Proceedings of the Conference of the World Forum for Acoustic Ecology, Atlantic Center for the Arts, FL, March 23-26, 2023

Thinking Like a Giraffe: Biosemiotics, Ethics, and Soundscape Ecology

Jonathan Beever
University of Central Florida
jonathan.beever@ucf.edu

ABSTRACT

Building on the unique intersection of biosemiotics ethical theory and a philosophical exploration of soundscape ecology, this project examines the ethical implications of considering soundscape analysis from a nonhuman perspective. I first outline the problem of the nonhuman listener for soundscape ecology before tracing the distinction between acoustic ecology and soundscape ecology. I then introduce biosemiotics as a theoretical model for understanding nonhuman experience, as a model to describe a soundscape study partnership with a local zoological park which examined the potential impact of anthrophonic noise events on a specific set of individuals: a trio of adult giraffes. Our study of this zoo's giraffes and their experiential interrelations with their soundscape proposes that if (soundscape) ecology is meant to help us in "thinking like a mountain," [1] we might then miss out on individual experience through, in this case, listening like a giraffe.[1]

1.SOUNDSCAPES AND THE PROBLEM OF THE NONHUMAN LISTENER

What is the nonhuman experience of soundscape like? At the heart of the experience of sound are deep philosophical questions about the nature of sound, the phenomenological experience of listening, and the ethics of listening and being heard. The history of acoustic ecology is, in large part, the history of the human experience of acoustic environments. Yet this anthropocentric bias is also read against the sense that soundscapes are, themselves, representative of or analogous to broader ecological relationships. The underlying philosophical and ethical questions, then, are often restricted by this same bias of the human listener. This presents, I think, a significant limitation to how acoustic ecologists have engaged sound, particularly relevant in given Anthropogenic impacts of human technologies on their sonic environments. The problem of the nonhuman listener is at once a problem of understanding others' experience of sound and noise, and also at the same time a problem of understanding ecological interrelations in a rapidly changing world. The intersections among the fields of acoustic ecology and soundscape ecology are intended to support this experience/ecology coupling. But neither resolves the problem of nonhuman experience of soundscapes.

2. FROM ACOUSTIC ECOLOGY TO SOUNDSCAPE ECOLOGY

One of the earliest uses of the term "soundscape" came from then MIT Master's student Michael Southworth, whose thesis project assessed Boston's urban environment through the distribution, typology, and links to specific settings of the sonic environment. Southworth hypothesized that the uniqueness and informativeness of a particular sound's identity would couple to a listener's level of delight in hearing it. Experimentally, Southworth assisted blind-folded research participants in a soundwalk of Boston's urban environment, and then asked them to map the sequence afterwards, trying to better understand the link between sonic environments and urban environments [2]. A decade later, R. Murray Schafer's foundational work on soundscapes set the stage for the field of acoustic ecology [3]. In that work, Schafer differentiates between keynote sounds, signals, and soundmarks [3, p. 9-10] as a means of further typologizing and standardizing analysis of soundscapes. This early framing of acoustic ecology was done with the explicit goal of understanding human listener's experience of sound, with Schafer's work on soundscapes focused on "the people hearing them," to what extent they "specifically regarded or noticed by the people in that community" [3, p. 9-10], and what they "may tell us about the trending and evolution of that society…" [3, p.7]. This anthropocentric focus, while centrally important to the developing study of sound as a phenomenon to be studied and better understood, also denied engagement with the experience of nonhuman listeners, treating them, if at all, as objects rather than subjects.

