



Awareness of greater numbers of ecosystem services affects preferences for floodplain management



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ABSTRACT

People's preferences for different habitat management scenarios determine the way that floodplain habitats are managed, and the ecosystem services that they provide. Making people aware of a greater number of ecosystem services may encourage them to design habitat management that better balances the provision of conflicting services. To investigate the impacts of ecosystem service information on people's preferences for floodplain habitat management options, we manipulated the number of ecosystem services that participants knew about, and the level of detail of the information they were provided with. The preferences of participants differed depending on the number of services that were described. Providing people with ecosystem service information had a quantifiable effect on their preferences among different habitat management options, and increased the variability in preferences between people. These findings are consistent with the theory that ecosystem service information should encourage people to consider a wider range of benefits that nature provides, and this in turn may enable habitat management that better balances trade-offs between different services. Simply describing more ecosystem services to people had no effect on their preferences for management options, suggesting that detailed, empirical data on ecosystem services are required to affect decision making.

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1. Introduction

Human choices determine the structure and function of many habitats: over 50% of the global land surface has been transformed by human management (Hooke et al., 2012). The choices that people make about habitat management are driven by their desires for the benefits (i.e. ecosystem services) that those habitats can provide. Habitat management decisions can have major implications for ecological quality and human welfare (MA, 2005), and the changes to ecosystems caused by management actions can be irreversible (Groffman et al., 2006). For example, removal of invasive shrubs in parts of the United States is intended to stimulate regrowth of grassland vegetation, but such restoration can be inhibited because the shrubs alter soil resource patterns (Brown et al., 1999). Despite the importance of habitat management decisions in determining ecosystem service provision, the underlying factors that influence these decisions have not been well studied (Cowling, 2014). In particular, it is not clear how people's preferences for management options may differ depending on the infor-

mation that is available to the person. The objectives of this study were to (1) analyse the impact that information about a greater number of ecosystem services had on people's preferences for hypothetical floodplain management options, and (2) to investigate whether preferences differed when the ecosystem service information was quantitative or qualitative. We investigated these questions through an experimental decision making exercise in which a group of non-experts stated their preferences for habitat management options. The proposed management options remained identical in all treatment groups, but the information that described the outcomes to participants was varied in terms of the number of services that were described, and whether quantitative or qualitative indicators were shown.

Ecosystem services are the benefits that nature provides to people, but different benefits are of greater or lesser interest to different people (Reed, 2008). People's preferences for habitat management scenarios depend on the way that they prioritise the relevant ecosystem services (Kørnøv and Thissen, 2000). To make a decision about their preferred scenario in a given management problem, people analyse their understanding of the effects of different management scenarios on service provision, in relation to their ecosystem service priorities (March, 1978; Hogan, 2002). The information that is available to describe the impacts of manage-

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ment scenarios on ecosystem service provision could therefore be expected to impact people's decisions, as it will impact their understanding of the management outcomes.

There are commonly trade-offs between the provision of different ecosystem services, meaning that it is rarely possible to maximise the provision of one service without reducing the provision of others (Bennett et al., 2009; Rouquette et al., 2011). In the past, many habitat management decisions have been made to prioritise the provision of one ecosystem service (typically food production) at the expense of others (Tallis and Polasky, 2009). In contrast, using an "ecosystem services" approach has been proposed as way of better taking into account the impacts of management on a broader range of services (Tallis and Polasky, 2009). Many ecosystem service studies analyse the effects of management actions on the provision of ecosystem services (e.g. Grêt-Regamey et al., 2008; Rouquette et al., 2011), and such information should make habitat managers aware of a broader range of services, and the trade-offs between their provision (Raudsepp-Hearne et al., 2010). Providing people with an understanding of the relationships between management practices and multiple services could be expected to encourage holistic management strategies that balance the provision of conflicting services (Fish, 2011). Despite considerable research into describing the relationships between ecosystem services and the impacts of habitat management on provision, little is known about the way that the quantity and quality of ecosystem service information that decision makers have can affect their management decisions (Laurans et al., 2013; Laurans and Mermet, 2013). In this study we investigate one component of habitat management decision making: the preferences that individual decision makers have for different management scenarios.

