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Dam Removals and River Restoration in International Perspective

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ABSTRACT: In the Anthropocene era, questions over institutions, economics, culture and politics are central to the promotion of water-society relations that enhance biophysical resilience and democratic modes of environmental governance. The removal of dams and weirs from river systems may well signal an important shift in how human actors value and utilize rivers. Yet the removal of water infrastructure is often lengthy, institutionally complex, and characterized by social conflict. This Special Issue draws insights from case studies of recent efforts in North America and Europe to restore river systems through dam and weir removal. These cases include both instances where removal has come to fruition in conjunction with efforts to rehabilitate aquatic systems and instances where removal has been stymied by a constellation of institutional, political and cultural factors. Drawing from diverse theoretical frames and methodological approaches, the authors present novel ways to conceptualize water-society relations using the lens of dam removal and river restoration, as well as crucial reminders of the multiple biophysical and social dimensions of restoration initiatives for water resource practitioners interested in the rehabilitation of socioecological systems.

KEYWORDS: Dam removal, weir removal, river restoration, case study, water-society relations

INTRODUCTION

Debates over the role of humanity in altering planetary processes have culminated in recent declarations of the Anthropocene as a new geologic era, where *Homo sapiens* have, for better or worse, become a dominant force in shaping the world's array of biophysical processes (Steffen et al., 2015; Bonneuil and Fressox, 2016). These debates are especially pronounced in the arena of water governance, where a range of social and environmental scientists, policy makers, and civil society organizations are struggling to find ways to address the multiple challenges of water-society relations relating to the water-food-energy nexus, water scarcity, water and security, and hydropolitics (Rockström et al., 2014; Sivapalan et al., 2014). Within these general discussions of governance and the Anthropocene era, a range of scholars and practitioners have directed attention to pressing questions surrounding the restoration or rehabilitation of aquatic socioecological systems, particularly rivers and watersheds. This work raises significant questions: what types of interventions make the most sense – environmentally, economically, culturally and politically – to rehabilitate river systems perceived as degraded as a result of decades or even centuries of human alteration? In the case of river restoration, what are the challenges and opportunities related to dam removal as perhaps the most impactful type of intervention?

Since the mid-1990s in North America, Europe and to some extent in other locales, new principles have been adopted for the ecological management of rivers. To improve water quality and aquatic environments, it is no longer considered sufficient to reduce pollution. It has become necessary to consider the very structure of river environments in order to re-establish or rehabilitate the biophysical processes that have a positive impact on river dynamics. Among the most emblematic ecological restoration actions, removal of dams and weirs is a management tool that is increasingly advocated by an array of scientists, environmental organizations and governmental actors.

The United States constitutes one of the largest breeding grounds for dam removal. American Rivers, a prominent US-based environmental group, initiated a campaign focused on dam removal in the 1990s and carried out a yearly count of dams removed since that time. Roughly 80 000 dams remain present on US streams and rivers, revealing a high level of exploitation. However, American Rivers reports that about 1400 dams have been removed since 1912, of which more than 70% since 1999. Interest from the scientific community directed towards dam removal has grown apace, and a significant number of studies have been published in the last few years (Bellmore et al., 2017). In Europe, anecdotal evidence suggests that dam removal initiatives have recently taken-off, but statistical data are too sparse to draw strong conclusions. According to the last dam removal report led by the non-governmental organization European Rivers Network ('Dam Removal Europe'),[1] at least 3450 in-stream barriers (dams and weirs) have been removed since the mid-1990s. In the United-States and Europe, most of these are small dams and weirs associated with former water mills. The removal of hydraulic works is often associated with a physical and symbolic 'liberating' of rivers that returns the system to some more or less 'natural' state. The geomorphic and ecological impact of these actions – in terms of processes, improvement and risk factors – as well as their technical aspects, are well documented by the scientific community, although many uncertainties remain (see Bednarek, 2001; Stanley and Doyle, 2003; Lespez et al., 2013; Magilligan et al., 2016).

However, the removal of these hydraulic structures also raises several issues in terms of the decision process, the shifting goals of river alteration, and the significance of landscapes and values directed towards rivers. In both Europe and North America, there are an increasing number of such actions in a context that oftentimes lead to disagreements if not outright controversies about the aims and methods of river restoration. The success and failure of consultation processes, public participation and the role of local communities, the linking of ecological restoration operations and local economic development projects, and the perceived loss of valued historic landscapes are among the issues studied by scholars of river restoration in the social sciences. This Special Issue specifically intends to bring together international specialists in order to better apprehend the recent trend towards dams removal based on a comparative analysis of its implementation and its spatial implications between North America and Europe.

