Disentangling human nature: Anthropological reflections on evolution, zoonoses and ethnographic investigations

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Abstract

Human nature is a puzzling matter that must be analysed through a holistic lens. In this commentary, I foray into anthropology's biosocial dimensions to underscore that human relations span from microorganisms to global commodities. I argue that the future of social-cultural anthropology depends on the integration of evolutionary theory for its advancement. Ultimately, since the likelihood of novel zoonoses' emergence, digital ethnography could offer remarkable opportunities for ethical and responsible inquiries.

Keywords

Anthropology, ethnography, zoonoses, evolution, human nature, multispecies entanglements

It is a vexing question to ask what the purpose of human beings on Earth is. After all, if we rule out teleological and metaphysical explanations, we only remain with biological ones. For example, since the advent of Darwinian evolutionary theory, modern science's advancements can now give us accurate molecular data to infer phylogenetic relationships (Oyston et al., 2022). We can also predict the evolutionary history of extant metazoans by analysing the Edicara Biota from 570–539 Mya (Evans et al., 2021). Besides this, we have good empirical evidence to estimate the African origin of our hominin clade, about 10–6 Mya (Steiper & Seiffert, 2012; Besenbacher et al., 2019; Püschel et al., 2021; Daver et al., 2022). Despite the limitation of the fossil record, we can provide the approximate emergence of *H. sapiens* in the African continent 315 ± 34 thousand years ago

(kya) (Hublin et al., 2017; Richter et al., 2017; Cabrera, 2020 but see Bermúdez de Castro & Martinon-Torres, 2022).

Thus, the more we delve into our evolutionary history, the more complicated it becomes to comprehend its subtleties, like our earliest dispersal into Asia, roughly 126–74 ka as hypothetically suggested by recent findings (Petraglia et al., 2010; Groucutt et al., 2015; Rabett, 2018). Since then, we have filled diverse ecological niches, interbreeding with other hominins like *H. neanderthalensis* (Stringer & Crété, 2022) and, therefore, becoming "the world's greatest evolutionary force" (Palumbi, 2001) which conquered almost every geographic region of the Earth. As a result, anthropogenic alterations to biodiversity are arguably the primary source of species extinctions and extirpations ranging from the Late Pleistocene of global human expansion to early urbanised societies and commercial networks (Boivin et al., 2016).

Based on the anthropogenic modification of Earth's strata, a new geological epoch called the Anthropocene supersedes the Holocene (see, e.g., Zalasiewicz et al., 2011; Waters & Turner, 2022). From this, it follows that our presence in the material world is inextricably intertwined with other existents paving the way for inexorable chaotic possibilities. Consistent with this statement, zoonotic pathogens likely diffuse via human-induced alterations of ecosystems and climate change (Páez et al., 2018; Del Lesto et al., 2022). That said, like *Yersinia pestis,* which devastated Eurasian populations during the Neolithic (Andrades Valtueña et al., 2022), the new SARS-CoV-2 (Rajendran & Babbitt, 2022) reminds us that cross-species transmission depends significantly on the different modalities of human existence. Zoonoses, therefore, are the by-product of the entangled and intricate relationships among humans, different animal taxa, and their econiches (e.g., MacGregor & Waldman, 2017; Doron, 2021; Milstein et al., 2022; Shaffer et al., 2022; van Vliet et al., 2022; Arregui, 2023).

No wonder, then, the predicament of our human condition involves a wide array of socio-ecological, political, and economic factors affecting a globalised world and its endangered life forms. How does socio-cultural anthropology scrutinise and tackle those insidious issues? Why ethnography's holistic and in-depth perspective is fundamental to drawing inferences concerning our contemporary life? Given our current global situation fraught with wars, pandemics, environmental degradation and socioeconomic inequalities, the inveterate practice of anthropological inquiry has an advantageous position to grasp conspicuous empirical realities. In short, the question of what it is to be human in connection with other entities is increasingly crucial

as long as life complexifies due to the acceleration of neoliberalism and technoscientific innovations.

