



WORKSHOP BRIEF, MAY 2024



"There is all too little awareness that man is part of nature, and that the price of conquest may well be the destruction of man himself." - Rachel Carson, 1962

"It is simply to recognise that for things to interact, they must be immersed in a kind of force field set up by the currents of the media that surround them." - Tim Ingold, 2011

During the 'Intertwined Biosphere' project workshop, taking place May 2024, we intend to trigger explorations of the critical interplay between humans, the biosphere, and the broader Earth system; promote concrete steps towards the analysis of the embeddedness of life and its empirics; and to generate knowledge for supporting a sustainable presence of humanity for all living beings. In this brief, we introduce what we mean by the 'intertwined biosphere', a provisional conceptual framework to study it, alongside potential entry points for inquiries: (i) empirical investigations, (ii) review and synthesis studies, and (iii) the rethinking of perception models and concepts.

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Project description

Enabling coexistence and living with dignity for all forms of life can only be achieved by synthesising and advancing current understandings of how humans are intertwined with all living and nonliving elements of Earth. This requires engaging with sensing, describing, and understanding humans as embedded within the intertwined biosphere.

The words 'intertwined biosphere' highlight that life is a continuous process of co-becoming between all elements embedded in the biosphere. With the notion of the biosphere, we refer to the collection of all living beings on planet Earth and their relationships, including their interactions with elements of the lithosphere, cryosphere, hydrosphere and atmosphere. The biosphere can therefore be conceptualised as the space on Earth in which life is embedded (Figure 1). Being intertwined, then, emphasises that all living beings are inextricably connected.



FIGURE 1: There is a dynamic interplay between the living biosphere and the broader Earth system, with the atmosphere, the hydrosphere, the lithosphere, the cryosphere, and the climate system. Humans have become a major force in shaping this interplay. Artwork by J. Lokrantz, Azote¹.

Within the Intertwined Biosphere project, we call for investigations and analyses through diverse approaches and methods which demonstrate what being intertwined with, and embedded in, the biosphere means. Through empirical investigations exploring the different ways humans are intertwined and embedded, we aim to contribute to narratives that: bridge divided human/nature imaginaries, employ multiple empirical methods to sense life, analyse and understand life as entangled with the biosphere, and foster a deeper understanding of humanity's role in the biosphere. Ultimately, we aim to provide a lens which spans across scales, beyond the local or global, to foreground unseen connections and 'blind spots' between living systems. This includes further developing approaches to recognise, protect, reimagine, and empirically study (human) life as embedded in the biosphere. In other words, the project goals are to:

- 1. Identify, discover, and understand critical intertwined interactions and feedback loops between people and nature as embedded in the biosphere;
- 2. Stimulate investigations and analyses through a diversity of approaches and methods that capture and demonstrate what being intertwined and embedded means, and the implications of such findings for the sciences and humanities, as well as for practice and policy; and
- 3. Inspire others to use the intertwined and embedded framework in investigations and actions.





The primary aim of this workshop is to connect you, as scholars and human beings across fields, to pioneer and advance the science of the 'intertwined' in pursuit of a revitalised Anthropocene biosphere. We aim to initiate multiple empirical investigations in pursuit of these aspirations.

Why study the intertwined biosphere?

Anthropogenic activity has expanded to such an extent that it has become a major global force shaping the dynamics of the Earth's systems and the evolution of all life. A sustainable presence of humanity for all life on Earth can therefore only be fostered through an advanced understanding of how life is intertwined within the biosphere.

Anthropogenic influence has resulted in more than 75% of Earth's ice-free land having been directly altered as a result of human activity, with nearly 90% of terrestrial net primary production and 80% of global tree cover under direct human influence². In the ocean, no area is unaffected by human influence, and a large fraction (>40%) is strongly affected by multiple human impacts³, while more than 50% of the vast ocean seabed is claimed by nations⁴. Research has found that 60% of the biomass of all mammals alive on the planet is kept by humans for food production⁵, and the widespread simplification of ecosystems has caused significant vulnerability in the biosphere⁶.