Accentuating the social, cultural and political dimensions of dam removal brings into focus several overarching questions. What do dam removals reveal about the shifting representations of rivers by diverse human communities? How are different arguments for and against dam removal presented, circulated and contested? What constellation of political, economic, cultural and ecological forces are driving dam removal and river restoration at this historical juncture? How do different social groups (e.g. government agencies, environmental advocates, community residents) perceive and speak about dam removal? To what extent do nonhuman actors (e.g. fish, rivers) shape dam removal debates and processes? What is the role of different types of knowledge (e.g. expert, scientific, local) in contested removals, and when and how do these knowledge domains come into conflict? What defines 'success' or 'failure' in the context of dam removal and river restoration, and how can seemingly

[1] Main partners: World Wildlife Fund for Nature ; World Fish Migration Foundation ; European Rivers Network ; The Rivers Trust ; Normandie Grand Migrateurs ; RiverWatch: http://damremoval.eu

incommensurable perspectives on removal come to be acknowledged and integrated? We address these questions through detailed case studies ranging across diverse locales: Vancouver Island (British Columbia) and New Brunswick in Canada; the Pacific Northwest and New England regions of the United States; multiple sites across France; and the Catalonia region of Spain. We acknowledge that this is not an entirely representative set of the multiple sites of dam and weir removal throughout the world, but it does create the basis for starting the important work of developing a collection of detailed cases from which, eventually, comparative analyses can be launched.

At a very broad level, this Special Issue focuses on a phenomenon, dam removal, that points to a potentially transformative period in environmental governance and politics. The time has long passed when, in the evocative words of former head of the United States' Department of Interior Stuart Udall, "dam building still had some magic" (Dean, 1997: 88). Udall was of course referring to the symbolic power that dams retained throughout much of the 20th century as unquestioned manifestations of economic and social good, and of the powers of human ingenuity and technology to overcome the vicissitudes of unruly biophysical processes. Dam removal has some magic of a different kind, and holds the promise of establishing a novel relationship between rivers and the societies that use them for economic purposes and that value them for aesthetic and/or ecological reasons. It is the sense of the co-editors that we are on the cusp of a quite remarkable historical moment in human interactions with river systems. Given the important geopolitical, economic, and symbolic roles fulfilled by dams throughout the late 19th and 20th centuries, when nearly all water infrastructure was viewed by national governments and most of the general public as an indisputable economic benefit and potent emblem of modernization, the act of removing dams and weirs can be seen as revolutionary.

PLURALISM AND THE MULTIPLE FACES OF DAM REMOVAL

The articles presented here represent an impressive range of geographical contexts, theoretical perspectives and methodological approaches. Rather than go through each paper and summarize the main arguments – we leave that to the reader – we instead want to highlight some of the conceptual, thematic, and methodological commonalities that run through the contributions as well as the singular contributions of the papers. Needless to say, we are deeply committed to the notion that a plurality of conceptual frames, themes and methodologies are fundamental to understanding complex socioecological phenomena. All contributions are normative to an extent, not in terms of favouring one dam removal outcome over another, but rather in the hopes that the in-depth analyses of dam and weir removal – and river restoration more broadly – presented here may lead to restoration initiatives that are equally attentive to the biophysical objectives of restoration (e.g. improved habitat for valued plant and animal species, increased aquatic biodiversity) and the socio-cultural and political actions that almost always shape such initiatives.

The studies represent a multiplicity of theoretical perspectives on dam removal and river restoration, but do so in ways that are respectful of empirical information and the research questions that drive each study. Notions from science and technology studies (STS) – including actor-network theory (ANT) and public understanding of science – guide several papers, offering insights into how both human and nonhuman actors influence and enter into conflict specific dam removal controversies, as well as how expert knowledge is circulated and contested. In the setting of France's Sélune River, both pro-and anti-removal forces coalesce in complex sociotechnical networks that include salmon and lakes within their purview, and the failure to remove some of the river's major hydroelectric projects can in large part be understood as a failure to translate across different knowledge domains (Germaine and Lespez, this Issue). In the New England region of the United States, fish such as river herring and various trout species became central actors, following the ANT model, in determining the pathway of dam removals in the Wood-Pawcatuck watershed of Rhode Island by virtue of their specific, and at times narrowly defined, relationship to human actors (Druschke et al., this Issue). The encounter

between scientific and expert knowledge, on one hand, and lay knowledge on the other, is a near universal dimension of dam and weir removal projects, and understanding how science becomes politicised in New England dam removals involves laying bare how expert knowledge is disseminated, re-configured and contested within regulatory and cultural settings (Sneddon et al., this Issue).