As a PhD student navigating across anthropological reflections about our biological and socio-ecological conditions, living amid future uncertainties strengthens the will for a better understanding of human nature. Socio-cultural anthropology, in particular, allows me to observe the interconnectedness between subjects and their socio-material actualities holistically. Crucially, the uniqueness of our discipline has been demonstrated since the dawn of long-term ethnographic immersion. Those theoretical and methodological contributions emphasise that either the Trobrianders (Malinowski, 1922), the Nuer (Evans-Pritchard, 1940) or the Tsembaga (Rappaport, 2000 [1968]) are nothing without the fabric of social relations established among humans and between humans and shells, cattle or pigs. Those phenomena are illuminating considering the latest anthropological and philosophical interests in multispecies entanglements (e.g., Kohn, 2007; Candea, 2010; Kirksey & Helmreich, 2010; Van Dooren, 2019; Kirksey, 2020; Daly, 2021; Hartigan, 2021; Arregui, 2023), not to mention the relational onto-epistemological underpinnings that arise from the analysis of ethnographic data (Viveiros de Castro, 1998; Bird-David, 1999; Ingold, 2006; Descola, 2013; Rose, 2013). So, why do relationships matter significantly in anthropological thinking?

It is hardly surprising that, as far as social anthropology is concerned, the tools of natural sciences determined how individual organisms' social relations were analysed empirically by the former (Radcliffe-Brown, 1952). Of course, those were principally human institutions' structural and functional properties. These societal systems are, however, enmeshments of sympatric species ranging from mammals to insects and plants, as in the case of totemism. It is thus palpable that, as anthropologists, we follow the "eternal pursuit of complexities" in that sociality transcends the anthropocentric order of things (Abad Espinoza, 2022c). This move towards holistic thinking has profound implications regarding the construction of anthropological knowledge. If a superorganic conception of human culture (Kroeber, 1917) elevates our rational soul from the rest of corporeal nature, then an ecocentric perspective (Ojalehto Mays et al., 2020) reverts our ontological status to our evolutionary roots as hominins. Notably, there are striking parallels between indigenous animistic ontologies and scientific studies ranging from animal culture and cognition (Griffin, 1998; Allen, 2019; Schuppli & Van Schaik, 2019) to plant intelligence (Marder, 2013; Mancuso & Viola, 2015; Calvo et al., 2020). Through these lines of evidence, we can better understand the

interwoven structures of life, thus absorbing human nature into the primordial order of things. Consequently, one might ask: what can social-cultural anthropology contribute to analysing these complexities and entwinements?

One of the most pivotal topics during ethnographic fieldwork is the attentiveness to social life, both locally and globally conceived. That is, anthropological thinking gives us the essential means to grasp the micro-macro contemporary societal issues. For example, during my first fieldwork among the Shuar of the Ecuadorian Amazon, I could observe the unrestrainable effects of neocolonialism and global capitalism on indigenous peoples and their ecologies. Notwithstanding the positive association between the extinction of indigenous languages and the loss of ethnobotanical knowledge (Cámara-Leret & Bascompte, 2021), the Shuar struggle to preserve some of their relationships with plant life. The vegetal world, therefore, still plays a crucial role in shaping their way of being, oscillating from their metaphysics to aesthetics and well-being (Abad Espinoza, 2019, 2022a).

The COVID-19 pandemic outburst, however, transformed the socio-material ethnographic immersion into imaginative anthropological voyages in the midst of isolation. Specifically, the inevitable cancellation of my second fieldwork had significant implications for ethnography's ethical, methodological and theoretical factors. On the one hand, it became clear that zoonotic spillover moves swiftly across geographic boundaries, underscoring our biological vulnerabilities; on the other, ethnography's plasticity allowed me to transform into virtual investigations the otherwise archetypal bodily engagement of participant observation. Though this radical shift changed the intimate multisensory experience of fieldwork's socio-ecological settings, digital ethnography operated as an impervious barrier to pathogenic transmission providing ethical and reflective methods to dive into indigenous' biocultural worlds immaterially. To put it bluntly, the myriad of natives' images, sounds, and voices circulated within the different spatio-temporal realities of the digital world functioned as stimulators of previous fieldwork's embodied experiences (Abad Espinoza, 2022b). Could one achieve such an understanding without careful anthropological reflection? The plain answer is no.

