

Rivers without rhythm? intermittent geographies and non-perennial rivers

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Abstract

Non-perennial rivers run dry part of the year. By length, they are the most common type of river on Earth, yet they receive comparably little attention in social science and humanities research. This article advances the idea of ‘intermittent geographies’ as a tool for conceptualising, researching, and increasing the attention paid to non-perennial rivers. It considers how increased scientific attention to non-perennial rivers over the past two decades offers insights into their unique ecologies and temporalities, as well as risks and vulnerability to climate change. It critically examines how predominant social theories for critical river research, such as hydrosocial scholarship, prioritises the materialities of water and human-water relations in ways that do not fully capture the dynamics of non-perennial rivers. It engages recent scholarship on rivers, time, and rhythm to show how, for at least some non-perennial rivers, there is an important sense in which the conflation of rivers with flowing water is inadequate. In this context, intermittent geographies enhance attention to non-perennial rivers by showing how the absence of water is as relational as is water’s presence. It also contributes to engagement with time and temporality by offering a conceptual language through which to understand phenomena that either lack rhythm or which have had it interrupted by anthropogenic forces of extraction or climate change.

Keywords

Non-perennial, rivers, rhythm, time, intermittent, absence

Introduction

Dry rivers are not necessarily dead rivers. This is not always clear from popular writing that ties the ‘life’ of rivers to whether water flows in them. Macfarlane (2025), for instance, presents as obvious evidence for dying rivers the fact that in 2022 the source of the river Thames in England moved downstream eight kilometres (see also Horton, 2022). That same northern hemisphere summer, the Loire River in France slowed to a trickle as its tributaries ran dry (Mahe, 2022). In 2026, drought

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drastically lowered many European rivers including the Rhine and the Elbe, while the Loire again dried up in places. Despite the intuitive inference that drying drains the life of rivers, however, what popular claims reveal is a disjuncture between particular social imaginaries of rivers and the phenomenological and physical realities of rivers that run dry. This article examines this disjuncture and how social theories built on water's flows and materiality must be rethought both with respect to rivers that naturally run dry and those that are induced into intermittent flows owing to climate change or to extraction.

Non-perennial rivers, sometimes also called intermittent rivers and ephemeral streams, run dry for some part of the year. Intermittent rivers are usually thought of as those that 'dry out' while ephemeral streams typically refer to headwater areas (such as small mountain creeks) that 'fill up' during precipitation or other runoff events such as snow melt (see on nomenclature: Busch et al. 2020). Importantly, and what is often overlooked in social theories of human-water relationships, in policy, and among activists is that non-perennial rivers exist in all climates and biomes, are found on every continent, and comprise 60% of the world's rivers by length (Messenger et al. 2021). In other words, rivers that run dry are not always deviations from the norm. For most of the rivers that wrap the Earth, they are the norm.

Despite their prevalence, attention to non-perennial rivers by social scientists mirrors the lack of attention they receive in policy and management—an oversight scientists have increasingly highlighted over recent decades (e.g., Acuña et al. 2014; Fovet et al. 2021).¹ It is an acute problem owing to accelerating anthropogenic impacts, which can induce previously perennial rivers into intermittent flow regimes directly and indirectly, such as through extraction, infrastructure (e.g., dams and diversions) and, increasingly, via climate change (see Datry et al. 2023a). In this context, popular accounts equating dry rivers to dead rivers present an incomplete picture. Bias towards treating rivers as bodies of perennial flowing waters is also evident in social theories, where watery prefixes (e.g., hydro) and metaphors index materiality to the metonyms of theory through what water does when it: flows, evaporates, circulates, erodes, or floods. These tendencies persist despite critique (see Camargo and Cortesi, 2019). And they remain despite long-standing practices that have evolved in many places where people live with non-perennial rivers, and which is evidenced by the many names used to refer to them: winterbourne in the UK; *wadi* in Egypt and other areas of North Africa and the Middle East; *balka* in Russia; *nallah* (*nala*) or *rau* in India; *corixos* in Brazil, or; *donga* in South Africa (see further: Steward et al. 2012).

This article introduces and develops "intermittent geographies" to reconceptualise social theories of rivers in relation to non-perennial rivers. These intermittent geographies are characterised by irregularity. They stop and start, yet they aren't necessarily cyclical. They erupt and can be evasive. The tempos of intermittent geographies are not, and cannot be, out of synch because they needn't be rhythmic. Instead, pulses range from the annual to the aleatory to the unannounced. Non-perennial rivers present important examples of the spatial and temporal relations of intermittent geographies because they show how these geographies are not necessarily deviations. Rather, they are discontinuous primarily with respect to normative modes of praxis that exclude them despite their preponderance—as in the United States, where intermittent rivers and ephemeral streams total 59% of stream length (excluding Alaska) with a higher percentage in arid regions (Nadeau and Rains, 2007). Ephemeral streams also contribute, on average, 55% of the water exported from regional river systems in the US (Brinkerhoff et al. 2024). By thinking with and through intermittent geographies a conceptual disposition comes into view that enables a rethinking of assumptions around time and temporality that have anchored—in different ways—the social theories through which human-water relations are often understood, and yet which exclude significant aspects of relations to rivers.

As I develop intermittent geographies, I advance a larger argument regarding the multiple temporal scales at work under conditions of global environmental change. The rationale for that larger

argument begins from the premise that rivers are central to social and ecological systems and relations. So too are dry rivers, including those induced into non-perennial conditions owing to climate change impacts or through extraction. Here, it is important to note that the opening distinction between the physical and phenomenological aspects of non-perennial rivers forms what Stengers (2005, 2011) would term a unique “matter of concern” for social theory and a need to attend to the ecologies of practice through which knowledge takes shape. In this regard, my argument is that, despite what might appear *in theory*—that is, in the explanatory apparatuses of theoretical constructs—to be rivers that are either wet or dry, it is imperative to treat rivers as wet *and* dry. Or, more accurately, just as rivers. This reorientation is crucial to ensuring that explanations of social theory are consistent with, but not reducible to, how hydrologists reject sharp divides between surface and subsurface flows in rivers (see Winter, 1999). In fact, significant contributions to hydrology regarding floods, river geometry, and sediment transport (among others) were made through the study of dry-land rivers, many of which are non-perennial (see Tooth, 2000).

