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Listening to Gibbons in the Anthropocene: Politics, Possibilities, and Precarity in the Aural Labor of Hylobatid Conservation

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Listening to Gibbons in the Anthropocene:

Politics, Possibilities, and Precarity in the Aural Labor of Hylobatid Conservation

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Ethnomusicology

by

Tyler Nathaniel Yamin

2022

ABSTRACT OF THE DISSERTATION

Listening to Gibbons in the Anthropocene:

Politics, Possibilities, and Precarity in the Aural Labor of Hylobatid Conservation

by

Tyler Nathaniel Yamin

Doctor of Philosophy in Ethnomusicology

University of California, Los Angeles, 2022

Professor Helen M. Rees, Chair

Bringing an ethnomusicological perspective to the front lines of environmental conservation, this dissertation is a multispecies ethnography conducted at the Gibbon Conservation Center in Southern California—a facility dedicated to the care of gibbons, severely endangered, arboreal ape species endemic to the threatened rainforests of South and Southeast Asia. Gibbons are known for the complex and coordinated vocalizations they sing each day, understood by primatologists to facilitate bonding amongst monogamously mated pairs and/or define territorial boundaries. Grounded in over a year's ethnographic fieldwork among a small group of conservationists and the approximately forty gibbons for which they care, this dissertation examines the ways in which sound—sometimes as a material force, and sometimes as a metaphor—suffuses the practical, ethical, and political aspects of saving a species from extinction. It traces how the ubiquity of gibbon song, and its importance to the sustenance of

gibbon sociality, translates into the work of gibbon caretakers. Not only does the ear figure as a crucial tool in the daily work of monitoring gibbon welfare; more broadly, the acoustic provides both motivational and methodological tools with which to sound an emergent human-gibbon interface. At the same time, the dissertation considers the problems that sonic models pose for gibbon conservation and multispecies relations more broadly. Demonstrating ethnomusicology's ability to participate within larger intellectual conversations regarding the material and theoretical implications of the Anthropocene, this dissertation concludes that gibbon conservation's elision of the otological and the ontological is precisely the fraught medium through which the future of each gibbon species will be realized.

The dissertation of Tyler Nathaniel Yamin is approved.

Erin P. Riley

David Delgado Shorter

Katherine In-Young Lee

Timothy D. Taylor

Helen M. Rees, Chair

University of California, Los Angeles

2022

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ACKNOWLEDGEMENTS

The process of satisfying UCLA's dissertation submission requirements by repeatedly recording my own name as sole author and copyright holder of this dissertation does not exactly encourage a sense of humility. Yet humility is among the values that that Max Liboiron suggests are most necessary to cultivate as research methodology. Distinguishing humility from modesty, they characterize humility as a recognition of the fact that "you are connected to others, and it is the recognition that you cannot do anything without these many others" (2021:30). I want to take this opportunity to recognize the many, many others who made it possible for me to produce this dissertation. At the same time, however, I want to emphasize that all failures and mistakes in the following pages are my own, and that I take full responsibility for them.

I learned about the existence of the Gibbon Conservation Center from Susan Perry, the professor of an undergraduate course on non-human primate behavior and cognition I took in 2017 on a whim. I moved from New York to Santa Clarita, CA in 2006 to pursue a bachelor's degree at California Institute of the Arts; it took a chance conversation during Dr. Perry's office hours to learn that I had been living only several miles away from the Center for over a decade!

Gabi Skollar, director of the Gibbon Conservation Center, was nothing but welcoming to me from the first moment I reached out to her about doing ethnomusicological research at the Center. In fact, in her very first email response to my query she invited me to collaborate on a research project. And although a large portion of this dissertation attempts to understand and contextualize Gabi's philosophy and practice of gibbon conservation, in a much more fundamental sense the project would not have been possible without her daily generosity,

whether her willingness to put up with, and correct, my many mistakes, or her sense of humor that made the worst of the summer days just barely manageable. Thank you, Gabi.

Alma and Jodi, your contributions were just as crucial. Thank you for taking the time to train me and answer my many questions. Jesse, we didn't speak much, but I always appreciated your taste in the music you played as you worked on the enclosures. And Orien—if you end up reading this someday, I have some great memories from our water gun fights! I also want to acknowledge the many other volunteers, researchers, and part-time staff I crossed paths with at the Center, and apologize for the fact that your words did not make it into the following pages.

The gibbons need acknowledgement too. I quite literally could not have done this project without Violet, Truman, Pierre, Astriks, Nate, Anastasia, Ivan, Goliath, Khusus, Reg, Simpang, Perak, Hercules, Shelby, Winston, Tuk, Iszie, Baby Boo, Howard, Hmwe Ni, U Maung Maung, Chantar, Alan Jr., Oula, Medina, Betty, Khin Maung Win, Phy Gyi, Arthur, Elwood, Nyi Ma Suu, Canter, Lucia, Vok, Pepper, Dennis G. Jacobson Jr., U Mynt Swe, and Marlowe.

Moving away from the Center, there are many more people to recognize. First, my committee members: I knew I wanted to work with Helen Rees even before I applied to UCLA, but at the time I had no idea what her mentorship would entail, or how my scholarship would change under her guidance. When I still thought I would be focusing on Balinese gamelan, Helen introduced me to scholarship on the cutting edge of organology that (inadvertently) put me on my current intellectual trajectory. At the same time, she helped me develop my writing in a way I would not have thought possible. Thank you, Helen: for your meticulous attention to every aspect of this project, your advice, and your unwavering support of my scholarly choices.

David Shorter also provided crucial intellectual and practical guidance. David, I can't say enough about how formative your Language Culture and Ontology seminar was, and how much I

appreciate the ways you've pushed me to write and think more clearly. There have been quite a few times when I've come across a notoriously complex text, understood it far faster than I expected, and only afterwards realized that it was because I was approaching it as if I were writing one of your Author Analyses. My attention to the relationship between sound and politics only developed under Katherine Lee's guidance; our weekly meetings leading up to my qualifying exams were among the most appreciated parts of my time at UCLA. Tim Taylor was not on my committee for long, but even during his short time he provided input that drastically improved the final result. And I'm grateful to Erin Riley for both her suggestions and willingness to sit on my dissertation committee; I look forward to further demonstrating what an ethnomusicological perspective can contribute to ethnoprimatology.

Another formative experience at UCLA came from my many quarters working as a GSR in the Ethnomusicology Archive under Maureen Russell and Aaron Bittel, where I learned invaluable lessons about the importance of, and the work required to maintain, archival materials. Sometimes my archival interests and research felt unconnected from my dissertation work, but as I was writing this dissertation's concluding chapter, I realized that I had not drifted as far as I thought from the issues of sonic preservation and maintenance that we dealt with in the Archive. Maureen, especially, deserves special thanks here.

Many of the ideas presented in this dissertation were first shared as conference presentations, and I'm indebted to the numerous friends and colleagues whose comments and suggestions changed my work for the better. I'm especially grateful to Steven Feld and all the organizers and participants in the 2019 Anthropology of Music masterclass on acoustemology hosted by the Department of Anthropology and African Studies and African Music Archives at Johannes Gutenberg-University in Mainz, Germany; Nancy Guy, for inviting me to share my

work with the UCSD Integrative Studies seminar; and Julianne Graper, for the inclusion in her multispecies/posthumanism panel for IU's 2021 symposium on "Musical Bodies." The numerous comments I received from attendees and discussants on my presentations at various conferences were all appreciated, no matter how critical. And in addition to thanking Alice Rudge for the discussions and literature references that always proved inspirational, whether held at various conferences or in the process of preparing our co-authored article manuscript, I want to apologize for the extreme flakiness I exhibited as my dissertation deadlines loomed ever closer!

Funding for my dissertation research was provided by several organizations: I am grateful to have been chosen as the recipient of a dissertation-year FLAS from the UCLA Center for Southeast Asian Studies, a Graduate Student Research Mentorship and Doctoral Travel Grant from UCLA Graduate Division, and the 2019 21st Century Fellowship from the Society for Ethnomusicology.

The encouragement I received from my parents and my sister—Michael, Wendy, and Shelby—was just as important. Jessica, I quite literally would not have made it to this point without all your expressions of love and support. I'm so grateful for everything you've done for me, and I can't wait to see what the next chapter of our life together brings.

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VITA

Education

2017	M.A., University of California, Los Angeles, Ethnomusicology Paper: "The Life of a Balinese Gamelan: Toward an Ethnomusicology of the Dividual" Advisor: Dr. Helen Rees
2012	M.F.A., California Institute of the Arts, Indonesian Music and Dance Advisor: Dr. I Nyoman Wenten
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Selected Fellowships, Honors, and Awards

2020–2021	Dissertation Year Fellowship, UCLA Graduate Division
2020	Best Article Prize, International Council for Traditional Music (ICTM), for article published in *Ethnomusicology* (2019)
2019	21st Century Fellowship, Society for Ethnomusicology
2019–2020	Foreign Language Area Studies (FLAS) Fellowship (Indonesian) for Dissertation Research, UCLA Center for Southeast Asian Studies
2018	Ki Mantle Hood Prize, Society for Ethnomusicology Southern California and Hawai'i Chapter (best student paper read at the 2018 Annual Meeting)
2018	Graduate Research Mentorship (Academic Year), UCLA Graduate Division
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2017	William E. Gribbon Student Travel Award, American Musical Instrument Society
2016–2018	Foreign Language Area Studies (FLAS) Fellowship in Indonesian, UCLA Center for Southeast Asian Studies (two years)
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Selected Publications

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2019	"One or Several Gamelan? Perpetual (Re)construction in the Life of a Balinese *Gamelan Semara Pagulingan*." *Ethnomusicology* 63(3): 357–392. **Awarded the 2020 Best Article Prize**, **International Council for Traditional Music.**
2019	"Introduction to the Mantle Hood Collection." In *Ethnomusicology: Global Field Recordings*. Marlborough: Adam Matthew. http://www.ethnomusicology.amdigital.co.uk/Explore/Essays.
2016	"Defending the Past, Present, and Future of *Gamelan Semara Pegulingan Saih Pitu* in Kamasan Village, Bali." In *Performing Indonesia*, eds. Andrew McGraw

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Selected Conference Papers

2022 "The Trap of the Anthropocene." Music Studies and the Anthropocene: Ruptures and Convergences, a conference of the Music Studies in/of the Anthropocene Research Network, 21–22 May, UC Berkeley.

2021 "Sounding out Acoustic Triangulation: Endangered Species Population Surveys and the Acousmatic Slight of Reason." 66th Annual Meeting of the Society for Ethnomusicology, 28–31 October, Atlanta, GA (virtual).

2021 "How Many Musicalities? On the Possibilities and Perils of Gibbon Song Research in Ecomusicology, Zoomusicology, and Acoustic Ecology." British Forum for Ethnomusicology Annual Conference, 8 April, Bath Spa University, Newton Park, Bath, UK (virtual; postponed from April 2020).

2019 "Listening for 'gHarmony' at the Gibbon Conservation Center: Acoustemological Filiation and the Compulsory Reproductive Biopolitics of an Endangered Species Breeding Program." 64th Annual Meeting of the Society for Ethnomusicology, 7–10 November, Indiana University Bloomington.

2018 "Creativity and Contestation in the Canopy: Reflections on the Material-Discursive Boundaries of Gibbon Song." 2018 Annual Meeting of the Society for Ethnomusicology, Southern California and Hawaii Chapter, 24–25 February, Pomona College. **Awarded Ki Mantle Hood Prize for best student paper**.

2017 "The *Cålåpitå*: The History, Uses, and (Attempted) Revival of an Extinct *Gamelan* Instrument." Joint conference of the Galpin Society and the American Musical Instrument Society, 1–4 June, Edinburgh, UK.

2016 "Drumming in 1928, Drumming in 2016: Insights from the Bali 1928 Project." 61st Annual Meeting of the Society for Ethnomusicology, 10–13 November, Washington, D.C.

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Teaching Experience

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Coda

In one of the last remaining forests of Central Kalimantan, Indonesia, the gibbon chorus begins every day with a coda. Nearly every morning, just before sunrise, the forest's adult male Bornean white-bearded gibbons (*Hylobates albibarbis*) awaken and begin producing vocalizations that reverberate through one of the planet's most biodiverse areas (see Husson et al. 2018). Beginning with short, distinct utterances, each gibbon's song grows in complexity over the course of the morning as those initial notes are combined into larger and larger phrases (see Mitani and Marler 1989). Several hours later, the adult females and juveniles join in, and the forest canopy becomes awash with the sounds of monogamously mated gibbon pairs singing what primatologists call a "duet," a bout consisting of sex-specific vocalizations combined according to relatively rigid organizational rules of synchronization and overlap (see O'Hagan 2013).

In 2018, I learned to describe those initial adult male vocal phrases as "coda" from the field staff of the environmental conservation NGO operating in the area. Although at that time my scholarly focus was on the traditional gamelan music of Bali (a very different part of Indonesia), I had developed an interest in gibbon song while preparing an article on Balinese conceptions of musical instruments and more-than-human personhood (Yamin 2019). While exploring the literature on posthuman expressive practices and agency, had I encountered a description of gibbon song in Frans de Waal's book *Are We Smart Enough to Know How Smart Animals Are?* (2016), and subsequently began searching for opportunities that resulted in my traveling to Kalimantan to participate in a three-week conservation field course during the summer of 2018. With the ability to speak *bahasa Indonesia* honed through over a decade of work with Indonesian artists, once there I developed a fast camaraderie with the NGO's

Indigenous employees, recruited from a village on the outskirts of the protected forest. These individuals immediately stunned me with their auditory virtuosity—specifically their ability to pick out increasingly subtle auditory details in an incredibly dense landscape and soundscape.

Even amidst the experiential overload of being thrown for the first time into demanding conservation work with unfamiliar people in an unfamiliar environment, their use of "coda" stood out. The term, after all, is an artifact of Western music theory, derived from the Italian word for tail (*cauda*) that describes the final section of a musical composition. As best as I could surmise, the term arrived in their lexicon by way of primatological scholarship, in which the musical term "coda" is popularly used as a technical term to describe a short male-specific phrase encountered in the duets of many gibbon species at the conclusion of the aforementioned male-female duet (e.g., Cowlishaw 1992). In the field, however, that term had spread to account for all male gibbon vocalizations, including those that precede the entrance of the females. In this condition is a major theme of this dissertation: not just the relationship between primatological theory and its application in the field, but more generally the traffic between the (ostensibly) aesthetically and ideologically disjunct zones of musical and biological knowledge.

The etymological roots of the term "coda" are furthermore striking because the absence of a tail is precisely what distinguishes gibbons—the twenty primate species understood to constitute the family *Hylobatidae*—from monkeys. Distributed taxonomically across four genera and geographically across the forests of South and Southeast Asia, these "lesser apes" (a description of physical size, not value),[1] gibbons are furthermore distinguished from the "great apes"—the orangutans, gorillas, chimpanzees, and bonobos that, with the possible exception of the latter, have entered popular environmental awareness in large thanks to the famous cohort of

[1] Susan Cheyne, a prominent gibbon specialist and native of Scotland, prefers the term "wee apes" (Cheyne 2020).

primatologists consisting of Birute Galdikas, Dian Fossey, and Jane Goodall. With arms 1.5 times longer than their legs, what positively characterizes gibbons are not only their aforementioned vocalizations but also their arboreal acrobatics; gibbons swing through the forest canopy dozens of meters above the ground in a dramatic form of movement called "brachiation."

Gibbons also enjoy the dubious distinction of being among the world's most endangered mammals, as their forest habitats are increasingly destroyed, whether felled for timber or converted to palm oil plantations infamous for their simultaneous abuse of ecological biodiversity and human rights. Indeed, the International Union for Conservation of Nature (IUCN) Red List, the global scientific community's standard for the assessment of species endangerment, lists all but one of the twenty recognized species as either Endangered or Critically Endangered. [2]

In the midst of these growing social and ecological threats, maintaining accurate estimations of gibbon population densities is the baseline according to which both conservation policy and advocacy might be conducted. This is easier said than done: as gibbons live in small, typically monogamous family units occupying large, individual territories in the upper branches of a visually impenetrable forest canopy, standard sight-based census methods fall short. By focusing attention on gibbon vocalizations, however, the spatial distribution that makes visual surveys so imprecise and time-consuming in fact lends itself to a method of aural evaluation called "acoustic triangulation." Estimating the direction and distance of vocalizing gibbons as recorded from multiple predetermined locations allows conservationists to count the number of individuals heard, and then extrapolate outward to yield population density estimates for the entire forest.

[2] See, for example, IUCN SOS (2022).

At roughly 4:30am on 11 July 2018, I was squatting alongside several fellow students and two of the NGO's field staff in the predawn darkness of the Kalimantan forest waiting for the gibbons to begin their daily song. We had already been awake for a full hour, having risen from our cramped quarters at the field camp and slowly made our way to our predetermined listening post. After slowly proceeding along a narrow wooden boardwalk precariously suspended several feet over the swamp, illuminated only by our dim headlamps, we had climbed down and carefully made our way to a destination already saturated with rainforest humidity, a persistent saw-like buzz of cicadas, and the worryingly close whine of mosquitoes and sweat flies.

But as the sun rose and the gibbons' characteristic vocalizations begin filtering through the dense undergrowth into a lively soundscape already full of bird song and the buzz of cicadas, other sounds became apparent. The call to prayer, broadcast from the loudspeakers of a mosque located just past the edge of the forest, competed for our attention with the gibbon calls that occupy similar frequencies. The thumping bass of Indonesian pop music, blasted by pleasure boats ferrying ecotourists down a nearby river, further frustrated our ability to accurately and coherently estimate distance. On one hand, this sonic disturbance might neatly make audible the material-semiotic incursion of human affairs into natural processes that has precipitated the current global condition Bruno Latour describes as "the fusion of ecology and eschatology" (2017). On the other, however, audible in the proliferation of concepts like "noise pollution" (Schafer 1993[1977]; see Chapter 5) used to characterize this sonic entanglement of nature and culture are anxieties over impending species extinction and ecosystem collapse that reveal an approach to conservation predicated upon normative distinctions between signal and noise,

fidelity and contamination. The acoustic constitutes at once the conditions for the possibility of conservation action and a threat to the objects of conservation.

I was sitting at the ground zero not only of a clash of acoustics, furthermore, but also of epistemologies and ontologies. In an important ethnography of conservation's effects on an Indigenous community in Quintana Roo, Mexico, Jose Martínez-Reyes describes "the coloniality of nature." "The underlying assumption," he writes, "[is] that the only way that nature can be managed is by the 'one world' ruled by Western expert knowledge, based on the principles of two fundamental practices: neoliberal capitalism as the logic of exchange, and the use and application of the science of ecology as the sole source of knowledge. This form of knowledge," he continues, "becomes dominant and, as a consequence, subalternizes all other forms of knowledge, particularly, in this case, local knowledge about the environment and ontological connections to place" (2016:29). The presupposition that a scientific epistemology is uniquely positioned to understand the workings of nature contributes to a deeply exclusionary and extractive form of environmental conservation. At the same time as the goals and knowledge systems of local communities are conceived as an obstacle to proper conservation action, those Indigenous residents themselves are often enfolded into the apparatus of conservation's menial labor (see Dowie 2011).

Constitutively attached to conservationist judgements about what sorts of sounds belong and are deserving of amplification, and which do not and are in need of suppression, are analogous treatments of entire lifeways. Indeed, as this dissertation argues, in the context of gibbon conservation ways of sounding and ways of being are constitutively entangled. Although I had signed up for the summer program mainly to investigate the possibility of studying gibbon song itself from an ethnomusicological perspective, in this one moment the issue I wanted to

explore became clear: how does sound, whether as a material force or a metaphor, impact the practical, ethical, and political aspects of saving a species from extinction?

I have not, however, been able to return. Despite a carefully assembled (and funded) research plan, acceptance from the NGO and establishment of a partnership between UCLA and an Indonesian university that is a legal requirement for conducting research in the country, the advent of the COVID-19 pandemic interrupted the lengthy process of applying for a research permit. Instead, I spent those ten months immediately prior to the COVID-19 lockdown, and several more in late 2020 and 2021 after I was cleared to return, at the Gibbon Conservation Center in Saugus, CA, a private facility dedicated both to the care of a resident gibbon population hovering around forty and the survival of the five endangered species they represent. Just as in that Kalimantan forest, every day, just before sunrise, the Center resounds with a chorus of gibbon vocalizations. But on the outskirts of suburban Santa Clarita, California, just north of Los Angeles, the presence of this refrain is a testament to the extreme lengths gone to—and sacrifices made—by a small group of conservationists to prevent gibbon extinction. Every day, regardless of holidays, temperature conditions (potentially 32–120 Fahrenheit), or existential threats (whether the annual brushfires or the current COVID-19 pandemic, the fatal shooting at a nearby high school [14 November 2019], or a hostile landlord [see Chapter 5]), the three women responsible for the gibbons' daily care monitor their health, prepare and distribute their eight daily meals, maintain the grounds, clean and repair enclosures, write grants, and maintain a social media presence publicizing the weekend tours that are their major source of financial support. Living permanently in tiny houses and campers on the property, committed to lives that regularly demand both physical and emotional extremes, these caretakers occupy a level of social precarity on par with the gibbons' own environmental vulnerability.

Like the gibbon chorus I heard in Kalimantan, I begin this dissertation with a coda. Doing so is a deliberate attempt not only to take seriously the unique expression of sonic knowledge I encountered, but also to explicitly question what sorts of rules are taken as immutable constraints and therefore impervious to critique. “It matters what stories tell stories,” Donna Haraway writes (2019a; cf. 2016), and the gibbon conservation practices I narrate always exceed the very theories and philosophies that make it possible to conceive of a nature and a species in need of protection. In this dissertation I write against what Nina Sun Eidsheim calls “the fiction of fidelity” (2019:23), a commitment to the existence of autonomous essences that explain both what is and what ought to be (see Daston 2019). In what follows I am not concerned with pinpointing sources or distinguishing between essential differences, but rather embracing the presence of interference—to narrative, to knowledge, to life, and to research projects—as generative and transformative rather than a value to be minimized. Attending to the effects of sounds (and sonic epistemologies) as they move, entangle, and interfere with one another, makes audible at once the politics, the possibilities, and the precarity that I argue defines the condition of multispecies life at the Center.

Chapter One

Introduction: Listening to Gibbons in the Anthropocene

"Stop," I shout in frustration. "Wait! You can't go in yet!"

It is late in the morning of 4 January 2020, although it could plausibly be any of the many Saturdays during which, while conducting participant-observation research as a volunteer caretaker at the Gibbon Conservation Center (hereafter "the Center"), my responsibilities included working at a small building at the entrance colloquially known among the staff as the "gift shop" (figure 1.1). Between the hours of 9:30am and 12 noon on weekends, while the Center was open to the public, I often acted as the initial point of contact for visitors—first checking their reservations, charging admission through a perennially malfunctioning credit card reader, and answering preliminary questions, then later selling a collection of stuffed animals and other gibbon-themed items on their way back to the parking lot.

Figure 1.1: The Center's "gift shop." 3 August 2019, photo by author.

But my shouts were meant in the context of a different responsibility. An hour earlier, after obtaining a cashbox and iPad loaded with merchant software from the Center's office, I had climbed a precariously unbalanced ladder in order to unhook then fold the large blue tarp that protected the unwalled structure's contents from wind and rodents during the rest of the week. Then, after arranging merchandise in what I hoped was an aesthetically appealing manner, I had filled two wide, shallow basins with a quarter-inch of water, mixed in a scoop of neon orange disinfectant, and placed them in front of a metal barrier that I had dragged to block the entranceway just inside the Center's front gate. Despite the presence of clear and instructive signage permanently affixed to the barrier exhorting visitors to "please dip the bottoms of your shoes!" with visual instructions (see figure 1.2), however, the vast majority of visitors (understandably distracted by their first experience of the Center's sights, sounds, and smells) walked right past without following these instructions. It became a game of sorts for me: I experimented with different placements of the barrier and basins. But whether placed directly in front of the entrance or behind it, only a small percentage of people noticed the instructions. When I moved the barrier next to the gift shop and gave verbal instructions while taking admission, the path to the Center's restroom was unblocked.

This mandatory shoe-dipping ritual is not an arbitrary requirement of the Center, however, but rather one expression of a protocol meant to protect the health of the Center's gibbons by limiting, as much as possible, their exposure to microscopic, organic contaminants. Indeed, separate signage pleads with visitors to stay home if they are experiencing "ANY signs of illness" (figure 1.3), pointing out the fact that "many human illnesses can be transmitted to gibbons due to their biological similarities" (ibid.). And for the Center's staff and those select volunteers whose duties bring them in direct contact with the gibbons, these restrictions only

increase. The medical clearances I was required to obtain before volunteering required at least one test that the UCLA student medical center had apparently never before performed. Hand sanitizer is consumed at the Center at a remarkable rate, the result of the need to clean one's hands immediately before and after physical contact with a gibbon; each of the eight daily feeding cycles, which conservatively might include dozens of individual interactions with gibbons, might deplete an entire small bottle of the substance whose value, especially in the spring of 2020, skyrocketed. In the Center's kitchen, the towels, utensils, containers, and cutting boards are clearly split between those used in the preparation of human and gibbon food (see figure 1.4).

Figure 1.2: "Please Dip The Bottoms of Your Shoes!" Photo by author.

Figure 1.3: "How are you feeling today?"

Figure 1.4: The Center's refrigerator. The left-hand laminated card, affixed to the refrigerator with a magnet, reads "gibbon towel, for drying gibbon containers and utensils," while the right-hand one reads "people towel, for drying people containers and utensils" (R). Photo by author.

Although I never heard it described at the Center in such technical terms, this protocol is conventionally understood as "biosecurity." From engagements with invasive species (see Lowe 2010; Raffles 2010; Subramaniam 2014) to philosophies of ecological governance (e.g., Helmreich 2009; Zhang 2020), biosecurity has emerged as a form of regulation predicated upon maintaining spatial difference, "a fantasy of separation," as Alex Blanchette writes while arguing that industrial hog farming's biosecurity mandates transform the lives of both the pigs and the humans it manages (2015:662). Indeed, keeping at once humans, gibbons, and a multitude of "microbial agents" (see Helmreich 2009; Paxson 2012) where each separately "belongs" is a central, if entirely banal, preoccupation of the Center. Manifestations of this goal include not only the padlocked enclosures within which the resident gibbons spend their lives, but also those heavy metal barriers perpetually shuffled around the grounds as visitors come and go.

As much as such an "enclos[ing of] humans and animals in specific, sterile, and segregated spaces" (Lezaun and Porter 2015:100) has come to be understood as central to the logistical functionality of the Center as well as the biological functionality of its gibbon inhabitants (see Chapters 3, 4, and 6), proper care comes to require a perpetual penetration of the boundaries it imagines. Those metal barriers, carefully arranged during visiting hours to prevent the public from getting too close to the gibbons, are just as often removed; with both hands occupied by heavy buckets of fruit and vegetables during my regular feeding rounds, I grew accustomed to shoving them out of the way with my hips in order to gain access to the gibbons I needed to feed. Indeed, my feeding rounds made clear the precise dimensions of the physical "contact zone" (Pratt 1991; Haraway 2008) between the Center's gibbons and volunteers like myself, unable to enter the enclosures: a spatial overlap facilitated by the porosity of the

enclosures' chain-link fence, allowing only a gibbon arm's length into my world, and perhaps a few fingers or the camera of an older generation iPhone into theirs.

Back at the gift shop, I am attempting to explain the foot-dipping procedure to a confused visitor when the gibbon chorus begins abruptly, filling the air with the loud vocalizations of nearly forty animals representing five distinct species. The initial whoops of the northern white-cheeked gibbons (*Nomascus leucogenys*) combine with the barks and cries of the eastern hoolock gibbons (*Hoolock leuconedys*) as well as the deep booms of a single siamang inflating her throat pouch (*Symphalangus syndactylus*); several moments later the pileated gibbons (*Hylobates pileatus*) begin a distinct loud bubbling and the Javan gibbons (*Hylobates moloch*) contribute their sharp ascending whoops in unison.[1] I stop mid-sentence: not only is my interlocutor's attention drawn immediately past the very spatial boundary I am attempting to protect, but also the sheer volume of the gibbons chorus makes impossible any semblance of verbal communication. Their song does not obey biosecurity's logic of spatial enclosure. Rather than occupying a spatial envelope measured in inches, it covers the entire Center and beyond, often encroaching into spaces in which it causes problems. This dissertation explores such conflicts and transformations sound makes possible in the context of gibbon conservation, with consequences at once social and biological, political and affective, epistemological and ontological.