As stated formerly, the practice of anthropology involves holistic thinking that bridges the gap between the biological and social domains. We cannot aim to understand our current climate crises, the emergence of zoonotic diseases, mass extinction, or rising socioeconomic inequality without paying close attention to the ecological and socio-cultural determinants of our evolutionary history.

For example, the Holocene saw the emergence of sedentary patterns through the intensification of plant and animal domesticates, triggering the loss of dietary breadth and the transmissibility of zoonotic pathogens (Larsen, 2023; Lewis et al., 2023). If social-cultural anthropology aims to clarify the current Anthropocene epoch, it must integrate these biosocial facts of human evolution. We can thus shed light on the variations of behavioural patterns and coevolutionary spatio-temporal dynamics of the human-environment interface. By bearing these evolutionary trajectories in mind, we can better appreciate how indigenous peoples coped and thrived during Holocene climate change events demonstrating adaptive and flexible socio-eco-cosmological systems (Robbins Schug et al., 2023). In the Amazon, for instance, recent archaeological findings suggest that complex settlements existed before the European invasion (Prümers et al., 2022), albeit domestication is foreign to natives' relations with nature characterised by "familiarisation", as in the case of human-plant interactions (Fausto & Neves, 2018). Accordingly, the virtual investigation with the Shuar corroborates these inferences since this society's ethnopharmacological knowledge provides not only means to combat COVID-19 but also reveals the intricate relationships between humans and the vegetal world (Abad Espinoza, 2022b).

To conclude, how will the future of anthropological thinking and ethnographic analysis be in the next half a century? Viewed through the lens of this paper, it emerges that to decenter the privileged ontological condition of human nature, anthropology must embrace a biosocial perspective concerning our primordial origins on Earth and the variations of our evolutionary paths within different econiches. This is a challenging commitment for socio-cultural anthropologists who primarily look at human cultural diversity paying little attention to ecological and biological determinants. If we aim to move beyond human categories of perception (Kohn, 2013), then a compenetration of diverse scientific pursuits might elucidate how life forms relate and coevolve, forming complex multispecies assemblages. Should we heed Amerindian myths of dinosaurs' big bones, like Lévi-Strauss's peculiar advice to Anne-Christine Taylor and Philippe Descola (Bacchiddu & González Gálvez, 2017) to comprehend human-environment temporal dynamics? Alternatively, could those mysterious and never heard myths address the interaction between humans and the Late Pleistocene megafauna? Indeed, the future of our discipline's advancements depends on a solid interdisciplinarity collaboration to tackle those complicated issues in the face of biocultural destruction.

Furthermore, given the likelihood of future pathogenic infections owing to our unsustainable relationship with nature (Lorenz et al., 2021; Weaver et al., 2022), technological innovations might provide the means to connect disparate geographic and socio-ecological realities, avoiding potential contagions. After all, smartphones circulate even in Amazonian villages, though there is still low internet access. Nevertheless, this has important implications for the future of digital ethnographic research among vulnerable communities since dematerialised forms of sociality provide ethical parameters that safeguard both interlocutors' and anthropologists' lives. By using the positive side of technology, we can enrich our methodological tools and combine, if possible, in-person and digital ethnographic methods to clarify our puzzling contemporary world. In sum, our relationships with microbes and a globalised planet indicate that we are part of a chain in which microecologies and planetary ones intersect.

References cited

Abad Espinoza, Luis Gregorio. 2019. "The moral philosophy of nature: Spiritual Amazonian conceptualisations of the environment." *Open Journal of Humanities* 1: 149–190. https://doi.org/10.17605/OSF.IO/68YNV.

Abad Espinoza, Luis Gregorio. 2022a. "Más allá de las operaciones del pensamiento salvaje entre los shuar de la Amazonía ecuatoriana." In *Antropologías hechas en Ecuador. El quehacer antropológico-Tomo IV,* edited by Tania González, Catalina Campo Imbaquingo, José E. Juncosa, and Fernando García, 274-286. Asociación Latinoamericana de Antropología; editorial Abya-Yala; Universidad Politécnica Salesiana (UPS) and la Facultad Latinoamericana de Ciencias Sociales (FLACSO-Ecuador).

Abad Espinoza, Luis Gregorio. 2022b. "The Ethnographic Quest in the Midst of COVID-19." *International Journal of Qualitative Methods* 21. https://doi.org/10.1177/16094069221135967.

