



Current Human Ecology in the Amazon and beyond: a Multi-Scale Ecossemiotic Approach

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Abstract

Umwelt theory is an expression of von Uexküll's *subjective biology* and as such usually applied in analysis of individual animals, yet it is fundamentally relational and therefore also suitable for analysis of more complex wholes. Since the birth of the modern environmental movement in the 1960s, there has been growing scientific and political acknowledgement of there being a *global* environmental crisis, which today manifests itself as a climate change and biodiversity crisis. This calls for a multi-scale ecossemiotic approach to analysis of human ecology at various levels and scales. In this article I explore to what extent ecossemiotic methodology, drawing on Umwelt theory and its consistently subjective perspective, can be applied in analysis of human ecology at different geographical and ecological scales ranging from the global to the local. The article incorporates a case study of human–animal relations in Mamirauá Sustainable Development Reserve in the Central Amazon. This is a seasonal floodplain forest area surrounded by rivers. I investigate aspects of the living conditions and ecology of the reserve, with a main focus on indigenous communities and the circumstances of two primate species, namely the red howler monkey (*Alouatta seniculus*) and the black-headed squirrel monkey (*Saimiri vanzolinii*). I outline matrixes of levels of study in ecossemiotics, and scales in human ecology, and apply two scales to the Mamirauá case. These take an individual animal's and an individual human being's subjective experience as their respectively starting points. This allows for multi-scale studies of human ecology from complementary angles.

Keywords Ecossemiotics · The Amazon · Human ecology · Umwelt theory · Seasonal floodplain forest · Monkeys · Locality · Scale

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Introduction

If you were to ask why on Earth anybody should study multi-species environments that involve humans, the informed response would be that human environments are typically multi-species, and that several environments which have for most of their history been largely non-human are increasingly affected by anthropogenic environmental change. Since the birth of the modern environmental movement in the 1960s, there has been growing scientific and political acknowledgement of there being a *global* environmental crisis. Scientific consensus documents from recent years highlighting the acute character of contemporary environmental developments include the first global assessment report on biodiversity and ecosystem services (IPBES 2019) and a report from the Intergovernmental Panel on Climate Change that makes the case that even if the global community manages to limit average global warming to 2 °C this will involve intolerable consequences (IPCC 2018). In addition to phasing out the use of fossil fuels, avoiding calamitous climate change will require fundamental changes in human land use, including an end to deforestation in rainforest areas. Today no less than 70% of the planet's land mass has been transformed by human activities (IPCC 2019), and by way of climate change the entire Earth system is affected by human actions.

How can ecosemiotics contribute to studies of multi-species environments in this context of global environmental change? That is the central question of this paper. As I will argue, mainstream framework notions of global human ecology are limited, from a semiotic point of view, in that they build on a physiochemical rather than an organismic or ecological view. There is therefore no ready-made model of or framework for global human ecology that can simply be reinterpreted in ecosemiotic terms – or rather, that would only take us so far. This would have implied a top-down approach to global human ecology. Instead, the most fruitful way to approach global human ecology with an ecosemiotic perspective is arguably to make use of a bottom-up approach with Umwelt theory at its foundation.

At the outset, there is a tension between Jakob von Uexküll's "subjective biology" (1928, 1956), which takes the individual organism's point of view, and global human ecology, which is planetary in scope. However, as I will demonstrate, with a multi-scale approach, these different perspectives are reconcilable. In this paper I develop a multi-scale ecosemiotic approach to global human ecology. The aim is to contribute to making ecosemiotic methodology scalable in a manner which allows its application at different geographical and ecological scales ranging from the global to the local. At the "bottom" of this approach, we find the Umwelten of organisms capable of experience and action. Our starting point is thus the subjective experience of humans, animals and the like, and the relations they engage in with other organisms. This results in a perspective that is simultaneously organismic and ecological. Getting the big picture right – a compulsory task in the field of global human ecology – comes with many potential pitfalls. These include generalizing non-representable local experience to the global level, and operating with big picture-notions that are not relevant under (some specific) local conditions. The overall challenge is developing big picture-notions that can meaningfully be down-scaled to more local levels or scales and be valid across levels or scales.

Ecosemiotics is, "in the broadest sense, a branch of semiotics that studies sign processes as responsible for ecological phenomena (relations between species, population patterns, and structures)" (Maran and Kull 2014: 41). Sign processes, according

to this outlook, are in many cases to be regarded as causal factors that shape ecological developments, through what Jesper Hoffmeyer called ‘semiotic causation’, “the bringing about of changes [in the physical environment] under the guidance of interpretation” (Hoffmeyer 2008: 149) in the perception–and–action of interpretative organisms. As phrased by the Swedish anthropologist and human ecologist Alf Hornborg (2001: 122), ecosemiotics rests on “the contention that ecosystems are constituted no less by flows of signs than by flows of matter and energy.” Ecosemiotics implies “a realist view” (Maran and Kull 2014: 42) and involves semiotic framing and interpretation of real-life processes of nature, with nature and society being seen as interconnected systems, “both of which are simultaneously material and communicative” (Hornborg 2001: 122). In this perspective, “spatial environments or landscapes as perceived today have largely resulted from sign processes of humans and other organisms” (Maran and Kull 2014: 42), with anthropogenic influence trending towards increasing. Von Uexküll’s Umwelt theory constitutes an integral part of the ecosemiotic enterprise and is crucial to understanding ecological relations from a subjective, organismic perspective. “As different species take part in the ecosystem by perception–action cycles,” as Maran and Kull (2014: 46) observe, “the environment becomes an interface in which ecological relations are organized and negotiated”.

The place and role of human life in the larger context of ecological semiosis overall can according to Maran and Kull (2014: 45) be understood in two different ways: “Energetically and biogeochemically, human culture is a part of [the] ecosystem. Semiotically, culture is both a part and a meta-level of the semiotic ecological network”. This is because cultural models can be models of the natural system of which it is part, and thus can establish “a meta-level in relation to the ecosystem” (2014: 45). This dual status of culture with regard to nature has been crucial for enabling human beings to have such a profound effect on the natural environment.

Given the multi-scale ecosemiotic approach taken in this article, the concept of ‘scale’ should be introduced already at this point, however briefly (a further presentation is given in the next section). For introductory purposes it will suffice to remark that scale has emerged as a major theoretical and methodological issue in various disciplines of relevance to human ecology, but with little synthesis across disciplines. As Nathan F. Sayre (2005: 277) notes, even though scale is a major issue in ecology as well as in geography, “[b]etween ecology and human geography [...] there appears to be no overlap or interaction on this subject.” By providing an alternative, more comprehensive framework for the study of human ecology, ecosemiotic theory and analysis can potentially contribute to better connecting what is conventionally seen as disparate fields of study, such as ecology and human geography. This is because human and ecological phenomena alike can be studied within one and the same ecosemiotic framework. Ecosemiotics could therefore be in a position to contribute with specific answers to the “perceived need to unify phenomena conventionally studied in isolation” that Sayre (2005: 283) refers to. The advantage of unifying phenomena in this manner is that it allows for studying complex multi-species environments from complementary angles (e.g. from human and animal points of view).

The structure of this article is as follows: I start by making theoretical considerations on globality and locality within the context of ecosemiotics, and offer a few key ecosemiotic readings of global environmental data. I then introduce a case study on human–animal relations and living conditions in Mamirauá Sustainable Development

Reserve, a seasonal floodplain forest area in the Central Amazon which I visited in the summer of 2018. Next, I develop multi-level and multiscale matrixes for mapping the ecosemiotics of human ecology, while using case study material to exemplify what can be studied under each level and scale. I finally analyze the case study by applying two of the scales that have been introduced and drawing on theoretical perspectives discussed in the article.

