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Chapter 1

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Title

What are the political, social and economic issues in river restoration? Genealogy and current research issues

Abstract

River restoration initiatives are now widespread across the world. The research efforts undertaken to support them are increasingly interdisciplinary, focusing on ecological but also on societal issues. Based on a review of previous contributions, this chapter provides an overview of research in human and social sciences in the field of river restoration. It illustrates how, in three decades, such approaches have evolved and strengthened within the restoration sciences. The scientific community working on societal issues has structured itself, often regionally and circumstantially, to contribute to critically assess and improve restoration policies and practices. Our scientific literature review highlights this research field is structured within three thematic axes. 1) human-river interactions – especially perceptions and practices of rivers - and how these interactions can be changed by restoration projects. 2) critical analysis of political processes with a particular interest in governance and decision-making, and a specific emphasis on the question of public participation in restoration projects. 3) evaluation of economic benefits of river restoration. All these scientific contributions on societal issues are based on survey methods, documentary analysis or economic valuation, which are introduced in dedicated inserts. Finally, we discuss how these research efforts and diversity of researcher's positions contribute to improve restoration approaches in practice.

1. Introduction

1.1. River restoration at the heart of river management policies

Faced with the ever-increasing impact of human activities on the environment, the biologist E.O. Wilson (1992) announced, probably with much hope, the opening of an era of ecological restoration in the 21st century. Although its scope and consequences may be a matter of debate (Choi 2007; Sudding 2011), the realization of this hope seems to be currently confirmed. In response to the observed degradation of ecosystems (Palmer et al. 2004; Steffen et al. 2007; Cardinale et al. 2012), ecological restoration measures have become a structuring element of environmental management policies in both developed and developing countries (Aronson et al. 2006; Wortley et al. 2013). In the field of river management, they have been actively deployed since the 1970s (Gore 1985; Boon et al. 1992) because of particularly significant degradation resulting from the use of water and hydraulic installations, both old

and increasingly numerous (e.g. Dudgeon et al. 2005; Vörösmarty et al. 2010; Grizetti et al. 2017). Faced with significant water pollution and profound physical modifications of river ecosystems, many countries, particularly western ones, have taken legislative and regulatory measures to preserve or restore a certain environmental quality to rivers. These measures consider, often in an integrated manner, physico-chemical, biological, and hydromorphological issues (e.g. the US Clean Water Act, 1972; UK Water Act, 1973; French Water Laws, 1992, 2006; EU Water Framework Directive, 2000; Australian Water Act, 2007). These legislative frameworks have provided a fertile ground for the multiplication of restoration projects, as shown by several reviews conducted around the world (e.g. Bernhardt et al. 2005; Nakamura et al. 2006; Brooks and Lake 2007; Morandi et al. 2017; Szalkiewicz et al. 2018).

River restoration policies, whether at the legislative or technical level, are supported by substantial interdisciplinary research efforts. Scientific work focused on the dynamics of restoration research has shown a major increase in productivity, starting in the 1990s (Shields et al. 2003; Ormerod 2004; Bennet et al. 2011; Smith et al. 2014; Wohl et al. 2015). This increase in scientific research accompanies an increase in the number of projects implemented (Bernhardt et al. 2005) and reflects the strength of science–management links in the field. Applied work in ecology, hydrology, and hydromorphology (Palmer and Bernhardt 2006; Vaughan et al. 2009; Wohl et al. 2015) has been carried out to better understand the functioning of river systems and to assess their responses to restoration actions. As these actions are often innovative, it is difficult to predict their effects, and adaptive approaches based on monitoring are therefore generally preferred (Downs and Kondolf 2002). The current thinking in the natural sciences — notably on the links between hydromorphological structures and processes (Kondolf 2000), or between habitats and biodiversity (Palmer et al. 2010) — has been nourished as much as it has nourished ecological restoration practices (Smith et al. 2014). Bradshaw (2002, p. 7) introduced “restoration as an acid test for ecology” and thus emphasized the links between ecological restoration (practice) and restoration ecology (science). While these special links have long led to the association of river restoration with natural sciences, they have not prevented calls to broaden the spectrum of disciplines involved in restoration approaches (Cairns 1995; Ormerod 2004; Palmer and Bernhardt 2006; Wohl et al. 2015).

1.2. An evolution in the positioning of societal issues in debates on river restoration

Societal stakes¹ have always structured thinking in the field of restoration. Back in the 1990s, Cairns (1995, p. 9) wrote that “ecological restoration must involve ecosocietal restoration. This is the process of reexamining human society’s relationship with natural systems so that repair and destruction can be balanced and, perhaps, restoration practices ultimately exceed destruction practices”. This thinking is part of a more general movement questioning the relationship between human and nature as it has been encompassed in modern Western thought. This questioning, which has permeated society since the 1970s, is socio-cultural, anthropological, and philosophical (Gobster and Hull 2000). It is sometimes championed by natural science researchers who advocate a new ethics of nature (e.g. Jordan III 2000; Clewell and Aronson 2013). These ethics are based on the recognition of nature as having an intrinsic value as much as they are based on observations of the degradation of this value by human societies. They are formed at the point of convergence between conservationist movements and scientific advances in the natural sciences. Human activities are characterized by the natural sciences, often in terms of pressures; it is a time of guilt. The ultimate goal of restoration projects is to return rivers to the good (pristine) state they were in before degradation by human societies.

Very quickly, the original idea of the river’s return to a past state — what some authors have called the myth of the return to Eden (e.g. Dufour and Piégay 2009) — was strongly criticized for reasons mainly related to scientific uncertainties and technical feasibility, but also to ethical positions. Restoration is certainly based on a new attitude towards rivers, but it must also deal with reality, including the social and economic reality of its implementation. The conceptualization of the Anthropocene is part of this evolution (Crutzen and Stoermer 2000). Studies highlight the importance of both biophysical and societal contexts in the implementation of actions. It is a time for pragmatism; leaders of restoration projects seek to do the best that they can ecologically within a given context. This realization is accompanied by a discussion of the concept of restoration and an evolution of its definitions (see Box 1). As Wohl et al. (2005, p. 2) point out “because both technical and social constraints often preclude “full” restoration of ecosystem structure and function, rehabilitation is sometimes distinguished from restoration”. The concept of rehabilitation often carries the idea of a relaxation of the restoration objectives and a redefinition of the references used to define these objectives (Dufour and Piégay 2009). What is being restored? But above all, why is it being restored? Restoration, which until now was guided by the intrinsic value of the river —

¹In this chapter, the adjective “societal” is used to refer to all work addressing the social, political, and economic issues involved in river restoration.

embodied by concepts such as ecological integrity — is opening up to more instrumental visions.

According to Palmer et al. (2014a), there has been a shift in ecological restoration from ecological theory to utilitarian concerns. This utilitarian approach to restoration is rooted in a more anthropocentric ethic, but paradoxically, it can also be instrumentalized to serve an eco-centric ethic. The articulation of intrinsic and instrumental values is at work in restoration approaches (Clewell and Aronson 2006). It is reinforced by the ever more pressing need to justify often costly policies in the fluvial domain (e.g. Bernhardt et al. 2005; Nakamura et al. 2006; Brooks and Lake 2007). The ecological or hydromorphological quality of a river is no longer justifiable as an end in itself, but must appear as a necessity with regard to the services that the good state and biophysical functioning of a river can provide, or the risks burdening societies in the case of non-action. This utilitarian vision is strongly based on the notion of services that has developed since the 1990s (Costanza et al. 1997). It finds particular resonance in the context of urban river restoration projects, which are highly constrained socially, politically, and technically (Eden and Tunstall 2006; Bernhardt and Palmer 2007). Moreover, it is largely in the context of urban ecology that the concept of “novel ecosystems” emerges, which requires consideration of the hybrid character — both natural and artificial — of the rivers to be restored (Francis 2014). The specificity of restoration in relation to other management approaches can also be called into question, as Elliot (1982, p. 81) anticipated when he denounced “faking nature”. Thus, there is a strong proximity between Martin’s (2017) proposed definition of ecological restoration — considered as “the process of assisting the recovery of a degraded, damaged, or destroyed ecosystem to reflect values regarded as inherent in the ecosystem and to provide goods and services that people value” and Mitsch’s definition of ecological engineering (2012, p. 5) — “defined as the design of sustainable ecosystems that integrate human society with its natural environment for the benefit of both”.

Box 1 - River restoration: an “essentially contested concept”.

The debates – and often polemics (e.g. Normile 2010) – concerning what is and is not river restoration are numerous (e.g. Roni and Beechie 2013; Wohl et al. 2015). These debates on the definition of restoration have been fueled by the proliferation of concepts that are now widely used in the literature such as “rehabilitation”, “renaturation”, “revitalization”, “enhancement”, and “improvement”. If there is one certainty emerging from these debates,

it is that attempts to provide an unequivocal and definitive answer to the question “what is restoration?” are doomed to failure. There has never been a consensus on definitions and there certainly never will be. The concepts of restoration, rehabilitation, or renaturation are “essentially contested concepts” (Gallie 1956, p. 169), that is to say, “concepts the proper use of which inevitably involves endless disputes about their proper uses on the part of their users”. The interest in the debates lies not in their conclusions, but in the debates themselves and the ideas that emerge from them.

The definitions that have been used as references in the field of restoration show the evolution of these debates. Initially conceived as techniques, the definitions raised ethical questions as early as the 1990s and particularly questioned the hermetic separation between human and nature (Table 1.1). According to Westling et al. (2014, p. 2614) “This dichotomy is challenged, both by alternative theoretical frameworks arguing for the relevance of natural-cultural hybrid models for restoration, and by pragmatic perspectives that take restoration to be the balancing of ecological and human goals through rehabilitating or enhancing landscapes, rather than seeking return to a redundant, historical reference state”. The efforts of scientists and managers are now aimed at clarifying the definitions of references and concepts such as ‘Lietbild’ (Kern 1992) or ‘guiding image’ (Palmer et al. 2005), to clarify the restoration objectives (Weber et al. 2018). In the definition of these objectives, the tension between an ecocentric approach that emphasizes the intrinsic value of the river and an anthropocentric approach carrying more utilitarian arguments is notable (Dufour and Piégay 2009).

Table 1.1 – Definitions of river restoration selected from the international scientific literature illustrating the place of societal issues in conceptual debates

NRC 1992, p. 18	“Restoration is defined as the return of an ecosystem to a close approximation of its condition prior to disturbance. In restoration, ecological damage to the resource is repaired. Both the structure and the functions of the ecosystem are recreated.”
Stanford et al. 1996, p. 393	“The goal of river restoration should be to minimize human-mediated constraints, thereby allowing natural re-expression of productive capacity. In some, if not most, intensely regulated rivers, human-mediated constraints may have progressed to the point that full re-expression of capacity is neither desired nor possible. Nonetheless, the implication is that basic ecological principles applied to rivers in a natural-cultural context can lead to restoration of biodiversity and bioproduction in space and time; but, the constraints must be removed, not mitigated.”
Downs and Thorpe	“It is now widely recognised that river restoration in the sense of Cairns (1991) — ‘The complete structural and functional return to a pre-disturbance state’ — is

2000, p. 249-250	seldom feasible.” “Practical ‘river restoration’ is, in fact, an historically-influenced exercise in environmental enhancement through morphological modification. It is probably more accurate to refer to the approach as river rehabilitation.”
McIver and Starr 2001, p. 15, citing SER website	“Ecological restoration can be defined as “the process of assisting the recovery and management of ecological integrity,” including a “critical range of variability in biodiversity, ecological processes and structures, regional and historical context, and sustainable cultural practices.”
Wohl et al. 2005, p. 2	“We define ecological river restoration as assisting the recovery of ecological integrity in a degraded watershed system by reestablishing the processes necessary to support the natural ecosystem within a watershed. Because both technical and social constraints often preclude ‘full’ restoration of ecosystem structure and function, rehabilitation is sometimes distinguished from restoration.”
Palmer and Allan 2006, p. 41-42	“River restoration means repairing waterways that can no longer perform essential ecological and social functions such as mitigating floods, providing clean drinking water, removing excessive levels of nutrients and sediments before they choke coastal zones, and supporting fisheries and wildlife. Healthy rivers and streams also enhance property values and are a hub for recreation.”
Chou 2016, p. 2	“river restoration means different things to different people. In terms of scale and scope, it can be a complete structural and functional return to the pre-disturbance state, a recovery of the partly functional and/or structural conditions of rivers (i.e., rehabilitation), a recovery of the natural state of a river ecosystem without really aiming at the pristine, pre-disturbance state (i.e., renaturalization), or an improvement of the present state of rivers and their surrounding areas with the intention of enhancing their ecological, social, economic or aesthetic features (i.e., enhancement).”

Adhering to Chou’s (2016, p. 2) assertion that “river restoration means different things to different people”, we adopt a relatively broad definition of restoration in this book. We do not distinguish between some commonly used concepts such as restoration, rehabilitation, renaturation, or revitalization actions. We consider as restoration any human intervention on the river aimed at recovering a quality considered degraded or lost. This quality can be perceived in terms of biodiversity, hydromorphological dynamics, physicochemical parameters, landscape beauty, or even the possibility of recreational use.

No matter how you look at this evolution, it has certainly increased the attention paid to societal issues in the field of restoration. Research in the humanities and social sciences has contributed to this evolution by proposing new methods to measure the socio-economic benefits that societies derive from restoration projects and also by analyzing the socio-political processes at work in the implementation of projects. If the objectives of restoration are no longer guided solely by a scientific conception of reference states, but also in response to political choices concerning what rivers should be, a new space for debate is opened up,

particularly in respect to the questioning of decision-making. To the questions “why are we restoring?” or “what are we restoring?” is added the question “who is restoring for whom?” The work carried out in political ecology shows that new relationships of power are being established within the frameworks for implementing restoration projects. As much as the objectives of restoration, it is the political mechanisms leading to the definition of these objectives that are at the heart of debates. Work on participation is essential, and questions the place of scientific and technical expertise as much as that of other interests, be they economic or more simple public interests.

1.3. What do we know about research on societal issues in the field of river restoration?

Although several reviews highlight the increasing place of societal issues within the scientific work devoted to river restoration (Bennet et al. 2011; Smith et al. 2014; Wohl et al. 2015), none of them have focused on a specific analysis of this research field. This introductory chapter offers this analysis; without claiming to be exhaustive, it gives a broad overview of the dynamics of work on the societal stakes of river restoration. 1) What is the magnitude of these dynamics? How are they structured at the international level? The first part of the paper looks at the way the scientific community is organized within the field. Particular attention is paid to the way in which the work carried out by this community fits within the dynamics of general research on river restoration, but also within work in human and social environmental sciences. 2) The second part then analyzes the main directions taken by researchers working on societal issues of restoration. What are the main problem areas that structure this field of research? In which disciplines or epistemological traditions are they rooted? What are the methodological approaches mobilized in the frameworks of the different projects? 3) Finally, the third part is devoted to the operational commitment of researchers working on societal themes. Do these researchers support the implementation of river restoration projects and policies, and if so, how?

The literature review that we present here is based on a qualitative and quantitative analysis of the body of international scientific articles devoted to river restoration. This body of literature was retrieved from a search of the titles of articles listed in the Web of Science (WoS) using the keywords river*, stream*, restor*, rehab*, renat*, and revit*. In total, this search identified 1677 articles published between 1971 and 2019 by authors from about fifty different countries. The content of these 1677 articles was analyzed and a subset of 121

publications specifically devoted to discussions of human and social sciences (HSS; e.g. historical, philosophical, sociological, economic, geographical, and political) on the theme of river restoration were identified. This collection of literature forms only a sample of the work published in the field, particularly because it prioritizes international articles written in English at the expense of national publications and books written in other languages. Nevertheless, it allows an overview of the relevant publications, and by extension, of the dynamics of HSS research in the field of river restoration. To this end, we base our analysis on scientometric methods (Mingers and Leydesdorff 2015), coupled with lexical analysis methods (Lebart et al. 1998) and content analysis (Berelson 1952) of the publications.

2. Genealogy of research on societal issues in river restoration

According to Palmer and Bernhardt (2006, p. 3) “the final research frontier is restoration science that is informed by social science scholarship.” Addresses to the humanities and social sciences to invest more in the field of river restoration are recurrent (e.g. Palmer and Bernhardt 2006; Ormerod 2004; Wohl et al. 2015). However, it is sometimes difficult to know which disciplines are expected to be involved, and what issues should be worked on. Bennet et al. (2011, p. 4) present the “recognition and promotion of human, societal, or cultural requirements for stream restoration” as a shift in restoration science, emphasizing the importance of participation. Palmer and Bernhardt (2006, p. 4) refer to “cultural anthropology, environmental education, landscape architecture and city planners” as “social sciences”. Ormerod (2004, p. 548) refers to the “socio-economic sciences” with a more explicit focus on economic approaches. All these authors address disciplinary contributions to the field of restoration according to the modern dichotomy between the “human sciences” and the “natural sciences” that is used to structure classical classifications in the scientific field. Other distinctions could have been made; for example, the Frascati Manual separates the “social sciences” (e.g. sociology, economics, psychology, geography) from the “humanities and the arts” (e.g. philosophy, history) (OECD 2015, p. 59). These divisions are sometimes inherited from schools of thought or institutional traditions that vary from one country to another. They are sometimes overtaken by fields of research that are structured in an interdisciplinary or even transdisciplinary manner. Many authors publishing on the societal issues of river restoration belong to environmental studies institutes, not to humanities and social sciences institutes. Epistemological positions are also rarely asserted in publications, and it is often difficult to identify the disciplinary tradition to which the authors adhere.