Several papers defy simple theoretical categorization and rely on finely detailed empirical investigations to shed much needed light on less well known dimensions of dam and weir removal. The Mactaquac hydroelectric facility on the Saint John River in New Brunswick, Canada was the subject of multi-year negotiations over the structure's potential removal, yet government and public discourses at both provincial and local levels revealed a rather strong preference for not removing the dam (Sherren et al., this Issue). A notable finding in this case was that the concerns of male and female respondents to both surveys and interviews diverged and were associated with different spatial scales. Both the Mactacquac case and an example involving potential dam removals in the Pacific Northwest of the United States (Chaffin and Gosnell, this Issue) underscore how the involvement of Native American or First Nation groups can profoundly influence the process and outcome of dam removal, typically in favour of removing structures that have devastated historically significant animal species or landscapes. Articulating a case study from the Columbia River basin in the northwestern United States, Grabowski et al. (this Issue) generate a conceptual framework for examining dam removals and other ecological restoration initiatives that combines the necessarily inter-related political, financial, environmental, social, and technological (PFESTs) processes orbiting river restoration. Both cases in the Pacific Northwest of the U.S. stress that the legal mechanisms involved in dam removal processes, while important, are not sufficient to promote the adaptive environmental governance and participatory management ethos that will be necessary to negotiate restoration conflicts and promote, where possible, socioecologically meaningful dam removal initiatives.

All the contributions either explicitly or implicitly intersect with recent work in political ecology, an approach to human-environment relations that emphasizes uneven power relations, political-economic dynamics, multiple scalar configurations, and how nature is constructed through social actors and institutions in explanations of socioecological degradation (Robbins, 2011). How different actors put forth alternative notions of what is 'natural' in the context of the slated removal of the Colliery dams in Nanaimo on Vancouver Island in British Columbia Canada, shows how river restoration raises difficult to resolve questions regarding what type of 'nature' is being privileged according to ecological, ethical and aesthetic rationales (Jørgensen, this Issue). One of political ecology's central concerns is dissolution of the artificial epistemic division between the 'natural' and 'social' sciences, a trenchant critique of the notion that the ontological domains of the nonhuman and human can be maintained as separate in thought and action. Dufour et al. (this Issue) adopt a critical physical geography approach to accentuate that multiple dam and weir removal processes in France tend to ignore key biophysical issues such as riparian vegetation and sediment transport because they reside outside the cognitive frames of both resource managers and the concerned lay public. One of political ecology's great strengths is its commitment to historicizing resource conflicts, and Barraud (this Issue) accomplishes this admirably by adopting a geohistorical approach to the shifting meanings and values associated with mill weirs in France and, importantly, a concurrent evolution in state practices in managing the weirs' environmental impacts.

At a methodological level, the papers presented here share a deep commitment to the case study as an invaluable conceptual approach, one that simultaneously sheds light on important theoretical debates in the social sciences and offers pragmatic examples of the opportunities and pitfalls of efforts to rehabilitate rivers and other socioecological systems. Many of the authors assume an explicitly comparative approach within their studies, explicating, for example, how the specific biophysical characteristics (e.g. riparian vegetation, sediment transport) of different geographical sites of dam and weir removal in France lead to divergent clusters of political and cultural issues (Dufour et al., this Issue). Many if not all are intentionally historical in their approach, recognizing how the at times

divergent and at times overlapping histories of economic development, environmental transformation, cultural value, and institutional change blend together within specific dam removal processes and conflicts. The dynamics of two cases of dam removal in the Ter River basin in the Catalonia region of Spain, for example, can only be illuminated by referencing the centuries-long environmental history of the intensely anthropomorphic landscapes of the region, a history that must be acknowledged prior to any meaningful engagement with stakeholders in the basin to work towards more democratic modes of engaging dam removal discussions (Brummer et al., this Issue).