[1] The fact that all these species can interact vocally despite occupying mutually exclusive habitat ranges in South and Southeast Asia is taken up in Chapter 4. As the name implies, the Javan gibbons are limited to several remaining protected areas in West Java, Indonesia. Siamangs are found in Indonesia as well, but instead on the island of Sumatra, in addition to peninsular Malaysia and southern Thailand. Pileated gibbons inhabit an area just north of the Gulf of Thailand, including parts of Thailand, Cambodia, and Laos. The last remaining wild northern white-cheeked gibbons are located in northern Vietnam and Laos, following the local extinction (extirpation) of the population in Yunnan, China ca. 2013 (see Fan et al. 2014). Finally, eastern hoolock gibbons occupy a range that straddles the border between Myanmar and China.

Gibbon drama

On the morning of 10 June 2019, during a mid-morning song bout,[2] I am standing just outside one of the fifteen large enclosures distributed throughout the three acres of space immediately behind that biosecured threshold that is the Center's front gate (figure 1.5). Small plaques hanging from a nearby steel barrier introduce the enclosure's four inhabitants: Tuk, Iszie, Baby Boo, and Howard, along with their birthdays; another announces their species ("Pileated gibbons"). Like the Center's other resident gibbons these four are housed as a family; Tuk is the mother to her daughters Iszie and Boo and infant son Howard.

As I stand there, Tuk begins initiating a vocal sequence from her position on a branch towards the enclosure's ceiling, nearly sixteen feet above the ground. While she makes a quiet series of alternating in-breath and out-breath vocalizations, barely audible from my position not even one enclosure away, Iszie and Boo gather close by (figure 1.6). Each extending a single arm to grasp the steel tubing that frames the enclosure's chain-link panels, pressing their faces close together to maintain intense physical, visual, and auditory contact, all three together begin vocalizing in unison. They begin with a series of exhaled utterances, each rising to sustain a distinct pitch for a moment before beginning again. But after several repetitions these tones cease to plateau; rather, they continue their sweep upwards through the animal's entire vocal range, each time faster than the one before. The result is a dramatic bubbling sound, the outcome of three gibbons not only each producing these vocalizations as loud and as fast as individually manageable, but their slightly different speeds producing a phasing pattern as the individual

[2] Besides the chorus that reliably begins each day just before the sun begins to rise, at the Center the gibbons produce several additional song bouts throughout the morning and early afternoon. The total number can range from one to five or six depending on various circumstances including weather (gibbons are less prone to singing in temperature extremes, although rain is not a factor) and social dynamics (there is far more song just after gibbons are moved into new enclosures and territorial boundaries are in need of re-negotiation, for example; see Chapter 3).

utterances move in and out of synchrony dozens of times a second. Tuk, Iszie, and Boo's entire bodies visibly shudder with the intense physicality of their vocal production, and on the ground, my ears throb with the material force of those vocalizations. After sustaining this intensity for nearly ten seconds, the three swing away from each other (figure 1.7), and their enclosure is silent once more.

Figure 1.5: The enclosure housing Tuk's family. Photo by author, 10 June 2019.

Figure 1.6: Tuk (C) and Boo (R) vocalizing, while Howard (L) looks on. Photo by author, 11 October 2019.

Figure 1.7: From left: Iszie, Boo, and Tuk in mid-swing. Photo by author, 10 June 2019.

I did not know it then, but the event I witnessed—despite having occurred in a similar form nearly every day since all three gibbons were physically capable of participating—was to be one of the family's last. Iszie, nearing eight years old, was reaching the age at which young gibbons are pushed out of their natal families so that they may establish their own (see Chivers 1974; Leighton 1987). Indeed, I began my involvement with the Center in the middle of this development. Gabriella Skollar (Gabi), the Center's director, told me soon after I began my training that "if Iszie sings along with Tuk's great call [now], at the end of the great call Tuk shows aggression towards her" (Interview, 25 July 2019). Gabi pointed out that Iszie had recently been beginning to assert her independence from her mother by initiating great calls herself, rather than waiting for her mother to begin—an endeavor met with a threatening response from a mother attempting to maintain her dominant status within the family group. By the end of July, the situation had escalated to the point where mother and daughter were no longer able to cohabitate. Simulating what in the primatological literature is termed "dispersal," Gabi and her staff moved Iszie into an adjacent, yet separate, section of the enclosure.

The drama culminating in Izsie's assisted dispersal played out predominantly through sound. As I describe in more detail below (Chapter 4), the communal great call of Tuk's family group was not only coordinated and negotiated internally, amongst the members of the family, but also externally, as a part of the Center's daily multi-family, multispecies chorus. Most relevant here is the interaction between Tuk's family and that of her adult daughter Violet, housed on the other side of the Center with her mate, Truman. Violet and Tuk would typically alternate initiating their own great calls, each waiting for the other to finish before beginning her own. Whereas Tuk's great calls would be joined by her juvenile offspring singing with her in unison, Violet's are instead answered by her mate, Truman. Specifically, Truman begins his

complementary, male-specific phrase during Violet's bubbling "trill" and continues a few moments after she completes her own sequence. Together, Violet and Truman's vocalizations constitute what primatologists call a "duet"—a coordinated set of sex-specific, yet complementary, vocalizations that they understand both to signal the cohesion of the mated pair performing it and, upon an appropriate response from a neighboring pair, to negotiate the position of shared border between their individual territories.

In late June 2019, however, Violet injured her foot and was brought to the indoor recovery area to heal. With the room's heavy, oversized door closed to keep out the worst of the summer heat, Violet stopped participating in the Center's daily chorus—as did Truman, whose own vocalizations were prompted by the presence of Violet's. But after several days of such sonic abstinence, Truman began producing a different set of vocalizations during the quiet periods in between the collective song bouts, phrases that the Center's caretakers identified as his "solo song." According to Gabi, during previous instances of Violet's recovery in isolation (she is a particularly injury-prone gibbon), Violet would respond to Truman's calls. "Whenever Truman and Violet are separated," Gabi tells me, "Truman continues calling. . . . It often becomes an exchange. . . . It's usually that Truman is calling, for two minutes or so, and then Violet will answer" (Interview, 25 July 2019).

This time, Truman's solo calls were answered not by Violet but rather by Tuk, who exchanged vocalizations with Truman from across the Center's grounds. This in fact was not the first time Truman and Tuk had engaged in this vocal exchange: a decade earlier, Gabi mentioned, "when Tuk was [still] single, . . . she was doing the solo song, and calling with [him], back and forth" (ibid.). This was remarkable, if somewhat exasperating, because at that time the Center had just imported a male named Domino, from a facility in Japan, for the express purpose

of forming a breeding pair with Tuk—a goal that would be compromised if she had established a pair-bond with Truman instead. Eventually, Tuk did begin duetting with Domino, leading to a coupling resulting in all four of Tuk's offspring. But by the time of Howard's birth in late 2017, Tuk and Domino were no longer reliably duetting together. Their pair-bond had deteriorated, and following several physically violent encounters Domino was sent to a zoo in Arizona to be paired with another female. Gabi tells me that now, two years later and no longer preoccupied with caring for her infant, Tuk is once again ready to find a new mate.

And later that very same day in July 2019 that Tuk began responding to Truman, the Center caretakers heard a scream. Tuk had bitten Iszie, which is what prompted them to move her into an isolated section of the enclosure. Immediately Iszie stopped joining the great calls led by her mother, remaining silent throughout the chorus despite her physical proximity to her mother and sister. Over the course of the next several weeks she occasionally attempted to participate, but completely skipped the section that builds in volume and frequency peak. Rather, she would only produce a quiet bubbling noise once Tuk and Boo had reached the loud climax of their own synchronized phrases. This attempt at involvement inevitably led to a dramatic response from Tuk, who would swing over to their shared chain-link wall and shake it forcefully. For the caretakers, this was the final sign that Iszie was no longer welcome in Tuk's enclosure. They began searching their network of zoos and sanctuaries for an eligible mate with whom Iszie could be matched.

As I describe in detail in Chapter 3, the Center participates in species-specific breeding programs, regularly accepting new gibbons or sending theirs away to be paired with mates deemed genetically suitable by an organization that maintains a studbook of all eligible animals. At this time there were no single male pileated gibbons to be found anywhere in the United

States.[3] Instead, the Center elected to temporarily pair her with a male buff-cheeked gibbon living alone at a zoo in Florida. After months of delays to this plan that would have sent Iszie across the country, however, the staff gave up and modified her enclosure, adding a large section that allowed her to occupy a space that had no walls in common with her mother's. Soon after she took up residence in the branches the caretakers had strategically distributed throughout the space, despite months of silence, she began singing again—not only loudly, not only full phrases. Iszie, rather, was initiating her own great calls, independently of her mother. Iszie had successfully left her natal group, and was ready to start her own family.

Acoustemology

Even an entire year after this event, the affective impact of the scene I initially witnessed remained fresh in the memory of an experienced Center staff member named Jodi. "When Iszie was [still living] with Boo and Tuk, and they were all [singing as] a threesome, taking breaths together, that [was] beautiful" (Interview, 2 June 2020). Jodi laughs, contrasting that sonic and social coordination with what she perceived to be the distinctly lackluster state of the family's current vocal performance. "Tuk and Boo will still do it," she points out, "but Boo is always off, and it's not in sync. But when all three of them were, it was like a group effort, . . . and that was really beautiful." With her description, however, Jodi also gestures towards an investment in the character of their vocal coordination beyond the aesthetic. Contrasting her understanding of gibbon song to its accepted territorial function in the primatological literature, she tells me, "I know that it is a territorial song, but to me I don't see that when I hear it." She corrects herself: "I

[3] As of a pileated gibbon birth announcement in early 2017 (Dantuono 2017), there were only thirteen animals of this species to be found across the United States, housed in two zoos in addition to the Center.

don't *hear* that when I hear it—I hear it [as] more of a bond, like it's their connection to each other."

Jodi's insistence that gibbon social bonds are audible, rather than visible or otherwise measurable, reveals the acoustemological character of both gibbon social life, in general, and human attempts to foster it at the Center, in particular. "Acoustemology" is a neologism famously coined by Steven Feld in 1992, a method of inquiry "conjoin[ing]," as he puts it, "'acoustics' and 'epistemology' to theorize sound as a way of knowing" (2017:84). Acoustemology, he continues, "ask[s] what is knowable, and how it becomes known, through sounding and listening" (ibid.). Invoking acoustemology here emphasizes that auditory ways of conceptualizing gibbon social bonds are far from arbitrary. As Center caretakers like Jodi understand, gibbon duetting does not convey information about but instead constitutes each's relationship, everything from a durable bond to its imminent collapse reflected in the degree to which participants are able to achieve proper vocal coordination. For those auditors attuned to the subtle intricacies of these gibbons' relationships unfolding in real time, whether themselves human or gibbon, a social analysis *is* a sonic analysis, and vice versa.

Just as Feld writes regarding his ethnographic engagement with his Bosavi collaborators in Papua New Guinea, the kind of relational knowing and being facilitated by an acoustemological approach makes audible not a static cultural or biological system informed by sonic metaphors, but rather an auditory attunement to temporal becomings always already in motion. "Listening to the rainforest as a co-inhabited world of plural sounding and knowing presences was, most deeply," Feld writes, "a listening to histories of listening" (ibid.:89). And as Jodi explained to me, her goal when leading the Center's public tours is to make these histories of listening audible to the tour participants once the gibbons begin singing. After "you already

learned all of these stories, all of the background of all of these families, then you can watch them sing together. . . . You just learned about all these gibbons, you learned about why they sing, and them watching them do it together is really beautiful" (Interview, 2 June 2020). Indeed, Jodi strives to conjure the same affective state she experienced upon her first visit to the Center, the informed result of hearing gibbon sociality consummated sonically: "I [give] the tours now, and I still picture myself on the tour even when I'm doing them. I look at everybody and I was like, 'I'm that person!' It makes me want to do the tours better." Jodi's goal, in other words, is to share the particular listening practices through which it is possible for anybody to appreciate the histories of listening audible in the gibbon chorus themselves. When the gibbons inevitably sing at the end of tours impeccably scheduled around the daily song bouts, Jodi says, "I see it in everybody else's eyes too" (ibid.).

Alma Rodriguez, the Center's operations manager, likewise emphasized the impact of gibbon vocalizations. Indeed, when I asked about her first encounter with the Center, she foregrounded the acoustic:

> I didn't know what a gibbon was, and I was being shown around the place, and they started singing. And, I just couldn't hear anything that the person was trying to communicate after that. I got a little teary eyed, which I was trying to hide, [laughs] because it was very overwhelming. It was so beautiful, then as time went on [the guide] was telling me about how Gabi knew all the different vocalizations, and how she could identify individuals, and at that point I couldn't even kind of completely wrap my head around what I was listening to. So, I thought that that was really cool. And, it's been nine years now. (Interview, 8 August 2020)

Beyond her personal experience of gibbon song's affective power, Alma finds it integral to her work and responsibilities as a caretaker, in which a primary concern of hers is for the health of the gibbon chorus in its totality. "Being here as long as I have," she told me, "I definitely feel like I know when it's off. And it'll take me a minute to figure out when it's off, but you can definitely hear the variation" (ibid.). An ability only cultivated over almost a decade of sustained

engagement not only with gibbons, not only with specific gibbon species, but more specifically a particular collection of individual animals, "that's one of the things that I definitely picked up after I could identify all the different vocalizations," she said (ibid.). "I think one of the first things was just picking up on which species was which, which part was the male, which part was the female, and then after that the little nuances in their voices" (ibid.).

In their article on zoo listening practices, Tom Rice and colleagues locate this sort of attentiveness to animal vocalizations across a broad array of animal keepers, noting that such professionals often become attuned to what one interlocutor described as "normal vocalizations" (quoted in Rice, Badman-King, et al. 2021:855) and ready to investigate whatever sounds "a little bit out of the ordinary" (ibid.). Rice and colleagues describe this as a form of what Trevor Pinch and Karin Bijsterveld term "monitory listening," a mode of audition attuned to the possibility of its object's functionality (2012:14). Whereas Rice and colleagues develop an understanding of monitory listening as "ambient," something that only registers if there is a problem, Alma described devoting constant, explicit attention to the acoustic signs of gibbon health or sickness. While we spoke, a siamang named Marlowe (see Chapter 4) was recovering from an illness indoors, her characteristic deep "booms" produced by inflating her throat pouch amplified in the small space of the recovery room. Alma paused to listen, before remarking that "being in there isn't exactly exciting for her because it gets very loud. But knowing that she's singing means she's feeling better. So that's a good thing" (8 August 2020).

As much as Alma's concern lies with the wellbeing of the gibbons for which she is responsible, her descriptions of listening complicate a key aspect of Pinch and Bijsterveld's formulation of monitory listening, as well as its usage by Rice and colleagues: for Alma, listening to the Center's gibbon chorus is not a means to a different end (the biological health of

individual animals) but rather itself a "matter of care" (Puig de Bellacasa 2017). Indeed, she characterized her experience of monitoring the gibbon chorus as sometimes "unnerving, in a sense that you want to be able to fix it" (8 August 2020). By describing the Center's gibbon chorus in such active terms, Jodi and Alma gesture to a multispecies acoustemology in which sound is not a means to access something else but is rather itself efficacious. Whether in the context of gibbon sociality or the sustained labor of caring for gibbons themselves, sound and its reception at the Center constitutes, like Alfred Gell's famous definition of art, "a system of action, intended to change the world rather than encode symbolic propositions about it" (1998:6).

Listening to gibbons in the Anthropocene

In particular, the world to be changed is one increasingly defined by the consequences of what Heather Davis terms "extractivism." As Davis writes, extractivism denotes "both an ideology and an economic system built on the understanding that the world, and all its beings, are inherently commodifiable, violently turned into 'things' operating as a standing reserve for the accumulation of profit and power in the hands of a few. . . . The devastating impacts of this ideology," she notes, "are not hard to find" (2019). As palm oil plantations and other expressions of capitalist extractivism proliferate across the rainforests of Southeast Asia, threatened is not only the survival of particular gibbons but what Deborah Bird Rose calls the "double death" (2006:75) of at once individual lives and the distinct multigenerational forms of life that are species (cf. Despret 2017).

The Center's work is conducted in the context of this global condition, which is popularly described as the "Anthropocene": a new global epoch, following the "Holocene," brought about and defined by the supposedly irreversible effects of human activity on the very geological

makeup of the planet Earth. Although torn on the details of the Anthropocene's origin, and even its name (e.g., Haraway 2016; Moore 2016; David and Todd 2017; Yusoff 2018), scholars generally agree that the irreversible effects of human activity have overtaken geological forces to become the primary source of planetary change (Steffen et al. 2007; Tsing et al. 2017). As much work has argued (e.g., Chakrabarty 2007), the fact that human activity can no longer be meaningfully differentiated from geological activity poses challenges to livability and conceivability alike; even as new critical attention is leveled towards the potential end of "life as we know it," the Anthropocene lays bare our deep-seated, unquestioned assumptions that provoke this sense of concern. In anthropology and STS, for example, Cristóbal Bonelli and Antonia Walford characterize the Anthropocene as an assemblage of "exhausted paradigms" (2021); increasingly depleted are not only the physical resources on which the perpetuation of life itself relies, but also the conceptual resources used to make sense of the demands this condition poses.

Studies of extinction make this paradox explicit by asking why earnest attempts to mitigate climate change so often reproduce the very values and extractive knowledge practices that initially engendered and licensed environmental exploitation. Whether critically examining habitat conservation successes "accomplished" at the expense of their human inhabitants' physical or political marginalization (Sundberg 2004, 2006; Garland 2008; Dowie 2010; Martínez-Reyes 2016; Hennessey 2018), or endangered species conservation programs in which captive animals are subjected to violence perpetuated in the name of their species' continuity (Chrulew 2011; van Dooren 2014; Biermann and Anderson 2017; Parreñas 2018), these inquiries show that the contemporary political and ecological developments of the Anthropocene have

engendered an intellectual moment where the foundational ontological and ethical commitments of environmentalism, not just their execution, need to be re-evaluated (Rose et al. 2017).

In this context, scholars have begun mining the affordances of sound and listening for ethical alternatives to the extractive modes of engaging with both knowledge and materiality that are understood to be at blame for the climate crisis. "How do we learn to listen to the beyond-human world?" ask Sophie Chao and Dion Enari in an article fittingly entitled "Decolonising Climate Change: A Call for Beyond-Human Imaginaries and Knowledge Generation" (2021). "Taking [this question] seriously is critical in eschewing human exceptionalism and its devastating impacts on the natural world," they write (ibid.). "It demands the cultivation of an intellectual and ethical openness to the possibility of other-than-human sentience, will, and desire, and a repositioning of the 'human' as one within a broad spectrum of matter and life in both deep and present time."

Donna Haraway suggests that rather than returning to a pre-Anthropocene state, what is necessary is to move past it: "our job is to make the Anthropocene as short/thin as possible and to cultivate with each other in every way imaginable epochs to come that can replenish refuge" (2016:100). As alternative to the Anthropocene, she proposes the notion of the "Chthulucene." Inspired not by H. P. Lovecraft's "misogynist racial-nightmare monster Cthulhu . . . but rather after the diverse earthwide tentacular powers and forces and collected things,"[4] Haraway reiterates that precisely what need to be cultivated are the "myriad temporalities and spatialities and myriad intra-active entities-in-assemblages—including the more-than-human, other-than-human, inhuman, and human-as-humus" (2016:101). This understanding of relationality owes at

[4] The science fiction/horror stories of the American writer H.P. Lovecraft (1860-1937) are among the genre's most beloved. Famously, he introduced the insanity inducing, tentacle-laden monstrosity Cthulhu; infamously, his personal correspondence reveals a deeply racist, misogynist, and xenophobic worldview (see House 2017).

least a little bit to sound and listening; discussing the Chthulucene in an interview in *Le Monde*, Haraway mentions that "the idea of this term began with my ears. . . . With the term chthulucene [*sic*], I wanted the ear to hear the sound of the terrestrial, of all that is related to the Earth, including the atmosphere. I wanted to say that we are connected to a myriad of temporalities and spatialities, related to the unfixed past, present and future" (2019b). The sort of relational ontology made possible through attentive listening is being offered in as precisely what is needed at a global scale to circumvent eschatological collapse.

In music studies, Jeff Todd Titon makes the connection between aurality and vitality explicit in his notion of a "sound ecology" (2020) in which the act of listening is inherently redemptive: "sound waves vibrate living beings into bodily experience of the presence of other beings," he writes (ibid.:237). "When that experience and awareness is mutual, sounds vibrate beings into copresence with one another. Sounds vibrate living beings into a way of knowing that proceeds by interconnection, a community of relations: a relational epistemology." Biologist David George Haskell explores a similar approach in his 2017 work *The Songs of Trees*, listening to the material and semiotic relations afforded by those arboreal entities characterized in the subtitle as "nature's great connectors." "Although tree trunks seemingly stand as detached individuals," he writes, "their lives subvert this atomist view. We're all—trees, humans, insects, bacteria, birds—pluralities. Life is embodied network" (2017:viii). Attention to sound might make audible the extent of anthropogenic degradation of natural environments (e.g., Schafer 1993; Krause 2012; Post 2021), then, but just as readily offers an alternate path forward. As Titon eloquently writes, "sound enables humans to construct a world worth wanting and keeping" (2020:237).

The ethical affordances of sound and listening have likewise begun to attract attention among environmental and endangered species conservationists. In a recent article, Staddon and colleagues (2021) present the act of listening as a remedy for the often-strained relations between conservationists and local peoples. Entreating conservationists to listen—to the hereditary inhabitants of the areas in which they work, to the environments they seek to conserve, and each other—for these authors, the ear provides at once a method of obtaining information and a method of establishing sound relations in the field. What listening offers is an alternative to environmental conservation's well-practiced (and well-critiqued) hero narrative, in which success is often achieved at the direct expense of the livelihoods and autonomy of local human communities (e.g., Martínez-Reyes 2016). The sort of relational interconnection the act of listening makes possible, as these authors argue, stands in direct opposition to mechanisms by which conservation programs operate by extending colonial logics of spatial and epistemological regulation to the natural environment (Garland 2008; Martínez-Reyes 2016; Parreñas 2018).

My dissertation intervenes in this conversation by demonstrating that listening by itself does not offer a solution; the sort of relationality sound so often promises (see Titon above; cf. Goodman 2010) does not imply reciprocity. Listening to gibbons in the Anthropocene, this dissertation shows, is an act constitutively laden with urgent pressures and anxieties of extinction and climate degradation (see Whitehouse 2015), a situation in which a reliance upon the acoustic can just as easily exacerbate the problem (see Chapters 3, 5, and 6). Several scholars do recognize this possibility: for example, despite proposing an "ontology of vibrational force [that] delves below a philosophy of sound and the physics of acoustics toward the basic processes of entities affecting other entities" while problematizing Western thought's commitments to dualisms and ocularcentrism, Steve Goodman (2010:82) remains attuned to "the means by which

audition is policed and mobilized" (ibid.:189). Critically reading the output of philosophers and theorists from Aristotle to Foucault, Attali to Barad, Cavarero, and Rancière, Robin James goes further to argue that any attempt to mine the purported behavior of the acoustic (as vibrational force) for ethical or ontological paydirt risks perpetuating what she calls the "sonic episteme":

> Although the sonic episteme presents these upgrades as fixes for modernity's bugs, especially bugs related to identity-based inequality, it actually repeats these bugs in a voice that makes those bugs sound and feel like features. Thus, though the sonic episteme's appeal to sound may appear revolutionary because it frees us from the conceptual and political baggage we've inherited from Western modernity, it just remakes and renaturalizes all that political baggage in forms more compatible with twenty-first-century technologies and ideologies. (James 2019:3–4)

Sound and listening, on their own, are not automatically antidotes for the ills of the Anthropocene. Indeed, as Andrew Chung argues in his recent argument that new materialism is ill-equipped to offer viable interventions into the conditions that brough about such socio-ecological catastrophe, invocations of acoustic phenomena like vibration and resonance carry as much potential to reproduce the deleterious conditions they are deployed to remedy (Chung 2021).

Sound's capacity to place entities in fields of sympathetic vibration goes hand in hand with the capacity to harm, to damage, and to control. Exploring the use of loud music as a form of torture against prisoners during the United States' "global war on terror," Suzanne Cusick demonstrates how through such manipulation of the acoustic "music becomes not a metaphor for power, but power itself, literally—a vibrating presence of power that can deliver a miraculously ubiquitous battering to the sympathetically vibrating bones and skin of a man, beating him from within and without, while leaving no marks" (ibid.:288). At notorious detention centers like Camp Cropper and Guantanamo Bay, the argument that "we are never quite . . . separate from other vibrating entities" (ibid.:276; cf. Eidsheim 2015—the refrain echoed in activist scholarship

everywhere from process philosophy to new materialism (e.g., Bennett 2010), multispecies ethnography (e.g., Tsing 2015) to feminist science and technology studies (e.g., de Laet and Mol 2000; Barad 2007; Puig de Bellacasa 2015; Haraway 2016) and even biology itself (e.g., Gilbert, Sapp, and Tauber 2012)—is what makes possible not ecological redemption but instead the "destruction of prisoners' subjectivities" (Cusick 2013:276). Without recognition of the violence potentially brought about through the forging of such relationality, calls to intensify (sonic) forms of connection across bodies and species simply reproduce "connectivism," philosopher Andrew Culp's term for the ideology in which the presence of connections (and possibility of making more) is automatically preferrable to their absence (Culp 2013).[5] What this dissertation attends to, then, is not simply the presence of sound in gibbon conservation at the Center but more deeply a certain set of listening practices, cultivated by the Center's expert staff, that resist at once the material and theoretical consequences of an extractivist worldview and the often reductive ways sound and listening are deployed in ecologically minded academic literature.

Multispecies ethnomusicology

In a recent article in *Ethnomusicology*, Michael Silvers proposes that a "multispecies ethnomusicology" can "help us study music and crisis, acknowledge music's effects on the nonhuman, and recognize the multispecies coconstructedness of our world, a world in which music is entangled" (2020:215). And although what Eben Kirksey and Stefan Helmreich famously term "the emergence of multispecies ethnography" (2010) is undoubtedly gaining interest in ethnomusicology (e.g., Brabec de Mori and Seeger 2013; Yamada 2016; Koons 2019; Graper 2019; Harrison 2020; Daughtry 2021; Steingo 2021), what distinguishes Silvers'

[5] Culp's project is to recast Deleuze—who is often considered to be the philosopher of connection, vitality, and affirmation *par excellence*—as an intensely negative and destructive thinker (Culp 2013).

approach is the manner in which he makes his argument. Through a literature review, Silvers identifies "nearly 150 distinct articles in ethnomusicological journals that refer to birds" (2020:202). Calling for an explicitly multispecies ethnomusicology is unnecessary, we might conclude, as it has been there all along—all that was needed, rather, was to call attention to the disciplinary contributions of musicality beyond the human. If Silvers' attention to this profusion of avian-influenced ethnomusicological scholarship evokes the image of a massive flock in flight, whose epistemological shadows have been cast over the whole of the field, to me it also asks what its presence eclipses. What other forms of musicality beyond the human have been silenced?

In contrast to ethnomusicology's ornithocentric leanings, gibbons and their songs have not attracted the same scholarly attention. This silence, furthermore, is pervasive not only in music studies, but also in the critical ethnographies of primate conservation influenced by anticolonial, feminist science studies—despite the attention focused towards orangutans (e.g., Parreñas 2018; Chua et al. 2020), bonobos, and chimpanzees (e.g., Alcanya-Stephens 2012, 2017, 2021).[6] This dissertation, however, does not seek to fill either lacuna (in music studies or science studies) by contributing an ethnography of "the gibbon." As Eben Kirksey points out in an important article, "multispecies ethnography contains a hidden ontology lurking within: that of 'species'" (2015:758). Rather than assuming the species to be the salient unit of analysis, this dissertation addresses specific gibbons, interacting in specific and contingent ways with specific

[6] In Donna Haraway's magisterial 1989 *Primate Visions*, perhaps the founding work of this approach, gibbons are discussed on exactly two pages (108–110) of this 486-page work addressing everything from the history of Western primatology to Jane Goodall's impact on popular culture, from the fraught ethics of monkey research labs to the ontological clashes between of Japanese and European primatological research modes. In another crucial text, *Primate Encounters* (Strum and Fedigan 2000), one of the few projects to put in dialogue primatologists and ethnographers of primatology, gibbons are only mentioned in passing.

human beings. At certain points (especially in Chapters 3 and 4), the taxonomic construction of the species (and its acoustemological basis) itself becomes the object of ethnographic analysis.