Intermittent geographies recommend a disposition towards rivers that does not see non-perennial rivers as aberrations, and confronts the limits of theories that are animated by water’s materiality as a way to understand issues of space, territories, and politics—e.g., hydrosocial relations, ‘wet’ ontologies, and to some degree ‘amphibious’ spaces (e.g., Camargo et al. 2025; Linton and Budds, 2014; Meehan et al. 2023; Steinberg and Peters, 2015; Visentin and Kaaristo, 2024; Zaragocin, 2024). These are all valuable to theorising human-water relations, but by foregrounding water’s materialities they risk eliding the dynamics of rivers without water. The core contribution of intermittent geographies, by contrast, is to identify, and to amplify attention towards, the ways that water’s absence is as relational as its presence. This understanding is critical to thinking beyond the semantic metaphors and metonyms of watery theories in view of dry and drying rivers, and towards a substantive reworking of how critical social sciences pay attention to rivers socially, ecologically, and ethically.

The article develops its argument in three sections. “River Relations Without Water” complicates social theories of human-water relationships as it reviews research on non-perennial rivers. Rivers are almost always defined in terms of flowing water, but non-perennial rivers matter not only because they periodically stop flowing but because they also take multiple forms in different environments (arid, humid, alpine, etc.). Using an example from Australia, I challenge norms of hydrosocial scholarship that configure spatial and temporal relations with and through water flows (e.g., Liao and Schmidt, 2023; Linton, 2010; Linton and Budds, 2014). “Rivers Without Rhythm” examines how the intermittent geographies of non-perennial rivers require rethinking notions of temporality in relations to rivers. Here, I engage research that attends to relational, place-based values that co-constitute the unique temporalities of rivers, and which often draw on theories of rhythm from Henri Lefebvre and temporality from Tim Ingold. Especially for rivers induced into non-perennial flow regimes owing to climate change or through extraction, there is a class of rivers that ultimately trouble notions of rhythm in explanations of human-river relations.

“Interrupted Rivers: Toward Intermittent Geographies” engages broader debates about activism, extraction, and climate change to argue that the challenge non-perennial rivers pose—intermittent geographies, generally—has broader implications for thinking about the multiple temporalities of rivers. Intermittent geographies interrupt the normative conflation of rivers and water flows in ways that are not about merely referencing ‘irregular’ times against those deemed—often made—uniform. There are also social relations that require thinking through intermittency, such as how river models may also naturalise ‘dryness’ in ways that shape social expectations of, and relations to, induced absence. Relations of presence and absence raise larger questions about time that require empirical work, and conceptual tools, but which also carry ethical implications for the ecologies of practice through which social scientists pay attention to non-perennial rivers.

River relations without water

This section presents some of the complexities of non-perennial rivers and contrasts these with the predominant social science approach to critical water studies: hydrosocial scholarship. It first reviews some of the biophysical and ecological dynamics of non-perennial rivers, with attention throughout to climate change, to consider how these are critical for social science research to apprehend and engage. It stages engagement with hydrosocial research through attention to time and temporality and considers how temporal considerations built on water's characteristics are challenged by rivers that run dry. Ultimately, the varied and generative approaches of hydrosocial scholarship that centre water's relations, materiality, and pluralities are complicated by non-perennial rivers in productive ways. To situate these concerns more concretely, the section analyses a case from Australia that scientists often identify as important to how non-perennial waters matter socially.

The factors affecting how and when non-perennial rivers stop and start flowing are multiple. In some cases, seasonality is a dominant factor such as spring freshets or monsoon rains. Diurnal differences also matter. Already in the mid-nineteenth century, Brown (1869) reported to the UK's *Royal Geographical Society* on the intermittent streams in the Pacific Northwest of North America, where daytime heating of alpine snowpacks led to strong evening flows in rivers that, by the morning, barely trickled if they flowed at all. Broader environmental factors are also important. For instance, determining when a non-perennial river is in 'drought' is difficult given that lack of water is not a reliable indicator (Sarremejane et al. 2022). Droughts do affect non-perennial rivers but without longitudinal data in regions experiencing higher than average rates of global warming, such as Europe, it is not easy to quantify drought parameters (Mimeau et al. 2025). Further, non-perennial rivers may lack water either naturally or owing to anthropogenic impacts, while the latter can also exacerbate the former (Datry et al. 2023a). For instance, groundwater extraction reduces subsurface water availability to maintain baseflows in rivers, and this can affect both the temporality of intermittent flows and the stream lengths affected along a river (Wöefle Hazard, 2022).

It also matters ecologically, and socially, which segments of a river run dry—both the location and length of dry areas in a watershed—and for how long, because these variables affect biodiversity and ecosystem tipping points (Datry et al. 2023b). Social and ecological concerns further matter owing to how non-perennial rivers are critical not only to groundwater recharge, but also to sediment transport, biota, and nutrient distributions (Shanafield et al. 2021). In the Pacific Northwest, groundwater changes owing to non-perennial rivers can be critical to biological lifecycles of salmon and other fish, for instance, that are of immense political and cultural importance to Indigenous peoples (see Larsen and Wöelfle-Erskine, 2018; Norgaard, 2019). As such, non-perennial rivers are not just of social or ecological concern owing to water quantity, they also impact biochemistry with consequences for water quality affecting drinking water, recreation, and ecological habitats (Zimmer et al. 2022).

In some cases, there is more predictability with respect to climate change impacts on intermittent flow regimes, with some river systems exhibiting a hierarchical response wherein certain river reaches consistently remain dry until after others resume flowing (Botter et al. 2021). Conversely, there are also important contributions of dry rivers to atmospheric greenhouse gases—which have only recently begun to be quantified for potential inclusion in climate models that often assume rivers comprised of perennially flowing water (López-Rojo et al. 2024). Ecological systems that evolved under conditions of flow intermittence may respond differently to, and be disturbed in different ways by, changes induced by anthropogenic forcing (Price et al. 2024). In places where previously perennial rivers are becoming intermittent, such as the UK, there are acute concerns for aquatic biodiversity (Stubbington et al. 2024). There are other complexities too, such as how sediment transport, nutrient availability, water temperature and (among others) affect aquatic and terrestrial biodiversity—and do so in different ways depending on when water flows (Bruno

et al. 2022; see also Foulquier et al. 2024). These complexities produce a variety of outcomes, including higher abundance and species richness on intermittent streams than those that flow perennially (Sánchez-Montoya et al. 2022). So, while climate change reduces local species diversity within some aquatic ecologies it can enhance regional species stability (combined aquatic and terrestrial) overall—an important outcome suggesting management scales must similarly adapt spatially to new intermittent geographies to conserve biodiversity across both aquatic and terrestrial ecologies (Gianuca et al. 2024).

