



Does the public's negative perception towards wood in rivers relate to recent impact of flooding experiencing?

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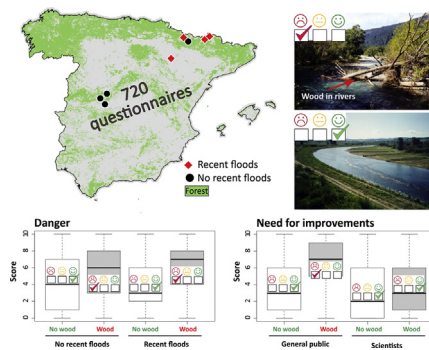
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HIGHLIGHTS

- Large wood is a key component of river systems.
- We surveyed scientists and lay people in areas affected and not affected by floods.
- People independently from flood history perceived rivers with wood as more dangerous.
- There is a gap between scientific and public perception of river systems with wood.
- Knowledge transfer is needed to implement balanced instream wood management policy.

GRAPHICAL ABSTRACT



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ABSTRACT

Instream large wood (LW) is widely perceived as a source of hazard that should be avoided. This is also the case of Spain, where wood has been systematically removed from rivers for decades. Consequently, people are accustomed to rivers with minimal or no LW at all. However, the presence and transport of wood is natural and has positive ecological effects. Previous studies reported that the general negative perception towards LW in rivers is related to the lack of background knowledge about stream ecology or fluvial dynamics. However, we hypothesize here that recent flooding experience has an influence on the perception of LW as well. To test this hypothesis, we surveyed groups of individuals living in different areas of Spain that have been affected more or less frequently by floods. In addition, we surveyed a group of scientists to test whether their perception towards LW differs from that of the general public. We observe that flooding experience is not the main controlling factor of how LW is perceived. Instead, we observe that respondents, independently of the time passed since the last flood, perceived watercourses with LW as less aesthetically, more dangerous, and with a larger need to improve channels than in watercourses without LW. Regional differences were detected, potentially related to differences in environmental attitudes. We confirm the existence of a gap in perception between scientific communities and the general public regarding natural river systems with wood; thereby highlighting the need to transfer knowledge, training, and education to bridge this gap. The generalized negative perception towards LW could have

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important consequences on the implementation of river management measures, such as LW augmentation for restoration purposes. This study underlines that wood removal should be more balanced in post-flood works and that public information is needed to implement a balanced LW management policy.

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1. Introduction

Extensive literature exists about the positive influence of instream large wood (LW) on river ecology in particular (e.g., Gregory et al., 2003) and on fluvial dynamics in general (Gurnell, 2012; Wohl, 2013; Le Lay et al., 2013; Ruiz-Villanueva et al., 2016). The physical complexity created by instream wood (i.e., wood enhancing the creation of steps, pools, bars, channel widening and shifting, etc.) provides habitats for fish and other organisms (Benke and Wallace, 2003; Nagayama et al., 2012; Roni and Beechie, 2013; Wohl, 2017). Moreover, wood enhances sediment and organic matter storage (Gurnell et al., 2009; Wohl and Scott, 2016).

However, in many regions, LW is still perceived as a source of hazards for a variety of reasons, including navigation and flood control (Sedell et al., 1991; Wohl, 2014), as wood obstructs flow and increases hydraulic resistance. Moreover, and despite the fact that instream wood usually remains relatively stable within river corridors (Rutherford et al., 2002), it is well known that large quantities of LW can be transported during floods. Because of these effects, LW may increase the negative consequences of floods (Diehl, 1997; Lyn et al., 2007; Mao and Comiti, 2010; Comiti et al., 2012; Ruiz-Villanueva et al., 2014; Lucía et al., 2015; Wohl et al., 2016; Steeb et al., 2017). Despite the positive ecological role of wood, landowners or public agencies are still required to remove wood from rivers in many national legislations, and without balancing pros and cons of wood conservation in river reaches. This is also the case of Spain, where the removal of LW from rivers is usually defined as “cleaning” or “clearing of rivers” (i.e., a procedure that usually includes the extraction of sediment, but also the removal of living vegetation together with dead wood).

However, now widespread recognition exists of the irreversible and negative changes that LW removal from rivers causes in river corridors. Clearance of LW increases sediment yields, decreases floodplain sedimentation and river complexity, decreases overbank flooding and the creation of secondary channels, which then eventually causes a fundamental, extensive, and intensive change in forested river corridors (Wohl, 2014, 2015; Wohl et al., 2016). For these reasons, wood reintroduction is increasingly used in restoration projects to improve the hydrological, morphological, and ecological status of degraded streams and rivers (Brooks et al., 2001; Reich et al., 2003; Kail et al., 2007).

