Infrastructure and the environment in anthropology

Alessandro Rippa [ID]

University of Oslo, Norway; Ludwig Maximilian University of Munich, Germany

Abstract

This article maps out a nascent field that is currently taking shape, one that bridges anthropological considerations of infrastructure, political ecology, and science and technology studies with transdisciplinary approaches to ethics of care beyond the human. This emerging field stimulates a re-thinking of the relationships between the built and the non-built environment and encourages exploring infrastructure as indexes by which to grasp, ethnographically and methodologically, the Anthropocene. In this article, I outline and review this field, paying particular attention to the multiple legacies that inform current anthropological research on the relations between infrastructure and the environment. In doing so I mobilize *environing* infrastructure as a guiding framework of analysis – a notion I borrow from recent scholarship in environmental history and that helps appreciating infrastructure as historically specific multi-species formations.

Keywords

Anthropocene, anthropology, anthropology of infrastructure, environing infrastructure, environment, environmental, envirotech

Résumé

Cet article dresse la carthographie d'un champ naissant qui prend actuellement forme et qui fait le lien entre les considérations anthropologiques sur l'infrastructure, l'écologie politique et les études sur la science et la technologie, et les approches transdisciplinaires de l'éthique du soin, par-delà l'humain. Ce champ émergeant incite à repenser les relations entre l'environnement bâti et non bâti, et à explorer les infrastructures en tant qu'indices permettant d'appréhender l'Anthropocène, d'un point de vue ethnographique et méthodologique. Dans cet article, je décris et passe en revue ce champ, en prêtant une attention particulière aux multiples héritages qui nourrissent la recherche anthropologique actuelle sur les relations entre l'infrastructure et l'environnement. Ce faisant, je mobilise l'infrastructure environnante comme cadre

Corresponding author:
Alessandro Rippa, Department of Social Anthropology, University of Oslo, Moltke Moesvei 31, 0851 Oslo, Norway.
Email: alessandro.rippa@sai.uio.no

d'analyse – une notion que j'emprunte aux travaux récents en histoire environnementale et qui permet d'apprécier les infrastructures comme des formations multi-espèces historiquement spécifiques.

Introduction

The anthropology of infrastructure is becoming an increasingly prominent sub-field within the discipline. Interrogating the reasons for such conspicuousness, Dominic Boyer (2018) points to the impact of human activities on the planet and thus addresses the 'conceptual promise of infrastructure' as a 'partial figuration of still deeper concerns about life in the Anthropocene' (p. 226). In an optimistic vein, Boyer then suggests that this turn toward infrastructure might well signify an attempt to 're-arm' the discipline for the current times, and this scholarship should thus be placed within broader post-humanist and multi-species turns across the social sciences.

This article takes Boyer's insight as a point of departure to address the emerging infrastructural turn *within* studies of human–environment relations in anthropology and beyond. In doing so, it maps out recent efforts to bridge two key disciplinary debates on the subject: between the anthropology of infrastructure and environmental anthropology. In the former, the relational and processual dimensions of infrastructures have long been recognized as 'world-making' (Carse, 2017; Harvey et al., 2017), yet scholarship on this 'world' remained until recently confined to the *human* orbit of culture and politics. In the latter, considerations of human–environment relations have generally avoided conceptualizing the material and technical systems that mediate and shape such interactions (Blok et al., 2016). Put it another way, infrastructure and the environment, as Kregg Hetherington (2019) has pointed out, share a specific 'background-ness' quality. Yet while scholarship on infrastructure has explicitly foregrounded the seemingly 'hidden' workings of infrastructure through epistemological and analytical 'inversions' (Bowker, 1994; Bowker and Star, 1999), less attention has been paid to the relations between the built and the non-built. Yet if, as Ashley Carse (2016) put it, 'the world has become infrastructure', which is to say that the primary implication of direct anthropogenic cause and effect is that everything in, of, and around us has become a space to be designed, then indeed infrastructure is quintessentially emblematic of the Anthropocene.[1] Its investigation thus needs to be conjoined by a close analysis of infrastructure's surroundings – the non-built, the environment, nature, and how these are continuously made and re-made.

As I will detail in the following sections, recent work in disciplines such as science and technology studies (STS) and political ecology has stressed the need to break down the boundaries between human infrastructure and (seemingly) non-human environments and entities (cf. Barua, 2021; Carse and Lewis, 2017; Goldman et al., 2010; Swyngedouw, 1997) and shown the usefulness of an infrastructural perspective for analyzing current environmental crises (Degens et al., 2022). In addition, pushing back against the work of

authors who described the environment as something explicitly 'outside' of the techno-logical system (cf. Hughes, 1983), scholars working at the convergence of environmental history and the history of technology – or 'envirotech' – have demonstrated the extent to which such divisions are illusory (cf. Pritchard and Zimring, 2020; Reuss and Cutcliffe, 2010). Against this backdrop, this review seeks to encourage anthropological studies of infrastructure to engage more explicitly with the non-built and non-human environment and with the work of those pushing such boundaries in other disciplines. In this sense, the focus of this article is not that of identifying a 'gap'. Rather, my aim is to map out – and in doing so, take stock of – the emergence of a new field and to connect anthropological scholarship on infrastructure with inter-disciplinary research on the environment. In doing so, I pay particular attention to scholarship in environmental history and the envi-ronmental humanities, for two reasons. First, unlike work on infrastructure and the envi-ronment across STS and human geography, scholarship in the environmental humanities has only rarely been considered by anthropologists. As I will show toward the end of this article, on the other hand, environmental historians have developed novel epistemologi-cal and theoretical tools to address the co-creation of human and non-human environ-ments that can be of precious use for anthropology.

Second, in order to navigate the ever-expanding, multi-disciplinary field I am map-ping out in this article, I employ 'environing infrastructure' as a guiding framework of analysis – a notion I borrow from recent scholarship in environmental history and the environmental humanities. By bringing together a processual understanding of the envi-ronment and of infrastructure as a historically situated intervention through which humans engage with and shape the planet, 'environing infrastructure' offers two impor-tant contributions to anthropology. First, it underscores a particular analytical approach that addresses the environment not just as passive 'surroundings' but rather as a process of *enclosure* through infrastructure. This approach speaks from (and to) the etymology of the word environment, one that, as Sörlin and Wormbs (2018: 104) remind us, reflects a future-oriented human-created process of encircling, or enclosing. By adding the activat-ing suffix '-*ing*', then, environing brings back this particular meaning of 'environment': one that speaks to a dynamic and co-creative relation between humans and their sur-roundings. Here, while the environment as 'surroundings' certainly implies some aspect of 'enclosure' and 'encircling' – that is, a *centripetal* force – it also suggests a more expansive and broadly spatial and processual dynamic – a *centrifugal* force. Crucially, environing infrastructure refers to the role of built structures in mediating this very pro-cess of co-creation and to the work that infrastructure performs in defining the environ-ment itself. In doing so, the notion's second contribution to anthropological debates on infrastructure lies in underscoring infrastructure as *historically* specific multi-species formations. This approach partly answers an important criticism recently made by Buier (2023), that is, 'to assimilate into infrastructure all material conditions of possibility for life is a move that erases the rise of infrastructure as a historically specific form of human-led intervention into the built environment' (p. 9). As it will become clear throughout this review, recent scholarship in environmental history – and at least partly, anthropology – emphasizes this particular need: explicitly addressing the historical and political relations underpinning current infrastructure development and how these ush-ered a contingent mode of socio-ecological transformation. My usage of environing

