

Introduction

What have environmental humanities and global ecological crises to do with semiotics? For most readers with a background in the humanities, the word “semiotics” probably brings to mind Roland Barthes, Michael Foucault, Umberto Eco, Jacques Derrida, and other authors of European semiology and post-structuralism. This tradition, which peaked in the 1970s, treated signs as building blocks of human culture. By highlighting the conventionality of meaning, it provided tools for critical analysis of culture, society, and their power dynamics. This Element, however, will take a different route. Semiotics has much to offer to environmental humanities, but for this some of its philosophical and conceptual underpinnings need to be revised. Most importantly, in this Element signs are treated not as fully conventional and arbitrary means of human culture, but as partly rooted in the natural world and in our corporality. In thinking about nonhuman nature, I rely on the biosemiotic tradition that has been arguing for the existence of semiotic processes on different levels of the biological world ranging from cells to ecosystems, and both inside and between organisms. In particular, I make use of the writings by Jakob von Uexküll, Jesper Hoffmeyer, Almo Farina, and Kalevi Kull. In the ecosemiotic view, semiotic processes are seen as shaped by available conditions, encumbered by their history, yet at the same time as partly autonomous and independent. This allows connecting semiotics with approaches that acknowledge the role of agency, communication, and information in animals and ecosystems.

Ecosemiotics as a branch of semiotics emerged in the mid 1990s to scrutinize semiotic or sign-mediated aspects of ecology (including relations between human culture and ecosystems). It has been defined as “the study of sign processes which relate organisms to their natural environment” (Nöth 2001: 71) or as the semiotic discipline investigating “human relationships to nature which have a semiotic (sign-mediated) basis” (Kull 1998: 351). This means that ecosemiotics is one of the semiotic theories that extends the scope of a central concept of semiotics – the sign (understood as a mediated relation) – from human culture to other species and, particularly, to ecological systems. More recently, ecosemiotics has been specified as “a branch of semiotics that studies sign processes as responsible for ecological phenomena.” (Maran and Kull 2014: 41) The concern of ecosemiotics may be considered to lie with the semiotic processes that relate to or address the broader context of living biological processes (Maran 2017a: 5).

The first section of this Element highlights the semiotic nature of ecosystems by scrutinizing semiotic relations between organisms (mostly focusing on animals) and the environment, intra- and interspecies communicative relations,

and the role of semiosis in ecosystems. Although such a semiotic take on ecology may remain somewhat technical, it serves as an important foundation for ecosemiotic argumentation. Demonstrating the semiotic nature of ecosystems allows us first to show that there is a vast semiotic realm that surrounds human culture and that we can relate to it through our everyday activities and cultural processes. Secondly, the semiotic approach to ecology allows us to comprehend that what are commonly described as ecological problems often have semiotic causes. They may be, in fact, semiotic problems – as in semiotic pollution (Posner 2000), in which human usage of sound and light interferes with the perception and communication of other species. And thirdly, connecting semiotics and ecology is a way of bringing issues of materiality, resources, and biological corporality into the humanities, which, in my understanding, is a prerequisite for working on solutions to the current ecological crises. That is, the healing and integrating of our episteme can only occur in two simultaneous ways: by arguing for the semiotic character and significance of the environment; and by showing the materiality, liveliness, and resource dependence of human culture.

The second section focuses on the criticism of the striving toward a fully conventional and symbolic human culture that has been a characteristic feature of modernity. Here, I treat culture as a sum of human creative, modeling, and transforming activities and leave the important topic of animal cultures aside. In ecosemiotics, Kalevi Kull (1998) has shown that human culture inevitably changes nature as our actions toward nature are motivated by our sign-based distinctions. A more abstract and self-contained culture results in more contrived actions, which lead to the impoverishment of ecosystems. At the same time, semiotic analysis allows us to demonstrate that the ideal of a self-contained and autonomous culture has never succeeded, and that different levels of cultural systems include presymbolic semiotic entities. In this argumentation I find partners in dialogue among such authors as Alf Hornborg, Kalevi Kull, Michel Serres, Ronald Posner, and Michael Polanyi. The presence of presymbolic icons and indexes, tacit signs, onomatopoeia, and environmental-cultural hybrid signs is not just the reality of culture, but most necessary for retaining sustainable relations between human culture and ecosystems, as well as for the dynamics and rejuvenation of the culture itself. Both Juri Lotman's understanding of communication as cultural creativity and Gregory Bateson's epistemology of the sacred have indicated that normal functioning of culture depends on the dialogue with what lies outside of cultural codes and hierarchies. Therefore, it is indeed necessary to support the practices and processes that foster culture's interaction with sign activities going on in the rest of the ecosystem.

