Landscape and Urban Planning 214 (2021) 104192

Contents lists available at ScienceDirect

Landscape and Urban Planning

journal homepage: www.elsevier.com/locate/landurbplan

What is a river basin? Assessing and understanding the sociocultural mental constructs of landscapes from different stakeholders across a river basin

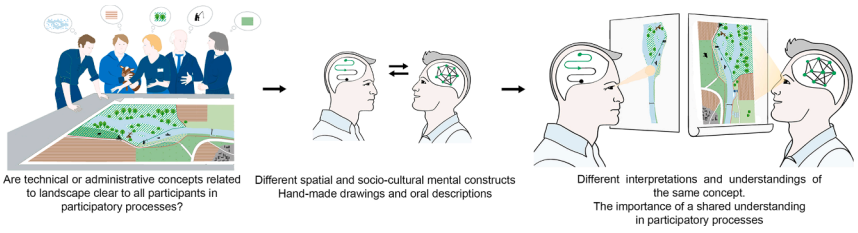
Enrica Garau [a,*], Mario Torralba [b], Josep Pueyo-Ros [a,c]

[a] Department of Geography, Institute of Environment, IMA-UdG, University of Girona, 17071 Girona, Spain
[b] Faculty of Organic Agricultural Sciences, University of Kassel, Steinstraße 19, 37213 Witzenhausen, Germany
[c] ICRA, Catalan Institute for Water Research, 17003 Girona, Spain

HIGHLIGHTS

- We explored the spatial and sociocultural mental constructs of the river basin concept.
- We combined semi-structured interviews and hand-made drawings.
- We found a knowledge gap on exploring potential biases in participatory processes.
- Stakeholders hold complex mental constructs related to the river basin concept.
- A shared understanding is essential to conduct effective participatory processes.

GRAPHICAL ABSTRACT



ARTICLE INFO

Keywords:
Drawings
Stakeholder perceptions
Participatory methods
Landscape management

ABSTRACT

In the Mediterranean basin, climate models predict future scenarios characterized by more frequently uncertain hydrological services. European policies increasingly promote new models of water management based on river basins as socioecological systems and participatory strategies to ensure better inclusiveness and representativeness of all local actors. Practice has demonstrated the value of stakeholder engagement for achieving more productive and beneficial outcomes of decision-making in landscape management and conservation policies. However, sometimes participatory processes do not lead to effective results. One reason could be related to different understandings of concepts. There is, in fact, still limited research assessing whether the concepts or technical terms used in those processes are understood in the same way by the participants. Therefore, our study aims to explore the mental constructs of stakeholders through a combination of semi-structured interviews and hand-made drawings, using the concept of the river basin as a study concept. We found differences in the relationships between stakeholders' ways of drawing and describing the river basin starting from its mental constructs. The results also showed that the way stakeholders construct ideas and views related to the landscape influenced some factors that stakeholders used to express them, such as the drawing shape, drawing length, emotions and associated values used in the descriptions. Likewise, mental constructs were influenced by stakeholders' profiles and their working position. This study highlights that a better understanding of stakeholders' perceptions and their understandings could be essential if we are to achieve more effective and inclusive participatory processes in complex and dynamic socioecological contexts.

* Corresponding author.
E-mail addresses: enrica.garau@udg.edu (E. Garau), mario.torralba@uni-kassel.de (M. Torralba), jpueyo@icra.cat (J. Pueyo-Ros).

https://doi.org/10.1016/j.landurbplan.2021.104192
Received 16 March 2021; Received in revised form 22 June 2021; Accepted 7 July 2021
Available online 15 July 2021

1. Introduction

The Mediterranean Basin, understood as an ecoregion (Blondel, 2006; Olson et al., 2001), is recognized as an important hotspot for biodiversity. However, it is critically affected by multiple drivers of global change at multiple spatial scales and is among the most vulnerable regions in the world to the effects of climate change (European Environment Agency, 2018; Masson-Delmotte et al., 2018). Climate models predict future scenarios characterized by an intense degradation of Mediterranean ecosystems and their capacity to supply ecosystem services, which will particularly affect aquatic ecosystems (Cramer et al., 2018; Vollmer et al., 2018).

European policies such as the European Water Framework Directive emphasize the need to consider a broader scale for the spatial organization of water, based on a river basin perspective (Commission, 2000), and the ability to recognize the spatial unit of the river basin as a system (Giakoumis & Voulvoulis, 2018b). However, despite the widespread acceptance of its core principles, its implementation in Europe is slow and incomplete (Commission, 2019). To advance this implementation, there is an urgent need to apply a radical shift in the paradigm of water resources and aquatic ecosystem management with respect to the previous models, with the goal of identifying more integrated, participatory and multi-scalar planning and management strategies (Giakoumis & Voulvoulis, 2018a; Iniesta-Arandia, 2011), specifically those that consider river basins as delimited complex socioecological systems (Martín-López et al., 2017).

Within these socioecological perspectives and sustainability debates, participatory approaches are gaining momentum as an approach for reaching agreed-upon beneficial decisions in conservation and environmental management (Johnson, Lilja, Ashby, & Garcia, 2004). In particular, participatory approaches allow the development of broader, more inclusive management decisions that integrate the different perspectives, values and priorities of the people living in the territory, and this approach ultimately increases the legitimacy, public engagement and general acceptance of the planning process (Kochskämper, Challies, Newig, & Jager, 2016; Reed, 2008; Turnhout, Van Bommel, & Aarts, 2010). A requisite for these positive outcomes is the true integration of the different experiences and knowledge from all stakeholders based on the principles of inclusiveness, equity and social justice (Reed et al., 2018).

Despite these benefits, ongoing discussions raise concerns in relation to the real effectiveness of participatory processes in achieving conservation objectives and policies. Specifically, some studies have warned about the importance of paying close attention to each step of the participatory process (Kochskämper et al., 2016; López-Bao, Chapron, & Treves, 2017). Overlooking any aspect of the process, particularly in its early stages, can easily lead to ineffective results contrary to the original principles of inclusiveness and social justice, such as encroachment of asymmetric power relations, the marginalization of some minority actors, the manipulation or misinterpretation of opinions, or the rupture of trust among local actors (Kochskämper et al., 2016; Reed et al., 2018). For these reasons, the importance of having fair and adequate conditions for the design and implementation of good participatory processes is a key ingredient in the management of natural resources.

Generally, participative processes should be based on a transparent introductory phase from policymakers to stakeholders, and this transparency is necessary to encourage a multilateral discussion about possible alternatives and scenario management to reach strategic objectives and a shared vision to provide the design of effective and integrated natural resource policies.

Regarding the existing blueprint articles and guidelines on how to design and develop participatory planning processes, one of the commonly described preliminary basic steps is ensuring a shared understanding of the territory, as well as the technical concepts related to the processes (Richards & Blackstock, 2004; Turnhout et al., 2010). However, in reality, this step is often overlooked (Fischer & Young, 2007). Particularly in consultation processes (such as surveys), participants are often asked to share their view of specific concepts (e.g., biodiversity, protected natural area, river basin, ecosystems, wilderness), and the researchers do not always confirm that the research terms are similarly interpreted and understood by all actors involved. It is often a priori assumed that highly technical or administrative concepts related to the landscape are clear to all participants (Buijs, Elands, & Langers, 2009; Fischer & van der Wal, 2007; Fischer & Young, 2007).

These various interpretations of the landscape, or of technical concepts related to it, represent different mental constructs, understood as the comprehension of a specific concept or idea, and these constructs are influenced by the individual perceptions, knowledge, former experiences and value systems (Brown, 1984; Heiskanen, 2006; Martín-López et al., 2012). This understanding of several landscape- and sustainability-related terms is based on prior knowledge and is influenced by the specific experiences of each actor. For example, people from starkly contrasting topographies would likely differ in their definition of a mountain, a river, or other natural feature. This variability happens across all societal sectors, including politics and academics, where these biases also exist. In practical terms, the definition of a tree, a forest, and other features of the environment can generate disagreements with real implications for policies and planning processes, as has been shown in other studies (Chazdon et al., 2016; Médail et al., 2019; Prager & Curfs, 2016). For these reasons, this different level of understanding can have important political implications, particularly in relation to political settings that span large and heterogeneous areas such as the European Union.

Likewise, a different comprehension can also create different expectations and understandings concerning the issues that should be addressed in a planning process. These diverging mental constructs can indeed be associated with different expressed emotions, aspects (biophysical, social, economic) or associated values (beauty, tranquility, cultural values) used to describe a certain concept. This information reflects individual attitudes and values that people assign to a particular concept or landscape, which become important elements in planning processes.