As scientific research on non-perennial rivers has expanded across ecology and hydrology over the past decade there have been increasing calls for interdisciplinary approaches to understand the unique dynamics of these rivers in relation to society, policy, and management (Magand et al. 2020; cf. Leigh et al. 2016; Datry et al. 2014, 2017; Fovet et al. 2021). These calls raise important questions, and opportunities, for social sciences and humanities in research on non-perennial rivers. For instance, the ways that scientific disciplines frame policy and management concerns have long been the subject to scrutiny by social scientists. The concerns of critical water scholarship ranges—in an extensive literature only indicatively cited here—across considerations of epistemology, ontology, quantification, and rationality, through to spatial and scalar assumptions, and to broader questions of power, political ecology, economics, history, race, gender, and colonialism (e.g., Espeland, 1998; Warner et al. 2008; Bakker, 2012; Mehta, 2005; Swyngedouw, 2015; Lave and Doyle, 2021; Meehan et al. 2023; Lane, 2024). For many social scientists, a key conceptual outcome of these critiques has been to adopt positions advancing hydrosocial scholarship. Hydrosocial approaches are varied but share in the rejection of binaries between society and nature that have historically anchored putative claims to objectivity. Instead, hydrosocial scholarship situates water sciences, policies and management in social contexts. So situated, concerns of power, knowledge, coloniality, and inequality are approached in a range of ways, including social constructivism (e.g., Linton, 2010), political ecology (e.g., Boelens et al. 2016), co-production (e.g., Bouleau, 2014; Flaminio et al. 2022), and attention to broader historical contexts (racialised, gendered) of Indigenous cosmologies and colonial refusals (e.g., Acuña and Tironi, 2022; Wilson and Inkster, 2018; Yates et al. 2017).

Given the influence of hydrosocial research across social sciences and humanities—anthropology, environmental humanities, geography, history, and sociology among others—it is important to consider the challenges non-perennial rivers present. My argument here is that there are important ways that the focus of hydrosocial scholarship on *water's* materiality, relations, and plurality require modification to adequately understand dry rivers. In particular, the spatial and temporal flux between flow and non-flow of surface waters—intermittent geographies—evokes important considerations for how hydrosocial scholarship attends to time. Following ecologists and hydrologists, I neither make nor reinforce a physical distinction of rivers as either wet or dry. However, it is important not to derive social theory from those sciences. Not only for the reasons above, but also because numerous biophysical concerns remain open questions; as Zimmer et al. (2022: 1) note, for instance, “...non-perennial rivers are missing from most conceptual and predictive models of aquatic ecosystems.” I return to scientific models below; here, the focus is on the conceptual models of hydrosocial theories and consideration of how, focused as they are on water's materiality, they cannot fully account for non-perennial rivers.

Linton and Budds (2014: 170) influentially defined the hydrosocial cycle “as a socio-natural process by which water and society make and remake each other over space and time” through a dialectic that also recognised “the agential role played by water” (cf. Linton 2022). Long before, as Liao and Schmidt (2023) point out, human geographers attended to water's temporal dimensions: from work by Halford Mackinder in the early twentieth century through to Yi-Fu Tuan's (1968) classic text that tied nineteenth century ideas of the hydrological cycle as an eternal round to the divine economy of Judeo-Christian thought. Linton's (2010) influential work defined hydrosocial

studies in relation to the time-infused neologism of “modern water,” and a way of knowing situated within the temporal imaginations of modernity. Hydrosocial scholarship often foregrounds time to consider the many ways that social relationships ebb and flow in ways that are not predicted by hydrological cycles but instead coproduced through and co-constituted by spatial and temporal human-water relations (e.g., Boelens, 2014; Morgan, 2017; Rusca et al. 2025).

Hydrosocial scholarship also consistently attends to time through the materiality, plurality, and properties of water. Clark et al. (2017) treat water as a “time-substance” to theorise—following Serres—how water holds together, and folds together, multiple aspects of social and environmental change and transformation. Berry and Cavazos Cohn (2023) treat water as the site through which different temporalities compete, in their case across settler imaginaries and Indigenous cosmologies in the United States. Competing temporalities feature in numerous hydrosocial studies that focus on how water flows—social and material—are impacted by infrastructure, especially dams (e.g., Keough and Saidou, 2021; Lord et al. 2020; Rieber and Nyaga, 2025). Others treat various waters for their temporal impacts: Ley (2022) shows how time is critical to understanding stagnant waters that arise from coastal flooding in Java; Gearey (2024) argues that wetlands reflect a temporal palimpsest of human-environment relations, and; Whitt (2022) argues that forms of “cyclic dissonance” characterise interruptions, negotiations, and dangers to desynchronised water flows in Bolivia. In their influential concept of ‘riverhood,’ Boelens et al. (2023: 1127, original emphasis) stress that, in their view of hydrosocial science, the suffix (i.e., -hood) “denotes a temporal and/or continuous and unifying state, condition, character or period (as in *livelihood*, *childhood*, *sisterhood*, etc.).” Accordingly, the various states of riverhood are intrinsically temporal even as they are contested and reworked. Most strident perhaps is Wantzen (2024:3), who argues for a view of “river culture” anchored in the idea that “multiannual flood-drought rhythms,” variable water flows, and different concentrations of dissolved substances are part of a “rhythmic pattern [that] is universal to any kind of aquatic ecosystem.”

Is there a universal rhythm to rivers? Not unless explanations can account for rivers without the water that animates hydrosocial theories. Some non-perennial rivers run dry only a day per year, many for longer, and others at unpredictable intervals. It is too simple to note that, in exchanging the ‘hydrological cycle’ for ‘hydrosocial relations’ the watery prefix ‘hydro’ was retained uncritically. Camargo and Cortesi (2019) argue the emphasis of hydrosocial theory on water’s chemical composition biases it towards an emphasis on the social construction of water (*qua* H₂O) at the expense of the ecological aspects of rivers as a sediment mover, habitat, or ecosystem. They use flood dynamics to further attribute conceptual shortcomings to the overburden of watery metaphors—flow and cycle especially—in hydrosocial theory. Metaphors, of course, always impact how social and physical scientists think because they are a feature of language (Lakoff and Johnson, 1980). This includes the floods that occupy Camargo and Cortesi, as well as Scott’s (2025) work “in praise” of how floods disrupt presumptively modern times. But there is another consideration that can be discerned in the case of non-perennial rivers. Namely, an adequate social theory of rivers must attend to rivers as they are—as rivers that may flow perennially and non-perennially. As such, an adequate social theory of non-perennial rivers must treat the absence of water in terms that are as relational as water’s presence.

