www.water-alternatives.org Volume 13 | Issue 3

Linton, J. and Krueger, T. 2020. The ontological fallacy of the Water Framework Directive: Implications and alternatives. Water Alternatives 13(3):

The Ontological Fallacy of the Water Framework Directive: Implications and Alternatives

Jamie Linton

Geolab, Université de Limoges, Limoges, France; james.linton@unilim.fr

Tobias Krueger

Geography Department & IRI THESys, Humboldt-Universität zu Berlin, Berlin, Germany; tobias.krueger@hu-berlin.de

ABSTRACT: This paper argues that in many cases the failure to reach the implementation goals of the Water Framework Directive (WFD) is not due to a lack of political will or to implementation deficits; rather, it is due to a fundamental conceptual problem that we characterise as an ontological fallacy that is built into the directive. This ontological fallacy is founded on a radical conceptual separation of nature from human society, one which Bruno Latour identified over 25 years ago as the "modern Constitution" (Latour, 1993). We draw mainly from research in political ecology to develop this argument; in the process, we discuss some of the main features of what we call the WFD system, especially the concept of 'reference conditions' and the Driver-Pressure-State-Impact-Response (DPSIR) framework. We build on this critical research by analysing controversies in England and France that surround efforts to attain good ecological status for water bodies under the WFD. Our paper is intended to help address what Boeuf and Fritsch (2016) identify as "a conspicuous lack of theory in WFD scholarship". We argue that unless European water policy is placed on a more realistic ontological footing, it risks losing political legitimacy as well as popular and scientific credibility.

KEYWORDS: Water Framework Directive, ontology, nature/society, reference conditions, DPSIR

INTRODUCTION

An 'ontological fallacy'?

We argue that the European Union Water Framework Directive (WFD) is based on an ontological fallacy and that it needs to be rethought for the end of the third planning cycle in 2027. By attributing the failure to achieve WFD implementation goals to an ontological fallacy, we suggest that there is a basic problem in the theoretical underpinnings of the directive. The problem, in effect, is in the conceptual separation of people from nature. The WFD articulates a set of propositions that presume a radical ontological distinction between nature and human beings or human society; humans are placed in a realm separate from nature and then a set of rules is constructed which is based on this separation. As with all constructions that are founded on this ontological distinction, the WFD inevitably manifests certain difficulties.

In describing the conceptual separation of people from nature as an ontological fallacy, we draw from a broad critique emanating from diverse disciplines and approaches that over the past three decades have called attention to the injustices, crises and absurdities produced by cleaving to this dualism (see, for example, Smith, 1984; Haraway, 2004 [1985], 1992; Deleuze and Guattari, 1987; Latour, 1993; Willems-Braun and Castree, 1998; Ingold, 2000; Castree and Braun, 2001; Braun, 2004; Castree, 2005).

This critique was already well advanced when the Water Framework Directive was being developed and adopted into law. Motivated in part by crises erupting in (or producing) problems that were evidently neither purely 'natural' nor entirely 'social', these critiques came from different theoretical and ideological positions; though they highlighted different issues and called for different (political) responses, they can be said to have converged on the same basic ontological problem of nature/society dualism that is characteristic of modern Western thought and practice (Castree, 2005). Reflecting our reading of this broad critique, this paper employs several theoretical approaches and languages in order to make the argument that nature/society dualism operates in various ways within the WFD.

Nature/society dualism has become such an entrenched aspect of modern Western thought that it is sometimes difficult to recognise. One of its better-known critics, philosopher and science studies scholar Bruno Latour, helps clarify this; he defines what he describes as "the modern Constitution", arguing that being modern means, by definition, subscribing to the idea that there is a basic ontological separation between nature and human society (Latour, 1993).[1] According to Latour, "Nature and Society" (which he capitalises in order to emphasise their separation), "must remain absolutely distinct" (ibid: 32). This distinction works in an epistemological sense, allowing for the production of objective 'scientific' knowledge, that is to say knowledge that appears to be free from human values. As this epistemological stance became hegemonic, however, "it eventually turned from a dominant epistemology to a dominant ontology, that is a strong belief that the world was actually ontologically split into things natural and things social" (Swyngedouw, 2004: 14).

This ontological position has provided the basis for much action; it has allowed for uninhibited human involvement in the world because, as per the modern Constitution, messing with a supposedly external Nature could hardly affect us in harmful ways (Latour, 1993). With the appearance of environmental crises, however, we now find ourselves surrounded by proof of the fallacy of this very notion of separation; the proof presents itself in the form of a range of problems (such as climate change and stratospheric ozone depletion) which are neither social nor natural, but are always both. For a time, Latour argues, these products of human hyper-intervention, which he terms socionatural "hybrids", posed little problem "because they did not exist publicly and because their monstrous consequences remained untraceable" (Latour, 1993: 42); however, as with problems such as water pollution, aquifer depletion, eutrophication of surface water bodies, and the hydrological effects of human-induced global warming, their presence can no longer be ignored. The problem is that we tend to revert to the modern ontological stance when attempting to fix these problems, shoring up the purity, integrity and sustainability of Nature, a process Latour describes as "purification" (ibid: 31); we thus drive ourselves ever more deeply into the modern predicament of creating problems whose ontological messiness – or hybridity – makes them impossible to recognise and deal with by the usual methods. The WFD, we argue, amounts to just such an exercise; it 'purifies' water, defining its natural condition as being entirely free of human involvement. Ironically, by so doing, the WFD's effectiveness in terms of reducing/mitigating problems like water pollution, aquifer depletion and eutrophication is greatly limited; this is attested to by the failures noted in the following subsection.

The basic ontological argument that we are making with respect to the WFD has already been pointed out directly or indirectly by researchers, especially in France. In 2007, for example, Bouleau (2007: 86), building on Aspe's (1995) critique of the social construction of environmental norms, argued that the WFD is built on "rendering humans guilty with respect to nature".[2] Steyaert and Ollivier (2007) have

[1] Latour has subsequently developed something of a programme of study-action associated with what he describes as 'nonmodern' or 'amodern' ontologies, most notably with the elaboration of actor–network theory. We do not engage with this larger programme in the paper as we do not find it relevant to the question at hand. We cite Latour as a theoretician who has reflected deeply on the nature–society dichotomy characteristic of modern Western thought and its consequences.

[2] The original phrase is, "une culpabilisation de l'homme vis-à-vis de la Nature" (Bouleau, 2007: 86).

shown that the concept of "good ecological status" – perhaps the key operational concept of the directive – is defined through an approach known as 'compositionalism'; this approach defines the integrity of biotic communities in terms of specific compositions of biota in a way that considers Homo sapiens to be fundamentally separate from nature (see Callicott et al., 1999).[3] Further, as discussed in detail below, numerous researchers have critiqued the "reference conditions" defined by the directive as being built on an idea of nature that explicitly excludes people.

Despite these arguments, and despite the failure of member states to achieve the directive's basic objective of good ecological status for European water bodies, the WFD itself has been subject to relatively little theoretical criticism. Undertaking a meta-analysis of journal articles published in English-language academic journals, Boeuf and Fritsch (2016: 14) found "a conspicuous lack of theory in WFD scholarship. Authors tend to describe implementation patterns and, at times, to apply normative frameworks, but only a minority of studies refer to theory (…)". We note, however, that there is more critical and theoretical analysis of the WFD in the French-language literature and we draw from this in our own analysis.

'Implementation deficit', or fundamental problem?

The WFD resulted from an unprecedented collaborative effort among water-related sectors across EU member states. It represents some major advances in water policy, such as promoting Integrated River Basin Management, focusing on improving ecological quality instead of merely on chemical water quality, and involving non-state actors; a further feature of the WFD is the integration of economic principles with water policy, as reflected in tools such as cost-effectiveness analysis, and the implementation of pricing and cost-recovery mechanisms at various stages of the planning process. The reason that so few researchers have questioned the fundamentals of the WFD – even in the face of such obvious anomalies as the numerous derogations and exemptions accorded right from the beginning (see below) – may be these widely lauded features; the lack of questioning may also be due to the unprecedented investment of scientific work in exercises to harmonise implementation across the various management regimes of the EU and to 'intercalibrate' ecological evaluation across a wide variety of climatic and ecological conditions (Steyaert and Ollivier, 2007: 8). The derogations and exemptions are well known to those familiar with the WFD; they include the designation of water bodies as artificial or modified (thus requiring eased mitigation efforts), the extension of deadlines for achieving good status, the reduced stringency of environmental objectives, and the acceptance of failure to achieve good status on the basis of economic and human development arguments. These exemptions apply to a very large proportion of European water bodies. As reported by Boeuf et al. (2016), by 2012, deadline extensions had been granted for 40% of all surface water bodies and 11% of groundwater bodies; moreover, "less stringent objectives" were authorised by member states for 19% of all surface waters, and "the number of exemptions is likely to be higher in the current planning cycle" (ibid: 2). The latest WFD fitness check, published by the European Commission at the end of 2019, plainly acknowledges that,

> no substantial progress in water bodies' overall status has been made between the first and the second river basin management cycles. The Directive's implementation has been significantly delayed and less than half of the EU's water bodies are in good status, even though the deadline for achieving this was 2015 (European Commission, 2019: i).