infrastructure is thus an attempt to further encourage anthropological explorations of the historical entanglements of infrastructure both within and *beyond* the built environment. Importantly, with 'environing infrastructure', my aim is not to introduce a new concept – a notion that can capture human relations with the non-built. Rather, my objective is to help foregrounding the analytical and epistemic connections between infrastructure and the environment and to critically structure the scholarship addressed in this essay. To this end, the article is divided into three parts. The first part briefly reviews with some of the key texts of the so-called 'infrastructure turn' in anthropology, alongside critical work in environmental anthropology that engages – ethnographically and conceptually – with the build environment. The aim of this juxtaposition is to discuss some of the disjunctures that characterize these bodies of literature as well as some of the conceptual grounds they share. In particular, I show that while the infrastructure turn literature is undeniably useful in order to understand the social and political ramifications of infrastructure development, it generally falls short of engaging with the question of how large-scale infrastructures, and the discourses surrounding them, contribute to making the world in specific cultural and ecological contexts. The environment, here, figures as something that is disrupted (environmental degradation), disruptive (natural disaster), or discursively constructed as an entity that remains immanently outside (spatially or temporally) of given planned or built infrastructure. Works in environmental anthropology, on the other hand, reveal the potential usefulness of multi-species approaches to account for infrastructure's more-than-human characteristics and ramifications. I conclude this section by pointing out the importance of understanding the environment as a historically situated process of *enclosure* through infrastructure, as highlighted by the notion of environing infrastructure. In the second part of the article, I then detail key anthropological scholarship that comprises the state of the art. I pay particular attention to the analyses of feral or ruderal effects of human-made infrastructure, of its projection and demise, and of how these analyses open up new venues for our understanding of more-than-human worlds. What remains however underdeveloped here is an explicit attention to the past- and future-oriented aspects of processes of environing – as in the original meaning of the word I highlighted previously. For this reason, in the third and final part of the article, I engage with envirotech and the environmental humanities scholarship: inter-disciplinary fields from which anthropology can draw in furthering this endeavor. This final section is thus meant to outline and suggest new intellectual companions for anthropologists working on the nexus of infrastructure and the environment.

The infrastructure turn and the environment in anthropology

The broadly defined field of infrastructure studies has emerged from a confluence of various disciplines to interrogate the ways politics, societies, and subjectivities are bound up in material infrastructural forms (Anand et al., 2018; Harvey et al., 2017; Knox and Gambino, 2023; Niewöhner, 2022). Within this field, it is possible to identify two related strands of inquiry that are particularly useful for the purposes of this review. One involves an interest in re-thinking the materiality of infrastructure not as an inert or relatively

stable foundation for dynamic social processes but rather as unstable assemblages of human and non-human agencies (Bennett, 2010; Coole and Frost, 2010; Rest and Rippa, 2019). The second explores the oftentimes hidden 'techno-political' work of infrastructural forms (Barry, 2013; Collier, 2011; Larkin, 2008; Von Schnitzler, 2016). Both approaches have been drawing on STS to show how the materiality of infrastructure spaces, and their relations with their non-built surroundings, are both revealing of, and consequential for, broader socio-political processes.

Within this context, studies on the politics and materiality of urban infrastructure in the global south have provided significant contributions to current anthropological knowledge on the political and various forms of exclusion, including inquiries into the impact of environmental policies that are particularly relevant to this review (cf. Anand, 2017; Björkman, 2015; Simone, 2004). Literature on South and Southeast Asian cities, for instance, has consistently shown how 'green' urbanism is often connected to forced evictions (Endo, 2014; Ghertner, 2011; Rademacher, 2011, 2017), and how it can become a particular 'mode of exclusion' leading to marginalizing policies (Harms, 2014). Here, crucially, the non-human environment is folded into various features of human intervention. A similar argument could be made for studies of transport and energy infrastructure: the connecting tissue between centers of extraction, production, consumption, and distribution (cf. Bear, 2007; Dalakoglou, 2016; Dalakoglou and Harvey, 2012; Heslop and Murton, 2021; Rippa, 2020). In their work on roads in Peru, Harvey and Knox (2015) argue that roads are sites where technicians have made 'new relations with materials as much as they ended up 'gridding' them' (p. 94). In cutting through natural environments, roads are also directly shaped by terrain, weather conditions, and temperatures. In the growing anthropological literature on roads more broadly, emphasis has thus been put on the need to bring such conditions into an analysis of roads' social and political ramifications (cf. Argounova-Low, 2012; Mrázek, 2002; Saxer, 2016).

While this overview is far from exhaustive, it lays out what has been identified to be infrastructure's main contribution to anthropological knowledge so far: an entryway into re-thinking our analysis of the political (Venkatesan et al., 2018). Here, to be sure, discussions of human–environment relations have remained relatively marginal, while primacy has been given to an analysis of the ways in which complex technical apparatuses shape social lives.

If infrastructure represents a recent issue of topical anthropological concern, the environment has been key to anthropological thinking from the very beginning (Bateson, 1972; Howe and Pandian, 2019: 20; Ingold, 2011; Pandian, 2019). To navigate this multi-layered literature in what we could broadly define as 'environmental anthropology', I identify three strands that are particularly fruitful to think with for an anthropological analysis of infrastructure: works on landscape; considerations of nature-culture and the ontological turn; and recent studies on ethics of care beyond the human. While infrastructure is not a central concern of most authors listed in this section, insights from these various bodies of literature play an important role in how anthropologists approach infrastructure spaces in terms of their relations to the non-human and the non-built. They also – and most importantly for the purposes of this article – show the multiple legacies through which current anthropological reflection on the infrastructure–environment nexus originates from.

A particular modernist narrative attached to infrastructure development sees infrastructure as the quintessential means for human control over nature. Be it by 'taming' wild rivers, reclaiming 'unproductive' land, or 'opening up' new resource frontiers, infrastructure seems to be the medium through which human desires are satisfied at the expense of the 'natural' environment, which is reduced to a resource to be taken advantage of (Graham and Marvin, 2002 [2001]); Edwards, 2003; Kaika and Swyngedouw, 2000). Perhaps for this reason, anthropological studies of landscape and the multi-disciplinary literature on infrastructure have rarely engaged with one another – the two representing seemingly opposite approaches to the 'natural' world. The etymology of the word 'landscape' itself is often said to date back to 17th-century Dutch paintings and is thus connected with the rise of a certain vision of beauty and the (natural) sublime (Cosgrove, 1998). As Tim (2011) Ingold pointed out, however, in early medieval times, landscape 'referred originally to an area of land bound into the everyday practices and customary usages of an agrarian community' (p. 126). The suffix '-scape' indicates this active labor of 'shaping' the land: the work of farmers, of human agents plowing and modifying the earth. There seems to be, then, a close relation between landscapes and human-made infrastructure – the landscape itself being the result of specific human interventions, or a particular *environing* process (see also Olwig, 1996; Tsing, 2017). Landscape thus understood underpins Dana Powell's (2018) work on the Desert Rock Energy Project on Navajo (Diné) land in Northern New Mexico. Through the 'landscapes of power' heuristic, Powell brings together questions of infrastructure development, ethics, and the sacred. In doing so, Powell (2018) conceptualizes landscapes as 'the vibrant, material interface of human and non-human interactions, (. . .) sites and processes of struggle over material infrastructure, as well as meaning and memory' (p. 14). The notion of the landscape, as such, seems to mediate between infrastructure and the environment and is thus a useful heuristic for the study of relations that lie at the core of this review article. Importantly, work on landscape in anthropology has also addressed the 'disruptive' connotations of infrastructure – their planning, construction, maintenance, and abandonment. One example is the work of Stefan Dorondel (2016), which focuses on socio-ecological change in the context of the transition from the socialist to the neoliberal regime in two Romanian villages. While the focus of Dorondel's book is on privatization of land and the introduction of certain rewilding and conservationist policies, he reveals how interactions between humans and their environment are often mediated by infrastructure – and by the lack of management and maintenance, in the case of Romania's post-socialist transition.

Issues of infrastructure development and the more-than-human have also been addressed by anthropologists engaging with ontological questions. A poignant example is the collaborative work of Atsuro Morita and Casper Bruun Jensen, which brings critical discourse on nature-culture in conversation with STS and infrastructure studies (Jensen and Morita, 2015, 2017; Morita and Jensen, 2017). In a special issue on infrastructure as ontological experiment (2017), they reflect on the 'world-changing capacities' of infrastructure. Far from simply being the 'substrate' of social and political action, they argue that infrastructure is better understood as giving way to 'practical ontologies, which give form to culture, society, and politics' (p. 3). In producing novel configurations of the world, infrastructure also shapes relations between humans and

other-than-human and between the built and the non-built. As Jensen and Morita point out, 'infrastructure are inhabited by entities as diverse as microbes, rice crops and spirits' (p. 5) and 'hold the potential capacity to do such diverse things as making new forms of sociality, remaking landscapes, defining novel forms of politics, reorienting agency, and reconfiguring subjects and objects, possibly all at once' (p. 6). This requires, the authors contend, a decentering of the human actor, one that allows us to focus on 'complex entanglements' between infrastructure and non-humans and on how such entanglements become 'matters of concern for particular people' (p. 7).