The multiple dynamics of non-perennial rivers mean water is present and absent at different times across a range of considerations for species, environments, and hydrological regimes at and below Earth’s surface. These temporalities do not stop and start with surface water flows because non-perennial rivers are not binary; lack of surface water is not an absence any more than flow is a presence. For cases where flow intermittence is induced through anthropogenic forces of extraction or climate change, absences also constitute losses to humans, other species and biophysical processes. These losses open theoretical considerations of ‘negative ecologies’ and of how environmental knowledge is often forged in response to (and in the aftermaths of) anthropogenic

disruptions (Bond, 2022). Loss also matters to the ‘negative geographies’ that seek to rebalance the emphases on non-human agency in emancipatory scholarship with considerations of absence, limits, and finitude (see generally: Bissell et al. 2021; Greaves, 2024). Doğmuş (2026), for instance, argues that the loss of water in lakes—an increasingly global phenomena (Yao et al. 2023)—is a world-disrupting event that requires a new political ontology to think about how ‘loss’ reorients relations, ecologies, and considerations of justice. Boelens (2026) points out that a new political ontology of ‘loss’ will also force a change to ontologies of abundance, scarcity and extraction affected by said losses. These other categories must bend around a new account of the ethics of remembering losses; memories often erased in power struggles over how accounts of human-water relations are documented, preserved, or told (see Matthews, 2025).

Losses are not always experienced or known in the same way. Accordingly, it is important to naturalise neither water’s presence nor its absence in non-perennial rivers. Concern with water’s relational presences and absences holds important consequences for anticipating considerations of justice that arise owing to water loss for rivers induced into non-perennial flow regimes. This is because, as Dotson and Whyte (2013) argue, many losses are *unknowable* owing to the profound impacts they can have on entire worlds, such as those of Indigenous peoples. This unknowability matters to relational obligations because there are lived forms of interdependence with non-humans that are non-negotiable within particular social worlds. The relational specificity of *those* social worlds exceeds the capacity of those who are outside of them to know what *those* losses entail. These unknowable losses, however, must not be excluded *a priori* by social theories of rivers, especially owing to the long-standing relations of Indigenous peoples to non-perennial rivers. As I show through a case study from Australia, non-perennial rivers require a more nuanced conceptual disposition.

Australia’s todd river

Over 70% of the rivers in Australia are non-perennial; a number increasing as climate change impacts Earth’s driest continent (Shanafield et al. 2024). Indigenous peoples in Australia have managed non-perennial rivers through multiple technologies and with multispecies relations for thousands of years (Jackson, 2023). Many of these practices have been severely constrained and oppressed through colonisation, while the different temporalities of Indigenous cosmologies and settler colonial imaginaries now complicate contemporary management challenges (see Hartwig et al. 2021). Amid this complex history, many scientists working on non-perennial rivers—notably, however, not Shanafield et al. (2024) who focus on Indigenous knowledges—cite the cultural importance of non-perennial rivers in Australia in reference to one river, and one event in particular: the Henley-on-Todd Regatta. Here, I use this reference point to consider how and why explicit social science attention to non-perennial rivers, and intermittent geographies, is needed.

The Henley-on-Todd Regatta has been held on the Todd River in the Northern Territory of Australia near Alice Springs for the past six decades. The river is dry and the ‘boats’ are propelled, according to the event website, “Flintstone style.”² That is, without bottoms so participants can use their feet to travel the sandy channel. Although ecological and scientific publications frequently highlight the regatta to show why non-perennial rivers matter socially, research into social relations on the Todd River are less well-developed (cf. Steward et al. 2012). This can result in well-meaning attempts by scientists to demonstrate the importance of non-perennial rivers, and their attendant values, perpetuating forms of erasure. For instance, in one of the few social science examinations of the Todd River’s non-perennial nature, Cottet et al. (2023: 146) describe the regatta as a “festive event likely to create a positive emotional history with the Todd River, and therefore the conditions of a social reinvestment in this intermittent river.”

Focusing on recreational events as moments of social reinvestment and historical connection contrasts sharply with how Indigenous histories and relations to the Todd River are affected by,

and structured through, settler-colonial violence. For instance, Perera and Pugliese (2011) situate the dry riverbed of the Todd River differently, identifying how it has long been a space where Indigenous peoples camp and live together. It is also a site of colonial genocide—from the 1928 Coniston massacre to more recent acts of racial terror, including an incident where white men drove at speed through an Indigenous camp where people were sleeping. Their violent actions led to the death of Kumantaye Ryder in 2010. Perera and Pugliese's (2011) analysis of these events attends primarily to the court ruling that followed Ryder's death yet does not erase the importance of place-based relations. These, Perera and Pugliese (2011: 77) argue, show how "relations of racist violence...inscribe the cultural geographies of dry riverbeds" as settlers dispossess Indigenous peoples of lands and relations.

Longer histories of how social science has extracted knowledge from Indigenous peoples in the region also matter to the Todd River. Wolfe's (1999) classic account of anthropology's alliance with, and co-production through, settler-colonialism details how local Arrernte beliefs regarding reproduction influenced nineteenth century accounts of totemism, which were used to construct hierarchical explanations of social evolution. Lynch (2015) shows how the lexicon of colonial travel writers foundered when describing the Todd River to audiences in the UK; a river "strangely" unlike the Thames that eventually became known as the "odd Todd river of sand" (see also Burke, 2019; Lynch, 2022). Reckoning Eurocentric histories and institutions has led to other engagements with the Todd River, such as Kanamori's (2010) reflections as a Japanese migrant and artist seeking appropriate relations with Indigenous peoples a region permeated by colonial power relations.

This example from Australia—from Country, as it would be held across numerous forms of Indigenous praxis within and beyond the academy (Bawaka Country et al. 2016)—helps illuminate why work on non-perennial rivers is not merely a matter of 'adding' social science or humanities research to environmental or biophysical sciences. Yet non-perennial rivers are also not cases where hydrosocial theories premised on and through water's material flows can be extended in a straightforward way either. Instead, there is a need for the unique ecologies and relations of these rivers to be understood in ways appropriate to them. In Australia, Maclean et al. (2018) argue for enhanced appreciation of the 'shadow waters' pushed to the margins by dominant cultural norms. Applied to intermittent geographies, this would mean including the ways that social science scholarship often conflates rivers with perennially flowing surface water and, in so doing, cast shadows over non-perennial rivers. This is not a minor tweak. The analytic priority assigned to the water's flows and its 'agential' dimensions requires potentially significant modification to hydrosocial accounts (e.g., Götz and Middleton, 2020; Jackson and Head, 2020). To think about the 'negative geographies' of water losses as relational losses—knowable and not—is thereby to also free up space to think with and through both relational presences and absences of water.