Semiotics also provides us with the means to understand and analyze the capacities of cultural artefacts – literary works, fine art, media texts – to relate with sign processes in the ecosystem. Here, the cultural semiotics of Juri Lotman offers a way to proceed. Lotman’s cultural semiotics includes several concepts with ecological potential, e.g. semiosphere, cultural boundary, and semiotics of space, but what is most relevant among these is probably the idea of semiotic modeling. The third section discusses the possibilities of using semiotic modeling as a tool to reconfigure culture–nature relations. The model is understood here as a cultural artefact that, on the one hand, has its own autonomy by having been compiled on the basis of cultural codes and languages. On the other hand, the model has an analogy-based relationship with the object to which it relates – be it the natural environment, human life history, or social groups. The analogy of the model is, however, always construed on a certain ground that is often the basic cultural image or mode of thinking. Now, analyzing the grounds for cultural models provides us with an effective tool for understanding from where the models come, how they work, and what their effects on culture–nature relations are. In this discussion, I use examples from literary works while acknowledging that a similar approach is applicable in film, art, and other cultural domains. Modeling theory also has a prescriptive potential as it enables us to create new bases of comparison that can be used to build new types of models to make sense of the ecosystem. Here, modeling theory can be seen as a playful approach that uses artistic means for reconnecting culture with ecologies. Using artistic and creative modes of modeling, one can shift focus, participate in, and become a source of meanings for the rest of the ecosystem. The final subsection provides an example of such a creative approach in which the image of the forest has been adopted as the ground for semiotic modeling.

Semiotics, especially as it is developed in the ecosemiotic paradigm, appears to offer new and unused capacities for environmental humanities. This potential springs from basic semiotic concepts and tools that allow connecting, relating, and integrating phenomena that are usually treated as belonging to different ontological domains or to subjects of different disciplines. For instance, the sign concept itself is well suited to a semiotic interpretation of ecological issues. Sign as developed in the semiotics of Charles S. Peirce (CP 1931–56) can be understood as a mediator, a connector between the various aspects of the world. The Peircean sign is tripartite: a connecting sign in a narrow sense (representamen); the object of the sign; and its interpretation (interpretant), while these parts can belong to different mental, textual, and physical realms. The sign – or, more precisely semiosis, that is the sign’s processual manifestation – allows some sort of connection to emerge that otherwise would be nonexistent. As

such, signs can glue together various entities and beings of the world into meaningful relations, thus embodying a huge ecological potential to reconnect, to heal.

Ecosemiotics is not a modernist or structuralist approach; nor does it belong to the postmodern schools of cultural studies and literary criticism (as it has developed from the 1960s onward). In line with the thought of British semioticians Paul Cobley (2016) and Wendy Wheeler (2016) on biosemiotics, ecosemiotics can be described as belonging to a third way of thinking that seeks to contextualize semiotic processes and creative freedom within the constraints and hard realities of the earth. Cultural creativity and material realities are not seen here as excluding or conflicting with one another, but rather their encounters are the very condition for the meanings and significance to unfold. This idea was entitled *Expecting the Earth* by Wendy Wheeler (2016) as an observation that we as well as all other biological organisms have innate cognitive and semiotic readiness to meet the earthly patterns and processes. We anticipate encountering the earth in its various forms but do so inventively and playfully. The focus of ecosemiotics is thus on the interactions between environmental conditions and semiotic processes and the diversity of life stories, meaning-making strategies, and narratives that spring from these intertwinings. Such an approach can perhaps be labeled the “ecological postmodern” as was proposed by Charlene Spretnak (1997) who characterized it as aiming at a plurality in contexts. Ecosemiotics builds its argumentation on the excluded middle and interplays between culture and the ecosystem, humans and other animals, signs and matter, freedom and causality.

1 Signs In Ecology

1.1 Organisms’ Relations with the Environment are Based on Signs

A few years ago, I witnessed a European robin *Erithacus rubecula* wintering in a large shopping mall near my home town. In Estonia, winters are normally too harsh for insectivorous birds; so robins stay and nest there just during summers. One bird, however, had discovered a warm refuge in a commercial center that kept her from leaving in the autumn. She wintered, and I believe successfully, in a novel environment with which she previously had no evolutionary or individual experience. During that winter, she, no doubt, needed to solve a number of practical issues, such as navigating in the artificial habitat, finding the right type of food and drinking water, finding shelter from curious people and cleaning machines, and so forth. She needed to use all her wit to combine her bodily and cognitive capacities with this new environment and find workable solutions.