Abad Espinoza, Luis Gregorio. 2022c. "Transcending Human Sociality: Eco-Cosmological Relationships between Entities in the Ecosphere." *Disparidades. Revista de Antropología* 77 (1): e005. https://doi.org/10.3989/dra.2022.005.

Allen, Jenny A. 2019. "Community through Culture: From Insects to Whales." *BioEssays* 41 (1900060). https://doi.org/10.1002/bies.201900060.

Andrades Valtueña, Aida, et al. 2022. "Stone Age Yersinia pestis genomes shed light on the early evolution, diversity, and ecology of plague." *Proceedings of the National Academy of Sciences* 119 (17): e2116722119. https://doi.org/10.1073/pnas.2116722119.

Arregui, Aníbal G. 2023. "Reversible pigs: An infraspecies ethnography of wild boars in Barcelona." *American Ethnologist*. 1–14. https://doi.org/10.1111/amet.13114.

Bacchiddu, Giovanna, and Marcelo González Gálvez. 2017. "Lévi-Strauss, el individualismo jíbaro y el Musée du quai Branly. Un diálogo con Anne-Christine Taylor." *Íconos. Revista de Ciencias Sociales* 59: 151-161. https://doi.org/10.17141/iconos.59.2017.2869.

Bermúdez de Castro, JM, and María Martinón-Torres. 2022. "The origin of the Homo sapiens lineage: When and where?." *Quaternary International* 634: 1-13. https://doi.org/10.1016/j.quaint.2022.08.001.

Besenbacher, Søren, Christina Hvilsom, Tomas Marques-Bonet, Thomas Mailund, and Mikkel Heide Schierup. 2019. "Direct estimation of mutations in great apes reconciles phylogenetic dating." *Nature ecology & evolution* 3 (2): 286–292. https://doi.org/10.1038/s41559-018-0778-x.

Bird-David, Nurit. 1999. "' Animism' Revisited: Personhood, Environment, and Relational Epistemology". *Current Anthropology* 40 (1): 67-91. https://doi.org/10.1086/200061.

Boivin, Nicole L., Melinda A. Zeder, Dorian Q. Fuller, Alison Crowther, Greger Larson, Jon M. Erlandson, Tim Denham, and Michael D. Petraglia. 2016. "Ecological consequences of human niche construction: Examining long-term anthropogenic shaping of global species distributions." *Proceedings of the National Academy of Sciences* 113 (23): 6388-6396. https://doi.org/10.1073/pnas.1525200113.

Cabrera, Vicente M. 2020. "Counterbalancing the time-dependent effect on the human mitochondrial DNA molecular clock." *BMC Evolutionary Biology* 20 (78): 1-9. https://doi.org/10.1186/s12862-020-01640-5.

Cámara-Leret, Rodrigo, and Jordi Bascompte. 2021. "Language extinction triggers the loss of unique medicinal knowledge." *Proceedings of the National Academy of Sciences* 118 (24): e2103683118. https://doi.org/10.1073/pnas.2103683118.

Calvo, Paco, Monica Gagliano, Gustavo M. Souza, and Anthony Trewavas. 2020. "Plants are intelligent, here's how." *Annals of Botany* 125 (1): 11-28. https://doi.org/10.1093/aob/mcz155.

Candea, Matei. 2010. "'I Fell in Love with Carlos the Meerkat': Engagement and Detachment in Human-Animal Relations." *American Ethnologist* 37 (2): 241–58. https://doi.org/10.1111/j.1548-1425.2010.01253.x.

Daver, Guillaume, F. Guy, Hassane Taïsso Mackaye, Andossa Likius, J-R. Boisserie, Abderamane Moussa, Laurent Pallas, Patrick Vignaud, and Nékoulnang D. Clarisse. 2022. "Postcranial evidence of late Miocene hominin bipedalism in Chad." *Nature* 609 (7925): 94–100. https://doi.org/10.1038/s41586-022-04901-z.

Daly, Lewis. 2021. "Cassava spirit and the seed of history: on garden cosmology in Northern Amazonia." *Anthropological Forum* 31 (4): 377-395. https://doi.org/10.1080/00664677.2021.1994918.