[3] Callicott et al. (1999: 22) distinguish between compositionalism and functionalism as bases for normative concepts in environmental protection/conservation:

> The former comprehends nature primarily by means of evolutionary ecology and considers Homo sapiens separate from nature. The latter comprehends nature primarily by means of ecosystem ecology and considers Homo sapiens a part of nature. Biological diversity, biological integrity, and ecological restoration belong primarily in the compositionalist glossary; the rest belong primarily in the functionalist glossary. The former set are more appropriate norms for reserves, the latter for areas that are humanly inhabited and exploited.

As virtually everyone agrees, and to put it conservatively, "[t]here is growing concern that the objective of good status, or higher, in all EU waters by 2027 is a long way from being achieved in many countries" (Carvalho et al., 2019: 1229).

In the face of this failure, the general response from researchers and policy makers has been to call for better, more, and improved implementation (Giakoumis and Voulvoulis, 2018; Carvalho et al., 2019; Poikane et al., 2019). Carvalho et al. (2019: 1235) conclude that, "this is not a policy design problem, but largely an implementation problem". Others put the challenge in terms of "the need to eliminate implementation deficits" (Schröder, 2019: 56). These deficits have been ascribed to a variety of factors including the legacy of historical environmental pressures, the lack of baseline data, the implementation failures of related European directives (Nitrates Directive, Urban Waste Water Treatment Directive), the failure to integrate water objectives into other policy areas such as agriculture and energy, a lack of financial resources, and the difficulty of establishing "a governance framework that takes into account the specific conditions in each Member State" (European Commission, 2019: i-ii). According to Giakoumis and Voulvoulis (2018), the root cause of implementation failure has been political manoeuvring that has led to ambiguity and vagueness in the wording of the WFD and the Common Implementation Strategy (CIS), and inertia of the established regulatory practices in the member states. Voulvoulis et al. (2017: 359) argue that the problem stems from the failure of member states to honour the systems approach that frames the WFD, and thus "practices might not be aligned to the Directive's initial aspirations". As we will argue, the systems approach of the WFD rests on the ontological fallacy of the nature – society separation and thus itself constitutes part of the problem; that is to say, the construction of this system is itself based on a shaky (ontological) foundation that renders it unworkable in the real world.

Signposting the article

In section 2, we describe the system that the WFD comprises; it is centred on the Driver-Pressure-State-Impact-Response (DPSIR) framework and integrates several key concepts, notably that of reference conditions. For this section, we draw mainly from critical research by French researchers working in the political ecology tradition; they have pointed out the centrality of the DPSIR model to the WFD and some of the basic problems involved. The WFD system is meant to resolve contradictions that had become apparent in the previous iteration of (command and control) European water management, especially the perceived conflict between environmental protection and economic growth/human development. The work of these critics points out that the system is not as perfect in practice as it seems to be in theory, and that it only deepens the contradictions that it sets out to transcend.

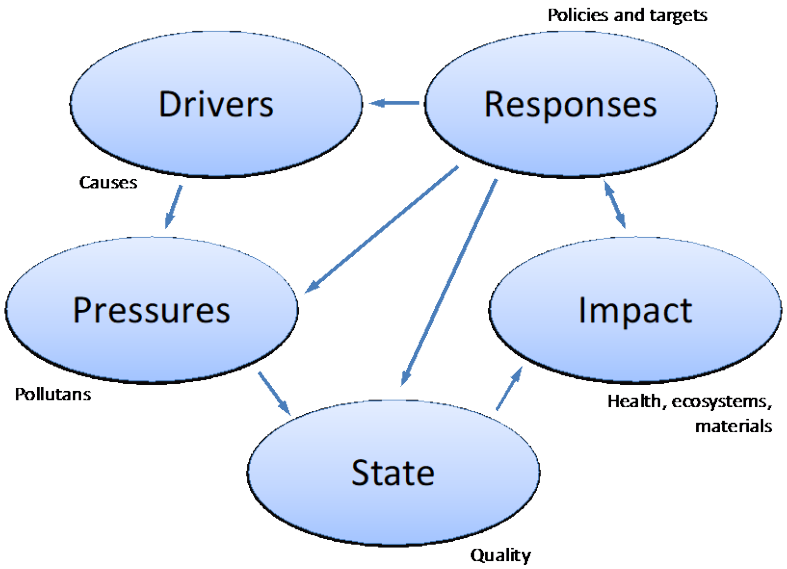
Section 3 focuses on a key component of the WFD, the concept of reference conditions; here we draw on the critical work discussed in the previous section and emphasise the ontological fallacy inherent in the reference conditions concept. Based on the example of the revision of the WFD phosphorus (P) standard for British rivers, we show how – far from being fixed, natural and certain – the actual definition of reference conditions inevitably involves interrelated fluidities, ambiguities and social elements. In section 4, based on the example of the policy of restoring ecological continuity of rivers in France, we examine how the ontological fallacy of the WFD produces specific implementation problems. These two examples (reference conditions and ecological continuity of rivers) represent signature elements of WFD implementation that flow from the naturalised systems frame as described in the second section. We aim to show that the widespread failure of these key policies flows from the ontological logic of the WFD rather than from inadequate efforts at implementation.

Having argued that there is a basic ontological problem with the WFD, we put forward some alternative ideas in the conclusion. Here, we draw partly on other international cases to suggest some ideas for reframing European water policy based on an ontological stance that regards people as inescapably part of nature and thus dependent on the co-construction of sustainable water futures.

A PERFECT SYSTEM?

In this part of the paper we describe the construction of the WFD as a system of components brought into a functional theoretical relationship that is underpinned by the basic idea that human society and nature constitute ontologically separate entities. This ontological separation, we argue, allows for the construction of a system that articulates ecological status and economic efficiency, an articulation that is characteristic of neoliberal environmentalism (Bernstein, 2002). We describe the WFD as a 'system' despite the text of the directive not referring to it as such; nor does the directive make explicit reference to the DPSIR model, despite it being described by some water managers as "the official concept of the WFD" (Loupsans, 2013: 32). DPSIR comes in explicitly only through the post-regulation implementation guidelines, specifically the Common Implementation Strategy Guidance Document No. 3 (WFD CIS, 2003a).[4] It is evident that the DPSIR framework was implicit in the formulation of the WFD text, as shown by researchers who have studied the history of the directive; these researchers argue that the DPSIR model provides the logic by which the WFD's ecological and economic components are brought together and made commensurable. The DPSIR framework can be described in its major components and interactions as: 'driving forces' (or 'drivers'), in the form of social, economic or environmental developments, exerting 'pressure' on the environment; as a consequence, the 'state' of the environment changes; this leads to 'impacts' that may elicit societal 'responses', which in turn feed back to the driving forces, pressures, states, or impacts (Figure 1).

Figure 1. The DPSIR model.



Source: Kristensen (2004).

This model provides a framework for comparing management actions (responses) in order to reduce, mitigate or compensate for human activities (pressures) so as to achieve or maintain a desired state in an economically efficient manner. (Cost effectiveness is a general characteristic of EU environmental directives.) As Fernandez et al. (2014: 18) have shown, the DPSIR framework "has become particularly

[4] This is relevant because the post-legislative rule-making of the CIS has been criticised for its lack of legal legitimacy (Josefsson, 2015).

pervasive throughout the European Union in water resources planning", as it provides a model that allows for comparing various environmental management options in terms of cost effectiveness. To illustrate how its logic pervades the WFD, Bouleau and Pont (2015: 34) have noted the frequent appearance in the English text of the terms 'impact' (67 times), 'pressures' (26), 'status' (242), and 'measures' (126).[5] The ideological implications of this model are discussed below.

What we are calling the WFD system is described by Voulvoulis et al. (2017: 359-360) as,

> aligning human-nature interdependencies with the goal of improving the system as a whole, under an ecological vision that considers human activities as a source of disturbance and water quality degradation (…). The WFD provides the definition of good ecological status as the state of the system in the absence of any anthropogenic pressures, or a slight biological deviation from what would be expected under undisturbed/reference conditions (…).

The ontological basis of this system is already evident in "an ecological vision that considers human activities as a source of disturbance and water quality degradation" (ibid: 359) and in "the definition of good ecological status as the state of the system in the absence of any anthropogenic pressures" (ibid: 360). As discussed below, defining the desired ecological status in these terms creates a problem for two reasons. First, such a condition (the absence of any anthropogenic pressures) is an ideal that does not actually exist in an era of human-induced environmental change and long-range transport of persistent pollutants. Second, this definition is itself an idea – a construction – that makes sense only if we have already made the intellectual commitment of separating society from nature, consistent with Latour's modern Constitution, as cited above.

It is on the basis of this modern Constitution that the WFD system is constructed; it is a perfect system in the sense that it is supposed to yield an optimal outcome, an "improvement of the system as a whole", as described by Voulvoulis et al. (2017), which in practise is frequently interpreted as being the most economically-efficient means of achieving a desired ecological status. We argue, however, that such a system can hardly function in the real world because it is based on an impossible condition, the "absence of any anthropogenic pressures" (ibid: 360) both conceptually and in fact.