To our knowledge, no study has empirically explored the existence of these potential biases in a participatory process. Reflecting on this gap is necessary, for failing to identify potential mismatched understandings in core concepts can be the source of important biases in the participatory process and its results.

Additionally, what effects the different understandings of the object of study might have on the outcome of a consultative process has not yet been studied. To fill this gap, our study contributes to a better understanding of stakeholders' spatial and sociocultural mental constructs of landscape and of the technical-administrative concepts related to landscape, using the concept of a river basin as the potentially disputed concept. In our study, when we refer to the river basin concept, we use the definition that coincides with the empirical definition of river basin, understood as "the area of land from which all surface run-off flows through a sequence of streams, rivers and, possibly, lakes into the sea at a single river mouth, estuary or delta" (Agency, 2021). We chose this definition, as it is the one most commonly used in current deliberative and participatory processes as an "axiom concept", that is, as an idea (concept) that is taken to be true and interpreted by everyone in the same way.

Although our study was not part of an ongoing participatory process but part of a larger research project to explore the conflicts around the water in both basins, we illustrate how our results would have direct implications for designing an effective participatory process in the study area, namely, offering guidelines to avoid important biases in the process. Our next step will be to share these results of the study with ACA technicians (Catalan Water Agency) to help them improve the initial phase of the ongoing participatory process "The future of water in Catalonia (2022–2027)" for the hydrological planning of the river basin of Catalonia (ACA, 2021).

The main aim of the study was to understand how local actors perceive, interpret and use the concept of river basins using an innovative method that combines stakeholder hand-made drawings and oral descriptions. Our hypothesis is that differences in the mental constructs, referring to the process of mental construction of concepts and ideas, incorporate diverging individual perceptions, knowledge and associated values into definition of the term. Specifically, we believe that exploring aspects of mental constructs, such as what a particular river basin is and where it is located (expressed through drawings), is then related to the understanding and perception of what the river basin contains (expressed through the oral description). Additionally, for the cases where differences exist, we will explore which factors affect the way an actor elaborates the mental constructs of what a river basin is and what implications the different mental constructs have on the participative process.

2. Methods

2.1. Study area description

This research was conducted in two Mediterranean river basin areas in northeastern Catalonia (Spain), just below the French border: the Muga and Fluvià River basin areas (Fig. 1). The Mediterranean Basin is characterized by a Mediterranean climate, with mild and humid winters, and hot and dry summers, accompanied by long periods of drought. Rainfall patterns vary according to the area, being generally greater in the north than in the south (Médail et al., 2019). The Mediterranean Basin is the result of a sociocultural process of co-evolution between ecosystems and human activity (Blondel, 2006), which makes it an area of extreme ecological and sociocultural diversity.

The Muga River basin covers a surface area of 854 km^2, and the river length is 64 km. The Fluvià River basin covers a surface area of 973.8 km^2 and for a length of 97.2 km. An important difference between the two river basins concerns the regulation of water flows of the entire basin. The Muga River has a mean annual flow of 2.5 m^3/s (IDESCAT, 2020), and the river has a typically Mediterranean regime, although its flow is regulated by the Darnius-Boadella Reservoir, which is the main water supply source for the entire basin. Additionally, the Fluvià River has an ecological flow (i.e., the minimum water flow to sustain the river ecosystems) that varies according to the river course (1.5 m^3/s upstream up to 10 m^3/s downstream); it has a pluvial regime (characterized by high water in winter and spring, and low water in summer), and its course is not regulated by any dam or artificial lock. Furthermore, the entire length of the river is protected by the Nature 2000 Network, as a Mediterranean fluvial space, with well-preserved riparian forests, acting as an important ecological corridor. Both rivers originate in the East Pyrenees and flow into the Aiguamolls de l'Empordà Natural Park (AENP), a natural reserve that has been a member of the Ramsar International Network of Protected Wetlands since 1993 (Ramsar, 1999). Both river basins represent a great diversity of topographic, climatic and environmental features, as well as different land uses, activities, and water demands (Pascual, Zabalza-Martínez, Funes, Vicente-Serrano, Pla, Aranda, & Biel, 2016).

In the last six decades, episodes of severe drought and water scarcity have been increasingly intense and combined with extended periods of very high temperatures, especially in the Muga River basin. In addition, the appearance of new uses and actors in the local scene has contributed to a constant increase in water demand. Since the mid-20th century, the Muga River basin has experienced a progressive increase in intensive crop and livestock farming and urban and tourism development, particularly along the coast. The particularities of the basin, coupled with the changes in recent decades, have fueled tensions and conflicts over increasingly scarce water resources (Saurí, Ventura Pujolar, & Ribas, 2000; Tàbara & Saurí, 2004). In the Fluvià River basin area, the situation is quite different, since the scarcity of water is perceived by local actors only at particular times of the year, usually during intense periods of drought that lack rain. Both basins are good examples of socioecological systems where the landscape has been shaped by dynamic interactions between society and ecosystems and where heritage elements related to water have historically been and continue to be of enormous social and cultural importance.

2.2. Data collection

We used a qualitative approach to explore the mental constructs of stakeholders regarding the concept of a "river basin". Inspired by the studies coming from environmental education (Alerby, 2000; Bowker, 2007; Buijs et al., 2009; Fischer & Young, 2007), we used a combination of hand-made drawings and oral descriptions circumscribed in semi-structured interviews with stakeholders from both river basins. Oral descriptions and hand-made drawings were contrasted to understand how stakeholders constructed and interpreted the concept of river basins and to identify the factors that influenced this process. We complemented these techniques in an interview model with open and closed questions designed to characterize the stakeholders and their context. The interview model was inspired by previous works focused on uncovering the factors driving landscape valuation (Iniesta-Arandia, García-Llorente, Aguilera, Montes, & Martín-López, 2014) (e.g., concern for climate change effects in the study area, perception of conflict among stakeholders concerning the use of natural resources, levels of influence

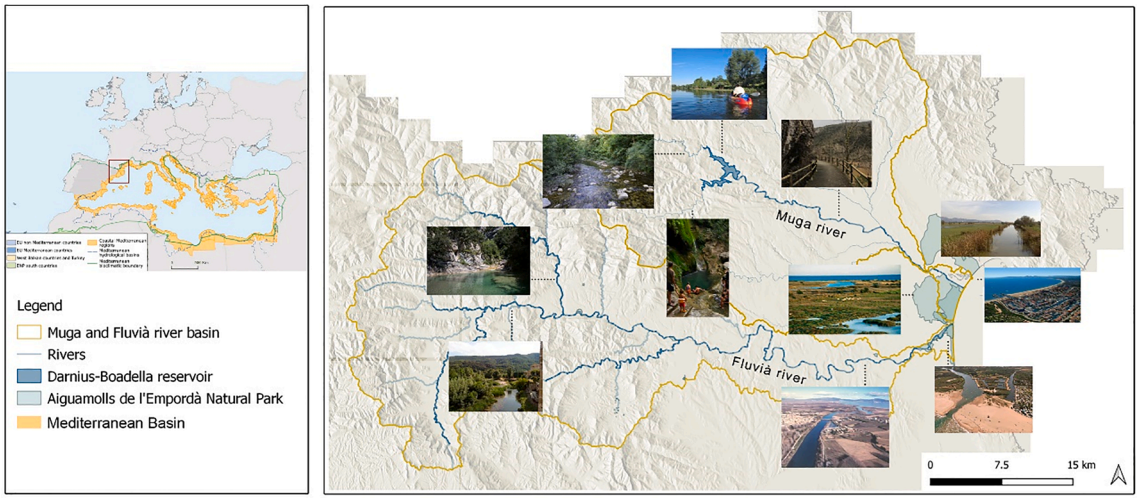


Fig. 1. Territorial framework of the Muga and Fluvià River basin, Spain. Adapted from (UNEP/MAP-Plan Bleu, 2020).

in decision-making processes). The interview model is shown in detail in Appendix A.

In the first part of the interview, we provided stakeholders with a printed map of the study area, and we prompted them to draw with a marker the borders of the river basin area by asking, "How would you draw the Muga/Fluvià River basin?". As explained in the study by (Fischer & Young, 2007), the action of drawing constitutes a moment where the interviewees can "individually reflect on their own mental construct and represent it through a non-verbal approach that allows them to express themselves, regardless of their knowledge of the scientific term". Subsequently, we asked the stakeholders to describe in their own words the river basin area in 60 s with the question, "How would you describe the river basin?", while we recorded the answers on a sheet of paper.