Despite "the power of multispecies scholarship [lying] not in how it 'centers the animal, but in its challenge to conventional taxonomic formulations of classification and belonging" (Yates-Doerr 2015:309), ethnomusicology's historical and contemporary engagement with more-than-human sounds and entities continues to structure the inclusion of the more-than-human in specific ways. Among the few (ethno)musicological works that do address gibbon song, it is represented as an epistemological resource for appropriation within human systems of meaning (e.g., Burman-Hall 2017). In the distinct field of zoömusicology (e.g., Rothenberg 2006, 2010, 2014; Martinelli 2009; Taylor 2017), gibbon song becomes the foil by which other non-human acoustic phenomena are valued according to the degree to which they reflect the aesthetic values of Western European classical music (cf. Tolbert 2001; see Chapter 5). Acoustic ecology uses the presence of gibbon song in particular environments to proselytize the spatial segregation of natural sound and human "noise" (Krause 2012; see Chapter 5); and, with recent attention to "the origins of music" (e.g., Geissmann 2000; c.f. Levitin 2008) in the natural sciences, gibbon song, in its perceived evolutionary distance from human musical practices, is used to construct speculative phylogenetic models that reproduce the racist cultural hierarchies of early comparative musicology on a species level (Mithen 2006; cf. Mundy 2018). Each performs a particularly deceptive intellectual operation: paraphrasing Matei Candea and Lys Alcanya-Stephens (2012:37), gibbon song becomes little more than a resource with which to make a musicological argument about something else.

Additionally, music studies' conventional approach to more-than-human sound often uncritically assumes that Western science provides accurate, untainted descriptions of the natural

world. “Ecomusicologists have not yet problematized nature,” writes Jeff Todd Titon, one of the few ethnomusicologists to consider these issues (2013:15). “They adopt the same modernist perspective that environmentalists do: that is, nature is real and endangered. Yet it was modern science combined with economic rationality that got us into our environmental crisis in the first place” (ibid). One example of this procedure is found in Eric DeLuca’s writings on a citizen science project of listening to wolf howls at Isle Royale National Park; despite exemplary attention to wolf howls as both “material object and socially constructed metaphor, infinitely interpretable and ideologically malleable, ultimately depending on the hearer’s own values and biases” (2016:87) in ways that problematize distinctions between “nature” and “culture,” DeLuca’s citational practices imply that scientific descriptions are exempt from his critique. His assertions regarding the function and acoustic character of wolf howls are presented objectively, each grounded on evidence drawn from a single edited volume on wolf biology.

In her own critique of the literature broadly linking themes of music, sound, and nature, Ana María Ochoa Gautier argues that “rather than unsettling the division between the cosmological and anthropological orders, that is, unsettling the very ontological grounds of ‘nature’ and ‘culture,’ [ecomusicology] seeks to establish a musicological holism on a disciplinary foundation that take such terms for granted” (2016:111). I contend that her insight applies not only to ecomusicology and other subfields that make links between music and nature explicit, but also to ethnomusicology’s most broadly accepted disciplinary tenets. Take, for example, John Blacking’s influential question “how musical is man?” (1973), which accounts for the striking breadth of musical variation found across the world by contextualizing it as different expressions of a singular capacity shared by all humans and wholly absent everywhere else. For Blacking, cultural diversity is made possible by virtue of biological singularity. While I take up

this issue's anthropocentric implications in Chapter 5, here I want to emphasize how Blacking's formulation was, following Rachel Mundy, perfectly symptomatic of a trend among social scientists that established "the special status of the human after World War II—the division of culture from biology that defined postwar notions of the humanities" (Mundy 2018:12).

This entrenched epistemological division between humans and nonhumans, nature and culture, is precisely what makes anthropological investigations into multispecies relations seem so difficult, and the possibility of multispecies ethnomusicology so novel—multispecies ethnographies are habitually narrated as either something found elsewhere in the few ethnographic locations that have not yet succumbed to the pressures of modernization (e.g., Kohn 2013), or something brand new only precipitated by humanity's unprecedented exploitation of social and/or natural resources (e.g., Tsing 2012; Blanchette 2020; Zhang 2020). Both these arguments are telling: the presence of what Lestel and colleagues describe as the "particular social complexity that results from interspecific human/animal communities" (2006:157) is in need of historicizing, while its absence is not. As numerous works in ethnography and philosophy of science have demonstrated, the promise of this epistemological separation of nature and culture—that social scientists and humanists could sidestep issues of biology and nature—only served to harden what Lorraine Daston calls the "'naturalistic fallacy'—a kind of covert smuggling operation in which cultural values are transferred onto nature, and nature's authority is then called upon to buttress those very same values" (2019:4). As the more successful approaches to theorizing multispecies relations (e.g., Viveiros de Castro 2003; Descola 2013; Haraway 2003, 2008; Tsing 2015) show, the ontological divide between human culture and animal "nature" is little more than epistemological baggage carried by the ethnographer (cf. Wagner 1975; Strathern 1988). Anna Tsing, for example, concludes that

"human nature is an interspecies relationship" (2012:144; cf. Haraway 2008; Sahlins 2008). Inspired by these critical approaches, in what follows I devote attention specifically to the ways in which the acoustic becomes the conduit that makes possible Daston's "covert smuggling operation" between nature and culture in the context of gibbon conservation.

Ethnography of science

In order to accomplish this, I draw methodological inspiration from the field of science and technology studies (STS), specifically from studies that devote ethnographic attention to the production of scientific knowledge itself. Rather than attending to social phenomena by writing off nature as irrelevant, or imagining the study of the natural world to be unaffected by social issues, Bruno Latour proposes an approach in which the composition, and relationship between, both is as much an explicit object of research as is the ethnographic situation (2005). In one particularly compelling (and relevant) example of this approach, Angela Willey (2016) conducts ethnographic research among scientists investigating the neuroscience of pair bonding. For these scientists, Wille shows, there exists a "monogamy gene" responsible for particular neurochemical processes that allow for the formation of the monogamous bonds understood to be crucial to the proper functioning of human society. This gene's absence or failure, furthermore, is seen as the root cause of the very sort of pathologized asociality the lab is attempting to solve pharmaceutically (indeed, as Willey mentions, funding was obtained in part from Autism Speaks, an organization that treats autism as a burden in need of a solution).[7]

[7.] In Willey's critical analysis, "coupling is essential to the health of individuals and society, and thus monogamy—the capacity to form a pair bond with a mate—is being researched not (solely) as an end in itself, but as a model for healthy relating. The model operates on the consensus that stable pair bonds are essential to the health of society. . . . The opposite of monogamy in this model is not only promiscuity but also *asociality*" (2016:54, original emphasis).

Part of Willey's ethnography attends to a particular experiment this lab conducts on prairie voles, a species understood (like gibbons) to be sexually monogamous.[8] As regularly occurring genetic variation results in some voles lacking a hormone receptor that rewards sexual fidelity, the scientists treat this as the perfect opportunity to test their pharmaceutical interventions. Crucial to the viability of this lab's work is an experiment called the "partner preference test" that purports to sort out the promiscuous and the monogamous voles by introducing a second female vole after a pair have already mated, and observing the proportion of time the male spends with each female. The purpose of the experiment is to "count the number of minutes that the male animal spends with each female. If the male spends more than one-third of the time with the 'familiar' female, then the animal is said to show a partner preference and thus to be 'monogamous'" (2016:63). Watching vole preferences unfold from a computer running custom software that maps the animals' movements through fast-forwarded, motion-capture video that renders each animal as a single-colored blob, the physical distance between each animal, and the duration of their contact, is obvious and quantifiable.

But moving from the computer screen to observe the voles directly, Willey's account changes tenor and is worth quoting at length:

> Neither the technological images nor my own analysis of the test results captured the profoundly social nature of vole behavior. What I observed in real time, in the actual lab, were twelve rectangular cages, each with a vole "tethered" at either end and a free one running back and forth. The collars are zip ties, closed tightly around their necks. They have to be tight, because a vole does not have much for a neck. The leashes with which they are tethered are short lightweight chains, resembling pieces of a cheap necklace. The leashes are attached to the cage well above the vole's head, providing very little leeway—if the vole takes more than one step it ends up on its hind legs. The free vole's head is fitted with a plastic shunt that is inserted through the top of the skull into the brain

[8] In an important article, Augustin Fuentes reviews reports of gibbon social organization to argue that despite widespread understandings of gibbons as "the 'paragons of fidelity,' the model family unit, and the standard bearers of the 'monogamous' primates" (2000:38), in actuality gibbons are often found in groups consisting of more than one adult male and one adult female. Monogamy, he concludes, is better understood as a flexible mating strategy than as an immutable fact of gibbon biology (cf. Fuentes 1998).

> so that the drug that may or may not encourage bonding can easily be administered. The plastic has a hole in the top for a needle and sticks up about half an inch on the top of the vole's head, so that it appears to be wearing a strange little plastic top hat.
>
> . . . As I watched, standing still, back to the wall, I saw free voles approaching tethered voles and chewing hard on their collars, pushing their paws against the other's face and pulling it with their teeth. I saw free voles climb on top of tethered voles and yank at the leash with their teeth, find the point of its attachment to the cage and shake it, pull it, bite it, or balance carefully on top of it, using it as a step to try to reach the top. I also saw tethered voles chew and pull on the hats of free voles, seemingly trying to remove them. . . . In my anthropomorphic reading, the voles were prisoners, restrained and tortured, frightened, and driven to be free of the cages and of the instruments of their suffering. They were systematic, determined, and creative toward this end. And if any among them was *promiscuous* (as opposed to monogamous), they certainly were not *asocial*.
>
> . . . After this part of the experiment, and before these same voles were to be killed, Researcher A came to get me, and I asked her if the voles were trying to escape. "Oh yeah," she said, "and they're really smart." (Willey 2016:65–66)

Such work, which views science as an inherently social practice whose claims to speak for objective reality conceal a multifaceted assemblage of effort and affective relations distributed among networks of humans and nonhumans (e.g., Latour 1988), has come under sustained critique for supposedly diminishing scientific research. Only in its weakest form, however, does this imply that scientific facts are "socially constructed" or only seek to cloak cultural assumptions in the veneer of objectivity; rather, as scholars like Bruno Latour (1984) and Isabelle Stengers (e.g., 2000) make clear, it shows how the very notion of positivism—a commitment to an objective existence prior to and unaffected by representations of it—occludes the great stakes and significance of scientific research. Attention to the "construction" of scientific knowledge, Latour contends, does not diminish it (by relegating scientific discovery to "culture") but rather augments it. "Usually, the great advantage of visiting construction sites is that they offer an ideal vantage point to witness the connections between humans and non-humans," he writes (2005:88). "When you are guided to any construction site you are experiencing the troubling and exhilarating feeling that things could be different, or at least that

they could still fail—a feeling never so deep when faced with the final product, no matter how beautiful or impressive it may be" (ibid.:89). For example, Natasha Myers conducts ethnography in protein crystallography laboratories in order to trace how understandings of biology are perpetually remade in the very process of attempting to pin down its forms. Myers demonstrates that the possibility of modelling proteins is conditioned through affective and embodied engagements between humans and molecules in which the former are "molecularized" (2015) as much as the latter are anthropomorphized. Following Latour, who demonstrates a sadness over scientists unwilling to realize just how game-changing their interventions are, unpacking the political, cultural, and ethical dimensions of gibbon conservation at the Center is the only way to make clear just how radically important their work is—an importance occluded, ironically, by the way the normative commitments of endangered species conservation are presented as self-evident (see, for example, Lowe 2006).

Ontological politics

The insights of ethnographic engagements with science offer a profoundly different understanding of nature than what is typically assumed in (ethno)musicological engagements with the so-called "natural" world—not a resource for material and/or semiotic appropriation, nor a domain that operates according to wholly knowable and predictable laws, but rather something that inherently exceeds human attempts to gain totalizing knowledge of it. In the context of the sonic dimensions of science-driven endangered species conservation, Feld's notion of acoustemology remains useful. Although his original formulation, developed in the multispecies context of the Bosavis' relations with birds (2012), is often interpreted by

ethnomusicologists to be an ethnographic account of an Indigenous culture's environmental consciousness, his more recent work directly complicates those assumptions:

> To Bosavi ears and eyes, birds are not just "birds" in the sense of totalized avian beings. They are *ane mama*, meaning "gone reflections" or, literally translated, "gone reverberations." Birds are absences turned into presence, and a presence that always makes absence audible and visible. Birds are what humans become by achieving death; . . . bird sounds are understood not just as audible communications that tell time, season, environmental conditions, forest height and depth but also as communications from dead to living, as materializations reflecting absence in and through reverberation. Bird sounds are the voice of memory and the resonance of ancestry. (2017:88–89)

As it takes seriously these Bosavi claims, Feld's work not only is immune to its typical dismissal by ethnomusicologists as an ethnographic account of a culture distinguished by its "closeness to nature" (e.g., Graper 2019) but also anticipates the more recent emergence of political ontology, an approach originating in anthropology and science and technology studies attuned to incompatibilities between Indigenous knowledge systems and Western science (e.g., Greene 2013; de la Cadena and Blaser 2018). These studies go beyond political ecology, the study of conflicts over control of and access to natural resources (Anderson and Berglund 2003; Dove et al. 2011), to maintain that non-Western understandings of animals and environments are not simply cultural meanings mapped onto scientifically determined taxonomies. Instead, they are taken seriously as contradictory metaphysical systems with independent definitions of, and ethical obligations towards, what counts as nature and what as a person. Such "contested ecologies" (Green 2013; cf. Lowe 2006) are not only political in the sense of disputes over their management, but further "cosmopolitical," at stake the authority to dictate the conditions and population of the cosmos where the conflict plays out (Latour 2004; Blaser 2016).[9]

[9] Originating with philosopher of science Isabelle Stengers (e.g., 2005), the notion of cosmopolitics is meant to directly complicate the standard Kantian notion of cosmopolitanism. Whereas for Kant, the achievement of cosmopolitanism resulted from one's transcendence of parochial biases and worldviews to become a citizen of a singular cosmos, postcolonial science studies has thrown the positivist underpinnings of this conception into question. In particular, it rests upon what Roy Bhaskar calls the "epistemic fallacy" (1975): the misconception that

In a famous essay, for example, Mario Blaser (2016) examines a clash over a hunting ban between the Indigenous Innu and the Canadian government to show that whereas the government's environmental policy makers, informed by scientific knowledge, treat caribou as members of a particular biologically determined category whose population has been reduced through human intervention, the Innu understand them as the means, through their hunting, of establishing a relationship with a particular other-than-human entity significant in their cosmology. Blaser locates a profound irony in this misunderstanding: for the Innu, the very means for maintaining sustainable ecological relations between humans and non-humans are those seen to be destroying it according to the scientific viewpoint. Rather than treat these two worldviews as incommensurable perspectives on the same object (the caribou), Blaser argues that Western and Innu understandings of "caribou" refer to two different yet related entities (or better, classes of entity), and for that reason the target of Innu hunting practices should not be called a "caribou" at all, but instead an "atiku" (the Innu language's equivalent). This implies, for example, that fundamental differences between animals and humans, the assumptions that lead to criticisms of anthropomorphism and projection, need to be critically reexamined.

While studies have followed the conflicts playing out over the differing ontological status of entities from (what are conventionally understood as) geological formations (de la Cadena 2015; Povinelli 2016) to fish (Todd 2016; Law and Lien 2018), and have in fact taken seriously the presence of the aural as a marker of non-human personhood (e.g., Povinelli 1995; Cruikshank 2015), sound's entanglement in ontological politics has attracted less attention. Indeed, the scholarship of the three thinkers whom Martin Holbraad and Morten Axel Pederson (2017) name

with enough effort, human representations (epistemology) can accurately mirror reality (ontology). Not only does this framework rely on the positivist faith in a reality wholly distinct from any one observer's experience of it, but it further establishes a hierarchy measured by the degree to which one's knowledge system reflects the composition of that singular cosmos.

as the primary influences behind the "ontological turn"[10]—the call to take seriously "a plurality of worlds, rather than simply worldviews" (Henare et al. 2007:18; cf. de la Cadena and Blaser 2018)—is couched in explicitly ocularcentric terms, whether Eduardo Viveiros de Castro's "perspectival multinaturalism" (1998), Roy Wagner's figure-ground inversions (e.g., 1986, 2001), or Marilyn Strathern's description of the process that enacts "partial connections" (1991) as "making visible" (1988). Ana María Ochoa Gautier's 2016 article, building on her 2014 analysis of the divergent ways in which the European naturalist Alexander von Humboldt and the Indigenous Yekuana were recorded to have divergent understandings of the meaning of animal vocalizations in early 19th century Colombia, calls for extending Eduardo Viveiros de Castro's perspectivism—in which "all beings see ('represent') the world in the same way, [and] what changes is the world that they see" (1998:477)—to sound: "acoustic multinaturalism."[11] Beyond hints of radically incommensurable formulations of the nature of sound in works like Anthony Seeger's 1992 questioning of Western copyright law as it applies to Kĩsêdjê songs learned from non-human animals, however, the strongest articulation is found in Dylan Robinson's monograph *Hungry Listening*, framed as it is around nothing less than "contrasting ontologies of what song is from Indigenous and Western perspectives" (2020:9). Building on these scholars' approaches, this dissertation devotes attention to the ways in which sound is not only itself ontologically plural, but may also act as the medium for other expressions of ontological plurality.

[10.] Due to its emphasis on productive multiplicity and alterity, I understand this "ontological turn" to be distinct from the concurrent "ontological turn" in philosophy and political science, in which the goal is to move past Kantian approaches and actually pin down the precise nature of reality (e.g., Meillassoux 2007; Bennett 2010; Harman 2005), even if both converge in their critiques of Western metaphysical dualisms.
[11.] Indeed, Ochoa Gautier cites Feld's work as an important precursor.

Yet the insistence upon ontological plurality that characterizes anthropology and STS's distinct expression of the ontological turn has made it the target of a sustained critique taking it to task for its apparent exoticizing of non-Western worldviews. Such an "awe of alterity holds up only so long as the ground of ontology is kept clean," Bessire and Bond write (2014:447). "Coca-Cola cans, shotguns, soccer balls, evangelical icons, petrochemical pollution, trinkets for tourists, and T-shirts from Grand Rapids—to name a few of the things we have encountered in far-flung Indigenous villages—are brushed aside, as the dreams of dogs and chants of elders come to stand in for the most pressing form of material becoming" (ibid.). Ontological anthropology, in this view, relies upon sorting out the perceived contamination of Enlightenment thought; it "is incapable of accounting for those disruptive beings and things that travel between ontologies" (Bessire and Bond 2014:446).

David Graeber, in an essay replying to Viveiros de Castro's critique of his apparently dismissive treatment of magic in Madagascar, echoes Bessire and Bond's concerns by characterizing ontological anthropology as the inheritor of structuralism's impulse to "place . . . people in boxes not of their own devising" (2015:34). Emphasizing ontology, he argues, "just substitutes a deeper box. Some people like deep boxes," he continues. "But by that same token, one must respect the desires of those who wish for their boxes to be shallower, or do not wish to be placed in any sort of box at all." Graeber counters with what he calls a combination of "ontological realism with theoretical relativism" (ibid.:3), a proposal that rather than accepting the existence of a near-infinite "pluriverse" of fully accessible, if mutually incompatible, worlds (cf. de le Cadena and Blaser 2018), what defines reality is instead its inexhaustibility. "Radical alterity is just another way of saying 'reality,'" as he titles his essay.

Ironically, I find in Graeber's issue with the ontological turn to be an extraordinarily powerful description of its promise. Radical alterity is not just found where modernity is not, nor should extreme relativism obviate any possibility of critique. Although for Graeber the ontological turn potentially "makes it effectively impossible for us to recognize one of the most important things all humans really do have in common: the fact that we all have to come to grips, to one degree or another, with what we cannot know" (Graeber 2015:22), its adoption by political ontology (e.g. Blaser 2016 above), I contend, does not imply a "deferral of critique" (Bessire and Bond 2014) but rather reminds people dogmatically committed to a particular version of nature (like the environmentalists described by authors like Dowie [2011] and Martínez-Reyes [2016]) that life inherently exceeds any and all attempts to account for it. Celia Lowe, for example, makes this point explicit in her 2006 study of the politics of environmental conservation in Indonesia by framing it as a "multisited ethnography in a single locality" (2006:6). Plenty of ethnographers are interested in the ways in which their interlocutors are able to reconcile statements they find to be obviously contradictory (famously, Evans-Pritchard 1937)—for example, Lys Alcanya-Stephens' (2012) study of a chimpanzee sanctuary in Catalunya, in which she extends the Orwellian concept of "doublethink" to account for the fact that keepers describe their charges interchangeably as mindless animals and wholly rational persons. Rather than treat such ontological plurality as contradictory and in need of resolution, however, I demonstrate it to be generative. Indeed, many of the very topics abstractly debated in academia—whether of more-than-human personhood, the phylogenetic evolution of music, or the behavior of sound waves as prescriptive model for ecological and social relations—are not problems to be resolved but precisely the productive "controversies" (Latour 2005; cf. Bubandt 2017) that I argue characterizes the practice of gibbon conservation.

The insights of the ontological critique therefore align quite nicely with those of social studies of science: the conceptual frameworks that inform and inspire scientific work are themselves the products of actual people, emerging at specific times according to particular circumstances (see Shapin and Schaffer 1985). These theoretical ideas, whether social or scientific, hold serious consequences for individual gibbons and/or their species. For gibbons, theory matters; the emergence and implications of particular "paradigms" (Kuhn 1962) are as much a part of the story of gibbon conservation this dissertation tells as are the "ontics and antics" (Haraway 2008) of the Center's gibbons and their caretakers. What Charis Thompson calls "philosophies of nature" (2004) matter; as I show in Chapter 3, even *Nature* matters. Therefore, although throughout this dissertation I make copious use of theory to aid my ethnographic analyses, at other points the emergence and adoption of certain theoretical orientations is itself the object of my analysis. For example, Chapter 3 examines the impact of neo-Darwinian evolutionary theory, and its genetic determinism, on policing what forms of coupling are acceptable in the context of a captive gibbon breeding program. A sociohistorically specific elision of musical and political theory, I show, did not only make possible the development of sociobiology but continues to be reproduced every time a pair of gibbons are compulsorily coupled for the purpose of their species survival. Chapter 5 examines the assumptions behind soundscape theory to argue that the concept of the soundscape itself hypocritically relies upon the very mixing of the subjective and objective it decries, and justifies hostility toward the Center on the basis of the volume of gibbon vocalizations. Sometimes my two uses of theory elide: in Chapter 2, I begin by applying the feminist STS concept of "involution," in which different species "reach toward one another and involve themselves in one another's lives" (Hustak and Myers 2012:96) to help theorize the listening practices of expert

gibbon caretakers, but conclude by tracing anthropology and STS's widespread adoption of involution as an ethical imperative under the specter of the Anthropocene—and the consequences this framework holds for gibbon futures.

In a short essay, Alice Rudge devotes ethnographic attention to the uses of laughter among the Batek of Malaysia to propose that the possibilities of failure and misunderstanding are crucial aspects of livable worlds (cf. Steingo 2018 on failure). "Reclaiming the potential for the failure when living among others . . . offers a challenge to the 45ntology45al45g idea that indigenous peoples inhabit multispecies worlds that are somehow more relational, or more spontaneously co-ordinated than capitalist or 'Western' ones" (Rudge 2020). She reminds us that the cultivation of efficient co-ordination and coherence is characteristic not of the sorts of ontologies interesting to anthropologists searching for alternatives to Western ecocidal hegemony, but rather of one of capitalism's most potent expressions: the palm oil plantation (see Tsing 2012; cf. Blanchette 2020 on the industrial hog farm). Throughout this dissertation, I remain attentive to ways in which the theories used to understand and mitigate ecological crisis become ironically predicated upon intensifying practices of extraction, exclusion, and oppression, through which the burdens and benefits of its mitigation become distributed across individuals, cultures, species, and environments in profoundly unequal ways. When the only solution for environmental precarity seems to be epistemological and/or ontological certainty, it is important to remember, as Anna Tsing writes, that "indeterminacy also makes life possible" (Tsing 2015:20; cf. Barad 2007).

For one example of this slippage, consider the immeasurably influential philosophy of Gilles Deleuze and Félix Guattari, whose collaborative work *A Thousand Plateaus* famously proposes a distinction between "arborescent" and "rhizomatic" ways of being. The former,

consisting of rigidly ordered, linear and hierarchical connections that either progress or branch off into increasing differentiation (see Helmreich 2003; Hustak and Myers 2012; Hejnol 2017), is contrasted with the subterranean organization of the latter that lacks a formal beginning and end, is Is multiple, and is on the way to becoming something else. "Any point of a rhizome can be connected to anything other, and must be," they write; "a rhizome ceaselessly establishes connections between semiotic chains, organizations of power, and circumstances relative to the arts, sciences, and social struggles" (Deleuze and Guattari 1987:7). Deleuze and Guattari's call to avoid arborescent thinking has offered several generations of philosophers and anthropologists a set of powerful conceptual tools with which to disrupt the repressive metaphysics of Western modernity and the ecological and social consequences thereof (e.g., DeLanda 2004; Puar 2007; Viveiros de Castro 2010).[12] Given how much the intellectual responses to ecological catastrophe are indebted to cultivating rhizomatic epistemologies, however, I am struck by the irony of combatting the serious issue of terrestrial deforestation (one of the key factors in gibbon endangerment) by demanding nothing less than an intellectual deforestation.[13] The predictable stability of tree branches that Deleuze and Guattari connect to repression and fascism is precisely what gibbons count on as they brachiate through the forest canopy at breakneck speed.

For that matter, what does a rhizome mean to a gibbon? For animals that spend their lives dozens of meters above the forest floor, encountering a rhizome (whose shoots typically only reach several feet above the ground) can only foreshadow an encounter of a much more terrestrial—and terminal—sort. At the Center, however, rhizomes like sweet potatoes are among

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12. For an exemplary application of rhizomatic thought to ethnomusicology, see Gill (2018).

13. In *When Species Meet*, Donna Haraway takes issue with another expression of Deleuze and Guattari's frustrating gift for productively identifying dualisms, but then inevitably declaring one valuable and the other damaging. In particular, Deleuze and Guattari make an insightful distinction between individuation and multiplicity, organism and species (which I address in Chapter 3), yet conclude that only the latter is politically and ethically desirable. For more impatience with the promise of Deleuzian thought, see Tuck (2010).

the gibbons' favorite foods. The conditions for their enjoyment are telling: sweet potatoes are only palatable to gibbons after undergoing a long steaming process that, in the summer, raises the Center kitchen's temperature far above the already scorching weather. The work involved in allowing gibbons to enjoy rhizomes (and benefit from rhizomatic thought) neatly anticipates many of this dissertation's themes: gibbon conservation involves human effort and sacrifice, fraught ethical decisions, and the supply chains that make available both physical commodities and intellectual histories (e.g., the socio-historically specific understanding of "nature" [see Daston 2019] that influences the choice to provision gibbons with foods they would not encounter in the wild).

Sounding the human-nonhuman primate interface

My attention to ways in which acts of sounding and listening condition the possibility of human-gibbon relations in the context of gibbon conservation draws inspiration from ethnoprimatology (e.g., Riley 2018), a field emerging in conjunction with the widespread turn to "multispecies ethnography" (e.g., Rose 2000; Haraway 2003, 2008; Kirksey and Helmreich 2010; Lorimer 2010; Locke and Buckingham 2016) and animal studies (Derrida 1990; Despret 2004, 2005, 2008, 2013; Haraway 2008) across the humanities and social sciences. "Ethnoprimatological approaches," in the words of Augustin Fuentes (2012:102), "affirm the role of humans as primates and of other primates as coparticipants in shaping social and ecological space, recognizing mutual roles in both ecological and cultural interconnections." And, as with ethnomusicology,

> the "ethno" prefix marks the inclusion of anthropogenic aspects, including the social, economic, and political histories and contexts as core components of inquiry into the lives of other primates and their interfaces with humans; . . . importantly different from the use of the "ethno" prefix in "ethnobotany" or "ethnomathematics," in which "ethno"

> marks a cultural distinction in the specific way of knowing under study from Western forms of the practice. (ibid.)

Erin Riley adds to this distinction that "while ethnoprimatology can indeed encompass local knowledge and perceptions about primates, it is more than that; it also encompasses a much more literal meaning, with 'ethno + primatology' signifying the intersection of human and nonhuman primate lives and livelihoods across both time and space" (2010:77).

