristic infrastructure, as well as land use information were used (see SI for more information). All the maps were created in QGIS.

3. Results

3.1. Participants

The questionnaire was filled in by 4100, and completed by 2220 respondents, corresponding to a 53.6% completion rate, with 94% of responses coming from Italy. For a breakdown of the detailed information regarding participants profiling, see Scaini *et al* (2021b). 58% of the respondents reside in the river basin and 32% in other municipalities of the Friuli-Venezia Giulia region. More than 30% of participants visit the river at least once a week, and more than half of participants do so at least once a month (34%). All age categories are well represented. In terms of the relation to the river, the two most frequently selected groups were related to recreational activities such as kayaking, swimming, hiking or biking (38%), followed by recreation such as hunting or fishing (21%) (figure 1). These groups were also the most represented combination (see figure SI1 for more details about overlaps between

Figure 2. Results from the CES questions Q1 and Q2. The average level of agreement from 1 ('completely disagree') to 5 ('completely agree') with standard deviations are shown for each CES option and other uses of the river landscape ('Agricultural/Industrial development').

groups). Artistic activities (artist, writer) ranked in third position (12%). The majority of respondents pointed to one option (58%), while 21% selected two and 8% selected three groups (figure SI1). Only 2% of respondents identified with more than three groups.

3.2. Cultural ecosystem services provided by the river

The valuation of the CES was consistent among the different groups of participants (age, residence, relation to river and river visits). With an average level of agreement above 4, most of the respondents agree or strongly agree with all the statements on CES (figure 2). This indicates the importance of the social and cultural values attached to the TR. On average, the respondents disagree with the statement 'The TR offers opportunities for agricultural/industrial development'.

The free-text responses to Q3 were filled in by a total of 643 participants. Among the comments nearly 40% of respondents gave detailed information regarding what they value about the river, and 74% of the comments contained some mention of CES and in particular expressed thoughts and concerns regarding the conservation of the river (35% of the comments).

3.3. River management and future priorities

Overall, the management priority that ranks first is river conservation, followed by education, river promotion (such as events and guided tours), flood protection measures, recreation and

infrastructure/energy production (figure 3). Across different participants, the first priority is always conservation, and the last is always infrastructure/energy production, while the ranking of the other priorities differ depending on age groups and place of residence (figure 3). The group of people older than 71, in particular, ranked education, flood protection measures and infrastructure/energy higher than the other groups. The residents of the lower course gave more priority to flood protection measures, which rank third.

Different groups based on their relation to the river mostly have similar priorities (figure SI2). Environmentalists assign a higher priority to education and promotion of the river, and a lower priority to flood protection than other participants. Participants with a production activity (e.g. agriculture) give slightly more priority to infrastructure, and technicians (e.g. engineers) give a higher priority to infrastructure/energy and flood protection than other respondents. However, even among these respondents, conservation is still the first priority on average, and infrastructure is still the last priority.

The vast majority of respondents (>80%) would like to see more protected areas in the river (figure 4). In addition, 70% of participants would like to see a larger number of cycling paths and 50% would like to see a higher presence of riparian woods in the river. Gravel extraction and the construction of dams or hydroelectric plants is discouraged by 55% and 40% of respondents respectively, with few respondents who would like to see more of them. 94% of respondents are against the use of chemical products in the riverbed, which is nowadays partially devoted to agricultural activities.

3.4. Favorite place and landscapes

The landscape of the middle course (i.e. braided channels) was selected as the preferred landscape by 60% of the respondents (Q8). Most respondents preferred the middle course but favorite places (Q6) are located along the entire river (figure 5(a)). The residents of the upper, middle and lower course tended to select locations closer to their place of residence but two areas were selected by all participants (see SI, figure SI4). The free-text response (Q7) was filled in by a total of 986 participants, who provided details on the reasons for their choices, such as vicinity to their current or past homes, or links to childhood memories. Among the most recurring words (Q7, see SI) are the names of specific places, whose occurrence is indicated by the size of the circles in figure 5(b). The most mentioned locations (Q7, figure 5(b)) coincide with the places with the highest number of clicks (Q6, figure 5(a)).