Intermittent geographies can help illuminate co-constitutive relations to non-perennial rivers. For instance, confronting travel writing regarding the Todd River, one premise of intermittent geographies is that, owing to how perennially flowing rivers aren't the empirical norm, neither should notions of 'flow' be naturalised in relations to rivers. In this sense, it is important to emphasise that non-perennial rivers are not aberrations. Their treatment as such is, in many cases, an uncritically accepted extension of inadequate environmental imaginaries. One similar, perhaps, to the ways that arid lands in general have been racialised and water practices therein marginalised, such as in naturalisations of "Black as drought" that still affect programs of international environmental governance (Meché 2022; cf. Davis 2016). Instead of treating social relations to non-perennial rivers as an exception, or exchanging the naturalisation of perennial rivers with wetness for the 'dryness' of non-perennial rivers, it is important to highlight how paying attention to these rivers shifts the entire ecology of practices through which rivers become matters of concern for different fields of social inquiry that largely ignore what are the most common types of rivers on Earth.

Rivers without rhythm

The temporalities of rivers are critical to social relations. Monsoon floods, slowing meanders, and sediment deposition in South Asia are all important to how rivers affect history, property, social processes, and urban and agricultural economies (Bhattacharyya, 2021; Lahiri-Dutt and Samanta, 2013; Roy, 2022); Amrith (2018) argues water possesses its own “chronology” both seasonal and episodic. In western environmentalism, the temporal rhythms of rivers have anchored ecological values, such as Leopold’s (1966: 198) memorable phrase in *Round River* that “the floodplain belongs to the river.” This section presses for a consideration of temporality that does not naturalise the flow of water to a putatively ‘natural’ rhythm of rivers and makes the case that, for some non-perennial rivers, there are no predictable periodicities. That is, there are rivers without rhythm. As I build the case for these points, I establish a further element of intermittent geographies as a non-foundationalist concept: intermittence shorn of expectations regarding recurrence, repetition, or return. Intermittence is not a binary—not on or off. To show how intermittent geographies unsettle the naturalisation of rhythm, while pointing towards an appreciation of the complexity non-perennial rivers present, I engage recent works that develop relational approaches to time, and relational values for water. These works eschew the idea that rivers are objects to which subjective social imaginations of time are either derived from or merely applied to. As with relational values more generally, they identify—insist on—relation itself as the site of analysis (cf. Muraca 2016). I show how some non-perennial rivers also fit this schema, and how citizen science has been critical to such understandings. Then I consider the more difficult case: rivers without rhythm.

River, time, and rhythm

How do rivers relate to temporality? There are many thorny ways owing to the complexity of time, and rivers. For instance, the “river of time” has long been unsatisfactory yet indispensable to philosophers (see Smart, 1949). Social scientists, like Adam (2005), identify the multidimensional nature of time with respect to environmental phenomena and their intersections with temporal modalities of industrialisation, risk, economy, householding, and so on. To complexity must be added competition, such as the competing times Forigua-Sandoval et al. (2025) discuss in their examination of ‘hydrotemporalities’ in territorial conflicts about fishing that involve various modalities of time, from biorhythms to those of production, labour, technology (e.g., maintenance/replacement) and remembrance. Others, such as Volynova (2024) show competing times do not scale to one another in Russian dam conflicts, while Drapier et al. (2024) show how contests over dam removals evoke temporal divergences across heritage, memory, and (re)emerging riverscapes. Dam removals not only upend efforts to comport rivers to modernity; they also place scientists, and their values, as key to what counts as ‘river restoration’ (Rhoads, 2026).

Recently, Jackson et al. (2022: 951, original emphasis) coined the idea of the “rhythmicity of rivers,” which they define “in terms of flows...as periodic, recurrent phenomena of a riverscape that are synchronized with the rise and fall of river water, creating regimes of *river time*.” Rhythmicity, they argue, can be thought of through many theoretical vantage points useful for unpacking the co-evolution of relations between people and rivers. It is a powerful idea, yet as I will show there are ways in which the many non-perennial rivers characteristic of such relations are an uneasy fit with it. To begin, Jackson et al. (2022) engage Ingold’s (1993: 152) argument for ‘dwelling’ as a category that moves beyond binaries in which landscapes are rendered as natural backgrounds to human action, or which take “the culturalistic view that every landscape is a particular cognitive or symbolic ordering of space.” For Ingold (1993; 2000), dwelling is instead a way to think with and through the shared lives of people, other species, and environments as they jointly produce a record of lines and lives lived together. Landscapes, then, are temporally and

qualitatively *lived* rather than environments merely subjectively experienced or encountered through cultural practices.

In Jackson et al.'s (2022) account of "river time" rhythm is everywhere. Drawing on Ingold's approach to landscape, they argue for a parallel with riverscapes insofar as time is understood as jointly enacted in a mutual relation of humans and rivers; here, rivers are anchored by water but extend to other species, their actions, ecological processes, and so on. For Jackson et al. (2022; 2025), aligning the land/riverscapes of river time to the periodicity of water flows draws crucially on Lefebvre's notion of rhythm. As Lefebvre (2004: 25, original emphasis) argued, "[e]verywhere there is an interaction between a place, a time and an expenditure of energy, there is *rhythm*." Underpinning Lefebvre's (2004) view is a significant challenge posed by water. However, and in contrast to Liao and Schmidt (2023), who note that Lefebvre (1991) at first considered, then rejected the idea that hydrodynamics could anchor the production of space, we can find in Lefebvre's later work a return to water and rhythm. In *Rhythmanalysis*, Lefebvre (2004) argues rhythm can be critically grasped precisely by looking at waves on the sea. These come in succession, each with its own unique and changing internal composition. Further, waves superimpose upon one another as they advance and retreat from shorelines. Interpenetrating waves, for Lefebvre, are indicative of broader rhythms ranging from wind and water through to seasonality. Critically, it is through such *rhythmic relations* that space is produced in Lefebvre's account.

The idea that waters, and times, operate across interpenetrating scales is also key to how Jackson et al.'s (2022) notion of "river time" draws on the work of Krause (2022a), who takes up Lefebvre's notion of rhythm to think through how solid flows on the (often frozen) Mackenzie Delta in northern Canada affect Inuit ideas of temporality. Inuit temporalities have long puzzled western researchers, yet Krause doesn't engage Inuit temporal practices more broadly, such as how Inuit people have been known to keep multiple clocks all set to different times (see Stevenson 2014). Time is only one part of Indigenous cosmologies that do not fit neatly to notions of time. As Indigenous geographers have argued, sharp divisions of land from water also do not capture Indigenous understandings, obligations, or relationality (Daigle, 2018; see also Tynan, 2021). Krause (2022a), however, parses out a focus on how solid waters, like permafrost and ice, flow in ways that must be thought of for what they reveal of interpenetrating human-environment temporalities. These flows of water range from the near immobile through to the rush of the Mackenzie River, which reaches 6 km wide at points. In work in Europe, Krause (2022b) further engages Ingold (2010) and Lefebvre to argue that rhythm is at the heart of how the land-water nexus is not merely a hybrid of different objects; instead, human-water relations emerge through the ways that humans and non-humans temper one another, and in so doing produce rhythmic temporalities. Across these engagements, Krause's arguments prove central to Jackson et al.'s (2025) subsequent work on how the seasonality of rivers offer additional insights into temporal rhythms.

