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Ecosystem benefits from coastal habitats—A three-country choice experiment

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ABSTRACT

Coastal habitats provide a variety of benefits for citizens living in littoral countries. The economic value of changes in coastal habitats in the context of the implementation of the Baltic Sea Action Plan, targeting good ecological status by 2021, in two coastal sites was estimated using the choice experiment method. The selected aspects of marine ecosystem were described in conjunction with ecological changes modeled within the Finnish–Swedish archipelago and the Lithuanian coast. The benefits for Finns, Swedes, and Lithuanians for changes in the adjacent coastal site were estimated with the conditional logit and random parameters logit models accounting for preference heterogeneity. The willingness to pay estimates for healthy perennial vegetation, protection of currently pristine areas, and size of fish stocks differed significantly between populations. The transfer errors ranging from 40%, when transferring the estimates for the same coastal site between populations, to 400%, when transferring between both sites and populations, underline careful consideration in value transfers.

1. Introduction

Marine habitats are a source of a variety of benefits for citizens living in littoral countries. Recreational opportunities, cultural heritage (traditional sea-related livelihood), fisheries, and buffering the wave action and the energy of the coastal currents, are examples of cultural, provisioning and regulating services. Habitats provide an interrelated set of marine ecosystem services; they are dependent on supporting fundamental traits of habitat, such as biodiversity and primary production. Even currently unknown benefits may exist and be found in the future [47,41,5,52,24,23]. Human activities on land and in the sea change the marine ecosystem and the associated supply of ecosystem services is in danger of decline. In the Baltic Sea, situated in the northeastern Europe, the construction of shipping lanes and recreational areas pose a regional threat for coastal ecosystems. All over the Baltic Sea, fisheries have a substantial impact on fish stocks, and eutrophication from the large catchment area is a serious problem [31,32,15,3].

The Baltic Sea Action Plan (BSAP) is a restoration programme governed by the Baltic Marine Environment Protection Commission—Helsinki Commission (HELCOM) that was founded in 1974 to protect the Baltic Sea environment through international co-operation. The BSAP targets achieving a good ecological status by 2021. It covers eutrophication, biodiversity, hazardous substances, and maritime activities. Important cross impacts are recognized. While reducing eutrophication helps to achieve a favorable state of biodiversity, reducing nutrient inputs from ships reinforces efforts to reduce eutrophication. The BSAP establishes a set of actions and national nutrient reduction goals, derived from sub-basin analysis to implement the plan by 2015 [30,33]. The aims of BSAP are supported by the European Union legislation, as the European Union Marine Strategy Framework Directive (2008/56/EC) protects the marine biodiversity and aims at achieving a good environmental status across Europe by 2020.

Besides ecological assessment and the identification and classification of services provided by marine ecosystems, sustainable coastal management can make use of the monetary estimation of non-market benefits associated with marine ecosystem services (see, e.g., [28,6,50,39]). To facilitate socially optimal decisions concerning marine protection, non-market benefits can be set against the profits from the economic use of marine ecosystems. The applicability of non-market valuation methods depends on the type of benefit and the involvement of use or non-use values in the valuation context. Methods that indirectly utilize the market data (hedonic pricing, travel cost method) are well suited for the valuation of recreational amenities used actually by citizens. For the estimation of value of changes that have not yet taken place and of non-market benefits associated with non-use values, such as knowledge of the existence of marine species and the option for future generations to enjoy the marine ecosystem services, the stated preference methods apply. The contingent valuation (CV)

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and the choice experiment (CE) elicit the preferences through hypothetical market scenarios, thus mimicking the market context in a survey [18,37,14].

The stated preference studies related to non-market benefits of the Baltic Sea concern various geographical scopes and populations [57]. The Baltic Sea wide CV applications include the studies of Gren et al. [26] and Ahtiainen et al. [1,2]. The former was conducted in three littoral countries (see [40]), the latter being Baltic Sea wide also in terms of the studied populations as the survey was conducted in all nine littoral countries. The previous CE applications in the Baltic Sea area are related to regional changes in water quality and to the valuations of one population, and they deal with different temporal and policy contexts, ecosystem services, and geographical areas [20,36,13].

The growing availability of non-market valuation studies increases the potential of transferring the values estimated for one site and one policy context to other sites and policy contexts instead of conducting time-consuming and expensive original studies. Benefit transfer (BT) may be applicable under certain conditions, such as ability to adjust the estimates for site differences [11]. The early research on the validity of benefit transfer related to stated preference studies focused on the CV method. The growing amount of the CE applications has promoted research into the applicability of the CE method in BT, as it is better adjustable for differences between sites and target levels [42,43,29,44].