Tourist infrastructure was concentrated in delta municipalities with some infrastructure present in
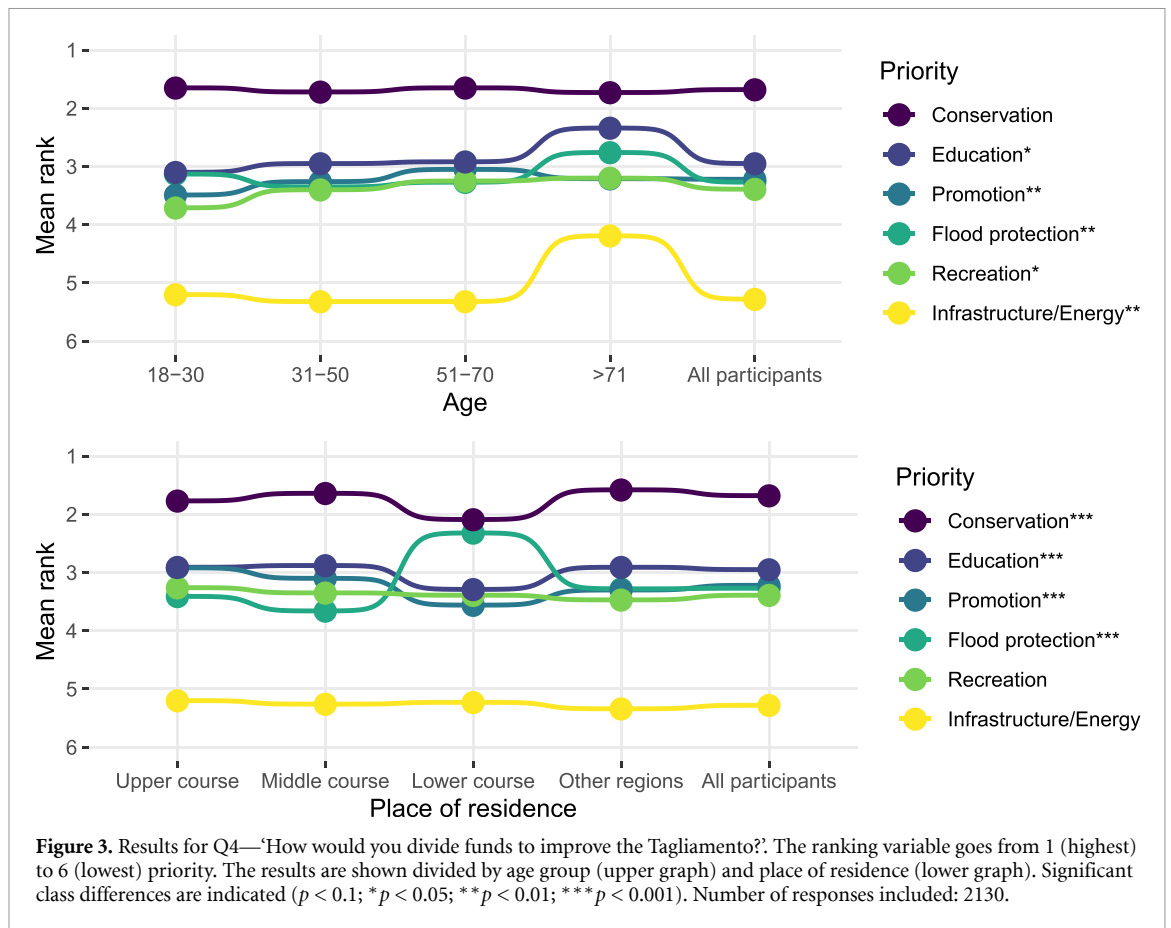
Figure 3. Results for Q4—'How would you divide funds to improve the Tagliamento?'. The ranking variable goes from 1 (highest) to 6 (lowest) priority. The results are shown divided by age group (upper graph) and place of residence (lower graph). Significant class differences are indicated ($p < 0.1$; $*p < 0.05$; $**p < 0.01$; $***p < 0.001$). Number of responses included: 2130.
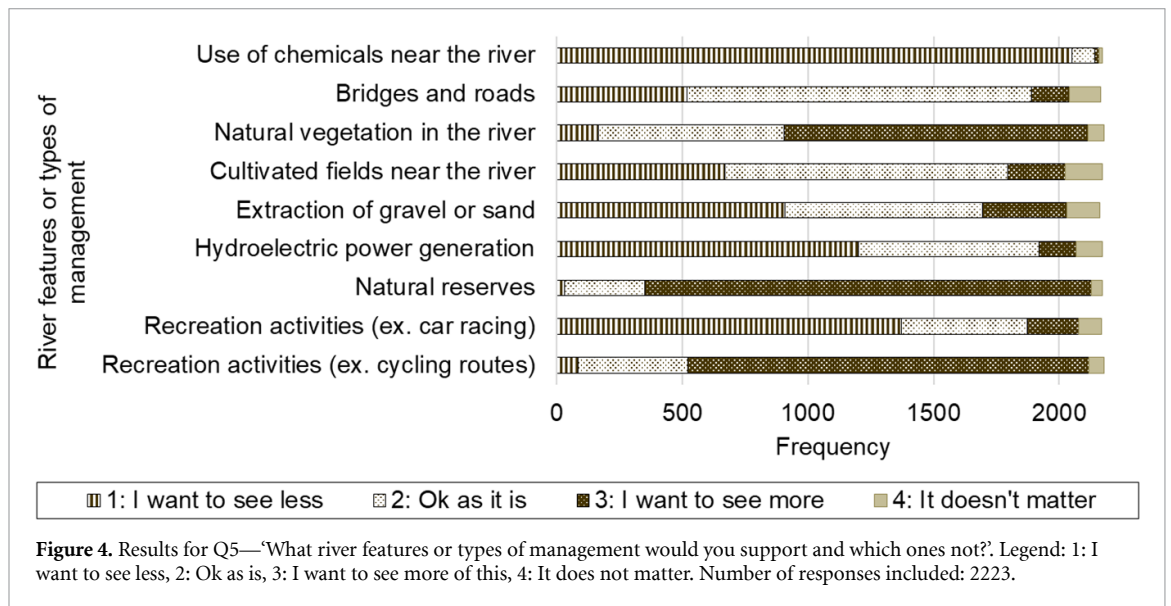
Figure 4. Results for Q5—'What river features or types of management would you support and which ones not?'. Legend: 1: I want to see less, 2: Ok as is, 3: I want to see more of this, 4: It does not matter. Number of responses included: 2223.