Although a number of ethnoprimatological studies have focused on representations of nonhuman primates within traditional societies (e.g., Wheatley 1999), and/or the impacts of these traditional relationships on conservation work (e.g., Dore et al. 2018; Turvey et al. 2019; Waters et al. 2018), the larger trend of the field has been to reject an epistemological and methodological commitment to studying neatly bounded cultures and/or species in favor of ethnographic situations in which multiple "primate species are simultaneously actors and participants in sharing and shaping [their] mutual ecologies" (Fuentes 2010:600). By focusing on the emergent "human-nonhuman primate interface" (Fuentes 2012, Riley et al. 2017), ethnoprimatology avoids earlier primatological preoccupations with separating out mutual human-nonhuman primate influences to get at "pure" states or "natural" behaviors, what Riley calls the "unnatural problem" (2019:55).

Despite this exemplary contribution to rethinking many of the "key concepts" (Riley 2018) that restrict positivist science within the context of productive scientific research, ethnoprimatology has yet to attend to the role of sound and listening practices in constituting the possibility of an interface between human and nonhuman primates. Even gibbons, notwithstanding ethnoprimatology's geographic emphasis on their endemic habitats of Indonesia (and Southeast Asia more generally), have received scant attention (e.g., Reisland and Lambert 2017; Pacciuli and Sabbi 2017; Palmer and Malone 2018). And none among this short list

privilege gibbon vocalizations. While my plans to conduct more conventional ethnoprimatological investigations at the Center—such as a comparative study of the gibbons' reception to different people's attempts to imitate their vocalizations—were thwarted by the onset of the COVID-19 pandemic, ethnoprimatology's emphasis on the emergent composition of the human-nonhuman primate interface remains a key dimension of my thinking.

Attending to the sonic dimensions of gibbon conservation's human-gibbon interface entails attention not only to sounding and listening bodies but also responses to, and ideas about, sound. Rather than focusing solely on specific sonic interactions (although there are plenty), this dissertation is concerned with a different sort of interface that perpetually resounds at the Center: the specific histories of listening that inform at once the practice of, and the theory behind, gibbon conservation.

Chapter outline

Following the current chapter's theoretical and ethnographic exposition, Chapter 2 explores the particular ethical and methodological challenges of researching and caring for gibbons through sound. Engaging with a recent rethinking of primatological habituation (in which success emerges not from achieving objective distance but rather from the establishment of an intersubjective relationship between observer and observed), it proposes that the listening practices of the GCC caretakers—which are diametrically opposed to what Rachel Mundy calls "evolutionary listening," in which animal vocalizations are parsed for what information they may yield about humanity's assumed superiority and evolutionary distance—can be understood as "involutionary listening." Exploring the aural dimensions of involution (a concept developed in Hustak and Myers' 2012 feminist reading of multispecies becoming; see above), this chapter

contends that the capacity of the Center caretakers to both affect and be affected by the Center's soundscape is what makes possible everything from everyday interspecies encounters made mundane and prosaic by their ubiquity, to pivotal moments in the life of the Center as well as its staff. Here, controversies over the possibility of non-human primate subjectivity, agency, and personhood are not matters for philosophical or political debate but rather re-orient gibbons, through attention to their vocalizations, as potential collaborators and sources of motivation and inspiration.

The next two chapters discuss the Center's participation in the gibbon Species Survival Plan® (SSP)—a program designed to preserve the genetic hygiene of the US captive gibbon population through carefully planned breeding. Chapter 3 argues that ideas about sound provide the very conditions for the possibility of conservationists understanding and evaluating the genetic measurements that indicate of reproductive compatibility among the gibbons they manage, in particular revealing how the musical metaphor of harmony potentially shapes the reproductive biopolitics of this matchmaking project. Unpacking a punning term once used by certain Center staff member for the gibbon SSP, "gharmony" (a play on the human matchmaking website eharmony.com), this chapter makes two claims. First, by critically reading historical invocations of harmony as a natural principle (in particular the philosophical biology of Jakob von Uexküll), it demonstrates that by providing a way of conceptualizing the conditions for the possibility of genetic relatedness (as determined by inherent properties of individual bodies antecedent to their pairing) and the mathematical tools for measuring kinship (normal curves, probabilistic mathematics/predictive calculus), harmony structures an aspirational vision of environmental justice, in which species are saved from extinction, achieved at the direct expense of reproductive justice for members of those species. Second, this chapter argues that the

particular form of compatibility afforded by harmony applies to more than the pairing of living gibbons, and harmonized in the process of captive breeding are only animals but also concepts, consequently reproducing animal lives concurrently with reproducing particular models of what life is and how it should be fostered.

Chapter 4 turns to examine how these concepts of life hold up as they are implemented in practice. By examining the ways in which the Center caretakers listen to the events that are actual gibbon pairings, this chapter sounds out an acoustemology of gibbon husbandry that obviates several of the key assumptions behind the version of nature modeled and reproduced by the gibbon SSP—namely genetic determinism, economic competition, and the ontological subordination of the individual to the species. Several cases demonstrate not only how the staff makes space for individual welfare in a program in which individual lives are but a flicker on algorithmically generated records of genetic retention, but further how the process of implementing the SSP breeding recommendations obviates the very biological models they intend to reproduce. Instead, ethnographic attention shows how the gibbons' sonic and social compatibility is not a pre-existing object under threat but rather a continual achievement realized precisely through the sorts of collective affiliations that cut across various material and epistemological categories of gibbon conservation's taxonomy. In particular, the gibbon SSP constitutes a paradox that complicates fundamental distinctions between the concepts of nature and nurture, body and environment: attempts to prevent a bounded entity (the SSP's concept of species) from changing end up remaking it into an assemblage no longer coextensive with gibbon biology, but rather comprising a heterogeneous array of bodies and technologies—including the caretakers' ears.

Chapter 5 explores a range of ways in which the acoustic may interfere with, rather than enable, the Center's project of gibbon conservation. The chapter's main focus is the Center's prodigious attempt to relocate to a permanent site, which after overcoming a number of financial and legal pressures ultimately failed due to the new community's hostility towards the loudness of gibbon vocalizations. Through analysis of this case in which the sounds of endangered species were deemed unwelcome, it complicates conservation science's investment in the notion of the soundscape, in which anthropogenic "noise pollution" is contrasted with the "healthy" sounds of an ecology's biological functionality. Analyzing the public newspaper editorials and internet memes circulated by members of that community, this chapter contends that their calls to protest the Center's relocation by "making more noise" than the gibbons model a political ideology in which power is a function of relative amplitude, consequently collapsing the intricate semantic, social, and ethical affordances of the acoustic into a one-dimensional competition for volume. The perceived mechanics of gibbon song, for the Center's adversaries, ironically became at once the object of complaint and metaphor for its overcoming. Understanding this treatment of the acoustic as what I call "sonic NIMBYism," I locate it as well in other forms of exclusion gibbons are subjected to because of the perceived qualities of their vocalizations; particularly the policing of the definitions of "song" and "music" as more-than-human phenomena.

Returning to the caretakers' descriptions of the everyday soundscape of the Center, a site in which the natural and the technological are constitutively entangled, this dissertation concludes by locating in the backbreaking, messy labor of caring for gibbons in captivity a human-gibbon interface characterized by a veritable ontological heterophony that is anathema to the very epistemological and ideological normativity of conservation biology. Arguing for critical attention to the listening practices of gibbon conservation without romanticizing the

acoustic, I examine the claims underpinning scientific assumptions regarding the nature of sound and the sounds of nature. Rather than treating the acoustic as either a medium of, or panacea for, the ecocidal harms of settler colonialism and capitalist extractivism that characterize the Anthropocene, this dissertation concludes that gibbon conservation's elision of to ontological and the ontological is precisely the medium through which the possible futures of gibbon species will be realized.

Chapter Two

Habituating Gibbon Caretakers

Gabriella (Gabi) Skollar has been the director of the Gibbon Conservation Center since 2014. Her involvement with the Center began another ten years earlier: a native of Hungary, in 2004 Gabi was in the final stages of a Master's degree at the University of Szeged, studying gibbon cognition, but unable to graduate without satisfying a requirement necessitating proficiency in the English language. With the assistance of a small travel grant from the Hungarian government, she reached out to a collection of zoos in the United States and England with the goal of studying English in a setting in which she could continue to work with gibbons.

Figure 2.1: Gabi Skollar (R), director of the Gibbon Conservation Center, handing a roasted zucchini to Astriks (L). Photo by author, 10 June 2019.

Among the individuals she contacted was Alan Mootnick, who had founded the Center in 1976 and remained its director until his untimely death in 2011. “I have no money, but I will work every day. That’s pretty much all I said [to him]!” (Interview, 6 January 2020). Although by the time Alan responded she had already made plans to volunteer at a zoo in the United Kingdom, she was ultimately swayed by the larger number of gibbon species housed at the Center.

As Gabi told me, her initial experience was fraught with difficulty. Even acquiring her US tourist visa, so that she could legally work as a volunteer, was memorable, as it required that successful candidates could demonstrate the social ties and financial stability that would ensure visa holders would return home. “So I went to the interview,” she says, laughing, “and said I have zero money in my bank account, I was not married, I had no job” (ibid.). Instead, “we just talk[ed] about monkeys. Seriously. They had no clue what a gibbon is.” As a result, her interviewers’ initial concern regarding her potential food insecurity was alleviated: “they were joking with me, saying that I would eat bananas!” (ibid.).

Gabi described to me her arrival at the Center as a similar combination of challenge and absurdity; her very first night, the roommate with whom she was to share a small Airstream trailer returned after midnight from an evening of heavy drinking and proceeded to keep her awake with the sounds of vomiting. She recalls a distinct sense of loneliness, exacerbated by her lack of English, by homesickness, and by physical exhaustion. Having put so much work into the trip, however, with nothing to her name but “two hundred bucks . . . and a backpack” (ibid.), she decided to “stick it out” (ibid.) and see the six months through.

“The first morning,” she told me, “I woke up with the white cheeks singing, went outside and watched them” (ibid.). But then “I came into the house, and seriously as soon as I came in

they told me to wash my hands and start cutting apples. . . . I was just put to work, and I went out to feed [the gibbons] right away. . . . [I] started training from the first day" (ibid.). She recalls that "the first months were hard," but by the end of her stay she had a change of heart. "Getting close to the end of the six months and my flight [back to Hungary], I was just getting depressed about leaving and very sad. I remember when we were actually heading to the airport I was just crying all the way—I couldn't stop!" Upon returning home she immediately began researching ways to return, and although it took another six months, she was able to secure a yearlong scholarship from a private Hungarian organization (the Rosztoczy Foundation) to study gibbon vocalizations at the Center. And she never left—at least in spirit.

For Gabi, attention to gibbon vocalizations were central to developing the expertise that led to her eventual appointment as director. During the early days of her work at the Center, she recalls, her training as a caretaker had stalled—understanding that her time in the United States was limited to only several months, Alan and the volunteer coordinator had decided to task her with minimal responsibilities in order to avoid the investment of time more detailed training entails. Gabi explained that she would "just . . . do what needs to be done, and then the rest of the time I was just out observing the gibbons, just stay[ing] outside" (Interview, 6 January 2020). "But after a couple of months," she told me, "I noticed a few things, especially about the hoolocks and their song—the way they were singing, and trying to coordinate" (ibid.). As an example, she described a time in which "we had the two pairs of siamang, and they were singing, and then Rumi, a female, started making a different sound that eventually sounded more like the male" (ibid.). And with her interest piqued, she began recording the gibbons with which she was cohabitating. "Especially when something changes or something is . . . out of the ordinary," she exclaimed, "then things get interesting!" Gabi's ability to discern increasingly subtle differences

in the cacophonous atmosphere of dozens of vocalizing gibbons led even Alan to recognize her expertise: recalling a visit by a prominent gibbon researcher who asked Alan to describe the differences between the male and female hoolock vocalizations, Gabi told me that Alan's response was, "um, I don't know, ask Gabi!" (Interview, 25 November 2019).

And as Gabi's aural skills increased, so did her responsibilities; after she had a year's experience volunteering, she was regularly left in charge during Alan's regular travels away from the Center (his expertise on gibbon behavior and conservation put him in high demand as a speaker and consultant). "Sometimes we had arguments that I shouldn't make decisions, that I always had to consult with him. But anyway," she laughs, "I completely ignored him, like 'No! You're away, I'm making decisions based on my knowledge and what the gibbons need'" (Interview, 6 January 2020). Gabi's emphasis on decision-making and obligation is echoed in a recent work by Max Liboiron—the director of CLEAR, a plastics pollution research lab that foregrounds feminist and Indigenous epistemologies—who notes that "Every morning when I put on my lab coat, I have decisions to make. How will we do science today?" (2021:113). "These are not theoretical questions," they note; "they are practical questions, questions of method-and-ethics (hyphenated because they are the same thing)" (ibid.). In this chapter, I consider how sound and listening condition the possibility of gaining knowledge about gibbons, and explore the ethical and methodological problems raised and/or resolved by doing so. Contrasting the expert listening practices of longtime Center staff with my own inchoate attempts at conducting auditory research on the human-gibbon interface, I argue that attention to the acoustic can both help tease out what is at stake in scientific practices of objectivity and suggest a more ethically and methodologically sound approach to forming and theorizing multispecies relations.

Sound and objectivity

Alan, who up until his death sustained the Center through what the documentary *The Center: Gibbons and Guardians* (2021) implies to be sheer force of will, managed a construction business that supported the Center financially during the day while attending to his research and its operations at night (see Mootnick n.d.). Although he had no formal primatological training, his sizable list of publications demonstrates his dedication to disseminating information about those animals that were his life's work, in one memorable instance excoriating in print those academically trained, yet "inexperienced taxonomists" unable to discern the physical signs understood to differentiate gibbon species (Mootnick 2006:103). Indeed, Alan's intellectual interests lay with taxonomic classification, and the majority of his publications deal with that topic (but several studies compiling anecdotal accounts of uncommon gibbon behaviors, like masturbation [Mootnick and Baker 1994], that only become discernable through long-term, continuous observation). Alan's scientific interest in gibbons, however, did not apparently extend to their vocalizations. His appreciation, instead, appears to be mainly aesthetic; he begins a short reflection on his career by stating that:

> My fascination with gibbons began at age 9 when I first heard them vocalizing at the zoo. . . . From that day on I wanted to care for gibbons and asked my parents if I could have a zoo of my own. . . . So I began by carrying the neighbors [sic] trash out for 10 cents a week to pay for the care of my rabbits and pigeons. . . . Although my original motivation to be in this field was the simple joy of being around gibbons, and still is to a large extent, I now feel I can honestly call myself a primatologist. (Mootnick n.d.)

The obituary note shared by Center leadership, furthermore, specifically mentions the recording of gibbon song playing at the time of his passing (Gibbon Conservation Center n.d.). In our discussions, however, Gabi struggled to recall any time they had spoken about gibbon song together. She knew that he was capable of identifying gibbon species based on their vocalizations, remembering that he had lent this service to gibbon owners uncertain of their

animals' pedigree, but "for some reason," she said, "we just didn't talk about vocalizations" (Interview, 6 January 2020).

Instead, as Gabi described it, her initiation into gibbon ethology was conditioned by Alan's insistence upon on a rigorously quantitative approach to behavioral data collection:

> He was very strict. We were trained as a pair: we [would] collect the information, and if it wasn't 100 percent [matching], [it meant] we were not ready to do it! We were not supposed to talk with each other, so we collected the observations for hours and hours, until we were completely 100 percent. And [only] then were we ready. . . . There were other volunteers who were also collecting data from different zoos, all [to be] analyzed at the Center by him. (Interview, 6 January 2020)

Such a concern with repeatability and the reduction of bias reflects Alan's attempts to produce objective knowledge. As Lorraine Daston and Peter Galison write in their lengthy history of objectivity's emergence as a scientific value, objectivity means "to aspire to knowledge that bears no trace of the knower—knowledge unmarked by prejudice or skill, fantasy or judgment, wishing or striving" (2007:17). Banu Subramanian, however, points out that these commitments, such as "the belief that science does not have a culture, . . . are ultimately intellectual and epistemological moves" (2014:181). Consequently, "scientists' individual identity does not matter because scientists are interchangeable, all independent nodes in the production of knowledge" (ibid.).

Numerous works in sound studies have addressed the way in which sound has been treated as incompatible with scientific objectivity. In studies of both field and laboratory science, for example, scientific preoccupations with the visually observable and quantifiable are shown to subordinate aural skills crucial to the acquisition of data (e.g., Mody 2005; Roosth 2009; Bruyninckx 2018, Pinch and Bijsterveld 2012). Indeed, the commitment to autonomy and atomism necessary to divine the essential nature of an experimental object was understood to be threatened by the state of sympathetic vibration; even the formation of the modern Cartesian

subject, as Veit Erlmann shows (2010), was not predicated on the banishing of a sonic epistemology (as earlier studies [e.g., Connor 1997] argued), as much as it relied on a sonic metaphor to conceptualize individuality, autonomy, and originality. "Resonance," understood in terms of "adjacency, sympathy, and the collapse of the boundary between perceiver and perceived" (Erlmann 2010:10), became that which individual "reason" was measured against.

When Gabi told me that senior primatologists questioned her career choice by saying, "Why gibbons? They don't do anything, they just sleep on a tree and sing," I was not surprised. "[They] almost tried to talk me out of them. Like, 'don't study gibbons! They are boring!'" (Interview, 11 December 2019). Gibbon song, apparently, did not elicit the same scientific interest afforded to more physically measurable or visually observable dimensions of primate behavior.

In our discussions, Gabi contrasted Alan's methodology, characterized by its attempts to reduce subjective interpretations by demanding a full equivalence between the conclusions of multiple observers, with her own experience of analyzing recordings of gibbon vocalizations by ear. While the former process allowed Alan to detach from the process of data collection itself and focus on subsequent analysis, for Gabi, proper understanding of audiovisual recordings is only possible if she had experienced the recorded event herself, firsthand. Such recordings were not a substitute or a perfect reproduction of the event: "when you have a recording and you're not there," she said, "it's completely different!" (Interview, 6 January 2020). Proper analysis of audio recordings, she suggested, cannot be accomplished without the sorts of prior familiarity with, even affective understanding of, the subject matter, that conventional understandings of scientific objectivity treat not only as superfluous, but as actively what prevents the acceptability of its conclusions.

In particular, Gabi's emphasis on "being there" as a precondition for obtaining knowledge resonates with Donna Haraway's famous 1988 proposal that knowledge and objectivity, as conventionally understood, are not produced through the absence of such a "trace of the knower" (Daston and Galison 2007:17), but rather by imagining the inhabiting of one particular subjective viewpoint as its conditions. "All Western cultural narratives about objectivity," Haraway writes (1988:583), "are allegories governing the relations of what we call mind and body, distance and responsibility." If the possibility of obtaining knowledge untainted by power relations is largely a myth, she reasons, then ethically necessary instead is the recognition of what she calls "situated knowledge," knowledge in which the positionality of the knower is integrally implied rather than denied. As Haraway writes, such a project should "offer a more adequate, richer, better account of a world, in order to live in it well and in critical, reflexive relation onto our own as well as others' practices of domination and the unequal parts of privilege and oppression that make up all positions" (ibid.:579). Situated knowledge is at once ethical, epistemological, and political; indeed, it puts pressure on theories of knowing and being that seek to separate these three domains.

Habituating gibbon caretakers

The production of knowledge ostensibly untainted by the positionality of the knower, what Haraway famously characterizes as "the god trick of seeing everything from nowhere" (ibid.:581), is precisely the goal of one of primatology's most foundational research methodologies: habituation. As conceived by Clarence R. Carpenter, one of the first primatologists to conduct field research (indeed, among gibbons in Thailand), habituation is a methodological strategy for obtaining behavioral information about non-human primates in what

is often described as their "natural habitats," specifically conducted in order "to observe the activity as it would have occurred had there been no observer present" (Carpenter 1934:22). In practice, habituation requires a lengthy process of gradual introduction, stretching from months into years depending upon the primate species under investigation, at the end of which "the animal behave[s] toward the investigator as if he or she were a socially insignificant part of the environment" (Estep and Hetts 1992:11).

Recent work in ethnoprimatology and science and technology studies has begun to rethink two key tenets of this classical primatological technique: both its epistemological commitments (in which objective, untainted knowledge is obtained by reducing the "presence" [see Despret 2013] of outside influence) and directionality (that habituation is something "done" by humans to animals). In a 2018 article, ethnoprimatologists K. T. Hanson and Erin Riley theorize the result of field habituation as not the erasure of the researcher's presence, but rather the opposite: habituation, they write, "actively engages both the researcher and the study group, transforming both in the process, and . . . is perhaps better characterized as a flexible, context-dependent spectrum of heightened observer tolerance" (Hanson and Riley 2018:874). This approach, in particular, calls attention to a quirk of field primatology noticed as early as the 1980s with the work of Barbara Smuts' field studies of baboons, in which she quickly realized that acting "neutral" (i.e., ignoring the baboons and avoiding eye contact) actually had a meaningful valence in baboon society (Smuts 2001). Instead, Hanson and Riley attend to "the co-shaping of humans and primates as the process of habituation unfolds" (2018:854) at their field site in Sulawesi. And widening the lens from nonhuman primates to study the role of habituation in meerkat research, Matei Candea (2012) shows that even the condition of

detachment that defines the classic notion of habituation requires cultivation and therefore is itself a form of social relation.

Whereas the term "habituation" is most often understood to apply to non-human primates being studied by human researchers, Lys Alcanya-Stephens attends ethnographically to the work of bonobo field research to argue that as much as they are invested in habituating the bonobos they study, bonobo researchers also undergo their own experiences of habituation in which they transform from clumsy, insensitive sylvan interlopers to skilled actors attuned to the forest's multimodal sensorium. "In the animated environment of the rainforest," she writes, "it soon becomes less clear what kind of verb 'habituate' is: Do researchers simply habituate to their environment? Do they habituate *themselves* to the elements of the forest through effort and reflexivity? Or might they be, in part, habituated by the forest and its beings?" (2016:834; original emphasis). In one memorable passage, indeed one of the few in the literature to devote attention to the usages of sound in field primatology, Alcanya-Stephens discusses these researchers' imitation of their bonobo subjects' long-range vocalizations, which they have adopted as an optimal method of communication in the dense forest.

Understanding the process of habituation in this manner recasts the non-human residents of the Center not as passive entities to which gibbon caretakers must become adapted, but rather as active participants with which knowledge and skill are mutually developed. In particular, the lens of habituation offers the possibility of understanding how Gabi and Alma's aural abilities and competencies were shaped by the beings to which they constantly listen, intently and intimately. Alma, for example, told me about a "gradual" recognition of the subtleties and nuances of each gibbon's "voice," specifically differentiating between the "little soft cooing sounds, for wanting the food, and the sharp inhale for not wanting it" only made by an adult

female Javan gibbon named Khusus when offered certain fruits and vegetables (Interview, 8 August 2020). This sort of acquisition of new categories of perception is theorized by Bruno Latour as the act of "articulation" (2004a). Latour's example is the process of becoming a "nose," that is, a perfumer who is "able to discriminate more and more subtle differences and able to tell them apart from one another, even when they are masked by or mixed with others" (ibid.:207). Suggesting that articulations are not made between preexisting elements or parts, Latour contends that such work is "a progressive enterprise that produces at once a sensory medium *and* a sensitive world" (ibid., emphasis in original)—selves and their environments emerge together from the act of articulation itself.

The sort of in-depth understanding of gibbon vocalizations that Gabi and Alma demonstrate contrasts with the way sound is conceptualized by acoustic ecologists and bioacousticians similarly advocating for attention to the rich sonorities of ecological functionality. David George Haskell, for example, describes a process of "open[ing] our ears to the whole acoustic environment" (CBC Radio 2017): "I challenge my students: Okay, now that you've learned the songs of 100 [sic] birds, your task is to learn the sounds of 20 [sic] trees. Can you tell an oak from a maple by ear?" (quoted in Yong 2017).[1] Haskell, evidently, treats the acoustic according to the same sort of taxonomic inquiry that Alan Mootnick practiced with gibbon bodies. But the acoustic inventory that results from Haskell's approach—in which auditory expertise is defined by the number of different sounds one can "articulate" (in Latour's sense)—is not what characterizes the (current) Center staff's listening practices. Instead, it is

[1] Haskell devotes a long passage to describing how listening to rainfall in Amazonia makes clear how "botanical diversity is sonified" (2017:6): "The expansive leaflets of flying moss tick under the impact of a drop. An arum leaf, an elongate heart as long as my arm, gives a *took took* with undertones that linger as the surface dissipates its energy. The stiff dinner-plate leaves of a neighboring plant receive the rain with a tight snap, a spatter of metallic sparks. A rosette of lance-shaped leaves sprouts from the tip of a *Clavija* shrub, each leaf twitching as rain smacks the surface. The sound is flat, *tup*, with none of the urgency of less yielding leaves. The leaf of an Amazonian avocado plant sounds a low clean, woody thump."

their striking ability to stay radically undecided towards possible outcomes. Telling me about the range of food calls produced by the Center's complement of white-cheeked gibbons, Gabi pointed out that rather than producing species-specific reactions to particular foods (the way they, and many other gibbon species, make distinct alarm calls that distinguish between aerial and terrestrial predators), there is instead individual variation unaccountable for by the primatological categories of inheritance or sex (field notes, 4 January 2020). The hard-boiled eggs that elicit a high-pitched squeal from the mated pair of Canter and Lucia, for example, are instead met with a series of grunts from Vok, Canter's father, from the next enclosure over.

Writing of mid-century ethologists like Konrad Lorenz, scholars who popularized the "fixed action pattern" model that treats animal behavior as simply instinctive reactions to external stimuli, philosopher of science Vinciane Despret pinpoints what is at stake: "Animals will lose what constituted an essential condition of the relationship, the possibility of *surprising* the one who asks questions of them" (2016:39, original emphasis). Rather than seeking to predict the minutiae of the gibbons' acoustic relations, the sense I got was that both Gabi and Alma remain fascinated by the capacity of gibbon vocalizations to exceed or resist the received possibilities imagined for them in advance. An articulation, then, might be understood not as an available form of sensory discrimination, but rather as the lack of the sort of overdetermination resulting from having already decided certain outcomes in advance.

The limited extent to which my own process of habituation at the Center was able to progress made clear how the development of such articulations at the Center is contingent upon at once physical exertion and a surrendering of the detachment and control that are preconditions to producing objective knowledge. My tasks began around 8:30 each morning; often, I would arrive over three hours earlier, setting up my recording equipment in the pre-dawn darkness in

order to catch the entirety of the gibbons' first bout of vocalizations (see below). But once the sun had risen, my daily work of preparing the gibbons' eight daily meals, doing the feeding rounds, and maintaining the grounds began. I learned to portion and/or cook the numerous fruits and vegetables the gibbons consume over the course of each day: I sliced apples, celery, cucumber, and bell peppers, as well as seasonal fruits (papaya, watermelon, mango, persimmon); steamed sweet potatoes, carrots, zucchini; boiled eggs and lentils; and prepared additional items needed for the diets of certain gibbons, such as an array of leafy greens (escarole, radicchio) and herbs (e.g. cilantro, celery, green onions), shredded chicken, and tofu. I learned to distribute the (literal) fruits of my labors, getting to know each gibbon individually as I handed them the most desirable elements of each feeding round—learning not only each animal's food preference, but also their own disposition (whether they would try to grab me or accept my offering) and the social dynamics of each family group. I was instructed to feed each enclosure's dominant gibbon (most often but not always the adult female) first, or they might try to take food from the subordinate animal and start a fight. And during moments in between, I would rake into piles the leaves constantly shed from the pepper trees that are the Center's only source of shade and then collect them in heavy garbage bins that I would drag outside the gates. After straining to lift the containers full of dirt, gravel, and plant matter high enough to be emptied into a dumpster, I was rewarded with the cloud of dust this action kicked up. Then, coughing and aching, I would head back inside and do it all over again.

My time at the Center, especially the first few months, was marked by a distinct sense of exhaustion. As my presence at this perennially understaffed facility became "more participant than participant-observer," as Alcayna-Stephens (2016:838) writes of her experience among bonobo researchers at a field site in the Democratic Republic of Congo, I struggled to shake the

feeling that the physical demands of the work were in fact preventing me from obtaining the results I was hoping for. My ability to focus on the gibbons, especially when they began singing, was hampered by the tasks I was assigned, and I routinely collapsed in bed after returning home without updating my field notes or labelling the recordings or photographs I managed to take. Although we interacted quite constantly, requests to interview the Center staff often came off as an imposition on their precious time (for this reason, my strategy ended up being taking careful notes of things mentioned in passing, then following up during long and sporadic interview sessions).

