

**ADVANCED REVIEW**

# Histories of habitability from the oikoumene to the Anthropocene

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**Funding information**

European Commission, Grant/Award  
Number: HORIZON-MSCA-2021-PF-  
01-01-101059732-HABITABILITY; Irish  
Research Council, Grant/Award Number:  
GOIPD/2020/44

**Edited by:** Matthias Heymann, Domain  
Editor and Mike Hulme, Editor-in-Chief

**Abstract**

The IPCC's Sixth Assessment Report warns in stark terms that many long inhabited parts of the world are now on course to become uninhabitable. As astronomers continue to search the universe for new habitable planets, it is equally essential to historicize the consequences of changing habitability on this one. This article reviews how scholars have engaged with the widely noted but rarely theorized categories of “habitability” and “uninhabitability.” While tracing longer imperial genealogies, the primary focus is on notions of habitability in relation to European global empires in the nineteenth and twentieth centuries, and their postcolonial legacies. The article traces three key themes in the literature: that habitability was inherently limited, and beyond those limits allegedly lay uninhabitability; that habitability was differential and that certain places were habitable for some groups but not others (but that this might be changed by technological interventions); and finally, that the limits of habitability were not static, but could change for both better and worse. Here the links between colonialism and ideas of acclimatization, terraforming, “improvement,” deliberate uninhabitability, and an “Anthropocene” have all been central to the literature. These have often been closely associated with insidious forms of environmental determinism, which are taking on new forms in an age of crisis (especially in narratives around climate and migration). By drawing together previously disparate literatures, this article ultimately calls on scholars to embrace habitability studies more widely, and to expand on their interdisciplinary potential for communicating the societal consequences of a changing climate.

This article is categorized under:

Climate, History, Society, Culture > Ideas and Knowledge

**KEYWORDS**

Anthropocene, climate change, empire, environmental determinism, habitability

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## 1 | INTRODUCTION

As the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) starkly warns, many long inhabited parts of the world are now on course to become uninhabitable (Portner et al., 2022). While the large scale effects of anthropogenic climate change are new and unprecedented, divisions of the world into “habitable” and “uninhabitable” regions are not, however, and have long shaped social, cultural and political relationships. At a time of increasingly acute concern, it is imperative that notions of habitability and uninhabitability be placed in their historical contexts. This article considers the various ways that scholars have engaged with questions of habitability and its changing limits, particularly in relation to European and global empires in the nineteenth and twentieth centuries (Arnold, 1996; Fleming & Jankovic, 2011; Heymann, 2010; Livingstone, 2012). It also focuses on the relationship of imperial ideas of habitability and uninhabitability to a long and pervasive history of environmental determinism and human potential in relation to the environment (Hulme, 2011; Locher & Fressoz, 2012), notions with new and insidious echoes in an age of crisis, especially in narratives around climate change and migration (Ahuja, 2021; Horton et al., 2021; McLeman, 2014).

By considering previously disparate interdisciplinary insights from history, geography, philosophy, the history of science, and literary studies, this article outlines the ways ideas of habitability shaped imperial environmental imaginaries and practices, and their legacies today. Examining “habitability” and “uninhabitability” as categories of historical analysis may nevertheless require some explanation of terminology. Both historically and now, scholars examining habitability have not always used precisely these terms, although the phrases “habitable globe,” “habitable world,” and “habitable earth” do appear in range of contexts, from natural history to politics, and from philosophy to literature. Perhaps the most extensive explicit engagement is provided by the geographer Clarence Glacken, whose contributions in “Changing Ideas of the Habitable World” and expansion of these ideas in *Traces on the Rhodian Shore* echo throughout this article (Glacken, 1956, 1967). In focusing on the period up to the end of the eighteenth century, Glacken divided his history of human relationships with the environment under three heads, self-consciously European in focus:

Is the earth, which is obviously a fit environment for man and other organic life, a purposefully made creation? Have its climates ... influenced the moral and social nature of individuals, and have they had an influence in molding the character and nature of human culture? In his long tenure of the earth, in what manner has man changed it from its hypothetical pristine condition? (Glacken, 1967, p. vii)

Glacken went on to summarize that these had elicited genres of response that may be organized into “the idea of a designed earth; the idea of environmental influence; and the idea of man as a geographic agent” (Glacken, 1967, p. vii). This article picks up Glacken’s story by tracing longer genealogies of imperial ideas of a “habitable globe” (and its limits), but focuses on more recent literature on the period of European imperial dominance in the nineteenth and twentieth centuries (Grove & Damodaran, 2006), as well as current work seeking to explain the direct links between colonialism in the past and climate change in the present (Mahony & Endfield, 2018).

Today notions of habitability are perhaps not most readily associated with questions about life on this planet. Rather, they evoke the idea of astronomers searching the universe for “habitable planets,” with the thought that the earth surely cannot be the only one (an idea lately also pursued by billionaires, albeit for different reasons and generally focused on planets within the solar system that could potentially be reached within their lifetimes). Natural scientists have meanwhile long examined and debated the biological and chemical conditions necessary for life to arise. Here they have addressed the fundamental requirements for planetary habitability, including liquid water, an atmosphere, a narrow temperature window, a relatively stable climate, and so on (Langmuir & Broecker, 2012). Concurrently, philosophers and science fiction writers have wondered if other “habitable worlds”—if or when discovered—will exactly resemble earth, or the ways they might differ. Questions have also focused on the possibilities (and attendant ethical implications) of terraforming, and whether Mars or other planets could ever be transformed from their current state and made habitable for humans (Beech, 2009).

Habitability also invites the idea of “habitat,” a notion more widely used in relation to nonhuman animals than for humans, except occasionally in discussions of artificial “habitats” for outer space or deep sea exploration (Bashford, 2014, p. 166). Questions in Earth System Science (ESS) likewise do not necessarily center humans in wider questions of habitability. Here Dipesh Chakrabarty has proposed to distinguish the “global” and “planetary,” via “sustainability” which centers human needs and “habitability” which “does not reference humans” but instead focuses on the possibility for the planet to support (and continue supporting) “complex, multicellular life” (Chakrabarty, 2019,

p. 20; see also Warde, 2018; Vatter, 2022). Put differently, “humans are not central to the problem of habitability but habitability is central to human existence” (Chakrabarty, 2021, p. 83). While acknowledging the potential value of this distinction, this article nevertheless focuses on the various ways scholars have understood questions of habitability in relation to humans. This does not exclude simultaneously acknowledging that changing the habitability of the earth to suit humans via technology and the consumption of resources has reduced the habitability of the planet for other species (in some case to the point of extinction), not to mention also likely diminishing habitability for humans yet to be born (Langmuir & Broecker, 2012, p. 595).

