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Research paper

Disamenity to amenity: Spatial and temporal patterns of social response to river restoration progress

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ABSTRACT

Our research explored the social dimension of river restoration by examining amenity development as a social response within two watersheds at different biophysical restoration states in Maine, USA. Our research provided the first systematic examination of progress in achieving federal- and state-regulated water quality improvements at an individual river segment level. Using spatial analysis, we documented spatiotemporal patterns of water classification shifts, examined the interactions among these shifts, and assessed the creation of amenity infrastructure and landscape patterns along the river corridors. Despite historical differences in patterns of water classification levels, these two systems were comparable in amenity infrastructure and in many landscape metrics. The pace of amenity development differed over time and along the rivers, with the more impaired system experiencing greater amenity development, raising questions about the larger role of amenity investment in fostering community awareness of river systems and pointing to the complexity of social response to river restoration. Communities may choose to invest in amenity development in advance of full restoration progress to provide greater connections to river systems. Alternatively, such investments may arise only after considerable progress has been achieved. Identifying why and when communities invest in amenities as a dimension of restoration is critical to advancing natural resource management.

1. Introduction

River communities have long managed river systems for a wide range of societal benefits, including power generation, transportation of goods, and waste disposal. While river systems' industrial legacies have led directly to community benefits, these benefits have sometimes undermined other long-term social benefits and contributed to impairment of vast stretches of the world's rivers. Investments in restoration stem from a growing awareness of rivers' broader ecological, physical, and social functions, including reconsideration of rivers' social value to river communities (Everard et al., 2011; Gobster et al., 2004).

As river systems move along the continuum from impaired to restored states, river communities may experience significant positive benefits (Everard & Moggridge, 2011). Social benefits of river restoration include enhanced quality of place, expanded tourism, and diversified economic development opportunities (Ayalasomayajula, Jeanty, & Hitzhusen, 2007; Bratman, Daily, Levy, & Gross, 2015; Everard & Moggridge, 2011; Hitzhusen, Ayalasomayajula, & Lowder, 2007; Howard, 2008). These benefits may trigger further restoration actions, such as the establishment of conservation and recreation areas along restored river corridors (Eckerd, 2010; Everard & Moggridge, 2011). In turn, river restoration also imposes social costs by attracting residential development with consequent impacts on water quality, gentrification of river corridors as these areas become more attractive locations to live, and a loss of jobs from traditional industries relocating away from river communities (Eckerd, 2010; Everard & Moggridge, 2011; Howard, 2008). The extent to which restoration processes deliver positive net benefits to river communities and society as a whole can significantly influence river systems' social and biophysical roles, as well as their overall restoration trajectory.

While there is extensive literature on biophysical responses to improvements in river systems, no comparable literature, in terms of breadth and depth, exists on social responses to river restoration (Westling, Lerner, & Sharp, 2009). Prioritization of restoration projects has relied to a large extent on ecological, physical, and technical benefits due to the lack of comprehensive understanding surrounding social benefits (Westling et al., 2009). One notable exception is economic valuation work, which has greatly informed assessments of major public projects like dam removals or changes to national water quality regulations and standards (Hitzhusen, Kruse, Abdul-Mohsen, Ferreti-

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Meza, & Hnytka, 2007; Robbins & Lewis, 2009). While some social science research examines resident perceptions and preferences for restored systems (Tunstall, Penning-Rowsell, Tapsell, & Eden, 2000; Wagner & Gobster, 2007), there remain numerous uncertainties regarding public support for restoration measures (Everard & Moggridge, 2011; Westling et al., 2009). This lack of comprehensive understanding of social impacts undermines advances in our conceptualization of river systems as dynamic social-ecological systems and therefore problematizes project and policy evaluation. An enhanced understanding of the nature and triggers of social feedback could better inform river restoration project assessments by focusing attention on the range of restoration patterns and potential outcomes from restoration projects, and the dynamic impacts of changes in public support for further restoration actions.

This study assesses social responses to river restoration by examining differences in community response between two Maine watersheds at different biophysical restoration states. In our research, we examine the dynamic nature of restoration and associated social impacts, such as improved community wellness or expanded development, and advance suggestions for measuring social responses to river restoration (Everard & Moggridge, 2011; Westling et al., 2009; Westling, Surridge, Sharp, & Lerner, 2014).

Considering rivers as natural amenities and their consequent impact on regional community and economic development processes provides a useful framework to examine the social dynamics of river restoration (Marcouiller, 2004; Marcouiller & Clendenning, 2005). In response to environmental advances such as improved water quality, river communities can invest in river amenities to bolster the value of river systems (Ayalasomayajula et al., 2007; Deller, Lledo, & Marcouiller, 2008; Howard, 2008). Another complementary perspective suggests that amenity investments by communities shift social preferences towards support for continued river restoration (Authors removed for blind review, 2017; Gobster & Westphal, 2004; Tunstall et al., 2000; Westling et al., 2009; Westling et al., 2014).