To develop this argument, we consider the DPSIR model in some detail; we take up the question of its ideological orientation in the following subsection and its ontological foundation subsequent to that.

The ideology of the WFD system

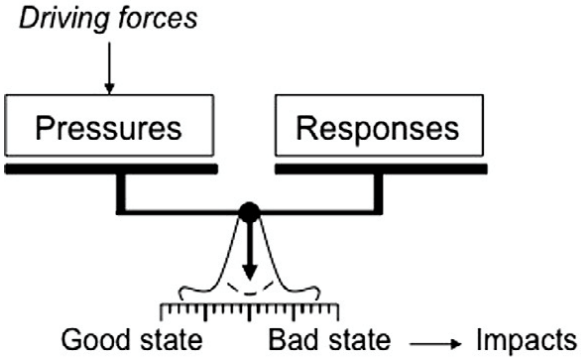
Researchers applying political ecology and other critical approaches have shown how the formulation of this new system of European water management fits into the historical context of Europe's embrace of neoliberalism, governance, and the doctrine of New Public Management;[6] this follows the development of these ideological trends in the United States and Great Britain, a key mechanism of their transfer being the OECD (see, for example, Kaika, 2003; Loupsans, 2013; Fernandez et al., 2014; Bouleau and Pont, 2014, 2015). Bouleau (2007) shows how the overall approach of the WFD is a fundamentally neoliberal idea in the way it fosters ecosystem integrity by achieving/maintaining a desired state, rather than regulating activities and substances deemed harmful; it is thus felt to constitute a shift towards governmentality in the Foucauldian sense (Bouleau, 2007; see also Fernandez et al., 2014). These critiques show how the WFD system, including the DPSIR model and its associated components, constitutes a scheme of (ostensibly) apolitical decision-making which automatically produces cost-effective results in

[5] The word 'status' is used in the WFD to refer to the environmental condition of a water body, and the word 'measures' refers to actions undertaken by states to restore the desired environmental conditions; in the language of the DPSIR framework, this refers to the environmental state and the responses to it.

[6] New Public Management is described as a "results-driven approach that relies on indicators and models which permit quantitatively defining management objectives in order to compare public actions based on economic criteria (to promote cost effectiveness)". It has been shown to be "inherent to the WFD" (Bouleau and Pont, 2014, 2015).

environmental protection and water management; this is akin to the way the market is championed as an apolitical mechanism that offers the most efficient means of allocating resources. As such, the system is seen to constitute a perfect model which needs only to be fully and correctly implemented for it to ensure an ideal outcome, that is to say an outcome that brings environmental protection and economic efficiency together in an optimal balance (Figure 2).

Figure 2. The DPSIR approach as 'gravity acting on a scale', with responses compensating for pressures.



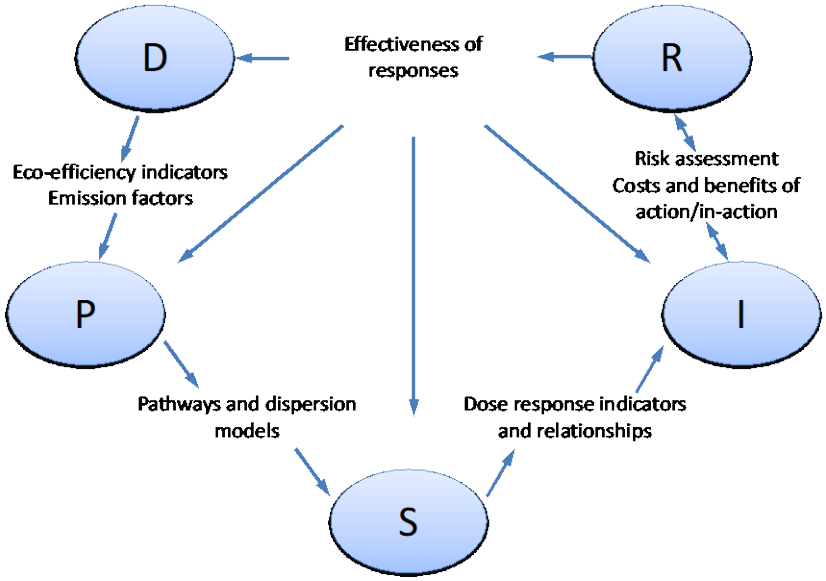
Source: Fernandez et al. (2014: 19).

Bouleau and Pont (2014: 3) point out that the school of New Public Management is grounded on the axiom that, "it is no longer the role of the State to provide and justify on-the-ground management actions, but the State must ensure that the actions implemented by others are the most cost-effective options". In order to promote this cost-effective "management at a distance" approach, the OECD developed the Pressure – State – Response (PSR) model in the early 1990s to measure the efficiency of environmental management actions, or responses, in reducing harmful pressures on the environment such that a desired state can be achieved. This original model was subsequently adopted by the European Environment Agency, with the components of drivers and impacts added to produce the DPSIR model; Bouleau and Pont (2015: 34) describe this framework as "a method for cost-benefit analysis based on mitigation logic".

Key to understanding how the DPSIR and the WFD system work is the use of environmental and economic 'indicators'; these serve to link the various components in a functional sense, rendering it a system that articulates and makes commensurate environment and economy (Bouleau, 2006, 2007). An important aspect of the WFD enterprise has been the development of indicators to bring each component of the system into a functional relationship; this allows for feedback between the various components which then improves the performance of 'the system as a whole' (Gabrielson and Bosch, 2003; see Figure 3). Bouleau and Pont (2015) stress the importance of environmental and biological indicators for the effective functioning of the system; such indicators are essential for making pressures and responses commensurable, that is to say they provide the basis for knowing when responses have addressed drivers, pressures or impacts adequately so as to achieve the desired state (Figure 3). Drawing from Gabrielson and Bosch (2003: 8-9), for example, indicators for driving forces describe "social, demographic and economic developments" that "exert pressure on the environment"; pressure indicators measure such things as emissions of harmful substances and other activities undertaken by society that impact on environmental conditions; impact indicators are used to describe changes in these conditions; state indicators measure "the quantity and quality of physical phenomena (such as temperature), biological phenomena (such as fish stocks) and chemical phenomena (such as atmospheric CO_2-concentrations)" (ibid). Response indicators refer to responses by groups (and individuals) in society as well as government attempts to prevent, mitigate, compensate, ameliorate or adapt to changes in the

state of the environment; environmental expenditures, for example, would be a commonly used response indicator.

Figure 3. Indicators and information linking DPSIR components.



Source: Kristensen (2004).

In addition to these indicators, policy makers have developed a series of meta-indicators for different stages of the policy life cycle. As Gabrielson and Bosch (2003: 12) note, "[t]he DPSIR framework refers to the analytical significance of indicators in a policy context". In order to make the model relevant in this context, a variety of "performance indictors", "efficiency indicators" and "policy-effectiveness indicators" have been developed – or are in the process of being developed – in conjunction with the descriptive indicators mentioned in the paragraph above (ibid: 13-16). Altogether, these indicators are intended to render the system theoretically functional in producing optimal policy outcomes (Figure 3).

A relationship between the ideology of the WFD environmental management system and the ontological separation of nature and society is suggested by a system that is intended to (automatically) render apolitical decisions about the best (most cost-effective) environmental management options as per a model that resembles and aspires to market perfection. In the operation of such system, there is a rather clean distribution of epistemological expertise with respect to the collection of information and the formulation of indicators that allow the system to function: defining and indicating the state of the environment as well as the impacts affecting it falls to the natural sciences, while the identification and accounting of the driving forces, pressures and responses is a matter for the social sciences. It is relevant to note that Latour identified such a division of intellectual labour as a hallmark of the modern Constitution and as being characteristic of the professionalisation of environmental decision-making which, he argued, prevented environmental politics from developing more original or radical approaches (Latour, 1998).

The ontology of the WFD system

Fernandez et al. (2014: 18) observed of the DPSIR model that it,

> draws implicitly upon the analogy of gravity acting on a pair of scales (Figure 2). It represents social practices as deterministic inputs – pressures (…). The term 'pressures' implies that relations between human practices

> and environmental degradation *are as inescapable as gravity.* The term 'responses' suggests that it is possible to redress the balance (…) (emphasis added).

We note the radical separation of humans from nature that is built into this model, such that human actions are a priori framed as harmful and degrading. This ontological foundation of the model is essential to its integrity. At every stage, society is external to nature; according to the model, by its various activities society exerts what can only be harmful pressures. According to the model, the only redemptive qualities that society has at its disposal are the dedicated responses that have the aim of correcting or mitigating the harmful pressures.