The extensive 'technosphere' dimension of the Anthropocene (AI, synthetic biology, energy, etc.) underscores the novelty of the ongoing planetary changes, plays a significant role in shaping global biosphere dynamics, and has already left a deep imprint on the Earth system⁷. For instance, through artificial selection and controlled reproduction of crops, livestock, trees, and microorganisms, varying levels of harvest pressure and selection, chemicals and pollution altering life-histories of species, and by sculpting the new habitats that blanket the planet, humans, directly and indirectly, determine the constitution of species that succeed and fail⁸.

The increase in scale and magnitude of humanity's activity is reflected in human population growth - from about one billion around 1800 to more than 8 billion today - and, with it, the imprint of behaviours, lifestyles, consumption patterns, value systems, urbanisation, and cultures¹. Since 2020, human-made materials, such as concrete, metal, plastic, bricks and asphalt, have outweighed Earth's entire biomass, i.e., the mass of living matter on Earth⁹.

The Anthropocene is also characterised as a tightly interconnected world operating at high speeds with hyperefficiency in several dimensions. These interconnections include the globalised food production and distribution system, the extensive trade and transport systems, strong connectivity of financial and capital markets, internationalised supply and value chains, widespread movements of people, social innovations, development and exchange of technology, and widespread communication capacities. This interplay is not only from the local to the global, and between people and societies, but also coevolving with biosphere dynamics shaping the preconditions for human well-being and civilisations. The Anthropocene therefore represents 'a new playing field', with new forms of interwoven interactions and dynamics, sometimes referred to as the polycrisis¹⁰.

The interactions between humans and nature shaping the Anthropocene serve as a prompt to reflect and think about humans' place in the universe, to challenge assumptions of human mastery over nature, and to call upon societal agency. Considering these developments, over the last decades researchers from the humanities, the natural sciences, and the social sciences have worked to bridge divides which saw humans and nature, the local and global, and some academic disciplines, as dichotomous¹¹⁻¹⁴. Through these works, interdisciplinary approaches have looked to overcome dualisms and work towards a more holistic understanding of humans as





part of the biosphere, rather than merely an external influence on it^{15,16}. Despite these developments, analysing the embeddedness of humans in a complex and intertwined biosphere remains challenging^{17–20}. And while there has been significant progress in researching the interactions and feedbacks between humans and the biosphere, further work is needed.

A conceptual framework for guiding embeddedness analysis

To initiate discussion on ways to research and analyse the intertwined biosphere, we propose three dimensions of embeddedness for analysis: compositional, relational, and evolutionary (see Figure 2).



FIGURE 2: Three dimensions of embeddedness: compositional, relational, and evolutionary.

Compositional embeddedness

Systems and entities, as well as behaviours and dynamics, could be studied in terms of their constituents. For example, the compositional embeddedness of a human body (as an entity/system) can be studied by identifying and assessing to what extent different human body components, such as water, minerals, and microbes, originate from other ecosystem activities or biosphere functions. The compositional embeddedness of non-material systems (such as behaviour/dynamics) could also be studied with a compositional lens, for example, by dissecting the contributions of various ecosystem functions for a certain type of behaviour or way of organisation (e.g., the role of weather patterns, land types, and flora and fauna in socio-political organisation).

As an illustration using a distinct but relevant approach, Fajzel et al. explored the make-up of the global human day, as an average across time and the global population, to estimate the number of hours spent engaged in different activities²¹. By analysing the composition of the global human day, the researchers were able to determine the time invested in directly modifying the state of the planet, and to identify potential leverage points and alterations within the determined time budget in pursuit of sustainable transitions.





Relational embeddedness

Relational embeddedness can similarly be studied with a material (metabolic) and/or non-material (cultural) focus. Through the relational dimension, the focus turns to flows, connections, and interactions, such as those through trade networks (metabolic), social forms of organisation (behaviour) or information exchanges (cultural). We envision that analyses of relational embeddedness can be studied by looking at the flows, connections, and interactions between predefined entities, or, as described below, by drawing from process-relational perspectives^{22,23}, which are increasingly being utilised in sustainability science^{16,24}.