Our research addresses gaps in understanding of river restoration progress by focusing on the interaction between restoration level and community investment in river amenities such as parks, trails, and river access points. We add to the literature on feedback systems between river restoration and social responses by examining interactions among water quality improvements, river amenity establishment, and landscape changes associated with amenity investments.

Connecting restoration progress with social responses at a community scale raises many interesting theoretical and methodological challenges. Identifying an accessible metric for restoration progress is a first step in understanding the linkage between the biological and physical dimensions of river restoration and how communities start to reconceptualize and use rivers. Upgrades to river system classification levels provide a useful means of tracking restoration progress: they can be mapped, are well documented, and are relevant to state and federal policy efforts. Developing metrics for measuring amenity development in response to discrete shifts in water regulation and quality is a second key component of exploring this linkage. We consider investments in recreational facilities in areas adjacent to rivers and measures of landscape change to serve as such metrics. Spatial mapping and analysis of change over time in land cover allowed for an examination of urbanization shifts and the identification of emerging green spaces in response to broader community-scale changes (Guneroglu, Acar, Dihkan, Karsli, & Guneroglu, 2013; Li, Li, Zhu, Song, & Wu, 2013; Tian, Jim, & Wang, 2014).

Our research contributes to the literature on the social dimensions of ecological restoration, especially river restoration, by comparing water quality improvement patterns in the form of classification upgrades, and recreational river sites across two river systems in Maine. Our overarching question is to better understand the points along the restoration spectrum where communities reconceptualize rivers and choose to invest in amenity supply. Two objectives drive our research: (1) assessing restoration progress by documenting the spatiotemporal pattern of water classification upgrades in river systems, and (2) assessing patterns of social responses to river restoration using quantitative measures of amenity investment and land cover change. We are specifically interested in the timing of amenity supply relative to restoration progress. We present data on shifts in water classification levels, the spatial and temporal pattern of amenity creation, and shifts in land cover patterns as one potential approach to explore the interaction between restoration measures and the mechanisms by which communities choose to invest in amenity supply.

2. Literature review

2.1. Natural and built amenities

Amenities are defined as location-specific public goods that make a place more attractive to work, live, and recreate. Amenities, such as parks or lakes, impact local economies by attracting tourism and influencing the in-migration of retirees and residents (Deller et al., 2008; Goe & Green, 2005; Howard, 2008). Conversely, disamenities, such as urban congestion, have social implications by discouraging in-migration (Eckerd, 2010; Shumway, Otterstrom, & Glavac, 2014; Wu & Plantinga, 2003). As natural resources are finite and therefore typically non-producible, the supply of natural amenities can only be the result of a gradual transformation of existing resources, shifts in community perceptions towards existing natural resources, or policies that lead to a reconceptualization of a natural resource as an amenity (Åberg et al., 2013; Deller, Marcouiller, & Green, 2005; Irwin, Jeanty, & Partridge, 2014; Marcouiller & Clendenning, 2005; Wu & Plantinga, 2003). Natural amenities are also typically non-tradable, and regions can make investments to expand access and promote these spatially fixed natural amenities through the development of amenity infrastructure or "built amenities." Built amenities include the provision of recreational services, parks, trails, kiosks, and access points like marinas. As a result, few studies examine the influence of amenities based solely on the presence of natural resource attributes or "natural amenities;" instead, these studies incorporate the interaction between natural amenities and "built amenities" (Deller et al., 2008; Marcouiller, 2004; Marcouiller & Clendenning, 2005).

2.2. Amenities and rural development

By viewing natural amenities as dynamic resources, Marcouiller and Clendenning (2005) advance a compelling theoretical framework for understanding the capture of amenity demand and the interaction between amenities and rural development. At certain stages, communities may value natural resources like rivers for providing services such as power generation or waste disposal, resulting in resource modification, as has occurred in the industrialization of river corridors. As communities rely less on natural resources for extractive purposes, social preferences shift, and the amenity value increases. Consequently, amenities start to become a priority (Åberg & Tapsell, 2013; Marcouiller & Clendenning, 2005).

Shifts in community conceptualization of rivers from disamenity to amenity can trigger positive feedback loops that serve to enhance rivers as natural amenities. For example, establishing built amenities such as parks and trails in proximity to restored river systems can contribute to improved public health outcomes, well-being, and aesthetics (Boone, Buckley, Grove, & Sister, 2009; Gobster, Nassauer, Daniel, & Fry, 2007; Jorgensen & Gobster, 2010; Westling et al., 2009). As populations become healthier and scenery improves, park and trail use near rivers may increase, offering further momentum for river restoration efforts and expanded engagement with river restoration programs. Shifts in community conceptualization can also trigger negative feedback loops, such as expanded development along river corridors with potentially adverse impacts on water quality (Irwin et al., 2014). Nonetheless, the future