As already suggested, the neoliberal orientation of the DPSIR framework is suggested by its eschewal of a command approach by the state and by the systems logic by which it is intended to yield cost-effective environmental protection. Fernandez et al. (2014), argue that the "DPSIR is a particular form of *biopolitics*, targeting an optimal environmental system. It does not prohibit harmful practices, but rather encourages their effects to be compensated for" (ibid: 20). The neoliberal ideology of this model might be further observed in the suggestion that it affords a conceptual means of improving environmental quality without discouraging economic growth. In fact, by allowing for pressures to be compensated for by responses, economic growth is always positive; this is true in the sense that all forms of economic activity – including actions that are clearly destructive of environmental quality (however this might be defined) as well as mitigation responses – contribute positively to an index such as Gross Domestic Product (GDP).[7] The DPSIR model thus helps legitimise a view of environmental protection and improvement that is fully consistent with conventional models of economic growth. Adopted as "the official concept of the WFD", it burnishes the directive's credentials as a policy that is fully in line with the convenient concept of "sustainable development" (Barraqué, 2001).

A related aspect of our critique focuses on the concepts of driving forces and pressures in the DPSIR framework. As noted above by Fernandez et al. (2014), the 'pressures' component of the model "implies that relations between human practices and environmental degradation *are as inescapable as gravity*" (emphasis added). Svarstad et al. (2008) find that the DPSIR framework allows for a limited understanding of the forces that drive environmental changes. With respect to biodiversity, for instance, they note that, "[d]riving forces are purely perceived as external forces damaging the area or species that need protection rather than as socio-economic and cultural processes that are integrated with developments in biodiversity" (ibid: 118).

It is this notion of inherently destructive driving forces and pressures that reflect the ontological fallacy of the WFD model; that is, the ultimate separation of humans and nature is taken as a given, such that human activity has an original and inevitable destructiveness to it, albeit one that can be mitigated by undertaking proper responses. This notion of human 'original sin' when it comes to our relations with nature, combined with the redeeming possibility of responses, can be interpreted as encouraging neoliberal economics, including larger units of production (such as agricultural production), freer trade, international guarantees of 'investment protection', and as already noted, continuation of classic models of economic growth that calculate ecologically and socially destructive activities as positive contributions to indices such as GDP. To repeat Svarstad et al.'s contention, such a model makes it impossible to accommodate such things as cultural processes around water, ecology, and conservation; it also does nothing to encourage 'alternative' forms of production, exchange and consumption that embody different kinds of socionatural relations and that are more 'sustainable' yet require models that capture more subtle dynamics of socionatural systems. We will revisit the possibility of alternative socionatural relations and their ontological implications for water policy in the conclusion of this paper.

[7] As already noted, one of the commonest types of response indicator used is the one that describes environmental expenditures.

REFERENCE CONDITIONS

The concept of reference conditions and reference waterbodies is fundamental to the WFD in that it provides the basis for defining policy objectives aimed at the goal of "good ecological status". The directive itself defines reference conditions only very generally; they are the conditions that would prevail in the absence of human activities, which are explicitly referred to as "disturbances" (European Commission, 2000: Annex V, section 1.2). The conceptual separation of humans from nature is evident here; human activities are considered to be a source of disturbance that prevents water bodies from reaching their natural reference status (Steyaert and Ollivier, 2007). The directive, however, already includes "slight deviations" from undisturbed conditions in the reference concept; this has left ample room for interpretation (Moss, 2008; Whittier et al., 2007) and – we will argue in this section – has turned reference conditions into unwieldy socionatural hybrids.

The ways in which reference conditions have been established in practice, and reference waterbodies selected, are very much social processes that are riddled with pragmatic approximations, negotiations and technical fixes that are at odds with the naturalistic claim of the reference conditions. How reference conditions for rivers and lakes should be established by member states is set out in the CIS Guidance Document No. 10 (WFD CIS, 2003c: 25, Figure 5). This guidance is a little more specific than the directive itself with respect to the high/good ecological status boundary which it identifies with "very minor anthropogenic disturbances", and the good/moderate boundary which is associated with "slight anthropogenic disturbances" (ibid: 24).[8]

The first step – the selection of reference sites – has largely been achieved via so-called anthropogenic pressure criteria (Pardo et al., 2012; Sánchez-Montoya et al., 2012), while the biological elements (the core indicators of the WFD) have been relegated to merely corroborating the pre-established high ecological status. For the second step – the establishment of reference conditions – the directive gives the following methodological options: 1) using present data from monitoring sites; 2) predictive modelling; 3) using historical data and/or paleoreconstruction; or 4) a combination of the aforementioned approaches. Where it is not possible to use any of these methods, reference conditions may be established by expert judgement. From the point of view of the positivist analyst, there is thus a spectrum of rigour that the naturalised concept of reference conditions evokes, with very "social" elements creeping in (Krueger et al., 2012).

The third step – the establishment of ecological status class boundaries – requires yet more ambiguous choices that are left to the discretion of the member states. They can choose summary statistics which describe reference conditions for all quality element indicators, as well as summary statistics which describe the high/good and good/moderate boundaries. These choices are subsequently intercalibrated between the member states using largely statistical methods (WFD CIS, 2003b; 2011); this is a process that is ongoing and which – as discussed next – has involved adjustments to ecological status class boundaries, as for the case of the phosphorus standard for British rivers.

Revising the phosphorus standard for British rivers

The case of the revision of the WFD phosphorus (P) standard for British rivers exemplifies reference conditions as socionatural hybrids which possess, simultaneously, the certainty of fixed, natural states and the ambiguity of fluid, sociotechnical negotiations (see Table 1 for technical detail). In 2013, along with other WFD standards for British rivers, the P standard was changed. According to the UK Technical Advisory Group on the WFD (UKTAG, 2013), the P standard was reviewed as part of the adjustment of standards for biological quality elements; these adjustments were part of the EU-wide intercalibration

[8] The WFD classifies the ecological status of water bodies into five categories: high (reference conditions), good, moderate, poor and bad.

exercise which showed a high number of mismatches between the P and the biological classifications of British rivers, with many sites failing in terms of biology but not in terms of P.

We now show how a myriad of socionatural practices are translated to form the revised P standard. The new standard[9] sets annual mean concentrations of 'reactive P' [10] for the ecological status classes as a function of the biological assessment for these classes and reactive P reference conditions. The definition of reactive P is by no means 'natural'; rather, it is technical, tied to the phosphomolybdenum blue colorimetric method of analysing water samples after an optional filtration of a given pore size (Table 1). The previous standard was referred to as 'soluble reactive P'. The functional relationship between the annual mean reactive P concentration and the biological assessment and reference reactive P concentration was determined by statistical regression on calibration site data (UKTAG, 2012). The ecological status class boundaries were then set between the confidence intervals of the reactive P predictions for adjacent classes (UKTAG, 2012: Figure 2); these choices are justified, but could have been made and justified differently.

Table 1. Technical definitions and calculations used in establishing the revised phosphorus (P) standard for British rivers.

Indicator	Annual mean reactive P concentration in micrograms per litre (µg/L), as determined by the phosphomolybdenum blue colorimetric method of analysing water samples after an optional filtration using a filter pore size no smaller than 0.45 micrometres (µm).
Ecological status class boundaries	Indicator values calculated by statistical regression against the ecological quality ratios (EQRs) resulting from the diatom and macrophyte assessments for these classes and reactive P reference conditions, using the data from 620 sites across the UK. Class boundaries for the indicator were set at the midpoints between the medians of the confidence intervals of the reactive P predictions for adjacent classes.
Reference reactive P concentrations	Modelled by statistical regression against alkalinity and elevation using the data from 116 reference sites, a subset of the 620 calibration sites. Reference condition reactive P subsequently limited to at least 7 µg/L, with smaller values resulting from the model adjusted to this boundary. Alkalinity is the concentration of calcium carbonate ($CaCO_3$) in water (mg/L), which the UKTAG procedure limits to 2-250 mg/L, with smaller and greater values, respectively, adjusted to these boundaries. Elevation is limited to ≤355 metres above mean sea level (mamsl) with greater values adjusted to this boundary. R-squared = 0.45, with unexplained variation hypothesised to be due to unmeasured processing rates, biological and sediment sinks, delivery routes, and climatic and other environmental factors.

Source: UKTAG (2012).

The reference conditions for reactive P are themselves modelled as a function of site alkalinity (positive effect) and elevation (negative effect). The values of alkalinity, elevation, and eventually reference condition reactive P are adjusted post hoc in order to stay within certain limits (Table 1). According to UKTAG (2012), without this adjustment the models would produce reference reactive P concentrations for some rivers that are close to the analytical detection limit, as well as misclassifications when combined with the biological quality elements for low alkalinity rivers. The former refers to a technical fix; the

[9] 'Standard' in WFD language consists of (1) an 'indicator' of ecological status, (2) 'class boundaries' for the five status classes (high, good, moderate, poor, bad), and (3) 'reference conditions' with respect to the chosen indicator (Table 1).

[10] Reactive P is that part of the P concentration in water that is considered most mobile, chemically reactive, and available for uptake by organisms.

reference condition is what can be analytically detected. The latter refers to a conceptual fix; the P reference condition is what the biological criteria say it should be. This process shows again that reference conditions are far from naturally given; rather, they are outcomes of complex negotiations between technical provisions and conceptual premises.