As much as definitions and delineations of human habitability hinge on biology, geography, and the physical environment, they have always also been cultural. Far from simply reflecting a material reality, judgments about the limits of the so-called “habitable globe” have never been neutral or free from political interest. As the geographer Denis Cosgrove notes, “from antiquity the bounds of the earth have been drawn to distinguish humanity from the rest of nature” as well as “register imperial claims over both nature and peoples” (Cosgrove, 2001, p. 13). Rather than comparing and assessing soil, rainfall, temperature, frequency of extreme weather events or other physical factors that were seen as essential to making a place habitable or uninhabitable, I thus especially consider scholarship on imperial “imaginative geographies” and “environmental imaginaries” (Mahony & Randalls, 2020). Here ideas of acclimatization, terraforming, “improvement” and deliberate uninhabitability have all been central to the scholarship on habitability and empire. This article ultimately traces three key themes that emerge from these literatures: (1) that habitability was inherently *limited*, and beyond those limits allegedly lay uninhabitability; (2) that habitability was *differential*, and that certain places might be habitable for some groups of people but not others (but that this might be changed by technological or other interventions); and (3) that the limits of habitability were not static, but *changeable* over both short and long timescales (this could be for both better and worse, and via both natural and artificial or anthropogenic causes).

The review begins with classic notions of the *oikoumene*, *klima* and “Airs, Waters, and Places,” ideas which continued to shape imperial imaginations. This is followed by discussions of the habitability of “the tropics” and questions of acclimatization in imperial expansion. Next, I consider scholarship on the way habitability featured in nineteenth-century imaginaries of deserts, tied to the pervasive idea of “improvement” which justified the taking of allegedly underutilized or “wasted” lands. This is followed by discussions of demography and concerns around exceeding the limits of habitable space in the early twentieth century, and an examination of recent work addressing the persistence of environmental determinism. Finally, I consider how scholars are addressing questions of habitability in relation to uncertain futures and the idea of the Anthropocene. The article concludes by considering future avenues for habitability studies, especially in bridging between disciplines to understand how relationships with a limited “habitable globe” have been imagined over time, and how they can—and indeed must—be imagined anew.

## 2 | GENEALOGIES OF IMPERIAL DEFINITIONS OF HABITABILITY

While adopted, adapted and revised in the age of global empires, the idea of a limited and differentially “habitable globe” was far from a new concept. Nineteenth and twentieth-century European geographers drew especially on older Greco-Roman (and later Islamic) environmental notions. Acknowledging it as a perhaps egregiously Eurocentric starting point, Denis Cosgrove explains that understanding the legacies of Greek geography still matters, because they provide many of the underlying assumptions that guided “the evolution of a Western geographical imagination” and remain embedded in commonly used environmental divisions of the globe today (Cosgrove, 2001, p. 36).

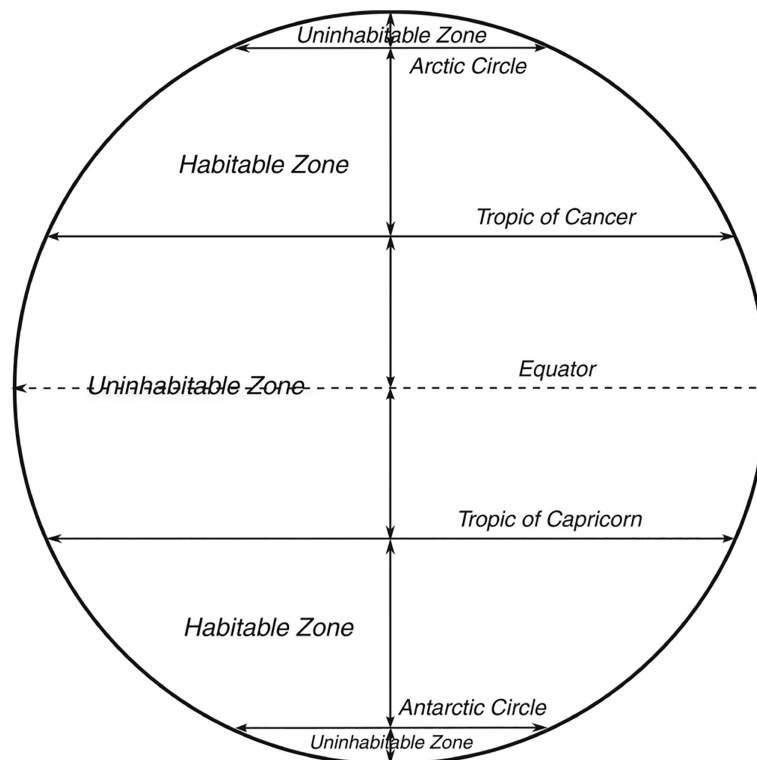
Of particular relevance is the Greek concept of the *oikoumene*, referring variously to the known, inhabited or habitable world (Cosgrove, 2001; Glacken, 1967). Centered, of course, on Greece, the classical *oikoumene* encompassed parts of what is today Europe, North Africa and Asia. As a notion it was nevertheless far from static, and in its earliest formulations the *oikoumene* had been “predominantly a geographic concept” but “in the Hellenistic world it assumed also a cultural connotation,” and was later associated not only with the inhabited world, but the supposedly “civilised” one (Glacken, 1967, p. 23). The *oikoumene* was also fundamentally about the limits of knowledge, dividing the world into known and unknown space, “us” and “them” (Cosgrove, 2001, p. 22). Ultimately, the *oikoumene* “called attention to the fitness of the earth itself as an environment for human beings,” but it also especially highlighted “the inequality of environments and the differences among them” and thus “to the unequal distribution of peoples and to the boundaries that might divide off a densely inhabited from a desolate region” (Glacken, 1967, p. 17).