Del Lesto, Irene, Claudio De Liberato, Riccardo Casini, Adele Magliano, Arianna Ermenegildi, and Federico Romiti. 2022. "Is Asian tiger mosquito (Aedes albopictus) going to become homodynamic in Southern Europe in the next decades due to climate change?." *Royal Society Open Science* 9 (12): 220967. https://doi.org/10.1098/rsos.220967.

Descola, Philippe. 2013. *Beyond Nature and Culture*. London: University of Chicago Press.

Doron, Assa. 2021. "Stench and sensibilities: On living with waste, animals and microbes in India." *The Australian Journal of Anthropology* 32: 23– 41. https://doi.org/10.1111/taja.12380.

Evans, Scott D., Mary L. Droser, and Douglas H. Erwin. 2021. "Developmental processes in Ediacara macrofossils." *Proceedings of the Royal Society B* 288 (1945): 20203055. https://doi.org/10.1098/rspb.2020.3055.

Evans-Pritchard, Edward E. 1940. *The Nuer*. Oxford: Oxford University Press.

Fausto, Carlos, and Eduardo G. Neves. 2018. "Was There Ever a Neolithic in the Neotropics? Plant Familiarisation and Biodiversity in the Amazon." *Antiquity* 92 (366): 1604–18. https://doi.org/10.15184/aqy.2018.157.

Griffin, Donald R. 1998. "From cognition to consciousness." *Animal Cognition* 1: 3–16. https://doi.org/10.1007/s100710050002.

Groucutt, Huw S., Michael D. Petraglia, Geoff Bailey, Eleanor ML Scerri, Ash Parton, Laine Clark-Balzan, Richard P. Jennings et al. 2015. "Rethinking the dispersal of Homo sapiens out of Africa." *Evolutionary Anthropology* 24 (4): 149-164. https://doi.org/10.1002/evan.21455.

Hartigan, Jr, John. 2021. "Knowing Animals: Multispecies Ethnography and the Scope of Anthropology." *American Anthropologist* 123 (4): 846-860. https://doi.org/10.1111/aman.13631.

Hublin, Jean-Jacques, Abdelouahed Ben-Ncer, Shara E. Bailey, Sarah E. Freidline, Simon Neubauer, Matthew M. Skinner, Inga Bergmann et al. 2017. "New fossils from Jebel Irhoud, Morocco and the pan-African origin of Homo sapiens.". *Nature* 546 (7657): 289–292. https://doi.org/10.1038/nature22336.

Ingold, Tim. 2006. "Rethinking the Animate, Re-Animating Thought." *Ethnos* 71 (1): 9-20. https://doi.org/10.1080/00141840600603111.

Kirksey, Eben. 2020. "Chemosociality in multispecies worlds: Endangered frogs and toxic possibilities in Sydney." *Environmental Humanities* 12 (1): 23–50. https://doi.org/10.1215/22011919-8142198.

Kirksey, Eben, and Stefan Helmreich. 2010. "The Emergence of Multispecies Ethnography." *Cultural Anthropology* 25 (4): 545–76. https://doi.org/10.1111/j.1548-1360.2010.01069.x.

Kohn, Eduardo. 2007. "How Dogs Dream: Amazonian Natures and the Politics of Trans-species Engagement." *American Ethnologist* 34 (1): 3–24. https://doi.org/10.1525/ae.2007.34.1.3.

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

Kroeber, Alfred Louis. 1917. "The Superorganic." *American Anthropologist* 19 (2): 163–213.

Larsen, Clark Spencer. 2023. "The past 12,000 years of behavior, adaptation, population, and evolution shaped who we are today." *Proceedings of the National Academy of Sciences* 120 (4): e2209613120. https://doi.org/10.1073/pnas.2209613120.

Lorenz, Camila, Mariana de Oliveira Lage, and Francisco Chiaravalloti-Neto. 2021. "Deforestation hotspots, climate crisis, and the perfect scenario for the next epidemic: The Amazon time bomb." *Science of the Total Environment* 783: 147090. https://doi.org/10.1016/j.scitotenv.2021.147090.

Lewis Jr, Cecil M., Mercy Y. Akinyi, Sharon N. DeWitte, and Anne C. Stone. 2023. "Ancient pathogens provide a window into health and well-being." *Proceedings of the National Academy of Sciences* 120 (4): e2209476119. https://doi.org/10.1073/pnas.2209476119.