The actual functional relationship between reference reactive P concentration, and alkalinity and elevation, was determined via statistical regression on reference site data, a subset of the aforementioned calibration sites. The reference sites either met the intercalibration criteria of Pardo et al. (2012) or "were only minimally impacted, using environmental predictors" (UKTAG, 2012: 27), whatever this has meant in practice. Modelling reference reactive P concentrations as a positive function of alkalinity has been criticised from within the hydrochemistry community by Tappin et al. (2018) for generating an overly relaxed standard in cases where alkalinity is elevated by sewage and industrial effluents and/or runoff from agricultural fields. Here too, the idea of what reference conditions mean for specific sites cannot procedurally be separated from human influences.

According to UKTAG (2012), alkalinity and elevation turned out to be the best predictors of reactive P among all available predictors considered. In the classical statistical framework used, the model explained 45% of the variation in the data (ibid). The rather large residual variation (55%) of reactive P at the reference sites is due to unmeasured factors (Table 1). This level of imperfection in the resulting reference conditions is tolerated as it is common in these types of statistical analyses; it is part of the scientific method and is accepted as valid despite being at odds with the notion of certainty inherent in the naturalised reference conditions concept. The result is once again a socionatural hybrid whose authority as an objective entity cannot be separated from the technical possibilities and conceptual choices that were made during its creation and which could have been made differently.

The revised standard, on the whole, is more stringent than the previous standard, except for the poor/bad ecological status class boundary which is now generally more relaxed. According to UKTAG (2013), the new standard would decrease the proportion of high and good sites with respect to P from 80 to 65%; since the revised standards for the biological quality elements are more relaxed, however, the proportion of sites classed as high or good for both biology and phosphorus would increase from 34 to 47%. The proportion of mismatched classifications would then be reduced, but they would still (at 62%) dominate over the aligned classifications. Consequently, the revised P standard does not fulfil its naturalised promises by compelling a unique course of action. As a socionatural hybrid, the standard is subject to qualification; this the UKTAG (ibid) itself provides on economic grounds by recommending expensive action to reduce P concentrations at a site only where there is supporting evidence of adverse biological impacts.

An ontological critique of reference conditions

There has been widespread criticism of the concept of naturalistic reference conditions and their relevance for guiding aquatic ecosystem restoration (Lévêque and Van der Leeuw, 2006; Dufour and Piégay, 2009; Perry, 2009; Davodeau and Barraud, 2018). Many critics have pointed out that it does not accord with recent ecological science, manifesting long-disproven notions of ecological stability, equilibrium, and fixed conditions rather than more recent understandings of the fluidity and unpredictability of ecosystems (Steyaert and Ollivier, 2007; Bishop et al., 2009; Loupsans and Gramaglia, 2011; Loupsans, 2013). Ecologists have also found it challenging from a practical point of view to find reference waterbodies given the variability of 'natural' conditions (Nõges et al., 2009; Hering et al., 2010); they have even questioned whether such conditions pertain at all given the anthropogenic pressures on European watercourses (Nones, 2016; Stoddard et al., 2006; Lévêque, 2016). As Bouleau and Pont (2015: 37) point out, "significant environmental modifications by humans have occurred for several millennia. The notion of an undisturbed state no longer has ecological significance". Others have abandoned the idea of stationarity in the light of climate change (Logez and Pont, 2013) and have cited the frequent

irreversibility of water quality conditions (Mao and Richards, 2012) as part of their critique of the notion of reference conditions.

Nature-based reference conditions nevertheless persist despite such widespread evidence of their conceptual flaws and practical challenges; this is because they are an essential component of the system of environmental management and serve the specific needs of the institutions and stakeholders which promote them (Bouleau and Pont, 2015). As Bouleau (2007) has pointed out, the component of reference conditions in the WFD is essential to making economy and environment commensurable as it provides a basis for costing environmental perturbation or disturbance. Within the logic of the WFD system, this commensurability is necessary for accomplishing what Espeland (1998) described as "mastering" the environment through causal knowledge of the impacts of human action. This is essential to the basic notion (now taken for granted) that we can identify and measure the environmental impact of human activities (ibid). It should be stressed that this notion is based on the original conceptual separation of ourselves from the 'environment', which becomes a kind of recipient that bears all traces of human actions. This conceptual separation, in turn, permits the construction of the DPSIR model discussed above, which enlists reference conditions.

When it comes to implementing the WFD, the (conceptual) exclusion of people from nature makes the management process intransigent; it particularly excludes approaches of adaptive management:

> [The WFD] is rather prescriptive in many ways. Once the natural reference conditions are established, the goals are set with a timetable for achieving the goals. There is no apparent provision for revising the goals. Thus, another problem with having 'natural' as the policy target is that the 'natural' is not something that lends itself to revision (Bishop et al., 2009: 212).

This dilemma is now explicit in the failure to achieve the status envisioned by the WFD for most European waterbodies. This failure is evident in the preponderance of exemptions and derogations that member states – as the only means of reconciling an impossible vision – have conferred on waterbodies; this is based on an ontological imperative that requires everything to be defined as either nature or society, while what, in fact, exists is a complex reality in which everything is actually some combination of these. This (hybrid) reality involves rivers, lakes, ponds, and aquifers that are inescapably socionatural; any effort to reduce their status to an abstract, natural norm is bound to run into persistent problems. In the following section, we give an example of where the ontological fallacy of the WFD produces such problems when confronted with the reality of rivers in France; we then suggest an alternative vision at the end of the paper.

INTRACTABLE PROBLEMS: COMPETING CONTINUITIES IN FRANCE

As an example of signature policies of WFD implementation that derive from the logic of the systems approach described earlier, we here examine the policy of restoring the ecological continuity of rivers in France. Our argument is that the widespread failure of these key policies flows from the ontological contradictions of the WFD rather than from inadequate implementation efforts.

Arguably, the signature policy for river restoration in France is *la continuité écologique des cours d'eau* (the ecological continuity of rivers, or ECR). ECR is defined as the capacity of a river or stream to support the longitudinal, lateral and vertical migration of "all living organisms belonging to the riverscape" and the free transport of sediments (Perrin, 2018). This policy translates into a nationwide programme to identify and erase thousands of structures – mainly weirs and small dams – that have been built in France over the centuries. According to some observers, the promotion of ecological continuity has become "the flagship tool for achieving good ecological status of rivers" in France (Germaine and Barraud, 2017: 18); it has even been described as "the panacea of the policy of river restoration in France" (Bravard, 2017: 10).

Built on a foundation of nature-based reference conditions, ECR is confronted with the reality of fluvial morphology in France, which can best be understood as an ongoing process of socionatural co-construction. Rivers in France and other parts of Europe (Nones, 2016) combine anthropogenic and natural elements, embodying socionatural processes that have been underway for hundreds, if not thousands, of years (Lespez, 2012). It is argued, in fact, that at least in Northwest France, from the Early Middle Ages to the Early Modern period, the influence of people operating mills and dams produced "socio-environments where an equilibrium was maintained by human societies for more than a millennium" (Lespez et al., 2017: 38) This makes it highly problematic to appeal to an ahistorical 'natural' status as a basis or reference for restoring rivers (Lespez et al., 2015; Dufour and Piégay, 2009; Bouleau and Pont, 2014).

There is a basic ontological contradiction between the anthropogenic nature of rivers in France and a policy that is based on an ideal of 'restoring' rivers on the basis of natural conditions. This contradiction is manifested in a protracted political struggle between two ideals of continuity: the continuity of 'natural' rivers and the (cultural) continuity of anthropogenic rivers; this has produced a widespread environmental controversy in France. In the name of the environmental continuity of rivers, an ambitious programme has been developed to demolish thousands of small dams and weirs, often associated with the historic legacy of watermills (Germaine and Barraud, 2017); this initiative, however, has been met with fierce and largely unexpected opposition from all directions, including owners and defenders of watermills, people living or owning property along rivers, producers (or would-be producers) of small-scale hydroelectricity, local fishing associations, local and national politicians including many members of parliament and hundreds of mayors, and senior and well-respected water scientists. These opponents have employed a variety of arguments and strategies to impede implementation of the policy (Barraud and Le Calvez, 2017; Barraud, 2017; Le Calvez, 2017; Perrin, 2018; Germaine and Barraud, 2013).

"Such conflict", writes Barraud (2017: 796-7), "reveals a yawning gap between social representations and the value systems of experts, local managers and the local population". Most studies indicate that an important factor in the opposition to small-dam dismantling is attachment to place; another factor is the power asymmetries that may exist between local users and residents, and environmental experts who are "often perceived as external to the local scene" (ibid). Yet another factor – one that may be perceived as being external to the local scene and associated with this expertise – is an abstract regard for rivers as fundamentally natural processes whose restoration requires the removal of vestiges and symbols of human interference such as small dams and weirs. The consideration of such structures as being integral to modified, yet viable and valuable, socionatural systems – as local populations often do – is a poor fit with a model of a reference state that defines such things as forms of disturbance and degradation.