Alongside notions of an *oikoumene*, Greek thinkers also proposed divisions of the earth by *klima* (plural *klimata*). The root of the modern “climate,” *klima* literally referred to the slope or angle of the sun above the horizon

(Fleming, 1998). Here climate was inherently geographically defined, in this case in relation to latitude. As popularized by Aristotle, the various climates of the world were divided into five (or later sometimes seven) latitudinal zones. In the north was the frigid Arctic zone, followed by the northern temperate, equatorial or torrid, southern temperate, and frigid Antarctic zones. These five divisions were also sometimes divided explicitly in terms of habitability and uninhabitability (See Figure 1).

A key assumption embedded in these divisions was that the globe was not everywhere inhabitable and that the “torrid” zone was too hot to be habitable, while the “frigid” zones were uninhabitable for the opposite reason (Cosgrove, 2001, p. 37). For the ancient writers this included considerable speculation, and the southern latitudes in particular remained empirically unknown (even as their existence was hypothesized as necessary to balance the earth). Building on these ideas was the Roman Macrobius, whose fifth century CE *Commentary on the Dream of Scipio* codified the tradition of mapping the earth with two habitable and three uninhabitable zones, something that lasted until the early modern period (Hiatt, 2007). Scholars have also shown that there was a considerable transmission of ideas about Greco-Roman climatic zones into Islamic thought. Here “the theory that the inhabited portion of the earth was divided into seven *climata* (Arabic *iq̄līm*, pl. *aq̄ālīm*) rapidly became an inalienable part of Islamic high learning” (Karamustafa, 1992, p. 76). Much as the Greeks, Islamic scholars placed themselves at the center of their “habitable world,” continuing a perhaps inevitable naturalization of the supposed superiority or suitability of any given author’s native climate (Al-Azmeh, 1992; Cosgrove, 2001).

Scholars have also examined the way notions that human potential was shaped by environmental conditions have been persistent and pervasive. If today there is increasing concern about the impact people have on climate, for much of human history the reverse proposition—that is, what impact climate has on people—was more pressing (Bashford & Tracy, 2012, pp. 496–497; see also Davies, 2016). Morality, intelligence, physiology, race and “energy” have all been attributed to climate. More broadly, the development of political and cultural institutions, and “civilisation” have all also been seen as environmentally and climatically determined (Arnold, 1996; Meyer, 2020). Here the Hippocratic corpus, and in particular the treatise *On Airs, Waters and Places* (c. 400 BCE) has been especially influential. Hippocrates (or whoever wrote the treatise that bears his name) argued that human health, constitutions, physical characteristics



**FIGURE 1** Five latitudinal zones dividing the earth, categorized in terms of “habitability” and “uninhabitability,” and often attributed to the ideas of early fifth century BCE philosopher Parmenides. Here the “contention that there are not one but two habitable zones on the Earth was revolutionary” (Geus, 2018, pp. 405–406). Image reproduced by kind permission of Cambridge University Press.

and even morals were shaped by climatic factors. In time, these assertions of differential habitability became tropes that reinforced alleged superiority: for example, that cold climates produced endurance, warm climates engendered passionate but lazy peoples, and temperate climates conferred intellectual superiority. In terms of limited habitability, barren places could nevertheless be seen to produce people that were hardy and brave, while fertile regions resulted in people who were soft and weak. These ideas were also developed by Islamic scholars, perhaps most famously in Ibn Khaldun's *Muqaddimah* (1377), which suggested that “the desert is the basis and reservoir of civilization and cities” and “the toughness of desert life precedes the softness of sedentary life” (cited in Khazeni, 2013, p. 134).

Ideas of differential habitability, and the alleged impact of environments on health and culture continued to have significant purchase in the medieval world, even as the scope remained limited. This was notable, for example, in the idea of a Christian ecumene, which appropriated and expanded the Greek *oikoumene*. As Denis Cosgrove notes, “until the fifteenth century the imagined bounds of Christian empire remained the Aristotelian *klimata*” (Cosgrove, 2001, p. 17; see also Chaplin, 2013). However, these bounds had to be adapted, notably as a result of encountering “new worlds,” and scholars have shown how the seaborne imposition of European interests on a global scale forced a rethinking of the limits of habitability (Davies, 2016). This was especially so when the oft supposed uninhabitability of the torrid zone become patently untenable, and new worlds and new peoples had to be incorporated into an expanding ecumene (Headley, 1997; Moretti, 1994).

This growing global connectedness meant previously multiple and largely separate ecumenes—notably the Eurasian and American worlds—became one (in the case of many indigenous peoples, forcibly and catastrophically so). The realization that “the entire world was potentially inhabitable by human beings was a tectonic geographical change” in European imaginaries, and “was key to the secularization of habitability ... transforming its biblical and classical images into new descriptions based on its geographical and political condition” (Onetto Pavez, 2022, pp. 1–2; 24). This secularization would lay the groundwork for new forms of universalism, and provide the intellectual framework for imperial ambitions to dominate a global ecumene shorn of classical limits. Separate *klimata* were no longer necessarily seen as natural bounds, with habitability sometimes linked to the availability of resources rather than climatic zones (Onetto Pavez, 2022, p. 24). Older ideas of “civilisation” and “barbarity” would also be adapted to support deterministic categorizations of “underutilized” and “uninhabited” lands, which were increasingly seen as not only potentially available for appropriation, but places which Europeans were morally obliged to bring into the ecumene in order to “improve.” As Cosgrove notes, “in practice, the European response to global difference” encountered beyond the classical ecumene “was to domesticate nature by colonization and cultivation” (Cosgrove, 2001, p. 137).

Differential habitability and the impact of climate on peoples nevertheless remained central to imperial imaginaries. These tensions are reflected in Montesquieu's infamous and oft-cited 1748 observation that “the empire of climate is the foremost of all empires,” and wider ruminations about the effect of climate on the habits, character, and laws of populations (cited in Meyer, 2020, p. 177). For Montesquieu, however, these deterministic visions did not necessarily strip away all agency, and allegedly negative qualities of different environments could “be counteracted by laws designed to offset their effects” (Meyer, 2020, p. 177; see also Fleming, 1998). In the eighteenth-century, notions of differential habitability and total habitability were also complicated by attempts to grapple with growing evidence that the habitability of the various parts of the earth was not static. Here scholars often single out the writings of French naturalist the Comte de Buffon as establishing that humans could potentially have as much agency in environmental changes as geographical factors like water or wind (Glacken, 1967). Buffon was particularly interested in the changes brought by the “the growth and expansion of civilization and the migration and dispersion of human beings and their domesticated plants and animals throughout the habitable parts of the earth” (Glacken, 1967, p. 663). Ultimately, however, he emphasized human creativity in reshaping environments over the potential for negative impacts, and assumed these effects anyway confined to local or regional scales.