At the same time, the gibbons too resisted my attempts to study them. Not only did many turn away or stop whatever interesting behavior they were engaged in as soon as a camera lens or shotgun microphone was pointed directly at them, but even while trying to record the daily gibbon chorus—as regularly predictable a sonic event as there ever was—I got the sense that the gibbons were always one step ahead of me. I was reassured to learn that I was not alone in this experience, as Gabi mentioned a similar feeling during her own attempts at research: "Many, many times, when I was trying to [record] the hoolocks," she told me, "my professor wanted me to get the full song since we were looking into coordination and possible synchronization, [but] I had a hard time because I set up and they were not singing. So I left and they started and I missed the first few seconds, it was super annoying! Or I let it record and I had a whole hour with nothing!"

And while this experience seems a little too universal to write off as random, a far more explicitly deliberate form of refusal was with a white-cheeked gibbon named Pierre, who had been transferred to the Center from a facility in France. Perhaps based on his experience there, Pierre developed an incredibly fearful reaction towards the presence of adult male humans. At

Gabi's request I did not feed him or his family, skipping his enclosure on my feeding rounds. Indeed, I kept my physical distance from his enclosure and therefore did not develop any form of relation with him, although I held out hope that over time things might change. Any methodology predicated upon the possibility of unimpeded access to the gibbons and/or their songs is ethically problematic.

As the months went on, I did notice an increase in my comfort with the tasks assigned. Rather than worrying about the hundreds of micro-interactions involved, from counting the pieces of fruit or vegetable allotted for each gibbon's unique diet, to developing the split-second timing needed to ensure that an empty-handed gibbon would not try to aggressively rob another, to keeping an eye and ear out for animals that would mischievously attempt to grab or urinate on me—my feeding rounds became second nature. I even became attuned to some of the kinds of subtle auditory clues that Alma described above. For example, I eventually realized that at the enclosure housing Oula and Medina, a mated pair of Javan gibbons, I would routinely start counting out their food without first looking for them. Hearing their distinctive food calls with my back turned, while rummaging in the feed buckets, told me precisely where each was, and I would face them for the first time already with the appropriate food for each in the correct hand.

This is not simply a consequence of paying close attention, however, but rather something that only emerged out of a process in which Oula and Medina, like all the other gibbons I interacted with, got to know me at the same time as I got to know them. Indeed, not only was I unable to differentiate between their food calls when I first started feeding, but I could barely approach their enclosure. Although Medina showed no signs of aggression during the initial three months during which my feeding rounds were supervised by a Center staff member, the very first time after I was approved to feed alone, he grabbed my wrist hard enough to draw

blood with his sharp fingernails when I went to hand him an apple slice, leaving a scar that persisted for the length of my fieldwork.[2] Consulting with the Center staff helped me realize that Medina most likely did not respect the dominance hierarchy I was taught to maintain by feeding Oula (the female) first; the remedy for this aggression was to feed the two gibbons simultaneously. Wrapped up in learning to recognize Oula and Medina's unique vocal signatures were the pressures of mitigating physical violence, on one hand, and establishing cross-species relationships, on the other. At the Center, the gibbons are not passive objects for information to be obtained about but rather active participants in the collaborative production of that knowledge.

Situatedness and immersive recording technologies

With the possible exception of Rachel Mundy's 2018 monograph *Animal Musicalities*, music studies and sound studies have yet to engage with the limitations of listening as scientific methodology. But these issues are foregrounded in David Shorter and Kim TallBear's recent co-edited volume addressing scientific attempts to listen for signs of life beyond Earth. The assumptions undergirding the Search for Extraterrestrial Intelligence (SETI), Shorter and TallBear show, uncritically replicate "the attitudes and practices of terrestrial explorers in the past" (2021:2) and their attendant investments in settler colonialism. Amongst the many critical insights made over the course of this journal volume—for example, what counts as "intelligence"?—is the scientists' ethical commitment to the fundamental passivity of listening, their understanding of the ear as a simple transducer of pre-existing phenomena in a manner whose objectivity renders unnecessary questions of accountability and engagement. Indeed, as

[2] Although I never observed it myself, Javan gibbons at the Center are notorious for their ability to extend their arms through the chain-link at lightning speed and snatch birds out of the air midflight.

Shorter describes the SETI scientists' response to a working paper produced by a group of Indigenous Studies scholars outlining their concern over the settler colonial assumptions motivating the larger project, "the response we received from them was simple: how could just listening be harmful?" (2021:38). But as William Lempert shows in his own contribution to the volume, the underlying association between acts of "just listening" (2021:57) and noninterference protocols "throughout history [served] not to protect the vulnerable, but rather to morally legitimize colonial enterprises" (ibid.:54).

While Lempert discusses examples of "just listening" drawn from history (Britain's conquest of Australia) and science fiction (*Star Trek's* "prime directive"), more relevant to this dissertation is primatology's classic conceptualization of habituation, as described above, wherein objective noninterference is presented as ethically and epistemologically necessary. In this sense, "just" is both adjective and adverb, "just listening" the auditory expression of what Jose Martínez-Reyes (2016) and Natasha Myers (2015) independently term a "moral ecology." Martínez-Reyes proposes the term to emphasize that in contrast to the way the forest of Quintana Roo, Mexico, is understood by environmental conservationists, for its Indigenous Mayan inhabitants it is instead defined by "relations of mutuality and interdependence with the species of the plant and animal world—relations that provide moral imperatives" (21).[3] Yet the concept surfaces as well in Myers' ethnography among protein crystallographers, in which she points out that "ethnographic attention to the moral and affective ecologies of the laboratory draws out crystallographers' often-ambivalent relations not only with other practitioners, but also with

[3] Crucially, this moral ecology is sustained by a particular set of practices—hunting and forest burning—that are seen as wholly counterproductive by the conservationists (although Martínez-Reyes goes to great lengths to demonstrate ethnographically that both these techniques in fact contribute to ecological sustainability). The result, he describes, is the proscription of the Mayan traditional livelihoods, while the conservation NGOs simultaneously devote their efforts to regulating Mayan practices rather than concentrating on meaningful conservation work.

nonhuman objects, instruments, and metaphors as they try to stay attuned to the task of crafting robust facts" (2015:142). Objectivity, as Myers emphasizes, does not describe the absence of accountability, but rather names the "very obligation [protein] modelers feel toward careful description of their rather evasive objects" (ibid.). Neutrality and distance, here, are morally necessary.

My attempts to document the entirety of the Center's gibbon chorus, the sonic interactions between up to forty animals distributed across a three-acre site, made audible precisely the limits of neutrality and the challenges of distance in the context of observation. Aiming conventional microphones at individual enclosures produced clear recordings of specific gibbons and family groups, but from the beginning my goal was to convey aurally the experience of being in the middle of such an event, listening not only to one vocalizing animal but instead all; indeed, to listen to each gibbon listening to all the others. In order to do so, I turned to a project I began developing when the possibility of research in Indonesia was still on the table: specifically, an attempt to convey the situated experience of conducting acoustic triangulation (see Coda above). The solution was a homemade spatial audiovisual recording setup modelled after commercially available units far outside my budget, consisting of four sets of custom-built binaural microphones and a 360-degree digital video camera (figure 2.2).

I found binaural recording appealing because separating a pair of microphones by the rough distance between a set of human ears produces a much deeper sense of spatial location than simple stereo (see Roquet 2020). With a pair of binaural microphones facing each of the cardinal directions, and a simple computer code that pans between them based on gyroscope data drawn from either a smartphone or an equipped set of headphones (e.g., Apple AirPods Pro), the result is an immersive sonic experience in which the listener can rotate their head to face any

direction, and follow any moving sound, within the recorded soundscape. Coupled with the data from the video camera and a virtual reality (VR) headset made to accommodate a smartphone displaying slightly different information for each eye, it was possible to approximate an experience of immersion within the Center's gibbon chorus.[4] Housed in a frame I turned from wood, PVC plastic, and Styrofoam on my lathe, with the video camera protruding from the top and resting above an 8-track audio recorder and enough rechargeable batteries to power the entire rig for the multi-hour duration of the chorus (I settled on a battery designed for jumpstarting a car), all mounted on a camera tripod, it cut an impressive figure—it was even included, along with myself, in the documentary *The Center* (figure 2.3).[5]

Put only slightly differently, however, the appeal of this device is that it offers the very same possibility of total surveillance that Michel Foucault famously critiqued in his discussion of Jeremy Bentham's omniscient prisoner monitoring system, the "panopticon." Indeed, examples of nonconsensual auditory surveillance are now gaining attention in sound studies (e.g., Sykes 2021). While it could be argued that the gibbons' evolved capacities to maximize not only the volume of their vocalizations, but the distance they are able to travel, make such potential for auditory voyeurism a non-issue, this was not the case for the Center's staff repeatedly making their way through the microphone's area of pickup, nor the weekend visitors. For this reason, I was careful to only record during convenient times (e.g., not during feedings or weekends).

[4] While my rudimentary coding skills (I taught myself to code in the iOS development engine Unity specifically for this project) and lack of an expensive developer's license means that currently my own iPhone is the only one able to run this program, the capacity to accurately gauge sonic distance and direction in three dimensions was crucial to my analysis of the chorus discussed in Chapter 4. Additionally, I plan to further develop this playback technology for subsequent dissemination of my project post-dissertation.

[5] Throughout the documentary I appear as both a talking head and an "actor" replaying some of the more memorable anecdotes I share on camera, although my name is absent from the credits.

Figure 2.2 (below): Closeup of my 360-degree A/V recording setup. Photo by author.

Figure 2.3 (left): My 360-degree A/V rig being filmed for the documentary *The Center: Gibbons and Guardians* (2021). Note Tuk, in the background, watching this scene unfold. 12 June 2020, photo by author.

More broadly, rather than making possible the auditory equivalent of Haraway's "god's eye view," such a recording setup produces a specific documentation not of the gibbon chorus in its entirety but of one situated, spatially positioned experience of it. Indeed, immersion is messy. In an interview, Steven Feld describes his own attempts at recording a three-dimensional forest soundscape for the documentary *Voices of the Rainforest*, complete with a soundtrack spectacularly mastered in Dolby 7.1 surround sound that was the result of an entire year of work at Skywalker Ranch's recording studio. "A good stereo image of a singer singing a song in the rainforest is not difficult," he says. "What is difficult is to get a correct mix of the singer and what s/he is hearing in the surrounding environment. The only spatial solution, at least with the equipment I had, . . . was to make and mix multiple recordings" (2021:2). Rather than capture

everything simultaneously, Feld chose to combine different recordings made not only in various locations around the forest but also at different heights ("to represent the biological richness of forest sound niches" [ibid.:3]). As he explains, however, this required a "radical" (ibid.) approach to including the songs of the stunning number of bird species encountered in the environment of the Bosavi:

> Basically, I would record a distant bird with a parabolic or shotgun microphone, and then immediately rewind and play the recording back at distortion level over a really cheap small radio speaker. This had the effect of holding a broken mirror up to the bird, creating a WTF? moment and drawing the bird closer. After doing this for two or three weeks it is often possible to record the bird close-up with great sound detail using the X-Y stereo mics or a short shotgun mic. This close-up can be turned into a sample and mixed on top of the bird calls on a guide track, with complete control of volume and depth. (ibid.)

The key to obtaining clear, isolated recordings of different bird species, as Feld makes clear, was habituating those birds.

Striking is what this practice treats as desirable detail/fidelity and what as interference. Each singing bird's presence in a particular place and time, as Feld describes it, poses a problem for the mixing of the recorded soundscape; better is to obtain an isolated recording of each animal and blend them in later. Feld is careful to clarify that his digitally manipulated soundscape is a composite, rather than a factually accurate representation of a particular moment in time; by mixing in higher quality recordings of different birds' calls, what J. Martin Daughtry calls "the radical situatedness of sounds and listening" (2012) is subordinated to an earpoint into the forest soundscape in which the members of each bird species are essentially fungible, interchangeable. What matters here instead is what Rachel Mundy calls the "sonic specimen" (2018), not the sonic and ecological relations within which the bird was participating on the original recording. Indeed, Feld's solution for making audible this rainforest environment in all

its interspecies complexity is ironically predicated upon decontextualizing and manipulating those sounds.

Conducting a thought experiment, Daughtry concludes that such an "acoustic palimpsest," an audio recording capable of capturing *all* sonic detail, is "patently impossible" (2012). "It would be an infinitely layered recording," Daughtry writes, "that would allow us to listen to history itself. It would enable a panacoustic politics of listening, with all the granularity and dynamism that term implies" (ibid.). Listening to Feld's rainforest is an experience not of immersion defined as the faithful reproduction of the details of specific event, but rather of an ontological palimpsest in which the reality of radically individuated entities has been gradually scraped away and overlain with the inescapability of what Matthew Chrulew calls "species-thinking, in which each individual animal is only perceived as a token of its inexhaustible taxonomic type" (2011:141; see Chapters 3 and 4). How can attempts to reproduce an authentic and faithful experience of "really being there" (Jones 1993:241) also require such a reduction of radially individual, living beings to type?

In an ethnographic study of marine biologists conducting research underwater, Stefan Helmreich makes that experience of immersion itself an object of critical attention. Specifically, he addresses "the material transformations across media that have to unfold for the seemingly seamless transfer of information . . . to be accomplished" (2007:623). Referencing Haraway, Helmreich remarks that "immersion is not necessarily situated knowledge" (ibid.:631); in the sense of cultural immersion as ethnographic methodology, what the invocation of immersion does is erase the contingency and effort necessary to sustain it, and hide the power dynamics in play (cf. Clifford and Marcus 1986). In this sense primatological habituation and ethnographic/technological immersion are quite similar, in their commitments to the existence

of, and access to, an authentic state independent of any observer. Helmreich reaches the same conclusion as the ethnoprimatologists mentioned above do in regard to habituation:

> After being immersed in the Pacific inside a titanium sphere, immersed ethnographically in a cultural practice of oceanography, and immersed in the sounds of sonar and the surrounding sea, I wondered how such immersion—as a sense of presence and immediacy—was itself produced. . . . Against immersion, I arrived at the analytic of *transduction*—the transmutation and conversion of signals across media that, when accomplished seamlessly, can produce a sense of effortless presence. (2010:10)

Attending to processes of transduction means remembering that the production of an immersive experience—like Feld's rainforest soundscape—was only made possible through fundamentally collaborative work conducted at multiple scales and temporalities: not only the year of production at Skywalker Ranch, but also the habituation of avian bodies and the long history of listening that renders animal vocalizations a property of the species rather than the individual (see Chapter 4).

From co-habitation to co-habituation

Besides her numerous appearances on local television and nature programs like Animal Planet's *Wild Jobs*, Gabi is featured in an online series called *Living Big in a Tiny House* which devotes an episode to her home, a 14-by-8-foot structure placed directly next to one of the gibbon enclosures (see figure 2.4). Alma, similarly, lives with her family in what was previously Alan's living quarters, a small apartment in the Center's only building directly above the kitchen and office, while Jodi occupied an RV parked directly outside the kitchen until she left the Center in mid-2020. As the experience of multispecies co-habitation gives way to the state of co-*habitu*ation, the sorts of knowledge and affordances forged with, as opposed to about, particular gibbons yield some spectacular payoffs.

Figure 2.4: Satellite view of the Center (Google Earth), with all occupied structures labelled. Legend on following page.

Human structures
a: Gabi's tiny house
b: Alma and family's apartment (above kitchen, office, and workshop)
c: Jodi's RV
d: gift shop

Gibbon enclosures (listed in feeding order)
1: Violet (f) and Truman (m), pileated
2: Astriks (f), Pierre (m) and Nate (m), Northern white-cheeked
3: Ivan (m) and Goliath (m), Javan
4: Khusus (f) and Reg (m), Javan
5: Simpang (f), Perak (m), and Hercules (m), Javan
6: Shelby (m), Javan
7: Winston (m), Javan
8: Tuk (f), Iszie (f), Baby Boo (f), Howard (m), pileated
9: Hmwe Ni (f), U Maung Maung (m), hoolock
10: Chantar (f), Alan Mootnick Jr. (m), hoolock
11: Oula (f), Medina (m), Javan
12: Betty (f), Khin Maung (m), hoolock
13: Phy Gyi (f), Arthur (m), Nyi Ma Suu (f), Elwood (m), hoolock
14: Lucia (f), Canter (m), Northern white-cheeked
15: Pepper (f), Vok (m), Dennis G. Jacobson Jr. (m), Northern white-cheeked
16: Marlowe (f), siamang, U Mynt Swe (m), hoolock

Legend for Figure 2.4

One memorable event transpired in 2017, after the Center lost Ricky, an adult female white-cheeked gibbon, to cancer. Almost right up until her death, Gabi told, me, Ricky had been the one to "start," or "lead" (Interview, 6 January 2020) each morning's dawn chorus, by which she meant that Ricky would habitually begin the very first great call of the day (see Chapter 4), a phrase that inevitably draws the rest of the resident gibbons into the chorus. Only during the last two weeks of her life did Ricky relinquish this role to her adult daughter Parker, although she kept participating. "The last day she didn't even come out of the sleeping box," Gabi remembers; "she just opened the door, the little Dogloo door, and she was singing like that" (ibid.). Soon after her mother's death, furthermore, Parker was transferred to the Cheyenne Mountain Zoo in Colorado to be paired up with a single adult male. In the absence of these two chorus leaders, Gabi and her staff were interested to see who would take over the role.

To their surprise, it was not one of the other adult female white-cheeks but rather Ricky's youngest daughter, Pepper, an adolescent who had not even begun the hormonal transition during which her fur would change color from black to the tan of adult females. Each day prior to Ricky's death and then Parker's transfer, Pepper had joined in the great calls begun by her mother and older sister (as young gibbons tend to do), but never initiated her own. But "the first morning after [Parker] left," Gabi told me, "it was just Pepper! And I did have a feeling that she was testing them. Because she would sing like in odd times of the day, like 6pm. There were a couple of times that she would sing late in the afternoon, just start getting everybody going. And she did!" (ibid.).

Pepper's unexpected achievement resonated with Gabi, who by that time had already been named director but, given the suddenness of her mentor's death in 2011, admittedly felt unprepared to step into his shoes. "I was not ready to be the director here," she conceded to me. "And while Alan was alive, I didn't even think about it!" (ibid.). In Pepper's accomplishment, against all genotypic and phenotypic indications to the contrary, Gabi found inspiration and motivation. "Her voice is strong," Gabi wrote in that year's holiday letter to the Center's members, "and it reminds me that sometimes we are not entirely ready to take over a position, but we just have to step up and do it" (Skollar 2017).

The Center presents this event as the dramatic peak of its narrative, bolstered by a slight confusion of timeline that makes it seem like it transpired just after Alan's death, rather than six years later. Yet even in the story of resilience and strength it puts forward, the documentary misses two things: not only the fact that this was only made possible by multiple entities' capacities for sounding and listening (both Gabi and Pepper), but just as importantly that it

demonstrates how difficult it is—how epistemologically and ethically dangerous it might be, even—to filter out each other's influence.

Drawing personal inspiration and motivation from meaning attributed to the observed behavior of a non-human animal may seem like projection, anthropomorphism—the sort of (willful) misattribution of human cognition to animals that is anathema to science-driven conservation work. And perhaps it is. Yet accusations of anthropomorphism are habitually made from positions of certainty regarding fundamental differences between humans and nonhuman animals, a binary deconstructed by scholars from Jacques Derrida (2008) to Frantz Fanon (1961; cf. Calarco 2008). Relevant here is a famous episode in the history of primatology in Japan: as discussed by Donna Haraway (1989), drawing upon the work of Pamela Asquith (see Asquith 1996, 2000), the first wave of post-WWII primatologists in Japan operated according to a worldview in which humans and the macaques they studied were not ontologically divided. Their Buddhist ethics of natural stewardship, furthermore, led to a research methodology of "strategic anthropomorphism" (Takasaki 2000:163) in which the value of compassion, rather than noninterference, was paramount. Rather than avoid interfering with the "natural" behavior of the macaque troops they studied, researchers habitually "provisioned," or distributed food to, the animals. Although this protocol and its resulting data was dismissed at the time by Western primatologists preoccupied with dominance structures (Haraway 1989; cf. De Waal 2003), it led to the very first observation of "culture" (defined by primatologists as the learned, rather than inherited, transmission of behavior [see Whiten et al. 2003)]) among nonhuman animals—after one macaque began washing her sweet potatoes in a stream to remove the grit, others observed and followed suit until the behavior had spread to the entire troop. A major theme of this dissertation is how the practice of science-driven gibbon conservation exceeds its self-

description; as I address in detail below (especially Chapter 4), taking seriously the possibility of gibbon personhood is a constitutive, rather than unwanted, part of efforts meant to prevent their extinction (see Rees 2007).

Rather than imputing human motivations and attributes to animals, I contend that such listening practices are the result of a habituation process that results not in the achievement of objective distance but rather with what carla bergman and Nick Montgomery describe as "an openness and vulnerability" across species difference. In contrast to the epistemological regulation and isolation characteristic of Alan's objective methodology, "the desire for full control or independence remains trapped in passivity, because learning to participate in joy's unfolding means being partially undone and transformed through an open-ended, uncontrollable process" (bergman and Montgomery 2017:354). The Center staff's listening practices do not "reach across difference," but rather perpetually (re)establish, and contest, precisely where those dividing lines fall.[6] A process at once somatic and conceptual, acoustic and affective, habituation thus conceived unsettles and historicizes the processes we uncritically assume reveal unbiased information about a pre-existing world. Rather than the immersive achievement of a seamless fit into a pre-existing environment, habituation describes the collaborative construction of that (new) world. Listening to Gabi's description, listening to Pepper continue to lead a multispecies chorus, what is audible is not separate stories of individual humans and individual gibbons, nor parallel species narratives (Chakrabarty 2007), but rather "histories," as Anna Tsing aptly writes in her multispecies ethnography of human-mushroom relations, "made in concert" (2015:172).

[6] In Chapter 4, I argue that the gibbons use their vocalizations to do precisely this same work.

Involutionary listening

In her 2018 monograph *Animal Musicalities*, Rachel Mundy outlines an approach to organizing audible variation across the vocalizations produced by various animal species described in her subtitle as "evolutionary listening." This form of listening, conducted by a large cast of twentieth-century ornithologists, song collectors, and music theorists, is essentially an approach in which animal vocalizations are parsed for what information they may yield about humanity's assumed superiority and evolutionary distance. For these investigators, at stake was nothing less than possibility of regulating the possibility of personhood. The act of listening, she shows, "became a way to channel such comparisons into an explicitly evolutionary, linear, hierarchical discourse about the relationship between birds, humans, races, and the forms of difference that lay between" (2018:27). Mundy goes as far as to argue that as an attempt to insulate the observer from vulnerability and accountability, such an investment in sound's capacity to make audible essential characteristics of species and races, contributed to the development of the notion of objectivity critiqued above. Animals, in this account, are reduced to passive, disposable objects, the material and/or epistemological resources consumed in the apotheosis of human exceptionalism.

In contrast to evolutionary listening's commitment to uncovering essential and ordered differences, I propose that the human-gibbon relations cultivated by longtime Center staff like Gabi and Alma are characterized by its opposite: what I call "involutionary listening." I take the notion of "involution" from a 2012 article by Carla Hustak and Natasha Myers, in which the authors tease out what they call an "involutionary momentum" underpinning Charles Darwin's notes on orchid reproduction through insect fertilization. Noting that contemporary neo-Darwinist accounts of evolution "reduce the complex relations among orchids and insects in a

way that stultifies both orchid and insect agency and renders ecologies populated by blind, reactive automatons" (ibid.:79), Hustak and Myers argue instead that "as Darwin trained his attention on the intimate encounters between orchids and their insect pollinators, his functionalist accounts of adaptation were sometimes muted by stories of affinities, attractions, and intimacies" (ibid.). For Hustak and Myers, then, involution describes

> the very momentum through which organisms reach toward one another and involve themselves in one another's lives. If, as the *Oxford English Dictionary* reminds us, *evolution* is a "rolling outwards," a kind of speciation through divergence in the shape of branching trees, we approach *involution* as the "rolling, curling, turning inwards" that brings distinct species together to invent new ways of life. . . . Involutionary momentum helps us to get a feel for affective push and pull among bodies, including the affinities, ruptures, enmeshments, and repulsions among organisms constantly inventing new ways to live with and alongside one another. (ibid.:96, original emphases)

This entanglement of the affective and the ecological, in which what results in nothing less than new modes of collaborative life across assumed impenetrable divides, is precisely what the form of listening practiced by the Center staff makes possible.

The term "involution" has its own intellectual genealogy (which fittingly resists the "straightening out" that Sarah Ahmed ascribes to genealogical thinking in general). Hustak and Myers borrow the term from Deleuze and Guattari's *A Thousand Plateaus* (1987), in which the notion of "creative involution" and its incompatibility with genealogical lines of descent is invoked in their discussions of rhizomatic "becoming," a philosophical position similarly advocated for by Donna Haraway (e.g., 2016; see applications in music studies by Koons [2019]; Graper [2019]); one of their examples, in fact, is "a becoming-wasp of the orchid and a becoming-orchid of the wasp" (Deleuze and Guattari 1987:10, cited in Hustak and Myers 2012:97) most likely inspired by the biophilosophical writings of Jakob von Uexküll (2010

[1934]; see Chapter 3).[7] For Deleuze and Guattari, the dissolution of ostensibly individuated entities into collaborative multiplicities carries a political and ethical imperative. Such a move is positioned squarely as resistance to a capitalist hegemony and its concomitant reduction of entities into their functional roles. Yet Deleuze and Guattari were not the first to coin this term; earlier it was popularized in cultural anthropology by Clifford Geertz, who in 1963 described the process of intensification of sugarcane and paddy crops in colonial Java as "agricultural involution." Geertz's use, itself derived from anthropologist Alexander Goldenweiser (1936), describes a system's development over time in ways that result not in external transformation or expansion, but rather the intensification of internal complexity—the "overdriving of an established form in such a way that it becomes rigid through an inward overelaboration of detail" (Geertz 1963:82). In particular, Geertz argues, pressures to extract more value/increase yields from a finite amount of available land resulted in the planting of sugarcane in rice areas and the planting of rice in sugarcane areas.

The Geertzian and Deleuzian usages of the term do overlap; indeed, Geertz explicitly writes of Javanese villagers, paddy, and sugarcane becoming increasingly involved in each other's existences: "all three 'flourish', if that is the proper word, together" (ibid.:75). Yet Geertz saw the presence of involution as undesirable: in Java, he writes, involution "maintained a comparatively high degree of social and economic homogeneity by dividing the economic pie into a steadily increasing number of minute pieces, a process to which I have referred elsewhere

[7] As "clarified" by Deleuze and Guattari, "each of these becomings brings about the deterritorialization of one term and the reterritorialization of the other; the two becomings interlink and form relays in a circulation of intensities pushing the deterritorialization ever further. There is neither imitation nor resemblance, only an exploding of two heterogeneous series on the line of flight composed by a common rhizome that can no longer be attributed to or subjugated by anything signifying. . . . More generally, evolutionary schemas may be forced to abandon the old model of the tree and descent. . . . Evolutionary schemas would no longer follow models of arborescent descent going from the least to the most differentiated, but instead a rhizome operating immediately in the heterogeneous and jumping from one already differentiated line to another" (1987:10).

as ‘shared poverty’” (ibid:97). Involution, Geertz contends, reduces Javanese villagers to “flaccid indeterminateness” (ibid.:103) and accounts for their “self-defeating” (ibid.:80) “advance towards vagueness” (ibid.:102-3); its result was “the ossification of the Indonesian agrarian economy” (ibid.:38) elsewhere described as “stultification” (ibid.:69). But involution only seems involuted when the underlying metric of evaluation is itself capitalist productivity, and its distinctions between neatly segmented, insulated apparati of production are seen as necessary conditions to vitality and success.[8]

Echoing an insight by Laura Berlandt (2011:192), Anna Tsing understands “precarity” as “the condition of being vulnerable to others” (2015:20). In Tsing’s multispecies ethnography of mushroom cultivation, conditions like precarity and interference are not values to be minimized but rather the provide very conditions for the possibility of life and knowledge; “thinking through precarity changes social analysis,” she writes. Rather than taking the autonomous, liberal subject to be the unit of analysis (cf. Strathern 1988), such approaches recast what bergman and Montgomery describe as the “‘free individual’ of modern, Western capitalism (an implicitly straight, white, able-bodied, cis-gendered, property-owning man) [as] a sad and lonely vision: a strange fiction invented by a violent and fearful society, walled in by morality and self-interest.