Taken together, the papers reveal a common set of processes that characterise most dam and weir removals to promote river restoration. One such process is the complex interplay between the institutional actors working in governments or environmental organizations, often associated with national or sub-national (e.g., states or provinces) spatial scales, and the community-based actors most directly affected by removal at local spatial scales. This dynamic sets the stage for the ecological and perhaps economic goals of dam and weir removal to come into conflict with goals related to preservation of both the structure and the cultural landscape. We see this conflict play out in many instances, and this partially explains another common characteristic of our cases: dam and weir removals can be lengthy processes, stretching over years or even a decade and beyond. Another shared element is constituted by the environmental and economic claims regarding the benefits and trade-offs associated with dam and weir removal are almost always contested by the voices of anti-removal advocates, prompting the emergence of political struggles that envelop both expert and lay knowledge domains. However, we caution that the factors that drive and shape dam and weir removal processes, and conflicts over removal, are almost never generalisable, and the papers in the volume are evidence of the incisive explanatory power that a collection of quite unique cases might offer.

WHAT'S NEXT?

We perceive this special issue as launching both a broader and more in-depth set of discussions about dam removal and river restoration. We highlight the numerous sociocultural and biophysical dimensions surrounding dam removals across a range of geographical and institutional settings, and bring to the fore several crucial elements of dam removal that have hitherto received relatively little attention in the emerging literature on dam removal. These include: the importance of historical analysis in understanding the social dynamics that shape the removal process; the site-specific contingencies related to micro-politics and cultural meanings attached to dammed landscapes; the role that scientific knowledge and its dissemination play in the vicissitudes of dam removal; how nature is constructed according to multiple ethical and political rationalities; and the importance of considering how actors and institutions operating across multiple spatial scales come into cooperative and contentious relations around the phenomenon of dam removal and river restoration. Yet there remains much to say.

Dam removal increasingly appears as a process co-produced by environmental NGOs operating across a range of scales and institutional stakeholders operating within a variety of public sectors. Activist campaigns in favour of removal have never been so numerous and creative. However, there have also been innovative grassroots campaigns that use the tools of environmental movements – e.g. petitions, public actions, social media campaigns – to prevent dam removal in the name of local control over resources and defence of the cultural landscape (see Fox et al., 2016). At the same time, the formerly radical idea of removing dams to set rivers free is being integrated into public policies and management actions directed towards river restoration. Although country-specific, this may lead to the impression that dam removal is becoming standardised and normatively designed across a diversity of geographical settings. Yet the aesthetic models and social representations that frequently underpin the implementation of dam removal, as a river restoration technical solution, need to be further assessed and explained. A massive flow of images is generated by dam removal initiatives (media coverage,

institutional communication, pro and anti dam removal campaign). This imagery (e.g. photography, timelapse videos) is more and more often used in structured storytelling campaigns (Jørgensen, this Issue) that seek a tangible influence on the dam removal process. These image flows feed into stories and popular imaginations about river environments and constitute yet another rich and useful theme for future research.

The authors of the collected papers utilize an assortment of innovative theoretical lenses and conceptual frameworks – political ecology, ecosystem services, actor-network theory (ANT), critical physical geography, science and technology studies (STS), and restoration ecology – but there are certainly other theories and concepts that will enrich the study of river restoration. For example, nearly every case highlights the crucial roles that government actors and institutions serve in dam and weir removal, yet none explicitly engages with state theory or state-environment relations in ways that might offer novel contributions to recent work on how state power is exerted at both structural and political levels or how agents of the 'everyday state' (e.g. watershed managers, fisheries officials, historic preservation bureaucrats) shape dam and weir removal processes (Painter, 2006; Jessop, 2007; Whitehead et al., 2007). There is likewise great promise in deepening the integration of approaches in the biophysical and social sciences, an inclination that is increasingly necessary in the context of complex ecological restoration initiatives involving rivers (Lane, 2014; Ashmore, 2015). Additionally, we perceive an engagement between dam removal studies and other controversies surrounding processes of ecological restoration and the recognition of novel ecosystems (e.g. forest regeneration, re-introduction of historically displaced species, battles over the existence of invasive species) as both theoretically and methodologically beneficial. Finally, we are certain that there are more cases of dam and weir removal to be found in the non-Western world, especially those regions – e.g. Japan, China, South Korea – with their own prolonged histories of dam construction, that would be valuable complements to the studies presented here.

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