upper basin villages (figure 5(c)). Park4Night locations were mostly concentrated within the upper-middle course. Two main recreation hotspots were identified with the InVEST approach: one in the delta and one in the middle basin (figure 5(d)). Various land use characteristics were compared to Q6 and Q7 results (see SI, figure SI4), and suggest favorite places are located away from highways and often coincide

with the presence of bike and pedestrian paths (figure SI5).

4. Discussion

More than 4000 respondents participated in the questionnaire, demonstrating interest and willingness to contribute. The results are discussed below in terms

Figure 5. (a) Georeferenced map of the favorite places (Q6) (number of clicks km^{-2}; total number of clicks: 8814). Clicks <5 were set to transparent for readability. (b) Most mentioned places (Q7, see figure SI5). Marker size is proportional to the number of mentions (N max = 76, N min = 10). River morphology is also shown. (c) Degree of tourist development shown by the number of hotels and camping sites by municipality and the number of rural touristic infrastructures (green). (d) Camping locations inferred through the Park4Night database (blue triangles), and recreation hotspots identified by the inVEST method (Adamowicz *et al* 2011) by choosing the areas with more than 20 photo user days (yellow circles, raw data available in SI). The OpenStreetMap background (© OpenStreetMap contributors) is available under the Open Database License (www.openstreetmap.org/copyright).

of river management priorities (section 4.1), linking favorite places and future management plans (section 4.2), and the challenges of accounting for what locals want in river management strategies (section 4.3).

4.1. River conservation has the highest priority across groups

A high value is attributed to the river by a wide range of participants (with all CES categories being highly valued, figure 1), showing the importance of conservation efforts. 85% of respondents identify a spiritual value with the river, and 35% of the comments received through the free-text responses reported river conservation as the main concern. In terms of management choices, all groups identified conservation as the highest priority for river management. This is confirmed by the fact that more than 88% said that it is possible to tackle both conservation and risk mitigation (Scaini *et al* 2021b). Based on these results, management options that address the challenge of conservation and flood protection are required here,

pointing to the importance of nature-based solutions (or other management options that could allow for river conservation).