CONCLUSION

We have argued that the conceptual separation of nature and society forms the main ontological presupposition of the WFD and that this leads to intractable problems that cannot be resolved by redoubled efforts to implement the directive. Basing the WFD on an idealised natural state that excludes people has allowed for the construction of an idealised system that, like nature itself, can hardly function in a world where water everywhere bears the physical and symbolic traces of human presence. Under such circumstances, the only possible way to move forward with the WFD is to grant derogations and exemptions to member states for the majority of Europe's water bodies (Howarth, 2009). This de facto 'honouring in the breach' of the directive allows its continued existence; we argue, however, that proceeding in this way undermines the credibility and legitimacy of European environmental policy as it pertains to water.

In conclusion, we argue the need for a water policy that is based on a more realistic ontological footing, which we feel is necessary to ensuring its legitimacy. In effect, this would mean making water

policy consistent with "the ontological turn"; this is a phrase used by researchers in a wide variety of fields – from philosophy and anthropology to science studies – to refer to a trend in thought that predates the implementation of the WFD (Farquhar, 2014; Heywood, 2017). Returning to Latour's critique of the modern Constitution, as invoked at the beginning of this article, some version of what he describes as "non-modern ontologies" (Latour, 1993) is in order when considering the next phase of water policy in Europe and elsewhere.[11]

In the 1990s, notably, Latour cited developments in French water policy as corresponding to his vision of what environmental policy might look like if it were based on a non-modern, or amodern ontology (Latour, 1998). Latour specifically highlighted what he saw as a new kind of political institution – or hybrid political forum – that was established by a 1992 law that created local water commissions to develop water management plans at the basin or sub-basin scale (Latour and Le Bourhis, 1995). These commissions, which included representatives of the 'natural' sciences as well as ordinary citizens, state and local politicians, and environmentalists, were dubbed "local parliaments of water" by Latour; he considered them to be "[a] very original experiment in the French context since they aim in part to make politically visible the river's health" (1998: 221).[12] Despite the enthusiasm that Latour may have had for these bodies, however, they do not seem to have effected radical change in the politics and practice of water management in France. Here, as elsewhere, the WFD was rendered less effectual than it may otherwise have been by powerful agricultural and industrial lobbies that succeeded in softening the requirements and obtaining exemptions and derogations (Lesage, 2013). While this would seem to bear out the argument made in Lave's (2015: 218) contention that, "there *is no necessary correlation between the ontologically radical and the politically radical*", it would nevertheless be worth revisiting these and similar forums in order to critically assess why they have not succeeded in functioning in the more radical manner that Latour envisioned. Particularly helpful in correlating the ontologically radical with the politically radical would be an examination of how such efforts to shift the ontological basis of water policy have articulated (or failed to articulate) the political and economic factors that have structured modern water policy.

In the meantime, based on the experience of implementing, or trying to implement, the WFD, some institutional actors as well as critical researchers have proposed reforms that could be considered to correspond to the ontological turn. An example of these would be the various arguments put forward for 'functional' alternatives to nature-based reference conditions. Dufour and Piégay (2009: 568) have proposed to replace the restoration strategy that is aimed at achieving a defined 'natural' ideal ecological state with "an objective-based strategy that reflects the practical limitations of developing sustainable landscapes". Similarly, Steyaert and Ollivier (see also Callicot et al., 1999) eschew fixed reference conditions based on compositionalism; they call instead for functional goals such as biological traits or ecosystem health (where people are part of ecosystems) as a basis for setting reference conditions. They argue that this approach challenges the model that is based on a transcendental nature which grants all authority to natural scientists and technocrats and thus prevents non-experts from participating in the definition of what healthy ecosystem functioning means.

[11] We should be under no illusions about the power and tenacity of the modern ontology. As Lennon (2015) points out with respect to the emerging concept of "novel ecosystems" of the Anthropocene, these entail an ontological critique of the concept of 'nature' upon which management tools and strategies such as the WFD have been built. He describes the

> depth of feeling in this debate as the newly emerging ontology of nature proffered by the novel ecosystems concept not only threatens to unwind profoundly interwoven epistemological and metaphysical concepts of 'nature', but also potentially imperils the careers of those entangled in such webs of meaning (ibid: 287).

[12] Similar forums had been established in other EU member states – and around the world (see Benson et al., 2013) – but seldom with an ontological underpinning as radical as that read into the French cases by Latour; for a water management forum in the UK inspired explicitly by Latour, however, see Tsouvalis and Waterton (2012).

> In that case, ecological knowledge will not be used to set the goals in terms of stabilized states but must help stakeholders make choices on what kind of water uses and management practices are acceptable to them and can ensure the resilience and reversibility of ecological processes in context (Steyaert and Ollivier, 2007: 11).

It should be stressed however that functional alternatives to nature-based reference conditions would not necessarily give rise to more open, democratic and socially just environmental decision-making. As demonstrated by critics of 'ecosystem services', functionalist approaches can provide the basis for further advancements in the commodification of nature, thus serving the interests of capital at the expense of both social justice and the environment (Robertson, 2006; Dempsey and Robertson, 2012; Kull et al., 2015). The important caveat must thus be added that functional conditions that serve as water policy goals must be understood as public goods; they must oblige public participation as well as efforts to promote social justice in terms of the enjoyment of such goods.

Without entirely rejecting the concept of reference conditions, which remains useful in moving towards any desired socio-ecological condition, such ideas suggest the possibility of considering reference conditions as if people were part of nature. Such a notion is impossible under the current directive, as is evidenced by the contradictions inherent in simultaneously including natural reference conditions, economic optimisation, and the directive's ambition (as described in Article 14) for public participation to be part of decision-making. As Green and Fernandez-Bilbao (2006) have argued, if stakeholder engagement is to be meaningful, it must include the defining of priorities. Currently, however, there is no room for meaningful citizen involvement in the defining of either the economic or the ecological aspects of the WFD system, as these are now determined by economic optimisation on the one hand, and by naturalistic reference conditions on the other.

The National Water Quality Management Strategy of Australia is a concrete example of an ontological perspective whereby reference conditions, and indeed water policy, are developed based on the assumption that people are part of nature; here, water management processes reference 'undisturbed' conditions but recognise that these conditions are usually unattainable and are sometimes not even desirable. Their approach is to use locally specific targets that are informed by the intended uses of the respective waterbodies; this, in turn, is meant to be informed by a deliberative stakeholder process (Australian Government Initiative, 2020). The notion of an undisturbed state is thus not absent in the Australian case, but neither is it automatically defined as the state "to be returned to", as it is in the WFD. Where the WFD deals with the embedded ontological fallacy via derogations and exemptions, the Australian approach, from the beginning, incorporates the different intended uses of waterbodies, hence carrying along the human component. To quote the Australian guidelines for water quality management,

> Our expectations for the quality of our water depends on the intended use. We might consider the water in a river to be good enough to swim in, but it might not meet drinking water guidelines. Guidelines for managing water quality help water managers and industry consistently manage their activities and make sure water quality is acceptable for the intended use (fit for purpose) (Australian Government Initiative, 2020: Introduction).

Finally, as 2027 approaches and as the European water policy community has the opportunity to reflect on the successes and failures of the WFD, we contend that there is an opportunity to fundamentally rethink the assumptions about the relationship between nature and people that underpin the directive. We call for moving towards a water policy that considers people to be part of nature; we believe that this would relieve the pressure to deal with inconsistencies in the directive's ambitions through exemptions and derogations, which undermine the legitimacy of the WFD. Such a shift would also enhance (and indeed necessitate) public participation in the implementation of the directive, which is another ambition of the WFD that has fallen behind expectations (Jager et al., 2016).

ACKNOWLEDGEMENTS

We wish to acknowledge three anonymous reviewers, whose comments have been very helpful in producing the final version of this article.

REFERENCES

Australian Government Initiative. 2020. Water Quality Australia. http://www.waterquality.gov.au (accessed 24 August 2020)

Aspe, C. 1995. Construction sociale des normes et mode de pensée environnemental. *Sciences, Sociétés, Environnement*, Actes de l'Ecole d'été Européenne p.231-243.

Barraqué, B. 2001. Les enjeux de la Directive cadre sur l'eau de l'Union Européenne. *Cahiers Scientifiques Internationaux Réseaux et territoires*, CNRS, Vol.46, n°IV-2001.

Barraud, R. 2017. Removing mill weirs in France: The structure and dynamics of an environmental controversy. *Water Alternatives* 10(3): 796-818.

Barraud, R. and Le Calvez, C. 2017. S'opposer aux projets de démantèlement d'ouvrage : Rhétorique, valeurs et vision de l'espace. In Barraud, R. and Germaine, M.-A. (Eds), *Démanteler les barrages pour restaurer les cours d'eau : Controverses et représentations,* pp. 129-142. Versailles: Éditions Quae.

Benson, D.; Jordan, A.; Cook, H. and Smith, L. 2013. Collaborative environmental governance: Are watershed partnerships swimming or are they sinking? *Land Use Policy* 30(1): 748-757.

Bernstein, S. 2002. Liberal environmentalism and global environmental governance. *Global Environmental Politics* 2(3): 1-17.