Globality and Locality in Light of Ecosemiotics

Timo Maran (2014) presents ‘locality’ as a key concept in ecosemiotics, linking ecosystems and semiotic theory. In the latter, locality may be associated with *context* that conditions meaning, “as a structure surrounding the text or the sign” that “influences both the formal aspects of the sign as well as the possible meanings a subject might attribute to the sign” (p. 84). Since the interpretive activity of a subject is subjective by nature, “we cannot describe the subject–context relation plainly from the objective viewpoint, [...] the individual, phenomenological and qualitative relations need to be taken into account” as well (2014: 85). Locality, in Maran’s conception, is to be taken to be “a characteristic of semiotic structures by which they merge with their surroundings in such a way that they cannot be separated from their environment without significantly altering their structure or information contained in this structure” (2014: 80). His understanding presupposes “that a semiotic process or semiosis always involves particular or singular phenomena” (2014: 80), a view that assumes that “culture, and for the most part also nature, can be considered as sequences or patterns of semiosis that inevitably put emphasis on their local identity” (2014: 80–81).

Locality is essential for both human and non-human-organisms, in that fitness always involves a match between subject and environment, and environments are always idiosyncratic, with characteristics that are related to their exact location on this planet and their place in the natural surroundings they are part of. In the case of human communities, “[l]ocal cultures interact with their environments, and this relation supports their identity” (2014: 85). Generally, “the mutual conditionality of a subject and its surrounding environment characterizes both living organisms and sign systems of human origin” (2014: 81). Maran’s notion of fitness amounts to a notion of ‘semiotic fitness’, as developed by Jesper Hoffmeyer (1998). In Maran’s words, semiotic fitness can be defined as “the success of a subject in adapting to its environment, its skill in bringing together information originating from itself and information originating from the environment with the help of semiotic processes” (Maran 2014: 82). “An organism is semiotically fit”, in this view, “if it succeeds in interpreting its organismic information in respect to the surrounding environment and vice versa” (2014: 82).

The contemporary global environmental crisis has its origin in the human species’ emergence as a ‘global species’ with several affiliated global species that have achieved global range in its wake (Tønnessen 2010). This has given rise to multiple ecologies built around our presence. The associated ecological developments in human ecology are intimately connected to processes of globalization. According to Maran (2014):

The modern world is foremost characterized by the unification of cultural contexts. Since natural environments unavoidably differ from place to place, this

process brings along the reduction of man's semiotic fitness in relating to local nature. The correspondence of subject-related and environment-related information is hindered, or in plain words – people do not know any more how to *be* in nature. (Maran 2014: 87)

As we see here, Maran claims that globalization with its drive towards unification of cultural contexts results in poorer semiotic fitness for human beings, at least when adaptability to the local environment is chosen as measure. In line with this, he also suggests (2014: 87) that “the emergence of cultural homogeneity, which is the prerequisite of globalization” leads to a “weakening of relations between local cultures and local natural environments”. Judging by these observations, a logical conclusion could be that solving the global environmental crisis requires re-adapting to local environments, thus in effect reversing globalization somewhat, or at least restraining it.

Hornborg (2001: 128) conceives of economic forces as decisive for current ecological developments. In his outlook, there are “three kinds of sign systems: *sensory, linguistic, and economic*”, with each of these “semiotic levels” being “a prerequisite for the next”. This perspective can easily be situated within the discourse of globalization. In Hornborg's view, “each level has a tendency to detach itself from the logically and phylogenetically prior one” (2001: 128), in effect making both the world of language and the world of economics appear as isolated domains. Nevertheless, the economic sign system represents an “ecossemiotic flow” that has a material basis or correlate, involving “the movements of artefacts, people, resources, and exchange values that comprise the subject matter of economics” (2001: 138).

According to Sayre (2005), scale “has emerged as a major issue in both ecology and geography”, but “[l]ittle effort has been made to compare these parallel debates, [...] or to seek an integrated conception of scale across the two disciplines [...] In both disciplines, globalization has lent practical urgency to problems of scale, revealing deeper theoretical issues” (2005: 276). Sayre stresses that “[m]ost participants in the debates acknowledge the need for studies that span multiple scales,” and that “most conceive of different scales as organized in some kind of hierarchical fashion” (2005: 277). Scale, in Sayre's view, is “both a methodological issue inherent to observation (its epistemological moment) and an objective characteristic of complex interactions within and among social and natural processes (its ontological moment)” (2005: 276). Scales, then, are “objective characteristics” of real-life processes and phenomena, and at the same time “necessary tools” for studying these (2005: 283).

One reason why the issue of scale matters is that environmental problems “cannot be addressed effectively in the absence of methods to relate processes of different temporal and spatial scales” (2005: 277). While geographers nowadays hold that “scale is socially constructed” (2005: 278), Sayre claims that “[e]cological scales are no less produced than geographical scales”, a realization which should according to Sayre “enable ecologists and geographers to theorize and study processes as simultaneously natural and social” (2005: 287). “It is”, in Sayre's outlook, “obvious that social and ecological phenomena are intimately linked across scales; it follows that the problems of one cannot be resolved in isolation from those of the other” (2005: 286). “Social and natural processes”, however, “may have widely divergent spatial and temporal scales (political versus evolutionary or geological time, for example)”, and such “scale differences do generate significant methodological disparities” (2005: 286).

Ecosemiotic Readings of Global Environmental Data

The last two generations have seen an increasingly *global* focus in the environmental issues discourse. From an academic point of view, this change in focus could be said to have started with the idea of Gaia, i.e. our living planet, as a planetary ecosystem (Lovelock 1979, 1988), which implies that the Earth system functions in similar ways as an organism. The global turn in the environmental discourse has culminated (so far) with the historically informed notion of the Anthropocene, the idea that the human impact on ecosystems globally is now so considerable that we should understand our geological era as dominated by human agency (Crutzen and Steffen 2003, Steffen et al. 2011). The related notion of planetary boundaries (Rockström et al. 2009) stipulates that there are global boundaries, or thresholds, related to earth systems that cannot sustainably be passed. The increased global focus in the environmental discourse has made Earth Systems Science more prominent and contributed to improved systemic understanding of the ecological crisis. The three mentioned framework notions have some affinities with eco-/biosemiotic thinking, such as the interest in coupled feedback mechanisms, thresholds and tipping points, which might be a good fit with instantiations of ecosemiotics that build on systems science. All the three mentioned notions, however, have a clear limitation when assessed from an ecosemiotic perspective: They are all built on a physiochemical rather than an organismic or ecological view. Their compatibility with ecosemiotic theory is therefore limited. Nevertheless, these framework notions may in some cases benefit from an ecosemiotic framing, and they should be regarded as complementary to ecosemiotic analysis.

What is lacking in the most referred to framework notions for global human ecology, is the subjective, organismic perspective. For ecosemiotics, this perspective is the logical starting point for any analysis of human ecology. As this article aims to demonstrate, by applying a multi-scale approach to human ecology, we can assess ecological developments at any scale or level while incorporating a subjective perspective at the foundation of our analysis. In this section I present key ecosemiotic readings of global environmental data, to demonstrate the feasibility of an ecosemiotic approach to global human ecology. I will return to the perspectives presented here when analyzing the Mamirauá case study towards the end of the article.