The tendency to break away from disciplinary divisions must be interpreted in the light of the epistemological evolutions that have marked the human and social sciences-based work on environmental issues since the 1970s (e.g. Turner et al. 1994; Lester 1995; Hannigan 2006; Castree et al. 2016). These developments, which have led in particular to the structuring of the field of environmental humanities (Blanc and Demeulenaere 2017; Emmet and Nye 2017; Heise et al. 2017), have made the disciplinary limits more labile. According to Emmet and Nye (2017, p. 4) “The environmental humanities have become a global intellectual movement that reconceives the relationship between scientific and technical disciplines and the humanities, which are essential to understanding and resolving dilemmas that have been created by industrial society”.

The WoS bibliometric analysis shows that the journals in which such research is published are very rarely humanities and social sciences journals (Figure 1.1). For the most part, studies on societal aspects of restoration are published in journals with an environmental editorial line, explicitly interdisciplinary and applied (e.g. *Environmental Management*; *Journal of Environmental Management*; *Ecology and Society*) or water management (e.g. *Water Resources Research*; *Water Alternatives*; *River Research and Applications*) journals. Journals on environmental economics issues (e.g. *Ecological Economics*; *Water Resources and Economics*) are the ones with the strongest disciplinary roots on the social science side. Much work on economic or political issues is published in natural science journals (e.g. *Hydrobiologia*, *Journal of hydrology*). Many societal issues have also been brought into the field of restoration by researchers in the natural sciences. For example, as early as the 1990s, it was the ecologist, J. Cairns (1995) who proposed the notion of “ecosocietal restoration”. Certain research approaches, initially undertaken by researchers in ecology, hydrology or hydromorphology, have largely contributed to placing societal issues at the center of thinking (e.g. Wohl et al. 2005; Palmer and Bernhardt 2006; Dufour and Piégay 2009). This is the case with the Long-Term Ecological Research (LTER), and then the Long-Term Socio-Ecological Research Network (Redman et al. 2004; Wells and Douggil 2019), which have been important steps in the emergence of more integrated approaches to restoration. This need to cross disciplinary divides is expressed in another way in projects such as critical physical geography, which pays “critical attention to relations of social power with deep knowledge of a particular field of biophysical science or technology in the service of social and environmental transformation” (Lave et al. 2014, p. 2).

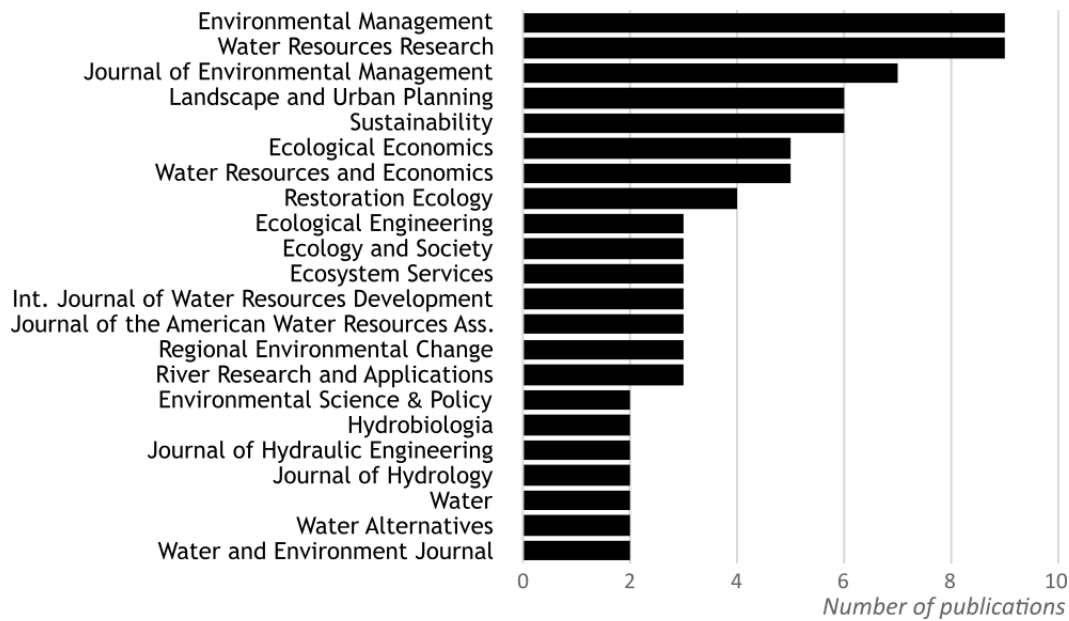


Figure 1.1 – Main international scientific journals in which research on societal issues of river restoration is published (1992-2019)

3. A scientific community organized regionally and occasionally around river restoration projects

A few years ago, Smith et al. (2014, p. 253) wrote that “the integration of social science into restoration is relatively rare”. Indeed, while research in the field of river restoration emerged in the 1970s and grew significantly from the early 1990s, studies specifically focused on societal issues only emerged in the 1990s and remained limited in number until the mid-2000s (Figure 1.2). Although societal approaches still represent a minority of the published work in the field of river restoration, it is a steadily growing minority. Over the decade 2010–2020, work on the social, economic, or political stakes of restoration represented 10% of all publications devoted to river restoration, whereas it represented only 5% in the 2000s and 2% in the 1990s. The results of this work seem to be increasingly mobilized by the interdisciplinary scientific community. According to WoS data, studies dedicated to societal issues are cited almost as much as studies addressing other topics in restoration (2.4 vs. 2.6 annual citations).

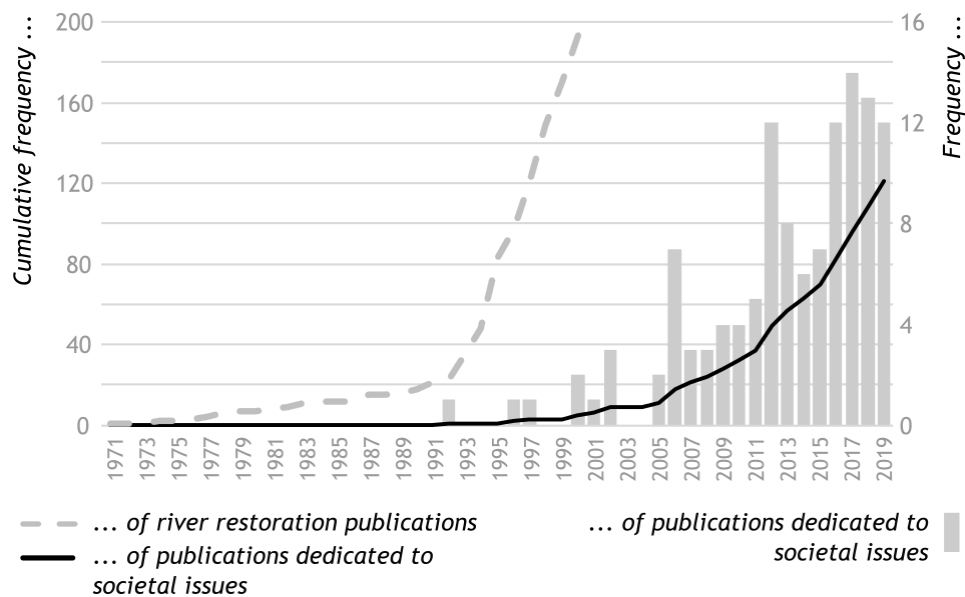


Figure 1.2 – Chronology of international scientific publications on societal issues in river restoration

The first works on societal issues listed in the WoS date from the 1990s, with these being published in Europe and the United States (e.g. Barendregt et al. 1992; Loomis 1996; Turner and Boyer 1997). Over the entire period, 72% of all publications dedicated to social, economic, and political issues were written by researchers from European and North American institutions, with 36% being written by US researchers alone. However, societal publications represent only 6% of all work in the field of river restoration published in the USA (Figure 1.3). Some countries, which publish less in the field of restoration, are proportionally more active on societal issues. This is the case for several European countries including Spain, Switzerland, Norway, and to a lesser extent Germany, which have been actively publishing since 2005. Studies published in Israel also give particular importance to work in economics (e.g. Axelrad and Feinerman 2009; Becker and Friedler 2013). Researchers from East Asian countries, whose first publications in the field of river restoration date back to the mid-2000s (Nakamura and Tockner 2006), very quickly became interested in societal issues (e.g. Tanaka 2006; Jia et al. 2010; Che et al. 2012). As a proportion of the total work they publish on river restoration, some countries such as Taiwan, South Korea, Japan, and China are among the most active on societal issues. In total, since the early 1990s, more than 400 authors from 31 countries have contributed to publications on societal issues in the field of river restoration.

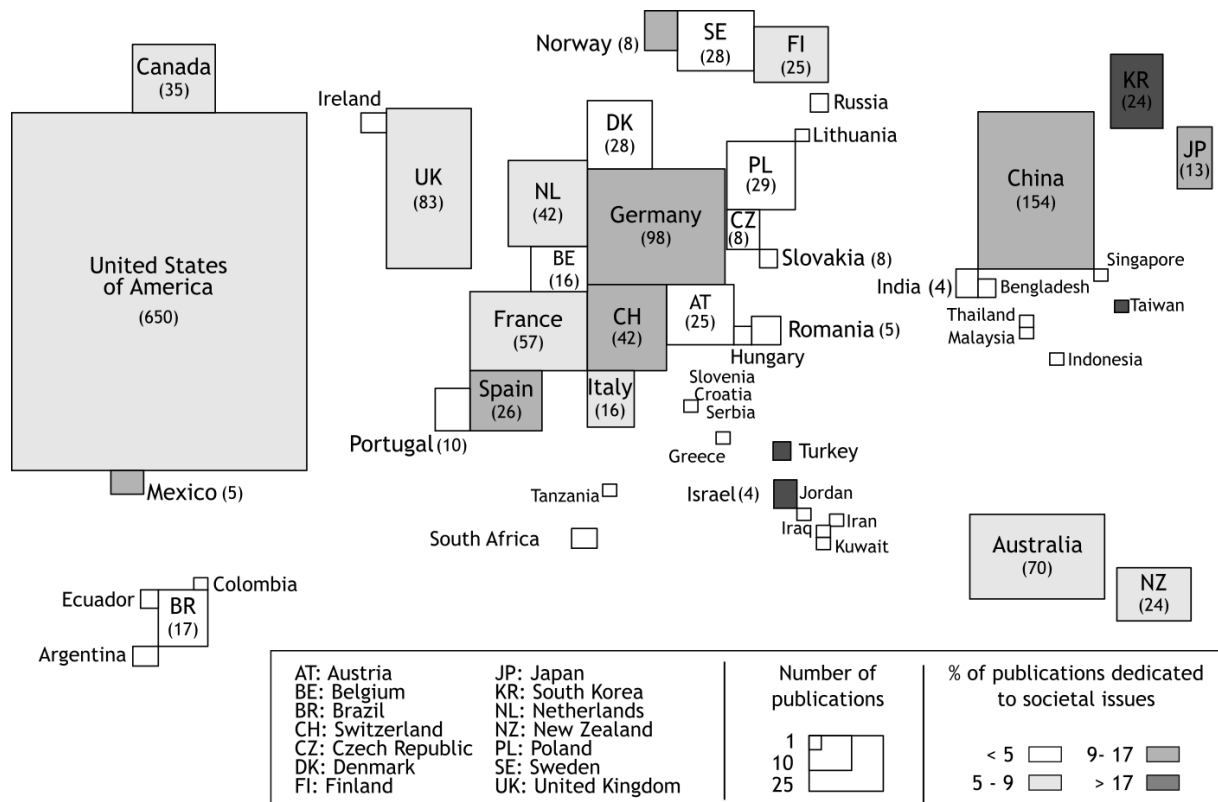


Figure 1.3 – Geography of international scientific publications on societal issues in river restoration (1992-2019)

Despite publications from a large number of countries, there does not seem to be an internationally structured scientific community around Humanities and Social Sciences. While most of the publications listed in the WoS involve authors belonging to different institutions, a minority are the result of international institutional cooperation. Scientific communities do exist, but they are multifaceted and rather structured on national or even regional scales. Sometimes it is more accurate to speak of scientific teams than communities. While these teams contribute to the production of societal knowledge in the field of restoration, they are often structured around broader or related research issues. Thus, significant works on river restoration have been published by a network of researchers from several English universities working on flooding and public perception issues (e.g. Tunstall et al. 1999, 2000; Eden et al. 2000; Åberg and Tapsell 2013). Also, in Switzerland, in the canton of Zurich, a scientific community specializing in public participation issues has produced notable work in the field of river restoration (e.g. Schläpfer and Witzig 2006; Junker and Buchecker 2008; Seidl and Stauffacher 2013). The dynamics of regionalized research often seem temporary. Several researchers, whose work is now a reference in the field, have only

had a momentary commitment to restoration issues (e.g. Buijs 2009; Pahl-Wostl 2006; Junker and Buchecker 2008). Out of more than 400 identified authors, less than one tenth have participated in multiple publications on the topic of river restoration.

The ad hoc nature of scientific commitments can be explained (in addition to deeper reasons linked to the increasingly precarious financing of international research and consequently the turnover of personnel) by the fact that research is often conducted in connection with the implementation of fixed-duration restoration projects. The bibliometric analysis identified more than a hundred rivers for which research was undertaken on societal issues related to the implementation of restoration projects (Figure 1.4). Some of these projects are known mainly through these societal studies. For example, in South Korea, several research teams (notably attached to universities in Seoul Province) have worked on the social, economic, and political evaluation of the restoration of the Cheonggyecheon and Anyancheon rivers, two rivers that are now emblematic of urban restoration (e.g. Lee et al. 2016; Kim et al. 2017). In Israel and the Palestinian Territories, it is economists who have published scientific literature on restoration projects on the Yarqon, Jordan, and Kishon rivers (e.g. Becker et al. 2014; Garcia et al. 2016). Societal research has also focused on emblematic river restoration projects conducted on major rivers such as the Rhine (e.g. Buijs 2009), Danube (e.g. Bliem et al. 2012), Colorado (e.g. Bark et al. 2016), Sacramento (e.g. Golet et al. 2006), and Kissimmee (e.g. Chen et al. 2016). It is often in the context of such projects that an interdisciplinary culture is forged. In France, several studies on the social and political issues involved in the restoration of the Rhône (e.g. Barthélémy and Armani 2015; Guerrin 2015) were developed as part of a global approach to long-term socio-ecological research (Lamouroux et al. 2015; Thorel et al. 2018). Similarly, research on the Cole River and Skerne River (Tunstall et al. 1999; Eden and Tunstall 2006; Åberg and Tapsell 2013) in the United Kingdom was undertaken as part of an interdisciplinary European project (Holmes and Nielsen 1998).