The reference to 'matters of concern' in Jensen and Morita's work points to the STS-inspired tradition in which the non-human is often approached through the framework of relational ontologies and ethics of care (De la Bellacasa, 2017). Recent work by Marisol de la Cadena (2015: 31–34), for instance, takes up the notion of 'partial connections' – a term she borrows from Marilyn Strathern's response to Donna Haraway's notion of the cyborg – as an analytical-political tool to approach the study of 'relations' without falling prey to 'plurality'. Partial connections, in de la Cadena's work, explains 'entities (or collectives) with relation integrally implied, thus disrupting them as unit' (p. 32). The entities de la Cadena addresses are particular 'earth beings' – a translation of the word *tirakuna*, which among the Runakuna refers to sentient entities that do not inhabit the landscape but rather are visible features thereof. These are the likes of mountains and rivers, which – de la Cadena shows – are in mutual relationships of care with the Runakuna. While not directly addressing human-made infrastructural spaces, de la Cadena's relational ontology does offer opportunities to rethink how human beings and the other-than-human are inherently connected – an 'intra-relation' of care understood not in terms of 'altruism' but rather of 'obligation' (for similar discussions in the Tibetan context, see the study by Yeh and Gaerrang, 2021). Relations of care are also at the center of Juno Salazar Parreñas's (2018) work on two orangutan rehabilitation centers in Malaysian Borneo, engaging with questions of extinction, conservation, gender, and human–animal relations. The story Parreñas tells, exploring the relations between orangutans and wildlife workers, is a global one – embedded as it is in the worldwide circulation of capital, environmental narratives, and (voluntary) labor. The ethnographic approach here, similar to de la Cadena's, centers on particular *individuals* (rather than broader communities) such as international volunteers, local wildlife workers, and orangutans. This approach is a key feature – indeed, a most inspiring one – of Parreñas's decolonial argument. Vis-à-vis the long colonial history of dehumanizing both human and non-human subjects, she foregrounds connections and mutuality among individuals who are vulnerable to one another. This vulnerability, she reveals, opens up spaces of possibility for care. Such a method can also open other kinds of spaces, particularly for a decolonial approach to infrastructure projects and their relations with more-than-human entities and environments. Parreñas hints at how such an analysis might look by addressing the case of some of the wildlife workers who had been displaced by a large hydro-electric dam – much like the orangutans they care for. The displacement caused by the dam not only affected the natural environment and other more-than-human communities but also produced environmental subjectivities.

Parreñas's work speaks also to scholarship on multi-species labor and care in agricultural and conservation settings (cf. Lorimer, 2015; Münster, 2016; Yamada, 2022). A

recent edited volume by Besky and Blanchette (2019) focuses specifically on the intersection of people, nature, and labor in the current time of ecological crisis. It does so by challenging a dominant idea of labor – that of it being a uniquely human quality. Instead, *How Nature Works* foregrounds the work of non-human, thus putting into question the category of labor itself. Moving from political ecology and multi-species perspective, contributions to the volume push forward an understanding of 'work' as emerging from activities performed by both humans and non-humans. In turn, this challenges one of the keystones of global capitalism: that 'nature' is a resource to be used, consumed, and *managed* by humans.

To conclude, and without erasing the complexities and overlaps that characterize these multiple bodies of anthropological scholarship, two trends emerge. In the anthropological literature on infrastructure the main focus and contribution clearly lie in an analysis of the interactions with and consequences of technical systems on social and cultural lives. In the literature addressed in the second part of this section, on the other hand, scholarship largely avoids discussing infrastructural politics and rather addresses infrastructure as a particular mean of engagement with the environment that underpins broader socio-political dynamics of development and dispossession. Similarly, scholarship on landscape and ethics of care beyond the human as outlined previously stops short of exploring the infrastructural qualities of the built environment, while focusing on how material structures mediate relations between humans, non-humans, and the landscape.

While the fact that these bodies of work have different foci is obviously not a problem per se, what it might lead to is to a reproduction of a dichotomy between the human world of infrastructure and the non-human world of nature. To avoid this, a re-conceptualization of the environment as a process of enclosure through infrastructure is helpful. Far from the meaning that the word 'environment' came to assume in the 20th century, tied to politics of conservation and the largely negative consequences of human activities (Warde et al., 2018), 'environing' speaks to an older form of the word: environ. That is, a premodern verb (and at times adverb and preposition) that used to indicate the process of encircling human bodies and enclosing land (Nardizzi, 2017). Far from pleasant and harmonious processes, 'environ' was often used in a military context and implied frictions and disruptions – and it represents a useful reminder of the socio-ecological violence of modern infrastructural interventions. As such, 'environ' held something of a future orientation, pointing to 'a dynamic relationship with vast, sometimes threatening, but also resourceful surroundings that humans were meant to transform and could turn into an ever-changing product of their ingenuity and practice' (Sörlin and Wormbs, 2018: 104). To understand the environment as a process of making – to environ – through infrastructure, then, can help place current human politics in a broader more-than-human perspective, while foregrounding the role of the built environment in our relationship with and understanding of the natural world.

Toward a new state of the art in anthropology

As I have anticipated, a new state of the art is taking shape, bridging the anthropology of infrastructure, STS, political ecology, and feminist scholarship on care and relationality. Drawing on both the 'materiality' and 'techno-political' strands of inquiry

identified previously, this emerging literature is facilitating important conversation on infrastructure that has concerns with the non-human. The environing infrastructure framework introduced here helps foregrounding 'feral' and 'ruderal' becomings, that is, the entanglements of built and non-built environments that originate from the continuous process of encircling outlined previously. Similar to the mirror notion of 'infrastructuring environments' offered by Blok et al. (2016), environing infrastructure points to the situated and contingent activities, materials, and practices that mediate and make the relations between infrastructure and the environment. Unlike this perspective, however, environing infrastructure attends not so much the organization, managing, and knowing of non-human environments but rather infrastructure's capacity to knot, amalgamate, and ultimately bring together human and non-human actors and doings. As much of the research reviewed in this article hints at, it is in these co-becomings that, I believe, lies a key to a non-anthropocentric study and comprehension of our world today.

The relationship between human-made infrastructure and the environment is at the core of Ashley Carse's work on the Panama Canal (2012, 2014; Carse and Lewis, 2017). In *Beyond the Big Ditch*, Carse articulates this interest by focusing not so much on the socio-political implications of the canal's construction but rather on the social and political consequences of the *landscape transformations* considered necessary to maintain this infrastructural system. As each ship passing through the canal requires huge amounts of water to navigate the docks, hydrology plays a major role in Carse's analysis. He thus turns his attention not only to watershed management but also the agricultural practices of local farmers and other actors. Carse demonstrates through ethnography and archival research that the environment all but disappeared from the story of Panama Canal once it was built. To the contrary, a huge effort continues to go into maintaining it by working with local farmers and also through rainforest management and by dealing with invasive weeds that have multiplied within this infrastructural landscape (see also Carse, 2019). Nature and infrastructure, he argues, are thoroughly intertwined in their background-ness, as well as for how they are grasped as particular service-providing socio-technical systems. Ultimately, Carse calls for an understanding of infrastructure that goes beyond material artifacts embedded in and generative of socio-political worlds.