Homo sapiens is an omnivore, and on the individual level the species includes everything from hunters, fishers and farmers to vegans. In the sense of Darimont et al. (2015), only hunters and fishers qualify as human ‘predators’. They have documented that towards many species, human beings *en masse* behave like an unsustainable super-predator, i.e., we kill potential prey more frequently than other predators do, and on a massive scale, given our considerable numbers. Darimont et al. (2015: 859) suggest that “aggressive reductions in exploitation are required to mimic nonhuman predators, which represent long-term models of sustainability”. As I have written elsewhere (Tønnessen 2016: 178), in relation to other predators, such a significant behavioral change “would be reflected in changes in our human *umwelt* with regard to how large predators are perceived and treated, as well as in the *umwelten* of wild carnivores”, where “humans would [...] become less prominent *umwelt* objects [...], noticeably as enemies.” The same goes for other prey that are today fearful of humans.

It is a paradox that while our ‘ecological footprint’ keeps increasing (WWF 2018), many places resulting in escalating anthropogenic environmental change, humans and

animals increasingly live in isolation from each other. This is largely due to urbanization, with the typical urban dweller having practically no contact with livestock, and increasingly industrialized animal husbandry practices, which means that even in many rural areas there are fewer animals to be seen despite their presence in the area in indoor environments. From the animal's perspective, the adoption of industrial-style practices implies that human contact is systematically replaced by automation, resulting in more artificial environments for a majority of animals in animal husbandry. As FAO (2006) has noted, there is in current animal husbandry "a shift of species" in relative terms from "ruminant production (cattle, sheep and goats, often raised extensively¹)" to monogastric species, notably pigs and poultry, that are mostly held in indoor industrial units (2006: xx–xi) their entire lifetime. While meat production from all these animals is increasing, the production of meat from poultry and pigs grows by far most rapidly, resulting in more "indoor Umwelten" relative to the occurrence of "outdoor Umwelten".

Seen in context, there is a tendency that companion animals, notably pets, are replacing animals in animal husbandry as humans' primary social companions among animals. In this sense pets appear to be social "substitutes" for livestock, as many have moved from rural to urban areas and gone from subsistence farming to other professions. The paradoxical situation implies that humans have an ever larger impact on the lives of non-humans, and yet we see (farm) animals less and less. In terms of *Umwelt* theory, we can state these developments in the following way: The aggregate human *Wirkwelt* (world of action) is an ever more influential factor (directly or indirectly) in the lives of most animals; and yet, humans appear less and less frequently as *Umwelt* objects to (farm) animals, and vice versa. In other words: While humans play an ever larger role as causal agents, we gradually play a lesser role in (farm) animals' 'core *Umwelt* experience' (Tønnessen 2011).

The issue of climate change is global by nature in the sense that we are dealing with measurable *global* climatic changes, though these may vary in their specifics from region to region. Climate change affects temperature and patterns of precipitations, but also has an effect on animals, plants and other organisms beyond this direct impact. This includes effects on physiology (e.g. related to photosynthesis and plant growth), phenology (e.g. advances in life cycle events) and distributions (e.g. movements towards poles and toward more elevated areas) (Hughes 2000). These effects might in turn lead to changes in species interaction, e.g. due to changes in competition, predator-prey relations or the occurrence of parasitic infections. Changes in species interactions can lead to further shifts in distribution, and extinction of some species, which again causes changes in community structure and composition, involving progressive impoverishment of some communities and a relative increase of opportunistic species. Long-term migration, i.e. changed ranges, for affected species due to changed climatic conditions with ripple effects is an issue for many different life forms. For instance, the range of the bird common grasshopper-warbler (*Locustella naevia*), which today covers most of central Europe, is given mainstream climate scenarios expected to move so far north, and be so much smaller than today, in 2070–2099 that it will likely disappear from most of the countries it now inhabits (Huntley et al. 2008: 3, 4). One possible approach for ecosemiotics in the study of climate change is to

¹ Being "raised extensively" refers to extensive land use as opposed to intensive land use.

investigate climate change by looking into how it affects the living conditions of animals, such as the common grasshopper-warbler. This can be done using Umwelt theory, with emphasis on ‘Umwelt transitions’, i.e. systematic changes in the appearances of Umwelten (Tønnessen 2009).

A Foray into the Worlds of Animals and Humans in the Amazon

The Amazon, a tropical rainforest area of great geographical extent that stands out by its rich biodiversity, is frequently framed as emblematic of nature or wilderness itself.² It houses 92 primate species, the most of any biome on Earth. The rich diversity of the region is supported by the Amazon River, which accounts for a fifth of the world’s riverine discharge to the ocean (Moura et al. 2016), and drains the Amazon basin that surrounds it. The precarious state of the Amazon in recent decades has caused widespread concern among environmentally minded people all over the world.

As portrayed by Hornborg (2001: 124), the Amazon is “a bioregion conventionally perceived as pristine wilderness yet inhabited for millennia by human populations that have actively transformed it.” For this reason, “Amazonia provides us with remarkable evidence for the extent to which human, cultural behaviour can be constitutive of ecosystems” (2001: 126–127). The historical background for the common image of the Amazon as iconic wilderness dates back to the drastic depopulation that followed the European colonization of the Americas (2001: 142). With lower populations, the Amazon was for a time less influenced by human activities than in the preceding centuries.³ After some time, however, colonization translated to accelerating resource utilization in the region, and in more recent times, the “incorporation of Amazonia in a global market economy has accelerated environmental destruction” (2001: 142). This is no less true today than when it was written nearly 20 years ago, although conscious conservation efforts have over time slowed deforestation rates.

The climate in the Amazon is 0,6–0,7 degrees Celsius warmer today than 40 years ago (Marengo et al. 2018: 1). As a result of increased climate variability, climate change contributes to more droughts as well as to more mega-floods (2018: 3). In the worst-case scenario, a “die-back” of the Amazon region would transform the rainforest biome with its hydrological system to a savannah-like landscape. News magazines report that the Amazon is on the brink of an “irreversible tipping point” (The Economist 2019), due to accumulated deforestation over the previous decades. This is with reference to researchers who worry that further deforestation can soon lead us to a tipping point which will make such a transformation feed on itself and in effect become inevitable (Nobre et al. 2007, 2008).

“Economic sign systems”, according to Hornborg (2001: 144), “have rapidly and drastically transformed human–environmental relations in Amazonia to the point where the entire rainforest ecosystem is under threat.” In his view, it is the interference of the economic sign exchange with the sign processes of the natural environment that best

² In this article, “the Amazon” refers to the Amazon rainforest as an ecoregion. In quotes from Hornborg 2001, “Amazonia”, which has the same reference, has been retained. “Amazonas” refers to the Brazilian state of Amazonas at the heart of the Amazon.

³ Another factor contributing to the (European) perception of the Amazon as pristine wilderness was clearly lack of recognition (sic) of indigenous cultural practices.

explains current ecological developments, as well as developments in how humans perceive the natural world.

In detaching themselves from the direct, ‘face-to-face’ communication between humans and their natural environments, flows of money and commodities – and the [decontextualized] knowledge systems they engender – have no means of staying geared to the long-term negotiation of local, ecological co-existence. On the contrary, their effect seems generally – in Amazonia as elsewhere – to have been to transform human perceptions of the environment from a community of sentient subjects to a mechanical assemblage of objects. (Hornborg 2001: 144)

Hornborg’s analysis of developments in the Amazon region is no less pertinent in the era of Bolsonaro’s presidency. Discussing conservation agendas for the Amazon, Brazil’s current President, Jair Messias Bolsonaro, has stated that “Brazil is a virgin that every foreign pervert wants” (Sassine 2019, author’s translation), and indicated that indigenous peoples in the Amazon are being used by foreign powers for the sake of their own commercial interests. He also accuses indigenous peoples of wanting to “create new countries within Brazil” (Sassine 2019, author’s translation). In 2018, Bolsonaro ran for the presidency with a campaign promising to promote the interests of agrobusiness and fight the influence of environmental and social justice Non-Governmental Organizations that support indigenous communities in the Amazon. In the summer of 2019, rapidly increasing deforestation (Daley 2019) and widespread anthropogenic forest fires in the Amazon have caused international outrage.