The more recent shift from acoustic ecology to soundscape ecology, led by musician and ecologist Bernie Krause, has pushed to understand sonic environments in ecological rather than experiential terms. Krause's study of the orchestration of sound by species [4] across a biodiverse ecosystem led him the "acoustic niche hypothesis," which posits that acoustic communities organize or orchestrate their performances such that they reduce the frequency overlap between species and reduce the temporal overlap between species within similar frequency

[1] I am grateful to the WFAE 2023 conference community for welcome feedback and excellent conversation between presentation and writing up of this work.

ranges, "the premise being that the voice of each organism in a given habitat strives for its own bandwidth – a clear channel of transmission and reception – to avoid masking, much like instruments in an orchestra are organized" [5]. Soundscape ecology's normative focus on conservation [6] pushes analysis of soundscapes from the urban to the wild, but at the same time pushes away from individual experience to ecosystemic. Through understanding soundscapes as composed on biophonic (as sound produced by organisms), anthrophonic (as sound produced by human-made objects), and geophonic sound (as sound originating from the geophysical environment), soundscape ecology pushes us to think ecosystemically – or, as America ecologist Aldo Leopold articulated in the 1940's, "think like a mountain" [1].

Leopold's compelling idea developed out of his experiences at a pivotal time in the U.S. where agricultural use in the western part of the country was yielding negative environmental impacts for arable land and wildlife alike. Leopold was among the first to articulate a fundamentally ecological position. In 1949 he wrote, "The cowman who cleans his range of wolves does not realize that he is taking over the wolf's job of trimming the herd to fit the range. He has not learned to think like a mountain. Hence, we have dustbowls, and rivers washing the future into the sea" [1, p. 129]. Thinking like a mountain demands a longitudinal, systemic perspective – a sense beyond the immediate and local human concern of the broad ecological implications of any particular action or event. This same idea forms the foundation of soundscape ecology, with its longitudinal big-data driven field recording to better understand ecological change over time.

While this shift from the human experience of particular soundscapes to the ecosystemic data analysis of soundscapes over time adds an essential level of complexity to soundscape study, neither acoustic ecology nor soundscape ecology address the problem of nonhuman experience of soundscapes. However, developing contemporary work in and around soundscapes applies novel theories and concepts to push soundscape researchers toward the nonhuman.

3.BIOSEMIOTICS, ETHICS, AND THE ZOO: AN EXPERIMENTAL DESIGN

Over a five-month period in 2017-2018, I partnered with an Association of Zoos and Aquariums (AZA) accredited local zoological park for a soundscape analysis focused on their giraffe habitat. We collected a total of nine-hundred and forty-five (945) hours of audio data and used the software package *Mangrove* [7] for preliminary analysis of that data. Our primary goal was traditional for soundscape ecology; that is, to better understand changes in the soundscape over time. In this case, zoo staff was particularly interested the extent to which either periodic high-density social events or regular freight and passenger rail traffic in close proximity to the habitat might be better understood and possibly mitigated. At stake here was not the general soundscape but, in much finer granularity: the experience of the soundscape by these particular giraffes. Methodologically, we developed intentional strategies to listen like giraffes. Our field recorders were installed eight feet off the ground to approximate the height of giraffe listeners, we captured hour-long recordings at regular intervals across full twenty-four-hour periods rather than only during hours the zoo was open to the public, and we analyzed that sound with the sounding and listening range of giraffe physiology in mind [8]. Our model here was a 2016 study by Wiseman and Wilson of white rhinos in a zoo enclosure. These soundscape researchers used a robust methodology including recording and analysis from the infrasonic to the ultrasonic, weather metering, and periodic photographic capture to assess chronic noise, high amplitude events, vibration, noise fluctuations, and sounds likely to cause fear [9]. These researchers have led the call for robustness and standardization of analysis of captive animal soundscapes [10].

Understanding an organism's experience of its soundscape requires conceptualizing the soundscape not as a series of physical signals and physiological responses, but instead as *ecologies of meaning* [11] valuable to the individual. To this end, the biological theory of *biosemiotics*, "concerned with the study of signs and meaning in living organisms and systems" [12], proposes to see ecological relationships through representation and interpretation novel to each organism as an individual. Biosemiotics relies on Baltic German biologist Jacob von Uexkull's concept of the *umwelt*, the unique lifeworld of each and every organism, through which it makes meaning of its experiences and relations. This biological semiotic approach to understanding individual experience requires a deep and richly local understanding of the individual subject, not only its species-specific physiological and psychological capacities but also its unique individual attributes to experience and share sound meaningfully. This focus on individual experience recenters our own moral evaluation of soundscapes from the big picture systemic to the local and individual in important ways [13]. Our research partnership further develops methods and analytic approaches with this individual emphasis in mind.