Despite apparently vast expansions of the ecumene, questions around habitability and demographic limits grew by the turn of the nineteenth century. Here English writer Thomas Robert Malthus is usually seen as central, especially his famous *Essay on the Principle of Population* (1798) which predicted a grim relationship between population growth and food production. Concern about exceeding the limits of habitability is central to Malthus' work, which argued strongly against optimistic contemporary assertions that “three fourths of the habitable globe is now uncultivated” and that the parts already under cultivation were “capable of immeasurable improvement” (Malthus, 1798, p. 180, quoting William Godwin). Scholars have shown that environmental concerns about limits were key to Malthus' own (and later “Malthusian”) thinking (Mayhew, 2016), while recent work also highlights the colonization of the “new worlds” (in which Malthus had direct financial involvement) as part of a “political economy” of habitability that sought to explain the danger of relying on indefinitely expanding the ecumene to escape demographic and resources limits

(Bashford & Chaplin, 2017). As is taken up later in the article, Malthusian imaginaries have a long legacy, and are today often applied to planetary concerns, with debates “whether both population increase and escalating per capita consumption will lead to Malthusian positive checks via climate change undermining the habitability of the earth as a home for humankind” (Mayhew, 2016, p. 16).

### 3 | ACCLIMATIZATION AND THE HABITABILITY OF “THE TROPICS”

Among imperial imaginative geographies of the eighteenth century onwards, few proved more powerful, adaptable and insidious than the idea of “the tropics.” The role of “tropicality” in the appropriation of territories and peoples has been extensively studied, especially by historians of medicine and historical geographers (Arnold, 2006; Driver & Martins, 2005; Endfield & Randalls, 2015; Mahony & Endfield, 2018; Morgan, 2018). Indeed, once accepted that the “tropics” were habitable at all—not always previously a given—questions then turned to for whom they were habitable. Here the geographer David N. Livingstone has made important contributions in seeking to explain how “geographical knowledge of the world’s climatic zones and the awareness of distribution patterns were cast in moral idioms by students of human nature and racial character” (Livingstone, 1991, p. 413, see also 1987, 2002). Here the suitability of particular bodies to particular climates “received reinforcement in the wake of European colonialism” but drew on a longer genealogy including Aristotle and Hippocrates, as well as later interpretations by the likes of Montesquieu, Jean Bodin and Abbé du Bois (Livingstone, 2002, p. 160; see also Seth, 2018). More widely, “the contrast between the temperate and the tropical” emerged as “one of the most enduring themes in the history of global imaginings.” While these imaginaries could at different times be positive or negative, “tropicality ... frequently served as a foil to temperate nature, to all that is modest, civilised, cultivated” (Driver & Martins, 2005, p. 3; see also Stepan, 2001). Indeed, as in imperial assessments of habitability more widely, “temperate” Europe was almost always the norm against which other places were measured and read as aberrations.

Embedded in these investigations were racialized questions of differential habitability and whether people could acclimatize to new places at all (whether as colonial settlers or via forced relocations through slavery and systems of indentured labor). These became central to visions of imperial expansion and settler-colonialism, but they also led to insecurity about the long-term stability of empires. Mark Harrison details the growing pessimism about acclimatizing or “seasoning” European bodies in “tropical” places like India and the Caribbean, especially in light of increasingly biologically essentialist views of race in the nineteenth century. These doubts “served to alienate the British from their new domains” because “if racial distinctions were fixed, then full acclimatization was no longer possible, and colonization a practical impossibility” (Harrison, 1999, p. 17). Here the question of for whom a place was safely and comfortably habitable could thus supersede questions about outright habitability. Locating, designating or designing certain places as habitable for some bodies but not others became central to both territorial acquisition and racialized labor regimes (Cosgrove, 2001; Mahony & Endfield, 2018). Historians and geographers have detailed how this spurred the search for new sites supposedly suitable for European habitability—such as “hill stations” in India or the quixotic “white highlands” of East Africa—temperate “goldilocks zones” which relied on altitude to offset tropical climates and replicate the allegedly ideal climate of the temperate world (Anderson, 1997; Livingstone, 2002). This was nevertheless often far from straightforward and “the imagined geographies of imperial spaces and their climates were frequently at odds with reality and lived experience” (Mahony & Endfield, 2018, p. 6).

Managing differential habitability and acclimatization in allegedly insalubrious spaces thus propelled increasingly systematic “medical topographies” and scientific investigations into climate in the nineteenth century, with disease ecologies becoming a central factor (Jepson, 2004; see also Nash, 2006; and for examples from Qing China, see Bello, 2005). Scholars have also shown how questions about habitability and acclimatization extended to plants, for example in relation to key imperial drugs like cinchona (the source of antimalarial quinine), as well as to animals as part of a wider “economy of nature” (Minard, 2019; Ritvo, 2012). Here acclimatization was heavily implicated in imperial practices, to the extent that it became “the paradigmatic colonial science” (Osborne, 2000). Indeed, rather than passively accepting differential habitability, attempts were made to modify and mitigate the supposed deleterious effects of tropical climates. As Deborah Coen argues more widely, the key change was that in the “eighteenth-century savants had typically regarded the fit between a society and its natural environment as the result of a divine plan” and hence out of their remit, but “nineteenth-century geographers saw it instead as the result of a process of biological and cultural adaptation, one in which imperialists intended to intervene” (Coen, 2018, p. 8). As a result, climatic sciences became essential (alongside “tropical medicine”) in understanding and seeking to modify the habitability of the

colonies, especially in enabling white colonization (Endfield & Randalls, 2015). These impulses echo today, for example in concern around the long-term of habitability of modern coastal and desert cities facing rising oceans and rising temperatures, with technological and architectural attempts to mitigate these effects distributed in highly unequal ways that are already engendering new questions of differential habitability.

#### 4 | DESERTS, UNINHABITABLE “WASTELANDS” AND IMPERIAL “IMPROVEMENT”

While much scholarly discourse around climatic determinism, differential habitability and acclimatization in the nineteenth century has centered on “the tropics,” imperial questions of habitability were just as key in arid regions. Here environmental anxieties and imaginaries took forms both similar and different. Despite having at times been home to up to one-third of the world’s population, arid regions have often been imagined as barren, desolate and empty; that is, spaces where habitability was particularly precarious and prone to change (Haynes, 2013; D. K. Davis, 2016a; Henni, 2022). Indeed, in modern Western imaginaries deserts still tend to be categorized as uninhabitable and sterile (although they are often romanticized in parallel, and pointed to as the “cradle of civilisation” or the originator of major world religions).