Now, the impact of human action on natural environments has turned the latter increasingly more unpredictable and unstable for other species. Metaphorically speaking, we are turning the entire world into a large shopping mall. What helps us understand the survival of other species in these shifting and changing environments is not fixed behavioral patterns and the struggle for survival, but approaches that connect animals and the environment by dynamical processes such as recognition, affordances, semiosis, and abduction. In most of twentieth-century biology, relations between animals and their environment have been seen in terms of rigid oppositions, while the role of animal subjects themselves has been considered quite minimal. Comparative psychology and classic ethology comprehended animals as sets of predispositions to react to the environment's stimuli in fixed ways. This understanding finds clear expression in the vocabulary of mid-twentieth-century animal biology: stimulus; releaser; instinct; fixed action pattern; and imprinting. The later evolutionist schools of animal behavior (sociobiology, behavioral ecology) understood animals mainly as executors of their genetic programs, competing against one another for environmental resources. From an ecosemiotic view, the main problem with these twentieth-century paradigms is their underlying presumption that the animal and the environment are two distinct and fixed entities. Mostly, this is not the case.

Animals using semiosis or mediated relations to make sense of the environment is a phenomenon so widely present that it is very easily overlooked. Let us recall that, for an animal, a sign is anything that indicates, shows the way, or makes evident something that would otherwise remain concealed or inaccessible. Even if we skip the philosophical question whether all perceptions of environmental objects are mediated by our senses and thus semiotic, we will find animals relying on mediated relations everywhere. A huge number of predatory species from snakes and sharks to big cats use smell or tracks to trace down the location of their prey. Many animals – fish, insects, birds, and mammals – rely in their movement and migration on various types of environmental signs: memorized landmarks; stellar constellations; chemical traces in air and water; and so on. Many birds gather and synthesize different qualities of the environment to decide on where to build their nest. Habitat preference is semiotic as it includes generalization, and generalizations cannot be made on the level of particulars but need semiotic mediation.

In semiotic terminology, sign relations between animals and their environmental entities are often *indexes* where the connection between the sign and the object the sign refers to is based on some form of causal effect, correlation, or spatial relation between the two. This is the case in many natural signs (e.g. smoke signifying fire) as opposed to conventional signs that are intentionally

conveyed in human language (Nöth 2001). Often such signs also have metric or metered qualities, that is, the scope or reach of the sign can be used as a measure to determine the quality or quantity of the related object (Farina 2008). We can think here about the size or brightness of flower blossoms signaling the quantity or sugar content of the nectar to bees and other pollinators. The sign relations between the animal and the environment can be further described and classified based on various criteria: the type of relationship between the sign and the object; the accessibility of the sign relations to the animal; the abstractness of the sign (see further, Maran 2017b). The astounding number and diversity of environmental signs defies reduction; that is, environmental signs cannot be viewed solely as projections of an organism's cognition to the environment nor can they be approached as objective properties of the environment. Rather, environmental signs appear where the qualities of the environment and the animal's meaning-making activities meet.

Broader foundations for the ecosemiotic model of approaching these subtle relations can be found in the works of German-Baltic (Estonian) biologist Jakob von Uexküll, who, in the early twentieth century, developed a view in theoretical biology that was based on relations and meanings (Uexküll 1982). One of his central concepts was *Umwelt*, understood as a subjective perception of the world where animal interacted with the surrounding environment through species-specific senses and activities. In Uexküll's view, each *Umwelt* is organized by central meanings and through the *Umwelt* each species perceives the world in a distinctive way, even if the species inhabited the very same physical environment. More specifically, the relationship between the animal and the environmental object could be broken down to an array of intermediate stages: sense organs, cues and cue carriers that together with the animal's activity toward the same environmental object, formed a cycle of interaction (the functional cycle or *Funktionskreis* in Uexküll's terminology). The *Umwelt* concept is also applicable to the human species. Differently from other animals, human perception of the world is largely organized by categories and distinctions taking place in the internal world (*Innenwelt*).

As described earlier, for ecosemiotics an important part of this relationship consists in the properties and patterns of the environment – what resources and perceptually accessible qualities the given environment provides to which the animal can relate. This potential of the environment is sometimes called *perceptual affordance* following the works of psychologist James J. Gibson (1979: 127ff). An environment can afford support, shelter, food, nesting place, and so on to an animal, and as animal *Umwelten* differ, the same environment can afford different things to different species. Including affordances and resources in the research model allows us to describe and compare semiotic potentials and

qualities of the environments by relying on the perspectives and judgments of the inhabitants of these environments. This in its turn gives a solid ground for arguing about the quality and intrinsic value of the environment – an issue that appears to be problematic for many postmodern paradigms.¹ There is also the practical method of *Ecological Repertoire Analysis* that focuses on local heterogeneity and semiotic relations that nonhuman species have with the environment (Maran 2020b). For instance, we can analyze how the meanings and affordances of the environment have impoverished for other species when comparing the situations before and after human intervention.