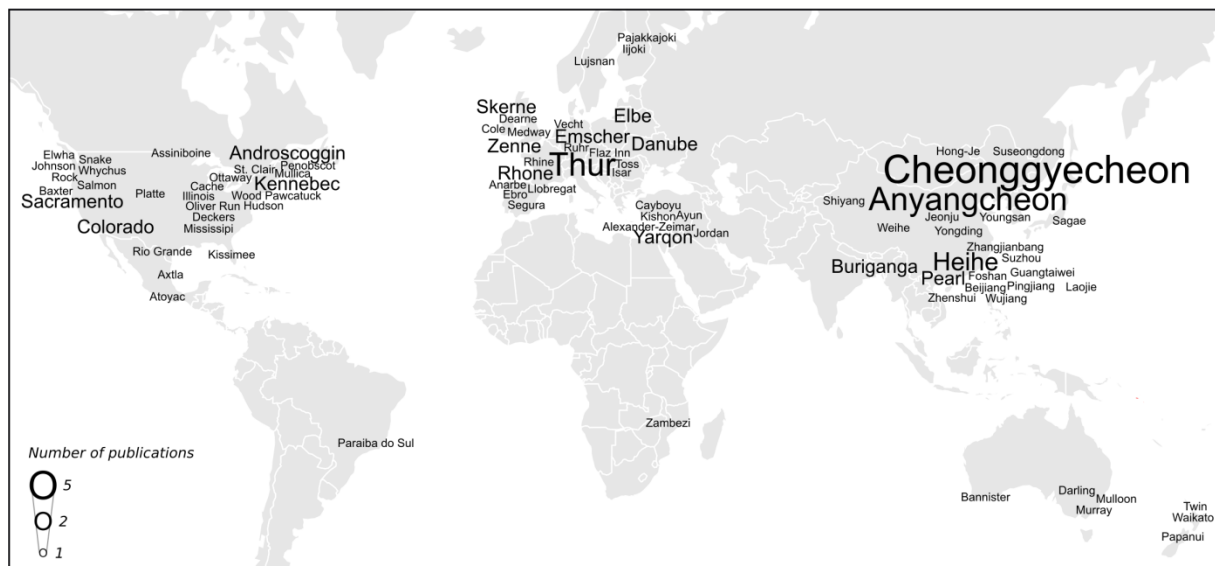


Figure 1.4. – Map of the study sites of international research publications on societal issues in river restoration (1992-2019)

4. A Research field structured according to three thematic axes

Among the publications in the field of river restoration, those devoted to societal issues are distinguished by a specific lexicon (Figure 1.5). The qualitative analysis of these publications makes it possible to reduce the apparent thematic diversity and to schematically draw three main lines of research. 1) The first brings together research on human-river interactions. The public's environmental perceptions and preferences as well as social practices are often central to this first corpus of 53 publications. Analysis of the different links that individuals have with rivers, of their consideration within the framework of projects or the way they are impacted by restoration measures, constitutes a first important challenge for researchers. 2) A second thematic corpus, composed of 38 publications, focuses more specifically on the political issues raised by the implementation of restoration projects. The analysis of governance and the roles played by the different actors involved in restoration projects structures the work in this corpus. In particular, the issue of public participation is at the heart of much of the work. 3) Finally, economic approaches structure a third problematic corpus consisting of 66 articles. Economic evaluations of restoration projects, sometimes based on cost-benefit analyses, are central to this work. Notably, strong methodological attention is paid to the evaluation of non-market ecosystem services restored by restoration projects. These different thematic fields are not independent. Understanding environmental perceptions, for example, is often a first step in the political analysis of conflicts between

actors. Similarly, the assessment of economic benefits, as well as the political analysis of opinions regarding restoration projects, often depends on the preferences of certain categories of stakeholders for different river states. Numerous publications therefore contribute to the advancement of knowledge within several thematic fields.



This wordcloud is produced from the calculation of lexical specificity scores. Based on a probability law, the specificity score assesses if some words occur more frequently in certain parts of a corpus (here, the words used in the titles of "societal" sub-corpus, n=121) than in the whole corpus (here, the "river restoration" corpus, n=1677) from which the parts are extracted.

Figure 1.5 – A lexicon specific to international scientific publications on the societal stakes in river restoration.

4.1. Understanding human-river interactions in the context of river restoration

Since the first works published on human-river interactions in the context of restoration in the early 2000s (e.g. Tunstall et al. 2000; Connelly et al. 2002; Piégay et al. 2005), a significant proportion of the publications in the corpus have dealt with this theme (Figure 1.6). These contributions are most often part of a constructivist conception of nature that posits that human is a stakeholder in the elaboration of the reality in which he intervenes; reality is seen as a mentally constructed representation (Moscovici 2001; Dunlap et al. 2002). The implications of this conception are important in the field of environmental action. Since the

river is no longer considered as an intangible reality, it is necessary to make room for the plurality of the modes of understanding in order to define the objectives and modalities of action. This is all the more true in the field of restoration, where determination of the reference — which can be defined as an approximation of the desirable state of the river, a standard chosen from several possible alternative states (Le Floc’h and Aronson 1995) — appears to be an eminently subjective value-laden activity (Hull and Robertson 2000); restoration is not only a scientific exercise based on rational criteria (Davis and Slobodkin 2004). Anchored in this epistemology, several research studies focused on the dynamics of human-river interaction within the framework of restoration projects.



This wordcloud is produced from the calculation of lexical specificity scores. Based on a probability law, the specificity score assesses if some words occur more frequently in certain parts of a corpus (here, the words used in the titles of “social” sub-corpus, n=53) than in the whole corpus (here, the “societal” corpus, n=121) from which the parts are extracted..

Figure 1.6 – A lexicon specific to international scientific publications dealing with human–river interactions in the context of restoration.

4.1.1. A broad public at the heart of the debate to characterize society’s support for river restoration projects

The majority of publications focus on the relationships that the “public” — “inhabitants”, “residents” or simply “people” or “citizens” — have with restored or to be restored rivers (e.g. Larned et al. 2006; Weber and Stewart 2009; Hong et al. 2019), notably through survey approaches (see Box 2). These designations generally refer to all people making up society, regardless of the relationship they may have with the river. Within this population, local people (local residents) occupy a special place insofar as they live within the confines of the river (Tunstall et al. 2000; Seidl and Stauffacher 2013; Westling et al. 2014). Proximity to the river is also a subject of discussion in the definition of local. From what distance is one concerned by a river restoration project? Are the expectations the same whether one lives near or far? These are questions raised by Soto-Montes de Oca and Ramirez-Fuentes (2019), whose objective was to evaluate the benefits of restoration perceived by inhabitants according to their proximity of residence to the Atoyac River (Mexico). This study shows that more than the distance of residence, it is the frequency of use of the river that determines the interest in its restoration. River users, whether residents or non-residents, are the focus of a number of scientific works (e.g. Polizzi et al. 2015; Deffner and Haas 2018; Zingraff-Hamed 2018). Generally speaking, publications dealing with human-river relationships often consider these different categories of stakeholders as forming public opinion and participating in political life, and through their positions, guiding the modalities of public action, and therefore, restoration projects. There are many publications linking the question of the relationship to the river to political issues (e.g. Junker et al. 2007; Davenport et al. 2010; Barthélémy and Armani 2015; Fox et al. 2017). The challenge underlying these publications is to understand how, in the context of projects, the relationships that local societies have with a river can give rise to support or opposition to its restoration. They sometimes position themselves ahead of projects to determine and anticipate, among the diversity of forms of relationships with the river, those that can help to ensure the adhesion of residents to the restoration project (e.g. Buijs 2009). They can also be located after projects to assess the degree of satisfaction or dissatisfaction with the changes that projects have brought about in terms of the links that residents have established with the river, or that they have established with each other around the river (e.g. Buijs 2009, Verbrugge and Van den Born 2018). In particular, Buijs (2009) has shown, through the case of the restoration of the Rhine (Netherlands), that opposition to restoration projects generally responds to questioning of the foundations of people’s attachment to the river.

4.1.2. Approaches focused on the values associated with rivers

To understand the relationship that the general public has with rivers, publications use different notions such as “perception”, “preference”, “attitude”, or “attachment” to the environment. Each of these notions has its own definition, sometimes changing (Table 1.2); however, they all reflect the values and attachments that individuals have with rivers.

Although such values have long been excluded from environmental action, their essential role “as rational motivators for the public to become involved and to voice their concern” (Vining 2000 p. 145), is now well recognized. The assumption is that individuals are more attentive to environments they care about and are more willing to protect them.

Table 1.2. How are the notions of “perception”, “attitude”, and “place attachment” defined in the literature on societal issues in river restoration?

Perception	Although the notion of perception is often used in the field of river restoration, it is rarely defined in publications. Its epistemology is difficult to establish with certainty across different studies. However, the use made of it by authors leads to its inclusion in the field of “environmental perception” studies, which since the 1970s have been positioned at the intersection of different disciplines such as geography, psychology, sociology, or anthropology (Saarinen and Sell 1980). According to Zube (1999, p. 214) “Environmental perception has commonly been defined as awareness of, or feelings about, the environment”. It is also “the act of apprehending the environment by the senses”. It is on this apprehension of river landscapes or the elements that constitute them that several studies in the field of restoration have focused (e.g. Piégay et al. 2005; Junker and Buchecker 2008; Seidl and Stauffacher 2013; Åberg and Tapsell 2013), with numerous works being specifically anchored in the field of “landscape perceptions” (Zube et al. 1982). Most are interested in “perceived landscape value” through different criteria such as aesthetics, naturalness, biodiversity, or ecosystem services. Other work is more detached from the landscape approach. Perception is then a mental construction as much as an act of sensory experience. This is the approach that seems to be defended in works focusing on the perception of environmental problems (e.g. Pahl-Wostl 2006; Alam 2011) or flood risk (e.g. Buijs 2009; Chou 2016). Behind the term perception is the idea of subjective evaluation, as Jähnig et al. (2011) explain when they compare the subjectivity of perception and the objectivity of scientific knowledge in the evaluation of restoration success. Although differences in the ways of perceiving reality may be certain, the hierarchy implied by the objective-subjective opposition is debatable. A number of works use the notion of perception in a more common sense, as being synonymous with opinion regarding project implementation (e.g. Davenport 2010; Feng et al. 2015). In some studies, a strong link is established between perception and attitude (e.g. Alam 2011; Åberg and Tapsell 2013; Deffner and Haas 2018). Knowing environmental perceptions would allow a better understanding of the support or opposition of certain categories of stakeholders to river restoration projects.
Attitude	The origin of the notion of attitude in the environmental field is to be found in psychological work (Kaiser et al. 1999). According to Gifford and Sussman (2012, p. 65) an “attitude is a latent construct mentally attached to a concrete or abstract object”. Attitude would thus be distinguished from perception, which has a more sensory origin. It would also have a more direct link to behavior (Kaiser et al. 1999). It must be noted that, like the notion of perception, that of attitude is rarely defined or referenced in work carried out in the field of river restoration. It is often invoked in a generic sense synonymous with an opinion or perception of the restoration project and its conduct or effects (e.g. Tunstall

et al. 2000; Purcell et al. 2002; Chin et al. 2005; Buijs 2009; Alam 2011). Support and opposition to restoration are sometimes defined as attitudes (e.g. Feng et al. 2015; Chou 2016). For example, Heldt et al. (2016, p. 5) speak of “positive”, “neutral” or “negative” attitudes towards projects.

Place attachment

Born out of research on “people place relationships” (Lewicka 2011), the notion of “place attachment” is mobilized by various social science disciplines, including psychology, sociology, and human geography. Although ancient, this notion appears relatively recently in the field of river restoration (e.g. Buijs 2009; Alam 2011; Fox et al. 2016; Verbrugge and Van den Born 2018). “In general, place attachment is defined as an affective bond or link between people and specific places” (Hidalgo and Hernandez 2001). As Alam (2011, p. 637) reminds us, the definition of the notion of place attachment is not really stabilized and has many synonyms. For Buijs (2009, p. 2681), “place attachment” is, along with “place identity” and “place dependency”, one of the dimensions of the “sense of place”. Verbrugge and Van den Born (2018, p. 242) propose a different perspective, presenting “place identity, place dependence, social bonding, and narrative bonding” as the four dimensions of place attachment. These authors also suggest that “place of attachment” is a dimension of the public’s perception of restoration. This was not the case for Fox et al. (2016), who spoke of “attachment to landscapes” to define the place of attachment and established a stronger synonymy with the field of landscape perception, which also gives an important role to places. The specificity of the notion of place attachment would then be mainly attributable to the central place given to emotions and the affective dimension. Verbrugge and Van Den Born (2018, p. 241) speak of “emotional connections to place” in their definition of the concept.

In order to grasp human-river relationships, many publications give an important place to “landscape” or “riverscape”. Landscape is defined as the sensitive side of the environment. Landscape perception is the mechanism by which individuals perceive ecological processes and the state of ecosystems. As such, landscape experience cannot be neglected in environmental action (Nassauer 1992; Gobster et al. 2007). Nevertheless, societal approaches to river restoration mobilize the landscape in a variety of ways. Some authors use it to highlight the cultural and historical anchoring of the relationship between residents and rivers that guides — or should guide — restoration projects (e.g. Fox et al. 2017; An and Lee 2019). Other researchers use the landscape to collect preferences towards different restoration scenarios (e.g. Junker and Buchecker 2008) or different river states according to their morphology or ecology (e.g. Piégay et al. 2005; McCormick et al. 2015). The landscape approach is also used to understand the impact of a restoration project on the relationship of riverside residents. In this respect, the work carried out in the United Kingdom by Åberg and Tapsell (2013) on the Skerne river, or by Westling et al. (2014) on the Dearne river, are particularly interesting; they are perfect examples of the impact that a restoration project can have on perceptions of river landscapes, both aesthetically and in terms of recreational practices. These works also present the original aspect of following-up human—river relationships over the long term. In this respect, they stress the importance of understanding the temporal dynamics at play in the construction of such relationships. These relationships

have a history, sometimes ancient, and evolve slowly, sometimes on the scale of several generations.

4.1.3. Practices supposed to guide the values associated with rivers

Although landscape perceptions are often at the heart of studies relating to human-river interactions, a significant part of the literature also focuses on the river-based activities that individuals engage in. These studies are often based on the idea that practices influence perceptions of the river, and therefore perceptions of restoration. In particular, a study on several urban rivers in the United Kingdom by Tunstall et al. (2000) showed that while most residents evaluate restoration projects very positively, particularly because of better access to the river banks and more recreational opportunities, some people are more nuanced. For example, anglers may denounce the degradation of fish resources following restoration, both in quantity and quality. Restoration projects may also create opportunities to renew practices between residents and their river, especially recreational ones, and increase the value they assign to it (e.g. Loomis 2002). Studies often show that the easier access provided by restoration projects contributes to intensifying or even creating new activities and attachments to rivers (e.g. Westling et al. 2014). These studies show that the diversity of links established between residents and rivers forges diverse expectations with regard to restoration actions. They also demonstrate that a restoration project will first be a political project, before being a technical one. This political project implies discussing both the diversity of links to the river and the diversity of expectations when defining restoration objectives (Wohl et al. 2005; Baker et al. 2014).

Box 2 - The field survey: a structuring method for many societal approaches in the field of river restoration

Surveys are the founding methods for HSS (see Bickman and Rog 2009; Gideon 2012). The first surveys in the field of river restoration date from the late 1990s and were conducted as part of economic studies (e.g. Loomis 1996; Loomis et al. 2000). They were quickly mobilized to develop studies on social and political issues (e.g. Tunstall et al. 2000; Purcell et al. 2002).

The majority of survey-based studies focus on the general public (Figure 1.7). They often

target residents of a neighborhood or town near to a restored river site (e.g., Tunstall et al. 2000; Perni et al. 2012; Seidl and Stauffacher 2013; Hong et al. 2019). They are also interested in the users and visitors of the sites, whether or not they are residents (e.g. Loomis 2002; Becker and Friedler 2013; Kim et al. 2017; Deffner and Haase 2018). These surveys are particularly used to evaluate the economic, recreational, or landscape benefits of a restoration project. They are also deployed to provide information for restoration policies on the relationships that a regional or national population has with rivers or river management (e.g. Piegay et al. 2005; Junker and Buchecker 2008). The surveys also focus on specific categories of the population, whose role in the restoration process is considered to be specific. They are identified as project stakeholders, actors, participants, or interest groups. The definition of these categories is often debated, and survey work can help inform such discussions (e.g. Tanaka 2006; Junker et al. 2007). Political studies are mainly based on surveys targeting elected officials and staff of public institutions, leaders of environmental or citizen associations, economic players, and scientists. The objective of these studies is to understand the position of the various stakeholders with regard to restoration approaches, but also the interactions between the stakeholders, their power relationships, and the conflicts or agreements that may be generated by the implementation of restoration projects (e.g. Junker et al. 2007; Lave et al. 2010; Heldt et al. 2016; Druschke et al. 2017). Stakeholders are also surveyed as part of the assessment of restoration projects (which is not guided by HSS questions, although they can feed them). These surveys, carried out by environmental scientists, are intended to gather factual information on the restoration practices implemented and on the evaluation of their effects from a biophysical point of view (e.g. Bash and Ryan 2002; Bernhardt et al. 2007; Kail et al. 2007).