Non-perennial rivers complicate the use of water flows—solid or liquid—as temporal signifiers. Without water to animate accounts of rivers and time, one might ask, where is rhythm? For at least some non-perennial rivers, there is a certain amount of predictability regarding when waters typically flow, such as spring melts or rainy seasons. There is not, however, sustained social science research on such rivers nor comparative work that would help to situate the differential ways that non-perennial rhythms are known and related to. This kind of empirical work is critical to understanding the modalities of time at stake in intermittent geographies either naturally occurring or anthropogenically induced. Currently, some of the strongest social accounts of these relations come not from academic studies but from citizen science initiatives. For instance, citizen scientists in the US state of Arizona annually map Cienega Creek, the San Pedro River, and Agua Fria River. Each June, citizens walk these rivers and use hand-held global positioning units (GPS) to record where surface water begins and ends (regardless of whether the water is flowing or stagnant). For scientists, the data sets built up over time by these citizen scientists has been key to augmenting

the lack of studies on long-term patterns of intermittent river systems. That lack of data has meant that “in many cases we [scientists] lack even a basic understanding of how much temporal variability in drying patterns exists in intermittent rivers, much less what factors are responsible for such temporal variation” (Allan et al. 2019: 245). The mapping of non-perennial rivers by citizen scientists has also spawned numerous attempts to enrol the public in similar data collection projects, such as smart phone applications (apps) in North America and Europe that allow people to contribute observations on watercourses where gauges and metering devices are less likely to be in place (Truchy et al. 2023).

It is vital to encourage social science and humanities research into non-perennial rivers. This is especially so where social perceptions of non-perennial rivers have been recognised as key to understanding socio-cultural values and their geographic variability (Jorda-Capdevila et al. 2021). Leigh et al. (2019) examined how student curricula affect perceptions of non-perennial rivers, and surveyed students to understand how the values of non-perennial rivers for ecosystems and communities are enhanced through education. In a study of perceptions of non-perennial rivers, Rodríguez-Lozano et al. (2020) found university students valued them less in comparison to perennial rivers and called for increased attention to their unique ecologies and dynamics to further environmental protection. Wölfe Hazard (2022), part of that study of university student perceptions, has argued that queering understandings of rivers, and river science, is key to rigorous, relational engagement with how multiple species, Indigenous peoples, and states might respond effectively to the challenges of non-perennial rivers. A critical step towards encouraging further research is to confront ideas that naturalise rhythm to water flows by probing and problematising intermittence.

Denaturalising rhythm: Towards critical intermittence

One everyday sense of being ‘naturalised’ refers to making something appear natural despite its not being so. Schmidt (2017) argues water was naturalised as a ‘resource’ through a convergence of liberalism, anthropology and geologic temporality in ways that makes it difficult for many people not to think of it as a ‘natural resource’ even if they acknowledge water can be other things too. In this section I argue that a key contribution of intermittent geographies is that it denaturalises rhythm as a normative mode of thinking about rivers. The claim is not that no non-perennial rivers have rhythm, but rather that some do not. Because the latter category may include non-perennial rivers that, owing to climate change and extraction, are increasing in number and scope, it is critical to consider how we might pry apart the assumptions that relations of rivers and time are naturally explained in reference to rhythms of water flow. The next step is to develop a critical approach to intermittence in which water’s absence is not merely ‘time-in-waiting’ for the return of flows. Absence has its own relations. So too do relational losses induced by ‘time-in-want’ that takes shape owing to direct and indirect anthropogenic forces. Some of these times and relations, as anticipated above, turn on how rivers are modelled and the pasts, present interventions, and futures imagined and coproduced through them.

Part of denaturalising rhythm involves revisiting Lefebvre’s ideas, which underpin the arguments of Jackson et al. (2022; 2025), Krause (2022a,b) and others who approach rivers by foregrounding rhythm, such as studies that examine the Thames in England (Jones 2010), the Mesna River in Norway (Gundersen et al. 2021), water infrastructure histories (Engels 2022), and the extremes of vanishing lakes and irrigation flooding in Bolivia (Whitt 2022). Here, it is essential not to conflate Lefebvre’s theoretical account of rhythm with its applicability. That is, with whether it is the case that, as Lefebvre (2004: 25, original emphasis) asserts, “[e]verywhere there is interaction between a place, a time and an expenditure of energy, there is *rhythm*.” There are numerous counter examples that meet Lefebvre’s criteria, where energy is expended in interactions of time

and place yet without rhythm. This is the case for phenomena both watery and not; phenomena likely to happen again, but which are not rhythmic in the sense of being recurrent, cyclical, repeating, and so on. Lightning strikes lack Lefebvre's sense of rhythm although they are sure to happen again and involve energy, time, and place in unique relations. Many meteors hitting the earth similarly lack rhythm, although there are some recurrent meteor showers his theory would capture if appropriately extended. Earthquakes are another example, particularly those induced by human activities such as wastewater injection in extractive activities like hydraulic fracturing for natural gas. Thermonuclear detonations started something entirely new on Earth, happened for a time, and may well happen in the future, but to say they have rhythm would seem odd despite their profound effects on energy, time, and place (see Kanngieser and Todd 2020). So, even if one agrees with Lefebvre (2004) that cycles of life, death, and dissonance are indicative of rhythm, not everything that meets his theoretical desiderata is an appropriate phenomenon for his theory to apply to. These counterexamples point toward the need to think about biophysical phenomena, and human-environment relations, that aren't rhythmic even though they meet the criteria that Lefebvre liberally extends to "everywhere" they are found.

The bare fact that something can happen more than once is not enough to establish rhythm. There is a class of non-perennial rivers for which this is also the case. These are not the non-perennial rivers with water that flows annually, or seasonally, or regularly after precipitation events. Rather, these are non-perennial rivers that flow sporadically and unpredictably, including those affected by forces of extraction and owing to climate change. For this class of non-perennial rivers, the fact that water flows at one time and then another should not be conflated with having rhythm. This is not to say that when the complex meteorological, geological, or land cover relations impacting non-perennial rivers converge to induce flow that it is something out of the ordinary (see on controls: Costigan et al. 2016). Rather, it is to open social science research to the possibilities of treating intermittent geographies on their own terms, rather than as deviations from a normative view of rivers as rhythmically flowing water.