We could also adopt a broader and more structured approach and describe, in the common framework, patterns of animal *Umwelten* and environmental properties. A possibility for articulating the animal–environment relationship spatially was proposed by Italian landscape ecologist Almo Farina (2006; Farina and Belgrano 2004, 2006) in his original research framework of *eco-fields*. Farina talks about the need–function–ecofield (or interface)–resource sequence (Farina 2012: 23), where needs are basic biological necessities that an organism has, functions are behavioral motivations that make it possible for an animal to relate with an environment in certain ways, whereas resources allow animals to fulfill their biological needs. The ecofield in Farina’s vocabulary is a meeting point of an animal’s biological requirements on the one hand, and the properties and resources of the landscape on the other. “The term ecofield is the contraction of the words ‘ecological field’, and means the physical (ecological) space and the associated abiotic and biotic characters that are perceived by a species when a functional trait is active” (Farina and Belgrano 2004: 108). If a behavioral function of the animal meets a suitable location in the environment, this location or patch becomes actualized as an ecofield. Functions and resources are therefore necessarily mediated by a semiotic component – the ecofield (interface) – that an animal needs to perceive and interpret correctly to make use of a resource.

For instance, an interface standing for drinking water may be the perception of a reflecting surface. Animals interpret the interface in order to gain access to related resources, but as a semiotic process this relationship is probable – an animal may also have inadequate competence to reach the interpretation or the interface may give a false premise about the resource. At this point we may

¹ A view that integrates life and matter, human and animals, the subjective and the objective, can also serve as a basis for an ecosemiotic definition of the environment. In this text, environment is understood as a complex phenomenon that has three characteristics: “environment: (1) includes multitudes of *Umwelten* of organisms of different species and interactions between them; (2) contains physical forces, structures, and resources that can be objects of interpretation, that can constrain interpretation or be a context for interpretation; (3) provides conditions for the multi-sensory and multilayered semiosis from tactile to symbol-based semiosis” (Maran 2017b: 356).

think about human-made surfaces such as asphalt or sheet metal that lure diving beetles *Dytiscus* with their reflection, yet do not offer the pond or creek habitat that the insect is looking for. A possibility for misinterpretation proves that we are dealing with semiotic phenomena, as, according to Umberto Eco, “semiotics is in principle the discipline studying everything which can be used in order to lie” (Eco 1976: 7). Farina’s ecosemiotic approach is also very suitable for analyzing cases in which normal sequences of need–function–ecofield–resource do not work and animals are not able to use signs accessible to them to find resources that they need. This may often be the case in semi-natural, urban, and technical environments, where the human impact is large.

Focusing on the animal–environment relationship will change the way eco-semiotics sees specific places or landscapes. Instead of approaching these objectively through measurements and geographies or, alternatively, taking these as human cultural constructions, ecosemiotics offers a third way of understanding landscapes. In an ecosemiotic view, the land area becomes a composition of various environmental resources and affordances with a number of perceivable interfaces and a variety of species that relate with the habitat based on their biological organization and needs. As Almo Farina and Nadia Pieretti have put it, “a landscape is not only a geographical entity but also a cognitive medium. The landscape may be considered a semiotic context used by the organisms to locate resources heterogeneously distributed in space and time” (Farina and Pieretti 2013: 1). A similar approach is adopted by Hans Van Dyck (2012) in his “functional landscape” with applications to species protection and landscape restoration. Through an ecosemiotic lens the environment in its spatial constitution becomes a matrix of qualitative meaning connections between animals and the land.

In past decades biology has developed in a direction more favorable to eco- and biosemiotic views. What has changed in particular, is the understanding of the role that the environment has in organisms’ development, while the two are increasingly less considered as radically distinct categories (West-Eberhard 2003). This has largely to do with better knowledge of epigenetic factors as individual or environmental properties that influence the manifestation of genes and related phenomena of polyphenism, reaction norms, etc. Evolutionary developmental biology, and especially ecological developmental biology as developed by Scott Gilbert (Gilbert and Epel 2008), has demonstrated the role of environmental factors in early individual development of animal species. Temperature influencing the sex determination in reptiles, the presence of natural predators in water causing crustaceans *Daphnia* to select different developmental tracks and develop a large protective crest, the presence of gut microbiota as linked to the development of the endocrine system in humans, are

some examples of these complex relationships. A more semiotic interpretation of such interrelations is provided by Morten Tønnessen (2014) as a concept of *Umwelt trajectories* to indicate that animals in their relations with the environment are dynamically shifting from one stage to another, forming a trajectory of changing world-schemas. Danish biosemiotician Jesper Hoffmeyer (2008) has further described the active role that an animal with its various semiotic competences has in creating a correspondence between its own genetic and bodily information and environmental information. In Hoffmeyer's view, matching an animal's genetic heritage with the conditions of the surrounding environment is an active and dynamic semiotic process similar to the human process of translating between different languages.