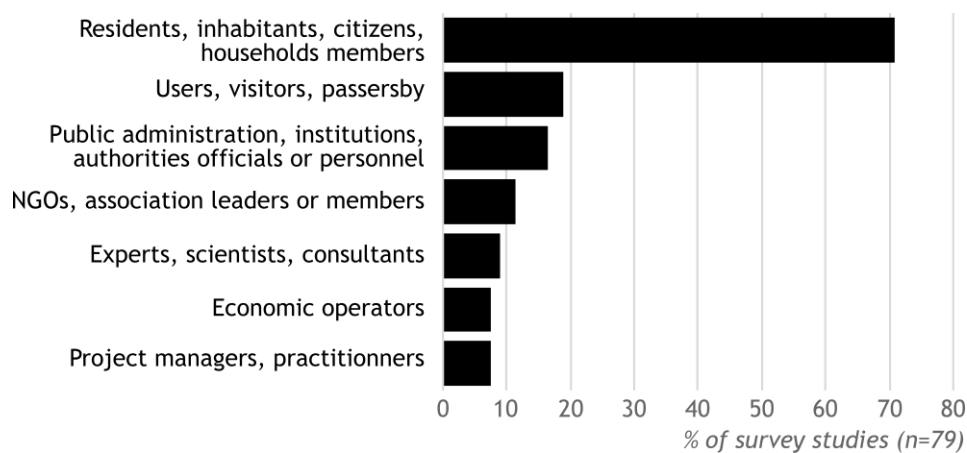
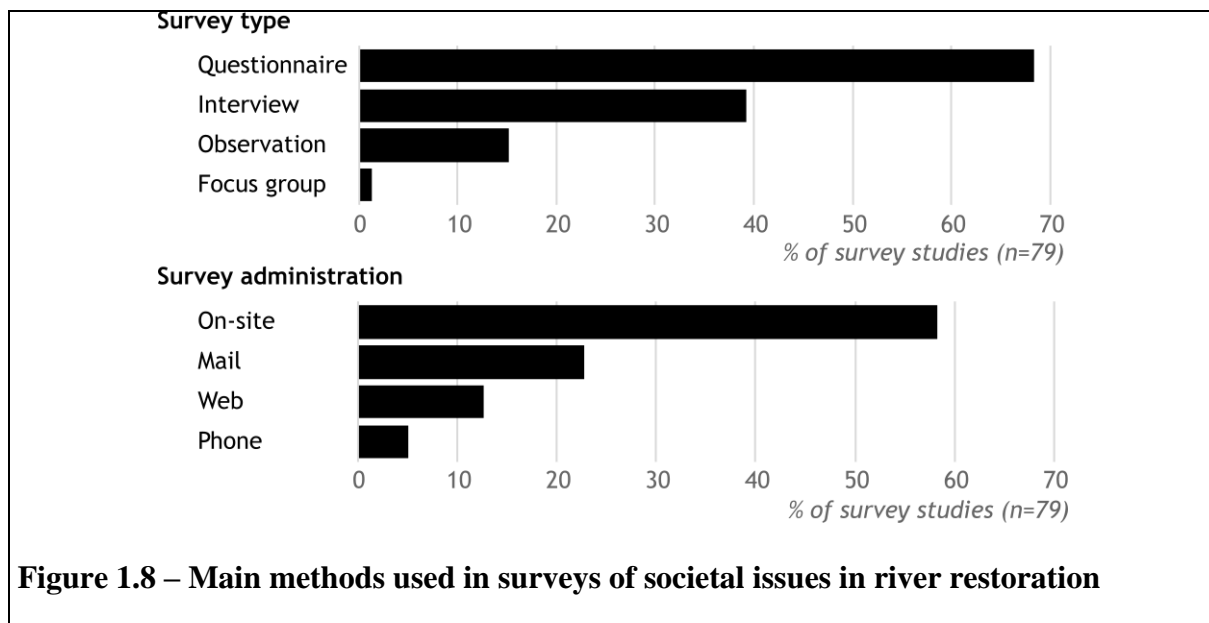


Figure 1.7 – Main categories of respondents targeted by surveys on the societal issues

of river restoration.

This diversity of survey approaches is addressed by a variety of methods (Figure 1.8). Most of these are on-site surveys, interviews, and questionnaires, conducted face-to-face with respondents. However, several studies used other survey methods such as telephone, mail, or internet surveys. These different modes of survey administration, which are less developed, are used in questionnaire-based surveys because they often make it possible to reach a larger number of respondents (e.g. Loomis 1996; Buijs 2009; Bliem et al. 2012). For example, most economic studies use questionnaires for contingency evaluations that rely on the willingness to pay (e.g. Loomis 1996; Lee 2012; Kim et al. 2018), and then make quantitative analyses of their data. Studies on social practices and perceptions also utilize questionnaires, sometimes coupled with interviews (e.g. Tunstall et al. 2000; Buijs 2009; Åberg and Tapsell 2013; Deffner and Haase 2018), and sometimes using specific survey methods such as photo-questionnaires (e.g. Piegay et al. 2005; Junker and Buchecker 2008; McCormick et al. 2015) or photo-based interviews (e.g. Westling et al. 2014). Social approaches also give room for in-depth interviews. The latter, and to a lesser extent observation methods, are the dominant methods supporting policy analysis (e.g. Tanaka 2006; Barthélémy and Armani 2015; Heldt et al. 2016; Druschke et al. 2017). Analyses of interview data are most often qualitative. They enable us to understand the complexity of the actors' roles and governance processes. Political and social studies often combine observations, interviews, and questionnaires (e.g. Junker and Buchecker 2007; Lave et al. 2010). Focus group interviews are rarely used as methods per se (e.g. Fox et al. 2017), but are often used to prepare the implementation of a questionnaire, particularly in economic studies (e.g. Loomis 2002; Kenney et al. 2012; Kim et al. 2018).



4.2. Studying the political stakes of river restoration

The first studies addressing the political dimension of river restoration were published in the 2000s, often in connection with analysis of the effects of restoration on human–river interactions (e.g. Tunstall et al. 2000; Connelly et al. 2002; Junker et al. 2007). They often involve both survey methods and literature reviews (see Box 3), and are based on the idea that environmental policies are the result of power plays between different interests (Baker and Eckerberg 2013). In fact, many policy approaches to river restoration are devoted to the issue of arbitration between different interests involved in decision-making. Which restoration objectives should be prioritized? How to intervene? On which sites should we prioritize action? The answers to these questions probably vary according to the actors questioned and the governance methods adopted for the project, but also more broadly according to the territorial context in which the project takes place. Thus, behind seemingly technical issues there are in fact significant and influential social and political processes that are at the heart of political approaches to restoration. For Light and Higgs (1996), the political stakes of restoration can be approached from two perspectives, often complementary. The first relates to the choices that are made, the reasons why they are made, and the manner in which they are made, and is referred to as “politics in restoration”. In the field of river restoration, there are therefore many publications related to governance and stakeholder participation. The second approach is the “politics of restoration”. It brings together work that looks at the way in which restoration approaches fit into further political, social, and economic mechanisms beyond the immediate realm. These two approaches examine the value of restoration policy (Light and

Higgs 1996), questioning what is a “good” or “bad” restoration project, particularly from the perspective of legitimacy (who makes the decisions and in what capacity?) or equity (are the decisions fair and made in the name of the common good?).



This wordcloud is produced from the calculation of lexical specificity scores. Based on a probability law, the specificity score assesses if some words occur more frequently in certain parts of a corpus (here, the words used in the titles of “political” sub-corpus, n=38) than in the whole corpus (here, the “societal” corpus, n=121) from which the parts are extracted.

Figure 1.9 – Lexicon specific to international scientific publications dealing with the political stakes of river restoration

4.2.1. A focus on stakeholders of river restoration: the participatory approach

According to Szalkiewicz et al. (2018), in Europe “52% of the projects analyzed have been designed and implemented without the participation of local Stakeholders”. Whether actively or passively concerned by a decision, the individuals or collectives (group or organization) that make up society nevertheless have interests that may be positively or negatively affected by its execution (or non-execution). These interests often determine their relationship to the river and their stance on restoration. In policy approaches to river restoration, stakeholders are at the heart of the discussion (Figure 1.9), and the question is often to determine which river

restoration stakeholders are or should be involved in decision-making (Junker et al. 2007). Political approaches to river restoration are often strongly biased towards broad participation. According to various authors, the river restoration decision, as well as its evaluation, is best made collectively (Jähnig et al. 2011; Deffner and Haase 2018). This positioning places river restoration at the center of a democratic debate. Indeed, it considers that a restoration project, insofar as it creates value (Light and Higgs 1996), must produce a value that is shared or at least collectively debated if the project is to have relevance and social legitimacy (Deffner and Haase 2018). The river is considered a common good around which a “community” gravitates. This community is made up of individuals who often have different or even divergent interests, but who come together around a shared project. By placing the democratic issue at the heart of restoration, political approaches make the river a tool for living together. In this sense, political action cannot be taken independently of the social and cultural contexts in which it takes place.

The form of the democratic debate is also at the center of considerations; representative democracy giving expert groups legitimacy to act is questioned. More and more authors are placing participatory approaches at the center of their work and considering the involvement of different stakeholders in the project; they approach the political dimension of river restoration from a governance perspective. According to Mansourian (2017, p. 402), “governance determines who takes decisions, and how these decisions are made and applied”. Some of these studies are interested in the satisfaction — or dissatisfaction — of stakeholders regarding the degree and manner in which they were involved in the project (Junker et al. 2007; Heldt et al. 2016). Others propose a monitoring of governance, and analyze, often in a critical manner, the way in which the interplay of actors within the loop has been able to influence decisions (Tanaka 2006; Lee and Choi 2012; Hong and Chun 2018). Thus, within the framework of the restoration of the Anyangcheon River in Seoul (South Korea), Hong and Chun (2018) were able to highlight power asymmetries between the different stakeholders of the project that contributed to prioritizing, in the choice of restoration objectives, scientific values to the detriment of non-scientific values such as cultural, aesthetic, social, or educational ones. The importance of the leadership of certain stakeholders — endowed with varied influence and capacity — for driving the concretization and orientation of projects is often mentioned (Lee and Choi 2012; Barthélémy and Armani 2015).

4.2.2. River restoration at the heart of power relationships: between conflict analysis and critical approaches

Several policy researches in the field of restoration offer analyses of power relations and conflicts related to project implementation. In particular, they seek to highlight the hidden tensions that result from the socio-political processes that animate and define the social situation. The political ecology field of research (e.g. Doyle et al. 2015; Sneddon et al. 2017; Drouineau et al. 2018), whose ambition is to study power relations (Benjaminsen and Svarstad 2019, p. 392), has particularly invested in these critical approaches, “questioning of the role and status of powerful actors as well as of what is taken for granted in leading discourses on environment and development”. These approaches, politically committed to a fairer and more sustainable organization of society, bring a particular color to the thinking on river restoration, being rather driven by an environmentalist commitment. For example, a special place is given to local communities in the tradition of post-colonial studies (e.g. Fox et al. 2017; Woelfle-Erskine 2017). These communities arouse a strong interest because of the original and ancestral links they have forged with rivers, and paradoxically, because of the small weight they are generally able to have in the decision-making process in the face of more powerful institutional, political, or economic actors. Their involvement raises issues of cultural recognition and preservation of traditions and worldviews. Contributions in political economy have also made achievements in the field of river restoration (e.g. Lave et al. 2010; Lave 2016). They have shown, for example, how neo-liberal logics have guided restoration practices in the United States by favoring the private sector in the production of expertise and promoting the creation of new markets related to ecosystem services (Lave et al. 2010).

Beyond the latent power balances, many publications also analyze restoration projects from the perspective of open conflicts, or at least the opposition they generate. These oppositions are particularly strong regarding certain restoration measures. Projects for restoring continuity, particularly dam removal, which generally result in major upheavals to landscapes and practices, appear to be the most controversial. These projects are therefore at the center of many political analyses (Figure 1.10) (e.g. Druschke et al. 2017; Sneddon et al. 2017; Drouineau et al. 2018).

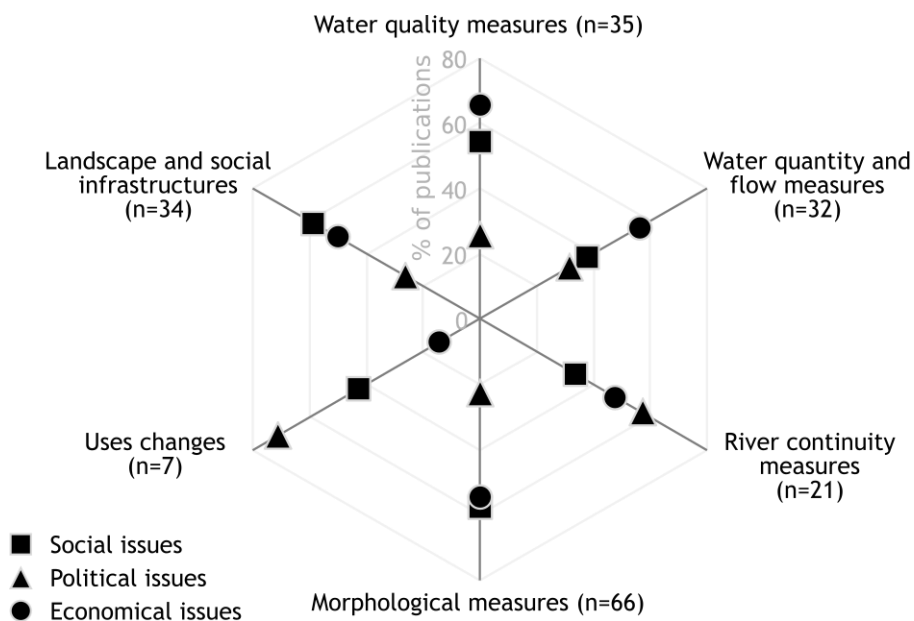


Figure 1.10 – Restoration measures tackled in scientific publications on the social, political or economical issues of river restoration.

While particular attention is paid to opposition to restoration, many of the works also focus on public support for the projects (Table 1.3). According to Junker et al. (2007), the primary objective of restoration — to increase the natural and ecological quality of rivers — would generally be a matter of consensus among the general public. Faced with the complexity of the socio-economic issues generally raised by restoration projects, this positive view of restoration approaches deserves to be highlighted.

Table 1.3. How are the notions of “expectation”, “support”, and “acceptance” defined in the literature on societal issues in river restoration?

Expectation	<p>The notion of expectation is rarely discussed and often used in a generic sense as “the action or fact of anticipating or foreseeing something” (OED 2020). In the context of restoration, this foresight often concerns the way a project is conducted or the results it should have. Expectations are <i>a priori</i> positive. They are based on what people, practitioners (e.g. Chen et al. 2017) or the public (e.g. Junker and Buchecker 2008; Tunstall et al. 2000) imagine and want in relation to the river. Contrary to the notions of perception or attitude that most often refer to existing objects or phenomena, the notion of expectation requires projection, and is mobilized in pre-restoration phase to nurture the restoration project (e.g. Åberg and Tapsel 2013). This does not prevent from also looking at how the project has met these initial expectations, which is then more a matter of studying satisfaction. Satisfaction can be a criterion of success. Conversely, disappointment is a significant risk in the case of river restoration projects (e.g. Tunstall et al. 2000). This is all the more true since such a project can not only reveal latent expectations, but can also generate new ones. Expectations can change over time and through the stages of a project.</p>
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Support	<p>The notion of support is most often used in the scientific literature in a common sense. It is the support that certain categories of stakeholders bring to a restoration project. The perspective is political. It is generally the “public support” that is at the center of analyses (e.g. Connelly et al. 2002; Schläpfer and Witzig 2006; Buijs 2009). As with the notion of willingness, the intensity associated with the use of the notion of support can vary widely, from accepting an action to publicly encouraging and defending it. Beyond the evaluation of project support, the various studies in the field of restoration seek to understand its determinants. The notion of support is thus often backed up by notions of perception or attitude, to understand the reasons why certain stakeholders or certain categories of stakeholders support or oppose restoration (e.g. Tanaka 2006; Schläpfer and Witzig 2006; Buijs 2009). For some authors, this analysis can help target environmental education approaches and build public support (e.g. Chin et al. 2008; Chen and Cho 2019), whereas for others, it is more the debating of different opinions in a participatory perspective that will help build support for restoration (e.g. Junker et al. 2007).</p>
Acceptance	<p>According to Depraz (2005), the notion of acceptance has its roots in German social psychology. This may explain why, in the scientific literature on river restoration, its use is highly standardized in Germany (e.g. Heldt et al. 2016; Zingraff-Hamed et al. 2018; Deffner and haase 2018) and Switzerland (e.g. Junker and Buchecker 2008; Schläpfer and Witzig 2006; Seidl and Stauffacher 2013). A generic definition of acceptance is “the action or fact of receiving something favorably” (OED 2020), and the concept of acceptance is a form of agreement. According to Heldt et al. (2016, p. 1052-1053) “It is highly important to understand that acceptance is not a stable property that can either be present or not”. Acceptance appears to be a process that is built particularly within the framework of participatory approaches (e.g. Junker et al. 2007; Seidl and Stauffacher 2013; Heldt et al. 2016). In the field of river restoration, the concept obviously echoes those of support and willingness, with which it is sometimes synonymous (e.g. Junker and Buchecker 2008). The concept of acceptance is sometimes discussed because it can be interpreted as a prescriptive process in which adherence is sought more than participation. Heldt et al. (2016) distinguish between acceptance, which would be descriptive, and acceptability, which would be more normative.</p>

4.2.3. A political look at the place of science in river restoration practice

In political approaches to river restoration, scientists are considered as fully-fledged protagonists of restoration policies and projects. Because of their knowledge, they are consulted in the development of projects and are often involved in their evaluation. Some authors critically analyze this expert stance (e.g. Lave et al. 2010; Lave 2016; Fox et al. 2017). For them, researchers are not immune to the influence of the political, economic, and social forces that influence the politics of restoration (Light and Higgs 1996). Scientific production is rooted in multiple values that have a particular weight in the practice of river restoration because of the credit generally given to scientific knowledge and the expert. Many publications interested in the political dimension of restoration aim to highlight these values and to discuss the ethical responsibility of researchers as they engage in dialogue with society. Among the avenues being explored, Drouineau et al. (2018) point to the importance of multidisciplinary in this science–society interface. According to the authors, the crossing of disciplinary viewpoints is an essential approach to address any problem in an integrated manner, and to take into account its various facets. Other publications put scientific

knowledge into perspective by comparing it with other more vernacular forms of knowledge (e.g. Woelfle-Erskine 2017; Hong and Chun 2018). They contribute to relativizing the weight of scientific knowledge in the decision-making process and make the scientist a stakeholder among others (Yun 2014). These approaches therefore reflect on processes for engaging local communities and citizens at large in decision-making processes (e.g. Heldt et al. 2016; Fox et al. 2017; Edwards et al. 2018). To this end, publications consider and evaluate the merits of alternative approaches for the production of knowledge in the field of river restoration. Pahl-Wostl (2006) insists, for example, on the principle of co-construction of knowledge to promote social learning in the field of river restoration. Restoration projects involving participatory science (e.g. Edwards et al. 2018) or collaborative research (e.g. Fox et al. 2017) are, however, rare. Fox et al. (2017, p. 532) showed that “spaces for the inclusion of new meanings, processes, and outcomes in restoration” were created through collaborations between researchers and indigenous communities. They have contributed to the recognition that the standards of indigenous communities are on a par with those of Western countries. According to the authors, however, this recognition is only one step on the long road to rebalancing power relationships in river restoration governance processes.