As in Carse's work, a common element in much current scholarship thinking through the relationships between infrastructure and the environment in anthropology is water. In an analysis of 'contrasting moral ecologies of infrastructure' among fishers, scientists, and residents in Turkey's Gezid Delta, Caterina Scaramelli (2019) compellingly shows how the worlds of infrastructures and ecologies are entangled and inseparable. To theorize this relation, Scaramelli offers the notion of a 'moral ecology of infrastructure', thus foregrounding people's ideas of just relations between humans and non-humans. The point here is not to show that infrastructure and the environment cannot be held separate today. The Gezid Delta, Scaramelli's interlocutors understand, has been infrastructural for as long as human communities lived in the region (p. 390). What calls for a moral ecological approach to infrastructure development, rather, are the particular and historically contingent 'infrastructural arrangements of organism, materials, and economies' (p. 390). Here, as in Carse's scholarship, the 'infrastructural' qualities of

seemingly 'natural' environments are approached through an analysis of long-term experiences and representations.

Similarly centered around ethnographies of water are two books that merge a techno-political approach to infrastructure outlined in the first section of this article with an explicit investigation of non-human environments and agency. These are Andrea Ballestero's *A Future History of Water* (2019) and Jessica Barnes's *Cultivating the Nile* (2014). Both studies draw on long-term research with experts and regulators, as well as local communities, in Costa Rica, Brazil, and Egypt, respectively. While Barnes's work examines how quotidian actions and interactions 'make' the waters of the Nile, Ballestero exposes how techno-legal devices, knowledge, and practices shape water futures and produce the differences between water as a human right and water as a commodity. Both, thus, recognize the liveliness of the material world – of both water infrastructures and regulatory institutions and of the relations between them. Similarly attentive to water and the material politics of the built environment is Matthäus Rest's (2019) work on the Melamchi Water Supply Project, an unfinished infrastructure meant to deliver drinking water to the residents of Kathmandu. Rest 'takes seriously' more-than-human forms, such as water and (the lack of solid) rock, in his analysis of a specific infrastructural space and imaginary. To do so, he evokes Ingold's (2011) notion of the meshwork to account for the different entities involved in what he calls the *hydrosocial*. Here, water, government institutions, and materials are entangled in inextricable ways to conjure up a 'future anterior' (Povinelli, 2011) in which the not-yet-made water infrastructure will eventually justify present sufferings. While Rest addresses a particular 'unfinished' infrastructure, Atsuro Morita (2017), in an article on floating rice and water management infrastructure in the Chao Phraya Delta, moves from a typical – for the literature on infrastructure at least – moment of breakdown to rethink the connections between humans and non-humans. As Morita (2017) puts it, 'attentiveness to the particular multispecies relations between people, rice, and other things facilitates a reconsideration of infrastructure's relationship with nature' (p. 739). Infrastructure, he contends, can make such often-hidden relations explicit. In the case of the Chao Phraya Delta, not unlike in Carse's analysis of the Panama Canal, the boundary between the infrastructural space and its non-human environments is indefinable. Nature, here, does not become infrastructure (Carse, 2012). Rather, both 'infrastructure' and 'nature' rely on what Morita terms an 'involutionary relation' – an affectively charged process of co-becoming that he defines as multi-species infrastructure. The key example is different rice species, particularly the shifting agricultural patterns between floating rice and non-floating varieties – changes that, Morita demonstrates, occur in tandem with flood-management practices and technologies. In this entanglement, farmers' 'care', rice paddies, and canals are all generative of co-emerging infrastructure that allows for cohabitation in the delta.

Urban infrastructure has also been a privileged place from where anthropologists have explored human–non-human entanglements. Amy Zhang (2020) addresses how the black soldier fly (*Hermetia illucens*) has been harnessed into a biotechnology of waste management in Guangzhou, China. Part of broader state-led effort to build modern 'green' cities, waste infrastructure in China encompasses the construction of waste-to-energy incinerators and citizen recycling programs. While incinerators have been criticized for their negative health impact, the latter programs rely largely on informal,

and largely invisible, labor (Liebman, 2022; Zhang, 2019). Within this highly political context, the black solder fly is meant to speed up the treatment of organic waste, relying on the appetite of the fly larvae to devour food waste, slaughterhouse waste, and animal manure. In doing so, Chinese scientists 'approach the life cycle of the [black soldier fly] as a natural or lively infrastructural system, one in which non-human labor sustains the organic exchange and circulation of matter and energy' (Zhang, 2020: 76). The fly's metabolic labor is thus seemingly appropriated by humans to produce surplus value. This appropriation, however, as Zhang shows through the principles of 'circularity' and 'enclosure' in urban China, is both shaping and revealing of particular cultural logics and imperatives. As Zhang (2020) concludes, the black soldier fly experiment in Guanzhou ultimately 'illustrate[s] the unacknowledged labor practices, both human and nonhuman, and ecological relations that undergird China's pursuit of a modern approach to waste management' (p. 79). Addressing a different kind of seemingly marginal and often invisible urban practices, Bettina Stoetzer (2018) coins the notion of 'ruderal ecology' to capture more-than-human communities that emerge in disturbed environments generally considered hostile to life. Drawing on ethnographic fieldwork in Berlin, Stoetzer employs ruderal 'as an analytical framework for re-thinking the heterogeneity of urban life in the ruins of European nationalism and capitalism' (Stoetzer, 2018: 297). By turning our gaze to what remains often unnoticed, to what is unexpected and precarious, the notion of the ruderal thus encourages anthropologists to direct ethnographic attention toward the relations between infrastructure spaces and the non-human and the often-unpredictable consequences of their encounters and entanglements.

Working at the intersection of human infrastructure and non-human forces, a recent duograph by Dominic Boyer and Cymene Howe deserves special attention. The paired volumes *Ecologics* (Howe, 2019) and *Energopolitics* (Boyer, 2019) address the development of wind power in southern Mexico, focusing on the social, political, and environmental ramifications of renewable energy transitions. Their ethnographic focus, similar to Carse's work, displaces global narratives of energy transition into local power structures, community initiatives, and human–non-human relations. In considering the changing relationship between political power and energy generation, both volumes follow the tradition of the anthropological literature on infrastructure by focusing squarely on the political. In doing so, however, Howe and Boyer pay close attention to non-human beings, techno-material objects, as well as geophysical forces that shape infrastructural transformations and energy transitions. Howe's *Ecologics* centers on 'the salience of human–non-human relations' (p. vii), explicitly foregrounding the role of more-than-human beings, relations, and material processes that extractivist frameworks deliberately omit. By pushing forward a de-terrestrialized ontology, Howe thus reveals how wind, its relationalities, and its material traits should be understood as an animating force and can help us move beyond human exceptionalism. Boyer's *Energopolitics*, while emphasizing the political, represents an attempt to think beyond human-centric notions of politics. Building on both Foucault and Timothy Mitchell (2011), he shows the ways in which the Anthropocene challenges the anthropocentrism of notions of capital and biopower. In general, the duograph by Howe and Boyer demonstrates that by taking the non-human seriously, anthropological studies of infrastructure can recast their attention

to the political in a way that accounts for some of the fundamental questions of our time, from climate change to mass extinction and the Anthropocene itself.

Speaking on one such issue, global warming, are two recent texts that might fall within the category of climate urbanism: Gökçe Günel's *Spaceship in the Desert* (2019) and Hannah Knox's *Thinking like a Climate* (2020). Günel's work details the development of the Masdar project in the United Arab Emirates, an eco-city designed around renewable energy and clean technology. Recounting the city's trajectory from its ambitious masterplan and vanguard architecture to its partial abandonment after the 2008 recession, Günel narrates different embodiments of what she calls 'technical adjustments', that is, ways of dealing with climate change based on technological solutions that set aside the ethical and political aspects of 'green' development. Such gaps are echoed by the 'spaceship' metaphor that Günel takes up for the title, conveying the intention of a definitive separation between the inside and the outside, the city and the desert, the built and the non-built. In narrating the ultimate failure of such a project, Masdar's city offers a cautionary tale concerning the limits of techno-science, clean technology, and renewable energy approaches that uncritically rest upon this ontological separation. Hannah Knox, on the other hand, moves from a close reading of the works of Eduardo Kohn (2013) and Gregory Bateson (1972) index the experience of a relationship between ontology and action. She uses '*Thinking like a Climate*' to address how the trigger for political advocacy among climate scientists is not so much political philosophy but rather a particular understanding of the relational dynamics of the human-natural climate system. As such, climate change through her work becomes what philosopher Timothy Morton (2013) calls a 'hyperobject' – something larger than life, omnipresent, shaping the everyday, yet not really here, somewhere displaced in the future, somewhat invisible.