Thinking of the experience of these specific three giraffes, we take for granted (as we do for human interpersonal interpretation) that giraffes have meaningful semiotic perspectives on the world. We use the same interpretive phenomenological techniques as we do with human animals: analogical, behavioral, and physiological. We start from the perspective that giraffe hearing is analogous to human hearing, so soundscapes matter to them in analogous ways to which they matter to us [14]. Then we turn to not just species-specific physiology, but individual specific when available. Giraffes, while often considered mute, vocalize (and therefore normally hear also) at a lower frequency range – at as low as 11 Hz and as high as 11,000 Hz – than human listeners [15]. Further, we assume

that older giraffes (including one of our individual research subjects), like older humans, lose the capacity to hear that full range. Our assumption results from a lack of species-specific data on this question, but correlation with other mammals including humans, ocean mammals [16] and bats [17]. We then couple those data to behavioral cues from these giraffes' care-takers. For instance, we learned from Zoo staff that the giraffe residents show no noticeable behavioral cues to the noise of passing or waiting freight trains, despite these being significant noise events in terms of their amplitude and frequency range [18]. Interpretation of signs by multiple interesting modes helping shape what soundscapes mean to or how soundscapes are experienced by individuals within them – and therefore the nature of biosemiotic analysis of meaning-making by nonhuman animals. Soundscape data collected for this project was merely piece of that network of signs.

At the giraffe site, the soundscape was recorded using a Wildlife Acoustics SM4 unit at a standard periodicity daily across a nearly five-month window. Figure 1 represent a subset of those data, analyzed using the Normal Difference Soundscape Index (NDSI) algorithm [19] as part of the R package *soundecology* [20]. Figure includes six sequential data collection periods. These data include some inconsistencies due to equipment failure (batteries dying sooner than anticipated, faults with SD memory card capture, et cetera) but all are included here for completeness. These preliminary findings from the data set visualize changes to the soundscape over time. Variations over time are likely explainable by the closer proximity of and increased amount of visitor traffic at this site. Anthrophonic sound held at relatively consistent levels, whereas biophonic sound fluctuated across each day. This kind of longitudinal data provides a baseline of soundscape against which to compare other markers of individual experience of that soundscape. Soundscape ecology data, while offering an important longitudinal sense of changes in particular soundscapes over time, is not sufficient for understanding individual animal experience of place. This project sought a loose coupling of coupling those data to other available behavioral, analogical, and individual physiological data. One result was that interventions in this soundscape might not be effective, despite substantial and regular noise events, in part because of the attunement of those individuals to those events. For hearing individuals, the context of interpretation matters more (within reason) than the details of the acoustic data can represent. The approach of soundscape analysis does not replace the active real-time listening to understand local sound impacts.

4.FROM LISTENING LIKE A MOUNTAIN TO LISTENING AS A GIRAFFE

A biosemiotic ethics for soundscape ecology requires attention to the individual organism as situated within the research site ecosystem. This central focus on the individual organism is as much a turn for soundscape ecology as it was for Aldo Leopold's land ethic. What's good in terms of the soundscape for one giraffe may not necessarily be what's good for some other giraffe, or for giraffe as a species. Some "noise" events *matter* to some listeners under some conditions more than others. This view has broad ethical implications for our local, contextual, and individualized obligations as moral agents in terms of noise and sound in our environments. If soundscape ecology, as a development of acoustic ecology, helps us think like mountains, the next shift is from thinking like a(ny) mountain to thinking like a (specific) giraffe.