Rivers without rhythm occur naturally and are increasingly induced into intermittent geographies owing to extraction and climate change. Extensive groundwater pumping, which now contributes more to sea-level rise than ice cap melting, is radically altering the relationships between surface and subsurface flows of water (Chandanpurkar et al. 2025). Conversely, enhanced understanding of precipitation sheds—the aerial equivalents of terrestrial watersheds that capture and direct water flows—makes clear that drivers of both evapotranspiration (i.e., drying) from some areas and precipitation in others is driven by human activities and induces new atmospheric and terrestrial water regimes (Keys et al. 2012, 2024). China currently deploys an atmospheric army of devices that are used to induce rainfall in the Himalayas—including in areas where it has not previously naturally occurred with the same frequencies (see Simon et al. 2023; Yeh 2022). These regime shifts operate on temporalities that draw together all of Lefebvre's elements, yet it would be peculiar to argue that they are rhythmic and not, instead, an outcome of contingent actions that intermittently impact water flows based on when and how technologies are applied. There are longer scale changes too, such as the radiative forcing on glacial melt as climate change impacts the water system, which Milly et al. (2008) argued combined with other human interventions in ways that meant key hydrological ideas, such as stationarity, were no longer viable (Savenije et al. 2014; Vörösmarty et al. 2013). Importantly, there is no guarantee of rhythmic return owing to the potential for climate change to exceed tipping points that operate on temporal scales that exceed, by orders of magnitude, the totality of human existence on Earth (Steffen et al. 2018). The existential comparison is not for rhetorical effect, but to throw into relief the temporal scales upon which intermittent geographies might play out, in this case with respect to rivers (and reaches of them) that become non-perennial.

Determining how intermittent geographies might play out for non-perennial rivers also requires attending to how models extend to, and construct, future scenarios. The challenges are significant.

Allen et al. (2020) note models typically do not explicitly address intermittent flows or drying events; reviewing 18 river models, they identified numerous challenges regarding: longitudinal relationships along rivers; lateral connections to terrestrial ecosystems; vertical connections of surface and groundwater, and; temporal scales of landscape dynamics. Price and Kaiser (2026) note process-based models (which represent hydrological processes through mathematic equations derived empirically) largely fail to capture the behaviour of non-perennial rivers, especially in arid areas. Social scientists raise further concerns over how models constrain or compel different futures. For instance, de Jong et al. (2025) show how model scenarios on the lower Magdalena River in Colombia presumptively function as baselines for contested understandings of futures with less, or no, water in wetlands. Visions of ‘progress’ have likewise long been premised on intentional drying and draining of lands for colonialisation and empire (e.g., Blackbourn, 2006). Eco-modern revisions to colonial imaginaries, however, present new challenges, as Atkins (2026) shows by examining the political ecology of heavily engineered urban rivers. What is at stake across empirical models and critical engagements is how plural futures of non-perennial rivers are fit—or not—with the powerful ways that models shape understandings of human-environment relations (Alba et al., 2025; ter Horst et al., 2024).

Non-perennial rivers may have rhythm or not. Intermittent geographies offer a conceptual tool to denaturalise rhythm and to think across the ways that time, space, and energy are not only interpenetrating, as in Lefebvre, but also subject to two dynamics. One is interruption, such as through anthropogenic forcing such as groundwater or surface water extraction and the effects of climate change. The other, however, reflects that fact that some non-perennial rivers are not rhythmic in the sense articulated by Lefebvre, or in the vernacular meanings of the term. In this context, intermittent geographies offer a vocabulary alert to river plurality. Rivers naturally non-perennial in different reaches, at different depths, and over different times. Rivers that have had perennial water flows but now, owing to anthropogenic forces, are part of the majority class of the world’s rivers that have intermittent flows.

Interrupted rivers, toward intermittent geographies

Non-perennial rivers present significant reasons for social theory to hesitate over relations to rivers as naturally flowing. There are many cases where it is entirely appropriate to think about rivers through water flows, as having rhythm, and so on. Yet these capture neither the entirety nor the plurality of what rivers are. In one sense, non-perennial rivers complicate river ontologies, especially those wherein the categories of what exists—biophysically, discursively, relationally—are normalised to social worlds that presume upon perennial river flows; Boelens et al. (2024: 655) argue that defending rivers through the “right to flow,” such as in the 2017 Universal Declaration of the Rights of Rivers, leaves little room for rivers that “naturally run dry during a large part of the year.” By contrast, a right to not flow is not guaranteed for naturally non-perennial rivers even though many are artificially supplied by systems of dams and reservoirs that use ‘low flow augmentation’ to treat rivers as nature’s sewers (cf. Benedickson, 2007). These are also important issues for examining contemporary contests over dam removals—aging infrastructure, generally—in which efforts to restore river connectivity should not be conflated with water flows (see Hommes, 2022). There is a further reason to hesitate because the lack of social science and humanities research discussing non-perennial rivers as such does not mean they are not already studied in different ways that seek to attend to practices of social life. Accordingly, this section discusses considerations that arise most acutely owing to how climate change is shifting river flows and how extractive practices are altering once-perennial rivers such that they have become, or are at risk of becoming, intermittent.

There are many social relations to non-perennial rivers practiced by peoples and cultures, and which are now shifting owing to climate change. Even those non-perennial rivers that have been

historically undervalued, such as in Spain, are nevertheless important contributors to local understandings of the good life (Nicolás-Ruiz et al. 2025). Non-perennial rivers can also be sites of urban renewal, as in Bhopal (Khan et al. 2021). They are critical to establishing toponym registers that effectively capture local descriptions of environmental relations, and for establishing baselines for wetland management and species conservation in Brazil (Castiglioni, 2018; Polaz et al. 2017). Under conditions of climate change, however, many new practices are also critical to understand as intermittent geographies are produced at multiple scales. For instance, the construction of ‘artificial glaciers,’ or ice stupas, in the Himalayas has been one response that seeks to augment the lack of streamflow owing to glacial retreat by stockpiling ice (Nüsser et al. 2019; Sharma, 2019). Elsewhere in Ladakh, caring for glaciers is tied closely to social relations, religion, and landscape ethics in which reciprocal relations matter whether water seasonally flows or not (Gagné 2018, 2020). These relations point to what Gagné and Rasmussen (2016) argue are ‘amphibious’ relations where water and land converge in the production of space (see also Camargo et al. 2025). Downstream, parts of the Himalayas are headwaters for the Ganges, which has experienced unprecedented millennial drying, and which has distributaries across the Sundarbans well known for their shifting river courses and landscapes, and in which non-perennial rivers are part of the lived social and economic fabric of environmental relations and economies old and new (Bhattacharyya, 2018; Cons, 2025; Lahiri-Dutt and Samanta, 2013; Singh et al. 2025).