Box 3 - Documentation sources: material that is little valued in river restoration research

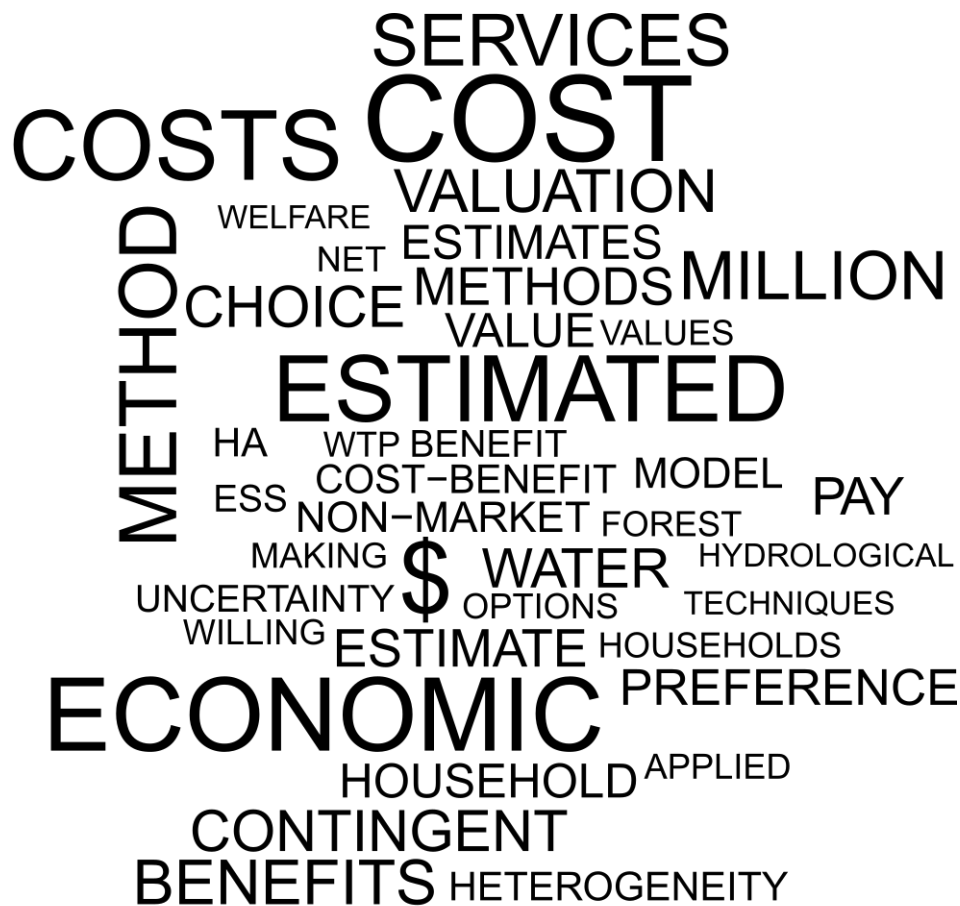
While documentation sources are often used in societal studies, they are rarely mobilized as foundational materials for research work. They are most often complementary to survey methods (e.g. Buijs 2009; Barthélémy and Armani 2015; Heldt et al. 2016; Druschke et al. 2017), to provide elements of interpretation, confirmation, or discussion of the information obtained during interviews. The nature of the documents is often little discussed and the methods of their analysis are rarely explained; they are most often qualitative.

However, document sources are valuable for providing information on river restoration projects. The most used are policy documents or administrative documents produced by national, regional, or local administrations, and operational documents related to projects (planning documents, technical reports, and communication documents). These documents contain technical and scientific information that (for example) has contributed to the inventories of projects carried out by environmental scientists to evaluate restoration practices and their effects on river ecology since the 2000s (e.g. Bernarhdt et al. 2007). The

bibliographical study shows that these documents are also more mobilized to answer the societal questions raised by river restoration approaches. For example, operational documents are sources providing data on project costs for economic studies (e.g. Alam 2008; Carah et al. 2014; Langhans et al. 2014). Above all, they provide key material for understanding the political processes at work in restoration processes (e.g. Tanaka 2006; Gerlak 2009; Lee and Choi 2012; Guerin 2015). Their analysis makes it possible to trace the genealogy of a restoration project and to identify the role played by the various stakeholders in its implementation, their positions in a political sense, and their strategies for action. Some studies, less numerous, focus more specifically on how public opinion reacts to certain river restoration approaches (e.g. Bark et al. 2016; Heldt et al. 2016; Druschke et al. 2017). For this purpose, they mobilize other documentation sources, such as the news media and particularly the press.

4.3. Economic evaluation of river restoration

Economic analyses were among the first societal approaches developed in the field of river restoration (e.g. Barendregt et al. 1992; Loomis 1996; Turner and Boyer 1997) (Figure 1.11). Several works are now widely referenced and utilized in the scientific community (Loomis et al. 2000; Chen et al. 2017; Acuña et al. 2013; Vermaat et al. 2016; Bliem et al. 2012; Gerner et al. 2018). Economic approaches focus primarily on producing an assessment of river restoration policies; however, in contrast to budgetary approaches to public policy evaluation, which are placed from the point of view of funders and primarily consider the financial costs of projects, they adopt a more socio-economic perspective for this evaluation (Brouwer and Sheremet 2017). Thus, the majority of economic publications integrate discussions on social practices and environmental perceptions. According to Brouwer and Sheremet (2017, p. 1), the economic value of a river restoration project is defined as “the calculation of all costs and benefits, including (second-order) indirect effects on sectors and (non-priced) environmental effects, often referred to as the broader social costs and benefits”.



This wordcloud is produced from the calculation of lexical specificity scores. Based on a probability law, the specificity score assesses if some words occur more frequently in certain parts of a corpus (here, the words used in the titles of "economical" sub-corpus, n=66) than in the whole corpus (here, the "societal" corpus, n=121) from which the parts are extracted..

Figure 1.11. A lexicon specific to international scientific publications on the economic stakes in river restoration.

4.3.1. Contributions focused on the evaluation of benefits of river restoration

The financial amounts committed to river restoration are an important issue, highlighted by several reviews on river restoration (e.g. Bernhardt et al. 2005; Szalkiewicz et al. 2018). Some economic publications are more focused on project costs alone. Cost reduction is very often the objective of these studies, which take note of the strong budgetary constraints imposed on the implementation of restoration actions. This search for cost optimization leads some authors to question and prioritize the restoration techniques that are adopted in projects (e.g. Hill et al. 2011; Kristensen et al. 2012; Carah et al. 2014). Other authors look at costs from a different perspective, assessing costs as losses to the stakeholders in the restoration. At the heart of these studies is the value of the assets that certain stakeholders must give up if the restoration project is to be carried out; these are opportunity costs. For example, Gómez et al.

(2014) consider the opportunity costs associated with the reduced power generation resulting from the implementation of flushing floods which are known to restore basic environmental functions in highly engineered rivers. In particular, they demonstrate that this cost is lower than the willingness to pay for such restoration measures. Losses are also sometimes considered in terms of the compensation to be paid to the stakeholders affected by the restoration project (e.g. Cheng et al. 2019). Such cost-only approaches are not dominant in the literature.

The vast majority of the literature with an economic approach to river restoration compares costs against benefits or focuses on assessing benefits alone. In the cost-benefit analyses, it is above all the evaluation of benefits that is at the heart of the research effort. The costs are considered as fixed data that are not very open to discussion. Behind this interest in the benefits, it exists a form of engagement of the scientific community that is in favor of river restoration policies. By making visible the benefits induced by the projects and highlighting their effectiveness from the point of view of public investment, these publications help to justify and promote river restoration to decision-makers and the general public. This focus on benefits can also be explained by the methodological challenges faced by researchers. While it is indeed relatively easy to access project cost data – at least for technical implementation – the measurement of benefits is more challenging (Brouwer and Sheremet 2017). This is all the more true because environmental benefits are most often of a non-market value that is difficult to measure. To determine this value — which some authors describe as a shadow price (e.g. Grossmann 2012; Becker et al. 2014) — economics relies on a substantial methodological arsenal (see Box 4).

Box 4 - Economic methods: assessing the benefits of river restoration

The evaluation of the benefits produced by river restoration in relation to the costs it generates is at the center of many economic studies. The bibliographical work makes it possible to distinguish two main approaches in the way this evaluation is conducted. 1) The first is cost-effectiveness analysis. Several publications measure the benefits of restoration according to ecological (e.g. Barendregt et al. 1992; Langhans et al. 2014) or socio-ecological (e.g. Golet et al. 2006; Jia et al. 2010; Kendy et al. 2018) indicators, which they compare against monetary project costs. 2) The second and more common approach compares costs to economic benefits. While the measurement of costs is not described in the

literature as posing any particular problems, the measurement of benefits raises important methodological issues. The benefits of a project are multifaceted, and in practice correspond to very different units of measurement (e.g. the quantity of fish available for angling, the beauty of the landscape, the number of visitors). To alleviate this problem, authors often conduct a monetary evaluation of the benefits of restoration. The monetary amount resulting from this evaluation is more readily comparable to costs. Money is thus used as the “common denominator” in cost-benefit analyses (Brouwer and Sheremet 2017). Several meta-analyses of the scientific literature dealing with non-market valuation of benefits have been undertaken within the field of river restoration (e.g. Bergstrom and Loomis 2017; Brouwer and Sheremet 2017).

It is possible to distinguish, within the literature, two main approaches to the monetary valuation of the benefits of restoration (Figure 1.12). The first is the benefit transfer approach, which is based on existing data on the value of certain ecosystem services. These data, measured for example on a previous restoration project, are used to deduce the value of the same services on another project at another site. This approach is generally used when study resources do not permit the production of primary data. For example, Alam (2008) used the work of Haque et al. (1997) to estimate the benefits produced by the restoration of the Buriganga River (Bangladesh) in terms of health and housing and land values. Several authors call for great caution in the use of this method because of the significant biases that exist when extrapolating data from one area to another, particularly because of the heterogeneity of their characteristics (e.g. Brouwer et al. 2016; Lewis and Landry 2017).

The second approach to assessing benefits, utilized in the majority of publications, is through primary evaluation exercises. This includes all methods that produce data specific to one or a set of restoration projects. Among them, price-based methods are currently seldom applied to restoration projects. These methods use the amounts of actual transactions for certain ecosystem services. For example, Vermaat et al. (2016) accounted for the benefits of several European restoration projects using, among other things, the real market prices of certain supplies (e.g. agricultural commodities, drinking water), regulations (e.g. fertilizers), or cultural services (e.g. fishing and hunting licenses, kayak rentals).

Cost-based approaches are more represented in the scientific literature. These use the costs incurred in the absence of the ecosystem services as a proxy for ecosystem services values. For example, this method is used by Kenney et al. (2012, p. 608) to “estimate the cost-

effectiveness of restoration for infrastructure protection by comparing it to the avoided cost of riprap bank protection”.

Revealed preference approaches are used in about a quarter of primary assessments. These consist of the analysis of individual choices in marketable goods transactions. Individual preferences reveal the market value of these goods. For example, some studies conduct hedonic pricing approaches and examine changes in real estate prices in the context of river restoration (e.g. Chen 2017; Lewis and Landry 2017; Netusil et al. 2019). Others conduct travel cost approaches and measure the amount people pay to access a service (e.g. Loomis 2002; Becker and Friedler 2013; Akron et al. 2017).

Finally, stated preference methods are the most used in the field of river restoration. These methods simulate a market for ecosystem services through surveys of hypothetical changes in the provision of ecosystem services. People are asked to indicate explicitly or implicitly their willingness to pay for positive change (e.g. Loomis 1996; Chen et al. 2017; Vásquez and De Rezende 2019) or their willingness to accept negative change (e.g. Zhang et al. 2019). The extensive use of stated preference methods echoes the recommendations of some authors (e.g. Honey-Rosés et al. 2013) who prefer, for operational reasons, to use approaches that rely on the demand for services to qualify their value. Generally speaking, these are more directly anchored in the reality and social expectations of the studied area.

Finally, it should be noted that these different approaches are not exclusive and that many studies use several of them to address the various benefits of restoration in a holistic manner. In this perspective, many authors refer to the conceptual framework of “total economic value” (TEV) (Randall 1987).

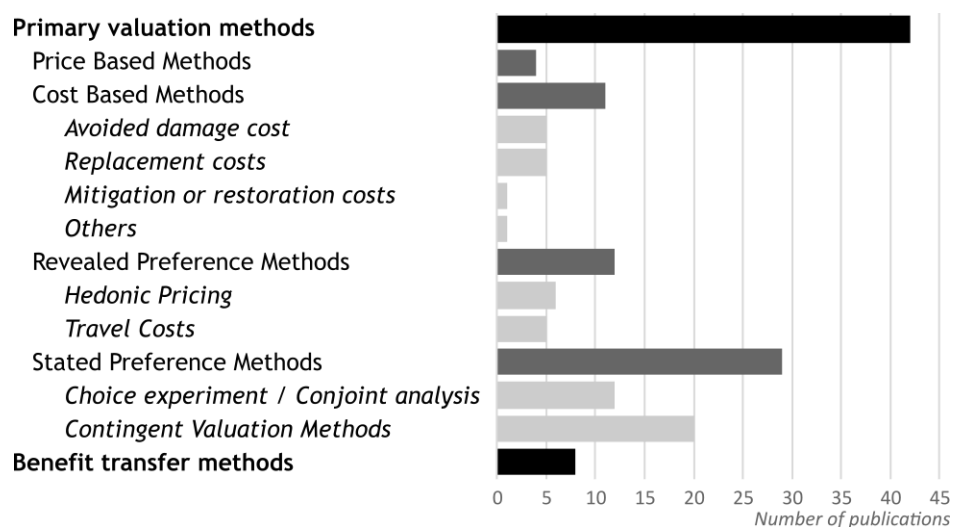


Figure 1.12 - Economic methods used in international scientific publications to assess the benefits of river restoration.

4.3.2. What river restoration benefits are we talking about? The ecosystem services approach

River restoration is likely to produce multiple benefits, whether ecological (e.g. restoration of certain ecological functions), economic (e.g. creation of a market and thus of companies or consulting firms specializing in river restoration), or social (e.g. development of recreational opportunities associated with rivers). To capture these benefits, economic approaches to river restoration are essentially based on the concept of ecosystem services. They are thus part of an anthropocentric paradigm of interactions between societies and rivers. Ecosystem services are defined as the benefits that society derives from ecosystems and that therefore contribute to human well-being (Costanza et al. 1997; Daily 1997; MEA 2005)². Ecological structures and processes perform ecological functions that are themselves sources of services for humans. However, these services are only regarded as benefits when society attributes a value to them (Haines-Young and Potschin 2010). Quantification of this value is an issue mobilizing a significant proportion of the economic science community working on restoration issues.

The perspectives adopted in the publications are, however, heterogeneous. Some authors focus their attention on a single type of service for which they wish to estimate the value. For example, Grossmann (2012) aimed to assess the economic benefits of retention of river-carried nutrients by floodplain wetlands. This evaluation of a so-called regulating ecosystem service (MEA 2005) had a demonstrative value, aiming to highlight the shadow price of the alluvial plains of the Elbe basin (Germany) according to evaluation of their capacity to retain pollutants. Following more pragmatic and operational approaches, other authors have attempted to estimate the value of ecosystem services based on the social demand for them, not only on their level of availability/supply (Honey-Rosés et al. 2013). These approaches generally lead the authors to anchor their thinking to a specific restoration project. It is then a

² According to the IPBES (2020), ecosystem services are “The benefits people obtain from ecosystems. In the Millennium Ecosystem Assessment, ecosystem services can be divided into supporting, regulating, provisioning and cultural. This classification, however, is superseded in IPBES assessments by the system used under ‘nature’s contributions to people’. This is because IPBES recognises that many services fit into more than one of the four categories. For example, food is both a provisioning service and also, emphatically, a cultural service, in many cultures”

question of determining all the services that could be affected and measuring the overall benefit to society. These approaches based on the assessment of social demand for ecosystem services sometimes mobilize different scenarios corresponding to different restoration measures. By evaluating the fluctuation of assigned value according to different scenarios, these studies make it possible to prioritize the measures to be implemented within the project. For example, several cost-benefit analyses of restoration projects in the field of pollution treatment carried out on the Alexander-Zeimar and Kishon rivers (Israel) show that while the most ambitious restoration measures may present the best cost-benefit ratios (Becker and Friedler 2013), more-targeted restoration measures may sometimes be more economically profitable (Becker et al. 2019).