According to previous results, the magnitude of the transfer error depends on whether the introduction of respondents' taste heterogeneity is random, non-theoretic, or theory-based [16,4] and on the choice and the amount of study sites from which values are transferred [17,12]. Apart from the challenges of transferring benefits across regions in one country, international benefit transfers are subject to differences in the levels of income and standards of living, tax rates, and the cultural context [48,49]. A limited number of surveys have addressed the international benefit transfer. Muthke and Holm-Mueller [45] do not suggest international benefit transfer based on the findings that the values differ more than in the national context in which transfers result in errors of around 50%. The similarity of sites and preferences matters. When the analysis excludes dissimilar sites, the reported transfer errors are in the range of 28–77% and of 37–137% when dissimilar sites are included [4]. When transfers are adjusted for heterogeneous preferences, the errors are in the range of 71–104% and of 87–140% when they are not [12].

This paper reports two choice experiment (CE) surveys focusing on habitats in two Baltic Sea coastal sites, the Finnish–Swedish archipelago and the Lithuanian coast. These sites are less-studied subareas of the Baltic Sea in terms of regional benefit estimates for management scenarios. The CE surveys were conducted simultaneously in three Baltic Sea countries: Finland, Sweden, and Lithuania, and addressed the selected aspects of the marine ecosystem and their change resulting from the implementation of the Baltic Sea Action Plan (BSAP). The changes were described on the basis of ecological modeling of the impacts of BSAP on key marine habitats [30,8]. The paper presents the welfare estimates for changes in the preservation of currently pristine areas as well as in two ecosystem variables, perennial vegetation and fish stocks. Moreover, the paper provides a cross-country comparison of welfare estimates calculated from alternative econometric model specifications, and investigates the feasibility of value transfer across populations and sites by comparing the transfer errors from single-country transfers. The rest of the paper is organized as follows. Section 2 describes study sites and research methods. Section 3 describes the application and the data. Section 4 presents the results of benefit estimations and transfer errors. Section 5 contains the discussion and conclusion.

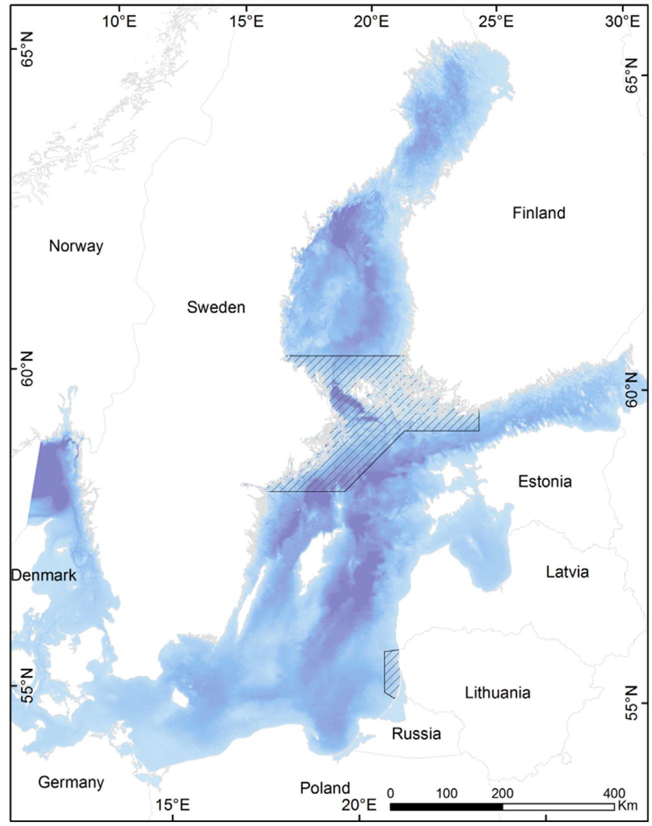

Fig. 1. Two study sites: the Finnish–Swedish archipelago area (1) and the Lithuanian coast (2).

2. Study sites and research method

2.1. Study sites

The study sites are located in the northern and eastern Baltic Sea (Fig. 1). The Finnish–Swedish archipelago has long and labyrinthine coastline consisting of 60 000 islands, while the Lithuanian coast, which lacks an island mosaic, is situated along the open sea on the Baltic Proper. Both study sites have hard rocky and soft sandy sea bottoms that contribute to providing several habitats for animal and plant species [51].

Both sites are strongly affected by human activities in the sea as well as in the densely populated and intensively cultivated catchment area. Waves from large leisure boats and passenger ships cause erosion and water turbidity. Dredging and coastal construction, such as summer cottages, other free time activities, jetties, breakwaters, and wind power plants, may threat biodiversity by changing the species composition and habitats for reproduction and nursing. Dredging reduces the visibility of the water and lifts nutrients from the sediment back into the water. Nutrient loading from the catchment area, originating from waste water from treatment plants and scattered settlements, traffic through air emissions, fish cultivation, industry, and non-point sources (e.g. agriculture), affects the habitats of fish and other animals directly via the associated water turbidity that limits the depth where underwater vegetation can grow. An indirect effect of eutrophication is related to the specific condition of the brackish water body i.e., the salinity difference between the bottom and top layers that prevents oxygenation in the sea bottom. In anoxic conditions, nutrients from the sediment can be released back to the water. While in the Lithuanian site, the quality of seawater is subject to both heavy nutrient loads and the severe impacts of internal phosphorus release, the Finnish–Swedish site is threatened mostly