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Public values and preference certainty for stream restoration in forested watersheds in Finland

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ABSTRACT

Agriculture and forestry activities increase the deposition of fine sediments in river and streambeds, with negative consequences for biodiversity and stream ecosystem functioning. However, little is known about the economic value of headwater stream restoration and the associated improvement in ecosystem services. Here, we apply the contingent valuation method to assess the awareness, knowledge, and values held by different stakeholder groups regarding a change in the set of ecosystem services related to the restoration of sediment-stressed forest streams in a large boreal catchment. The majority of respondents (69%) place positive value on restoration. A multiple bound discrete choice (MBDC) format is applied and sensitivity analysis is carried out on willingness to pay (WTP) values with respect to preference uncertainty. Preference uncertainty related to willingness to support and pay for a forest stream restoration program is estimated and compared with ordered probit and non-parametric WTP models. According to our study, only 15% of the more than 450 respondents with a positive WTP are completely certain about their preferences. Higher preference certainty is significantly correlated with, for example, the stated easiness in revealing the household's WTP, trust in the restoration program, and support for the restoration of the living conditions of trout, in addition to a lower education level. Making restoration benefits more visible and involving the public and stakeholders in the projects could help in setting restoration targets, creating more effective plans with better public and stakeholder support, and establishing a stronger basis for the funding of restoration efforts.

1. Introduction

Ecological restoration has played an increasingly important role in global environmental policy as a strategy to compensate for the human-induced degradation of ecosystems, biodiversity loss, and the decline in ecosystem services (see e.g., [15,19,27]). For effective, sustainable management and conservation of ecosystems, decision makers and stakeholders need to understand the value of ecosystem services [25,54], as well as landowner characteristics and motivational factors related to these services [32,47]. The valuation of ecosystem services allows for consideration of the importance of pristine (or nearly so) ecosystems to human welfare, and changes therein as a result of human pressures such as population and economic growth. Valuation is necessary for the informed allocation of limited resources, aiming at maximizing benefits for society [21,6].

Headwater streams are an important functional component of forest ecosystems. Streams transport water, eroded material, and

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nutrients downstream, and constitute habitats for stream fauna and flora. Accordingly, ecotones between streams and riparian forests are considered as hotspots of regional biodiversity with considerable conservation value (see e.g., [42,51]). However, streams are under significant anthropogenic pressure [46], with consequences as severe as habitat degradation and loss [4,41]. Experimental [43,57] and correlational studies [58] in agricultural streams have demonstrated streambed sedimentation to be one of the leading causes of stream habitat degradation and biodiversity loss.

The first stream restoration projects in Finland were launched in the 1970s and 1980s, with the aim to improve the habitat conditions for juvenile salmonids and thereby secure salmonid fisheries [39]. Recently, the focus in stream restoration has shifted towards headwater tributaries, where streams have been degraded by forestry activities and sedimentation typically emerges as the most serious threat [28,51].

Few studies have examined the willingness of private forest owners to protect or enhance riparian habitats [32,47,5,55], and stream-related use values have to our knowledge only been assessed in two previous stated preference studies. Barak and Katz [7] used choice modeling to estimate the relative priorities that the public assigns to in-stream versus land-based uses of stream areas in Israel. In their study, respondents valued the rehabilitation of stream banks for recreational purposes more than for in-stream water uses such as fishing and swimming, indicating that the majority of the preferred stream-related benefits can be achieved by rehabilitating stream banks and riparian areas. Kenney et al. [31] evaluated the social benefits of aesthetic and recreational enhancements while estimating the economic effects of urban stream restoration in Baltimore, USA. Similarly to Barak and Katz, they concluded that restoration projects with public access to streams should focus on the improvement of aesthetic and recreational elements.

Recent stated preference studies have assessed the willingness of landowners to participate in voluntary forest conservation programs [37,45,47,55]. Although there is an extensive and growing body of literature concerning the valuation of freshwater ecosystems, ecosystem restoration, and conservation (see e.g., [11,12,26,38,59,61]), very little information is available about the valuation of stream restoration activities in rural and, specifically, forested watersheds. Furthermore, few studies have adequately described the links between forest conservation and water quality in a valuation context [33]. In addition to landowners' willingness to participate in voluntary forest conservation programs, little is known about public preferences for alternative conservation and restoration approaches [33], and few cost–benefit analyses (CBA) exist on riparian restoration activities [5,55].

Given the general lack of public awareness and familiarity with the role forests play in providing water services and biodiversity, there is a need to better understand the factors influencing public preferences and the preference certainty of respondents in a stated preference survey when asked to give their valuation estimates [1,2,62]. This uncertainty may arise for a variety of reasons [50]. Respondents may be uncertain about the specific public good that they are valuing or, due to the hypothetical, complex nature of the valuation exercise, they may be unable to fully comprehend the tradeoff between the public good and money income they are being asked to give up.

Here, we assess the values and motivations of rural residents, the general public, and residential forest owners in relation to the ecosystem services provided by boreal forest streams in northeastern Finland. We use the contingent valuation (CV) method to assess the values placed on improvements in a set of ecosystem services, accounting for preference uncertainty. In particular, we investigate whether the stated importance of forest and stream-related benefits, land ownership, and uncertainty towards the personal cost involved affect the willingness to participate in and willingness to pay (WTP) for a stream restoration program. Specifically, our main objectives are to explore:

1) Potential differences in preferences, motivations, and WTP for the ecosystem services provided by stream restoration activities between rural residents and residential forest owners; and
2) Factors influencing public preference (un)certainty underlying public valuation estimates.

2. Theoretical and econometric models

Contingent valuation (CV) is a stated preference method. Since no market price information is available for public goods, a CV survey creates a hypothetical market to elicit individual preferences and hypothetical WTP. CV is the most frequently applied non-market valuation method in valuing environmental assets [9], and it is also widely used in the case of ecological restoration [49]. The elements typically described in a CV scenario are (e.g. [44]): (1) the environmental problem, such as impaired water quality, (2) the change in the provision of a public good, and the environmental policy needed to ensure a change towards an improved situation (e.g. the implementation of a restoration program), (3) the cost or price of the policy implementation for the individual respondent, and (4) the payment vehicle, i.e., the method of payment (e.g. a tax or an entrance fee).

Here, we present a study in which individual WTP for a change in the provision levels of ecosystem services resulting from the restoration of sediment-stressed forest streams was elicited using a variation of the multiple bound discrete choice (MBDC) elicitation method (see [3,10,13,60]). Each survey respondent was asked whether he/she would pay some amount from a range of sums of money (bids). To capture preference uncertainty, a matrix of payments was presented in the questionnaire and categories of certainty (definitely yes, almost definitely yes, almost definitely no, definitely no). The payment card is presented in the Annex of this paper. Respondents were asked to indicate for each bid amount on the payment card how certain they were that they would actually be willing to pay (or not) the specific bid amount for the restoration program using the mentioned categorization. This then generated not only an indication of where their maximum WTP was expected to lie, but also certainty bounds around all bid amounts on the payment card. The maximum WTP value for each certainty level is presumed to lie between the chosen bid and the next highest bid given on the payment card. These two bids form an interval of an upper and lower bound on the respondent's unobserved