While deserts were increasingly seen as degraded, barren and empty—and often dismissed with blanket assessments of uninhabitability—there was nevertheless a tension in that many of these places had clearly long been inhabited. Moreover, sophisticated technologies to mitigate high temperatures and limited rainfall, especially around canals and irrigation, had been used for millennia to transform—or even terraform—arid landscapes, increase agricultural productivity, and exert political power by expanding the limits of habitability (Wittfogel, 1957; D. K. Davis & Burke, 2011). A common way to resolve this tension and justify appropriation was to relegate sophisticated existing forms of habitability management to a former “Golden Age”—as in orientalist discourse more broadly—and compare this to an allegedly degenerated present where mismanagement and cultural failings had led to environmental degradation and decline (D. K. Davis, 2016a).

Here arid environments would become the center of declensionist narratives in the nineteenth century, with deserts seen as “desiccated former forests that must be rescued and made forests again” (D. K. Davis, 2016a, p. 79). Intertwined with—and fundamental to—these beliefs was not only that existing or indigenous populations had not made effective use of their environments or sufficiently improved habitability, but even worse, that they had squandered and mismanaged them. The corollary of this was that deserts came to be seen as not only wastelands but “wasted” environments, and “signs of divine retribution against those immoral and destructive ‘natives’ who had ruined the land” (D. K. Davis, 2016a, p. 102). Here “spreading sands represented the antithesis of all that settlement promised. They were terrible, un-Christian, an evil to be remedied” (Beattie, 2011, p. 177).

More widely, the idea of “improvement” and the expansion of habitability became key to the justification of territorial acquisition and the legitimation of colonial rule (Drayton, 2000). Judgments were often tied to discussions about land use, with longstanding assumptions that nomadic lifestyles or pastoralism were inherently less “civilised” than that of settlement and cultivation. As Neeladri Bhattacharya explains, for the British in India “lack of interest in cultivation was a sign of ‘apathy’.” This further buttressed the idea that ground not used for cultivation was “‘waste’, ‘barren’, a ‘wilderness’” (Bhattacharya, 1995, pp. 71–72). These distinctions were not only made in European empires, and as Arash Khazeni notes “the interface between the steppe and the sown is among the long-standing themes in the environmental history of Islamic Eurasia and North Africa” (Khazeni, 2013, p. 133).

Meanwhile, James Beattie elaborates on “environmental anxiety” in empire, “when environments did not conform to European preconceptions about their natural productivity” or when colonial practices resulted in “unintended environmental consequences” which might imperil health, political stability and the edifice of colonial power itself (Beattie, 2011, p. 1). These debates reflect a tension in the literature on empire and environmental history: on the one hand, imperial expansion unquestionably wrought enormous ecological damage through resource extraction, exploitation, and ill-conceived “improvement” schemes to expand the limits of habitability; but on the other hand, a number of conservationist or even proto-environmentalist ideas might be discernible in imperial policies. This tension is most famously articulated in Richard Grove’s *Green Imperialism*, which identifies concerns with deforestation and changing habitability as far back as the eighteenth century and traces various notions of conservationism—if motivated by resource management and maximization rather than the “enlightened” or “radical” environmentalism prevalent since the 1960s—across the British and French Empires (Grove, 1995; see also Beinart & Hughes, 2007; Beattie et al., 2015).

Changes in—or even simply the recognition of the potentially dynamic nature of—habitability could nevertheless lead to imperial insecurity. Scholars have shown that in the nineteenth century there was increasing interest in the complex ways that the limits of the “habitable globe” could be altered by humans for both better and worse, amidst growing understandings that the limits of the habitability were not and never had been static (Beattie et al., 2015; Lehmann, 2022). This could have “positive” and “negative” dimensions, and habitability could be deliberately changed, as in the building of canals and irrigation systems which had long expanded habitability, or inadvertently altered via salination, erosion or pollution, which could decrease habitability or even threaten it entirely. These could of course be interrelated, and attempts to expand habitability in the present could and did diminish it in the future. At the same time, environmental imaginaries around changing habitability might also be manipulated, and for example recent scholarship has shown how colonial photographers worked to shape settlement patterns by managing perceptions of habitability in Australia and America (Hore, 2022).

Here there is also a considerable literature on colonial hydrology, and the way existing technologies were appropriated, adapted and expanded by empires (Bhattacharyya, 2018; Gilmartin, 1994; Haines, 2013; Heffernan, 1990; Peterson, 2019). Questions have particularly centered on whether the colonial period represented a rupture from previous practices of managing habitability through mastery over water. For example, Rohan D’Souza asks whether it is possible to “characterise the colonial interventions in water as comprising a cogent and distinct hydraulic paradigm” (D’Souza, 2006, p. 625). Other scholars have shown how many of these increasingly grandiose “geo-engineering” projects ultimately remained unrealized (Lehmann, 2022), but that the vast intended and unintended consequences of “colonial terraforming” need to be acknowledged (Ghosh, 2021).

Scholars have also shown that negative consequences might not be accidental, and at times empires deliberately sought to render places uninhabitable (whether through chemical intervention, from salting the soil of Carthage to Agent Orange in Vietnam, or biologically via the deliberate introduction of diseases such as smallpox to populations with no existing immunity). Here David Nye proposes the concept of “anti-landscapes” (Nye & Elkind, 2014). He explains that these have a long history, but warns that today the scale at which uninhabitable “anti-landscapes” might be wrought through factors including climate change, pollution and nuclear fallout is greater than ever (Nye & Elkind, 2014, p. 11). Other scholars have meanwhile examined uninhabitability and enduring responses (and modes of resistance) to colonial and capitalist anti-landscaping (Stoler, 2016; Tsing, 2021). Here uninhabitability emerges as a powerful imaginary, and one that seems only too likely to gain further scholarly and societal resonance in coming decades.