The stakeholders were selected by non-proportional quota sampling (Raymond et al., 2009; Tashakkori & Teddlie, 2003) to ensure that all major stakeholder groups in the river basin were represented. The initial list of potential participants was expanded with the help of stakeholders already identified in previous studies in the same area (Ricart Casadevall, 2014; Ventura Pujolar, 2005). We divided the respondents into five different groups according to their profession and their direct or indirect relationship with river ecosystems: administrative sector, agricultural sector, environmental protection sector, industrial sector and tourism sector. The interviews were held between June 2019 and July 2020. Fifty-one stakeholders agreed to participate in the interview and we obtained 49 drawings, as two of the participants refused to draw. The facilitators responsible for leading the discussions were key to the success of the drawing and description exercises, where the communication between the interviewee and the interviewer was fundamental to ensure that there were no right or wrong answers in relation to the drawing and description of the territory, as explained by (G. Brown & Kyttä, 2014).

2.3. Data analysis

2.3.1. Content analysis: coding and processing

Each interview was audio-recorded and transcribed in full. The answers were coded by categories and analyzed by discourse analysis using an inductive coding process with Maxqda software (v. 10, 2012) (MAXQDA, 2020). This coding process allowed us to extract the variables that we then used to explore mental models.

The coded variables could be summarized into three categories: (1) variables related to the river basin hand-drawings; (2) variables related to the river basin descriptions; and (3) variables related to the respondent characteristics.

The second category, the river basin descriptions, included variables related to the emotions expressed (positive or negative), the different landscape aspects included, such as biophysical (geographical characteristics, biodiversity, weather), social (demographic organization and changes, opportunities, quality of life), and economic (land use changes, communication and movement, socioeconomic changes), and the associated values (cultural and intangible aspects, such as beauty, tranquility, gastronomic aspects) used by the respondents to describe the river basin area during the interviews.

The third category included variables related to the respondent's individual characteristics, which we extracted from the other sections of the interview, such as concern for decreased water availability, familiarity with the concept of ecosystem services (ES), perception of conflicts over water between multiple stakeholders or the respondent's profile and their working position within the river basin. Table 1 summarizes the variables we used for the statistical analyses.

Finally, the first category, river basin hand-drawings, included variables related to the drawings made by the participants. Each drawing obtained during the interview was georeferenced, digitized and analyzed using QGIS v.3.10.3 (QGIS Development Team. (2020), 2020). Subsequently, each drawing was coded by three different researchers according to four criteria, previously established between the researchers: i) accuracy of the river basin location (accurate – inaccurate location, depending on the degree of similarity with empirical administrative limits); ii) shape chosen for the drawing (line or polygon); iii) length of the drawing (exact – short – long length, depending on whether

Table 1
Summary of variables used to explore the relationship between stakeholders' mental constructs and other variables.

Category	Variable	Description	Type
1. River basin hand-drawings	Drawing accuracy	The degree of similarity between the limits of the river basin as drawn by the respondent in relation to the real geographical limits	Binary (Accurate; Inaccurate)
	Drawing shape	The type of geometric shape used by the respondent to draw the river basin	Binary (Polygon; Line) Categorical
	Drawing length	The length of the drawing drew by the respondent, depending on whether it included the beginning area of the river and its mouth or just one of the two	Ordinal (Exact; Long; Short)
	Drawing perspective	The perspective expressed in the drawings by the respondent, depending on whether drawings included different parts of the landscape or just a small buffer of territory around the river	Binary (All basin; River)
2. River basin descriptions	Emotions	The type of emotions expressed by the respondent to describe the river basin	Binary (Positive; Negative)
	Biophysical aspects	The use of biophysical aspects expressed by the respondent to describe the river basin (geographical description, biodiversity weather)	Binary (Yes; No)
	Social aspects	The use of social aspects expressed by the respondent to describe the river basin	Binary (Yes; No)
	Economic aspects	The use of economic aspects expressed by the respondent to describe the river basin	Binary (Yes; No)
	Associated values	The use of associated values expressed by the respondent to describe the river basin	Binary (Yes; No)
3. Respondent characteristics	Stakeholder profile	The different stakeholder profiles (agricultural; environmental protection; administrative; industrial-hydroelectric; tourism and recreation sector)	Categorical (1; 2; 3; 4; 5)
	ES concepts	The respondent's familiarity with the concept of ecosystem services or environmental services (MEA, 2005)	Binary (Yes; No)
	Water concern	The respondent's concern about a decrease in water in the river basin	Binary (Yes; No)
	Conflict	The respondent's perception of conflict and competition for water among multiple stakeholders	Binary (Yes; No)
	Position work	The respondent's position work in the river basin (upstream, midstream, downstream, all basin)	Categorical (1; 2; 3; 4)
	Watershed	The river basin area of origin of the respondent	Binary (Muga; Fluvià)

it included the beginning area of the river and its mouth); and iv) perspective (river level – all basin level perspective, depending on whether drawings included merely a buffer around the river or different parts of the landscape) (Fig. 2).

We calculated Cohen's kappa statistic to validate the degree of accuracy and inter-rater reliability of our codification process. Whenever there was a kappa code <0.7, the contested codes were discussed and agreed upon to eliminate subjective interpretations. The final kappa coefficient was 1 for all coding criteria.

To spatially visualize which parts of the river basins were more often included or excluded in the mental constructs of participants, we transformed all drawings from vectors to raster and summed them to calculate the times each pixel was included within the drawn basin.

2.3.2. Statistical analysis

We used chi-square tests to explore the relationships among the drawings, the descriptions and the respondents' characteristics.

We additionally performed a multiple correspondence analysis (MCA) to explore and represent any underlying interrelationships between the way respondents drew and described the river and their individual characteristics. The active variables we used were those related to the mental construct of the river basin: drawing accuracy, drawing shape, drawing length, drawing perspective, emotions, biophysical aspects, social aspects, economic aspects, and associated values. To infer the potential interrelations between the characteristics and backgrounds of the respondents and the mental constructs of the river basin, the variables of stakeholder profile, water concern, conflict and position work were projected in the MCA as supplementary variables, following the perspective that cultural, social and individual contexts offer a better understanding of public views (Fischer & Young, 2007). The main purpose of this analytical step was to focus on the relationships between variables that can best help explain variations and diversity in mental constructs. This step thus allowed us to identify different or shared mental models of the participants in relation to the object of study and to select the factors that interfere the most in their constructions. All statistical analyses were performed using Jamovi v.1.0.7.0 software (Jamovi, 2020) and combining the *factoextra* package v.1.0.7 (Alboukadel & Mundt, 2020) and *ggplot2* package v. 3.3.0 (Wickham, 2016) in R v. 3.6.3 (R Core Team. (2020), 2020).

3. Results

3.1. Mental constructs of the river basin: descriptions and hand drawings

The descriptive analysis showed that there was a nearly even distribution for all variables between the respondents from the Muga and Fluvià River basins. For this reason, we will present the results grouped for both river basins, as we did not encounter significant differences between the study areas. Fig. 3 shows the parts of the river basin areas that were most often included in stakeholder drawings.

We found that 36.7% of the drawings were accurate, that is, they were similar to the empirical boundaries, while 63.3% were completely different or quite different from the actual boundaries. More than half of the drawings (83.7%) were drawn as a polygon and with an exact length, and only 16.3% were drawn as a line and with a short or long length. A total of 63.3% of drawings used a river basin perspective, including in the drawings different land uses of the landscape, such as mountains, agricultural fields, and wetlands, while 32.7% drew the river basin area with a river perspective, including only the river or the area immediately surrounding it.

Regarding the oral descriptions of the river basins, the totality of the stakeholders included at least one biophysical aspect in the description of the river basin (e.g., environmental characteristics, weather, biodiversity, topography). A good example of the inclusion of such elements, included in one of the descriptions of the Muga River basin, was as follows: *"It is a very touristic area, with very marginal agriculture; there are fruit trees in the southern part, the northern part is mountainous and poor; in the northeast there are vines and olive trees; there are industries in Figueres; the weather is pleasant, apart from the Tramontane wind"* (from a respondent working in the agricultural sector and located downstream). Of the descriptions, 40.8% included social aspects (social organization, characteristics of the people living in this area, social opportunities), and 36.7% included economic aspects (land use, economic activities). Finally, 26.5% included landscape-associated values, such as a sense of belonging, beauty, tranquility, and quality of life, and 24.5% used emotions to describe the territory, emphasizing distinct features of the river basin, such as the following: *"There is a literary quote from a priest writer, Mossèn Pere Ribot, who said that the Alt Empordà is like the buttresses of the Pyrenees mountains, it is what connects the mountain with the valley, it is like a buttress, like the lower part of the castle. It is a high mountain that quickly approaches the sea and it has this connection function. This is the*