Life in the Mamirauá Sustainable Development Reserve

This section presents a case study of human–animal relations in Mamirauá Sustainable Development Reserve in the Central Amazon which, established in 1996, was the first of its kind in Brazil. The study area is a seasonal floodplain forest area surrounded by rivers in the Brazilian state of Amazonas.⁴ I investigate selected aspects of human living conditions and animal ecology in the reserve, with a main focus on indigenous communities and their relations to two primate species, namely the red howler monkey (*Alouatta seniculus*) and the black-headed squirrel monkey (*Saimiri vanzolinii*). Other mammal species in the reserve include eight more monkey species, two species of sloths, namely brown-throated three-toed sloth (*Bradypus variegatus*) and southern two-toed sloth (*Choloepus didactylus*), jaguar (*Panthera onca*), puma (*Felis concolor*), two species of freshwater dolphins, namely the Amazon river dolphin (*Inia geoffrensis*) and tucuxi (*Sotalia fluviatilis*), and Amazonian manatee (*Trichechus inunguis*), the only sirenian, i.e. sea cow, to live exclusively in freshwater. There are further more than 300 bird species in the reserve, as well as piranha and other fish, snakes, and alligators (Reserva de Desenvolvimento Sustentável Mamirauá 2018) – with the latter few species making swimming in the rivers of the reserve somewhat risky.

⁴ The state of Amazonas, Brazil’s largest state, has a population of about 4 million people distributed across an area of 1,6 million km². The area is larger than Mongolia; or larger than France, Spain and Germany combined.

The case study work builds on a brief visit to the Mamirauá Sustainable Development Reserve in July 2018, supplemented by a review of relevant scientific literature, including work done by researchers at Mamirauá Institute for Sustainable Development.⁵ This research institute is tasked with management of protected areas as well as with promoting social (i.e. human) development in the same areas, and to run related research programs. The concept of a ‘sustainable development reserve’ rests on forming formal alliances with local communities; making community-based management arrangements; facilitating a decentralized but state-controlled natural resource management; emphasizing education and empowerment of communities; and a pragmatic approach to local subsistence hunting traditions, as long as game species are sufficiently plentiful (Campos-Silva et al. 2017).

The headquarters of Mamirauá Institute for Sustainable Development is located in the town of Tefé, a town with some 60.000 inhabitants which is the commercial center of this region of the Brazilian state of Amazonas. Though there are some local roads in Tefé, in addition to the local airport, there are no roads connecting Tefé with any other town (this results in a predominance of motor bikes on local roads). River boats and airplanes provide the only long-distance means of transportation. The municipality of Tefé covers about 24.000 km², an area larger than Slovenia or Djibouti.

Though Tefé is the closest major town to the Mamirauá Sustainable Development Reserve, the reserve does not lie within the borders of the municipality of Tefé. The area of the reserve is 11.240 km², and it is located in the municipalities of Uarini, Tonantins, Maraã, Japurá and Fonte Boa, with more than half of the reserve being within the borders of the latter municipality. Mamirauá Sustainable Development Reserve is delimited by Solimões River to the south and Japurá River to the north. These two rivers converge close to the town of Alvarães, which is the only town in the area that is closer to the reserve than Tefé. The main means of transportation of the inhabitants of the reserve is walking by foot (around home all-year, and in the forest in the low-water season), canoeing (on rivers all-year, and in the forest in the high-water season), and going by small outboard motor boats. Throughout the seasons, the waterways are the main channels of transportation and arenas for contact with other humans and animals.

According to Pereira et al. (2017), the population of Mamirauá Sustainable Development Reserve is 11.532, resulting in an average population density of 1,03 humans per km². The local population is situated in ca. 200 communities, which have an average population of 58 persons each. A neighboring reserve which is also managed by the Mamirauá Institute for Sustainable Development, the Amanã Sustainable Development Reserve, covering 23.500 km², has 86 communities and a population of 3.860, resulting in an even lower population density (0,16 humans per km² and 45 people per community). Taken as a whole the two reserves cover 34.740 km², an area larger than Belgium or Lesotho.

Life in the area is heavily affected by the seasonal variations in water levels that are characteristic for seasonal floodplain forest areas. With a latitude of 3° 21' 14" S, temperatures are quite stable throughout the year, at around 26 °C. Water levels, which regularly vary with as much as 10 to 12 m, and whether the waters are rising or residing, is what primarily determines the character of the season. The high-water period lasts May–July, followed by receding water levels August–September. This

⁵ Mamirauá Institute for Sustainable Development acts as one of the research units of Ministério da Ciência, Tecnologia e Inovação (Brazil's Ministry of Science, Technology and Innovation), MCTI.

leads to the low-water period in October–January, which is followed by rising water levels in February–April, in the lead-up to another high-water period (Paim et al. 2017). In the high-water period, the local forests are flooded. This upsets the behavior of both animals and humans, particularly with regard to foraging and movement patterns. The inhabitants of the floodplain forest areas live in an ecosystem where, due to the pulsating waters, there are no fixed borders between the terrestrial and the riverine environments – a fluid, dynamic ecosystem where rivers can change paths rapidly, and where seasonal adaptability is key for survival and thriving.

Overall, flooded tropical forests cover 800.000 km² or 14% of the Amazon basin, with the “extreme environmental fluctuations” implying that many trees are submerged by water “for more than 230 days every year” (Paim et al. 2017: 573). The Amazon *várzea* (i.e. floodplain) forests constitute the largest riverine flooded forest area on Earth. It is worth recalling that as a rainforest, the Amazon in general is characterized by high and continuous rainfall, and that the Amazon as an ecoregion is furthermore characterized by the ongoing re-distribution of water carried out by the Amazon River. This means that even *terra firme* [solid ground] forests, i.e. forests that are not seasonally flooded, in the Amazon have access to substantial amounts of water. The floodplain forests stand out, however, by their greater seasonal environmental fluctuations, and the ways in which local flora, fauna, and humans have adjusted to these circumstances.

The customs and livelihoods of the local communities are highly adapted to the specificity of the environment the floodplain forest peoples inhabit. Houses, which are typically one-level only, are built on stilts, and repairs and reconstruction must be made quite frequently,⁶ particularly if the water rises to higher levels than usual and causes unexpected damages. In Fig. 1, we see a house on stilts where the darker bottom parts of the house mark how high the water rose in one of the previous high-water seasons, in 2015. As we see, that year the water rose until it covered about half of the house’s height (stilts not included), making residence in the house temporarily unattainable and necessitating evacuation of the house’s residents and their in-door belongings.

Living in such a volatile environment is challenging even under normal circumstances. Some inhabitants adjust to an increasingly capricious environment by moving to the near-by town Alvarães, or by sharing their time between Alvarães and their original community, though most residents would only move to Alvarães in case of emergency, as part of a temporary evacuation from their regular homes. Quite stable population numbers in the many riverine communities of the reserve attest to the attraction that the more traditional community-based life still has for a majority of the areas’ inhabitants. In Alvarães there is a hospital, and some communities have their own publicly funded health assistants, but most people in the communities still prefer to rely on the medicinal plants that they grow. For most residents, going to see a doctor is only an option if the traditional methods do not work out.