## 5 | DEMOGRAPHY, ECOLOGY AND THE LIMITS OF HABITABLE SPACE

Notions of a limited “habitable globe” always carried implications of allegedly uninhabited, and perhaps uninhabitable, lands beyond these limits (however they were defined). Scholars have examined the way supposedly uninhabitable lands became the subject of intense interest. Across the nineteenth century, European empires increasingly turned their attention to continental interiors, notably in Africa, Australia and Central Asia, which were the last remaining “blank spaces” on imperial maps (Kennedy, 2013). As well as possibly claimable for empire, these “empty” or “blank” spaces were also sources of considerable anxiety. Of course, these spaces were frequently very far from uninhabited or “blank,” and defining the edges of the habitable globe as “empty” overwrote existing indigenous topographies in preparation for appropriation. Here “emptiness simplified and standardized” and could be “the first step to transforming ‘alien’ land into legible, knowable landscape” (Keating, 2019, p. 49).

This dynamic resulted in imperial fears—in Joseph Conrad’s oft-cited estimation—of “Geography Triumphant” and the filling in of the last “blank” spaces on European maps (Driver, 2001, pp. 3–8). Whether in the mapping of Central Asia or the settlement of the American West, in the imperial imagination there was “a pervasive sense that spatial limits had been reached,” and this had profound effects on imperial questions of population, resources and scarcity in the early twentieth century (Cosgrove, 2001, p. 221). Scholars have pointed to the geopolitical “pivot” theory of English geographer Halford Mackinder, advanced in a lecture to the Royal Geographical Society in 1904 as emblematic of these anxieties (Mackinder, 1904; see also Dodds & Sidaway, 2004; O’Hara & Heffernan, 2006). Here there was a growing fear that possibilities for geographical exploration were almost exhausted and as a result in this “post-Colombian age ... we shall again have to deal with a closed political system, and none the less that it will be one of worldwide scope” (Mackinder, 1904, p. 422).



These concerns about the absolute and relative limits of the “habitable globe” had broader connotations in the first decades of the twentieth century when “geopolitics became biopolitics” (Bashford, 2014, p. 359). Notions of the limits of habitability were bound up in questions of population, which were in turn tied to questions of war and peace. Here “density in relation to cultivable land—the crowded and the empty parts of the planet—was the problem of the era” (Bashford, 2014, p. 3). Indeed, the limits of habitability were increasingly linked to arguments about demography, with the idea that “overcrowded” and “overpopulated” areas could move surplus population to “unoccupied” places (even if the distinction been sparse and no occupation were often “rendered problematically equivalent”) (Bashford, 2014, p. 133; see also Hore, 2022). This was reflected in various forms of Malthusianism and neo-Malthusianism, fears of unsustainable population growth and questions of food security. The English economist John Maynard Keynes argued around 1914, for example, that “if the population of the world were to increase no faster than that of Europe during the last 25 years, we should at the end of 1000 years be standing shoulder to shoulder over the whole habitable globe” (cited in Bashford, 2014, p. 49; see also Merchant, 2022).

Another result of these fears of limited space was that even more “extreme” regions and environments “came under expert, economic, and demographic consideration,” including parts of the Antarctic and Arctic, as well as previously dismissed tracts of dense rainforest or arid desert, which were investigated for both resettlement and food production potential (Bashford, 2014, pp. 134–135). The result was that “an entire generation of geographers was busy mapping global limits and new human-natural frontiers: world wheat lines, rice lines, and maize lines; lines of rainfall; latitudes and altitudes where average temperatures fell beyond the possibility of cultivation or even habitation” (Bashford, 2014, p. 135). Indeed, scholars have shown that the limits of the “habitable globe” were traced not only latitudinally but also vertically in this period, as scientists and geographers investigated the height at which mountains became uninhabitable (and speculated about the deep sea), concluding that the possibilities for human habitation were confined to a relatively narrow elevational band (Fleetwood, 2022; Heggie, 2019; Reidy, 2011).

In the late nineteenth and early twentieth centuries, many of these imperial concerns relating to the limits of habitability coalesced in theories of ecology, as a new way of explaining environmental relationships (and the place of humans) holistically. While figures like the Prussian polymath Alexander von Humboldt arguably developed and deployed ecological thinking *avant la lettre* (Dettelbach, 1999; Zeller, 2006), ecology flourished especially around the turn of the twentieth century, where it was applied to increasingly diverse sets of environmental and social problems (Anker, 2001). Here remaking “environmental relationships” and actively “altering ecosystems” was at the core of imperial practices (Ross, 2017, p. 3), alongside a growing realization that “people were inescapably part of a larger ecosystem” (Nash, 2006, p. 1). The language of ecology thus became central to attempts to explain and extend the limits of habitability, and if acclimatization was the “paradigmatic” colonial science of the nineteenth century, ecology was the flagship imperial science of the twentieth (Griffiths & Robin, 1997).

In the second half of the twentieth century, scholars have meanwhile shown how the modern notion of “the environment”—in the global, interconnected and planetary senses often thought of today—emerged amidst heightened awareness of (and concern about) human impacts on habitability and an increased need for food and other resources in the context of post-war reconstruction and population growth (Warde et al., 2018). Here “the environment” needs to be considered as distinct from nature, created “where humans have entered into a self-conscious relationship with their surroundings,” such as via attempts to expand habitability (which might nevertheless also diminish it, inadvertently or otherwise) (Sörlin & Warde, 2009, pp. 2–3). Meanwhile, scholars have traced post-war ideologies of improvement and assertions that habitability might be mediated by technology. Here Perrin Selcer examines the “metaphor of Spaceship Earth” and uneven attempts by international organizations to delineate the “global environment” and manage it by technocratic means (Selcer, 2018). Scholars have also critically examined the so-called “Green revolution” and the modification of seeds and agricultural technologies with hopes of breaking the Malthusian shackles and exponentially increasing global wheat (and rice) production (Baranski, 2022), ultimately emphasizing an ongoing need to be wary about narratives of scientific triumphalism around indefinitely expanding the limits of habitability.

## 6 | HABITABILITY AND CLIMATIC DETERMINISM IN THE TWENTIETH CENTURY

Nineteenth-century assessments of limited and changeable habitability, and their multifarious justifications for and threat to imperial control remained potent in the early twentieth century. This nevertheless increasingly played out on a new scale, with questions over planetary and population limits, “no longer just an imperial issue, but an international one”

(Bashford, 2014, p. 147). As in the nineteenth century, theories of differential habitability and climatic determinism continued to be used to justify colonialism, inequality, and the worldviews and geopolitical needs of their proponents. Perhaps most notorious here is the American geographer Ellsworth Huntington, who argued that everything from “civilisational” attainment to racial characteristics were almost entirely attributable to climate (Huntington, 1915). Inevitably, American and European climates were seen as privileged in support of an imperial worldview, even as Huntington's expansive and often uncritical determinist explanations were increasingly discredited within mainstream academic geography towards the mid-twentieth century (Fleming, 1998; Hulme, 2011; Mahony & Randalls, 2020).