Bishop, K.; Beven, K.; Destouni, G.; Abrahamsson, K.; Andersson, L.; Johnson, R.K.; Rodhe, J. and Hjerdt, N. 2009. Nature as the "natural" goal for water management: A conversation. *AMBIO: A Journal of the Human Environment* 38(4): 209-214.

Boeuf, B. and Fritsch, O. 2016. Studying the implementation of the Water Framework Directive in Europe: A meta-analysis of 89 journal articles. *Ecology and Society* 21(2).

Boeuf, B.; Fritsch, O. and Martin-Ortega, J. 2016. Undermining European environmental policy goals? The EU Water Framework Directive and the politics of exemptions. *Water* 8(9): 388.

Bouleau, G. 2006. Des indicateurs pour contrôler des équilibres. Conférence Internationale « Usages des indicateurs de développement durable » Montpellier, France, April, 2006.

Bouleau, G. 2007. La gestion française des rivières et ses indicateurs à l'épreuve de la directive cadre. PhD Thesis, AgroParisTech, Paris, June 8, 2007.

Bouleau, G. and Pont, D. 2014. Les conditions de référence de la Directive cadre européenne sur l'eau face à la dynamique des hydrosystèmes et des usages. *Natures, Sciences, Sociétés,* 22 **:** 3-14.

Bouleau, G. and Pont, D. 2015. Did you say reference conditions? Ecological and socio-economic perspectives on the European Water Framework Directive. *Environmental Science & Policy* 47: 32-41.

Bravard, J.-P. 2017. Preface. In Barraud, R. and Germaine, M.-A. (Eds), *Démanteler les barrages pour restaurer les cours d'eau : Controverses et représentations,* pp. 9-12. Versailles: Éditions Quae.

Callicott, J.B.; Crowder, L.B. and Mumford, K. 1999. Current normative concepts in conservation. *Conservation Biology* 13 (1): 22-35.

Carvalho, L.; Mackay, E.B.; Cardoso, A.C.; Baattrup-Pedersen, A.; Birk, S.; Blackstock, K.L.; Borics, G.; Borja, A.; Feld, C.K.; Ferreira, M.T.; Globevnik, L.; Grizzetti, B.; Hendry, S.; Hering, D.; Kelly, M.; Langaas, S.; Meissner, K.; Panagopoulos, Y.; Penning, E.; Rouillard, J.; Sabater, S.; Schmedtje, U.; Spears, B.M.; Venohr, M.; van de Bund, W. and Solheim, A.L. 2019. Protecting and restoring Europe's waters: An analysis of the future development needs of the Water Framework Directive. *Science of the Total Environment* 658: 1228-1238.

Castree, N. 2005. *Nature.* London: Routledge.

Castree, N. and Braun, B. (Eds). 2001. *Social nature: Theory, practice and politics*. Malden, MA: Blackwell.

Davodeau, H. and Barraud, R. 2018. Quelle position adopter face au patrimoine qui vient ? La médiation paysagère pour mettre en débat les temporalités. *Développement Durable et Territoires* 9(2), 19.

Dempsey, J. and M.M. Robertson. 2012. Ecosystem services: Tensions, impurities, and points of engagement within neoliberalism. *Progress in Human Geography* 36(6): 758-779.

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.

Braun, B. 2004. Nature and culture, On the career of a false problem. In Duncan, J.S.; Johnson, N.C. and Schein, R.H. (Eds), A companion to cultural geography, pp. 151-179. Wiley

Deleuze, G. and Guattari, F. 1987. *A thousand plateaus: Capitalism and schizophrenia.* Trans. Brian Massumi. Minneapolis: University of Minnesota Press.

Espeland, W.N. 1998. *The struggle for water: Politics, rationality, and identity in the American Southwest*. Chicago: The University of Chicago Press.

European Commission. 2019. Fitness check of the Water Framework Directive and the Floods Directive. Brussels, 10.12.2019.

European Commission. 2000. Directive 2000/60/EC of the European Parliament and of the council of 23rd October 2000 establishing a framework for community action in the field of water policy. Official Journal of the European Communities, L327/1. Brussels, European Commission.

Farquhar, J. 2014. 'A reader's guide to the "ontological turn" – Part 1". *Smartosphere*, January 25, 2014. http://somatosphere.net/2014/a-readers-guide-to-the-ontology-turn-part-1.html/ (accessed March 3, 2020)

Fernandez, S.; Bouleau, G. and Treyer, S. 2014. Bringing politics back into water planning scenarios in Europe. *Journal of Hydrology* 518: 17-27.

Gabrielson, P. and Bosch, P. 2003. Environmental indicators: Typology and use in reporting. European Environment Agency, EEA Internal Working Paper. August 2003.

Germaine, M.-A. and Barraud, R. 2013. Restauration écologique et processus de patrimonialisation des rivières dans l'ouest de la France. *VertigO, Revue électronique en sciences de l'environnement*, Hors-série n°16, Patrimonialiser la nature, http://vertigo.revues.org/13583. *VertigO, Revue électronique en sciences de l'environnement,* Hors-série n°16, Patrimonialiser la nature.

Germaine, M.-A. and Barraud, R. 2017. Introduction. In Barraud, R. and Germaine, M.-A. (Eds), *Démanteler les barrages pour restaurer les cours d'eau : Controverses et représentations,* pp. 13-23. Versailles: Éditions Quae.

Giakoumis, T. and Voulvoulis, N. 2018. The transition of EU water policy towards the Water Framework Directive's integrated river basin management paradigm. *Environmental Management* 62(5): 819-831.

Green, C. and Fernandez-Bilbao, A. 2006. Implementing the Water framework directive: How to define a "competent authority". *Journal of Contemporary Water Research and Education* 135: 65-73

Haraway, D. 2004 [1985]. A Manifesto for Cyborgs: Science, Technology, and Socialist Feminism in the 1980s. In *The Haraway Reader,* pp. 7-45. New York: Routledge.

Haraway, D. 1992. The promises of monsters: A regenerative politics for inappropriate/d others. In Nelson, C.; Grossberg, L. and Treichler, P. (Eds), *Cultural studies*, pp. 295-337. New York: Routledge.

Hering, D.; Borja, A.; Carstensen, J.; Carvalho, L.; Elliott, M.; Feld, C.K.; Heiskanen, A.-S.; Johnson, R.K.; Moe, J.; Pont, D.; Solheim, A.L. and de Bund, W.V. 2010. The European Water Framework Directive at the age of 10: A critical review of the achievements with recommendations for the future. *Science of the Total Environment* 408(19): 4007-4019.

Heywood, P. 2017. 'The Ontological Turn'. In Stein, F.; Lazar, S.; Candea, M.; Diemberger, H.; Robbins, J.; Sanchez, A. and Stasch, R. (Eds), *The Cambridge Encyclopedia of Anthropology,* http://doi.org/10.29164/17ontology.

Howarth, W. 2009. Aspirations and realities under the Water Framework Directive: Proceduralisation, participation and practicalities. J*ournal of Environmental Law* 21(3): 391-417.

Ingold, T. (2000) *The Perception of the Environment: Essays on livelihood, dwelling and skill.* London: Routledge.

Jager, N.W.; Challies, E.; Kochskämper, E.; Newig, J.; Benson, D.; Blackstock, K.; Collins, K.; Ernst, A.; Evers, M.; Feichtinger, J.; Fritsch, O.; Gooch, G.; Grund, W.; Hedelin, B.; Hernández-Mora, N.; Hüesker, F.; Huitema, D.; Irvine, K.; Klinke, A.; Lange, L.; Loupsans, D.; Lubell, M.; Maganda, C.; Matczak, P.; Parés, M.; Saarikoski, H.; Slavíková, L.; Van der Arend, S. and von Korff, Y. 2016. Transforming European water governance? Participation and river basin management under the EU Water Framework Directive in 13 Member States. *Water* 8(4): 156.

Josefsson, H. 2015. Ecological status as a legal construct – Determining its legal and ecological meaning. *Journal of Environmental Law* 27(2): 231-258.

Kaika, M. 2003. The Water Framework Directive: A new directive for a changing social, political and economic European framework. *European Planning Studies* 11(3): 299-316.

Kristensen, P. 2004. The DPSIR Framework. Paper presented at the 27-29 September 2004 workshop on a comprehensive / detailed assessment of the vulnerability of water resources to environmental change in Africa using river basin approach. UNEP Headquarters, Nairobi, Kenya. wwz.ifremer.fr/dce/content/download/69291/913220/../DPSIR.pdf

Krueger, T.; Page, T.; Hubacek, K.; Smith, L. and Hiscock, K. 2012. The role of expert opinion in environmental modelling. *Environmental Modelling and Software* 36: 4-18.

Kull, C.A.; de Sartre, X.A. and Castro-Larranga, M. 2015. The political ecology of ecosystem services. *Geoforum* 61: 122-134.

Latour, B. 1993. *We have never been modern*. Cambridge, Massachusetts: Harvard University Press.

Latour, B. 1998. "To modernize or to ecologize? That's the question. In Castree, N. and Willems-Braun, B. (Eds), *Remaking reality: Nature at the Millennium,* pp. 221-242. London and New York: Routledge.