The Black-Headed Squirrel Monkey (*Saimiri vanzolinii*)

The black-headed squirrel monkey has a geographical range of just 870 km², the least of any known primate. Its current range is delimited by rivers. These are not natural

⁶ Even under normal circumstances, the wood below water only lasts for 5 years or so, according to locals, while the wood used above water may last for some 30 years.



Fig. 1 A house in the Mamirauá Sustainable Development Reserve. The photo was taken early July 2018, towards the end of the high-water season. Photo: The author

barriers – i.e., it would be physically possible for the squirrel monkeys to cross the river, but they nevertheless stay within these borders. From an ecosemiotic point of view, it is tempting to interpret the black-headed squirrel monkey's behavior in this respect as involving a sort of conventional, group-based choices, operating with a cognitive map that is not inborn but rather collectively constructed.

The black-headed squirrel monkey is classified by the International Union for Conservation of Nature (IUCN) as “vulnerable”. Due to its low body weight and therefore moderate meat value, it is generally not hunted by any of the local communities in the area. A two-year study of the diet of the black-headed squirrel monkey found that “food selection changed between seasons, and *S. vanzolinii* focused more on fruit in the low-water period, when fruit was less available, than in the high-water period, when fruit was more available” (Paim et al. 2017: 572–573). The researchers observe that the monkey “spent more time consuming fruit than arthropods in the high-water period”, but not in the low-water period (2017: 572), implying that fruit is preferred and efforts made to maintain a diet with satisfying amounts of fruit. The adaptations of the black-headed squirrel monkey to the water level that changes with the seasons also implies that it travels over long distances in the low-water season, and travels less but spends more time feeding in the high-water season.

Despite its fairly numerous population (>120.000), the black-headed squirrel monkey is at risk due to ongoing climatic changes, since it is confined to such a small and specific area. As Maran (2014: 83) notes, “[p]ronounced specialization to specific environmental conditions tends to go along with rareness”, and generally “specialized species are more vulnerable to environmental change.” One question that occupies

conservation biologists in the area is whether it might be possible to relocate the black-headed squirrel monkey to another location, if living conditions at its current locality at some point stop being suitable for this monkey because of increased flood levels due to climate change.⁷ However, relocation of species with a small range involves considerable risks. This can be analyzed by applying the notion of semiotic fitness referred to earlier. “While adapting to the environment”, writes Maran (2014: 82), “the subject localizes itself in the environment; thus, semiotic fitness indicates success in localization. On the other hand, it shows how much the structure of the subject will be affected if separated from its environment.” In light of semiotic fitness, and the matching of subject/species/organism to environment/locality, the question is: Is there, somewhere, a workable substitution for the black-headed squirrel monkey’s current local environment, and if needed, would it be available for this monkey? The answer is far from given, for one thing because the species composition of the “new” environment would be decisive for any successful relocation, whereas the species composition of most ecosystems currently undergoes changes due to climate change and other human impact. As Sayre (2005: 279) observes, “natural systems are determined by multiple processes operating simultaneously on numerous spatial scales”, and increasingly, this today includes *global* anthropogenic influence on the developments of *local* ecosystems. While making emergency plans for relocation of the black-headed squirrel monkey might be called for given current climate change dynamics globally, successful relocation cannot be taken for granted, and avoiding dramatic climate change is clearly preferable. However, this preferable “solution” requires successfully resolving the global environmental issue of climate change. Local action alone will not secure the survival of the black-headed squirrel monkey.

The Red Howler Monkey (*Alouatta seniculus*)

The red howler monkey, also referred to as Venezuelan red howler, is known for its loud guttural howls, which in social terms serve the purpose of marking and defending its territory, and can be heard over several miles even through dense forest. It is only the males that howl. This monkey is bigger and weightier than the black-headed squirrel monkey, and, with its greater meat value, it is quite frequently hunted by some inhabitants of local communities in the area.⁸ With its loud and frequent howls, it is not hard to locate. There is a further reason for why it is being hunted, namely that the locals hold the traditional, indigenous belief that drinking a brew made from its enlarged hyoid bone (i.e. jawbone, which supports the tongue) can cure throat infections.⁹ It is this bone that enables the red howler monkey to make its loud and characteristic vocalizations. Despite the hunting that takes place, the population of red howler monkeys is quite stable. The strategy of local conservationists has not been to lobby for strict protection of the red howler monkey, or to criticize traditional beliefs. Instead, they have aimed to educate communities in the Mamirauá Sustainable

⁷ With this in mind, a sperm and egg bank with samples from the black-headed squirrel monkey has recently been established.

⁸ According to the law, community inhabitants in the reserve can legally hunt most monkeys in the area (including the black-headed squirrel monkey and the red howler monkey), whereas outsiders cannot.

⁹ This and the following disposition is largely based on a lecture by Karine Lopes, a researcher at the Mamirauá Institute for Sustainable Development.

Development Reserve and the neighboring Amanã Sustainable Development Reserve about their self-interest in limiting hunting so that monkey populations remain viable (which also makes it possible to continue with traditional uses of the hyoid bone of the red howler monkey).

Guide X, referred to in the subsection “[Analysis of the Mamirauá Case Study](#)”, recounts how he once tasted red howler monkey meat as a child, “to try it out”.¹⁰ He now thinks it is not right to hunt it for meat, as in his opinion it “does no harm to anyone”. Even so, he says he thinks it makes sense to hunt them for the sake of its hyoid bone, the key ingredient in the brew made from it, thought to cure throat infections. According to Guide X, there is no need to hunt red howler monkeys in order to provide adults with this brew, but for small children with their greater vulnerability, any effort should be made to provide them with the best possible care, so for their sake, the hunting of the red howler monkey can be justified.

Multi-Level and Multiscalar Matrixes for Mapping the Ecosemiotics of Human Ecology

In this section I develop matrixes for mapping human ecology, occasionally using the case study on the Mamirauá Sustainable Development Reserve in the Brazilian state of Amazonas to exemplify levels and scales. The matrixes will come in two main versions, one for coarse-grain studies and another one for fine-grain studies, with the former being multi-level matrixes by design, and the latter being multiscalar matrixes by design.

In ecology, it is commonplace to distinguish between scales and levels.

Scale [...] refers specifically to processes and relations among organisms or other units of analysis, such as a pond skater’s relation to the surface tension of water; a level need not entail relations or processes at all (e.g., the pond skater as an organism), referring simply to a locus of organization or observation. (Sayre 2005: 282)

Sayre suggests that such a distinction between level and scale can be useful within geography as well, but cautions (2005: 286) that social processes “generate ‘a mosaic of unevenly superimposed and densely interlayered scalar geometries’, not ‘an absolute pyramid of neatly interlocking scales’ (Brenner 2001: 606)”. Given ecosemiotics’ affinity to empirical relationality, a multiscalar approach is often the most suitable, but as in most academic studies, a multi-level approach often serves as a logical starting point from an observational point of view. Wu and Loucks (1995), drawing on the work of R.V. O’Neill and colleagues, have proposed that “ecological studies should examine (at least) three levels: the level of the process at issue, plus the levels above and below it” (Sayre 2005: 286). They claim that a good

understanding of the dynamics of ecological systems usually is achieved by considering a few (e. g., two) adjacent levels in addition to the focal level (O’Neill, 1988; O’Neill et al., 1989). The focal level is the level at which the

¹⁰ Author’s translation from Portuguese, here and in the following.