MacGregor, Hayley, and Linda Waldman. 2017. Views from many worlds: Unsettling categories in interdisciplinary research on endemic zoonotic diseases. *Philosophical Transactions of the Royal Society B* 372 (1725): 20160170. https://doi.org/10.1098/rstb.2016.0170.

Malinowski, Bronislaw. 1922. *Argonauts of the western pacific*. London: Routledge & Kegan Paul.

Mancuso, Stefano, and Alessandra Viola. 2015. *Brilliant Green: The Surprising History and Science of Plant Intelligence*. Washington, DC: Island Press.

Marder, Michael. 2013. "Plant intelligence and attention." *Plant signaling & behavior* 8 (5): e23902. https://doi.org/10.4161/psb.23902.

Milstein, Marissa S., Christopher A. Shaffer, Phillip Suse, Aron Marawanaru, Daniel A. Heinrich, Peter A. Larsen, and Tiffany M. Wolf. 2022. "A mixed-methods approach to understanding domestic dog health and disease transmission risk in an indigenous reserve in Guyana, South America." *PLoS neglected tropical diseases* 16 (6): e0010469. https://doi.org/10.1371/journal.pntd.0010469.

Ojalehto Mays, Bethany, Rebecca Seligman, and Douglas L. Medin. 2020. "Cognition Beyond the Human: Cognitive Psychology and the New Animism." *Ethos* 48 (1): 50-73. https://doi.org/10.1111/etho.12264.

Oyston, Jack W., Mark Wilkinson, Marcello Ruta, and Matthew A. Wills. 2022. "Molecular phylogenies map to biogeography better than morphological ones." *Communications Biology* 5: 521. https://doi.org/10.1038/s42003-022-03482-x.

Páez, David J., Olivier Restif, Peggy Eby, and Raina K. Plowright. 2018. "Optimal foraging in seasonal environments: implications for residency of Australian flying foxes in food-subsidized urban landscapes." *Philosophical Transactions of the Royal Society B* 373 (1745): 20170097. http://dx.doi.org/10.1098/rstb.2017.0097.

Palumbi, Stephen R. 2001. "Humans as the world's greatest evolutionary force." *Science* 293 (5536): 1786-90. https://doi.org/10.1126/science.293.5536.1786.

Petraglia, Michael D., Michael Haslam, Dorian Q. Fuller, Nicole Boivin, and Chris Clarkson .2010. "Out of Africa: new hypotheses and evidence for the dispersal of Homo sapiens along the Indian Ocean rim." *Annals of Human Biology* 37 (3): 288-311. https://doi.org/10.3109/03014461003639249.

Prümers, Heiko, Carla Jaimes Betancourt, José Iriarte, Mark Robinson, and Martin Schaich. 2022. "Lidar reveals pre-Hispanic low-density urbanism in the Bolivian Amazon." *Nature* 606: 325–328. https://doi.org/10.1038/s41586-022-04780-4.

Püschel, Hans P., Ornella C. Bertrand, Joseph E. O'Reilly, René Bobe, and Thomas A. Püschel. 2021. "Divergence-time estimates for hominins provide insight into encephalization and body mass trends in human evolution." *Nature ecology & evolution* 5: 808–819. https://doi.org/10.1038/s41559-021-01431-1.

Rabett, Ryan J. 2018. "The success of failed Homo sapiens dispersals out of Africa and into Asia." *Nature ecology & evolution* 2: 212–219. https://doi.org/10.1038/s41559-017-0436-8.

Radcliffe-Brown, Alfred. R. 1952 [1929]. *Structure and Function in Primitive Society*. London: Routledge and Kegan Paul.

Rajendran, Madhusudan, and Gregory A. Babbitt. 2022. "Persistent cross-species SARS-CoV-2 variant infectivity predicted via comparative molecular dynamics simulation." *Royal Society Open Science* 9 (11): 220600. https://doi.org/10.1098/rsos.220600.

Rappaport, Roy. A. 2000 [1968]. *Pig for the Ancestors: Ritual in the Ecology of a New Guinea People* (2nd edn). Long Grove, Illinois: Waveland Press, Inc.