Management priority choices depend in part on people's relations to the river and their place of residence. Some differences across management priorities occur across participants from profiled groups, with only some link to age, residence, and the relation to the river (a proxy of stakeholder groups). Residents from the lower course give more importance to flood protection, which is likely related to the higher perceived risk of floods in the lower course (Scaini *et al* 2021b). Flood protection is also given the second highest priority by technicians, who also rank conservation first. Even the respondents who have a production activity related to the river give the same general ranking, highlighting that the overall opinion regarding management options is similar across groups. Among the more exhaustive list of priorities of management (Q5), more natural development options like bike paths and natural reserves are preferred to infrastructure, bridges and flood protection

measures (figure SI5). This could be read in light of the idea that ecosystem service delivery is correlated to ecological status (Grizzetti *et al* 2019).

The strong responses in favor of conservation in this survey may in part reflect a self-selection bias (Brown *et al* 2012), where people interested in the conservation of the TR may have been more likely to participate in the survey. However, the high level of consistency of responses across different user groups, which were targeted through various specific channels (table SI2), as well as across age groups and locations, suggests that similar results could be expected over a wider range of participants. Furthermore, self-selected sampling can be beneficial for the quality of participatory mapping, as participants with a better knowledge of the area are likely to invest more effort in mapping and contribute to more usable results (Brown *et al* 2012).

4.2. Mapping favorite places in relation to future infrastructure

Respondents' favorite places and landscapes were identified widely across the whole river course. In fact, the map of favorite places shows that most of the river is considered 'favorite' by the locals, reflecting the fact that many people relate to the river locally. The braided middle course, where the more natural part of the river is located (Müller 1995, Bertoldi *et al* 2009), was selected as a favorite river landscape by most participants, and the two locations most mentioned by participants were within the middle course. Hence, river morphology and landscape appear most important to visitors. The upper part of the middle course is attractive to a certain type of tourism (figure 5(c)), e.g. Park4Night locations, which represent non-conventional tourism. Interestingly, these points are found in areas with less touristic infrastructure, suggesting that this kind of visitor avoids 'crowded' places. Overall, the comparison of participatory mapping with other proxies for CES performed here indicates that none of the individual proxies, such as InVEST map of recreation or density of tourist infrastructure, fully reflects the distribution of the favorite places identified by local participants.

The mapping application used for this work has some limitations related to the platform and software used. For instance, results are provided in image form, and additional steps are needed to perform quantitative analyses (e.g. number of clicks at a given location) (SI). More sophisticated tools would enhance the data gathering phase, but might discourage some user categories, such as elder people, from participating. The use of clicks as favorite points is the least challenging way to map locations, but is not always the most suitable as it does not provide information on the spatial extent of the selected location (Brown and Fagerholm 2015). Another limitation is related to the scale used for the analysis, discussed by Jaligot *et al*

(2019). The mapping tool used through Questionpro did not allow zooming-in to define precise locations, which might have provided more useful information to assess local management issues at higher resolution, such as local recreation infrastructure. In spite of these limitations, it was possible to relate the map of favorite places to the presence or absence of river morphology features, infrastructure and land-use characteristics, demonstrating some of the potential offered by participatory mapping methodologies, e.g. Fagerholm *et al* (2021). More extensive analysis of participatory mapping data could allow to further assess specific CES (Casado-Arzuaga *et al* 2014, Fagerholm *et al* 2021), and future studies might be devoted to exploring the relationship between bike and pedestrian paths (SI) and favourite places at local scale. For example, river stretches with lower ecological status and accessibility corresponded to lower attachment between residents and the Wigger River in Switzerland (Garcia *et al* 2021).