Table 1 Adjacent levels of study in general semiotics and ecosemiotics

Level	General semiotics	Ecosemiotics
Higher adjacent level	Context	Environment
Focal level	Text	Experiential subject
Lower adjacent level	Subtext	Physiological subject

phenomenon or process under study characteristically operates. [...] The higher level provides a context and imposes top-down constraints on the focal level, and the lower level provides mechanisms and imposes bottom-up constraints. (Wu and Loucks 1995: 451).

On one condition, this three-level approach can be consistent with Maran’s (2014) conception of locality as being related to the common text/context relation in semiotic theory. In ecosemiotics, the text/context relation typically involves a subject/context relation (across levels), which can be interpreted as a subject/environment relation. The condition for making the ecological three-level approach consistent with Maran’s text/context relation is to presume that we can fittingly add “subtext” as a lower adjacent level to the focal level of “text”, cf. Table 1. If we stipulate that the “subject” in the subject/context relation is an *experiential* subject, the subtext can be taken to be the *physiological* subject (i.e. the same subject in its physiological aspects). In the sense of Wu and Loucks, the “environment” imposes top-down constraints on the experiential subject, whereas the “physiological subject” imposes bottom-up constraints on the experiential subject. This ecosemiotic three-level approach frames the subject, i.e. organism, as environmentally, experientially and physiologically considered.

In a further step, we can relate this three-level ecosemiotic approach to Umwelt theory, as shown in Table 2. In Table 1, we saw that the environment is an arena, as it were, for the experiencing subject. In Table 2, we see that the environment in its capacity as higher adjacent level of study to the focal level of the experiencing subject is the arena, so to speak, of the Umwelt of the subject under study. Conversely, the physiological subject is the arena of the *Innenwelt* of the subject under study. Generally,

Table 2 Adjacent levels of study in ecosemiotics with regard to related aspect of Umwelt.



Level	Ecosemiotics	Related aspect of Umwelt
Higher adjacent level	Environment	 Umwelt
Focal level	Experiential subject	
Lower adjacent level	Physiological subject	 Innenwelt

Table 3 Various scales in the context of global human ecology

Traditional geographical scale	local / regional / national / international / global
Typical administrative scales	municipality / county / country <i>or</i> municipality / state / country
Administrative scale from personal point of view	person / household / community / municipality / county / state / country
Plant ecology scale ^a	individual plant / patch / community / landscape / ecoregion / global ecosystem
Animal ecology scale	individual animal / population / species / ecosystem / ecoregion / global ecosystem
Human ecology scale from global/human perspective	individual human being / human community / humanity / global ecosystem
Human ecology scale from local/ecological perspective	individual human being / local ecosystem / regional ecosystem / global ecosystem
Scale of global human ecology from personal point of view	person / household / community / landscape / ecoregion / global eco-system
Scale of personal-to-global human ecology from semiotic point of view	physiological subject / experiencing subject / local ecology / regional ecology / global ecology
Scale of Umwelt from Innenwelt to Nature	Innenwelt / Umwelt / Aggregate Umwelten / Nature

^a Based on Sayre 2005: 286.

the Umwelt of a subject is grounded in the *Innenwelt* of that subject, in parallel with the way in which the environment/experiential subject relation is grounded in the experiential subject/physiological subject relation.

This three-level ecosemiotic approach will generally be appropriate in coarse-grain studies, but not in fine-grain studies. As we have seen in the case of ecological developments and developing human-animal relations in the Mamirauá Sustainable Development Reserve, assessing *adjacent* levels of observation is not always sufficient. In the Mamirauá case study, the global level of study, for instance related to aggregate anthropogenic climate change, strongly influences the local ecosystem, affecting e.g. human dwellings and livelihoods, and the future prospects of the black-headed squirrel monkey. This calls for the use of a multiscale perspective, focused on scales of empirically verifiable interaction and relationality rather than on levels of study.

As shown in Table 3, scales occur in highly disparate contexts with relevance for global human ecology. When developing a fitting research design for a specific ecosemiotic case study, one or more of these scales may be chosen, consistent with the research needs arising from the case. A further research design-related choice includes selecting scales among all possible scales within one scale, whether these are adjacent scales or not.¹¹

Table 4 shows the four scales from Table 3 that are explicitly related to human ecology with types of semiosis involved indicated for all finer scales. These alternative

¹¹ Three of these scales (namely ‘Plant ecology scale’, ‘Animal ecology scale’ and ‘Scale of global human ecology from personal point of view’) make mention of an “ecoregion”. Further distinctions are possible. Specifically, an ecoregion (e.g. the Amazon) is part of an ecozone or biogeographical realm (in the case of the Amazon, the Neotropical realm covering most of Latin America), and can be further described in terms of its biomes (in the case of the Amazon, mainly tropical rainforest).

Table 4 Types of semiosis involved in alternative scales in human ecology

Scale	Scales	Types of semiosis involved
1. Human ecology scale from global/human perspective	1a. individual human being	Endosemiosis, human Innenwelt, human Umwelt
	1b. human community	Cultural semiosis
	1c. humanity	Inter- and transcultural human semiosis
	1d. global ecosystem	Global biosemiosis
2. Human ecology scale from local/ecological perspective	2a. individual human being	Endosemiosis, human Innenwelt, human Umwelt
	2b. local ecosystem	Ecosemiosis, human-animal/plant/etc. sign exchange, human Umwelt (primarily core Umwelt)
	2c. regional ecosystem	Ecosemiosis, human-animal/plant/etc. sign exchange
	2d. global ecosystem	Global biosemiosis, ecosemiosis, semiosphere
3. Scale of global human ecology from personal point of view	3a. person	Human Innenwelt, human Umwelt
	3b. household	Human Umwelt (primarily core Umwelt), Cultural semiosis (internalized)
	3c. community	Cultural semiosis, human Umwelt (primarily core and mediated Umwelt)
	3d. landscape	Human Umwelt (primarily core and mediated Umwelt), cultural semiosis
	3e. ecoregion	Human Umwelt (primarily mediated and conceptual Umwelt), cultural semiosis
	3 f. global eco-system	Human Umwelt (primarily mediated and conceptual Umwelt)
4. Scale of personal-to-global human ecology from semiotic point of view	4a. physiological subject	Endosemiosis, human Innenwelt
	4b. experiencing subject	Human Umwelt, zoosemiosis, cultural semiosis
	4c. local ecology	Ecosemiosis, human-animal/plant/etc. sign exchange, human Umwelt (primarily core Umwelt)
	4d. regional ecology	Ecosemiosis, human-animal/plant/etc. sign exchange, human Umwelt (primarily mediated Umwelt)
	4e. global ecology	Ecosemiosis, human-animal/plant/etc. sign exchange, human Umwelt (primarily conceptual Umwelt)

scales in human ecology all take a human subject as their local starting point, with the scale progressing towards the global scale as the end point. While all four scales involve specific kinds of semiosis at each finer scale, their suitability will vary with the case or topic at hand. For instance, scale 1, “Human ecology scale from global/human perspective”, proceeds from an individual human being via a human community and humanity to the global ecosystem, implying that the crucial point is how human semiosis at lower scales affect global biosemiosis. Such a perspective may be suitable for studies of Earth systems and environmental issues requiring coordinated global efforts in changing human behavior. Scale 2, “Human ecology scale from local/

Table 5 Scale of global human ecology from personal point of view applied to the Mamirauá case