Black and Indigenous scholars both within and outside anthropology have explored the relations between the making of built environments and patterns of colonialism, enslavement, and de-humanization. In their criticism of the notion of the 'Plantationocene', for instance, Davis et al. (2019) reveal not only how multi-species framing tend to '[minimize] the role of racial politics' (p. 3) but also how the possibilities for ecological justice in the present and future require centering colonialism, racism, and enslavement in our discussions of the Anthropocene (see also McKittrick, 2013). Infrastructure is clearly central in both the establishment and dismantling of colonial and racist structures: From plantations to the expansion of railways, for instance, were conditions and consequences of the displacement of Indigenous peoples. In this scholarship, settler colonialism is seen as ecological domination, committing environmental injustice against Indigenous peoples (cf. Whyte, 2018). In this context, the very term 'Anthropocene' is something to be 'distrusted' (Todd, 2015), as it flattens responsibility for the contemporary environmental crisis. If infrastructure, as I argued above, is quintessentially emblematic of the Anthropocene, then it becomes fundamental to realizing how the Anthropocene itself is not a new event: It instead 'can be viewed as a continuation of, rather than a break from, previous eras that begin with colonialism and extend through advanced capitalism' (Davis and Todd, 2017: 771). As a 'deliberate extension of colonial logic', the Anthropocene underpins violent and extractive logics that anthropologists of infrastructure would do well to foreground in their analyses.

These recent developments at the confluence of the anthropology of infrastructure and studies of the other-than-human found their way into the recent volume of *Infrastructure, Environment, and Life in the Anthropocene* (2019) edited by Kregg Hetherington. In his introduction, Hetherington (2019) posits that as the earth has become a record of human actions, it is increasingly impossible to distinguish human infrastructure from their environment. The very notion of the Anthropocene, although undeniably ambiguous and contested, is here employed as a useful analytic lens through which the social sciences can question the contemporary moment. Moving from a similar perspective, perhaps one of the most exciting ways to think the relations between infrastructure and the environment in the Anthropocene to have appeared in recent years is the *Feral Atlas* (2020), an open-access volume edited by Anna Tsing, Jennifer Deger, Alder Keleman Saxena, and Feifei Zhou. Through a captivating interactive design, the volume explores 'the ecological worlds created when non-human entities become tangled up with human infrastructure projects'. Tsing et al. see infrastructure as the pre-eminent landscape-modifying project and differentiate between different kinds of infrastructure, namely imperial and industrial. The argument they put forward is that both imperial and industrial infrastructure have non-designed – or 'feral' – effects. Those effects make up the Anthropocene. *Feral Atlas* is a rich, plural, and open-ended project that should be explored in its own right. For the sake of this review, however, one aspect in particular is worth mentioning – not because it is the main outcome of the volume, but because it speaks directly to how anthropological studies of infrastructure can engage with the now. Tsing et al. do not intend to cast 'feral' ecologies in either a positive or a negative way; in a sense, we all *need* feral ecologies. In the Anthropocene, however, feral effects are so much out of control that we must find ways to address them. *Feral Atlas*, and the feral infrastructures addressed in it, offer ways to tell such stories. These are quite often terrible and terrifying stories – yet it is important that anthropologists *learn* how to tell such terrible stories, without terrifying their readers. This is something that, perhaps, the anthropology of infrastructure should take up as a guiding principle in order to analytically, methodologically, and ethically engage the planetary crises we face.

In conclusion, there are a few key common threads that traverse the variegated scholarship I outlined. First, this scholarship is characterized by an explicitly multi- and interdisciplinary approach. Second, scholars in this emergent field are seeking novel ways to both studying and communicating the urgency of current environmental and social crises. This includes recent efforts to draw out new methodologies and imaginary pathways for the Anthropocene that have relevance well beyond the anthropology of infrastructure (Bubandt et al., 2022; Howe and Pandian, 2019). Finally, the texts I reviewed all point to the importance of a detailed historical approach to analyzing how human-made infrastructure and the non-human are intimately entangled, and how these relations are generative of social and multi-species worlds. This latter point remains, however, largely implicit. In the next section, on the other hand, I sketch out how anthropologists can benefit by further engaging work on infrastructure and the environment in the humanities and how this can be particularly useful to comprehensively address issues of power and inequality that underpin more-than-human relations.

Beyond anthropology: Environing infrastructure in and from the humanities

As historians Svenker Sörlin and Nina Wormbs (2018) point out in their work on environing technologies, 'if environing is regarded as a historical process, it allows us to redefine the social into also including a larger part of the "natural environment"' (p. 104). This perspective foregrounds a relational and processual approach, one which moves from an understanding of how infrastructure displaces environment to an investigation into how it co-constructs it. As such, it not only broadens the scale of investigation, addressing the role of infrastructure in *making* environments, but also requires a longitudinal approach. It is of little surprise, then, that historical studies of environment and technology have been at the forefront of such efforts. In this section, I show how such work – often framed within the growing field of 'envirotech' history (Pritchard and Zimring, 2020) – can complement anthropological explorations at the nexus of infrastructure and the environment, and particularly how it can provide a much-needed historical situated-ness to our understanding of the current infrastructural moment.

While there is an abundance of excellent historical work on the relations between the development of particular human technologies and their impact on, and reliance upon, non-human environments (cf. Cronon, 1991; Kohler, 1994; Nash, 2007), envirotech has emerged fairly recently as a further way to bridge environmental history and the history of technology. Such line of inquiry necessarily extends to some of the key ideas that underpin human–environment relations and of the role infrastructure plays in shaping the planetary (Jørgensen, 2014; Warde et al., 2018). Importantly, more than a collection of both macro- and micro-histories, envirotech scholarship shows the value of merging environmental history's foregrounding of the non-human in the analysis of long-term social processes, with STS's conceptual and methodological approaches to the study of complex systems. These include black boxes, boundary-work, actor-network theory, knowledge production as a social process, and other key tenets of STS research that have deeply enriched historical analyses (for an overview and several examples, see Jørgensen et al., 2013).

An example of what can be achieved through this approach is the work of Sara Pritchard. In *Confluence* (2011), Pritchard shows how, in the process of (re)shaping the Rhône since 1945, various groups and agencies have engaged in enviro-technical modifications. Rather than thinking infrastructure and nature as separate, such practices, as is well reflected in Pritchard's study, entangled them in continuous ways – both with one another and in broader national politics. More generally, as anthropologists are increasingly interested in exploring issues connected to the socio-political and environmental legacies of infrastructure projects, approaches developed by envirotech scholars can be useful in extending our gaze to the long-term technical consequences of particular human interventions. Conversely, such approaches shed light on how seemingly non-human environments shape particular technological developments. This is particularly relevant for studies focusing on the unbuilt and the unfinished, as well as on the nexus of infrastructure, the archive, and the social (Carse and Kneas, 2019; Rippa, 2021; Schwenkel, 2020).

Explicitly employing the *environing* framework is the recent scholarship by environmental historians working in colonial Africa. Particularly influential has been Kreike's

(2013, 2021) notion of 'environmental infrastructure', that is, 'a coproduction of human ingenuity and labor on the one hand and non-human actors (animals, insects, microbes, and plants) and forces (physical, chemical) on the other' (Kreike, 2021: 2). Kreike's own usage of the environing framework thus speaks to the multiple and messy agencies involved in infrastructure development and the role of non-human in social and technological processes. Those are not, importantly, processes devoid of politics and hierarchies. As Kalb (2022) shows in the context of colonial German Southwest Africa, '*environing* offers the analytical space to incorporate technological, human, and animal engineering while acknowledging messy hierarchies' (p. 3). These, significantly, index both the success and the failure of infrastructure, as Kalb notices: 'The exploitation of contract, migrant, and forced labor to build and maintain such structures was essential, and Germans employed discriminatory policies, everyday colonial violence, and genocide to use African bodies meant to compensate for the failures of existing structures' (p. 3). At the same time, non-human mattered greatly: From cattle plague pathogens to climatic regions and shipworms, these forces not only affected projects of construction and circulation but also 'reshaped power structures' (p. 3). In this body of work that, in increasingly shaping historical research, the case for a multi-species approach in studying infrastructure is intimately tied to issues of environmental justice, colonialism, and dispossession – and as such offers a precious framework for anthropological research on the subject.