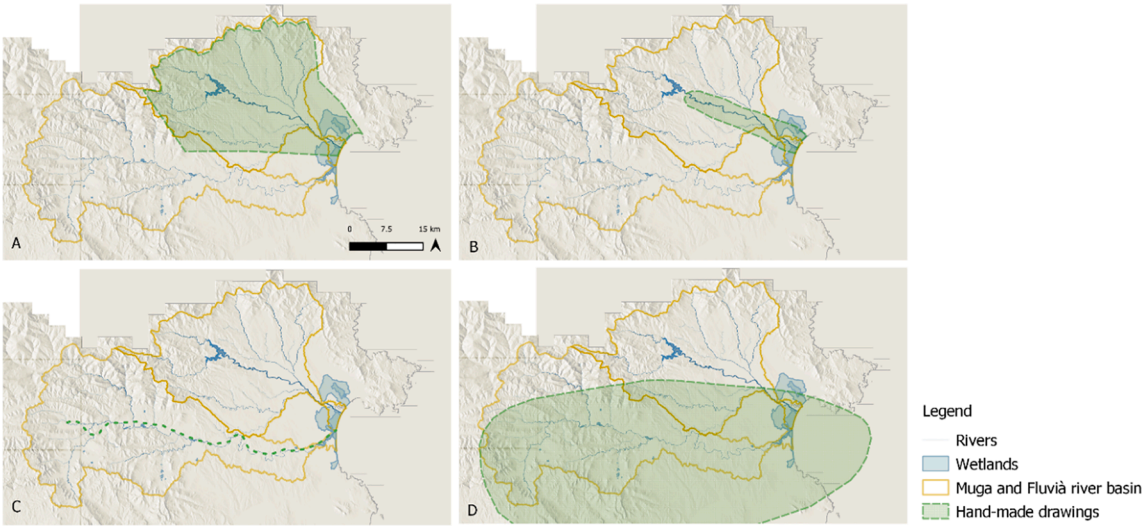


Fig. 2. Example of different drawings of the Muga and Fluvià River basin areas and their codifications: A. Muga River basin: coded as "accurate location", "polygon shape", "exact length" and "all basin perspective"; B. Muga River basin: coded as "inaccurate location", "polygon shape", "short length" and "river perspective"; C. Fluvià River basin: coded as "inaccurate location", "line shape", "short length" and "river perspective"; D. Fluvià River basin: coded as "inaccurate location", "polygon shape", "long length" and "all basin perspective".

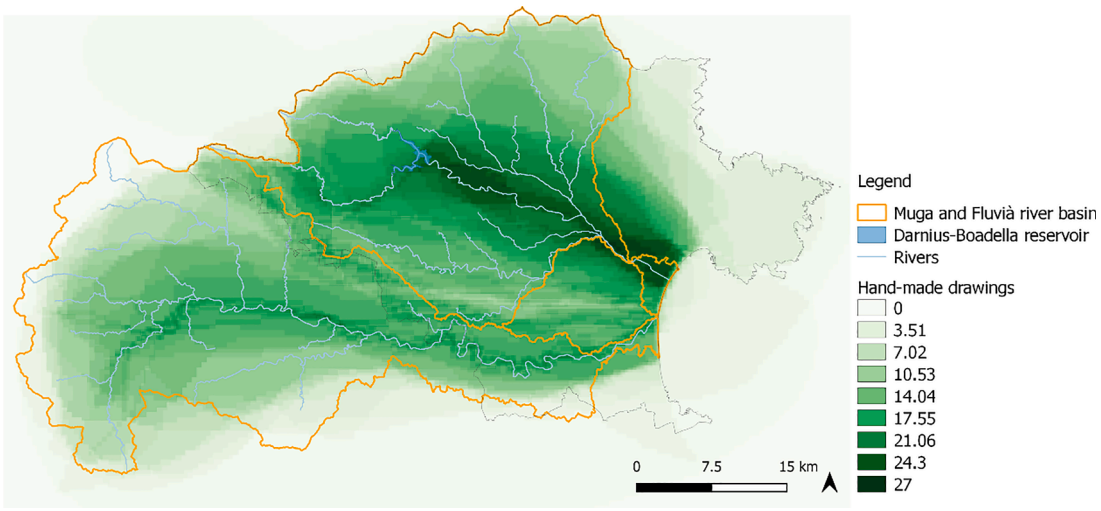


Fig. 3. Number of times each pixel has been included within the hand-made drawing, allowing to visualize which parts of the basins have been drawn the most (darker colours) and which less (lighter colours).

river basin, it is a very beautiful landscape" (from a respondent working in the recreational sector and located downstream). Of these descriptions, 16.3% expressed positive emotions, while 8.2% expressed negative emotions. Table 2 summarize the results.

3.2. Determinants and implications of mental constructs

The chi-square test results allowed us to identify whether there were significant relationships between the method of drawing and the method of describing the river basin concepts (Table 3). Regarding the drawings, we observed that the variable of accuracy, understood as the similarity of the drawing with the empirical administrative limits, had a significant relationship with not only the other variables of the drawings (i.e., exact length, geometric shape of polygon and a river basin perspective) but also the different stakeholders' profiles and stakeholders' familiarity with the concept of ES.

We found, more specifically, that the variables "drawing perspective" (river or landscape) and "drawing length" (exact, short, long) showed a significant relationship with the presence of emotions (positive or negative) and the social and associated values used to describe the concept of river basin.

We also found that some variables not directly related to the drawings or the descriptions of the river basin showed a significant chi-square value. This relationship was found for the variables "concern for a decrease in water resources", perception of "conflicts" between multiple stakeholders and the "working position" of stakeholders within the river basin.

We did not find significant relationships between the mental constructs of the river basin (the way of drawing and describing it) and the socioeconomic variables of the interviewees, such as age, gender, educational level, income or place of residence inside or outside the study area.

Table 2
Summary results.

Variable	Summary of values in % (Total n = 49)
Drawing accuracy	Accurate = 63.3%; Inaccurate = 36.7%
Drawing shape	Polygon = 83.7%; Line = 16.3%
Drawing length	Exact = 63.3%; Long = 4.1%; Short = 32.7%
Drawing perspective	All basin = 67.3% ; River = 32.7%
Emotions	Positive = 16.3%; Negative = 8.2%; No emotions = 75.5%
Biophysical aspects	Yes = 100.0%; No = 0%
Social aspects	Yes = 40.8%; No = 59.2%
Economic aspects	Yes = 36.7%; No = 63.3%
Associated values	Yes = 26.5%; No = 73.5%
Stakeholders profile	Agricultural = 14.3%; Environmental protection = 16.3%; Administrative = 24. 5%; Industrial-hydroelectric = 10.2%; Tourism and recreation = 34.7%
ES concepts	Yes = 53.1%; No = 46.9%
Water concern	Yes = 77.6%; No = 22.4%
Conflict	Yes = 53.1%; No = 46.9%
Position work	Upstream = 36.7%; Midstream = 8.2%; Downstream = 32.7%; All = 22.4%
Watershed	Muga = 53.1%; Fluvià = 46.9%

Table 3
Chi square results. The results indicate a significant p value at the ·p < 0.1, *p < 0.05, and **p < 0.001 levels. The blue color indicates Fisher's exact test results. Cells in white represent results with a no significant p value (n = 49).

	1	2	3	4	5	6	7	8	9	10	11	12	13
1 Drawing accuracy													
2 Drawing shape	*												
3 Drawing length	**	*											
4 Drawing perspective	**	**	*										
5 Emotions		*	**	**									
6 Social					*								
7 Economic	*												
8 Associated values			*		*								
9 Group	*			*			*	*					
10 ES Concepts	*								**				
11 Position work		*						*					
12 Water concern					·	·	·				*		
13 Conflict					*	*	*				*	*	

3.3. Interrelations associated with mental constructs of the river basin

The first two axes of the MCA accounted for 47.36% of the inertia (Fig. 4). The first axis (28.13%) was described by the relationship between the way of drawing and describing the river basin and the stakeholder characteristics (profile and water concern). It was clearly separated; for example, on the negative side was the accuracy of the drawing with the familiarity with the concept of ES, with the environmental protection and the administrative stakeholders' profiles, with the concern for a decrease in water resources, and midstream and all basin working positions of stakeholders. In contrast, the positive side included the inaccuracy of drawings, with a river-level perspective, with the recreation-tourism and agricultural stakeholders profiles, the use of negative emotions, and a working position in the lower part of the river basin.