The distinction between favorite places for upper, middle and lower course residents (figure SI3) indicates that generally people prefer, or know better, the part of the river they are closest to. However, two locations were selected by people from all areas: the river delta, which is very touristic, and the braided channels section of the river. The most mentioned favorite places coincide with natural areas (including two Natura 2000 sites) and the location of planned infrastructure, namely a highway and a flood detention dam (figure 6).
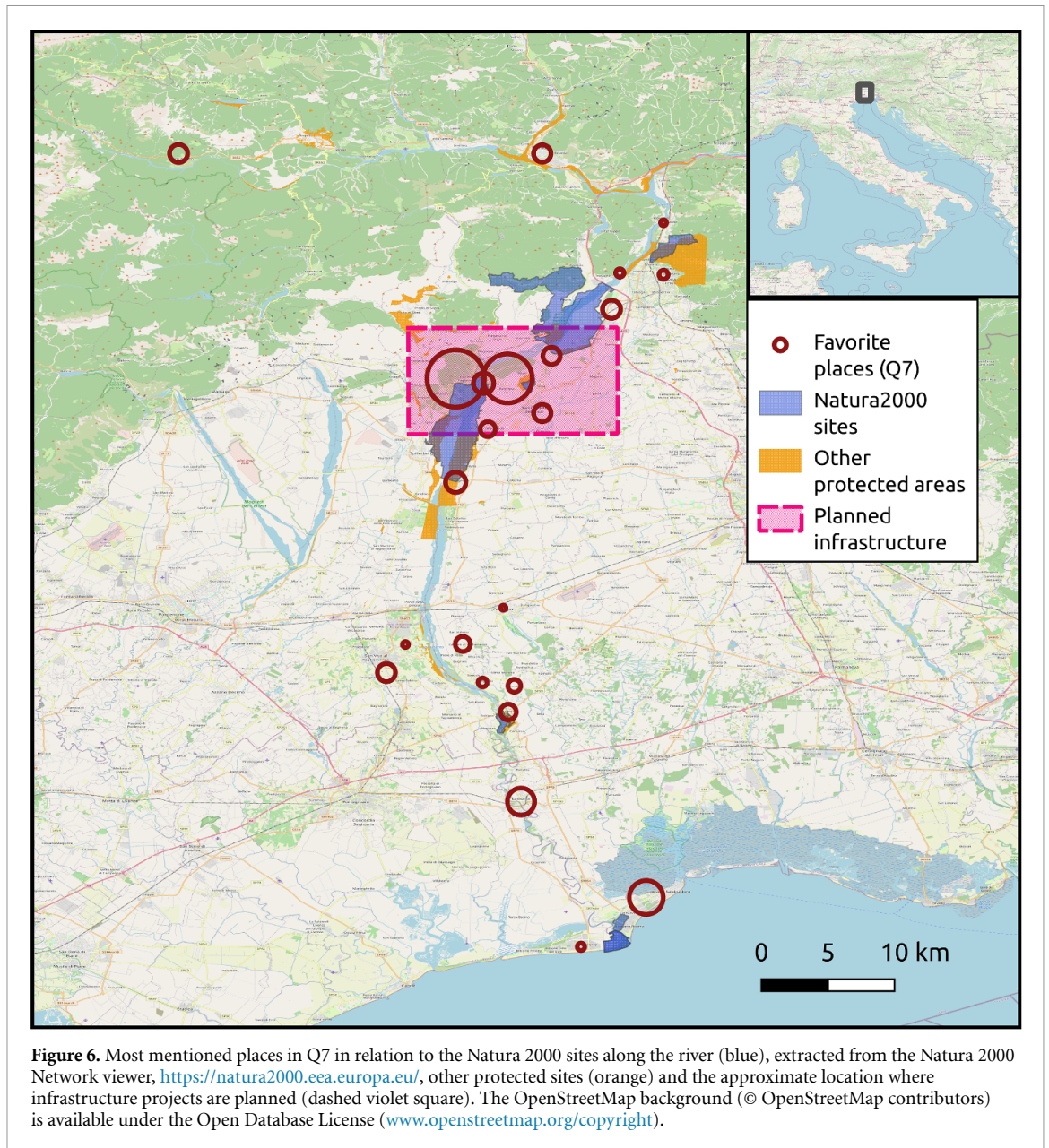
At the scale analyzed here, the results show that people's river management priorities do not align with current management plans. In fact, widely recognized river values would be affected by the proposed infrastructure measures. Higher resolution data may be valuable for decisions at the local scale, but any management plans should consider local recreation, tourism, and important places identified here.