[8] Bruno Latour, one of the most prominent thinkers in the History of Science, concludes his 2017 reflections on the ethical and epistemological implications of what he calls such a “new climatic regime” with a call to embrace the very sort of involutionary momentum proposed by Hustak and Myers (2012). What is necessary to avoid planetary catastrophe, he argues, is nothing less than “the discovery of a new Earth” (Latour 2017:290). But in contrast to the settler colonial forms of extractivist discovery that scholars like Heather Davis and Zoe Todd (2017) link to the advent of the Anthropocene and David Shorter and Kim Tallbear (2021) locate in even contemporary scientific initiatives, Latour clarifies that “we are still dealing with space, with the earth, [and] with discovery, but it is the discovery of a new Earth considered in its *intensity* and no longer in its *extension*” (2017:290, original emphasis). Latour furthermore uses these contrasting positions to differentiate between two kinds of beings: “whereas the Humans had ‘*Plus ultra*’ as their motto, the Earthbound have no motto but ‘*Plus intra*’” (ibid.:291). “Humans living in the epoch of the Holocene,” Latour proposes, “are in conflict with the Earthbound of the Anthropocene” (ibid.248; cf. Viveiros de Castro and Danowski 2018); “further inward” is Latour’s involutionary call to arms. The Anthropocene's capacity to unsettle a profoundly deep-seated trust in the status quo, he reasons, should force people to recognize their responsibility to respect and sustain the fragile web of interdependence that constitutes the conditions for the possibility of life at once individual and collective.

This is an uprooted being who sees his rootlessness—his very incapacity to make and sustain transformative connections—as a feat of excellence" (2017:107). Following these scholars' lead, I propose to understand involutionary listening as the auditory substantiation of the vulnerable capacity to at once affect and be affected, in which human and gibbon lives are collaboratively remade. Inquiring into the conditions for the possibility of a sonic sensibility as cultivated, practiced, and sometimes resisted by the longtime residents of the Center, this chapter has argued that what makes sound such a potent force in the theory and practice of gibbon conservation is neither a function of materiality (e.g., its frequency or volume), biology, or preconstituted meaning, but rather the far-reaching physical, ethical, and methodological consequences of the capacity to affect and be affected by sound, the always noninnocent ability to "listen," precisely as Feld writes, "to histories of listening" (2017).

In an essay entitled "The Promises of Monsters," Haraway suggests that the metaphor of diffraction offers a way to theorize interactions and emergent complexity without conceptually separating out their preexisting elements, or subscribing to the existence of "special taxonomic marks grounding difference as apartheid" (2004:74). Instead, "diffraction is a mapping of interference, not of replication, reflection, or reproduction. A diffraction pattern does not map where differences appear, but rather maps where the effects of difference appear" (ibid.). Karen Barad locates diffraction in her feminist reading of quantum physics, in which the behaviors of waves (as opposed to particles) provide both ethical and epistemological alternatives to the doctrine of classical objectivity. Teasing out the implications of the phenomenon made famous by quantum physics, the fact that light can act as either a wave or a particle and exhibits one or the other based on the particular experiments it is subjected to, Barad concludes that "practices of

knowing are specific material engagements that participate in (re)configuring the world" (2007:91).

And while this chapter has addressed an auditory approach to knowing and caring for gibbons positioned in resistance to hegemonic notions of objectivity and extractivism, the following chapters recognize that histories of listening and their worldmaking consequences are not inherently reparative or deserving of preservation. I devote attention to the sounds and listening practices that make possible the reproduction of gibbon bodies—and thus the sonic dimensions of gibbon genealogies, phylogenies, and ontogenies (biology's terms for the histories of families, species, and individuals, respectively). But I also address the histories of listening that lead to gibbon song being heard as an aesthetically valuable phenomenon that justified their singers' protection in captivity, and of specific bloodlines bred in captivity, by human beings motivated by what Andrew Whitehouse calls "the anxious semiotics of sound in the Anthropocene" (2015). Turning to examine the Center's involvement in a nationwide captive gibbon breeding program, the next two chapters address ways in which culturally and/or individually situated listening practices, often themselves naturalized and/or universalized, constitutively impact the way in which those gibbon forms of life may or may not unfold into the future.

Chapter Three

Listening for gharmony at the Gibbon Conservation Center: Captive Gibbon Breeding and the Acoustemological Politics of Compatibility, pt.1

My official introduction to the sonorous world of the Gibbon Conservation Center over the summer of 2018, funded by the Graduate Summer Research Mentorship award that kickstarted my eventual dissertation research project, happened to transpire simultaneously with a very different sort of introductory event. Just as I was beginning to plan where to focus my attention, Gabi Skollar, the Center's director, informed me of her plan to introduce together several pairs of unmated northern white-cheeked gibbons (*Nomascus leucogenys*). When I had first visited during the previous fall, the Center's eight white-cheeked gibbons were distributed between three enclosures: one housing the adult female Astriks with her daughter Lucia and son Nate; another with the elderly Vok and his two sons, Canter and Dennis G. Jacobson Jr., and one daughter, Pepper (see Chapter 2); and a third in which an adult male named Pierre lived alone. But the social dynamics both among and between these three gibbon families—the state that primatologists Jan Fischer and Thomas Geissmann call "group harmony" (1990) in a paper comparing siamangs and white-handed gibbons—were already audibly unstable.

Canter, like Iszie described in Chapter 1, was beginning to be pushed out by his father; during the daily song bouts, their usually cohesive family would spatially divide into two factions, with Vok, Pepper, and Dennis calling loudly against Canter from opposite ends of their shared enclosure. Meanwhile, Astriks' former mate Sasha had passed away several years earlier, but the Center staff were waiting for Astriks and Sasha's young son Nate to grow to the point that he would not attempt to prevent his mother from bonding with a new mate.[1] By the early

[1] On the primatological phenomenon of "infanticide" and the debates it sparked in the scientific community, see Rees (2009).

summer both were deemed ready, so the staff moved Pierre into Astriks' enclosure, while removing both Lucia and Canter from their respective natal groups and placing them together in Pierre's now vacant enclosure.

Primatologists have produced a substantial amount of scholarship on the development of the pair-bond between newly introduced gibbons in captivity (e.g. Geissmann and Orgeldinger 2000), demonstrating that for species like the white-cheeked in which mated pairs produce "duets" consisting of precisely coordinated sex-specific vocalizations, the development of their pair bond that is a precondition for copulation and child-rearing goes hand-in-hand with the coordination of their shared duet (Maples et al. 1989).[2] Describing siamangs, a species with a high degree of vocal variability, Geissmann has observed the way in which a partner exchange between two siamang pairs in captivity resulted in each animal altering or omitting distinct phrases that they had uttered while duetting with their previous partners, in an apparent effort to establish coordination with their new ones. While the standard white-cheeked duet consisting of the female "great call" followed by the male "coda" (see figure 3.1) has been described in detail, the development of its coordination between newly introduced captive animals has been less studied (see Dooley and Judge 2007); for this reason I was excited to focus my research project on this dimension of the Center's changing soundscape. Quickly establishing with Gabi that direct observation of Pierre and Astriks would be unfeasible for me due to Pierre's anxiety around adult human males (see Chapter 2), I decided to concentrate instead on Lucia and Canter. And so in late May 2018, I prepared my recording equipment, set an alarm to wake up at 4am, and groggily arrived at the Center before dawn to observe the entirety of the acoustic interactions between this newly introduced pair.

[2] Specifically, these studies demonstrate that the proportion of incomplete or atypical "great calls" decreases substantially over the first few months after a pair's initial introduction.

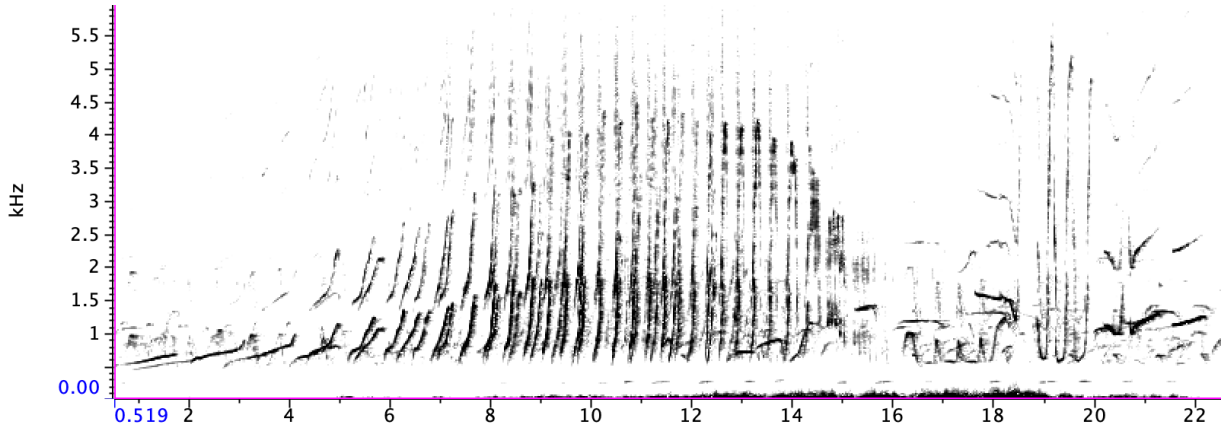

Figure 3.1: Spectrogram of an "ideal" white-cheeked gibbon duet (Astriks and Pierre, recorded on 21 December 2020). Astriks' "great call" transpires from 0:00 to 0:16; Pierre's "coda" begins at 0:18.

What I heard that morning was miles away from the attempts to coordinate I was expecting from the primatological literature. In fact, I heard no duetting at all between Canter and Lucia. While Canter sang continuously and loudly, Lucia initially did not sing at all. In fact, she remained in her insulated sleeping box far after the other gibbons had emerged and begun their dawn chorus. Only after several weeks did she begin producing great calls, and at that point she would only participate in the great calls initiated by other white-cheeked females rather than beginning her own. Even then, she would stop short of the sonic climax that would, theoretically, invite Canter's response and consummate the duet. As Gabi pointed out in a later interview (25 November 2019), during that entire time Canter had been attempting to coordinate with the great calls initiated by his sister Pepper from her own neighboring enclosure, just as he had done before being moved to his new home. And Lucia, separated from her mother for the first time in her life, appeared too scared to sing.

Gabi told me that this was to be expected:

> Once [white-cheeked females are] separated from their mother, they just don't sing. They need to sing with somebody. . . it's not easy to do the great call, for young females. And then, because there was an enclosure between [Lucia] and [her] mother, it probably makes it even harder for her. It was hard for her to hear Astriks, and Canter was still singing with Pepper. So, [laughs] it is kind of a complicated situation. It would be completely different if they would have just went to another zoo, I think—she would sing the great call, eventually with Canter, just independently. (ibid.)

Gabi was able to hear humor in this situation, finding it funny how Lucia's vocal timidity contrasted with her otherwise dominant and confident personality (ibid.). Nevertheless, Lucia's eventual participation—although initially under her breath—still came as a great relief to her caretakers, who might have otherwise rethought the pairing.

gharmony

In the context of gibbon conservation, attention towards, and proper management of, the audible compatibility between adult gibbon pairs in captivity affords more than monitoring the development of their pair-bonds. The stakes are far higher: especially as the wild white-cheeked gibbon population has dwindled to the point that there are currently more animals alive in captivity, the pairing of gibbons capable of producing offspring in captivity bears consequences for the possible continuity of their species as a whole. In the United States, this work is overseen by the Association of Zoos and Aquariums (AZA), an organization that facilitates species-specific breeding programs termed Species Survival Plans® (SSP). The particular threats to gibbon flourishing that the SSP's intervention seeks to remedy are not those like habitat loss that concern *in situ* conservationists (see Braverman 2014), however, but rather the interior threats that are the very living creatures that populate the category of species itself. In particular, the gibbon SSP seeks to carefully manage the degree of biological relatedness between the members of potential breeding pairs in order to avoid minimizing copulations in which gibbon offspring

may have inherited the same allele from both parents—a condition called "homozygosity"—and therefore the inevitable progression towards genetic homogeneity that occurs within a limited population. "Essentially stopping evolution in the captive population" (2010:291), as Jonathan D. Ballou and colleagues put it, "management strategies attempt, as much as possible, to retain every aspect of the genetic diversity of the founders over time." Sexual reproduction, here, is treated as both the means of maintaining the fragile integrity of those threatened species and a problem in need of management.

Although the official gibbon SSP supervises only two of the five species found at the center (northern white-cheeked gibbon and siamang), the Center treats the remaining three according to the same management strategies. Partnering with other accredited facilities and/or international organizations (in the case of pileated and Javan gibbons), the Center acts as a single node in a network within which gibbons are regularly moved or exchanged so that they may be paired with other eligible candidates for breeding. The complexities of such a program—in which the act of actually implementing the SSP's breeding recommendations is but the very final step in a long chain of labor and decision-making that implicates everything from skilled caretakers, primatologists, and geneticists within a logistical infrastructure of import/export permits, live animal shipping, and inter-facility communication—is understandably difficult to convey to a lay public often learning about even the existence, let alone the endangerment, of gibbons for the first time. But the Center staff are all skilled public educators: while taking a tour early on during my association with the Center, the guide—who left the Center before I began my IRB-sanctioned study—introduced this "global apparatus of technoscientific production" (Donna Haraway's description of the tiger SSP [2008:147]), with the tongue-in-cheek nickname

"gharmony," a play on eharmony.com, self-billed on its homepage as "the #1 trusted dating app."[3]

"There was once a town in the heart of America where all life seemed to live in harmony with its surroundings," as Rachel Carson begins her landmark 1962 exposé on the environmental impacts of pesticides. Indeed, invocations of harmony have only proliferated under the specter of socio-ecological crisis that Anna Tsing, Heather Swanson, Elaine Gan, and Nils Bubandt call the "ghosts and monsters of the Anthropocene" (2017). Take, for example, the World Soundscape Project's professed mission to "find solutions for an ecologically balanced soundscape where the relationship between the human community and its sonic environment is in harmony" (Truax et al. 2006); Paul Carter's claim in *Hearing Cultures* that the empirical backbone of acoustemology, the Bosavi of Papua New Guinea as described by Steven Feld, exemplifies a society sheltered from the modern condition of being "cut off from organic harmony" (2004:60); or sociologist Murray Bookchin's call for "the reconciliation of nature and human society in a new ecological sensibility and a new ecological society—a reharmonization of nature and humanity through a reharmonization of human with human" (1982:11). While at the Center gharmony was only a joke, in this chapter I use it as a conceptual springboard for thinking through what is at stake in the usage of acoustic metaphors to imagine solutions for ecological crisis.

In particular, I show that the pun of gharmony does not only establish a simple analogy between a program of captive gibbon reproductive management and the widespread human practice of turning to dedicated services for assistance in finding romantic partnership, but also reveals how the acoustemological metaphor of harmony is deeply implicated in the ethics and

[3] Prior to 29 September 2020, the line on the eharmony homepage read "the #1 trusted dating site."

practice of managing captive animal populations. Bringing together insights from scholarship on sound and human-animal relations, I show that harmony has historically made possible a set of techniques and technologies with which to achieve a form of ecological justice, in which species are saved from extinction, at the expense of reproductive justice for members of those species.[4] Appropriately, all the Center staff I spoke with for this dissertation all found the joke to be problematic. Thinking through gharmony here makes audible everything that could go wrong in the high-stakes environment of endangered species management; I argue that the condition of harmony characterizes a form of animal management, identified in literature examining cases from birds to elephants, wildcats to orangutans, in which actual animal lives are reduced to the resources expended for the sake of their species' perpetuation. In the following chapter, I show that the Center staff's listening practices offer an alternative—one that not only avoids the critiques levelled in this literature, but also problematizes many of its own reductive assumptions about the operation of Species Survival Plans.

[4] In his entry on "space" in *Keywords in Sound* (2015), Andrew Eisenberg makes clear that although the term "ecology" is commonly associated with the "natural world," it more properly marks "an environment . . . as a space of relations" (ibid.:197). Philosopher Timothy Morton calls for "ecology without nature" (2007), arguing that an equivocation of the relational and the natural only serves to muddy the conceptual underpinnings of the contemporary environmental movement. Ecological justice, as I refer to it over the course of this chapter, is not a synonym for environmental justice; rather, it more inclusively implies the achievement of forms of relating that do not actively damage those entities implicated within them. Defining ecological justice in this manner immediately evokes the famous Navajo cosmological concept of *hózhó*, of "right relations"—most commonly translated as "harmony." But as Donna Haraway suggests (2016:14), these are "imperfect translations." My critique of harmony sustained over this chapter is not intended to argue against this philosophy, nor others like it. Instead, I ask specifically whether the acoustemological baggage of the Anglophone term "harmony"—saturated as it is with millennia of entitlement from Western thinkers benefitting from, and therefore intellectually justifying, the material and epistemic violences of white supremacist patriarchy, of colonization, and most recently of capitalist ecocide through extractivism—is a worthy keyword with which to process such urgently necessary ontological orientations. And given the way I have just framed the question, my answer should be obvious.

Harmony

Scholars of extinction have commented extensively on the paradox that Aryn Martin, Natasha Myers, and Ana Viseu aptly describe as "care's darker side: its lack of innocence and violence committed in its name" (2015:627), especially when the reproductive capacities of particular animals come to bear responsibility for the survival of their threatened species. Thom van Dooren, for example, coins the term "the violent-care of captive life" (2016) to highlight the juxtapositions of kindness and cruelty that underpin a famous program of whooping crane breeding and rewilding. Van Dooren tells a story of dramatic successes—such as the training of fledgling cranes to follow a light aircraft to their hereditary breeding ground—tempered by the animal lives consumed in the process: the forced reproduction and artificial insemination of birds kept only for breeding purposes, and the sacrifice of the "expendable" offspring of less-endangered bird species conscripted into acting as surrogate parents. In the context of orangutan rehabilitation, Parreñas describes a "system of sexual violence, . . . experienced between individuals for the sake of producing future generations of an endangered species" (2018:84), in which female orangutans are expected to "take it for the team" ibid.:88), in the words of one interlocutor, during their enforced copulations with brutal and aggressive males. "What kind of life is deemed worth living," Parreñas asks, "when the survival of a few individual members of endangered species is at stake, when their lives come to stand in for the entire species?" (ibid.:84).

The very system of values that these scholars identify underpinning endangered species management, in which the survival of the whole takes precedence over the experiences of its parts, is characterized in a different context by anthropologist Laura Nader as nothing less than "harmony." Nader has devoted much of her long career to examining what she calls "harmony

ideology" (1990), beginning with ethnographic research among an Indigenous group in Mexico who strategically used the appearance of social cohesiveness to deflect the colonial government's primary justification for intervention, but later addressed in situations as diverse as late 20th-century U.S. politics and museological challenges to modern science's claim to pure objectivity (1997). What Nader makes clear is that the value of social harmony, in a legal context, places a value on conflict resolution—on conciliation and compromise that maintains the integrity of the whole—over that of either party actually achieving justice. "Harmony coerced," as Nader titles an important article (2001), "is freedom denied." And although Nader ethnographically demonstrates that the rhetoric of harmony can be a powerful form of resistance to the intercessions of a colonial government on marginalized Indigenous communities (1991), as an ethical principle it can only result in the maintenance of the status quo and therefore a form of "reconciliation," like Dylan Robinson describes in the context of musical collaborations between Indigenous peoples and settler colonists in Canada (2020), that rewards those who have benefitted from the status quo itself rather than those oppressed by it.

In contrast to scholars like Nader, who treats the term as purely a descriptor for a form of social relation, numerous scholars of music and sound have devoted attention to its musical dimensions. As philosopher of popular music Robin James demonstrates (2019), the concept of harmony surfaces numerous times in what she names as "the sonic episteme"—a philosophical approach that posits sound as a redemptive solution for the numerous documented problems with a sight-based metaphysics of representation, but ends up just exacerbating, rather than resolving, the problem. In a book aptly titled *Imposing Harmony* (2008), Geoffrey Baker reveals how appeals to harmony were used to justify and structure the terms of the Spanish invasion of Peru: "The Spaniards sought to recreate the harmony of the cosmos in strange lands," he writes

(ibid.:30), "to make the New World resonate with the consonance of the Old." Describing a much more recent case, Jessica Schwartz examines the political affordances of US nuclear bomb testing and nonconsensual studies of radiation poisoning on the Indigenous inhabitants of the Marshall Islands to argue that the post-WWII "social contract of global harmony is predicated on nuclear ruins and, more specifically, Indigenous ruins as subjects of nuclear colonialism" (2021:39). Finally, in a very relevant study, Jack Harrison (2020) shows how the aesthetic ideal of "horse-rider harmony" in classical dressage is meant to mask the fact that the horse is fully under the control of its rider. "Harmony," as Rebecca Solnit puts it (2014), "is often purchased by suppressing those with something to say."

In each of these cases, the term acts as what James terms a "conceptual *jacquemart* (a clock [that is] supposed to disguise a sound made by an ugly machine as one made by an aesthetically pleasing one) that hides ugly mathematical and managerial mechanics behind a metaphor for sonic and musical pleasure" (2019:171). Sometimes, however, the social and/or natural hierarchies that harmony implies are invoked explicitly. For example, the fifteenth-century Elizabethan jurist Sir John Fortescue invoked harmony as a cosmological principle in his characterization of the Great Chain of Being: "there is no worm that crawls upon the ground, no bird that flies on high, no fish that swims in the depths, which the chain of this order does not bind in the most harmonious concord" (1869:322). And in his study of the acoustemology underpinning the neoplatonic philosophy of medieval Europe (2017), Andrew Hicks addresses medieval philosopher William of Conches' proclamation that "*Mundus diligit concordiam*, the world loves harmony" (ibid.:17). If the *anima mundi*, the living soul of the world, is sustained by an apparently inaudible cosmological harmony, then "*si fieret discorida elementum, dissolueretur et mundus.* If the elements were to become discordant, the world would also

dissolve" (ibid.:18). Christopher Hight, too, shows that in the context of European colonialism "harmony provided a conceptual apparatus by which bodies that seem totally 'other' and foreign cultures could be assimilated and controlled according to their degree of likeness" (2003:15; cf. Taylor 2007). Each of these examples perform what Lorraine Daston calls "the naturalistic fallacy," or the slippage from "is to ought" (2019). Linking harmony to the presumptive operation of nature makes its presence seem not just desirable but fully necessary.

Building on this work, my contribution is to examine the use of harmony as a distinct principle that structures the practical and conceptual possibilities of conducting reproductive matchmaking—in order to query whether harmony is a viable means of achieving the ecological justice to which it often aspires. To telegraph my conclusions, it is not. At root is the specific wain in which harmony treats the condition of compatibility—as predictable in advance. And although by the end of this chapter harmony's historical association with the development of the mathematics that makes it possible to manage animal lives solely on the basis of their genetic makeup might seem obvious, I admit that I might not have made this connection had a particular Center tour guide not used the term gharmony during that public tour I took in early 2018. Indeed, eharmony's promotional materials, and the acoustemological commitments they draw upon, proved surprisingly helpful for thinking through just what is at stake in the SSP's project of gibbon matchmaking.

Harmony as latent compatibility

As an eharmony.com commercial (that suspiciously began saturating the advertisements on my preferred television streaming service just as I began drafting this chapter) proclaims, "compatibility matters." eharmony proposes to predict this compatibility by means of a

proprietary algorithm purportedly capable of evaluating the compatibility of potential matches according to a "29 DIMENSIONS® [sic] model"; this "compatibility matching system®," as eharmony's home page makes clear, is what allows its users to "find the right match." While the validity of algorithms like eharmony's have long occupied a position between skepticism and ridicule in the scientific community (see Finkel et al. 2012)—let alone studies critical of the tendency of algorithms themselves to become what Cathy O'Neil calls "weapons of math destruction" (2016; cf. Seaver 2018, 2019)—my goal here is not to evaluate its efficacy; rather, it is to flesh out a powerful metaphysical commitment that obviously resonates with the service's numerous users. For eharmony's algorithm to seem as though it may yield useful results, compatibility must be conceived as something not as cultivated and maintained in contingent, situated and collaborative relation between those users paired together, but rather as objectively measurable in terms of quantifiable variables. Crucially, the variables that might predict the compatibility of a match must be understood as the properties of individual users as measured antecedent to their pairing. Here, just as Anna Tsing writes in her account of the process of generalization that produces universals from particulars, "compatibility must pre-exist the particular facts being examined" (2005:89). Rather than being a simple euphemism for romance, harmony acts as what Lakoff and Johnson call a "metaphor we live by" (1980): it implies that a particular set of conditions are necessary for the possibility of its achievement.

Perhaps nowhere are the consequences of treating compatibility as metaphorically structured by harmony more apparent—and relevant—than in the philosophical writings of the biologist Jakob von Uexküll, for whom harmony was nothing less than the underlying law through which "the fundamental principle of the whole technology of Nature is enunciated" (2010 [1934]:190). The impact of Uexküll's early twentieth-century notions of more-than-human

subjectivity and biosemiosis cannot be overstated. His ideas famously influenced renowned philosophers like Martin Heidegger, Maurice Merleau-Ponty, and the collaboration between Gilles Deleuze and Félix Guattari (see Buchanan 2008), and they remain important with philosophers and scientists concerned with the mechanisms of embodied cognition and the ecological conditions of consciousness (e.g., Dennett 2015; Clark 1997; Godfrey-Smith 2001; Baggs and Chemero 2018), multispecies ethnographers (e.g., Schroer 2019; Chrulew 2020), anthropologists of art (e.g., Gell 1999; Corsin Jimenez 2018), and posthumanists (e.g., Grosz 2008). But Uexküllian thought carries an additional degree of relevance: as extinction studies scholar Matthew Chrulew makes clear over a series of essays (2011, 2019, 2020), Uexküll's theory of *umwelten*, his technical term for the uniquely meaningful "life-worlds" subjectively inhabited by various organisms due to their sensory mechanisms, proved a crucial inspiration for the contemporary approach of captive animal management pioneered by Heini Hediger.[5] This subjectivist metaphysics—the recognition that animals are not mindless automata shaped by evolution to unthinkingly react to external stimuli but rather that each has an individual perspective and meaningful experience of its environment—is at the heart of Uexküll's "theory of meaning."

Famously, Uexküll invites his reader to inhabit the umwelt of the common wood tick, arguing that what would be for humans an experience of near-sensory deprivation, for the tick is an event made rich in meaning by the olfactory markers of butyric acid; the warmth of mammalian blood; and the tactile sensation of fur and bare skin. On one hand, then, Uexküll's is a forceful argument for an interspecies sympathy wholly incompatible with the "great chain of

[5] Following the Uexkullian notion that "each animal lives in its own specific world" (Hediger 1964:27), Hediger suggested that the task of the zookeeper is to recognize the meaning the elements of the captive animal's built environment hold for it, and subsequently construct that environment in ways salient for that animal's own welfare.

being" argument in which the differential complexities of species sort them into a fixed hierarchy; despite its "impoverished structure" (2010 [1934]:51) relative to the human, Uexküll insists that the experience of the tick is no more or less meaningful. On the other hand, however, Uexküll's theory relies upon nothing less than an ontological commitment to species apartheid, composed as it is of entities entirely segregated from one another by virtue of their non-identical sensory capacities, each of which contributes to the impermeable boundary of their own umwelten. "We must therefore imagine all the animals that animate Nature around us, be they beetles, butterflies, gnats, or dragonflies who populate a meadow," he proposes, "as having a soap bubble around them, closed on all sides, which closes off their visual space and in which everything visible for the subject is also enclosed. . . . The birds that flutter about, the squirrels hopping from branch to branch, or the cows grazing in the meadow, all remain permanently enclosed in the bubble that encloses their space" (ibid.:69).

Uexküll's task is consequently to explain how all these individually constrained organisms, locked within their own incommensurable worlds that still "intersect in many ways without disturbing each other," can somehow still combine into the larger relational assemblages that would later be termed "ecologies." It is music, and more specifically European tonal harmony, to the rescue; harmony solves the problem of mutual alienation because, as he continues, umwelten "do not interact mechanically but are still connected according to a plan as the notes of an oratorio are harmonically connected. It is thus musical and not mechanical laws that we need to study if we want to find out about the laws of Life" (2001:117). To emphasize this musical conception of biology, Uexküll recollects his experience in the audience of a Mahler symphony:

> Next to me sat a young man who was totally absorbed in the score and who closed the book of music with a sigh of contentment as the final chord faded away. In my musical ignorance, I asked him what pleasure he could take from following in musical notation with his eyes that which his ear heard directly in sounds. He assured me fervently that only someone who follows the score can obtain the full vision of a musical artwork. Each voice of a person or instrument is a being for itself, but one which melts into a higher form through point and counterpoint with other voices, which form then grows further, gaining richness and beauty in order to bring forward to us the composer's soul. Only [by reading the score] does one get a glance into the many-membered form of the performed artwork. (2010 [1934]:185–186)

Like the various instrumental parts that make up the score to a symphonic composition, then, the significance of individual organisms can only be known in their relation to the whole, in particular, according the terms preconceived by the composer. This is not a metaphor, however, but rather an insistence upon a "common denominator between animals and musical instruments" (ibid.)—a philosophy of biology according to which "instead of laws of mechanics the laws are here closer to the laws of musical harmonics" (2001:117). Uexküll vacillates between understanding "Nature" as composer or performer—in one section, he argues that the task of the biologist is to transcribe the "score of Nature." In another, Nature is not the epitome of the Romantic genius composer but rather the performer, the (literally) supernatural entity whose "masterful hand" has been "gliding over the keys of life since time immemorial" (2010 [1934]:195). If for Uexküll the behavior of nature, most broadly, is best understood in terms of Western tonal harmony, then the field of biology is nothing but a species of *organology* (the study of musical instruments).