The *representational* aspect of the infrastructure–environment nexus, on the other hand, has recently been taken up by work in the growing field of environmental humanities, and particularly by ecocriticism (Clark, 2011; Emmett and Nye, 2017; Garrard, 2012; Glotfelty and Fromm, 1996). Rivke Jaffe and Lucy Evans (2022) recently outlined what they call an 'infrastructural humanities', that is, a field of studies attempting to bridge literary geography and related fields with the infrastructural turn in anthropology and geography. Moving from the example of infrastructure of gullies in Kingston, Jamaica, Jaffe and Evans convincingly show that the study of various cultural texts (literature, popular music, films) can expand our understanding of infrastructure space beyond its socio-political and spatial aspects. Indeed, as Brian Larkin (2013) pointed out in his review article, infrastructures 'need to be analyzed as concrete semiotic and aesthetic vehicles' (p. 239). Yet, the 'poetics' of infrastructure, in the anthropological literature on the subject, still largely remain subdued to an analysis of their political functions, and issues of form are thus largely neglected. While a comprehensive review of humanist approaches to infrastructure is beyond the scope of this article, one example of what such an approach can achieve is evidenced in Corey Byrnes's *Fixing Landscape* (2018). In this work, the landscape surrounding the Three Gorges dam in China is addressed not so much as an unchanging natural background but rather as a surface of poetic inscription. This landscape, Byrnes shows, was re-imagined and ultimately re-*written* according to imperial fantasies and epistemologies of resource frontiers but also by way of racialized representations and debates over Chinese-ness. *Fixing Landscape* thus makes it clear that we cannot disregard the material force of representation in our analysis of particular infrastructural landscapes. This insight, and the methodology that underpins it, represents a further contribution to anthropological understanding of the landscape as something ultimately fluid and unstable. On the other hand, it also points to infrastructure's

role in constituting subjects as well as dominant cultural forms; in turn contributing to shifting the line of inquiry from one centered around environmental issues to one focused on *making* of environments. As such, anthropology would gain by paying closer attention to how the built and the natural worlds are portrayed across various media forms and to how this in turn affects current infrastructural formations.

By approaching environing as an historical process, two valuable contributions for anthropology emerge. First, by historicizing infrastructure *beyond* the built environment, such approach fosters reflections of the role and agency of non-human actors for infrastructure politics. Or, to put it in a different way, if infrastructure's main contribution to anthropological knowledge so far has been a re-thinking of the political, a thorough appreciation of non-human politics is not only ethically urgent but also epistemologically essential. Once again, infrastructure can be a prominent ethnographic entry point in this regard, and the environing infrastructure approach points toward this direction. Second, by foregrounding the power dynamics that shape relations between infrastructure and the environment historically, an environing approach can help environmental anthropologists thinking *beyond* ethics of relationality that risk remaining devoid of politics.

In conclusion, as the growing scholarship on the topic reviewed in this article indicates, anthropologists are increasingly introducing inter-disciplinary reflections on the relations between infrastructural spaces and the motley non-human worlds they are profoundly entangled with. As Hetherington (2019) remarks, infrastructure and the environment share a lot of conceptual ground, both being associated with a particular 'backgroundness' – or, as per Larkin's (2013) phrasing, as 'the matter that enable the movement of other matter' (p. 329). How to distinguish, then, between the built and the non-built? How to speak of the environment without re-imposing old dichotomies, yet addressing its specificities? And how to write about infrastructure without leaving out the non-human, yet maintaining the importance of power and social relations more broadly? The notion of environing infrastructure, alongside recent scholarship reviewed in this article, points to an alternative approach that understands the world not as a fixed sensorial apparatus – a background, or a foreground – but in terms of active engagement. Environing infrastructure stresses the active role that humans and non-human play in co-making the world and the role of man-made structures in such processes. These, importantly, are not just human projects: They are mediated, shaped, and oftentimes initiated and resisted by the materiality of infrastructure forms and their complex multi-species entanglements. They should also, at the same time, be understood in their historical situated-ness as particular co-constructs of socio-ecological worlds.

Acknowledgements

Funding

ORCID iD

Alessandro Rippa https://orcid.org/0000-0002-9533-3988

Note

1. The notion of the Anthropocene has become a fundamental analytical lens through which scholars and activists question the contemporary moment. As widely known, it has also received numerous critiques, most notably for seemingly reinforcing the centrality of the human (Haraway, 2015), as well as flattening responsibilities and ultimately denying the profound colonial and capitalist inequalities that lie at the core of the crises it is meant to narrate (Todd, 2015). While a thorough discussion of the pros and cons of the term Anthropocene (and the ever-growing number of alternative '-cenes') is beyond the aims of this article, I do not take this notion for granted. Rather, and echoing the approach outlined by Kregg Hetherington (2019: 3), the Anthropocene here functions as a keyword: serving 'the purpose not of smoothing over contention, but of linking epochal discussions in the social sciences with those in the natural sciences and environmental movement'. As this article shows, discussions around the Anthropocene have been crucial in shaping the emerging body of literature I aim to map out. As such, while not devoid of profound epistemological and ethical problems, the Anthropocene has been generative of many of the conversations that this article takes stock of and that are leading toward novel approaches to the relations between infrastructure and the environment.

References

Anand N (2017) *Hydraulic City: Water & the Infrastructures of Citizenship in Mumbai*. Durham, NC; London: Duke University Press.

Anand N, Gupta A, Appel H (eds) (2018) *The Promise of Infrastructure*. Durham, NC: Duke University Press.

Argounova-Low T (2012) Narrating the road. *Landscape Research* 37(2): 191–206.

Ballestero A (2019) *A Future History of Water*. Durham, NC: Duke University Press.

Barnes J (2014) *Cultivating the Nile: The Everyday Politics of Water in Egypt*. Durham, NC: Duke University Press.

Barry A (2013) *Material Politics: Disputes along the Pipeline*. Malden, MA; Oxford: Wiley Blackwell.

Barua M (2021) Infrastructure and non-human life: A wider ontology. *Progress in Human Geography* 45(6): 1467–1489.

Bateson G (1972) *Steps to an Ecology of Mind*. Chicago, IL: University of Chicago Press.

Bear L (2007) *Lines of the Nation: Indian Railway Workers, Bureaucracy and the Intimate Historical Self*. New York: Columbia University Press.

Bennett J (2010) *Vibrant Matter: A Political Ecology of Things*. Durham, NC: Duke University Press.

Besky S, Blanchette A (eds) (2019) *How Nature Works: Rethinking Labor on a Troubled Planet*. Santa Fe: School for Advanced Studies Research Press.

Björkman L (2015) *Pipe Politics, Contested Waters: Embedded Infrastructures of Millennial Mumbai*. Durham, NC: Duke University Press.

Blok A, Nakazora M, Winthereik BR (2016) Infrastructuring environments. *Science as Culture* 25(1): 1–22.

Bowker GC (1994) *Science on the Run: Information Management and Industrial Geophysics at Schlumberger, 1920–1940*. Cambridge, MA: MIT Press.

Bowker GC, Star SL (1999) *Sorting Things Out: Classification and Its Consequences*. Cambridge, MA: MIT Press.

Boyer D (2018) Infrastructure, potential energy, revolution. In: Anand N, Gupta A, Appel H (eds) *The Promise of Infrastructure*. Durham, NC: Duke University Press, 223–244.

Boyer D (2019) *Energopolitics: Wind and Power in the Anthropocene*. Durham, NC: Duke University Press.

