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Research article

Benefits transfer and the aquatic environment: An investigation into the context of fish passage improvement

Steve King [a], Iain Fraser [b, c, *], Jesse R. O'Hanley [b]

[a] UNEP World Conservation Monitoring Centre, United Kingdom
[b] University of Kent, United Kingdom
[c] La Trobe University, Australia

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ABSTRACT

We present findings from a choice experiment investigating improvements in the aquatic environment from mitigation of barriers to fish passage. Implemented at a local and national level, results reveal positive preferences for increased numbers of fish species as well as fish abundance. In addition, we examine if in this case the willingness to pay estimates are suitable for direct transfer between national and local settings. For both samples, we consider the extent to which stated attribute non-attendance impacts estimates of willingness to pay and the potential ability of researchers to transfer values between contexts. Implications of the use of benefit transfer within this policy context are discussed in light of our findings.

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1. Introduction

River systems comprise some of the most complex, dynamic and bio-diverse ecosystems on earth (Dynesius and Nilsson, 1994). However, as a society, we have extensively modified these ecosystems in order to provide socioeconomic benefits such as water supply, flood suppression, power, and transportation. Obtaining these benefits typically involves the construction of river infrastructure (e.g. dams and road crossings), which fragments the continuity of rivers (Bednarek, 2001). Numerous studies have demonstrated the negative effects of these artificial in-stream structures on fish populations (e.g., Fullerton et al., 2010; Nislow et al., 2011). Removing physical barriers that inhibit fish passage has been demonstrated to deliver increased spawning, fish density (Gardner et al., 2013), diversity (Catalano et al., 2007), and rapid colonization of formerly impounded reaches (Roni et al., 2008). As such, there is now considerable interest in river barrier removal and mitigation as a cost effective means of improving fish populations at the catchment scale (Roni et al., 2008; Kemp and O'Hanley, 2010; O'Hanley, 2011; O'Hanley et al., 2013; King and O'Hanley, 2016).

River ecosystem improvements are typically driven by legislation. For example, across England and Wales, the Environment Agency (EA) has prioritised 2500 river barriers for mitigation action in order to meet requirements of the EU Water Framework Directive (WFD) and eel regulations at an estimated cost of £540 million (Moghraby, 2008). However, such investment may not be justified on economic efficiency grounds, implying it could be put to better environmental protection use elsewhere. Indeed, where costs are disproportionate to benefits, derogations from the requirements of the WFD may be sought (Hanley et al., 2006b). As the benefits of river ecology improvements will frequently be positive externalities, non-market valuation techniques are required to inform cost benefit analysis (CBA) of river barrier mitigation action. Unfortunately, undertaking repeated valuation studies across catchments is both expensive and time consuming and, therefore, likely to be limited to large, controversial cases (Hanley et al., 2006b). Although benefit transfer (BT) can, in principle, provide an inexpensive solution to this problem (Morrison and Bennett, 2004), there remains considerable debate regarding its validity and which are the most appropriate methodologies of employing it (Hanley et al., 2006a).

In this paper, we estimate the willingness-to-pay (WTP) for local river ecosystem improvements delivered from river barrier mitigation actions using a choice experiment (CE). We administer the CE to local and national samples so that we can assess any differences that emerge and, in turn, inform future BT applications in this context. In particular, we evaluate if the national estimates for river ecosystem improvements for a generic river are valid for application in a specific local context. Furthermore, we explicitly examine the impact of attribute non-attendance (ANA) on our model estimates and BT robustness. To assess ANA, we explicitly asked all

* Corresponding author. University of Kent, United Kingdom.
E-mail address: i.m.fraser@kent.ac.uk (I. Fraser).

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survey respondents to state which attributes they used in making their choices. The existence of ANA is potentially problematic for CE data analysis. If not taken into account during model estimation, WTP estimates may be biased.

We make three main contributions to the literature. First, we add to the small number of valuation studies on environmental improvements that result from modifications of multiple river barriers. To date, there are many studies that examine the benefits of improvements to general river quality, including those realised through the WFD, such as Hanley et al. (2006a,b), Bateman et al. (2011a), Bliem et al. (2012), and Glenk et al. (2015). However, few CE studies have focussed specifically on the ecosystem service benefits resulting from changes to river barriers that impact fish passage. Johnston et al. (2011) administered a CE to assess migratory fish passage restoration in the Pawtuxet watershed, Rhode Island, USA following the provision of fish passage facilities at 22 dams. They identify benefits from increased biological integrity, habitat accessibility, fish dependent wildlife, and viability of migratory fish runs. However, they did not find significant benefits from enhanced recreational fishing opportunities, unlike Laitila and Paulrud (2008), who considered river barrier removal in the Ljungan River in Sweden.