The study of environmental determinism and its relation to questions of differential habitability nevertheless remains crucial, not least because 1930s and 1940s scholarly repudiations of Huntington and other strongly determinist geographers like Ellen Church Semple notwithstanding, ideas linking climate, ecology, and civilization have never gone away (Livingstone, 2012). Notable have been the biologically determinist explanations of Alfred Crosby's *Colombian Exchange* and *Ecological Imperialism*, which sought to explain the transformation of environments (and the decimation of peoples) through plants, animals and disease both resulting from and enabling European imperial expansion (Crosby, 1972, 1986). While influential, these explanations around the biologically determined creation of “Neo-Europes” have subsequently been criticized for imputing too much to a monocausal explanation, and for implying that vast ecological and changes to habitability were wrought outside of Europeans' control (and by implication responsibility) (Arnold, 1996, pp. 86–91; Griffiths & Robin, 1997). More recently, neo-environmental determinist interpretations have also seen a resurgence in fields from anthropology to evolutionary biology, especially since the 1990s, with perhaps the most prominent practitioner and popularizer being Jared Diamond (Diamond, 1997, 2005).

Deterministic view of habitability also continued to flourish in relation to arid regions, where turn of the twentieth century imperial scientists' preoccupation with desiccation morphed into political and economic concern over anthropogenic “desertification” (D. K. Davis, 2016a; Heymann, 2020). Growing especially during the 1930s, these concerns were codified in the second half of the twentieth century by institutions like the UNESCO Arid Zone Programme and the World Bank, with Davis showing how these programs carried the legacies of colonial thinking on habitability in policies “that have often systematically damaged dryland environments and marginalized large numbers of indigenous peoples, many of whom had been using the land sustainably” (D. K. Davis, 2016a, p. 4). Here the African Sahel region has been central and responses to famines in the 1970s (Lofchie, 1975) led directly to the United Nations Conference on Desertification (1977) and its successor the United Nations Convention to Combat Desertification (1994). Scholars have nevertheless identified ongoing determinism in relation to the Sahel and climate change, where categorizations of growing uninhabitability and negative ideas around nomadic land use have continued to echo colonial rhetoric in assigning blame for degradation, and underpinning policies as wholesale as the evacuation of entire populations (Behnke & Mortimore, 2016).

Scholars have been right to insist that environmentally determinist explanations of habitability are deeply problematic, even while noting that the resultant disciplinary scarring has not been without its downsides: “there are fears that the histrionics associated with climatic determinism, and its apparent revival, might lead to a reluctance to engage in investigations of climate and society at a time when the need to (re)connect climate and human histories is arguably more important than ever” (Endfield, 2011, p. 144). Indeed, questions about climatic determinism have only become more prominent in the 21st century, Mike Hulme argues, where “heightening anxieties about future anthropogenic climate change are fueling—and in turn being fueled by—a new variety of the determinist fallacy” (Hulme, 2011, p. 247). While this version of determinism is not the same as “the politically and ethically discredited climate determinism epitomized by Huntington and his followers” it is nevertheless the case that “climate has regained some of its former power for ‘explaining’ the performance of environments, peoples, and societies” (Hulme, 2011, p. 247). The result is “climate reductionism,” in which climate is isolated and then cast as the primary variable in various prediction models rendering “the future free of visions, ideologies, and values” (Hulme, 2011, pp. 264–265).

Given its prevalence, flexibility, and durability—from Hippocrates to Ibn Khaldun, and from to Ellsworth Huntington to Jared Diamond—scholars have wondered whether deterministic explanations of the limits of habitability and our relationship to nature are inescapable. One solution to this challenge is showing “climate in dynamic interplay with a number of human and other environmental (non-human) factors” (Carey, 2012, p. 237). Mike Hulme provides a similar answer in calling for a closer examination of attempts to “tame these climatic influences and constraints and to live beyond them” by looking at the way “human beings change microclimates, insulate themselves against climatic extremes, and adapt technologies and practices for survival and prosperity” (Hulme, 2011, p. 246). Foregrounding questions of habitability can help here, especially in historicizing the way that humans have rarely been willing to simply accept the limits of habitability without seeking to intervene, for better and for worse.

## 7 | CLIMATIC CHANGE AND CRISES OF HABITABILITY IN THE ANTHROPOCENE

Alongside peers in the natural sciences, humanities scholars are increasingly urgently trying to address—and to effectively communicate—the realities of climate change and the uncertain future habitability of our planet. Scholars have highlighted a range of fallacies, inequalities, and neo-deterministic explanation in current thinking, policies, and models (Degroot et al., 2022). Here scholars have also sought to explain understandings of both anthropogenic and non-anthropogenic climatic change over time, and the impacts of these on society and politics. This research has reminded us that recognition of anthropogenic impacts on climate is not something entirely new to the twentieth and 21st centuries, even while it is correct to highlight that the scale of current changes is unprecedented (M. Davis, 2016b). Clarence Glacken nevertheless insists that “even though its sources lie in observations which differed little from those made” earlier “the idea of man as a geologic or geographic agent is a modern one” (Glacken, 1967, p. 462). Indeed, a key moment in understandings of human-induced climatic change is frequently identified with American writer George Perkins Marsh, whose *Man and Nature* (Marsh, 1864) is often held up as the most significant contribution since Buffon (though arguments for other antecedents can and have been made) (Glacken, 1967, p. 663; see also Thomas, 1956).

Deborah Coen meanwhile explains that grappling with geological time in the nineteenth century created significant challenges and “it was not easy to reconcile the apparent stability of the earth’s climate in the present with a theory positing such a radical shift in climate in the relatively recent past” (Coen, 2018, p. 276; see also Cushman, 2011). Indeed, the big change here was one of scaling because “mid-nineteenth-century theories of anthropogenic climate change had hinged on a regional definition of climate” and this would become “the problem of conceptualizing interactions across scales of space and time, from the human to the planetary” (Coen, 2018, pp. 2; 253; see also Cosgrove, 2001; Lehmann, 2022).