Latour B. and Le Bourhis, J.-P. 1995. "Donnez-moi la bonne politique et je vous donnerai le la bonne eau…" Rapport sur la mise en place des Commissions Locales de l'Eau pour le compte du Ministère de l'Environnement. Centre de Sociologie de l'Innovation. École National Supérieure des Mines de Paris.

Lave, R. 2015. Reassembling the Structural: Political ecology and Actor-Network Theory. In Perrault, T.; Bridge, G. and McCarthy, J. (Eds), *The Routledge handbook of political ecology*, pp. 213-223. London: Routledge.

Le Calvez, C. 2017. Les usagers confrontés à la restauration de la continuité écologique des cours d'eau : Approche en région Bretagne. PhD Thesis, Université Rennes 2 – Haute Bretagne, Géographie-Aménagement de l'espace.

Lennon, M. 2015. Nature conservation in the Anthropocene: Preservation, restoration and the challenge of novel ecosystems. *Planning Theory and Practice* 16(2): 285-290. https://doi.org/10.1080/14649357.2015.1027047

Lesage, M. 2013. Rapport d'évaluation de la politique de l'eau en France *« Mobiliser les territoires pour inventer le nouveau service public de l'eau et atteindre nos objectifs de qualité ».* Mission d'évaluation de la politique de l'eau. Paris.

Lespez, L. (Ed). 2012. *Paysages et gestion de l'eau : Sept millénaires d'histoire des vallées en Normandie*. Caen: Presses Universitaires de Caen – MRSH.

Lespez, L.; Viel, V.; Rollet, J. and Delahaye, D. 2015 The anthropogenic nature of present-day low energy rivers in western France and implications for current restoration projects. *Geomorphology* 251**:** 64-76.

Lespez, L.; A. Beauchamp, M.-A. Germaine and Barraud, R. 2017. De l'aménagement au déménagement : Les temps de l'environnement des systèmes fluviaux ordinaires de l'ouest de la France. In Barraud, R. and Germaine, M.-A. (Eds), *Démanteler les barrages pour restaurer les cours d'eau : Controverses et représentations,* pp. 27-42. Versailles: Éditions Quae.

Lévêque, C. 2016. *Quelles rivières pour demain? Réflexions sur l'écologie et la restauration des cours d'eau*. Versailles: Éditions Quae.

Lévêque C. and van der Leeuw S. (Eds). 2006. *Temps et espaces des crises de l'environnement.* Versailles : Quæ.

Logez, M. and Pont, D. 2013. Global warming and potential shift in reference conditions: The case of functional fish-based metrics. *Hydrobiologia* 704(1): 417-436.

Loupsans, D. 2013. L'influence normative de l'OCDE sur la Directive-cadre Européenne sur l'Eau (DCE). *VertigO – La Revue Électronique en Sciences de l'Environnement* 13(3).

Loupsans, D. and Gramaglia, C. 2011. L'expertise sous tensions. Cultures épistémiques et politiques à l'épreuve de l'écriture de la Directive-cadre Européenne sur l'Eau. Centre international de formation Européenne. 2011/3 No. 361, pp. 87-114.

Mao, F. and Richards, K. 2012. Irreversible river water quality and the concept of the reference condition. *Area* 44(4): 423-431.

Moss, B. 2008. The Water Framework Directive: Total environment or political compromise? *Science of the Total Environment* 400(1): 32-41.

Nõges, P.; van de Bund, W.; Cardoso, A.C.; Solimini, A.G. and Heiskanen, A.-S. 2009. Assessment of the ecological status of European surface waters: A work in progress. *Hydrobiologia* 633(1): 197-211.

Nones, M. 2016. River restoration: the need for a better monitoring agenda. Conference paper. www.researchgate.net/publication/308413537

Pardo, I.; Gómez-Rodríguez, C.; Wasson, J.-G.; Owen, R.; van de Bund, W.; Kelly, M.; Bennett, C.; Birk, S.; Buffagni, A.; Erba, S.; Mengin, N.; Murray-Bligh, J. and Ofenböeck, G. 2012. The European reference condition concept: A scientific and technical approach to identify minimally-impacted river ecosystems. *Science of the Total Environment* 420: 33-42.

Perrin, J.-A. 2018. Gouverner les cours d'eau par un concept : Etude critique de la continuité écologique des cours d'eau et de ses traductions. PhD Thesis, Université de Limoges, France.

Perry, S.L. 2009. more than one river: Local, place-based knowledge and the political ecology of restoration and remediation along the lower Neponset River, Massachusetts. PhD Thesis, University of Massachussets Amhurst, Graduate School of the University of Massachusetts Amherst.

Poikane, S.; Kelly, M.G.; Salas Herrero, F.; Pitt, J.-A.; Jarvie, H.P.; Claussen, U.; Leujak, W.; Lyche Solheim, A.; Teixeira, H. and Phillips, G. 2019. Nutrient criteria for surface waters under the European Water Framework Directive: Current state-of-the-art, challenges and future outlook. *Science of the Total Environment* 695: 133888.

Robertson, M. 2006. The nature that capital can see: Science, state, and market in the commodification of ecosystem services. *Environment and Planning D: Society and Space*. 24: 367-387.

Sánchez-Montoya, M.d.M.; Arce, M.I.; Vidal-Abarca, M.R.; Suárez, M.L.; Prat, N. and Gómez, R. 2012. Establishing physico-chemical reference conditions in Mediterranean streams according to the European Water Framework Directive. *Water Research* 46(7): 2257-2269.

Schröder, N.J.S. 2019. IWRM through WFD Implementation? Drivers for integration in polycentric water governance systems. *Water* 11(5): 1063.

Smith, N. 1984. *Uneven development: Nature, capital and the production of space.* Oxford: Basil Blackwell.

Steyaert, P. and Ollivier, G. 2007. The European Water Framework Directive: How ecological assumptions frame technical and social change. *Ecology and Society* 12(1), www.ecologyandsociety.org/vol12/iss1/art25/

Stoddard J.L. ; Larsen, P. ; Hawkins, C.P.; Johnson, R.K. and Norris, R.H. 2006. Setting expectations for the ecological condition of running waters: The concept of reference condition. *Ecological Applications* 16(4): 1267-1276.

Svarstad, H; Petersen, L.K.; Rothman, D.; Siepel, H. and Wätzold F. 2008. Discursive biases of the environmental research framework DPSIR. *Land Use Policy* 25(1): 116-125.

Swyngedouw, E. 2004. *Social power and the urbanization of water*. New York: Oxford University Press.

Tappin, A.D.; Navarro-Rodriguez, A.; Comber, S.D.W. and Worsfold, P.J. 2018. The role of alkalinity in setting water quality metrics: Phosphorus standards in United Kingdom rivers. *Environmental Science: Processes & Impacts* 20(10): 1361-1372.

Tsouvalis, J. and Waterton, C. 2012. Building 'participation' upon critique: The Loweswater Care Project, Cumbria, UK. *Environmental Modelling & Software* 36: 111-121.

UKTAG 2012. A revised approach to setting Water Framework Directive phosphorus standards. https://wfduk.org/sites/default/files/Media/Environmental%20standards/A%20revised%20approach%20for%20setting%20WFD%20phosphorus%20standards_101012.pdf

UKTAG 2013. Updated recommendations on phosphorus standards for rivers. https://wfduk.org/sites/default/files/Media/UKTAG%20Phosphorus%20Standards%20for%20Rivers_Final%20130906_0.pdf

Voulvoulis, N.; Arpon, K.D. and Giakoumis, T. 2017. The EU Water Framework Directive: From great expectations to problems with implementation. *Science of the Total Environment* 575: 358-366.

WFD CIS. Common Implementation Strategy for the Water Framework Directive (2000/60/EC) 2003a. Guidance Document No. 3, Analysis of Pressures and Impacts. Luxembourg: Office for Official Publications of the European Communities.

WFD CIS. Common Implementation Strategy for the Water Framework Directive (2000/60/EC) 2003b. Guidance Document No. 6, Towards a Guidance on Establishment of the Intercalibration Network and the Process on the Intercalibration Exercise. Luxembourg: Office for Official Publications of the European Communities.

WFD CIS. Common Implementation Strategy for the Water Framework Directive (2000/60/EC) 2003c. Guidance Document No. 10, Rivers and Lakes – Typology, Reference Conditions and Classification Systems. Luxembourg: Office for Official Publications of the European Communities.

WFD CIS. Common Implementation Strategy for the Water Framework Directive (2000/60/EC) 2011. Guidance Document No. 14, Guidance Document on the Intercalibration Process 2008-2011. DOI: 10.2779/99432.

Whittier, T.R.; Stoddard, J.L.; Larsen, D.P. and Herlihy, A.T. 2007. Selecting reference sites for stream biological assessments: Best professional judgment or objective criteria. *Journal of the North American Benthological Society* 26(2): 349-360.

Willems-Braun, B. and Castree, N. (Eds). 1998. *Remaking reality: Nature at the Millennium*. London: Routledge.