Process-relational perspectives focus their attention on change, and can be contrasted with substantialist perspectives. Substantialist perspectives present change as secondary, giving priority to the analysis of entities and their properties²⁴. Through a process-relational approach, however, processes are understood as patterns, with their properties and functions defined by the set of relations that constitute them. As a result, relations emerge as the primary constituents of reality. In other words, process-relational perspectives emphasise the interconnectedness and interdependence of all entities in the world, rejecting the notion of separateness, or hierarchy, between humans and nature. These approaches involve recognising and valuing the intricate web of relationships that exist between humans, nonhuman beings, and the environment. Process-relational studies are seen to provide an opportunity to move beyond normative dualisms in research (e.g., mind/body, culture/ nature), while being responsive to dynamic, cross-scale, and complex interactions within the biosphere²⁵.

Evolutionary embeddedness

Evolutionary embeddedness can be studied as historical explanations (the roots of embeddedness), potential future co-existence (existential interdependence), and co-evolving feedbacks. The evolutionary perspective allows for explaining and complementing contemporary compositional and relational dimensions (e.g., the current microbe content of human bodies explained by evolutionary theory), as well as for identifying asymmetrical interdependencies (e.g., that humans depend existentially on the water cycle, whereas the existence of the water cycle is relatively unaffected by human existence).

Evolutionary embeddedness can also be relevant regarding changes occurring over contemporary timescales. For example, by moving beyond gene-centric approaches, some proponents of research in evolutionary theory have argued that living beings do not evolve to fit into pre-existing environments, but instead co-construct and coevolve with them^{26,27}. In this context, researchers have observed accelerated rates of phenotypic change (changes in an organism's behaviour, morphology and physiology in response to its environment) in animals, plants, fungi, and other organisms in urban settings²⁸.

Entry points for studying the intertwined biosphere

In the following section, we present a selection of entry points, in no particular order, to support discussions for identifying promising lines of inquiry.

Empirical investigations

One entry point is to study the intertwined biosphere with a specific topic centre stage, to analyse the intertwinedness of the composition, relations, and/or feedbacks of a given topic over time and across scales. One could, for example, look at the topic of the water cycle. Life is affecting, framed by, and dependent on precipitation patterns, soil moisture, atmospheric rivers, water vapour, the spread of ice sheets and glaciers, upwelling currents of coastlines, and the ocean's global conveyor belt. A potential avenue for investigation is to





study the co-evolutionary emergence of an intertwined and embedded Anthropocene hydrosphere since deep time, synthesising how the water cycle in the Earth system drives and is also driven by, living processes, and how humanity is one actor within these interactions shaping the water cycle.

Another potential topic is the compositional, relational, and evolutionary embeddedness of the human body in the biosphere. Here, a study could focus on not only the human-biosphere interactions involved in the chemical composition of the human body, but also how a sense of place and relationships with nature across geographies affect embeddedness²³. Research studying humans as holobionts –an assemblage of host and multiple other species– has also explored how symbiotic relationships between the human body and gut microbiota dynamically shape physical and mental health, surpassing dichotomies of human/nature and mind/body²⁹. Here, studies have highlighted the complex interactions between geographies, diet, the microbiome in the human gut, and malaria severity³⁰. Using an intertwined lens, another study could build on existing research and analyse how feedbacks and interactions between humans and gut microbiota affect, and are affected by, Anthropocene dynamics in the biosphere such as antibiotic resistance, changing species composition, and both the migration of human populations and vector-borne diseases, with their associated political implications.

Review and synthesis studies

Another entry point for advancing the understanding of the intertwined biosphere, is the synthesis of ontologies and epistemologies across disciplinary boundaries, and human-nature dichotomies, to search for new lenses for understanding the complexity of human-biosphere relationships. One way we envision that this can take shape is a study collecting words and idioms from multiple languages and disciplines to open up vocabulary to express multiple ways of (inter)being-in-the-world. A further option is a review paper to explore how different ways of knowing have expanded our understanding of environmental and sustainability issues, by opening up the ways we understand existence (what is) and the ways we have come to know, or understand, the world. A preliminary abstract for such a review paper can be found in the Appendix of this brief. The review intends to elaborate avenues for inter- and transdisciplinary work foregrounding humanity's embeddedness in the biosphere.