The ever-changing relations between an animal and the environment are not relations between distinct entities, but what is changing is rather the semiotically active and intertwined complex of organism plus the environment. The diversity of environmental conditions and micro-environments challenge animals for cognitive plasticity, as they have to learn and adapt to the changing local conditions. Even such a simple task as a bird looking for an insect in the foliage is actually a complex puzzle because of the changing light conditions, the variety of shapes of leaves and branches, the movement of wind, and so on. Behavioral ecologists Lyndon A. Jordan and Michael J. Ryan (2015) have argued that in complex environments, behavioral plasticity depends on the animal's ability to integrate numerous sensory stimuli and, to understand this process, the animal's own perceptual space or *Umwelt* needs to be brought into a central focus. Under such conditions, the animal *Umwelt* can be seen as a focal point, where different sources of information are put together, where interpretation and choices are made.

When looking for such correspondence between itself and the environment, the animal has different possibilities: its own biological structure can change (as demonstrated by developmental biology); it can change its location and involvement in the environment by interpretation and active behaviors (such as migration or habitat selection); or it can actively change the environment for the environment to become more suitable for itself. The latter option is known under the label of *niche construction* (Odling-Smee et al. 2003; Peterson et al. 2018): animals' changing of their ecological niches to make these more suitable for themselves: "Niche construction involves reciprocal responses between organisms and the biota (and abiota) comprising their surrounding environment. When organisms respond to environmental pressures the environment itself can be modified and a feedback mechanism may be created and later canalized" (Peterson et al. 2018: 183). Niche construction may be passive as just a by-product of living processes or actions, e.g. animals making paths in landscapes

simply by moving across them, or it can be the result of more intentional activities such as nest building of collective Hymenopteras (wasps, bees, bumblebees). By constructing their niches, various species create conditions in which they benefit more from the flows of matter and energy (e.g. creating a more stable microclimate, storing food), etc.

From an ecosemiotic perspective, the result of niche construction is that animals and the environment become even more intertwined and the boundaries between them blurred. Through intentional alteration of the environment, an animal becomes *rooted* in the environment both energetically and semiotically. Orb-weaving spiders serve as a vivid and often-used example. Uexküll (1982) gave the spider as an example of the plan-based structure of nature, but from an ecosemiotic perspective we may also ask if there is any reasonable way to determine the borders that separate the spider from its environment. The silk that the spider produces is its bodily secretion, thus, by its chemical constitution very much what the spider is. Without the silk, orb-weaving spiders would not be able to feed. Still, the spider's web becomes functional only if carefully positioned between straws, branches, or other environmental objects and taking into account open flyways and the movement of insects. The combination of glued and glueless silk needs to suit the local micro-topology, as well as the spider's own needs and movement possibilities. In this sense, the surrounding straws and branches also become a part of what the spider is. In weaving the web the spider takes into account and combines all these different sources of information. We can thus describe different connection zones and thresholds, but, from a semiotic perspective, it becomes extremely difficult to draw any fixed border between the animal and the environment. What glues an animal and the environment together is the meaning relations, semiosis.

Animals' ability to cope with the changing ecologies of the contemporary times (spread of urban environments, anthropogenic changes in interspecies relations, shifting boundaries of seasons, extreme weather events, etc.) largely depends on the plasticity or rigidity of the semiotic relations that they have with the environment. For instance, if the abundance of prey species diminishes quickly, will a predator be capable of finding and developing a novel image of prey as has been noticed in black-footed ferrets in regard to the declining prey populations of prairie dogs (Candland 2005)? In other cases, animals' semiotic relations with the environment can be intentionally used by humans to create new habits in animals as reported by Van Dyck (2012) on the experiments made with orange-tip butterflies *Anthocharis cardamines*. In this study, regular host plants of the butterfly were planted outside the limits of their regular habitats to invite the butterfly to new locations. From an ecosemiotic perspective the important question is what the possibilities are for adjusting semiotic relations