Among the publications reviewed, few presented a negative economic balance of river restoration projects (e.g. Lee and Jung 2016). Most report excess cost-benefit analyses (e.g. Lee 2012; Polizzi et al. 2015; Kim et al. 2018; Logar et al. 2019). In other words, river restoration projects are presented as being economically profitable overall in relation to the benefits they produce. However, these publications show that not all services are equal when it comes to understanding the overall benefit of restoration projects. Some projects do not stand up to cost-benefit analyses if they do not take into account cultural services, particularly aesthetic or recreational services (e.g. Kenney et al. 2012; Garcia et al. 2016). The authors of these studies also underline the importance of these specific services for supporting river restoration policies, especially in urban areas. Cultural objectives, particularly landscape and recreational objectives, can also be added to traditional ecological objectives to strengthen the social amenities of rivers, and these are known to greatly increase the value of projects (e.g. Bae 2011).

Table 1.4. How are the notions of “preference” and “willingness” defined in the literature on the societal stakes of river restoration?

Preference	The notion of preference is used recurrently in publications dealing with human-river interactions in the context of restoration, but according to different epistemological anchors. A number of these uses are part of a tradition of research in environmental psychology that focuses on the affective and cognitive relationships that individuals have with the environment (Kaplan 1987). In this perspective, the notion of environmental preference is closely linked to that of environmental perception. According to Van Den Berg et al. (2003, p. 136) “environmental preference is determined by environmental properties that possess a potential functional significance for the perceiver”. The notion of environmental preference is, however, more in line with a logic of prioritization and comparative judgment. It is therefore often mobilized for the aesthetic or landscape evaluation of different restoration scenarios (e.g. Chin et al. 2008; Junker and Buchecker
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2008; McCormick et al. 2015; Hong et al. 2019). Preference is also a benchmarking process that is very often invoked in economic evaluations (Hausman 2011). The concept refers particularly to revealed and stated preferences methods (Adamowicz et al. 1994; Boxal et al. 1996). These methods are widely used in the framework of restoration benefit assessment (Brouwer and Sheremet 2017; Bergstrom and Loomis 2017). Preference is synonymous with choice regarding the services that restored rivers can provide; the individual is positioned as a consumer of these services. Preference is used as a founding notion to determine the value of the river.

Willingness The notion of willingness is difficult to define because it can be understood as being synonymous with wishing in a pro-active sense, as much as a more passive “disposition to consent or comply” (OED 2020). In any case, the notion seems to have its origin in economics work using willingness to pay (WTP) or willingness to accept (WTA) as the structuring concept for the method of evaluation; it is within this methodological framework that it is used in publications on river restoration (e.g. Loomis 1996; Bliem et al. 2012; Kim et al. 2018). The notion of willingness is closely associated with that of preference. It is mainly discussed methodologically, between an approach that measures the amount that an individual is willing to pay to access or retain a service and an approach that measures the price he or she is willing to accept for losing that service (Zhao et al. 2013; Polizzi et al. 2015). Beyond economic valuations, the notion of willingness is also used to evaluate support or opposition to restoration actions. Willingness is less a matter of consent than of commitment (Connelly et al. 2002; Alam 2011). Alam (2011, p. 636) uses the term “willingness to contribute” (WTC), understood in terms of money or time invested. Some approaches are even demonetized, such as the work of Januchowski-Hartley et al. (2012, p. 24), who are interested in ‘landholders’ willingness to engage in restoration on their land”.

A number of publications also discuss the fact that the assessment of restoration benefits is highly dependent on the spatial and temporal scale at which one places oneself (e.g. Becker et al. 2014; Turner and Boyer 1997). For example, there may be imbalances between the territories that pay for projects and those that benefit from them. Thus, Logar et al. (2019) highlight the tensions that exist in Switzerland between the scales at which projects are financed (national scale) and the scales at which projects are implemented (local scale), and they stress the interest in securing additional local funds to guarantee territorial equity. From a temporal point of view, Polizzi et al. (2015) showed that the benefits of a restoration project undertaken in Finland offset the costs in only 3 to 10 years, whereas Garcia et al. (2016) estimated the net benefit of an Israeli project at 30 years. Any evaluation of river restoration cannot be separated from consideration of the timescales of the project and its benefits.

5. A diversity of researchers’ positions with regard to operational action

Research in the field of river restoration is essentially an applied research field; it is concerned with and involved in the transformation of river environments. Studies interested in restoration often express, among their objectives, a desire to contribute to the improvement of policies and to assist in the implementation of projects. The increasing number of restoration

assessment procedures performed to enable appropriate management is illustrative of this desire to support environmental action. By studying restoration policies and projects and analyzing their objectives, the way they are implemented, and their socio-economic effects, societal approaches obviously contribute to the critical work that is carried out on restoration approaches. Rarely does societal research maintain a distant position with respect to action. Most authors make recommendations or more generally suggest ways to improve actions. If the commitment of researchers is real, it obviously takes different forms, depending on the research issues, the traditions specific to different disciplines, the individual positions of researchers, and the expectations of practitioners.

If the objective of many works carried out on societal issues is to improve river restoration policies and projects, the manners in which these improvements are considered are obviously based on different ethical positions. The primary challenge may be to contribute to achieving the environmental objectives defined within the framework of restoration projects, most often on the basis of ecological criteria. Analysis of environmental perceptions or expectations of a project is then seen as a means of removing opposition to ecological restoration approaches. The production of knowledge is thus often articulated with environmental education approaches. For example, the work conducted by Chin et al. (2008, p. 894) “is advocated to bridge the gap between scientific knowledge and public perception for effective management and restoration of river systems with [in-channel] wood”. Research thus focuses on the socio-economic benefits of restoration in order to provide arguments to justify and support ecological action.

There may, however, be some mistrust within the community of researchers working on societal issues when faced with work aimed essentially at fostering social acceptance, which could be conceived as a simple recording of decisions taken. Many studies show a strong commitment to a participatory conception of public action in the field of restoration, both for political reasons — a vision of the democratic process — and for pragmatic reasons — involvement in the decision-making process reinforces public support for restoration practices (e.g. Junker et al. 2007). Improvement in restoration is also improvement in the governance processes. The question is then political, about who makes the decision and who participates in the decision making. It is often a question of encouraging a more shared and therefore more consensual approach to restoration. Improvement is not about facilitating the implementation of decisions, but about enhancing equity in decision-making. In a frequently referenced work, Pahl-Wostl (2006, p. 12) recommends “to implement a participatory process that facilitates

social learning and institutional change, and leads to an adaptive management strategy for the restoration”. Participation should thus facilitate a broad acceptance of environmental issues, but also enable projects to evolve by taking into account and bringing together a wide range of expectations. Restoration is thus approached from a more integrated perspective.

Ecological restoration then becomes a means of environmental and territorial development leading to the long-term well-being of the inhabitants. While the ecological dimension occupies an important place, the social question — and in particular social justice within the constraints and benefits of restoration — is also at the heart of the debate and must not be neglected.

Some studies also question the objectives of restoration without guiding the participants in their choice. Social science researchers often have a particular relationship to the commitment and expertise. The deconstruction of the figure of the expert, discussions around the hierarchy of knowledge (e.g. Fox et al. 2017), and more generally, the study of power relations linked to knowledge (e.g. Lave 2016), can lead to paradoxically opposed positions. Some researchers — in political ecology, for example — adopt a resolutely committed stance and affirm it as a postulate of their research approach. To the contrary, others may be cautious in their links to action. It is therefore necessary for those involved in restoration to think differently about the science-management relationship, which in the field of water-related issues has long been dominated by an engineering logic based precisely on a logic of solution. Work in the humanities and social sciences often carries with it a tradition of the question rather than the answer. This is also related to the spatial and temporal scales on which such work is conducted, which sometimes differ from the scales of river management. For example, the work of Lave et al. (2010) on the relationship between science and management in the United States does not have an immediate application in the framework of projects, but serves to accommodate the thinking of restoration stakeholders in the scientific and technical models on which their actions are based.

6. A book to share a diversity of societal approaches in the field of river restoration

6.1. What will you find in this edited book?

This book is the result of a long collaborative process. It stems from the observation that many researchers have worked for many years on the societal issues of river restoration. However, these scientific commitments remain relatively short-term and are most often carried out within the framework of interdisciplinary projects led primarily by the natural sciences. Researchers addressing the social, political, or economic issues raised by restoration are relatively isolated when it comes to their ability to consider common reflexive approaches and share their work with the broader community working in river restoration. For example, there are few major dedicated events where they can come together to exchange and discuss the approaches, scientific results, and operational perspectives opened up by their research. This book was conceived to open up a space for sharing such perspectives, and to highlight the rich and dynamic interdisciplinary community.

This book forms a compendium of the diversity of scientific work carried out over the last ten years on societal challenges to river restoration. It proposes 14 contributions by researchers from different research fields such as environmental economics, critical physical geography, human or social geography, hydromorphology, ecology and biology, sustainable management studies, philosophy and ethics, political ecology, political science, architecture and urban studies, and anthropology. Each of these disciplines enriches the book with concepts and methods from different epistemological traditions. Some contributions propose syntheses of already published works, whereas others present original studies. Most of them base their analysis on case studies and empirical data. To account for the diversity of the environmental, socio-political, and cultural contexts in which river restoration takes place, the contributions of this book are international. They come from research teams in Austria, France, the Netherlands, New Zealand, Spain Switzerland, the United Kingdom, and the United States of America. Collecting these contributions together makes it possible to emphasize their complementarity nature. This compendium is intended to be a showcase of research achievements: questions, methods, and scientific results. It provides stimulating perspectives for understanding restoration in its social, economic, and political dimensions.

6.2. Who is this book aimed at?

This book is intended for scientists working on the theme of river restoration, and for those working on broader environmental issues. It is, of course, intended for researchers in the humanities and social sciences who wish to learn about the latest work carried out in this field by their peers. It is also, and more generally, addressed to the interdisciplinary scientific

community working in the field of river research and restoration, which has strong expectations regarding societal approaches.

It is also intended for students in environmental sciences who intend to go into research or river management professions. This book will help them to understand the social, political, and economic dimensions of river restoration, and their linkages with ecological issues; it will therefore help to forge an interdisciplinary culture to better respond to the issues raised by river restoration and environmental management in general.

Finally, this book is aimed at operational players in river restoration, whether they be project leaders, technical partners, or financiers. It will be of interest to public bodies such as governmental, regional, and local agencies with expertise in the field of river restoration. It will also be of interest to NGOs, whether they are specialized in the field of river restoration or more broadly interested in river management. The book may also be of interest to design offices that advise such parties. These various professionals in the midst of the action are often the first to be confronted with the social, economic, and political stakes of restoration. This book will provide them with keys to better understand the mechanisms in action and to better integrate them into the implementation or support of river restoration policies and projects.

References

Åberg, E.U. and Tapsell, S. (2013). Revisiting the River Skerne: The long-term social benefits of river rehabilitation. *Landscape and Urban Planning* 113: 94–103.

Acuña, V., Díez, J.R., Flores, L., et al. (2013). Does it make economic sense to restore rivers for their ecosystem services? *Journal of Applied Ecology*, 50 (4): 988–997.

Adamowicz, W., Louviere, J., and Williams, M. (1994). Combining revealed and stated preference methods for valuing environmental amenities. *Journal of environmental economics and management*, 26 (3): 271–292.

Akron, A., Ghermandi, A., Dayan, T., et al. (2017). Interbasin water transfer for the rehabilitation of a transboundary Mediterranean stream: An economic analysis. *Journal of Environmental Management*, 202: 276–286.

- Alam, K. (2011). Public attitudes toward restoration of impaired river ecosystems: Does residents' attachment to place matter? *Urban Ecosystems*, 14 (4): 635–653.
- Alam, K. (2008). Cost-benefit analysis of restoring Buriganga River, Bangladesh. *International journal of water resources development*, 24 (4): 593–607.
- An, D.W. and Lee, J.Y. (2019). Influence and Sustainability of the Concept of Landscape Seen in Cheonggye Stream and Suseongdong Valley Restoration Projects. *Sustainability*, 11 (4): 1126.
- Aronson, J., Andre F. Clewell, A.F., Blignaut, J.N., et al. (2006). Ecological restoration: A new frontier for nature conservation and economics. *Journal for Nature Conservation*, 14: 135–139
- Axelrad, G., and Feinerman, E. (2009). Regional planning of wastewater reuse for irrigation and river rehabilitation. *Journal of Agricultural Economics*, 60 (1): 105–131.
- Bae, H. (2011). Urban stream restoration in Korea: Design considerations and residents' willingness to pay. *Urban Forestry & Urban Greening*, 10(2): 119–126.
- Baker, S. and Eckerberg, K. (2013). A policy analysis perspective on ecological restoration. *Ecology and Society*, 18(2).
- Baker, S., Eckerberg, K., and Zachrisson, A. (2014). Political science and ecological restoration. *Environmental Politics*, 23(3): 509–524.
- Barendregt, A., Stam, S.M.E., and Wassen, M.J. (1992). Restoration of fen ecosystems in the Vecht River plain: cost-benefit analysis of hydrological alternatives. *Hydrobiologia*, 233 (1-3): 247–259.
- Bark, R.H., Robinson, C.J., and Flessa, K.W. (2016). Tracking cultural ecosystem services: water chasing the Colorado River restoration pulse flow. *Ecological Economics*, 127: 165–172.
- Barthélémy, C. and Armani, G. (2015). A comparison of social processes at three sites of the French Rhône River subjected to ecological restoration. *Freshwater Biology*, 60 (6): 1208–1220.
- Bash, J.S. and Ryan, C.M. (2002). Stream restoration and enhancement projects: is anyone monitoring? *Environmental management*, 29 (6): 877-885.

Becker, N., Helgeson, J., and Katz, D. (2014). Once there was a river: a benefit–cost analysis of rehabilitation of the Jordan River. *Regional Environmental Change*, 14 (4): 1303–1314.

Becker, N., and Friedler, E. (2013). Integrated hydro-economic assessment of restoration of the Alexander-Zeimar River (Israel-Palestinian Authority). *Regional Environmental Change*, 13 (1): 103–114.

Becker, N., Greenfeld, A. and Zemah Shamir, S. (2019). Cost-benefit analysis of full and partial river restoration: the Kishon River in Israel. *International Journal of Water Resources Development*, 35 (5): 871–890.

Benjaminsen, T. A., & Svarstad, H. (2019). Political ecology. In: *Encyclopedia of ecology* (ed. B.D. Fath), 391-396, Amsterdam: Elsevier.

Bennett, S. J., Simon, A., Castro, J.M., et al. (2011), The evolving science of stream restoration. In: *Stream Restoration in Dynamic Fluvial Systems: Scientific Approaches, Analyses, and Tools* (ed. A. Simon, S.J. Bennett and J.M. Castro), 1–8, Washington D.C.: American Geophysical Union.

Berelson, B. (1952). *Content Analysis in Communication Research*. New York : Free Press.

Bergstrom, J.C. and Loomis, J.B. (2017). Economic valuation of river restoration: An analysis of the valuation literature and its uses in decision-making. *Water Resources and Economics*, 17: 9–19.

Bernhardt, E.S., and Palmer, M.A. (2007). Restoring streams in an urbanizing world. *Freshwater Biology*, 52 (4): 738–751.

Bernhardt, E.S., Palmer, M.A., Allan, J.D., et al. (2005). Synthesizing U.S. river restoration efforts. *Science*, 308: 636–637.

Bernhardt, E.S., Sudduth, E.B., Palmer, M.A., et al. (2007). Restoring rivers one reach at a time: results from a survey of US river restoration practitioners. *Restoration Ecology*, 15 (3): 482–493.

Bickman, L. and Rog, D.J. ed. (2009). *The SAGE Handbook of Applied Social Research Methods*. Thousand Oaks, CA: SAGE Publications, Inc.

Blanc, G., Demeulenaere, E., & Feuerhahn, W. (2017). *Humanités environnementales. Enquêtes et contre-enquêtes*, Paris: Éditions de la Sorbonne.