Finer scales	Types of semiosis involved	Locality or similar	Key characteristics
3a. person	Human Innenwelt, human Umwelt	Guide X	Young father; eco-tourism guide; Portuguese mother tongue; part-modern lifestyle
3b. household	Human Umwelt (primarily core Umwelt), Cultural semiosis (internalized)	Family with two small children; house	Family with two small children to support; marriage; fatherhood; traditional beliefs; Christian faith
3c. community	Cultural semiosis, human Umwelt (primarily core and mediated Umwelt)	Riverine community X	Family relations; community council; school; church; small-scale agriculture (e.g. manioc, corn, bean, onion, fruits); fishing
3d. landscape	Human Umwelt (primarily core and mediated Umwelt), cultural semiosis	Mamirauá	Trade among communities; trade with Alvarães, Tefé; social events (e.g. football matches); wildlife management; eco-tourism/work
3e. ecoregion	Human Umwelt (primarily mediated and conceptual Umwelt), cultural semiosis	The Amazon	Manaus (state capital) – been there once; contact with other communities upstream/downstream; outsiders; tourists; researchers
3 f. global eco-system	Human Umwelt (primarily mediated and conceptual Umwelt)	Earth	Brazil, other countries – impression from TV, school; visiting tourists, researchers

ecological perspective”, progresses from an individual human being via the local and regional ecosystem to the global ecosystem, resulting in a perspective that rests on the assumption that the mixture and interaction of human and non-human semiosis can meaningfully be studied at all finer scales. Scale 3, “Scale of global human ecology from personal point of view”, proceeds from a person (implicitly a *human* person) via a household, a community, a landscape and an eco-region it partakes in to the global ecosystem this person is part of. This scale, which is one of two scales that will be applied in analysis of the Mamirauá case study, situates the human subject as a subject endowed with an Umwelt that plays a role at all finer scales, and with cultural semiosis playing a role at most scales (household, community, landscape, ecoregion). Here, as well as in the case of the fourth scale, “Scale of personal-to-global human ecology from semiotic point of view”, the tripartite Umwelt model (Tønnessen 2011) is applied, distinguishing between the core Umwelt, the mediated Umwelt, and the conceptual Umwelt, referring to Umwelt objects as encountered, as anticipated, and as conceptualized respectively. For both these two scales, we observe that the movement *local* > *global* is paralleled by a change of focus in our study of the human Umwelt that goes from the actually experienced towards the merely imagined/envisioned or conceptualized.

Scale 4 is arguably the most comprehensive of these four scales in human ecology in terms of the variety of types of semiosis involved (though the third scale has an advantage for studies focused primarily on cultural semiosis and its implications for human ecology). Starting with the physiological (implicitly human) subject and proceeding with the experiential subject, it incorporates the *Innenwelt*-Umwelt dimension implied in the adjacent levels of study in ecosemiotics as presented in Table 1 and Table 2, as well as endosemiosis, i.e. foundational biosemiosis, and cultural semiosis, which is a significant factor when analyzing human impact on ecosystems. The next three finer scales are all of an ecological nature, emphasizing the way in which the human subject is embedded in nested ecologies ranging from local via regional to global ecology. Throughout these ecological scales, ecosemiosis and human-animal/plant/etc. sign exchange play a role, with the Umwelt of the human subject being involved related to the core, the mediated, and the conceptual Umwelt respectively. In this perspective, the human subject primarily engages in *actual* ecological encounters (as experienced first-hand) in local ecology, while regional ecology is primarily anticipated/mediated, and global ecology is primarily conceptualized. This rests on the assumption that there may be a disconnect between actual human-animal/plant/etc. sign exchange at different ecological scales, and the human subject’s experience and understanding of these ecologies.

The two administrative scales presented in Table 3 are often associated with economics, or as Hornborg (2001) would have it, economic sign systems. In the case of the Mamirauá Sustainable Development Reserve, “eco-semiotic flows [in the form of] movements of artefacts, people, resources, and exchange values” (2001: 138) evidently play a significant role. According to the researchers of Mamirauá Institute for Sustainable Development, there are concerns locally about resource extraction performed by outsiders, i.e. people that are not local to the area and therefore not legally allowed to e.g. fish or utilize timber resources, which is the privilege of the local, indigenous population. In this context, involving the indigenous population in wildlife management, and making sure that the law is abided to, has a twofold purpose: Empowering indigenous people, and effectuating the law and thereby safeguarding the law’s intention, namely

that illegal logging, fishing and other resource extraction should not compromise the integrity of the forest or of the forest people. In Brazil, lawlessness tends to benefit the powerful rather than disadvantaged groups. In the bigger picture, the incorporation of the Amazon into the global market has led global trade flows to the region, implying that global market conditions can now influence local ecosystems.

Analysis of the Mamirauá Case Study

In this penultimate section, I will apply two scales introduced in the previous section to the Mamirauá case study, namely the “Animal ecology scale” and “Scale of global human ecology from personal point of view” (cf. Table 3), adopting an animal and human point of view respectively. I further draw on theoretical perspectives introduced earlier in the article, starting with ecosemiotic readings of global environmental data, which is suitable for contextualizing the specific circumstances of the Amazon in general and the Mamirauá Sustainable Development Reserve in particular.

On a global scale, humans behave like an unsustainable super-predator (Darimont et al. 2015). In the communities of the Mamirauá Sustainable Development Reserve, many locals make a living as both fishers and hunters. In their contact with the communities, researchers at the Mamirauá Institute for Sustainable Development relate pragmatically to local subsistence hunting traditions, emphasizing sustainable populations of fish and animals and the avoidance of overexploitation. The increasing difference between indoor and outdoor environments for livestock globally is less of an issue in the Central Amazon, given the near absence of industrialized agriculture here, and in the reserve, practically all animal *Umwelten* are outdoor *Umwelten*. At the outskirts of the Amazon, however, industrialized agriculture is an important driver of deforestation, with much of the produce being exported and therefore also affecting living conditions for livestock and people alike in far-away countries (e.g. by enabling Norwegian farmers to feed pigs with feed made of soy beans and keep them in indoor environments all year). The Central Amazon remains one of the least urbanized regions of the world, with human settlements in the Mamirauá Sustainable Development Reserve being of modest sizes. The global proliferation of pets – animals kept primarily as social companions – has reached the Mamirauá Sustainable Development Reserve. However, whereas globally the aggregate human *Wirkwelt* is an ever more influential factor in the lives of animals, while humans and animals appear less and less frequently as *Umwelt* objects to each other, in the Central Amazon the latter does not appear to be the case. Humans in the area frequently encounter animals, and vice versa. As the best-preserved part of the Amazon, the Central Amazon remains a place for wildlife and traditional sustenance. Circumstances in Manaus, the capital city of Amazonas with more than two million inhabitants, are quite different, and the same goes for the more deforested outskirts of the rainforest. There is, however, a sense in which the aggregate human *Wirkwelt* globally is an ever more influential factor even for animals living in the Central Amazon – namely, in relation to climate change, a topic to which I shall soon return.

Table 5 shows the scale of global human ecology from a personal point of view (scale 8 in Table 3; scale 3 in Table 4) applied to the Mamirauá case study, focused on a young man who works part-time as a guide in eco-tourism in the Mamirauá Sustainable Development Reserve.¹² It portrays the circumstances of Guide X (person), who is the

¹² The information is drawn from field work notes.

father in a family with two small children (household),¹³ residing in a riverine community (community) in Mamirauá (landscape) in the Amazon (ecoregion) on planet Earth (global eco-system). Through his work as an ecotourism guide, Guide X has contact points with the world beyond the Amazon, the only ecoregion he has ever been to in person (this includes a visit to Manaus). While his core Umwelt experience is geographically limited to parts of the Amazon, this, along with exposure to school and TV,¹⁴ makes his outlook influenced by several national and international sources of information and ideas. Maintaining traditional indigenous beliefs and practices in some contexts, in yet other contexts he is first and foremost a Portuguese-speaking Christian,¹⁵ as most Brazilians. His life, in this sense, defies strict categorization.