The lived intermittent geographies of climate change pose deep challenges to social notions of time and landscape. The 2019 funeral service held for the Okjökull Glacier in Iceland has prompted reflections by artists and anthropologists on how it entangles the loss of water flows—glacial ice and meltwater—on scales at once geological and human (Howe and Boyer, 2024; Magnason, 2020; cf. Boelens, 2014). Claims about geosociality—the idea that geological and social scales of time increasingly run together (Clark and Yusoff, 2017)—often foreground metaphors of the loss of geologic stability. For glaciers, they are qualified by the loss of solid and liquid waters and prompt rethinking of what kind of loss is being experienced, by whom, and for which social worlds (Schmidt, 2021). In proposing intermittent geographies, one core concern is to think critically about temporalities that do not fit with rhythmic, cyclical or otherwise predictable norms, or what Bulkeley (2019) describes as ‘climate-as-condition.’ Therein, climate change is not an external phenomenon but instead a lived condition of social life in ways unique to it, but intersecting with, conditions of gender, class, race, coloniality, and so on. Intermittence, from this perspective, is a lived condition with respect to non-perennial rivers in many places already, and increasingly so for those human-river relations induced into new flow regimes owing to climate change.

Intermittent geographies respond to the extraction that induces perennial rivers into non-perennial flow regimes. This includes denaturalising ‘wet/dry’ binaries and model futures discussed above. It extends to how extractive relations affect and are affected by plural river temporalities. Extractive relations affect non-perennial rivers in many ways such as surface and groundwater withdrawals for irrigation or mining. But there are other facets and temporalities too, such as mining operations where dry riverbeds flush pollutants to downstream lagoons when rain arrives (Cuevas et al. 2023). There are also temporalities that pace the rapid expansion of data centres, which require significant amounts of water for cooling (Diaz Bejarno and Valdivia, 2026). Unlike non-perennial rivers where absence is not time-in-waiting for surface water flows, rivers induced into non-perennial regimes through extraction experience time-in-want. For rivers experiencing water loss, the temporalities of direct extraction has immediate effects while those of climate change are longer, uneven, and often stretched through hydrological drought extremes. Intermittency, here, involves plural temporalities that crisscross human-environment relations in ways that make future scenarios and models of them contested terrain (Adams, 2005). Distinguishing ‘not waiting’ from being ‘in want’ in a critical approach to intermittency opens research to further points of purchase to issues of ethics and injustice that arise when neither water’s

absence nor its presence are naturalised. Ethical concerns arise in different ways, and at different temporal scales, owing to relations of both absence and presence. Empirical attention to multitemporal scales will need to increase in view of accelerating water extraction and given an estimated 4000 glaciers are predicted to vanish annually between 2041–2055 owing to climate change (Van Tricht et al. 2025).

Geographers have been pushing for some time at questions regarding what a natural river is given anthropogenic forcings on rivers, both through direct interventions and indirect forcings through climate change (Wohl and Merritts, 2007). Intermittent geographies provide a language for further understanding how anthropogenic forcing bends understandings of what a river is owing to how it identifies emerging concerns in reference to an underappreciated condition; namely, the condition of most of the world's rivers being characterised by intermittence and more rivers expected to join their ranks. However, the idea of intermittent geographies does not begin by departing from an uncritically accepted norm about rivers as water flows or draw binary distinctions in which the start or stop of flow necessarily equates to continuity or discontinuity. Instead, intermittent geographies appreciate that non-perennial rivers come in many forms. Aridity and drought are prevalent reasons why rivers may lack water, but so too are icy conditions. Under conditions of climate change and other modes of anthropogenic forcing, such as groundwater abstraction, the inducement of non-perennial flow regimes involves multiple temporalities and relations that interrupt naturalised explanations of what a 'river' is or is not. Here, notions of environmental temporality, which Adam (2005) argued must not lose touch with lived social realities even as they incorporate multiple temporal scales, create opportunities to think through intermittent geographies not only with respect to rivers, but also other phenomena where rhythms or cycles do not adequately explain human-environment relations.

Conclusion

Relations to water are not coeval with relations to rivers. Intermittent geographies provide a tool for thinking of non-perennial rivers in ways consistent with, but not reducible to, how hydrologists reject sharp divides between surface and subsurface flows. Intermittent geographies index an understanding of rivers—other phenomena too—without the presumption that they necessarily operate rhythmically. Some do, but not all. Those phenomena that do not require social theories that treat them on their own terms and not as deviations from the norm. Amplifying an appreciation of how globally widespread non-perennial rivers are distributed is also important for arresting the extent to which the prefix 'hydro' premediates relations to rivers through the anticipatory work done through categories and concepts prior to encountering something (see Grusin, 2004).

Intermittent geographies are inherently temporal, and meant to capture sporadic, fitful spatial formations that increasingly characterise Earth system responses to anthropogenic forces. Intermittent geographies is an idea borne of a need to explain phenomena, such as non-perennial rivers, that have not received significant attention despite their global distribution and which do not fit easily with prevailing categories of, or frameworks for, explanation. Non-perennial rivers are not a static category; rivers are currently being induced into flow intermittence in novel ways owing to anthropogenic impacts across the hydrosphere. This article is an effort to draw attention to a critically overlooked area of social science and humanities research on rivers and to propose a conceptual orientation that does not merely add non-perennial rivers to a growing list of environmental concerns. Instead, it seeks to show how treating intermittent geographies on their own terms requires rethinking a range of starting points that critical scholars frequently use, but which might be put to new kinds of scrutiny in view of what there is to learn from the many non-perennial rivers the world over.

Highlights

- Non-perennial rivers are common everywhere on earth, yet are not captured by existing theories in critical environmental scholarship
- Notions of temporality used to explain river rhythms require amendment owing to the intermittent dynamics of rivers that run dry
- Climate change, and other anthropogenic impacts, are inducing more rivers into intermittent flow regimes in ways critical to understand

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1. Non-perennial river research networks include: Science and Management of Intermittent Rivers and Ephemeral Streams (<https://smires.hub.inrae.fr/> last accessed 12 August 2026).
2. The Henley-on-Todd Regatta website: www.henleyontodd.com.au last accessed 12 August 2026.

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