Bubandt N, Oberborbeck Andersen A, Cypher R (eds) (2022) *Rubber Boots Methods for the Anthropocene: Doing Fieldwork in Multispecies Worlds*. Minneapolis, MN: University of Minnesota Press.

Buier N (2023) The anthropology of infrastructure: The boom and the bubble? *Focaal – Journal of Gobal and Historical Anthropology* 2023(95): 46–60.

Byrnes C (2018) *Fixing Landscape: A Techno-Poetic History of China's Three Gorges*. New York: Columbia University Press, 2018.

Carse A (2012) Nature as infrastructure: Making and managing the Panama Canal watershed. *Social Studies of Science* 42(4): 539–563.

Carse A (2014) *Beyond the Big Ditch: Politics, Ecology, and Infrastructure at the Panama Canal*. Cambridge, MA: MIT Press.

Carse A (2016) The anthropology of the built environment: What can environmental anthropology learn from infrastructure studies (and vice versa)? *Engagement*, 17 May. Available at: https://aesengagement.wordpress.com/2016/05/17/the-anthropology-of-the-built-environment-what-can-environmental-anthropology-learn-from-infrastructure-studies-and-vice-versa/

Carse A (2017) Keyword: Infrastructure: How a humble French engineering term shaped the modern world. In: Harvey P, Jensen CB, Morita A (eds) *Infrastructure and Social Complexity: A Companion*. London: Routledge, 27–39.

Carse A (2019) Dirty landscapes: How weediness indexes state disinvestment and global disconnection. In: Hetherington K (ed.) *Infrastructure, Environment, and Life in the Anthropocene*. Durham, NC: Duke University Press, 97–114.

Carse A, Kneas D (2019) Unbuilt and unfinished: The temporalities of infrastructure. *Environment and Society* 10(1): 9–28.

Carse A, Lewis J (2017) Toward a political ecology of infrastructure standards; or, how to think about ships, waterways, sediment, and communities together. *Environment and Planning A: Economy and Space* 49(1): 9–28.

Clark T (2011) *The Cambridge Introduction to Literature and the Environment*. Cambridge: Cambridge University Press.

Collier S (2011) *Post-soviet Social: Neoliberalism, Social Modernity, Biopolitics*. Princeton, NJ; Oxford: Princeton University Press.

Coole D, Frost S (eds) (2010) *New Materialisms: Ontology, Agency, and Politics*. Durham, NC; London: Duke University Press.

Cosgrove D (1998) *Social Formation and Symbolic Landscape*. Madison, WI: University of Wisconsin Press.

Cronon W (1991) *Nature's Metropolis: Chicago and the Great West*. New York: W.W. Norton.

Dalakoglou D (2016) *The Road: An Ethnography of (Im)mobility, Space, and Cross-Border Infrastructures in the Balkans*. Manchester: Manchester University Press.

Dalakoglou D, Harvey P (2012) Roads and anthropology: Ethnographic perspectives on space, time and (im)mobility. *Mobilities* 7(4): 459–465.

Davis H, Todd Z (2017) On the importance of a date, or, decolonizing the anthropocene. *ACME: An International Journal for Critical Geographies* 16(4): 761–780.

Davis J, Moulton AA, Van Sant L, et al. (2019) Anthropocene, capitalocene, . . . plantationocene? A manifesto for ecological justice in an age of global crises. *Geography Compass* 13(5): 1–16.

De la Bellacasa MP (2017) *Matters of Care: Speculative Ethics in More Than Human Worlds*. Minneapolis MN: University of Minnesota Press.

De la Cadena M (2015) *Earth Beings: Ecologies of Practice across Andean Worlds*. Durham, NC: Duke University Press.

Degens P, Hilbrich I, Lez S (2022) Analyzing infrastructure in the anthropocene. *Historical Social Research* 47(4): 7–28.

Dorondel S (2016) *Disrupted Landscapes: State, Peasants and the Politics of Land in Postsocialist Romania*. New York and Oxford: Berghahn Books.

Edwards P (2003) Infrastructure and modernity: Force, time and social organisation in the history of sociotechnical systems. In: Miss T, Grey P, Feenberg A (eds) *Modernity and Technology*. Cambridge, MA: MIT Press, 185–225.

Emmett R, Nye D (2017) *The Environmental Humanities: A Critical Introduction*. Cambridge, MA: MIT Press.

Endo T (2014) *Living with Risk: Precarity and Bangkok's Urban Poor*. Singapore: NUS Press.

Garrard G (2012) *Ecocriticism*. New York: Routledge.

Ghertner DA (2011) Green evictions: Environmental discourses of a 'slum-free' Delhi. In: Peet R, Robbins P, Watts M (eds) *Global Political Ecology*. New York: Routledge, 145–65.

Glotfelty C, Fromm H (eds) (1996) *The Ecocriticism Reader: Landmarks in Literary Ecology*. Athens, GA: University of Georgia Press.

Goldman M, Nadasdy P, Turner M (eds) (2010) *Knowing Nature: Conversations at the Intersection of Political Ecology and Science Studies*. Chicago, IL: Chicago University Press.

Graham S, Marvin T (2002 [2001]) *Splintering Urbanism: Networked Infrastructures, Technological Mobilities and the Urban Condition*. London and New York: Routledge.

Günel G (2019) *Spaceship in the Desert: Energy, Climate Change, and Urban Design in Abu Dhabi*. Durham, NC: Duke University Press.

Haraway D (2015) Anthropocene, capitalocene, plantationocene, chthulucene: Making kin. *Environmental Humanities* 6: 159–165.

Harms E (2014) Urban space and exclusion in Asia. *Annual Review of Anthropology* 45: 45–61.

Harvey P, Jensen CB, Morita A (eds) (2017) *Infrastructure and Social Complexity: A Companion*. London: Routledge.

Harvey P, Knox H (2015) *Roads: An Anthropology of Infrastructure and Expertise*. Ithaca, NY: Cornell University Press.

Heslop L, Murton G (2021) Why highways remake hierarchies. In: Heslop L, Murton G (eds) *Highways and Hierarchies: Ethnographies of Mobility from the Himalaya to the Indian Ocean*. Amsterdam: Amsterdam University Press.

Hetherington K (ed.) (2019) *Infrastructure, Environment, and Life in the Anthropocene*. Durham, NC: Duke University Press.

Howe C (2019) *Ecologics: Wind and Power in the Anthropocene*. Durham, NC: Duke University Press.

Howe C, Pandian A (eds) (2019) *Anthropocene Unseen: A Lexicon*. Punctum Books.

Hughes T (1983) *Networks of Power: Electrification in Western Society, 1880–1930*. Baltimore, MD: Johns Hopkins University Press.

Ingold T (2011) *Being Alive: Essays on Movement, Knowledge and Description*. New York: Routledge.

Jørgensen D (2014) Not by human hands: Five technological tenents for the environmental history of the anthropocene. *Environment and History* 20(4): 479–489.

Jørgensen D, Jørgensen FA, Pritchard S (eds) (2013) *New Natures: Joining Environmental History with Science and Technology Studies*. Pittsburgh, PA: University of Pittsburgh Press.

Jaffe R, Evans L (2022) Imagining infrastructure in Urban Jamaica. *GeoHumanities* 8(1): 17–32.

Jensen CB, Morita A (2015) Infrastructures as ontological experiments. *Engaging Science, Technology, and Society* 1: 81–87.

Jensen CB, Morita A (2017) Introduction: Infrastructures as ontological experiments. *Ethnos* 82(4): 615–626.

Kaika M, Swyngedouw E (2000) Fetishizing the modern city: The phantasmagoria of urban technological networks. *International Journal of Urban and Regional Research* 24(1): 120–138.

Kalb M (2022) *Environing Empire: Nature, Infrastructure, and the Making of German Southwest Africa*. New York and Oxford: Berghahn Books.

Knox H (2020) *Thinking Like a Climate: Governing a City in Times of Environmental Change*. Durham, NC: Duke University Press.

Knox H, Gambino E (2023) Infrastructure. In: Stein F (ed.) *The Open Encyclopedia of Anthropology*. Available at: https://www.anthroencyclopedia.com/entry/infrastructure

Kohler R (1994) *Lords of the Fly: Drosophila Genetics and the Experimental Life*. Chicago, IL: University of Chicago Press.