An individual making a decision about habitat management is typically presented (implicitly or explicitly) with multiple options. The individual must then compare options based on their expected outcomes in terms of ecosystem services. It may be possible to logically discount some of the available options (Kørnøv and Thissen, 2000) because, assuming that people act rationally, they should avoid management options which underperform in relation to all ecosystem services (Tversky and Kahneman, 1986). If there are multiple scenarios which cannot be discounted rationally, an individual must decide how best to balance trade-offs between ecosystem services (Craik, 1972; Koontz and Thomas, 2006). This personal decision will be affected by the way that an individual prioritises the various ecosystem services that they are aware of, and their understanding of the effects of different management scenarios on service provision (March, 1978; Hogan, 2002).

The information that is available about the impacts of habitat management scenarios can be expected to impact people's preferences for the different options. Information shapes people's understanding of the relationships between ecosystem services, including their understanding of whether, or how, services trade-off against each other. In the simplest case, where information about the provision of only one ecosystem service is provided under multiple scenarios, there is only one logical choice; the scenario which maximises the provision of the given service. As more ecosystem services are considered and more complex trade-offs become apparent, a person making a decision can discount fewer options through logic, so must prioritise the relevant ecosystem services and weigh up the net values of different combinations (Costanza, 2000; Laurans and Mermet, 2013). The way that an individual chooses to prioritise ecosystem services can be expected to vary considerably between people, as it depends on their personal background and set of beliefs (Kumar and Kumar, 2008). We therefore hypothesise that a group of people's decisions may be more varied when they have information about the impacts of habitat management on a greater number of ecosystem services.

Floodplain systems are a habitat that is of high management interest: in Europe over 90% of the area of lowland floodplain has been modified (Tockner and Stanford, 2002). There are commonly trade-offs between floodplain services (Rouquette et al., 2011), so decisions must be made about which services to manage floodplain habitats for. Floodplains have historically been managed for agriculture and to reduce flood risk in downstream areas (Tockner and Stanford, 2002), despite their potential to provide a broad range of services (Tockner and Stanford, 2002; Posthumus et al., 2010; Rouquette et al., 2011). Several previous studies have proposed ecosystem service frameworks for floodplain management decision making (Morris et al., 2009; Posthumus et al., 2010; Sanon et al., 2012), but the impacts of such ecosystem service information on people's preferences for different management scenarios have not been investigated.

2. Materials and methods

2.1. Overview of the study design

We set up an artificial habitat management problem, in which participants were asked to make a series of decisions about their preferred floodplain management options. Participants were asked to take on the role of a representative of a local community during a consultation on a floodplain management project, and were asked to make a series of choices between pairs of seven management scenarios. The scenarios were hypothetical, but were based on the ecosystem services provided by a real floodplain: the Fishlake wetlands in South Yorkshire in the United Kingdom.

Artificial management problems are commonly used to quantify preferences for ecosystem services, for example using choice experiments (Morey et al., 2002; Birol and Cox, 2007). In contrast to a typical choice experiment, we asked questions about only 7 specific management scenarios, rather than generating a fully factorial set of scenarios. We chose not to present a fully factorial choice experiment for reasons of efficiency; it greatly reduced the number of questions that we needed to ask, thus allowing greater replication. The challenge of obtaining a reasonable sample size was particularly great in the present study because of the need to essentially conduct three preference studies, one for each of the information treatments. Furthermore, a fully factorial choice experiment was not required for the present study because the focus was on measuring what people's preferred management options were, rather than quantifying the underlying utility that the choices revealed.

Individual preferences for habitat management options were quantified by asking people to choose between multiple options. Students and staff (both academic and non-academic) from The University of Sheffield in the United Kingdom were recruited for an online decision making exercise over two periods; once in June and once in September 2013. The factor levels for the survey questions were developed through pilot testing with 30 students to ensure that they varied over a magnitude that was large enough to be considered notable by the participants.

2.2. Case study site

The Fishlake wetlands lie adjacent to the River Don, to the east of Doncaster (Latitude: 53.61, Longitude: -1.00). Historically, the area was drained and disconnected from natural flooding, except at extremely high river flows, but in August 2009 restoration works were carried out, which established greater hydrological connectivity between the river and the floodplain. The English Environment Agency designed the Fishlake restoration project following discussions with local stakeholders, government departments,

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