- Bliem, M., Getzner, M., and Rodiga-Laßnig, P. (2012). Temporal stability of individual preferences for river restoration in Austria using a choice experiment. *Journal of environmental management*, 103: 65–73.
- Boon, P.J., Calow, P. and Petts, G.E. ed. (1992).: *River conservation and management*. Chichester, UK: John Wiley & Sons Ltd,.
- Boxall, P.C., Adamowicz, W.L., Swait, J., et al. (1996). A comparison of stated preference methods for environmental valuation. *Ecological economics*, 18 (3): 243–253.
- Bradshaw, A.D. (2002). Introduction and philosophy. In: *Handbook of ecological restoration. Principles of restoration*. (ed. M.R. Perrow, A.J. Davy), 3-9, Cambridge, UK: Cambridge University Press.
- Brooks, S.S., and Lake, P.S. (2007). River restoration in Victoria, Australia: change is in the wind, and none too soon. *Restoration Ecology*, 15 (3): 584–591.
- Brouwer, R., Bliem, M., Getzner, M., et al. (2016). Valuation and transferability of the non-market benefits of river restoration in the Danube river basin using a choice experiment. *Ecological Engineering*, 87: 20–29.
- Brouwer, R. and Sheremet, O. (2017). The economic value of river restoration. *Water Resources and Economics*, 17: 1–8. <https://doi.org/10.1016/j.wre.2017.02.005>
- Buijs, A.E. (2009). Public support for river restoration. A mixed-method study into local residents' support for and framing of river management and ecological restoration in the Dutch floodplains. *Journal of Environmental management*, 90 (8): 2680–2689.
- Cairns Jr, J. (1995). Ecosocietal Restoration Reestablishing Humanity's Relationship with Natural Systems. *Environment: Science and Policy for Sustainable Development*, 37 (5): 4–33
- Carah, J.K., Blencowe, C.C., Wright, D.W., et al. (2014). Low-cost restoration techniques for rapidly increasing wood cover in coastal coho salmon streams. *North American Journal of Fisheries Management*, 34 (5): 1003–1013.
- Cardinale, B.J., Duffy, J.E., Gonzalez, A., et al. (2012). Biodiversity loss and its impact on humanity. *Nature*, 486: 59–67
- Castree, N., Demeritt, D., Liverman, D., et al. ed. (2016). A companion to environmental geography. Chichester, UK: John Wiley & Sons, Ltd.

- Che, Y., Yang, K., Chen, T., et al. (2012). Assessing a riverfront rehabilitation project using the comprehensive index of public accessibility. *Ecological Engineering*, 40: 80–87.
- Chen, W.Y. (2017). Environmental externalities of urban river pollution and restoration: A hedonic analysis in Guangzhou (China). *Landscape and Urban Planning*, 157: 170–179.
- Chen, W.Y. and Cho, F.H.T. (2019). Environmental information disclosure and societal preferences for urban river restoration: Latent class modelling of a discrete-choice experiment. *Journal of cleaner production*, 231: 1294–1306.
- Chen, W.Y., Liekens, I., and Broekx, S. (2017). Identifying societal preferences for river restoration in a densely populated urban environment: evidence from a discrete choice experiment in central Brussels. *Environmental Management*, 60 (2): 263–279.
- Chen, X., Wang, D., Tian, F., et al. (2016). From channelization to restoration: Sociohydrologic modeling with changing community preferences in the Kissimmee River Basin, Florida. *Water Resources Research*, 52 (2): 1227–1244.
- Cheng, B., Li, H., Yue, S., et al. (2019). Compensation for Agricultural Economic Losses Caused by Restoration of Healthy Eco-Hydrological Sequences of Rivers. *Water*, 11 (6), 1155.
- Chin, A., Daniels, M. D., Urban, M. A., et al. (2008). Perceptions of wood in rivers and challenges for stream restoration in the United States. *Environmental Management*, 41 (6): 893–903.
- Choi, Y.D. (2007). Restoration Ecology to the Future: A Call for New Paradigm., 15 (2): 351–353.
- Chou, R.J. (2016). Achieving successful river restoration in dense urban areas: Lessons from Taiwan. *Sustainability*, 8 (11), 1159.
- Clewell, A.F. and Aronson, J. (2013). *Ecological restoration: principles, values, and structure of an emerging profession*. Washington, DC: Island Press.
- Clewell, A.F. and Aronson, J. (2006). Motivations for the restoration of ecosystems. *Conservation Biology*, 20 (2): 420–428.
- Connelly, N.A., Knuth, B.A. and Kay, D.L. (2002). Public support for ecosystem restoration in the Hudson River Valley, USA. *Environmental Management*, 29 (4): 467–476.

- Costanza, R., d'Arge, R., De Groot, R., et al. (1997). The value of the world's ecosystem services and natural capital. *Nature*, 387 (6630): 253–260.
- Crutzen P.J. and Stoermer E.F. (2000). The “Anthropocene”. *IGPB Newsletter*, 41: 17–18
- Daily, G. C. (1997). *Nature's services (Volume 3)*. Washington, DC: Island Press.
- Davenport, M.A., Bridges, C.A., Mangun, J.C., et al. (2010). Building local community commitment to wetlands restoration: A case study of the Cache River wetlands in southern Illinois, USA. *Environmental management*, 45 (4): 711–722.
- Davis, M.A. and Slobodkin, L.B. (2004). The science and values of restoration ecology. *Restoration Ecology*, 12 (1): 1–3.
- Deffner, J., and Haase, P. (2018). The societal relevance of river restoration. *Ecology and Society*, 23(4).
- Depraz, S. (2005). Le concept d'«Akzeptanz» et son utilité en géographie sociale. *L'Espace géographique*, 34 (1): 1–16.
- Downs, P.W. and Kondolf, G.M. (2002). Post-project appraisals in adaptive management of river channel restoration. *Environmental Management*, 29 (4), 477–496.
- Downs, P.W. and Thorne, C.R. (2000). Rehabilitation of a lowland river: reconciling flood defence with habitat diversity and geomorphological sustainability. *Journal of Environmental Management*, 58 (4): 249–268.
- Doyle, M.W., Singh, J., Lave, R., et al. (2015). The morphology of streams restored for market and nonmarket purposes: Insights from a mixed natural- social science approach. *Water Resources Research*, 51 (7): 5603–5622.
- Drouineau, H., Carter, C., Rambonilaza, M., et al. (2018). River Continuity Restoration and diadromous fishes: much more than an ecological issue. *Environmental management*, 61 (4): 671–686.
- Druschke, C.G., Lundberg, E., Drapier, L., et al. (2017). Centring fish agency in coastal dam removal and river restoration. *Water Alternatives*, 10 (3): 724–743
- Dudgeon, D., Arthington, A.H., Gessner, M.O., et al. (2005). Freshwater biodiversity: importance, threats, status and conservation challenges. *Biol. Rev.*, 81: 163–182.

- Dufour, S., and Piégay, H. (2009). From the myth of a lost paradise to targeted river restoration: forget natural references and focus on human benefits. *River research and applications*, 25 (5), 568–581.
- Dunlap, R.E., Buttel, F.H., Dickens, P., et al. ed. (2002). *Sociological Theory and the Environment: Classical Foundations, Contemporary Insights*. Oxford, UK: Rowman & Littlefield.
- Eden, S. and Tunstall, S. (2006). Ecological versus social restoration? How urban river restoration challenges but also fails to challenge the science–policy nexus in the United Kingdom. *Environment and Planning C: Government and Policy*, 24 (5): 661–680.
- Eden, S., Tunstall, S. and Tapsell, S. (2000). Translating nature: river restoration as nature-culture. *Environment and Planning D: Society and Space*, 18: 257– 273.
- Edwards, P.M., Shaloum, G. and Bedell, D. (2018). A unique role for citizen science in ecological restoration: a case study in streams. *Restoration Ecology*, 26 (1): 29–35.
- Elliot, R. (1982): Faking nature. *Inquiry: An Interdisciplinary Journal of Philosophy*, 25(1): 81–93
- Emmett, R.S., and Nye, D.E. (2017). *The environmental humanities: A critical introduction*. Cambridge: MIT Press.
- Feng, Q., Miao, Z., Li, Z., et al. (2015). Public perception of an ecological rehabilitation project in inland river basins in northern China: Success or failure. *Environmental Research*, 139: 20–30.
- Fox, C.A., Reo, N.J., Turner, D.A., et al. (2017). “The river is us; the river is in our veins”: re-defining river restoration in three Indigenous communities. *Sustainability Science*, 12 (4): 521–533.
- Fox, C.A., Magilligan, F.J., and Sneddon, C.S. (2016). “You kill the dam, you are killing a part of me”: Dam removal and the environmental politics of river restoration. *Geoforum*, 70: 93–104.
- Francis, R.A. (2014). Urban rivers: novel ecosystems, new challenges. *Wiley Interdisciplinary Reviews: Water*, 1 (1): 19–29.
- Gallie, W.B. (1956). Essentially Contested Concepts. *Proceedings of the Aristotelian Society, New Series*, 56: 167–198

Garcia, X., Corominas, L., Pargament, D., et al. (2016). Is river rehabilitation economically viable in water-scarce basins? *Environmental Science & Policy*, 61: 154–164.

Gerlak, A.K., Eden, S., Megdal, S., et al. (2009). Restoration and river management in the arid Southwestern USA: exploring project design trends and features. *Water policy*, 11 (4): 461–480.

Gerner, N.V., Nafo, I., Winking, C., et al. (2018). Large-scale river restoration pays off: A case study of ecosystem service valuation for the Emscher restoration generation project. *Ecosystem Services*, 30: 327–338.

Gideon, L. (2012). *Handbook of Survey Methodology for the Social Sciences*. New York: Springer.

Gifford, R. and Sussman, R. (2012). Environmental attitudes. In: *The Oxford handbook of environmental and conservation psychology* (ed. S.D. Clayton). Oxford, UK: Oxford University Press.

Gobster, P.H., and Hull, R.B. ed. (2000). *Restoring nature. Perspectives from the Social Sciences and Humanities*. Washington DC: Island Press.

Gobster, P.H., Nassauer, J.I., Daniel, T.C., et al. (2007). The shared landscape: what does aesthetics have to do with ecology? *Landscape ecology*, 22 (7): 959-972.

Golet, G.H., Roberts, M.D., Larsen, E.W., et al. (2006). Assessing societal impacts when planning restoration of large alluvial rivers: A case study of the Sacramento River project, California. *Environmental management*, 37 (6): 862–879.

Gómez, C.M., Pérez-Blanco, C.D., and Batalla, R.J. (2014). Tradeoffs in river restoration: Flushing flows vs. hydropower generation in the Lower Ebro River, Spain. *Journal of Hydrology*, 518: 130–139.

Gore, J.A. (1985). *Restoration of rivers and streams*. Oxford, UK: Butterworth-Heinemann Ltd.

Grabowski, Z.J., Denton, A., Rozance, M.A., et al. (2017). Removing dams, constructing science: Coproduction of undammed riverscapes by politics, finance, environment, society and technology. *Water Alternatives*, 3 (3): 769–795

Grizzetti, B., Pistocchi, A., Liqueste, C., et al. (2017). Human pressures and ecological status of European rivers. *Scientific reports*, 7: 205. <https://doi.org/10.1038/s41598-017-00324-3>

- Grossmann, M. (2012). Economic value of the nutrient retention function of restored floodplain wetlands in the Elbe River basin. *Ecological Economics*, 83: 108–117.
- Guerrin, J. (2015). A floodplain restoration project on the River Rhône (France): analyzing challenges to its implementation. *Regional Environmental Change*, 15 (3): 559–568.
- Haines-Young, R. and Potschin, M. (2010). The links between biodiversity, ecosystem services and human well-being. *Ecosystem Ecology: a new synthesis*, 1: 110–139.
- Hannigan, J. (2006). *Environmental Sociology*. New York: Routledge, Taylor & Francis.
- Haque, A.K.E., Faisal, I. and Bayes, A. (1997) Welfare costs of environmental pollution from the tanning industry in Dhaka: an EIA study. Mid-term review workshop, Yogyakarta, Indonesia.
- Hausman, D.M. (2011). *Preference, value, choice, and welfare*. Cambridge, UK: Cambridge University Press.
- Heise, U.K., Christensen, J. and Niemann, M. ed. (2017). *The Routledge companion to the environmental humanities*. New York: Routledge, Taylor & Francis.
- Heldt, S., Budryte, P., Ingensiep, H. W., et al. (2016). Social pitfalls for river restoration: How public participation uncovers problems with public acceptance. *Environmental Earth Sciences*, 75 (13): 1053. <https://doi.org/10.1007/s12665-016-5787-y>
- Hidalgo, M.C., and Hernandez, B. (2001). Place attachment: Conceptual and empirical questions. *Journal of environmental psychology*, 21(3): 273–281.
- Hill, M.R., McMaster, D.G., Harrison, T., et al. (2011). A reverse auction for wetland restoration in the Assiniboine River Watershed, Saskatchewan. *Canadian Journal of Agricultural Economics*, 59 (2): 245–258.
- Holmes, N.T. and Nielsen, M.B. (1998). Restoration of the rivers Brede, Cole and Skerne: a joint Danish and British EU- LIFE demonstration project, I—Setting up and delivery of the project. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 8 (1): 185–196.
- Honey-Rosés, J., Acuña, V., Bardina, M., et al. (2013). Examining the demand for ecosystem services: The value of stream restoration for drinking water treatment managers in the Llobregat River, Spain. *Ecological Economics*, 90: 196–205.

Hong, C., and Chun, H. (2018). Barriers, challenges, conflicts, and facilitators in environmental decision-making: A case of An'Yang Stream restoration. *River Research and Applications*, 34 (5): 472–480.

Hong, C.Y., Chang, H. and Chung, E.S. (2019). Comparing the functional recognition of aesthetics, hydrology, and quality in urban stream restoration through the framework of environmental perception. *River Research and Applications*, 35 (6): 543–552.

Hull, R.B. and Robertson, D.P. (2000). Which Nature? In: *Restoring nature. Perspectives from the Social Sciences and Humanities* (e.d. P.H. Gobster, R.B. Hull), 299–307.

Washington DC: Island Press.

IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) (2020). Ecosystem services. Glossary. <https://ipbes.net/glossary/ecosystem-services> (accessed 08 December 2020)

Jähnig, S.C., Lorenz, A.W., Hering, D., et al. (2011). River restoration success: a question of perception. *Ecological Applications*, 21 (6): 2007–2015.

Januchowski-Hartley, S.R., Moon, K., Stoeckl, N., et al. (2012). Social factors and private benefits influence landholders' riverine restoration priorities in tropical Australia. *Journal of environmental management*, 110: 20–26.

Jia, H., Dong, N. and Ma, H. (2010). Evaluation of aquatic rehabilitation technologies for polluted urban rivers and the case study of the Foshan Channel. *Frontiers of Environmental Science & Engineering in China*, 4 (2): 213–220.

Jordan III, W.R. (2000). Restoration, community, and wilderness. In: *Restoring nature. Perspectives from the Social Sciences and Humanities* (e.d. P.H. Gobster, R.B. Hull), 23–36.

Washington DC: Island Press.

Junker, B. and Buchecker, M. (2008). Aesthetic preferences versus ecological objectives in river restorations. *Landscape and urban planning*, 85 (3-4): 141–154.

Junker, B., Buchecker, M. and Müller- Böker, U. (2007). Objectives of public participation: which actors should be involved in the decision making for river restorations? *Water Resources Research*, 43 (10).

- Kail, J., Hering, D., Muhar, S., et al. (2007). The use of large wood in stream restoration: experiences from 50 projects in Germany and Austria. *Journal of Applied Ecology*, 44 (6): 1145–1155.
- Kaiser, F.G., Wölfing, S. and Fuhrer, U. (1999). Environmental attitude and ecological behaviour. *Journal of environmental psychology*, 19 (1): 1–19.
- Kaplan, S. (1987). Aesthetics, affect, and cognition: Environmental preference from an evolutionary perspective. *Environment and behavior*, 19 (1): 3–32.
- Kendy, E., Aylward, B., Ziemer, L.S., et al. (2018). Water transactions for streamflow restoration, water supply reliability, and rural economic vitality in the western United States. *Journal of the American Water Resources Association*, 54 (2): 487–504.
- Kenney, M.A., Wilcock, P.R., Hobbs, B.F., et al. (2012). Is Urban Stream Restoration Worth It? *Journal of the American Water Resources Association*, 48 (3): 603–615.
- Kern K. (1992). Rehabilitation of streams in south-west Germany. In: *River conservation and management* (ed. P.J. Boon, P. Calow P., G.E. Petts), 321–335. Chichester, UK: John Wiley & Sons Ltd.
- Kim, J.H., Kim, H.J. and Yoo, S.H. (2018). A cost- benefit analysis of restoring the ecological integrity of Jeonju stream, Korea. *Water and Environment Journal*, 32 (3): 476–480.
- Kim, M., Gim, T.H.T. and Sung, J.S. (2017). Applying the Concept of Perceived Restoration to the Case of Cheonggyecheon Stream Park in Seoul, Korea. *Sustainability*, 9(8): 1368.
- Kondolf, G.M. (2000). Process vs form in restoration of rivers and streams. *Annual meeting proceedings of the American Society of Landscape Architects*. Washington, D.C.: American Society of Landscape Architects.
- Kristensen, E.A., Baattrup-Pedersen, A., Jensen, P.N., et al. (2012). Selection, implementation and cost of restorations in lowland streams: A basis for identifying restoration priorities. *Environmental Science & Policy*, 23: 1–11.
- Lamouroux, N., Gore, J.A., Lepori, F., et al. (2015). The ecological restoration of large rivers needs science- based, predictive tools meeting public expectations: an overview of the Rhône project. *Freshwater Biology*, 60 (6): 1069–1084.