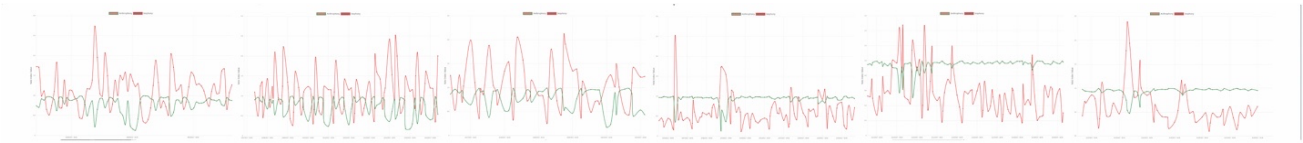

Figure 1: Giraffe site series, part 1 of 2

5. REFERENCES

[1] A. Leopold, *A Sand County Almanac: And Sketches Here and There*, Oxford University Press, 1949, p. 149.

[2] M. Southworth, *The Sonic Environment of Cities*. Massachusetts Institute of Technology, 1967.

[3] R. M. Schafer, *The Soundscape: Our Sonic Environment and The Tuning of the World.* Destiny Books, (1994[1977]).

[4] B. Krause, *The Great Animal Orchestra*, Little, Brown, and Co., 2012.

[5] B. Krause and A. Farina, "Using ecoacoustic methods to survey the impacts of climate change on biodiversity," *Biological Conservation,* 2016, vol. 195, p. 247, 2016.

[6] S. L. Dumyahn and B. C. Pijanowski, "Soundscape Conservation," *Landscape Ecology,* 2011, doi: 10.1007/s10980-011-9635-x.

[7] J. Beever, *Mangrove*, [Online]. Available: https://github.com/ jonathanbeever/mangrove, 2023.

[8] E. von Muggenthaler, "Giraffe Helmoltz resonance," *Proceedings of Meetings on Acoustics*, 2013, vol. 19, issue 1, doi: https://doi.org/10.1121/1.4800658.

[9] S. Wiseman, P. S. Wilson, and F. Sepulveda, "What comprises a healthy soundscape for the captive southern white rhinoceros (Ceratotherium Simum Simum)?," *The Journal of the Acoustical Society of America*, 2014, vol. 136, no. 2305.

[10] Wiseman, S. M. and P. S. Wilson. "An Argument for a Standardized Method to Record, Measure, Characterize, and Compare Captive Animal Soundscapes," *Inter-Noise 2016*, 2016, pp. 2074-2085.

[11] J. Beever, "Sonic liminality: Soundscapes, semiotics, and ecologies of meaning," *Biosemiotics,* vol. 13, no. 1, pp. 77-88.

[12] Y. H. Hendlin, "About the journal," *Biosemiotics*, [Online]. Available: https://www.springer.com/journal/12304/.

[13] J. Beever, "Meaning matters: the biosemiotics basis of bioethics," *Biosemiotics*, 2012, vol. 3, no. 2, pp. 181-191.

[14] S. P. James, "Phenomenology and the problem of animal minds," *Environmental Values*, vol 18, no. 1, pp. 33-49.

[15] E. von Muggenthaler, Giraffe Helmoltz resonance, *Proceedings of Meetings on Acoustics*, 2013, vol. 19, no. 1, doi: https://doi.org/10.1121/1.4800658.

[16] University of Rhode Island, "Hearing loss in mammals," *Discovery of Sound in the Sea*, 2021. [Online]. Available: https://dosits.org/animals/effects-of-sound/potential-effects-of-sound-on-marine-mammals/hearing-loss-in-mammals/.

[17] Y. C. Tarnovsky, S. Taiber, Y. Nissan, A. Boonman, Y. Assaf, G.S. Wilkinson, K.B. Avraham, Y. Yovel, "Bats experience age-related hearing loss (presbycusis)", *Life Science Alliance,* vol. 30, no. 6: e202201847.

[18] Personal correspondence.

[19] E. P. Kasten, S. H. Gage, J. Fox, & W. Joo. "The remote environmental assessment laboratory's acoustic library: An archive for studying soundscape ecology, *Ecological Informatics*, 2012: 50-67.

[20] L. J. Villanueva-Rivera, "An introduction to *soundscapeecology* package," [Online]. Available: https://cran.rproject.org/web/packages/soundecology/vignettes/intro.html