Directly relevant to questions of changeable habitability, today an ever growing number of scholars are engaging with questions relating to planetary scales and the idea of an Anthropocene (Bonneuil & Fressoz, 2016; Ghosh, 2016). Indeed, few if any notions have proved as evocative in recent years, and the Anthropocene concept has provoked a lively debate on its usefulness and limits, as well as its chronology. Inaugurated in the context of atmospheric chemistry in the early 2000s, the Anthropocene was proposed as the geological epoch that succeeds the Holocene (Crutzen, 2002; Crutzen & Steffen, 2003). In the following 20 years, the concept has gained resonance, and attracted discussion, debate, and controversy across a notably wide range of disciplines (Bonneuil & Fressoz, 2016). Here the “Anthropocene” is not the only possible term, and alternatives including “Capitalocene,” “Plantationocene,” and “Econoscene” (Malm & Hornborg, 2014; Moore, 2016) have been proposed to better center responsibility, while other scholars have provided forceful and eloquent reminders that colonialism and the Anthropocene are inextricably linked (Ghosh, 2021; Yusoff, 2018).

The challenges of Anthropocene narratives for thinking about time and history have also increasingly been noted. Until only relatively recently it was believed “that human chronologies were insignificant compared with the vastness of geological time; that human activities were insignificant compared with the force of geological processes. And once they were. But no more” (Oreskes, 2018, p. 57). One consequence is “that anthropogenic explanations of climate change spell the collapse of the age-old humanist distinction between natural history and human history” (Chakrabarty, 2009, p. 201, see also 2018). As Christophe Bonneuil and Jean-Baptiste Fressoz argue, the idea of the Anthropocene brings with it the need for a “new environmental humanities to rethink our visions of the world and our ways of inhabiting the Earth together” (Bonneuil & Fressoz, 2016, p. 12), and here histories of habitability can have an important role to play.

## 8 | CONCLUSION: WHY HISTORIES OF HABITABILITY?

The entangled histories of climate, environment and empire have received welcome attention in recent decades, from a variety of methodological and theoretical directions. Habitability studies offers a way to build on this. At a time when governments, corporations and individuals are altering habitability on an unprecedented scale, understanding the societal and environmental consequences of changing habitability has never been more important. Similarly, by examining how delineations of habitability and uninhabitability were developed and deployed in the context of empire, it is possible to better understand their postcolonial legacies (Locher & Fressoz, 2012). Imperial categories, from the

uninhabitability of “the tropics” to idea of deserts as “wastelands,” continue to shape our environmental imaginations and are in need of further denaturalization (Chakrabarti, 2020). Historicizing habitability is likewise essential to countering a recurrence of racist and neo-determinist thinking in narratives of climate-induced migration, and debates over adaptation and mitigation given the unequal distribution of impacts (Ahuja, 2021). By learning to recognize the recurring and insidious tropes and language of determinism and differential habitability scholars can better counter these. Unpacking histories of habitability and empire might also be seen as essential in countering the way climate change seems to overwhelm imaginations and narrative capacities (Ghosh, 2016).

As the scholarship reviewed in this article shows, judgments about a limited, differential and changeable “habitable globe” have always been political, and imbricated in attempts to divide, define, include, exclude and control. Questions of habitability nevertheless did not always conform easily to imperial or nation state bounds. As James Beattie notes, “ecological and climatic processes—like the spread of plants or drought—have a habit of slipping over, through or under human-created boundaries” and “focussing on natural, rather than national, boundaries can thereby provide new angles on environmental change” (Beattie, 2012, p. 131). This article has followed the literature in its bias towards the legacies of ideas of habitability and uninhabitability in the context of European global empires. Important work is nevertheless also being done on other contexts, for example, in the Ottoman lands (İnal & Köse, 2019; Mikhail, 2011) and imperial China (Elvin, 1998; Pei & Forêt, 2018; Williamson & Janković, 2020), while recent interest in indigenous climatic knowledges can also offer new and different answers to questions of habitability (Smith & Sharp, 2012). Indeed, habitability is arguably a universal concern, and scholars might also look to the way this has been examined across a wider range of times and places, especially by anthropologists (Ingold, 2021).

Widespread engagement with the notion of an Anthropocene—whether understood as a scholarly concept or a contentious stratigraphical debate—has provided an important forum for interactions between the natural sciences and the humanities to both understand the issues around climate change and attempt to develop just solutions (Robin & Steffen, 2007). For scholars, this framework has also had a special resonance when it comes to telling stories about the past—and the future—by placing the human and planetary on the same scale. However, the “Anthropocene” concept is increasingly ubiquitously and sometimes uncritically used. The notion of habitability might thus provide a valuable complement, as well as an alternative way of allowing scholars to weave together otherwise sometimes disparate threads and disciplinary concerns to communicate the societal consequences of a changing climate. This will be especially important in light of growing discussions around attempts at terraforming and geo-engineering on a planetary scale. Further theorization and engagement with understandings of habitability and uninhabitability can thus provide new opportunities for thinking across the environmental humanities and beyond. As astronomers continue to search the universe for new habitable planets, it has never been more essential to also historicize the consequences of the changing limits of habitability on this one.

## AUTHOR CONTRIBUTIONS

**Lachlan Fleetwood:** Conceptualization (lead); funding acquisition (lead); investigation (lead); methodology (lead); writing – original draft (lead); writing – review and editing (lead).

## ACKNOWLEDGMENTS

I would like to express my appreciation to the anonymous reviewers, Tom Simpson, and the members of the LMU “Global Dis:connect” reading group for their insightful comments on versions of this article. Likewise, my thanks to Roland Wenzlhuemer and Jennifer Keating for enlightening discussions about “habitability” and its scholarly relevance. Open Access funding enabled and organized by Projekt DEAL.

## FUNDING INFORMATION

The work for this article was generously supported by grants from the Irish Research Council (GOIPD/2020/44) and the European Commission (HORIZON-MSCA-2021-PF-01-01-101059732-HABITABILITY).

## CONFLICT OF INTEREST STATEMENT

There are no conflicts of interest to report.

## DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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**How to cite this article:** Fleetwood, L. (2023). Histories of habitability from the oikoumene to the Anthropocene. *WIREs Climate Change*, 14(5), e840. <https://doi.org/10.1002/wcc.840>