The second axis (19.23% of inertia) was represented especially by

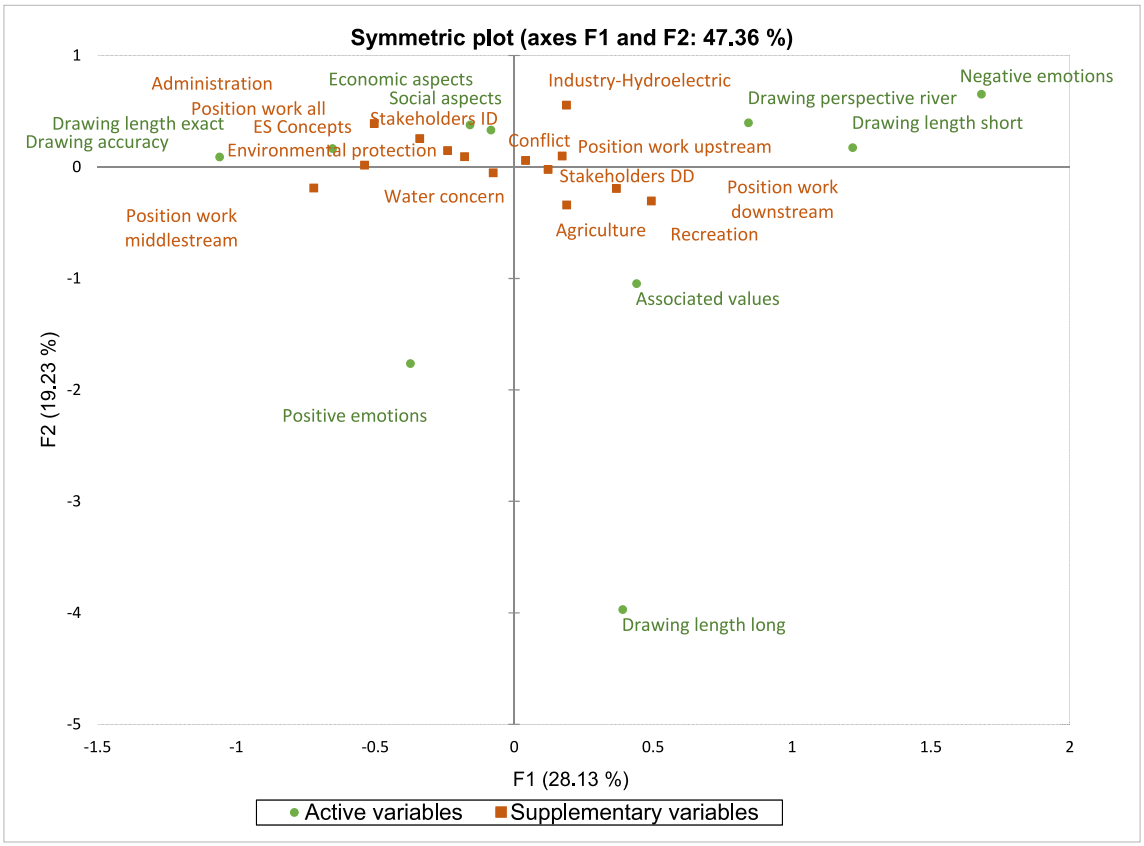


Fig. 4. Biplot of the first two axes of the multiple correspondence analysis (MCA) (47.36% of the variability absorbed). The plot shows the relationship between the variables related to stakeholders' mental constructs (handmade drawings and oral description) in green and the other variables that influence them in orange. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

the association between the length of the drawing and the use of emotions or aspects in the descriptions. In particular, it revealed the tendency of stakeholders who drew long drawings to express positive emotions and include associated values related to the landscape, in negative scores, compared to those who used a short length, with a tendency to include economic aspects and express negative emotions in the descriptions, in positives scores. The results of the MCA are shown in detail in Appendix B.

4. Discussion

4.1. The mental construct of the river basin concept is not the same for everyone

Our results demonstrated how individuals in a participatory process often hold different mental constructs. These differences were clearly expressed in the way people understand the concept, which was illustrated by the manner they drew and described the object of study, in this case, the two specific river basins. The different understandings spanned aspects related to the extension and location of the river basin and the very concept of what a river basin is.

Before delving into the core of the discussion of the differences observed between stakeholders, we emphasize that the mental models we present and discuss here reflect the perceptions expressed by stakeholders during the interview, without judging them as true or false, better or worse (Moon & Blackman, 2014). We merely assess the degree of similarity and difference of these mental models and their likeness to the empirical river basin (which is the object of the participatory process). This evaluation is important to consider, given that, as Prager and Curfs (2016) claim, "within one individual, a mental model changes with time and even during the flow of a single conversation" (Forrester, 1971; p. 213).

In relation to what was included in a river basin, we found two diverging understandings of the concept. On the one hand, most respondents agreed with the commonly accepted concept of river basins and generated drawings that included the landscape. As found in the study of (Fischer & Young, 2007), despite not having technical knowledge of the administrative concept, stakeholders have included different aspects in the idea of river basins. Specifically, these aspects refer not only to elements related to water but also to geographical aspects and associated values, such as beauty, social structure, gastronomic and intangible aspects of the territory. It is important to highlight that the concept they were drawing consists of several elements. Statements such as the following for the Muga Basin illustrate this complexity: *"It is the most important agricultural plain in Catalonia, it is all flat. It is surrounded by mountains starting from the Alta Garrotxa in the Pyrenean area; it is a region known for the Costa Brava tourist destination. […] We are inside a very important Mediterranean corridor. Then, there are other realities, the rural towns that are very small. It is a region with high biodiversity: we have the sea, mountains, agricultural plain; we have many habitats and landscapes"* (from a respondent working in the conservationist sector and located in the all-basin category). In contrast, some respondents differed from this perspective by drawing river basins that included only the territory directly adjacent to the river. This result indicates a mental construct of a river basin spatially represented only by the aquatic element of the river from its origin to the river mouth, excluding any other aspects: *"I do not know exactly what you mean, but come on, the river basin, it is a short river. It is born near where it ends. One thing is where it originates, which is a very mountainous area, and another thing is where it ends, which is a plain"* (from a respondent working in the agricultural sector and located downstream). Although a considerable proportion of the respondents were able to correctly trace the course of the river, an

important proportion drew it shorter or longer.

We also found differences in the descriptions of the river basin concept among stakeholders. The socioecological perspective of the basin was present in less than half of the respondents. We observed that there were some shared aspects (mainly geographical), but some included social and/or economic issues. These differences also had major implications for participatory processes related to how people understand the basin (on the same level as the differences in the drawings). Some people understand it as a socioecological system in which natural and social aspects are closely connected, while for other people, both are separate.

We found that the ways in which people draw and describe a concept are inherently personal. This result highlights that each person has a different way of understanding concepts such as a river basin, and that each method includes aspects of form (as we see in the drawings) and content (as we see in the descriptions).

This result also has important implications for all participatory methods in which participants are asked to record spatial knowledge (such as participatory mapping). It is often assumed that everyone shares the same geographical area to be mapped. This assumption can lead to significant biases in the interpretation of the results. For these reasons, it is important to clearly define the concepts and spatial boundaries before a study and dedicate some time to explain this to the participants, in case the interviews are part of a larger campaign; furthermore, if it is a group process, it could be useful to dedicate some time for people to share their understandings of the terms and reach a consensus over the object of study, as this approach could be used to provide some useful recommendations to prevent interpretation biases and problems of this type.

4.2. Differences in the form and content of the river basin concept

We observed linkages between emotions and drawings and descriptions. In detail, the relationships between the emotions expressed during the descriptions and the length and shape of the drawing were particularly interesting. Some stakeholders used positive emotions to describe the river basin area: "*It is the best landscape in the world; it is a fantastic place; there is everything; there are very few people who live there and there is high biodiversity. The Aiguamolls Natural Park is my paradise. […] My natural habitat is here!*" (from a respondent working in the conservationist sector and located downstream), highlighting a sentimental and emotional relationship with it (Alerby, 2000). We found that these descriptions that included positive aspects and emotions were related to long river basin drawings, with a territorial perspective, almost as if there was a willingness to express these emotions or these positive aspects in a graphic way, causing the drawings to be longer. However, we also noticed that descriptions with negative emotions, such as "*All the biodiversity of the river disappeared, for various reasons, because people do not understand it*" (from a respondent working in the recreational sector and located downstream), corresponded to short drawings with a river perspective.

Although most stakeholders did not express emotions in their descriptions (only 14 of 49 used emotions), when they did, a connection between emotions and the drawing type was clear, thus resulting in different spatial interpretations of the river basin. Although relationships between both aspects cannot be assumed, the results suggest that this has implications on the attitude of the participants (as we see with emotions). In fact, it highlights that it is not just that participants might have different understandings of what they are talking about but that this is sometimes related to their divergent attitudes towards the object of study they are talking about, i.e., they are expressing their subjective and social concerns of a place (Kahila-Tani, Kytta, & Geertman, 2019).