As I observed myself during my visit to the reserve, in some communities, cats and dogs are kept as pets.¹⁶ Along with the occurrence of TVs and health assistants in some communities, and of motor boats, schools, textbooks and teachers (as well as Christian churches) in practically all communities, these are examples of modern traits in the current lifestyles of indigenous communities in the area. Such modern traits may be taken as symptomatic of the “unification of cultural contexts” that Maran (2014: 87) identifies as characteristic for globalization. From the perspective of cultural preservation, a crucial question is whether the modernizing forces of globalization promotes or endangers preservation of cultural heritage. As the ritual use of the red howler monkey’s hyoid bone illustrates, cultural change may in some cases be regarded as desirable – an assertion that is partially supported by Guide X’s ambivalence with regard to the ritual use of the hyoid bone in traditional brews. Moreover, the introduction of health and educational services in indigenous communities is generally interpreted as indications of progress in human development (UNDP 2015), regardless of whether or not it endangers cultural heritage. In short, maximal cultural preservation may not be compatible with optimal living conditions.

Returning once again to Maran’s notion of ‘semiotic fitness’ as developed by Hoffmeyer, a key question from a normative point of view is whether or not a community with certain cultural characteristics is semiotically fit. Evidently, semiotic fitness is a dynamic rather than static phenomenon, and ‘the context’ a community continually adapts to must be understood as multi-scalar in range – which in the cultural context implies that in times of globalization, communities must in some cases adapt to global cultural features. In the age of globalization, semiotic fitness therefore requires adaptation to certain unified cultural contexts. However, ‘semiotic fitness’ in this

¹³ He is 21 years old, with a wife that is 17 years old. The couple became parents when he was 18 years old and she was 14. This is not uncommon in the area (though several fathers abandon their partners, leaving the girl’s parents to care for them).

¹⁴ Use of TVs is usually limited to selected evenings, as they depend on the use of a costly community diesel-generator which produces electricity on-site, something that is only prioritized during important events (such as football matches).

¹⁵ A few generations back, church missions encouraged indigenous people in the region to settle closer to each other and form more collaborative communities. To legally form a community, at least five households must be involved. The establishment of schools, once pioneered by church missions, is in contemporary times supported by federal policies which give the *Bolsa Família* (family grant) to families that send their children to school.

¹⁶ This sheds new light on ‘global species’, which I have previously defined solely in terms of the *geographical* range of species (Tønnessen 2010). A supplementary definition could involve the *cultural* range, as it were, of species (i.e. the extent to which a species occurs in different cultures, including those of indigenous peoples).

pragmatic cultural sense should not be confused with long-term environmental sustainability, which may, as Maran indicates, require adaptation to local environments.

In the reserve, due to the ever-changing water levels, staying semiotically fit requires routinely adapting to seasonal changes. Routine adaptation includes readiness for improvisation e.g. when rivers change paths in unpredictable ways. The rising vs. residing water level determines the scope of possibilities for fishing, hunting and horticulture, as well as for mobility. In such an environment, the use of a canoe on the rivers is the most reliable and affordable means of transportation. For animals of the reserve, too, the changing water levels determine the scope of possibilities for foraging and for mobility. Several primate species, and also other arboreal mammals, such as sloths, have adapted to seasonal floodplain forests by dwelling and navigating in the trees. While the low-water season allows for more mobility, tree tops, with the fruits some of them can offer, remain these animals' preferred medium throughout the seasons. This includes both the black-headed squirrel monkey and the red howler monkey.

These two monkey species exemplify ongoing processes of environmental change in two distinct ways, both involving human agency and thus representing human ecology. The black-headed squirrel monkey is, with its unusually small range, particularly vulnerable to climate change, which could affect it in at least one of two ways in the short term: Either by forcing it to migrate to an unknown territory, or by changing the species composition within its current range so drastically (due to the migration of other species) that its living conditions changes considerably no matter what. The problematic human agency involved is in this case of a global nature, since aggregate human climate gas emissions have global repercussions; but local conservation efforts can potentially be decisive as a counterweight. The red howler monkey's circumstances are more closely related to ongoing cultural developments in the communities of the reserve. Treasured by locals for its meat value and the traditional belief in the curative effects of drinking a brew made from its enlarged hyoid bone, it is more vulnerable than the black-headed squirrel monkey during encounters with humans. From an Umwelt perspective, the red howler monkey plays a more significant role for the locals, and the locals in turn pose more of a direct threat to the red howler monkey (as reflected in the core Umwelt experience of both locals and the monkey, and in the cultural semiosis of the locals).

From the *individual animal's* point of view, as framed by the Animal ecology scale, the environment may be experienced as meaningful (i.e. functional) for as long as it remains fundamentally the same environment as the animal is adapted to live in. Given the natural borders of the reserve, and the more limited range of the black-headed squirrel monkey within the reserve, it makes sense to refer to the *population* of black-headed squirrel monkeys and red howler monkeys respectively as a sort of natural units. In the black-headed squirrel monkey's case, the population in the reserve makes up the entire *species*; implying that if these monkeys were to migrate to another territory, unlike the red howler monkey, the black-headed squirrel monkey would not have any chance of encountering established conspecifics. Both these monkeys are adapted to live in a particular *ecosystem*, namely a floodplain forest surrounded by and occasionally flooded by rivers. If the entire *ecoregion* of the Amazon were to reach a tipping point due to massive deforestation in combination with accelerating climate change in the *global ecosystem*, the predominant ecosystem of the region might change from rainforest to savannah. That would likely be the end of both of these two

monkeys, along with all the communities of the Mamirauá Sustainable Development Reserve and most of those of the Central Amazon.

Summary and Conclusion

I started out by pinpointing the tension between von Uexküll's "subjective biology" and global human ecology, with its global perspective increasingly dominating the environmental issues discourse. Key frameworks for global human ecology all build on a physiochemical rather than an organismic or ecological view, and their compatibility with ecosemiotic thinking is therefore limited. However, an ecosemiotic approach to global human ecology can be built bottom-up, with Umwelt theory at its foundation and applicability at various levels and scales ranging from the local to the global. Drawing on a discussion of globality and locality, I introduced matrixes for different levels of study in ecosemiotics, and different scales in human ecology, demonstrating that the latter are all approachable by way of ecosemiotic study. The aspects under scrutiny, however, will vary by the scale chosen. For some scales, I observed a tendency to the effect that a change of perspective *local* > *global* is paralleled by a change of focus in our study of the human Umwelt that goes from the actually experienced towards the merely envisioned or conceptualized. An exaggerated focus on the global level can result in an overly abstracted perspective, and an impoverished understanding of experience-based aspects of the ecological crisis. Being applicable to all scales in human ecology from the personal to the planetary, the main advantage with ecosemiotic analysis drawing on Umwelt theory's consistently subjective point of view is its adjustability to different levels of study and scales of ecological reality. This is exemplified by the Mamirauá Sustainable Development Reserve case study, which entails elements of local, regional, national and global influence factors that shape and determine local ecology. Only a multiscalar approach to human ecology can result in a comprehensive understanding of the global environmental crisis with all its local repercussions.

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