4.3. Giving voice to citizens in river management

Dealing with qualitative and intangible information is challenging. At the same time, what people want should be taken into account in river management. Here, we show that asking about CES and favorite places and landscapes as a means to estimate the value associated with the river, together with questions on priorities of river management, can be a way to identify areas of interest and possible socioeconomic development (e.g. tourism). This methodology can serve as a first step to empower citizens and give them a voice.

Empowering citizens has helped pave the way for comprehensive conservation approaches of rivers across the world, including the emblematic case of the Whanganui river in New Zealand, recognized as a living entity (Salmond *et al* 2019), as well as the planned

Figure 6. Most mentioned places in Q7 in relation to the Natura 2000 sites along the river (blue), extracted from the Natura 2000 Network viewer, https://natura2000.eea.europa.eu/, other protected sites (orange) and the approximate location where infrastructure projects are planned (dashed violet square). The OpenStreetMap background (© OpenStreetMap contributors) is available under the Open Database License (www.openstreetmap.org/copyright).

Vjosa national park (Aleko *et al* 2018, Schiemer *et al* 2020). The results of the questionnaire on the TR provide evidence that any intervention should be pondered carefully accounting for its environmental impact including the potential loss of river ecosystem services. In particular, protected areas have a great and globally recognized importance for conservation, but are often disconnected and fragmented (Harris 2007), including in the case of the TR (figure 4). Here the favorite places and landscapes are located along most of the river, resonating with the responses of Q4 and Q5 prioritizing nature reserves, natural landscapes and conservation measures (section 3.3). Our results show that people use the river locally, but also value areas further away (i.e. the braided landscape). With this questionnaire we identify potential trade-offs between ecosystem services, as various cultural services can be affected by the planned infrastructure. Even though such trade-offs are concentrated in the middle course of the river, new infrastructure projects would likely affect the landscape and services both upstream and downstream (Blue 2018). Therefore, management strategies that account for river values and prioritize conservation need a basin-scale strategy.

The participation of the locals to the TR questionnaire was very strong, showing the importance of involving locals in the areas that are studied. To share the questionnaire results and their implications with the locals, thematic discussions called 'Past, present and future scenarios of the Tagliamento River management' were organized by the authors in a fully volunteering setting, as a first step toward a citizen-centered river management. Written feedback

collected by nearly 400 attendees (over four evenings) indicated that the most appreciated part of the discussion was regarding the value of the TR. Participants were also asked what they would like to know more about: 30% wanted to know more about river management, and 20% wanted to know more about future scenarios for the TR. While setting up this participatory process can help gain information and foster social learning (Mostert *et al* 2007), it would also be important for stakeholders to be able to influence the decision making process (Euler and Heldt 2018), which is currently not happening (Wehn *et al* 2015).

5. Conclusion

This work explores and compares river values (in the form of CES and favorite places and landscapes) to river management choices. A questionnaire is used to assess values and priorities of people who know the TR in Italy. CES are rated very highly by all respondents. The high cultural and spiritual values suggest a strong emotional connection with the river. Although management priorities depend partly on participants' relation to the river and their place of residence, the top management priority across all groups is conservation. This is confirmed by the fact that more than 88% said that it is possible to tackle both conservation and risk mitigation (Scaini *et al* 2021b).

We show this with our data and we highlight:

(a) the huge (intangible) cultural and social value of the TR to its inhabitants,
(b) the discrepancies between management choices and citizen values and priorities,
(c) the need for including river values in river management and their potential role for tackling conflicts of values and support informed discussion on river management strategies.

More generally, this work points out that any river intervention should be pondered carefully accounting for its environmental impact also in terms of loss or degradation of the cultural services provided by rivers. Our study is a step towards a management that includes nature-based solutions to cope with the challenge of ecosystem conservation as well as flood protection. The questionnaire is transferable to other rivers and environmental contexts. The approach presented here can be used to align expectations and realities—for managers to include voices and desires, while identifying gaps in information provided to citizens.

Data availability statement

The data that support the findings of this study are available upon request from the authors.

Ethical statement

The research involved exclusively non-identifiable human participants. All participants were volunteers and over 18 years old. The research was conducted in accordance with local statutory requirements. Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

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