Richter, Daniel., Rainer Grün, Renaud Joannes-Boyau, Teresa E. Steele, Fethi Amani, Mathieu Rué, Paul Fernandes, Jean-Paul Raynal, Denis Geraads, Abdelouahed Ben-Ncer, Jean-Jacques Hublin, and Shannon P. McPherron. 2017. "The age of the hominin fossils from Jebel Irhoud,

Morocco, and the origins of the Middle Stone Age." *Nature* 546: 293–296. https://doi.org/10.1038/nature22335.

Robbins Schug, Gwen, et al. 2023. "Climate change, human health, and resilience in the Holocene." Proceedings of the National Academy of Sciences 120 (4): e2209472120. https://doi.org/10.1073/pnas.2209472120.

Rose, Deborah Bird. 2013. "Val Plumwood's philosophical animism: Attentive interactions in the sentient world." *Environmental humanities* 3 (1): 93-109. https://doi.org/10.1215/22011919-3611248.

Schuppli, Caroline, and Carel P. Van Schaik. 2019. "Animal cultures: how we've only seen the tip of the iceberg." *Evolutionary Human Sciences*. 1: E2. https://doi.org/doi:10.1017/ehs.2019.1.

Shaffer, Christopher A., Marissa S. Milstein, Laramie L. Lindsey, Tiffany M. Wolf, Philip Suse, Elisha Marawanaru, Evan J. Kipp, Tyler Garwood, Dominic A. Travis, Karen A. Terio, and Peter A. Larsen. 2022. "Spider Monkey Cotton": Bridging Waiwai and Scientific Ontologies to Characterize Spider Monkey (Ateles paniscus) Filariasis in the Konashen Community Owned Conservation Area, Guyana. *International Journal of Primatology* 43: 253–272. https://doi.org/10.1007/s10764-021-00272-w.

Steiper, Michael E., and Erik R. Seiffert. 2012. "Evidence for a convergent slowdown in primate molecular rates and its implications for the timing of early primate evolution." *Proceedings of the National Academy of Sciences* 109 (16): 6006-6011. https://doi.org/10.1073/pnas.1119506109.

Stringer, Chris, and Lucile Crété. 2022. "Mapping Interactions of H. neanderthalensis and Homo sapiens from the Fossil and Genetic Records." *PaleoAnthropology* 2: 371-381. https://doi.org/10.48738/2022.iss2.130.

Van Dooren, Thom. 2019. *The Wake of Crows: Living and Dying in Shared Worlds*. New York: Columbia University Press.

van Vliet, Jonas Muhindo, Jonas Nyumu, Charis Enns, Francis Massé, Brock Bersaglio, Paolo Cerutti, and Robert Nasi. 2022. "Understanding Factors that Shape Exposure to Zoonotic and Food-Borne Diseases Across Wild Meat Trade Chains." *Human Ecology* 50: 983–995. https://doi.org/10.1007/s10745-022-00361-1.

Viveiros de Castro, Eduardo. 1998. "Cosmological Deixis and Amerindian Perspectivism." *Journal of the Royal Anthropological Institute* 4 (3): 469–88. https://doi.org/10.2307/3034157.

Waters, Colin N., and Simon D. Turner. 2022. "Defining the onset of the Anthropocene." *Science* 378 (6621): 706-708. https://doi.org/10.1126/science.ade2310.

Weaver, Amanda K., Jennifer R. Head, Carlos F. Gould, Elizabeth J. Carlton, and Justin V. Remais. 2022. "Environmental factors influencing COVID-19 incidence and severity." *Annual review of public health* 43: 271-291. https://doi.org/10.1146/annurev-publhealth-052120-101420.

Zalasiewicz, Jan, Mark Williams, Richard Fortey, Alan Smith, Tiffany L. Barry, Angela L. Coe, Paul R. Bown, Peter F. Rawson, Andrew Gale, Philip Gibbard, F. John Gregory, Mark W. Hounslow, Andrew C. Kerr, Paul Pearson, Robert Knox, John Powell, Colin Waters, John Marshall, Michael Oates, and Philip Stone. 2011. "Stratigraphy of the Anthropocene." *Philosophical Transactions of the Royal Society A*. 369 (1938): 1036–1055 http://doi.org/10.1098/rsta.2010.0315.