- Langhans, S.D., Hermoso, V., Linke, S., et al. (2014). Cost-effective river rehabilitation planning: Optimizing for morphological benefits at large spatial scales. *Journal of environmental management*, 132: 296–303.
- Larned, S.T., Suren, A.M., Flanagan, M., et al. (2006). Macrophytes in urban stream rehabilitation: establishment, ecological effects, and public perception. *Restoration Ecology*, 14 (3): 429–440.
- Lave, R. (2016). Stream restoration and the surprisingly social dynamics of science. *Wiley Interdisciplinary Reviews: Water*, 3 (1): 75–81.
- Lave, R., Doyle, M. and Robertson, M. (2010). Privatizing stream restoration in the US. *Social studies of science*, 40 (5): 677–703.
- Lave, R., Wilson, M.W., Barron, E., et al. (2014) Critical physical geography. *The Canadian Geographer*, 58 (1): 1–10.
- Lebart, L., Salem, A. and Berry, L. (1998). *Exploring Textual Data*. Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Lee, S. and Choi, G.W. (2012). Governance in a river restoration project in South Korea: The case of Incheon. *Water resources management*, 26 (5): 1165–1182.
- Lee, M., and Jung, I. (2016). Assessment of an urban stream restoration project by cost-benefit analysis: The case of Cheonggyecheon stream in Seoul, South Korea. *KSCCE Journal of Civil Engineering*, 20 (1): 152–162.
- Lee, J.S. (2012). Measuring the economic benefits of the Youngsan River Restoration Project in Kwangju, Korea, using contingent valuation. *Water international*, 37 (7): 859–870.
- Le Floch, É. and Aronson, J. (1995). Ecologie de la restauration. Définition de quelques concepts de base. *Natures Sciences Sociétés*, 3: 29–35.
- Lester, J.P. ed. (1995). *Environmental politics and policy. Theories and evidence*. Durham, USA: Duke University Press.
- Lewicka, M. (2011). Place attachment: How far have we come in the last 40 years? *Journal of environmental psychology*, 31 (3): 207–230.
- Lewis, L.Y. and Landry, C.E. (2017). River restoration and hedonic property value analyses: Guidance for effective benefit transfer. *Water resources and economics*, 17: 20–31.

- Light, A. and Higgs, E.S. (1996). The politics of ecological restoration. *Environmental Ethics*, 18 (3): 227–247.
- Logar, I., Brouwer, R. and Paillex, A. (2019). Do the societal benefits of river restoration outweigh their costs? A cost-benefit analysis. *Journal of environmental management*, 232: 1075–1085.
- Loomis, J. (1996). Measuring the economic benefits of removing dams and restoring the Elwha River: results of a contingent valuation survey. *Water Resources Research*, 32 (2): 441–447.
- Loomis, J., Kent, P., Strange, L., et al. (2000). Measuring the total economic value of restoring ecosystem services in an impaired river basin: results from a contingent valuation survey. *Ecological economics*, 33 (1): 103–117.
- Loomis, J. (2002). Quantifying recreation use values from removing dams and restoring free-flowing rivers: A contingent behavior travel cost demand model for the Lower Snake River. *Water Resources Research*, 38 (6).
- Mansourian, S. (2017). Governance and restoration. In: *Routledge Handbook of Ecological and Environmental Restoration* (ed. S. Allison, S. Murphy), 401–413. New York: Routledge, Taylor & Francis.
- Martin, D.M. (2017). Ecological restoration should be redefined for the twenty- first century. *Restoration Ecology*, 25 (5): 668–673.
- McCormick, A., Fisher, K. and Brierley, G. (2015). Quantitative assessment of the relationships among ecological, morphological and aesthetic values in a river rehabilitation initiative. *Journal of Environmental Management*, 153: 60–67.
- McIver, J. and Starr, L. (2001). Restoration of degraded lands in the interior Columbia River basin: passive vs. active approaches. *Forest Ecology and Management*, 153 (1-3): 15-28.
- MEA (Millennium Ecosystem Assessment) (2005). *Ecosystems and Human Well-being: Synthesis*. Washington DC: Island Press.
- Mingers, J., and Leydesdorff, L. (2015). A review of theory and practice in scientometrics. *European Journal of Operational Research*, 246 (1): 1–19.
- Mitsch, W.J. (2012). What is ecological engineering? *Ecological Engineering*, 45: 5–12.

- Morandi, B., Kail, J., Toedter, A., et al. (2017). Diverse Approaches to Implement and Monitor River Restoration: A Comparative Perspective in France and Germany. *Environmental Management*, 60 (5) : 931–946
- Moscovici, S. (2001). *Social representations: Essays in social psychology*. NYU Press.
- Nakamura K., Tockner, K. and Amano, K. (2006). River and wetland restoration: Lessons from Japan. *Bioscience*, 56 (5): 419–429
- Nassauer, J.I. (1992). The appearance of ecological systems as a matter of policy. *Landscape Ecology*, 6 (4): 239–250.
- Netusil, N.R., Jarrad, M. and Moeltner, K. (2019). Research note: The effect of stream restoration project attributes on property sale prices. *Landscape and Urban Planning*, 185: 158–162.
- Normile, D. (2010). Restoration or devastation? *Science*, 327–5973: 1568–1570.
- NRC (National Research Council) (1992). *Restoration of aquatic ecosystems: science, technology, and public policy*. Washington DC: National Academies Press.
- OECD (Organisation for Economic Co-operation and Development) (2015). *Frascati Manual : Guidelines for Collecting and Reporting Data on Research and Experimental Development. The Measurement of Scientific, Technological and Innovation Activities*. Paris: OECD Publishing. <http://dx.doi.org/10.1787/9789264239012-en>
- Oxford English Dictionary (OED). <https://www.oed.com/> (accessed 08 December 2020)
- Ormerod, S.J. (2004). A golden age of river restoration science? *Aquatic Conservation: Marine and Freshwater Ecosystems*, 14 (6): 543–549.
- Pahl-Wostl, C. (2006). The importance of social learning in restoring the multifunctionality of rivers and floodplains. *Ecology and society*, 11(1).
- Palmer, C., McShane, K. and Sandler, R. (2014b). Environmental ethics. *Annual Review of Environment and Resources*, 39: 419–442.
- Palmer, M.A. and Allan, J.D. (2006). Restoring rivers. *Issues in Science and Technology*, 22 (2): 40–48.
- Palmer, M.A. and Bernhardt, E.S. (2006), Hydroecology and river restoration: Ripe for research and synthesis. *Water Resources Research*, 42 (3). <https://doi.org/10.1029/2005WR004354>

- Palmer, M.A., Hondula, K.L. and Koch, B.J. (2014a). Ecological restoration of streams and rivers: shifting strategies and shifting goals. *Annual Review of Ecology, Evolution, and Systematics*, 45: 247–269.
- Palmer, M.A., Menninger, H.L. and Bernhardt, E.S. (2010). River restoration, habitat heterogeneity and biodiversity: a failure of theory or practice? *Freshwater biology*, 55: 205–222.
- Palmer, M.A., Bernhardt, E.S., Allan, J.D., et al. (2005). Standards for ecologically successful river restoration. *Journal of Applied Ecology*, 42: 208–217
- Palmer, M.A., Bernhardt, E.S., Chornesky, E., et al. (2004). Ecology for a Crowded Planet. *Science* 304: 1251–1252
- Perni, Á., Martínez- Paz, J. and Martínez- Carrasco, F. (2012). Social preferences and economic valuation for water quality and river restoration: the Segura River, Spain. *Water and Environment Journal*, 26 (2): 274–284.
- Piégay, H., Gregory, K.J., Bondarev, V., et al. (2005). Public perception as a barrier to introducing wood in rivers for restoration purposes. *Environmental Management*, 36 (5), 665–674.
- Polizzi, C., Simonetto, M., Barausse, A., et al. (2015). Is ecosystem restoration worth the effort? The rehabilitation of a Finnish river affects recreational ecosystem services. *Ecosystem services*, 14: 158–169.
- Purcell, A.H., Friedrich, C. and Resh, V.H. (2002). An assessment of a small urban stream restoration project in northern California. *Restoration Ecology*, 10 (4): 685–694.
- Randall, A. (1987). Total economic value as a basis for policy. *Transactions of the American Fisheries Society*, 116 (3): 325–335.
- Redman, C.L., Grove, J.M. and Kuby, L.H. (2004). Integrating social science into the long-term ecological research (LTER) network: Social dimensions of ecological change and ecological dimensions of social change. *Ecosystems*, 7 (2): 161–171.
<https://doi.org/10.1007/s10021-003-0215-z>
- Roni, P., and Beechie, T. (2013). Introduction to restoration: key steps for designing effective programs and projects. In: *Stream and watershed restoration, a guide to restoring riverine*

processes and habitats (ed. P. Roni, T. Beechie), 1–11. Chichester, UK: John Wiley & Sons Ltd.

Saarinen, T.F. and Sell, J.L. (1980). Environmental perception. *Progress in human geography*, 4 (4): 525–548.

Schläpfer, F. and Witzig, P.J. (2006). Public support for river restoration funding in relation to local river ecomorphology, population density, and mean income. *Water resources research*, 42 (12).

Seidl, R. and Stauffacher, M. (2013). Evaluation of river restoration by local residents. *Water Resources Research*, 49 (10): 7077–7087.

Shields, F.D., Cooper Jr, C.M., Knight, S.S., et al. (2003). Stream corridor restoration research: a long and winding road. *Ecological engineering*, 20 (5): 441–454.

Smith, B., Clifford, N.J. and Mant, J. (2014). The changing nature of river restoration. *Wiley Interdisciplinary Reviews: Water*, 1 (3): 249–261.

Sneddon, C.S., Barraud, R. and Germaine, M.A. (2017). Dam removals and river restoration in international perspective. *Water Alternatives* 10 (3): 648–654

Soto-Montes de Oca, G. and Ramirez-Fuentes, A. (2019). Value of river restoration when living near and far. The Atoyac Basin in Puebla, Mexico. *Tecnología y Ciencias del Agua*, 10 (1).

Stanford, J.A., Ward, J.V., Liss, W.J., et al. (1996). A general protocol for restoration of regulated rivers. *Regulated Rivers: Research & Management*, 12 (4- 5): 391–413.

Steffen, W., Crutzen, P.J. and McNeill, J.R. (2007). The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature? *Ambio*, 36(8): 214–221

Sudding, K.N. (2011). Toward an Era of Restoration in Ecology: Successes, Failures, and Opportunities Ahead. *Annu. Rev. Ecol. Evol. Syst.*, 42: 465–487

Szałkiewicz, E., Jusik, S. and Grygoruk, M. (2018). Status of and perspectives on river restoration in Europe: 310,000 Euros per hectare of restored river. *Sustainability*, 10(1): 129.

Tanaka, A. (2006). Stakeholder analysis of river restoration activity for eight years in a river channel. In: *Human Exploitation and Biodiversity Conservation* (ed. A.T. Bull, D.L. Hawksworth,) 447–471. Dordrecht, The Netherlands: Springer.

- Thorel, M., Piégay, H., Barthelemy, C., et al. (2018). Socio-environmental implications of process-based restoration strategies in large rivers: should we remove novel ecosystems along the Rhône (France)? *Regional Environmental Change*, 18 (7): 2019–2031.
- Tunstall, S.M., Penning- Rowsell, E.C., Tapsell, S.M., et al. (2000). River restoration: public attitudes and expectations. *Water and Environment Journal*, 14 (5): 363–370.
- Tunstall, S.M., Tapsell, S.M. and Eden, S. (1999). How stable are public responses to changing local environments? A 'before' and 'after' case study of river restoration. *Journal of Environmental Planning and Management*, 42 (4): 527–545.
- Turner, R.E. and Boyer, M.E. (1997). Mississippi River diversions, coastal wetland restoration/creation and an economy of scale. *Ecological Engineering*, 8 (2): 117–128.
- Turner, R.K., Pearce, D. and Bateman, I. (1994). *Environmental economics: an elementary introduction*. Hemel Hempstead, UK: Harvester Wheatsheaf.
- Van den Berg, A.E., Koole, S.L. and Van der Wulp, N.Y. (2003). Environmental preference and restoration:(How) are they related? *Journal of environmental psychology*, 23 (2): 135–146.
- Vásquez, W.F. and de Rezende, C.E. (2019). Willingness to pay for the restoration of the Paraíba do Sul River: A contingent valuation study from Brazil. *Ecohydrology & Hydrobiology*, 19 (4): 610–619.
- Vaughan, I.P., Diamond, M., Gurnell, A.M., et al. (2009). Integrating ecology with hydromorphology: a priority for river science and management. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 19 (1): 113–125.
- Verbrugge, L., and van den Born, R. (2018). The role of place attachment in public perceptions of a re-landscaping intervention in the river Waal (The Netherlands). *Landscape and urban planning*, 177: 241–250.
- Vermaat, J.E., Wagtenonk, A.J., Brouwer, R., et al. (2016). Assessing the societal benefits of river restoration using the ecosystem services approach. *Hydrobiologia*, 769 (1): 121–135.
- Vining, J., Tyler, E. and Kweon B.S. (2000). Public Values, Opinions, and Emotions in Restoration Controversies. In: Restoring nature. Perspectives from the Social Sciences and Humanities (e.d. P.H. Gobster, R.B. Hull), 143–162. Washington DC: Island Press.

- Vörösmarty, C.J., McIntyre, P.B., Gessner, M.O., et al. (2010) Global threats to human water security and river biodiversity. *Nature* 467 (7315): 555–561.
- Weber, C., Åberg, U., Buijse, A.D., et al. (2018). Goals and principles for programmatic river restoration monitoring and evaluation: collaborative learning across multiple projects. *Wiley Interdisciplinary Reviews: Water*, 5 (1): 1257.
- Weber, M.A. and Stewart, S. (2009). Public values for river restoration options on the Middle Rio Grande. *Restoration Ecology*, 17 (6): 762–771.
- Wells, H.B.M. and Dougill, A.J. (2019) The importance of long term social ecological - - research for the future of restoration ecology. *Restoration Ecology*, 27 (5): 929–933.
- Westling, E.L., Surridge, B.W., Sharp, L., et al. (2014). Making sense of landscape change: Long-term perceptions among local residents following river restoration. *Journal of hydrology*, 519: 2613–2623.
- Wilson, E.O. (1992). *Diversity of life*. Cambridge, USA: Harvard University Press.
- Woelfle-Erskine, C. (2017). Collaborative approaches to flow restoration in intermittent salmon-bearing streams: Salmon Creek, CA, USA. *Water*, 9 (3): 217.
- Wohl, E., Lane, S.N. and Wilcox, A. C. (2015). The science and practice of river restoration. *Water Resources Research*, 51 (8): 5974–5997.
- Wohl, E., Angermeier, P.L., Bledsoe, B., et al. (2005). River restoration. *Water Resources Research*, 41(10).
- Wortley, L., Hero, J.M. and Howes, M. (2013). Evaluating ecological restoration success: a review of the literature. *Restoration Ecology*, 21 (5): 537–543.
- Yun, S.J. (2014). Experts' Social Responsibility in the process of Large-Scale Nature-Transforming National Projects: Focusing on the case of the Four Major Rivers Restoration Project in Korea. *Development and Society* 43 (1): 109–141
- Zhang, Y., Sheng, L. and Luo, Y. (2019). Evaluation of households' willingness to accept the ecological restoration of rivers flowing in china. *Environmental Progress & Sustainable Energy*, 38 (4): 13094.
- Zhao, J., Liu, Q., Lin, L., et al. (2013). Assessing the comprehensive restoration of an urban river: An integrated application of contingent valuation in Shanghai, China. *Science of the total environment*, 458: 517–526.

Zingraff-Hamed, A., Noack, M., Greulich, S., et al. (2018). Model-based evaluation of urban river restoration: Conflicts between sensitive fish species and recreational users. *Sustainability*, 10 (6), 1747.

Zube, E.H. (1999). Environmental perception. In: Encyclopedia of Earth science (ed. D.E. Alexander, R.W. Fairbridge,) 214–216. Dordrecht, The Netherlands: Springer.
https://doi.org/10.1007/1-4020-4494-1_120

Zube, E.H., Sell, J.L. and Taylor, J.G. (1982). Landscape perception: research, application and theory. *Landscape planning*, 9 (1): 1–33.