In Spain, as in many other regions of Europe (Liébault and Piégay, 2002; Comiti, 2012), intensive territorial occupation over the last century has led to significant changes in rivers and streams. These changes have presumably also been favoured by the historical removal of wood accumulations from rivers (Wohl, 2014). As a result, people are nowadays accustomed to rivers with minimal or no instream wood, and when present, they may perceive it in a very negative way. In Spain, this perception seems to be enhanced after floods when people affected by catastrophic events are usually asking for severe river clearing, even if wood was reportedly not at the origin of the disaster (Correa, 2013; Ollero, 2013; Comiti et al., 2016). On the other hand, exposure and vulnerability to floods have increased across Spain due to extensive urbanisation in flood-prone areas, and also potentially as a result of climate change. Consequently, river and flood risk management should regulate LW in rivers by balancing the good ecological status of the fluvial ecosystem and the potential hazards during floods. Recently, the European Water Framework (2000/60/EC) and the related Flood Directive (2007/60/EC) provided a legal framework to favour good ecological and geomorphic conditions of watercourses, which may in fact have implications for current LW management in rivers.

The perception of riverscapes by people should be one important aspect to be considered in river management, however, unless in forest planning decisions, in which aesthetic values are regularly considered (Ribe, 2006; Palmer, 2008; Ribe, 2009), landscape assessments applied to rivers are at an even earlier developmental stage (Pflüger et al., 2010). It is recognised that environmental projects are more acceptable if they contain a management design consistent with the population's perception (Higgs, 1997; Vining et al., 2000; Miller and Hobbs, 2007). In the case of perception towards instream wood in riverscapes, the extent to which individuals recognize that wood is beneficial in rivers depends on different socio-cultural aspects (Piégay et al., 2005; Mutz et al., 2006; Chin et al., 2008, 2014; Le Lay et al., 2008; Wyzga et al., 2009). First surveys on the perception of wood were realized with students from several countries in 2005, and revealed the need for education on what constitutes a natural river in a forested context (Piégay et al., 2005). The same survey, based on riverscapes scenes with and without wood, has later been used around the World and with different target populations. We review these studies and available literature about instream wood perception and summarize the key findings in Table 1 (other landscape perception studies are out the scope of our work). Interestingly, students from China, India, and Russia perceived LW as unnatural elements in rivers (Le Lay et al., 2008). On the other hand, in regions with abundant forests and active research on aquatic ecosystems and wood functions, such as Germany, interviewed students had a more positive attitude towards wood (Mutz et al., 2006). However, differences persist and likely depend on the background of surveyed people (Wyzga et al., 2009) or their familiarity with the environment (Le Lay et al., 2008).

People evaluate landscapes and environments in terms of how they meet psychological, social, and/or physical needs (Brown and Daniel, 1984; Daniel and Boster, 1976; Rosenberger and Smith, 1998; Bechtel and Churchman, 2002), and perception is highly dependent upon the experiential context of the place being evaluated (Carlson, 1977; Zube and Pitt, 1981; Stokols, 1995; Wapner and Demick, 2002). Following this reasoning, we hypothesize that the perception of wood in rivers in Spain is not only influenced by the knowledge and information on the significance of wood in stream systems (Wyzga et al., 2009; Le Lay et al., 2008), but also by the experiencing of recent floods. Due to the generalized idea that negative consequences of floods are enhanced by the presence of wood in rivers – while ignoring any positive effects – we present a follow-up of the perception study published by Piégay et al. (2005) to test this hypothesis. The aim of this work is to evaluate whether people living in areas that have been affected recently by floods have a different perception towards instream wood than people living in areas that have not been affected by floods and who are therefore lacking recent flood experience. Our target people are therefore divided in controlled groups of individuals living in different mountain areas which were recently (i.e. 2012, 2013) affected by floods. In addition, we surveyed a group of people with linkages to the scientific community (e.g., universities, research institutes, water authorities). This allowed us to test whether the perception of instream wood of scientists is different from the perception towards instream wood of the general public.

As we analysed different groups of people with different backgrounds, ages, and knowledge of rivers, we investigated potential sub-groups (or clusters within previous groups) underlying different socio-demographic and cultural factors. Moreover, we analysed their opinion regarding river management in general.

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