These aspects can have direct consequences for environmental conservation policies and how participatory processes occur, as they expose the different spatial interpretations, contrasting semantics and meanings, and the reasons for different degrees of acceptance of environmental policies or conservation projects (Sodhi et al., 2010) of local actors, who are talking about completely different things. This result highlights an important reflection about how people can agree with a better forest management plan in the upstream part of the basin while for someone else, the river basin area is only the river and they are not even aware of the upper part or how forests are related to better water management.

4.3. Factors influencing stakeholders' mental constructs of the river basin concept

In our study, we observed that the mental construct of the respondents was related to their direct relationship with the river basin and with their prior experience working in it. We also found a positive relationship between more accurate drawings of the river basin borders and the interviewee's familiarity with the concept of ES. This result is in line with other studies that showed that people with a good knowledge of the territory and those with a direct relation to landscape management (e.g., farmers) (Buijs, Pedroli, & Luginbühl, 2006), were able to perceive more aspects of the area and perceive more types of ES (Castro, Vaughn, Julian, & García-Llorente, 2016; Iniesta-Arandia et al., 2014) (for example, we observed this result in the richest and most varied descriptions of the river basin).

Specifically, we found that the stakeholder profile variable could influence how stakeholders perceived and understood the landscape and, in our case, how they represented it spatially, as explained by other studies (Buijs et al., 2006; García-Nieto et al., 2015; Iniesta-Arandia et al., 2014).

Notably, certain stakeholders who did not have a direct relationship with the landscape but who work to manage it, such as those in the conservationist sector or the administrative sector, made more accurate drawings than stakeholders who directly depend on water resources, such as those in the agricultural sector. We did not find a positive relationship between a good knowledge of the river basin (more accurate drawings and richer descriptions) and the number of years a stakeholder lived in the study area, as found in the study by (Sodhi et al., 2010). These results reflect the distance between real-world contexts and scientific and technical knowledge, similar to a common situation, stressing that knowledge of technical terms related to the landscape, such as the concepts of a river basin, ES or biodiversity, are often not internalized and do not permeate grounded sectors. This aspect, in turn, underlines the urgent need to shorten this distance, considering that for the benefit of the landscape and the maintenance of ecosystem functions, stakeholders should know what river basin limits are or what kind of biodiversity there is (although not in technical terms).

Finally, we found that the stakeholder working position was a factor that interfered with the mental model or their understanding of the river basin concept. The results showed how the stakeholders working upstream stated that they were worried about a decrease in water resources within the river basin and that they perceived increasing conflicts and competition among stakeholders for water resources. This result can be explained by the mental disconnection between ES providing units and their beneficiaries (García-Nieto et al., 2015). These results are in fact consistent with those of other studies that revealed that the actors located in the consumption areas of ES showed a certain disconnection with the landscape in relation to the stakeholders located in the production areas, which was in turn related to the way they perceived and valued ES (Palomo, Martín-López, Potschin, Haines-Young, & Montes, 2013).

In contrast to other studies, we did not find significant relations between mental constructs and the socioeconomic characteristics of stakeholders. This result could be partly explained by the fact that the design of the study did not aim to obtain a good representation of gender or age but rather of how stakeholders understand a river basin. Previous studies (Buijs et al., 2006; Iniesta-Arandia et al., 2014; Quintas-Soriano et al., 2018; Sodhi et al., 2010) showed a clear influence of certain

socioeconomic characteristics, such as age, gender, educational level and income, on these differences in perceptions, preferences, and values.

4.4. Implications for the design of participatory processes

All aspects mentioned above should be carefully considered during participatory processes, taking into consideration priorities, contrasting interests, values, preferences and needs, as they allow decision makers to balance the power between multiple actors and ensure greater fairness and representativeness during the process (Mease, Erickson, & Hicks, 2018) to achieve landscape management based on a shared vision. The consideration of mental constructs, what can influence them and differences in our ways of understanding concepts have many important implications for the effective design of participatory processes.

A strength of the applied method is that it can be replicated in different contexts, modifying it according to (i) the purposes of the study and (ii) the techniques that best capture the dimension of the participants' mental models that the study aims to explore. On the one hand, our results showed that the use of non-verbal language techniques, such as drawings, certainly represented a useful perspective of analysis that allowed us to explore elements of the perception of stakeholders in an in-depth way and allowed us to visualize them. As explained by (Fischer & Young, 2007), we found that the mental constructs related to the river basin idea were complex and were often based on the use of terms associated with the concept, different definitions of the same concept and prototypes of images that represent typical general examples of the concept we were talking about. The stakeholders were able to draw their idea of the river basin on a map, expressing distinct mental associations during the construction of the concept, despite not having a specific knowledge of the technical term. This result disputes those who argue that local actors should not be involved in participatory processes given their lack of technical knowledge (Pfadenhauer, 2001).

On the other hand, we affirm that it is essential that everyone shares the same vision when participating. Participatory planning or participatory methods are often applied without considering the different views, ideas and ways of understanding held by stakeholders. This result highlights an important aspect: we should return to the information phase of the participatory process and pay more attention to it to ensure that the process of communication and information by decision-makers towards stakeholders is clear, transparent and shared before we move to the phase of knowledge synthesis, participation and the generation of shared decisions.

When documenting a participatory process, it is probably very common for this phase to be omitted/skipped. For these reasons, perhaps the proposal should require that the documentation of this previous "check-phase" become part of the agreed-upon good practices for the design of participatory processes as a guideline to avoid biases and ensure that concepts between participants have been clarified before starting the process. Otherwise, we will be building the house starting with the roof, asking which actions are better for a river basin without ensuring that anyone knows what a river basin is or what they mean by it.

Our findings illustrate that the aspects we discussed in this study could be considered a source of guidelines for the design of more effective and inclusive participatory processes. Other studies, even several based on the study of creative drawings, focused on studying how people perceive concepts such as biodiversity, tropical forests, plants and animals through the study of their drawings (Alerby, 2000; Bowker, 2007; Buijs et al., 2009; Smith, Meehan, Enfield, & Castori, 2005). In line with the findings of these studies, we found that people associated different aspects in the construction process of the mental idea of a certain element. Their personal experience, their beliefs, and their own value systems were factors that were relevant in shaping the construction of these mental ideas. In short, we can affirm that the mental constructs related to the landscape or to certain landscape aspects were influenced by several internal and external factors of the stakeholders.

Including these aspects in participatory processes is therefore necessary. Furthermore, we advocate for participation models that are co-constructed and co-designed with the same participants, based on an inclusive, transdisciplinary, horizontal, community-based and interactive approach (Lang et al., 2012). So, we stress (1) the importance of this previous period of check-control before participatory processes to ensure that everyone shares a common understanding of the study object and (2) the importance of providing guidelines for it. In this sense, differences observed in mental models during this phase should be not only valued but also re-integrated into the participation process (Lang et al., 2012). Incorporating the various meanings and semantics that the river basin could have for stakeholders allows for redefining the river basin concept and co-constructing shared mental models, thus minimizing the gap-dualism between "technical knowledge" and "non-technical knowledge" and mobilizing inclusive learning processes. From an ontological perspective, the methods proposed allow us to clearly determine how different the constructs of the object are from the empirical entity and how different are the constructs among them (Moon & Blackman, 2014). Sometimes, such differences could be problematic in participatory processes because each individual can give multiple meanings to an object and build multiple realities (Moon & Blackman, 2014) that are not universally shared. In natural resources planning, the object of a study often exists and is defined without considering the meaning people assign to it. For example, the limits of a watershed area are based on hydrological criteria. Changing them according to people's perceptions could have important consequences from an environmental perspective. In this sense, although someone perceives the river basin area without considering the upper part, this perception does not change the fact that forest management of the upper part influences water flow in the mouth. However, in such cases where the object of study is defined top-down, the constructs of the object should acknowledge the different understandings of a shared reality. This recognition should be the basis for going beyond participation as a good "engaging and democratic" service contract practice (Reed, 2008) for its own sake, using this information to define and discuss what the study object is with the participants. This process has the potential to transform the understanding and learning process of each individual, thus shifting from subjective mental models to shared models, maximizing the correspondence between the object of study and the term used to describe it (Moon & Blackman, 2014).