Crucially, the role of these organisms/musical instruments is to sound the "tones" that, heard together, represent Nature's composition. Uexküll defines a "tone" in a precise way: understanding that the character of any given organism's umwelt facilitates a particular set of ways in which it can interact with the environment it perceives, a tone is the realization or

performance of such an action.[6] Tones are species' ecological functions; if Uexküll had written of gibbons, he would most likely define the tones they produce not as their various vocalizations, but rather their dispersal of seeds throughout the forest.

Sometimes the realization of these tones puts organisms in relationships with others. "Like every instrument," Uexküll writes, "every animal harbors a certain number of tones, which enter into contrapuntal relationships to the tones of other animals" (ibid.:187); indeed, "at least two tones are necessary in order to form a harmony" (ibid.:172). When this happens, for example in the case of orchids and their insect pollinators that proved crucial to the development of Hustak and Myers' (2012) notion of "involution" addressed in the previous chapter, it is because there is an underlying connection between the two disparate forms of life. "How is it possible," Uexkull asks, "that two things of such different origin as, for instance, the bumblebee and the snapdragon blossom, are constructed so that they suit each other in every detail?" His answer: "only by the fact that these two formative melodies influence each other mutually—that the snapdragon's melody intervenes as a motif in the bumblebee's melody and vice versa" (ibid.:202). He makes this particularly clear through a short poem inspired by a couplet by Goethe (Were the eye not sunlike,/It could never gaze upon the sun [quoted in Uexküll 2010:190]):

> If the flower were not bee-like,
> If the bee were not flower-like,
> The harmony would never succeed. (ibid.:198)

Harmony is nothing less than the fundamental principle that structures life in all its observable complexity. Uexküll is describing a simple principle of underlying mutuality,

[6] Fulton and Turvey note a strong similarity between an Uexküllian "tone" and the celebrated "affordance theory" of James Gibson (1979), in which "the affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill" (ibid.:127).

precisely the "resonance" that, as Veit Erlmann writes, denotes "the ability of each and every element to be affected by and in turn to influence all the other elements by similitude, adjacency, antipathy, and sympathy" (2010:49). Yet Uexküll's statement also implies that this resonance is only possible because the various entities that populate a harmonious ecology have been articulated for one another in advance; their admissible forms of relating are, in a word, precomposed. "It is [the] requirements of musical harmony that define the design of the instrument" (2001 [1934]:117).

This becomes particularly apparent in the final pages of his *Theory of Meaning*, wherein he speculates on how human ingenuity might intervene following the potential extinction of moths. The goal of such an effort, he suggests, would not be to attempt what has recently been termed "de-extinction" (see Searle 2020)—to artificially revive or reconstruct the species—but instead to "replac[e] this loss on the clavier of life with the help of natural technology" (2010 [1934]:206). Uexküll's suggestion to "retrain" (ibid.) butterflies to attend to the nocturnally blooming flowers left unpollinated by the moths' extinction shows that the moth's *tone*, and not the organism itself, is what is in need of preservation in order to maintain life's harmonious balance. Indeed, for Uexküll the "tune is complete master of the individual musician" (ibid.:121). And when Uexküll proclaims that for hares, "hawks and foxes become benefactors of [their] species . . . by snatching away the weak prey animals" (ibid.:183), we glimpse the way in which the possibility of harmonious order rests upon not only its participants wholly submitting to their functional roles, but further the maintenance of a proper *proportion* of each; too many hares would unsettle that balance just as much would too few moths. For Uexküll, harmony is not the emergent result of multiple organism-instruments sounding the various tones available to them—

as preexisting, autonomous units arranged together by a higher organizational principle—but rather what determines in advance and regulates those organisms' forms and functions.

And in this sense, I am reminded of John Comfort Fillmore's pejorative nineteenth-century musical and evolutionary theory of "latent harmony," which was grounded in Fillmore's observation that "although the Indians never made any attempt at singing in parts, whenever their songs were played for them on a piano or organ, *they were not satisfied without the addition of chords to the melodies*" (1994:61). Having noticed that what he called "Indian songs" could be harmonized according to the principles of European tonality despite conventionally being sung in unison, Fillmore concludes that "this fact . . . indicated the presence of a latent harmonic sense which might, unconsciously on their part, be a determining factor in their choice of melody tones" (ibid.). For Fillmore this latent harmonic sense in the music of Native Americans legitimized both the descriptive and prescriptive conclusions of evolutionary race science; as he puts it, "whatever chords were natural and satisfactory to me were equally so to them, from which it seems proper to draw the conclusion that the sense of harmony is an innate endowment of human nature, that is the same for the trained musician and for the untrained primitive man, the difference being purely one of development" (ibid.). Harmony offers such an apt metaphor for predictive matchmaking programs because harmony is a theory of latency; harmony comes with, to paraphrase Roy Wagner, the teleological conditions for the possibility of its realization "integrally implied" (1991:163).

Rather than using the language of latent harmony, Paige Edmiston describes a matchmaking algorithm similar to eharmony, which every year determines the placement of medical residents in hospitals across the United States, as a "technology of destiny" (2021). Edmiston describes the implications of what is colloquially known as "The Match" in strikingly

similar language to gharmony: “In the weeks leading up to my partner’s Match Day,” she writes, “friends, family, and other medical students frequently assured us that my partner would end up ‘where he was meant to be’” (ibid.); furthermore, she shows, these placement decisions have life-altering consequences not only for the residents matched with hospitals but also for their families. There is one major difference: the algorithm behind The Match, whose development won Alvin Roth the 2012 Nobel Prize in economics, is a technology with which to evaluate mutual preferences; each resident and each hospital chooses their most desirable choices from a pool of available candidates, and the algorithm processes this data in an attempt to accommodate as many choices as possible. The allure of matchmaking algorithms based upon the measurements of individual bodies, in contrast, is that they render unnecessary any active participation from their users once the initial statistics are entered; as a number of smiling actors conclude in those omnipresent television advertisements, “that’s why I *trust* eharmony.” It is precisely the presumed objectivity of such computational processes—placed in opposition to the messiness of subjective choice—that is leveraged to convince their users to surrender their decision-making agency to a curation algorithm.

Nick Seaver has written extensively on how the popular assumptions that recommendation algorithms operate purely according to rational principles mask the fact that the operations they automate were designed by fundamentally fallible human beings (e.g., 2018); in one article he explicitly describes them as “traps” (Seaver 2019). Suzanne Thomas, Dawn Nafus, and Jamie Sherman propose to consider such “algorithms as fetish” (2018), building on David Graeber’s (2005) understanding of the fetish as the contingent product of human creativity that nevertheless comes to take on a life of its own that, ironically, comes to pose demands for those people who produced it. And indeed the particular computer programs used to calculate genetic

relatedness among captive animal populations exhibit this fetishism not only implicitly, in their managers' trust in the objectivity of their output, but further explicitly: in the instruction manual for a software package called GENES, designed to process genealogical information not only to calculate things like the inbreeding coefficients of hypothetical offspring but also provide stochastic simulations of allele retention across generations, the authors explicitly state that their software will only do these things "if asked politely" (ISIS 2005:47).

Thinking through the particular way in which the acoustemological metaphor of harmony shapes the latent possibility of compatibility shows how the project of predictive matchmaking mobilizes a metaphysical commitment to the prior existence of atomistic units whose individual characteristics make them suitable for entering into some pairings and not others. eharmony's promotional materials again make this clear: proper matchmaking relies upon being able to calculate "who really fits together" (eharmony Editorial Team 2021). Like the process of assembling a jigsaw puzzle, a collection of unique, individual pieces, the situation that the matchmaking algorithms of e- and gharmony alike are designed to process is one in which the elements each accounts for are already capable of entering into some combinations and not others. The form of compatibility structured by harmony describes the capacity of some individual units to cohere precisely because they are already articulated for each other in advance of their pairing. Compatibility is treated as something to be measured and realized rather than developed or intervened upon; matchmaking is envisioned as a managerial project of realizing latent possibilities. Just like the branch of science that accounts for the aggregation of discrete elements into compound molecules based on their individual properties—as the formation of a water molecule from independent atoms of hydrogen and oxygen, for example, is explainable by the individual electron configurations of each—compatibility is fully accountable and predictable

based on the inherent characteristics of the individuals in question. In this context, the harmony promised at the end of the matchmaking process is a function of chemistry indeed.

Predicting biological compatibility

The literature on captive animal management describes a strikingly similar theory of matchmaking predicated upon the existence of a latent compatibility between the entities to be matched. Instead of modelling either twenty-nine or thirty-two dimensions of compatibility, as eharmony's regularly updated homepage sometimes claims, however, publications like the chapter "Demographic and Genetic Management of Captive Populations" (Ballou et al. 2020) are interested in far fewer factors. While captive population management programs potentially make use of a number of complex algorithmic formulas to calculate reproductive pairings (ibid.), these formulas are all based upon a single variable. Alternately termed the "kinship coefficient" or "coefficient of relatedness," the particular form of compatibility that informs matchmaking decisions is the proportion of genetic material held in common between two potential mates:

$$R = (\#\text{ recent ancestors}) \times (1/2)^n$$

The calculations are straightforward enough: the fewer "reproductive events" separating two individuals that share an ancestor (the variable represented by the "n"), the higher "the probability that two alleles, taken at random from two individuals, are identical by descent" (Ballou et al. 2010:47). The formula is based upon Mendelian probabilities of inheritance, that is, the assumption that offspring inherit an average of 50% of their genes from each parent. The kinship coefficient between a parent and child is therefore statistically ½, as is that between full siblings. The kinship coefficient between a grandparent and grandchild—separated genealogically by an additional generation—is ¼; cousins, separated by three reproductive

events, share on average 1/8 of their genetics, and so on. Calculating kinship coefficients helps the conservationists planning animal pairings to avoid in the potential offspring of those pairs what is called "homozygosity," the condition in which an individual has inherited the same allele for any given gene from both parents and thus made each parent's *other* allele unavailable for future inheritance—which amounts to the removal of potential genetic diversity from the population's gene pool. The less related two parents are, the better.

This work is made possible by the keeping of what is called a "studbook": a (now) digital record of every animal in the captive population maintained in a dedicated software package called ZIMS (Zoological Information Management Software), each assigned a unique identifier and linked to the identifiers of its parents, or alternatively marked as a "founder" animal. Yet this approach does not stop at comparisons of individual animals; its matchmaking decisions, furthermore, are informed by a formula that assigns each gibbon a "mean kinship value," which expresses not the proportion of genetic material it has in common with another living animal but rather with the population (figure 3.2).

$$mk_i = \frac{\sum_{j=1}^{N} k_{ij}}{N}$$

Figure 3.2: The formula for calculating an animal's "mean kinship value," as presented in Ballou et al. 2010:241. It indicates that "mk_i", the mean kinship value of an individual, is equal to the summation (Σ) of that individual's kinship coefficients (k_{ij}) with N different animals (N is the number of individuals in the population), divided by N.

Resulting from the averaging of the kinship coefficients obtained between a particular gibbon and every other living member of the captive population, mean kinship values allow the SSP to "rank individuals according to their genetic importance in preserving gene diversity in the population" (ibid.). And after adjusting those mean kinship values with further processes that return "the probability that a gene carried by an individual is unique (i.e., not carried by any other living animal)" (ibid.:48), the managers can sort the animals they manage into hypothetical pairings, and finally generate a set of recommendations that accounts for *all* individuals in need of pairing.

The subordination of the individual to the needs of the collective, the use of statistical calculations to manage the population; these are all defining characteristics of what Michel Foucault famously describes as "an entire series of interventions and *regulatory controls: a biopolitics of the population*" (1978:139). An inversion of the more "ancient right to *take* life or *let* live" (1978:138) that is "sovereign power," for Foucault biopower is the more modern practice of managing life itself, expressed alternately as "a power to *foster* life and *disallow* it to the point of death" (ibid.) and "the power to 'make' live and 'let' die" (2003:241). Although Foucault coined the terms "biopolitics" and "biopower" to discuss forms of human subjugation, numerous scholars have pointed out that his concepts are eminently applicable to the treatment of animals in a variety of managed settings (e.g., Wolfe 2009; Chrulew 2011; Fredriksen 2015). What the evaluation of genetic compatibility makes possible is the management of captive animals' entire lives to a biopolitical system of regulation based on the already existing distribution of a purportedly quantifiable trait. Indeed, as Foucault makes clear, this form of power is grounded on a concern for the perpetuation of "life itself," that is, the sort of collective life that emerges when attention is "focused on the *species body*" (1978:139).

But "whereas in human biopolitics, the subversion of the individual to the population or species is often hidden from plain view," as Aurora Fredriksen points out for the case of wildcat conservation (2015:691), "in conservation biology it is both explicit and fundamental." In his own investigation into captive breeding programs Chrulew pithily summarizes this perspective's consequences: "in its focus on the anatomical or genetic species body at the expense of emplaced creatures, the zoo produces not full, flourishing lives but a wounded life, robbed of vital connectivities and expressions" (2012:139). And even the losses of individual captive animals, Chrulew shows, may be deemed "acceptable—as each animal was in principle replaceable" (ibid.:141). While in the next chapter I argue that this critique fails in the case of gibbon conservation as practiced at the Center, here I remain focused on the fact that the condition of harmony perfectly exemplifies the concerns these scholars express.

The stakes of kinship evaluations

Particularly apparent in these calculations is the privileged role of what Evelyn Fox Keller describes as the epistemological "insistence on unidirectional causality" (1995:93) inherent in the "central dogma" of the influential neo-Darwinian evolutionary theory called sociobiology: "DNA makes RNA, RNA makes proteins, and proteins make us" (ibid.:18). Such "gene fetishism," as Haraway terms it, "is about mistaking *heterogeneous* relationality for a fixed, seemingly objective thing, . . . forgetting that bodies are nodes in webs of integrations, forgetting the tropic quality of all knowledge claims" (1997:142; cf. TallBear 2014 on "gene talk"). This section is concerned with the implications of this knowledge claim: what does it mean to say that two gibbon bodies contain a certain fraction of genetic material in common—that all the answers can be found "in her genes," as the cover to an issue of *Nature* featuring an

article on gibbon genetics proclaims (figure 3.3)? The reproductive compatibility indexed by kinship coefficients are not just factual descriptions of genetic similarity, but as measurements of precisely the "latent harmony" measured by gharmony—the potential continuity already present between distinct bodies—they also carry prescriptive demands for those gibbons they describe.

Figure 3.3: **The September 2014 cover of *Nature*, featuring Pepper (see Chapter 2 and above) as an infant. Used with permission.**

The notion of the kinship coefficient was originally proposed by W. D. Hamilton in 1964 as a way of theorizing the significance of the proportion of genetic material surviving across the reproductive events that mark genealogical time. It was developed in the context of what is known as "the problem of altruism" in ethology, the paradox in which animals are regularly observed expending resources for the benefit of others in ways that seemingly reduce their own chances of survival and/or reproductive success. But if those two animals in fact share a proportion of genetic material, Hamilton reasoned, then the situation can be understood as one

that increases the reproductive fitness of those particular genes they hold in common rather than the individual bodies that carry them. If this was true, then a parent would be twice as likely to expend resources for the benefit of a child (who statistically carries half of that parent's genetic material) as a grandchild (who only shares, on average, one quarter).

As a measure of genetic identity—the proportion of what anthropologist David Schneider, in his landmark ethnography *American Kinship* (1968), calls "biogenetic substance" that two gibbons have in common—the characterization of this variable as a coefficient of "kinship" is apt: it proposes one medium (the gene) of quantifying precisely how Marshall Sahlins defines kinship. For Sahlins, kinship is the "mutuality of being." "Kinfolk are persons who participate intrinsically in each other's existence; they are members of one another" (2013:ix). "To the extent they lead common lives," he writes (ibid.:28), "they partake of each other's sufferings and joys, sharing one another's experiences even as they take responsibility for and feel the effect of each other's acts." As a measure of precisely the sort of "shared substance" that Sahlins describes, kinship coefficients and the "kin selection theory" they make possible, at its most basic, is a way to understand the consequences that the actions of one body may have on another. Sahlins, however, is insistent that kinship is not biology and only a product of a uniquely human capacity for symbolic meaning-making. But Richard Dawkins paints essentially the same picture in his popular account of the influential and longlasting strain of neo-Darwinian evolutionary theory known as sociobiology, *The Selfish Gene* (1989; cf. Wilson 1975), in which he demonstrates that biological understandings of genetic kinship depend on a particular form of semiotic relatedness, a way to define what counts as similarity and locate equivalences across a distributed array of heterogeneous entities. This is necessary not only analytically but further vitally because the gene, as Dawkins argues, is "a distributed agency, existing in many different

individuals at once" (1989:114); as he makes abundantly clear, evaluating the presence and degree of shared biogenetic substance is not just a way of measuring relationships but rather the very bedrock of his gene-centered view of evolution. At stake is nothing less than survival; Dawkins' suggestion that calculating kinship coefficients would be "useful in making your will" (ibid.:119) was foreshadowed in the 1930s, when in response to an earlier formulation of Hamilton's principle, the biologist Jack Haldane asserted that he would be willing to die "for two brothers or eight cousins" (cited in Graeber 2014).

Haldane, famously, was exaggerating. His statement, however, pithily expresses the way in which sociobiological theory assumes a latent compatibility between nature and economics: kinship coefficients quantify how much risk an altruistic investment of resources would be worth. An altruistic act that benefits two siblings, from this perspective, is worth precisely the same as one that benefits eight cousins.

Sociobiology posits that nature essentially operates according the self-interested, utilitarian principles of economic rationality; that the inherited behaviors of an organism that give its genotype a reproductive advantage are those in which resources are utilized in a way that maximizes benefits and minimizes costs. "Generally speaking," David Graeber writes in his reflection on the (in)ability for sociobiology to account for non-human play behavior, "an analysis of animal behavior is not considered scientific unless the animal is assumed, at least tacitly, to be operating according to the same means/ends calculations that one would apply to economic transactions. Under this assumption, an expenditure of energy must be directed toward some goal, whether it be obtaining food, securing territory, achieving dominance, or maximizing reproductive success" (2014:50).[7] In this manner "ethologists," as Graeber concludes, "have

[7] Take, for example, a very recent attempt to account for a peculiar octopus behavior observed by Sampaio et al. (2020) during collaborative hunting events involving octopi and multiple fish species in the Mediterranean Sea:

boxed themselves into a world where to be scientific means to offer an explanation of rational terms—which in turn means describing an animal *as if* it were a calculating economic actor trying to maximize some sort of self-interest" (ibid., original emphasis). And as Graeber implies, economic rationality in this sense is simply the ability to perform cost/benefit calculations (or, as midcentury economists like Gary Becker [e.g., 1962] made explicit, rewarded for their actions in ways that reflect the predictions of those calculations in precisely the same way that Dawkins writes that "an animal may be pre-programmed in such a way that it behaves *as if* it had made a complicated calculation" [124; original emphasis; cf. Dilts 2011]). "Rationality, from the neoliberal point of view, is simply another word for predictability," as Robin James insightfully writes (2015).

The complex array of calculations that allow conservationists and geneticists to make claims about the distribution of genes across time and space, in this sense, are simply extensions of the same sorts of calculations animals like gibbons are assumed to be doing constantly and unthinkingly on a daily basis. Such genetic measurement, however, requires a very particular kind of mathematics; as Kimberly TallBear makes clear in her deconstruction of the assumptions spread by popular DNA ancestry services, DNA markers do not operate as fixed, discrete things but rather "are found at higher frequencies in some populations and at lower frequencies in others" (2014:82), whether the population in question encompasses a particular racialized human group or, in this case, a group of (potentially) biologically related gibbons. What is necessary to parse is not the distribution of discrete, bounded units of biogenetic substance but rather the frequency—the probability rates—of their occurrence: the studbook's hypothetical calculation of 1/4 between Vok, for example, and the future offspring of his son Canter with Lucia, does not

"From an ecological perspective," they reason, "actively punching a fish partner entails a small energetic cost for the actor (i.e., octopus), and simultaneously imposes a cost on the targeted fish partner" (ibid.:2).

mean that Vok's grandchild would have exactly one quarter of his alleles, but rather that this outcome is the most statistically probable. The calculations underpinning altruistic behaviors—whether performed by animals or human managers—might best be understood as wagers, as an informed investment whose outcome might yield some positive return.

Calculations of relatedness within a bounded population, then, rely upon treating the genomes of individual organisms as composed of various copies, each ontologically subordinate to the unique source it indexes. Writing of *Homo sapiens*, Dawkins once again clarifies: "Humans as a species, as well as humans as individuals, are temporary vessels containing a mix of genes from different sources" (2016:72). Origins become the keys at once to genetic identity and individual value; in her landmark study of the ways in which "gene talk" hampers Indigenous sovereignty, TallBear notes that "the representation of living groups of individuals as reference populations all require the assumption that there was a moment, a . . . body, a marker, a population back there in space and time that was a biogeographical pinpoint of originality" (2014:6). What the joke of gharmony suggests—a system of managing captive animal reproduction through measures of genetic equivalence—is only possible because of its human managers' commitment to a concept of fidelity not as much romantic as ontologically and genetically definitive.

Harmony and probabilistic statistics

Distributions of genetic frequency amongst populations, animals and scientists conducting predictive cost/benefit analyses; I have apparently drifted far from my discussion of the theory behind captive animal breeding and the way in which its notion of compatibility is best understood through the logic of harmony. But not so fast—harmony, in fact, has been

lurking in the background the entire time. In addition to prescribing the compatibility between gibbon bodies, it shapes the mathematics used to make these calculations. As Robin James makes clear in *The Sonic Episteme*, calculating the speculative distribution and pattern of frequencies, rather than fixed quantities, requires a particular kind of mathematics: probabilistic statistics. More specifically, statistics makes use of a mathematical function called the "normal curve," which plots the relative frequency of a variable's occurrence across a collection of data points. Also known as the "bell curve," this process as applied to human populations is infamous for objectifying racial stereotypes; furthermore, the use of statistical normalization is precisely the tool Foucault locates as necessary to the implementation of biopower (1978; cf. Mader 2011).[8] Even as immediate forms of sonic and corporeal compatibility between particular gibbons recede under the managerial strategies of statistical prediction and genetic comparison, then, a different set of conceptual compatibilities emerge: those heard by a particular history of listening that afforded the very possibility of measuring genetic relatedness.

Historically, harmony had a hand in developing this form of quantitative analysis. In *Alien Listening*, Daniel K. L. Chua and Alexander Rehding ground their provocative, humorous "Intergalactic Music Theory of Everything" in the insight that "music theory, in all its speculative glory, was the first 'string theory' of the universe" (2021:51). Chua and Rehding are

[8] Both Michelle Murphy and Banu Subramaniam echo this point: for Subramaniam, the concept of distributed frequency is linked to what she calls "eugenic scripts," through which "the benign language of variation is . . . converted into the profoundly political language of difference" (2014:14); "the question of variation," she insightfully argues, "is fundamentally about power—the politics of life and death" (ibid.:7). And Murphy makes clear the way in which the logic of the normal curve rendered the notion of population itself as "a quantity problem fixed by *adjustable* birth and death rates" (2018:103). Indeed, the probabilistic metaphysics behind statistical mathematics is precisely what affords the phenomenon Lisa Gannett calls "statistical racism" (2001), in which individuals are reduced to token expressions of statistically derived racial categories; as Subramaniam points out, the celebrated shift from typological thinking to population thinking that Darwin's work supposedly facilitated is reversed in the epistemological practices of even contemporary biologists: "Despite the apparent move from typology," she notes (2014:66–67), "in practice 'types' are very apparent in how biological knowledge gets applied in the field."

referring to the fact that ancient Greek philosophers like Pythagoras conceived of the cosmos as consisting of heavenly bodies moving on paths whose consistent proportions were expressible as integer ratios (the "music of the spheres"). For example, in the *Timaeus*, Plato's account of the creation of the universe, the Demiurge first establishes a musical scale defined by intervals based on the particular musical frequency ratios Pythagoras famously describes as consonant (e.g., 3:2 and 4:3), and only then proceeds to base the distances between the heavenly bodies that populate the cosmos (described as a set of concentric rings) on that scale. The fact that particular mathematical ratios translated to sonorously pleasant musical intervals was particularly clear when realized on the monochord, a string instrument. "Pythagoras would have called this his 'big twang theory,'" Chua and Rehding joke (2021:51), "were it not for the fact that such music didn't have a beginning. It was eternal, a resounding ring of timeless integers that intimated a metaphysical reality." What counted as sonorously harmonious were the particular frequency ratios derived from calculating planetary orbits. "Music theory *ratio*-nized the cosmos," they write (ibid.); "it was a theory of everything."

This musical and cosmological model, based on planets moving in perfect circles, was however not supported by empirical evidence. In the 17th century, the renowned astronomer Johannes Kepler, based on his own faith in the harmonious perfection of particular geometric shapes, proposed to solve this issue by concluding that planetary orbits are not spherical but elliptical; the ellipse being a function itself of the proportional relationship between the perihelion and aphelion, or largest and smallest radii, of those geocentric orbits. In his 1619 treatise *Harmonices Mundi* (*The Harmony of the World*), Kepler describes the ratio between the perihelion and aphelion of the planet Saturn as 135:106, which reduces to practically 5:4—a major third. In this manner the ratios used to prescribe sonorous harmony moved from being a

relation of exteriority between discrete, moving bodies, to a quality interior to each; rather than imagining a musical scale whose intervals were determined by the phase relationships between the orbits of various planets, here Kepler suggests that each heavenly body instead possesses an entire scale of its own—the particular gamut of frequencies each planet covers as it traverses its elliptical path.

Ideal ovals, however, proved no more empirically grounded nor capable of predicting planetary movements. This was solved in 1801 by a mathematician and astronomer named Carl Friedrich Gauss, who successfully predicted the trajectory of the dwarf planet Ceres by inventing a formula that distributes the statistical probability of errors so that the most accurate choices are foregrounded; graphed, this becomes the "bell curve" made notorious when adopted by eugenicists seeking to quantify racial differences and measure deviations from a norm (see James 2019; Saini 2019). Gauss, unlike his forebears, did not attempt to parlay this mathematical strategy into a musical system. As Christopher Hight makes clear, however, the form of measurement afforded by the normal curve allowed eugenicists to justify their work in acoustemological terms: one example is Mary Olmstead Stanton, "a late-19th-century physiognomist [who] employed harmonic measures as the criteria for discerning a natural order of the races" (2003:14). Harmonic models, as Hight argues, "contributed to the conceptual organization of the colonial world" (2003:13) by providing the epistemological basis for European scientists to evaluate racialized bodies upon a single continuum, as frequency ratios (2003; cf. Taylor 2007; Mader 2011). Today, these same harmonic models also contribute to the conceptual organization—and management—of the threatened biological world of biodiversity.

Articulations: conceptual compatibility

As Robin James points out, the statistical mathematics afforded by a sociohistorical fascination with cosmological harmony did not result in the dissolution of the kinship between (subjective) musical speculation and (objective) science (*pace* J. James 1995), but rather produced an increasingly nuanced set of calculative strategies for measuring typological essences in terms of phase relationships and managing the entities they represent for productive ends. James derives this from a reading of Jacques Attali (e.g., Attali 1983), from which she understands that "the mathematical principles behind neoliberal models of the market are the same as the basic principles of the physics of sound" (R. James 2019:26). "The 'laws of acoustics' and probabilistic statistics are analogs in the strict sense of the term," she concludes: "they share a common logos" (ibid.:48). This insight brings me to the third way in which the concept of harmony is relevant to the captive breeding program that is the SSP. Not only did harmony play a constitutive role in the development of the mathematical principles necessary to carry out these calculations, but more specifically, the sociobiological theories crucial to the gibbons' genetically informed management rely on the assumption of a latent, harmonic compatibility between *concepts*, namely nature and neoliberalism.