Kohn E (2013) *How Forests Think: Toward an Anthropology beyond the Human*. Berkeley, CA: University of California Press.

Kreike E (2013) *Environmental Infrastructure in African History: Examining the Myth of Natural Resource Management in Namibia*. Cambridge: Cambridge University Press.

Kreike E (2021) *Scorched Earth: Environmental Warfare as a Crime against Humanity and Nature*. Princeton, NJ: Princeton University Press.

Larkin B (2008) *Signal and Noise: Media, Infrastructure, and Urban Culture in Nigeria*. Durham, NC: Duke University Press.

Larkin B (2013) The politics and poetics of infrastructure. *Annual Review of Anthropology* 42: 327–343.

Liebman A (2022) High metabolism infrastructure and the scrap industry in urban China. *The China Quarterly*. Epub ahead of print 21 November. DOI: 10.1017/S0305741022001606.

Lorimer J (2015) *Wildlife in the Anthropocene: Conservation after Nature*. Minneapolis, MN: University of Minnesota Press.

McKittrick K (2013) Plantation futures. *Small Axe: A Caribbean Journal of Criticism* 17(3): 1–15.

Mitchell T (2011) *Carbon Democracy: Political Power in the Age of Oil*. New York: Verso Books.

Morita A (2017) Multispecies infrastructure: Infrastructural inversion and involutionary entanglements in the Chao Phraya Delta, Thailand. *Ethnos* 82(4): 738–757.

Morita A, Jensen CB (2017) Delta ontologies: Infrastructural transformations in the Chao Phraya Delta, Thailand. *Social Analysis* 61(2): 118–133.

Morton T (2013) *Hyperobjects: Philosophy and Ecology after the End of the World*. Minneapolis MN: University of Minnesota Press.

Mrázek R (2002) *Engineers of Happy Land: Technology and Nationalism in a Colony*. Princeton, NJ: Princeton University Press.

Münster U (2016) Working for the forest: The ambivalent intimacies of human–elephant collaboration in south Indian Wildlife Conservation. *Ethnos* 81(3): 425–447.

Nardizzi V (2017) Environ. In: Cohen JJ, Duckert L (eds) *Veer Ecologies: An Ecotheory Companion*. Minneapolis MN: University of Minnesota Pres, 90–105.

Nash L (2007) *Inescapable Ecologies: A History of Environment, Disease, and Knowledge*. Berkeley, CA: University of California Press.

Niewöhner J (2022) Infrastructure. *Oxford Research Encyclopedia of Anthropology*. Available at: https://oxfordre.com/anthropology/display/10.1093/acrefore/9780190854584.001.0001/acrefore-9780190854584-e-128;jsessionid=9E0EE44A71F9F29E884C50E33F4E5223

Olwig K (1996) Recovering the substantive nature of landscape. *Annals of the Association of American Geographers* 86(4): 630–653.

Pandian A (2019) *A Possible Anthropology: Methods for Uneasy Times*. Durham, NC: Duke University Press.

Parreñas JS (2018) *Decolonizing Extinction: The Work of Care in Orangutan Rehabilitation*. Durham, NC: Duke University Press.

Povinelli E (2011) *Economies of Abandonment: Social Belonging and Endurance in Late Liberalism*. Durham, NC: Duke University Press.

Powell D (2018) *Landscapes of Power: Politics of Energy in the Navajo Nation*. Durham, NC: Duke University Press.

Pritchard S (2011) *Confluence: The Nature of Technology and the Remaking of the Rhône*. Cambridge, MA: Harvard University Press.

Pritchard S, Zimring CA (2020) *Technology and the Environment in History*. Baltimore, MD: Johns Hopkins University Press.

Rademacher A (2011) *Reigning the River: Urban Ecologies and Political Transformation in Kathmandu*. Durham, NC: Duke University Press.

Rademacher A (2017) *Building in Green: Environmental Architects and the Struggle for Sustainability in Mumbai*. Berkeley, CA: University of California Press.

Rest M (2019) Dreaming of pipes: Kathmandu's long delayed Melamchi water supply project. *Environment and Planning C: Politics and Space* 37(7): 1198–1216.

Rest M, Rippa A (2019) Road animism: Reflections on the life of infrastructure. *HAU: Journal of Ethnographic Theory* 9(2): 373–389.

Reuss M, Cutcliffe S (eds) (2010) *The Illusory Boundary: Environment and Technology in History*. Charlottesville, VA: University of Virginia Press.

Rippa A (2020) *Borderland Infrastructures: Trade, Development and Control in Western China*. Amsterdam: Amsterdam University Press.

Rippa A (2021) Archive: An introduction. *Roadsides* 5: 1–5.

Saxer M (2016) Pathways: A concept, field site and methodological approach to study remoteness and connectivity. *HIMALAYA: The Journal of the Association for Nepal and Himalayan Studies* 36(2): 104–119.

Scaramelli C (2019) The Delta is dead: Moral ecologies of infrastructure in Turkey. *Cultural Anthropology* 34(3): 388–416.

Schwenkel C (2020) *Building Socialism: The Afterlife of East German Architecture in Urban Vietnam*. Durham, NC: Duke University Press.

Simone A (2004) People as infrastructure: Intersecting fragments in Johannesburg. *Public Culture* 16(3): 407–429.

Sörlin S, Wormbs N (2018) Environing technologies: A theory of making environment. *History and Technology* 34(2): 101–125.

Stoetzer B (2018) Ruderal ecologies: Rethinking nature, migration, and the urban landscape in Berlin. *Cultural Anthropology* 33(2): 295–323.

Swyngedouw E (1997) Power, nature, and the city. The conquest of water and the political ecology of urbanization in Guayaquil, Ecuador: 1880–1990. *Environment and Planning A: Economy and Space* 29(2): 311–332.

Todd Z (2015) Indigenizing the anthropocene. In: Davis H, Turpin E (eds) *Art in the Anthropocene: Encounterns among Aesthetics, Politics, Environment and Epistemology*. Open Humanities Press, 241–254.

Tsing A (2017) The buck, the bull, and the dream of the stag: Some unexpected weeds of the Anthropocene. *Suomen Antropologi: Journal of the Finnish Anthropological Society* 42(1): 3–21.

Tsing A, Deger J, Saxena AK, et al. (2020) *Feral Atlas*. Stanford: Stanford University Press.

Venkatesan S, Bear L, Harvey P, et al. (2018) Attention to infrastructure offers a welcome reconfiguration of anthropological approaches to the political. *Critique of Anthropology* 38(1): 3–52.

Von Schnitzler A (2016) *Democracy's Infrastructure: Techno-Politics and Protest after Apartheid*. Princeton, NJ: Princeton University Press.

Warde P, Robin L, Sörlin S (2018) *The Environment: A History of the Idea*. Baltimore, MD: Johns Hopkins University Press.

Whyte K (2018) Settler colonialism, ecology, and environmental injustice. *Environment and Society: Advances in Research* 9: 125–144.

Yamada K (2022) On more-than-human labor: Revisiting Japan's ecological modernity and the politics and ethics of interspecies entanglements. *Japan Forum* 34(5): 624–648.

Yeh ET, Gaerrang (2021) Pests, keystone species, and hungry ghosts: The Gesar epic and human-pika relations on the Tibetan Plateau. *Cultural Geographies* 28(3): 461–478.

Zhang A (2019) Invisible labouring bodies: Waste work as infrastructure in China. *Made in China Journal* 4(2): 98–102.

Zhang A (2020) Circularity and enclosures: Metabolizing waste with the Black Soldier Fly. *Cultural Anthropology* 35(1): 74–103.

Author biography

Alessandro Rippa is an Associate Professor at the Department of Social Anthropology, University of Oslo, and Project Director at the Rachel Carson Center for Environment and Society, LMU Munich. His research concerns infrastructure, global circulations, and the environment. He is the author of *Borderland Infrastructure: Trade, Development and Control in Western China* (Amsterdam University Press, 2020)