5. Conclusion

When making decisions about land management or planning, participatory methods are gaining much prominence to enhance the legitimacy of decisions, give voice to all actors, and generate more correct solutions that integrate the knowledge of all stakeholders in landscape management. However, our study shows that, at times, different actors may potentially understand the landscape or elements related to it differently. This result provides two important contributions: (i) adding value both theoretically and empirically to the study of mental model in landscape planning; and (ii) proposing useful methods for exploring mismatches in participatory processes in relation to landscape perceptions, thus helping avoid biases. Understanding differences in mental models is critical to ensure that the outcomes of participatory processes coherently and meaningfully express the knowledge, needs and opinions of each participant concerning the object of study, as participants often think they are talking about the same thing when they are not. We showed how stakeholders hold heterogeneous mental constructs related to technical concepts such as river basins, which can be expressed with verbal and non-verbal languages. In our study, a river basin was sometimes narrowed to the river level, while others had it span the whole territory. Sometimes it encompassed only biophysical features, while others included economic or social aspects.

Sometimes it was tightly associated with positive emotions and others associated it with negative emotions. Therefore, the construction of mental ideas and the views of the river basin concept were complex. Including these aspects in decision-making processes is crucial to be able to apply adaptive planning models of natural resources capable of addressing current global changes and environmental challenges, particularly in social ecological contexts such as the Mediterranean Basin characterized by increasing complexity.

If we want participatory processes to be truly effective, it is necessary that these processes are based on shared and agreed-upon background knowledge and understanding of the landscape.

CRediT authorship contribution statement

Enrica Garau: Conceptualization, Data curation, Methodology, Writing - original draft, Writing - review & editing. **Mario Torralba:** Conceptualization, Data curation, Methodology, Writing - original draft, Writing - review & editing. **Josep Pueyo-Ros:** Conceptualization, Data curation, Methodology, Writing - original draft, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The authors would like to thank the editor and reviewers for their constructive comments and valuable suggestions for improving the article.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.landurbplan.2021.104192.

References

ACA. (2021). El futur de l'aigua a Catalunya (2022-2027). Retrieved June 7, 2021, from <https://participa.gencat.cat/processes/tercercicleaigua>.

Alboukadel, K., & Mundt, F. (2020). factoextra: Extract and Visualize the Results of Multivariate Data Analyses. Retrieved from <https://cran.r-project.org/package=factoextra>.

Alerby, E. (2000). A Way of visualizing children's and young people's thoughts about the environment: A study of drawings. *Environmental Education Research, 6*(3).

Blondel, J. (2006). The "design" of Mediterranean landscapes: A millennial story of humans and ecological systems during the historic period. *Human Ecology, 34*(5), 713–729. https://doi.org/10.1007/s10745-006-9030-4.

Bowker, R. (2007). Children's perceptions and learning about tropical rainforests: An analysis of their drawings. *Environmental Education Research, 13*(1), 75–96. https://doi.org/10.1080/13504620601122731.

Brown, T. (1984). The concept of value in resource allocation. *Land Economics, 60*(3), 231–246. https://doi.org/10.2307/3146184.

Brown, G., & Kyttä, M. (2014). Key issues and research priorities for public participation GIS (PPGIS): A synthesis based on empirical research. *Applied Geography, 46*, 122–136. https://doi.org/10.1016/j.apgeog.2013.11.004.

Buijs, A. E., Elands, B. H. M., & Langers, F. (2009). No wilderness for immigrants: Cultural differences in images of nature and landscape preferences. *Landscape and Urban Planning, 91*(3), 113–123. https://doi.org/10.1016/j.landurbplan.2008.12.003.

Buijs, A. E., Pedroli, B., & Luginbühl, Y. (2006). From hiking through farmland to farming in a leisure landscape: Changing social perceptions of the European landscape. *Landscape Ecology, 21*(3 SPEC. ISS.), 375–389. https://doi.org/10.1007/s10980-005-5223-2.

Castro, A. J., Vaughn, C. C., Julian, J. P., & García-Llorente, M. (2016). Social demand for ecosystem services and implications for watershed management. *Journal of the American Water Resources Association, 52*(1), 209–221. https://doi.org/10.1111/1752-1688.12379.

Chazdon, R. L., Brancalion, P. H. S., Laestadius, L., Bennett-Curry, A., Buckingham, K., Kumar, C., … Wilson, S. J. (2016). When is a forest a forest? Forest concepts and definitions in the era of forest and landscape restoration. *Ambio, 45*(5), 538–550. https://doi.org/10.1007/s13280-016-0772-y.

Cramer, W., Guiot, J., Fader, M., Garrabou, J., Gattuso, J.-P., Iglesias, A., … Xoplaki, E. (2018). Climate change and interconnected risks to sustainable development in the Mediterranean. *Nature Climate Change, 8*(11), 972–980. https://doi.org/10.1038/s41558-018-0299-2.

European Commission. (2000). Directive 2000/60/EU: European Water Framework Directive. Offical Journal of the European Communities, 372(1)(72). Retrieved from <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060>.

European Commission. (2019). Evaluation of EU water legislation concludes that it is broadly fit for purpose but implementation needs to speed up. Retrieved February 10, 2021, from <https://ec.europa.eu/info/news/evaluation-eu-water-legislation-concludes-it-broadly-fit-purpose-implementation-needs-speed-2019-dec-12_en>.

European Environment Agency. (2018). National climate change vulnerability and risk assessments in Europe, 2018. In *European Environment Agency*. Luxembourg: Publications Office of the European Union. https://doi.org/10.1109/TDEI.2009.5211872.

European Environment Agency. (2021). River basin. Retrieved June 4, 2021, from <https://www.eea.europa.eu/archived/archived-content-water-topic/wise-help-centre/glossary-definitions/river-basin>.

Fischer, A., & van der Wal, R. (2007). Invasive plant suppresses charismatic seabird - the construction of attitudes towards biodiversity management options. *Biological Conservation, 135*(2), 256–267. https://doi.org/10.1016/j.biocon.2006.10.026.

Fischer, A., & Young, J. C. (2007). Understanding mental constructs of biodiversity: Implications for biodiversity management and conservation. *Biological Conservation, 136*(2), 271–282. https://doi.org/10.1016/j.biocon.2006.11.024.

Forrester, J. (1971). Counterintuitive behavior of social systems. In J. W. Forrester (Ed.), *Collected Papers of J. W. Forrester* (pp. 211–244). Cambridge: Wright-Allen Press.

García-Nieto, A. P., Quintas-Soriano, C., García-Llorente, M., Palomo, I., Montes, C., & Martín-López, B. (2015). Collaborative mapping of ecosystem services: The role of stakeholders' profiles. *Ecosystem Services, 13*(13), 141–152. https://doi.org/10.1016/j.ecoser.2014.11.006.

Giakoumis, T., & Voulvoulis, N. (2018a). A participatory ecosystems services approach for pressure prioritisation in support of the Water Framework Directive. *Ecosystem Services, 34*(October), 126–135. https://doi.org/10.1016/j.ecoser.2018.10.007.

Giakoumis, T., & Voulvoulis, N. (2018b). The transition of EU water policy towards the water framework directive's integrated river basin management paradigm. *Environmental Management, 62*(5), 819–831. https://doi.org/10.1007/s00267-018-1080-z.

Heiskanen, E. (2006). Encounters between ordinary people and environmental science – a transdisciplinary perspective on environmental literacy. *The Journal of Transdisciplinary Environmental Studies, 5*(1–2), 1–13.

IDESCAT. (2020). Sistemas fluviales. Aportación. Por temporadas. Metodología. Retrieved January 20, 2021, from <https://www.idescat.cat/pub/?id=aec&n=211&lang=es>.

Iniesta-Arandia, García-Llorente, M., Martín-López, B., Castro, A., Aguilera, P., & Montes, C. (2011). La evaluación de los servicios de los ecosistemas: una aproximación socio-ecosisté- mica a la gestión de cuencas hidrográficas (pp. 1–7).

Iniesta-Arandia, I., García-Llorente, M., Aguilera, P. A., Montes, C., & Martín-López, B. (2014). Socio-cultural valuation of ecosystem services: Uncovering the links between values, drivers of change, and human well-being. *Ecological Economics, 108*, 36–48. https://doi.org/10.1016/j.ecolecon.2014.09.028.

Jamovi. (2020). Jamovi, 2020. Retrieved from <www.jamovi.org>.

Johnson, N. L., Lilja, N., Ashby, J. A., & Garcia, J. A. (2004). The practice of participatory research and gender analysis in natural resource management. *Natural Resources Forum, 28*(3), 189–200. https://doi.org/10.1111/j.1477-8947.2004.00088.x.

Kahila-Tani, M., Kytta, M., & Geertman, S. (2019). Does mapping improve public participation? Exploring the pros and cons of using public participation GIS in urban planning practices. *Landscape and Urban Planning, 186*, 45–55. https://doi.org/10.1016/j.landurbplan.2019.02.019.