Our second contribution is to inform the debate surrounding the use of BT (Kaul et al., 2013). Specifically, we conduct a site specific CE and a generic national CE that were designed in such a way that we can compare attribute estimates of WTP between the samples. Within the literature, both significant differences (e.g., Morrison and Bennett, 2004) and no differences (e.g., Hanley et al., 2006b) in WTP estimates for CE attributes between samples have been observed. To assess differences in WTP, we employ the test introduced by Poe et al. (2005) that has been used extensively within the BT literature (e.g., Rolfe and Windle, 2012; Glenk et al., 2015).

Third and finally, as part of our CEs, we collected ANA information. In analysing our CE data, we assess the extent to which stated ANA impacts our WTP results for each CE. As observed by Glenk et al. (2015), much effort has gone into examining convergent validity (Kaul et al., 2013), whereas the emergence of transfer errors between sites might well occur because of differences in the way in which CE respondents have engaged with survey instrument (i.e., due to ANA). We consider the need to examine ANA an important issue when undertaking CE research and the lack of attention within the BT literature regarding this is a conspicuous oversight given its relative importance within the wider CE literature (e.g., Balcombe et al., 2011, 2015; Scarpa et al., 2013; Kragt, 2013; Kehlbacher et al., 2013). Indeed, Scarpa et al. (2013) argue that ANA may be of greater importance than unobserved heterogeneity. To date, the only BT study that has considered ANA is Glenk et al. (2015). In that study, the authors examined ANA using an inferred approach that requires the estimation of an equality constrained latent class model specification. We take a different approach: we explicitly asked CE respondents to state which attributes they ignored. Although there is debate within the literature as to which approach is preferred, the use of stated ANA data is helpful within a BT context as it allows for straight forward comparisons of WTP without the need for being concerned about different model specifications. Thus, we consider the impact resulting from ANA on our BT results with the same model specification and so avoid the need to run different model specifications, which could yield differences in WTP over and beyond those that result from BT.

In the present study, we explore BT issues by administering an almost identical CE to a national sample and a local sample for a specific river (i.e., the River Wey in South East England). We investigate preference heterogeneity for river ecology improvements delivered from barrier mitigation actions. In addition, we evaluate, in this limited context and points of comparison, the impact of such heterogeneity in the context of population effects that could compromise the validity of transferring national generic benefit estimates for river ecology improvements to our specific case study river, thus evaluating a novel form of BT.

The remainder of the paper is structured as follows. In Section 2, we introduce our case study river and discuss the design of our CE. In Section 3, we detail our choice model specifications. Results of our CE and our BT analysis are presented in Section 4. Finally, we discuss our findings and provide some concluding remarks in Section 5.

2. The choice experiment

We designed two almost identical CE survey instruments to examine preferences for improving the aquatic environment that result from the removal of physical in-stream barriers (e.g., dams, weirs, culverts, and locks) within a river system. The construction of our CE began with the development of a survey instrument for the River Wey. By drawing on river specific information, we were able to develop meaningful policy options. We then took the River Wey survey instrument and made minor changes to yield our National CE survey instrument. Specifically, the main difference in the design of the two CEs is that the local CE explicitly names a river: the River Wey. For the National survey we use identical information to describe the CE context and issues, but without explicitly naming a river. Thus, apart from the inclusion/exclusion of the river name, the two survey instruments were identical.

While it is acknowledged that the valuation context for the National survey will vary across respondents due to the proximity of a local river and any substitute rivers, the majority of households in the UK have a nearby watercourse that they can readily relate to as being their “local” river. Furthermore, river systems have been dramatically altered throughout the UK by the introduction of barriers, such that almost all rivers are subject to the environmental problem we consider in our CE.[1]

2.1. The River Wey

The River Wey, located in South East England, is a tributary to the Thames with a watercourse of approximately 190 miles. Over the centuries, construction of dams, weirs, locks, and other hydromodifications has significantly compromised river connectivity in the Wey such that fish and other aquatic organisms are unable to move freely through the system. The Environment Agency Fisheries Action Plan (EAFAP) for the catchment (EA, 2008) identifies the presence of physical obstructions as one of the key pressures on fish diversity and abundance. The EAFAP also notes that iconic species such as river otter and kingfisher are dependent on the existence of healthy fish populations.

2.2. Survey design

2.2.1. Attribute selection

Based on a literature review, extensive discussions with ecologists' familiar with the River Wey[2] and UK rivers in general, focus group work, and piloting[3] of the survey instrument, we arrived at four attributes:

[1] A summary of the extent of river restoration activities in the UK demonstrates proximity of UK households to watercourses can be found at the River Restoration Centre web site: (http://www.therrc.co.uk/uk-projects-map).

[2] The River Wey has been the subject of extensive ecological and environmental research activity: http://www.icer.soton.ac.uk/case-study-the-river-wey/.

[3] Our two focus groups consisted of 10 individuals each from the South East of England. Their interpretation of the survey instrument was analysed using a combination of cognitive testing and verbal protocol analysis. Focus was on the River Wey survey instrument and how the information provided was perceived and understood. Following this pre-testing, a pilot survey was given to 82 adults from South East England. Results indicated good engagement and understanding of the tasks required.

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