Rethinking perception models and concepts

A third entry point is to revisit perception models and concepts. One could, for example, work on the further development of the perception models in Earth System modelling, exploring how they can better reflect humanity's embeddedness in the planetary system. Additionally, we propose a conceptual framework paper to rethink the notion of 'scapes' as a concept that can potentially offer an effective lens for capturing how living beings are embedded in webs of relations, and which can be used to express both material and immaterial flows.

Here, a scape can be defined as a combination of material and immaterial flows that, together, form the configuration of an environment in which an observer can be immersed. With flows, we mean anything that can be sensed to go from one place to another. As an example, the notion of the soundscape describes the configuration of multiple soundwaves. The notion of a soundscape has proven useful for inspiring empirical methods for sensing life in the field of soundscape ecology, by exploring the compositional, evolutionary, and communicative interactions of species in an ecosystem³¹⁻³³. Another potential application of the scape concept is through the waterscape, which has been applied to describe how water travels through time and space and is shaped by both culture and geography³⁴. In addition, Arjun Appadurai has proposed the concepts of the ethnoscape, mediascape, technoscape, financescape and ideoscape to describe the global configuration of flows of people, media, technologies, money and capital, and ideas, respectively, alongside individuals' positionality within them³⁵.





We argue that scapes can offer an opportunity to build further on relational perspectives (e.g., those using assemblage, wayfaring, and dwelling), and represent a concept that enables both descriptive analyses and quantitative assessments of flows. One reason for this is that no distinction is made between 'natural' or 'social' flows (similar to the assumption in Actor-Network Theory that actants are not categorised as natural or social, for example). The next step in our conceptual thinking would be to translate the concepts presented above into empirical methods. One source of inspiration that could help develop quantitative modelling approaches would be the depiction of force fields which can be perceived as a dynamic environment consisting of flows (Figure 3). To model a scape, in this analogy, we can draw from systems thinking and include an identification of the components that give shape to the scape and 'weigh' how much their influence on the shape of a given scape is.



FIGURE 3: The gravitational field which the Sun and the Earth create and inhabit. It is a dynamic system in which the movement of these celestial bodies is influenced by each other and their 'environment'. Vchalup / Adobe Stock.

Conclusion

We aim to initiate, co-develop, and synthesise studies which foreground humanity's embeddedness in the biosphere. We intend to look for new scientific ways to sense, describe, and analyse life in order to further explore how living things shape spaces and constantly produce them³⁶. These goals call for both conceptual and methodological developments.

In this brief, we describe the intertwined biosphere as the layer around the Earth in which all life is inextricably connected. The persisting and increasingly unprecedented human influence on all life on Earth marks the Anthropocene biosphere as a 'new playing field', and calls for understanding people and nature as intertwined and embedded in the biosphere as the foundation for action. We additionally present a provisional conceptual framework to help foster this understanding and to study compositional, relational, and evolutionary dimensions of embeddedness. Finally, we propose multiple entry points for future research: (i) empirical investigations, (ii) review and synthesis studies, and (iii) the rethinking of perception models and concepts.





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Appendix: Abstract for Review Paper

The Anthropocene epoch brings to the forefront a series of challenges and considerations regarding humanity's relationship and positioning within the biosphere. Central to these challenges is the perception of humans as disconnected or separated from the biosphere. In the context of ongoing socio-ecological crises, recognizing humans as integral components of the biosphere raises a compelling need to explore and integrate diverse forms of knowing in practical and theoretical domains. The shift towards repositioning humans as an integral part of the biosphere, rather than separate from it, not only signals a significant conceptual evolution but also unlocks avenues for transformative research. Such research holds the promise of generating new theories, empirical evidence, and insights that can be effectively applied in practical contexts. In this review, our objective is to explore how different ways of knowing have expanded our understanding of environmental and sustainability issues, by opening the ways we understand existence (what is) and the ways we come to know or understand the world. With this, we want to elaborate avenues for inter- and transdisciplinary work foregrounding humanity's embeddedness in the biosphere.