Kochskämper, E., Challies, E., Newig, J., & Jager, N. W. (2016). Participation for effective environmental governance? Evidence from Water Framework Directive implementation in Germany, Spain and the United Kingdom. *Journal of Environmental Management, 181*, 737–748. https://doi.org/10.1016/j.jenvman.2016.08.007.

Lang, D. J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., … Thomas, C. J. (2012). Transdisciplinary research in sustainability science: Practice, principles, and challenges. *Sustainability Science, 7*(S1), 25–43. https://doi.org/10.1007/s11625-011-0149-x.

López-Bao, J. V., Chapron, G., & Treves, A. (2017). The Achilles heel of participatory conservation. *Biological Conservation, 212*(December 2016), 139–143. https://doi.org/10.1016/j.biocon.2017.06.007.

Martín-López, B., Palacios-Agundez, I., Montes, C., Gómez-Baggethun, E., Iniesta-Arandia, I., Palomo, I., … Bawa, K. (2012). Uncovering ecosystem service bundles through social preferences. e38970 *PLoS ONE, 7*(6). https://doi.org/10.1371/journal.pone.0038970.

Martín-López, B., Palomo, I., García-Llorente, M., Iniesta-Arandia, I., Castro, A. J., García Del Amo, D., … Montes, C. (2017). Delineating boundaries of social-ecological systems for landscape planning: A comprehensive spatial approach. *Land Use Policy, 66*, 90–104. https://doi.org/10.1016/j.landusepol.2017.04.040.

Masson-Delmotte, V., Zhai, P., Pörtner, H.-O., Roberts, D., Skea, J., Shukla, P. R., … Waterfield, T. (2018). *Global warming of 1.5°C An IPCC Special Report. Report of the Intergovernmental Panel on Climate Change*. Switzerland: IPCC.

MAXQDA. (2020). MAXQDA 2020 [computer software]. Berlin, Germany: VERBI Software. Available at <https://www.maxqda.com/> (accessed on July 15, 2020). Berlin, Germany: VERBI Software. Retrieved from Available from maxqda.com.

MEA. (2005). *Ecosystem and Human well-being. Synthesis* (Vol. 5). https://doi.org/10.1196/annals.1439.003.

Mease, L. A., Erickson, A., & Hicks, C. (2018). Engagement takes a (fishing) village to manage a resource: Principles and practice of effective stakeholder engagement. *Journal of Environmental Management, 212*, 248–257. https://doi.org/10.1016/j.jenvman.2018.02.015.

Médail, F., Monnet, A. C., Pavon, D., Nikolic, T., Dimopoulos, P., Bacchetta, G., … Leriche, A. (2019). What is a tree in the mediterranean basin hotspot? A critical analysis. *Forest Ecosystems, 6*(1). https://doi.org/10.1186/s40663-019-0170-6.

Moon, K., & Blackman, D. (2014). A guide to understanding social science research for natural scientists. *Conservation Biology, 28*(5), 1167–1177. https://doi.org/10.1111/cobi.12326.

Olson, D. M., Dinerstein, E., Wikramanayake, E. D., Burgess, N. D., Powell, G. V. N., Underwood, E. C., … Kassem, K. R. (2001). Terrestrial ecoregions of the world: A new map of life on Earth. *BioScience, 51*(11), 933–938. https://doi.org/10.1641/0006-3568(2001)051[0933:TEOTWA]2.0.CO;2.

Palomo, I., Martín-López, B., Potschin, M., Haines-Young, R., & Montes, C. (2013). National Parks, buffer zones and surrounding lands: Mapping ecosystem service flows. *Ecosystem Services, 4*(2005), 104–116. https://doi.org/10.1016/j.ecoser.2012.09.001.

Pascual, D., Zabalza-Martínez, J., Funes, I., Vicente-Serrano, S. M., Pla, E., Aranda, X., … Biel, C. (2016). Impacts of Climate and Global Change on the Environmental, Hydrological and Agricultura Systems in the LIFE MEDACC Case Study Basins. Retrieved June 24, 2020, from <http://medacc-life.eu/>.

Pfadenhauer, J. (2001). Some remarks on the background of restoration ecology. *Restoration Ecology, 9*(2), 220–229.

Prager, K., & Curfs, M. (2016). Using mental models to understand soil management. *Soil Use and Management, 32*(1), 36–44. https://doi.org/10.1111/sum.12244.

QGIS Development Team. (2020). QGIS Development Team (2020). QGIS Geographic Information System. Open Source Geospatial Foundation Project. Available at: <http://qgis.osgeo.org>.

Quintas-Soriano, C., Brandt, J. S., Running, K., Baxter, C. V., Gibson, D. M., Narducci, J., & Castro, A. J. (2018). Social-ecological systems influence ecosystem service perception: A programme on ecosystem change and society (PECS) analysis. *Ecology and Society, 23*(3). https://doi.org/10.5751/ES-10226-230303.

R Core Team. (2020). R: A Language and Environment for Statistical Computing. Vienna, Austria. Retrieved from <https://www.r-project.org/>.

Ramsar. (1999). SISR. Servicio de información sobre Sitios Ramsar. Aiguamolls de l'Empordà. Retrieved January 20, 2021, from <https://rsis.ramsar.org/es/ris/592?language=es>.

Raymond, C. M., Bryan, B. A., MacDonald, D. H., Cast, A., Strathearn, S., Grandgirard, A., & Kalivas, T. (2009). Mapping community values for natural capital and ecosystem services. *Ecological Economics, 68*(5), 1301–1315. https://doi.org/10.1016/j.ecolecon.2008.12.006.

Reed, M. S. (2008). Stakeholder participation for environmental management: A literature review. *Biological Conservation, 141*(10), 2417–2431. https://doi.org/10.1016/j.biocon.2008.07.014.

Reed, M. S., Vella, S., Challies, E., de Vente, J., Frewer, L., Hohenwallner-Ries, D., … van Delden, H. (2018). A theory of participation: What makes stakeholder and public engagement in environmental management work? *Restoration Ecology, 26*(August), S7–S17. https://doi.org/10.1111/rec.12541.

Ricart Casadevall, S. (2014). *Vers una gestió territorial del regadiu. Model i aplicació a tres casos d'estudi de l'Europa meridional*. Girona, Spain: Universitat de Girona.

Richards, C., Blackstock, K.L. e Carter, C. E. (2004). Practical Approaches to Participation. SERG Policy Brief No. 1;, (1), 23. Retrieved from <http://www.macaulay.ac.uk/ruralsustainability/SERG PB1 final.pdf>.

Saurí, D., Ventura Pujolar, M., & Ribas, A. (2000). Gestión del agua y conflictividad social en la cuenca del río Muga (Alt Empordá). *Geographicalia, 38*, 59–76. https://doi.org/10.26754/ojs_geoph/geoph.2000381379.

Smith, M. H., Meehan, C. L., Enfield, R. P., & Castori, P. (2005). Using drawings to assess self-animal perceptions. *Anthrozoos, 18*(2), 122–139. https://doi.org/10.2752/089279305785594199.

Sodhi, N. S., Lee, T. M., Sekercioglu, C. H., Webb, E. L., Prawiradilaga, D. M., Lohman, D. J., … Ehrlich, P. R. (2010). Local people value environmental services provided by forested parks. *Biodiversity and Conservation, 19*(4), 1175–1188. https://doi.org/10.1007/s10531-009-9745-9.

Tàbara, J. D., & Saurí, D. (2004). Stakeholders report on: The Muga River Basin Catalonia, Spain.

Tashakkori, A., & Teddlie, C. (2003). *Handbook of mixed methods in social & behavioral research*. Thousand Oaks: Sage.

Turnhout, E., Van Bommel, S., & Aarts, N. (2010). How participation creates citizens: Participatory governance as performative practice. *Ecology and Society, 15*(4). https://doi.org/10.5751/ES-03701-150426.

UNEP/MAP-Plan Bleu. (2020). *State of the Environment and Development in the Mediterranean*. Nairobi: UNEP/MAP-Plan Bleu. https://planbleu.org/wp-content/uploads/2021/04/SoED_full-report.pdf.

Ventura Pujolar, M. (2005). *Conflictes socioterriorials i participació pública en la gestió de l'aigua de la conca del riu Muga (Alt Empordà)*. Girona, Spain: Universitat de Girona.

Vollmer, D., Shaad, K., Souter, N. J., Farrell, T., Dudgeon, D., Sullivan, C. A., … Regan, H. M. (2018). Integrating the social, hydrological and ecological dimensions of freshwater health: The Freshwater Health Index. *Science of the Total Environment, 627*, 304–313. https://doi.org/10.1016/j.scitotenv.2018.01.040.

Wickham, H. (2016). *ggplot2: Elegant Graphics for Data Analysis*. New York: Springer-Verlag.