In a recent article, Stefan Helmreich attends to attempts by twenty-first century astrophysicists to sonify the gravitational waves emitted by the collapse of black holes. In his analysis, Helmreich proposes what he calls "rhetorical reverb" to account ethnographically for the fact that what he calls "the mathematico-computational *formalisms* . . . through which gravitational waves are known and made audible . . . operate alongside less fully disciplined collections of acoustic, auditory, and even musical similes and metaphors [called] *informalisms*. Those informalisms," Helmreich argues, "can then bounce or reflect back on the original

articulations," making it "difficult to fully isolate [them] (for scientists as well as their ethnographers) from the rhetorical reflections they generate" (2016:468). In addition to the popular interest in astrophysics generated in the process of making gravitational waves audible—including, interestingly, a promotional video of famous scientists imitating the "chirp" (the sound of black holes collapsing) in a manner that bears a striking resemblance to gibbon vocalizations[9]—culturally situated ideas about musical form and aesthetics condition the very possibility of knowing nothing less than "the universe," as one lead scientist describes it (quoted in Hicks 2017:1).

Across her writings, Robin James provides numerous examples of the way in which precisely this elision of the otological and the cosmological endowed "the concept of harmony," in Baker's words, with "a coerciveness born of the belief in its universality" (2008:30; cf. Daston 2019). One particularly clear example is the writings of eighteenth-century music theorist Jean-Philipe Rameau, whose general claim in his numerous treatises is that tonality represents the epitome of musical form (just as objective science is supposed to trump superstition) because it most accurately approximates the natural, physical behavior of sound waves (in particular, the overtone series) (see James 2010). As Timothy D. Taylor remarks, the authority of both (a musical system and a political system) were legitimized through the ways they were seen to be inevitable expressions of nature rather than violent impositions (cf. James 2019); "tonality and its ability to create centers and margins were construed as natural, inevitable, stable," he writes, "just as Europeans naturalized their selfhood vis-a-vis non-European Others" (Taylor 2007:28; cf. Hight 2003). Here, the presumed latent compatibility between the laws of music and the laws

[9] https://www.youtube.com/watch?v=0uzicC9qujg.

of nature legitimated its deployment as the logic with which to manage projects of biological suppression—whether of colonization, of eugenics, or of zoological captivity,

In his article on gravitational sonification, Helmreich deploys the concept of "articulation" to historicize these connections between music and nature. Invoking this famous theoretical contribution from cultural studies, Helmreich references Stuart Hall's definition, in which an articulation involves "two parts [that] are connected to each other, but through a specific linkage, that can be broken. An articulation," Hall continues, "is thus the form of the connection that *can* make a unity of two different elements, under certain conditions" (Grossberg 1986:53). Like Manuel DeLanda's "assemblage theory," articulation theory highlights the fact that "the so-called 'unity' of a discourse is really the articulation of different, distinct elements which can be re-articulated in different ways because they have no necessary 'belongingness'" (ibid.). Indeed, as Jonathan Sterne and Mitchell Akiyama put it in another relevant essay on the history of sonification, "articulation theory might best be described as antiessentialism in action" (2012:547). The particular proliferation of rhetorical reverb Helmreich chronicles might thus be understood as but one recent inflection point in a veritable genealogy of articulations described above, beginning in Ancient Greece, a specific chain of events in which distinct and mutually exclusive concepts were articulated together in order to yield acoustemological knowledge of the fabric of reality.

Helmreich's rhetorical reverb, with its constitutive distinction between mathematical formalisms and metaphorical informalisms, is not a perfect model for the development of social and cosmological speculation I have laid out here, in which the acoustemological metaphor of harmony afforded at once the logic behind statistical mathematics and the ideological justification for subordination. But to consider the history of harmony's entanglement with

models of nature, from Plato to Rameau, from the probabilistic astronomy of Gauss to the sociobiology of Hamilton, Dawkins, and E.O. Wilson, as a genealogical chain of articulations is to denaturalize their inevitability. Remembering the multiple, contingent articulations that established and reproduced the possibility of hearing such a latent compatibility between sound and nature offers a way to consider the claim underpinning the efficacy of kinship coefficients—that economic models of capitalism best approximate the workings of nature, and by corollary that neoliberalism offers its adherents the best chance at freedom—as not much more than a modern updating of Rameau's claim regarding the musical preeminence of European tonality.

Yet even as both Helmreich (2016) and Sterne and Akiyama (2012) deploy articulation theory to counter sound's potential to perpetuate the naturalistic fallacy, I find lacking a critical examination of precisely what allows these different elements to be articulated—to be matched—at all. In her own reading of Rousseau's critique of Rameau, for example, Robin James addresses precisely how Rameau was able to "articulate" nature and tonal harmony together in a way that parleyed its assumed similarity into an organizational principle for colonialist expansion (cf. Taylor 2007, Baker 2008). Their apparent compatibility, she shows, emerged only from Rameau picking and choosing which aspects were compatible. "Western music theory privileges the octave, major third, and fifth not because they are 'inherent' within or natural to frequencies we recognize as sound," as James concludes from Rousseau's argument, "but because these are the most obvious to us, given our methods and instruments of analysis and their predispositions and limitations. . . . What counts as (most) natural has nothing at all to do with nature, but with the tools and methods with which we articulate the distinction between nature and artifice" (2010:42).[10]

[10] James justifies this claim by comparing the frequency ratios understood to be consonant by Rameau and Pythagoras: "Due to the specific characteristics of their musical instruments and philosophical systems, our Western

James, in other words, implies that the reason Rameau was able to claim a correspondence between the laws of tonal harmony and the physical behavior of sound waves is because the two in fact have some inherent similarities, even if the correspondence is not totalizing. Rameau's invocation of the existence of individual, unique elements, already inherently capable of being combined in certain ways that yield certain results, should raise eyebrows given my above discussion of matchmaking and latent harmony—the claim that two discrete entities mutually possess a predictable dimension of latent compatibility, of course, being precisely what is behind the possibility of projects of reproductive management that harmony has made possible: "regimes" as Murphy writes (2017:12) "of temporal forecasting in which individual lives are but a flicker and what comes into view are tendencies and relationships only perceivable in aggregation, at the macrodimension, across generations."[11] The latent possibility of making particular articulations and not others, following Murphy, is precisely what affords "a way to speculate with bodies now for the sake of the future, . . . a means to make adjustments in time by acting on the future in the present" (ibid.).[12]

In *The Life of Lines*, Tim Ingold protests "the fateful equation of joining with articulation" (2015:22), worrying that the metaphor of articulation "lead[s] us to imagine a world

forbearers [*sic*] the ancient Greeks found the fourth and the fifth most consonant, for these are the intervals produced when a single string is divided in half or in thirds. Furthermore, just as Rameau argued that the major triad is most consonant because it contains the most "naturally occurring" intervals, Pythagoras argued that the fourth and fifth were the most powerful and consonant intervals because these were the most 'naturally occurring' intervals" (2010:42).

[11] Indeed, I suggest any situation in which a match is justified based upon an assumed pre-existing compatibility—for example, to anticipate my argument in Chapter 5, when Marcello Sorce Keller suggests that "a marriage" between zoömusicology and ethnomusicology "should be arranged—and, ideally, celebrated in heaven" (2012:176)—is in need of interrogation.

[12] The capacity for compulsion I have located in the concepts of both articulation and latency is made explicit in Marié Abe's theory of resonance when she describes it as "a simultaneously acoustic and affective work of sounding that articulates latent socialities, the acoustic environment, and sedimented histories" (2018:28–29). For Abe, the ability of these musicians "to sound their instruments in a way that 'resonates with listeners' hearts'" (ibid.:28) is because those listeners are already predisposed to a reaction—"if a sound reaches listeners at the right frequency," she writes, "certain imaginations, memories, or sentiments are triggered" (ibid.:31).

comprised of rigid elements . . . linked externally. . . . Interiorities cannot therefore mix or mingle. They can only fuse in the constitution of compound elements, in which any trace of joining immediately disappears" (ibid.). Like the tuning of a carpenter's mortise-and-tenon joint, in which the possibility of mating the two is contingent upon external acts of shaping (in particular, the removal of material), joinery foregrounds the act of making two non-coextensive phenomena compatible to the point that they may be linked together (no matter how fleetingly). Such joinery—as I treated the concept in a 2019 article (Yamin 2019:379)—calls attention away from the proximate emphasis on the elements being articulated to inquire into the structural conditions that have shaped each element's very capacity to be articulated at all.

Harmony, I have argued here, inflects captive matchmaking through the comparative measurement of kinship coefficients in two major ways. It provides a certain set of conceptual tools, statistical mathematics, through which things being matched can be known and managed. It also informs a particular epistemological and ontological framework, expressed as latent harmony or the technology of destiny, by which matches are understood to preexist their realization. As a matchmaking principle, latent harmony describes the epistemological process of retroactively making those contingent results appear compatible, and therefore objectively natural and inevitable. In this latter regard I showed the compatibility retroactively established between harmony and a host of disparate concepts like nature and neoliberalism has justified and perpetuated multiple forms of hegemonic power and violence. Understanding the work of captive animal management as recommended by Ballou and colleagues as a project of articulation, we now see how this program of matchmaking consists not only in articulating particular animal bodies for purposes of biological reproduction, but also articulating concepts—

and indeed, bodies with concepts—consequently reproducing animal lives concurrently with reproducing particular models of what life is and how it should be fostered.

Conclusion

"What is reproduced in the name of reproduction?" Murphy asks (2017:8). My answer in this chapter has been that the practice of managing animal reproduction in captivity solely by means of kinship coefficients results in the reproduction not only of living bodies but also of a particular understanding of life itself; one, furthermore, whose reliance upon the sociohistorically contingent concept of harmony makes audible its own set of reproductive compatibilities not only between the sonic and the social but also between economy and ecology, nature and neoliberalism, romance and repression. Harmony, therefore, does not just provide a set of mathematical techniques for quantifying genetic relatedness nor an ideological wager that the survival of the whole places obligations on its parts; it is not just a principle for conceptualizing the possibility of compatibility nor a way of accounting for the difference between originals and copies. Rather, the proliferation of apparently latent compatibilities—the articulations—between these dimensions is the point; the way in which each interferes historically and conceptually with all the others *is* the sort of distribution across heterogeneous bodies and concepts that makes harmony not as much a "metaphor to live by" as a metaphor for life—a sort of life characterized by the reproduction of the same across multiple biological scales. Harmony provides at once a set of values, technologies, practices, and knowledge forms all working together to produce value by managing the flow of becoming that is vitality in a way that makes it seem that its result was a foregone conclusion.

Musicologists like Susan McClary (e.g., 1990) have famously argued that the manipulation of desire for a harmonic resolution is what produces an affective response in Western classical music. But just what satiates this desire? By critically reading through the way in which Jakob von Uexküll is able to posit harmony as at once the mechanism that poetically links together all of nature into a meaningful, purposeful whole, and the justification for potentially violent suppression of its parts, I have tried to highlight the way in which the condition of harmonious resolution implies an all-to-easy compatibility between romance and repression.[13] In harmony we "desire," as Michel Foucault puts it in his preface to Deleuze and Guattari's *Anti-Oedipus*, nothing less than "the very thing that dominates and exploits us" (1983:xiii). Harmony is the result of maintaining or achieving proper proportion between differentially constituted subjects—what emerges, as Foucault writes elsewhere regarding Plato's concept of the "sophron," when "the different parts . . . are in agreement and harmony, when the part that commands and the part that obeys are at one in their recognition that it is proper for reason to rule and that they should not contend for its authority" (1990:87). But given that the sorts of thinkers who invoke this concept were precisely those who were poised to benefit from these systems of inequality,[14] we might also consider harmony to reassure the naturalness of the conditions it describes, its teleology aimed not for a resolution of dissonance ("dissonance is the truth of harmony," Adorno reminds us), but rather, as Dylan Robinson characterizes the settler mode of audition he calls hungry listening, "the felt confirmations of square pegs in square holes,

[13] Gilles Deleuze frankly characterizes this particular association: "Hitler and the fascist machine gave people hard-ons" (2004:268).

[14] In 1933, for example, Uexküll described his adopted country of Germany as a biological organism, particularly in need of attention from the "ingenious doctor" who would restore harmony to his "deeply sick patient" (Uexküll 1933, quoted and translated in Feiten 2020:8). But recall, furthermore, the rhetorical uses of harmony by Plato (Foucault 1990; cf. James 2019) or Baker's example of the prominent fifteen-century political theorist Rodrigo Sánchez de Arévalo, who argued that "the kingdom is well ruled when it conserves musical harmony, that is to say, when out of its diverse and opposing members, by the art and ingenuity of the leader, emerges a harmony which is unity and concordance in the kingdom" (Baker 2008:26, citing Leon Tello 1962:206–7).

for the satisfactory fit as sound knowledge slides into its appropriate place" (2020:51). Implying that certain bodies and concepts are indeed "composed for each other," as Uexküll puts it (2010:175), gharmony conflates compatibility and destiny. In each case a key dimension of the program's claim to efficacy is the latent character of those compatibilities: found, or realized, rather than actively or agentively joined together. And the reproduction of the same (at whatever biological scale) consequently comes to appear natural and necessary, rather than a contingent act with political and material consequences, and furthermore occludes the labor necessary to bring about that result.

So far, my focus has been on the well-critiqued musical and biological theories and models that make possible a certain, theoretical form of population management. In the next chapter, I turn to examine the way in which these concepts hold up in practice. By attending ethnographically to the ways in which gibbon matches are implemented at the Center, I show that the actual event that is a gibbon pairing suggests a very different metaphysics of compatibility, in particular one that obviates the very commitment to latent harmony underpinning the genetic determinism I have addressed in this chapter. In stark contrast to the commitment to the social and epistemological fidelity insisted upon by harmony's practices of evaluation—in which concepts are subjected to the same sense of compatibility as the gibbons they are deployed to understand, measure, and regulate—the listening practices deployed to implement these determinations instead make audible a distinct ontological promiscuity, in which the very possibility of preventing extinction is made possible by a willingness to reject normative notions of compatibility that determine what belongs with what, who with whom, and which categories and phenomena are determinant of which. If the concept of harmony promises "a place for everything and everything in its place," as Brent Keogh and Ian Collinson write of

ecological metaphors in musicological writing more generally (2016), then the multi-species soundscape of the Center, I will demonstrate, is decidedly non-harmonious.

Chapter Four

Listening against gHarmony at the Gibbon Conservation Center: Captive Gibbon Breeding and the Acoustemological Politics of Compatibility, pt.2

The Center: Gibbons and Guardians, a 2021 documentary on the Gibbon Conservation Center, devotes considerable attention to the initial introduction between Violet and Truman in 2012 (the pileated gibbon pair whose medical separation in the summer of 2019 kicked off the dramatic events described in Chapter 1). Accompanied by a lively soundtrack, the documentary intersperses video of the two gibbons with narration provided by interviews with several of the Center's key players.[1]

> Alma: Right around the time I got here, we decided that it might be a good idea [to] introduce Violet with Truman.
>
> Gabi: We had this young male, Truman, and we wanted to introduce the two. We thought that Truman might be a good partner for Violet because he has younger sisters and is very easy-going. And [so] we housed Violet next to Truman.

Despite this evaluation of potential compatibility, the introduction initially turned out very differently:

> Gabi: She . . . didn't want to be with him, and he sometimes [would] just reach towards her, just let his hand be there and just wanted her to touch it, and she would just grab it, and bite it.

Chris Roderick, formerly the chair of the Center's board of trustees, adds some color to the story while the film's generic background music changes into a playful melody:

> Chris: [Violet] rejected the first suitor she had in a rather dramatic way: [Truman] cozied up to her, she turned her back on him, bent over and farted right in his face!

[1] This scene begins at 37:20.

Boing, goes the soundtrack. And after an interlude narrated by Kalli, a former Center researcher who explains that Violet's action is in fact a recognized gibbon behavior, technically called "hostile presenting" but colloquially referred to as "mooning," the camera returns to Gabi.

> Gabi: So we housed Truman and Violet next to each other," Gabi says, yet "we had a mesh between the two so she had more privacy. And we did that for nine months. After nine months she started picking the mesh, and she made a hole big enough for her head to fit there.
>
> Kalli: She would kind of spy on him, wait until he got close, then she'd leave. . . . One time, on Valentine's Day, she had been just so mischievous that whole weekend. And then, . . . through the chain link, she let him kiss her. And that was sort of the beginning of, alright, it's time to see, you know, how much we can get this to progress!
>
> Gabi: It looked very positive, so we removed the tarp, and we allowed them to have contact through the chain link. They started hugging, they started playing with each other, and grooming, and most of the time they were nice to each other, but from time to time Truman wanted to hold her. And she didn't want to be held, so she would move away and scream and jump towards him. The neighbors around her, they're all watching, and waiting to have something happen, so everybody's paying attention to these guys—it's kind of like a soap opera right now!

This humorous, lighthearted account of Truman and Violet's introduction, however, does not address how important the acoustic was in the development of their pair-bond. Still housed together as a mated pair, nearly a decade later, on most days the coordination of their vocalizations is apparent (figure 4.1): Violet initiates their duet with her "great call"; just like that of her mother Tuk, whose vocalizations were described in great detail in Chapter 1, it consists of a set of upwardly sliding vocalizations that slowly increase in speed and pitch to culminate in the "trill." In the middle of Violet's trill, Truman begins his own part (the "coda"), and continues his distinctive series of inhaled and exhaled vocalizations for several seconds after Violet's trill has concluded.

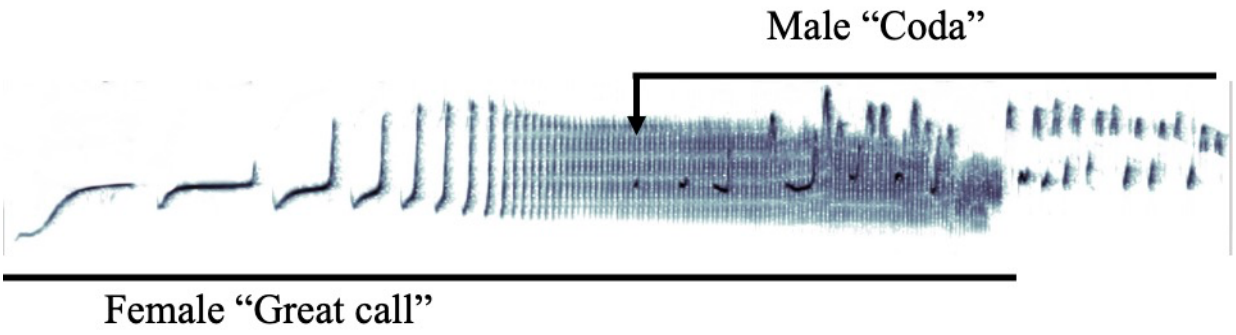

Figure 4.1: Spectrogram of an “ideal” pileated gibbon duet, characterized by the temporal overlapping of the female and male parts.

Truman and Violet did not achieve this coordination or their pair-bond automatically; rather, as Alma told me during an interview, it was only developed over a long, arduous process:

> With Truman and Violet, they did take a long time to coordinate their call. In the very beginning, they were not singing with each other at all. They weren’t looking towards each other when they sang. Then, Truman, this was actually when they were separated still, there was still a divider between them, Truman would come over, and he, they sang towards each other. They were looking at each other. Then gradually, he started chiming in just at the very end of her call. And then, that progressed to kind of going into her song, so that a little bit of it they were singing together. And he worked his way backwards into her song because, I guess, that’s how he managed. . . . It definitely took him effort to figure out when he was supposed to chime in. (Interview, 12 August 2020)

It definitely took him effort. Rather than a matter of time, or an inevitability, Alma hears the pair-bond that Truman and Violet have—one so strong, in fact, that during periods of medical separation the two can often be heard exchanging calls across the distance between their enclosure and the recovery room—as the contingent result of effort and exertion, continually expended by those animals. While her comments here were directed towards Truman, whose overlapping entrance during Violet’s trill puts the majority of the responsibility on his own ability to “chime in” (ibid.) in a satisfactory manner, at another point in our discussion Alma described the exertion necessary for Violet to produce her loud vocalizations in a similar manner. In order to explain, Alma distinguished for me between two sections of Violet’s great call: an

initial “long cry” and the subsequent “bubbling part.” Having observed multiple juvenile pileated gibbons physically struggling to produce their great calls, she emphasized to me that “the kids,” as she colloquially calls them, “do the long cry but it’s harder for them to hold it. So, they jump into the bubbling part faster than their parents would, just because it’s, like, a relief” (ibid.).

Jumping into the bubbling section prematurely, however, comes at the expense of the great call’s volume (recall Iszie’s behavior described in Chapter 1), and for Gabi, that “wind-up” that provides the possibility of the female pileated gibbon’s bubbling carrying through the dense forest environments in which it evolved, is key. “The pileated great call is just so long, and it has the period when it’s very, very fast, but that’s actually not the hardest part of the great call,” she told me (Interview, 25 June 2020). The hard part, instead, is “getting it up there,” achieving the necessary frequency, amplitude, and duration of what Alma called the “long cries” that will ensure a loud, sustained trill. Just like Alma’s characterization of Truman’s attempts at coordination as “manag[ing],” furthermore, Gabi indicates that the exertion of effort that might result in a successful vocalization is the direct result of intention. “They have to concentrate,” she insists, “to get up there.”

Both affording and interfering with the possibility of establishing a pair-bond, the acoustic figures as a crucial aspect of the project of gibbon conservation for both the gibbons and the caretakers attempting to manage and oversee the pairings. Success in this regard is contingent upon a form of compatibility at once sonic and social, an elusive relational quality that, despite the best efforts of biologists and caretakers alike, exceeds their attempts to measure, define, or predict its general character and particular instances. At once a locus of intervention, a potential source of knowledge, and a site of anxiety, gibbon compatibility is the focus of this chapter. By attending to the auditory dimensions of gibbon compatibility, this chapter reveals sound to act as

more than an audible, tangible index through which those caretakers are able to diagnose the quality of gibbon relationships. In their listening practices, furthermore, sound becomes a medium not only for establishing procreative relations between particular animals, but also for conceptualizing the conditions for the possibility of belonging, both ethically and ontologically, within larger networks of ecological and social relations.

Listening against "gharmony"

Gabi and Alma's soundings of the intentionality and effort expended by pileated gibbons in their attempts to vocalize fly in the face of the ways in which the possibility of non-human labor is denied within theories of both economy and biology. These are two positions whose latent compatibility, I argued in the previous chapter, is assumed in the model of life that thinking through the joke of gharmony helped me unpack. Take, for example, Marx's famous claim that although "a bee puts to shame many an architect in the construction of her cells, . . . what distinguishes the worst architect from the best of bees is . . . that the architect raises his structure in imagination before he erects it in reality" (2007 [1867]:198); the bee's ability to construct such intricate hives, Marx implies, is pre-programmed, and therefore there is nothing at stake in its material realization. Discussing the field of biology, Natasha Myers devotes significant attention to the prevalent mechanistic metaphor of cellular automation, noting that "machine tropes have played a central role in shaping how molecules have come to matter as experimental objects in the history of the life sciences" (2015:161). These approaches imply that the only form of effort encountered in the more-than-human world is that of evolution, development that has already concluded to set in motion a predetermined set of actions.

As Sara Ahmed points out in her reading of inheritance as constraint, what she describes as "the implied relation between the acquisition of form and the lessening of effort" (2019:8) becomes the source of a certain "fatalism" (ibid.:90). "In having stronger arms," she writes, "the blacksmith's son is already equipped to become a blacksmith; his arm has a hand in deciding his future" (ibid.:90). In both economy and biology, it is only humans who are capable of purposeful, productive action (whether designing buildings or reflecting on life processes), while other kinds of organisms (or their elements) can only aimlessly realize the reproductive and metabolic functions already encoded in their genomes through evolution. The very possibility of determining gibbon pairings suggested by the pun of gharmony, as I demonstrated previously, is predicated upon the particular fatalism that Paige Edmiston calls a "technology of destiny" (2021), the conviction that knowing genes is equivalent to knowing outcomes and thus that the rules of belonging are "composed in advance," predictively measurable even before pairs have been introduced to one another. What compatibility is, here, is a way to predict the potential value generated by the assembly of the elements described as compatible. As what Sarah Franklin calls a "method of genealogical reckoning that not only looks back at how certain conditions came into existence but at how they are orientated toward the future, and how they can be seen as promissory repositories of purpose toward particular ends" (2007:127). Yet the Center staff's insistence on their gibbons' active effort in pursuing the development of their vocalizations and the pair-bonds those vocalizations afford complicates the ways in which gibbons are understood to behave in those approaches. Following Alma's insight, in this chapter I ask: what kinds of effort does the project of captive gibbon breeding take?

In what follows, I attend to the development of several gibbon pairings at the Center, to argue those reductive and impoverishing models of gibbon biology and ethology used to match

gibbons together are first exhausted, then exceeded, by the very process of implementing them. "I haven't seen pairs being introduced at this point where I was like, oh, that was exactly like the other one," Alma told me (Interview, 12 August 2020), and examining the ways in which the caretakers understand those events those events shows that the gibbons' sonic and social compatibility is not a pre-existing object, but rather a continual achievement realized precisely through the sorts of collective affiliations that cut across various material and epistemological categories of gibbon conservation's taxonomy. I sound out an acoustemology of gibbon husbandry that obviates several of the key aspects of harmony I identified in the previous chapters—namely genetic determinism, utilitarian economic competition, and the ontological subordination of the individual to the species. Several cases demonstrate not only how the staff makes space for individual welfare in a program in which individual lives are potentially but a flicker on algorithmically generated charts of genetic retention, but further how the material, conceptual, and ethical work practiced by both humans and gibbons throughout the process of implementing the SSP breeding recommendations problematizes both the very biological models they are meant to reproduce and the academic critiques levelled at programs of captive animal management.

Audibilities of individuals and species

In the late morning one day in June 2019, I was preparing the gibbons' afternoon feed in the Center's kitchen, alongside Alma, when Violet began to sing. At that point in the morning the gibbon chorus had already subsided, leaving her duet with Truman as the sole gibbon vocalizations to punctuate, every few minutes, the Center's otherwise quiet soundscape of bird song, ground squirrel calls, and the occasional whirr of a passing car (I address the Center's

soundscape in more detail in Chapter 6). But that day something stood out about their duet, and Alma stopped her work to listen. Alma pointed out the change to me. Truman was beginning his coda far after Violet had concluded her great call, rather than during it (figure 4.2). About a week earlier, Violet had injured her foot, was taken away for medical treatment, and had just been returned to the enclosure she shares with Truman. Apparently repeating his initial months-long process of synchronizing his coda to her great call in miniature, Truman was once again "working his way backwards into her song," as Alma described it, over the course of several duet sequences (rather than the weeks or months he took at first), initiating his coda earlier and earlier in relation to Violet's vocalizations. This was not an isolated incident; rather, Alma confirmed to me that it would occur without fail every time Violet was returned after a period of medical recovery. "When they haven't been together for a little while, . . . he needs to remember how to sing with her. . . . It takes effort on their part" (Interview, 12 August 2020).

By focusing on the particularities of these gibbons, rather than on the abstract mechanics of their species, Alma's description of the event reveals an auditory approach to the animals she cares for grounded not in defining essences or shared natures but rather their distinct individualities. "Their personalities are *so* different," she told me during that same interview, drawing out that "so" for emphasis. Indeed, as our conversation drifted from gibbon vocalizations to her philosophy for training new employees and volunteers, it became clear that the value she prioritized in the process of granting them more autonomy was precisely their realization that the animals she felt responsibility for are not token members of species categories but instead radically unique living beings not easily reduced to the sorts of entities capable of being sorted into cleanly differentiated typological boxes.

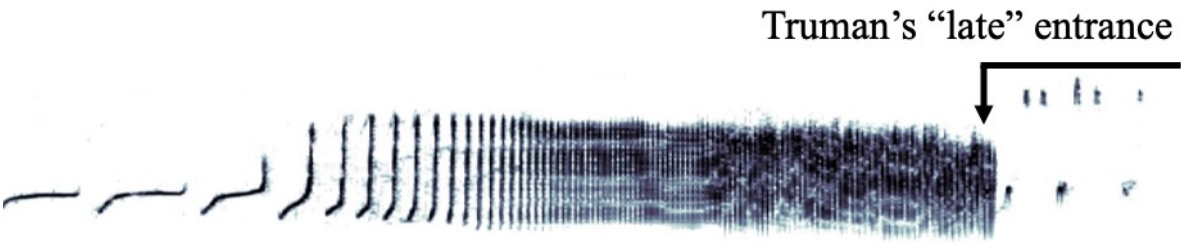

Figure 4.2: **Spectrogram of Violet and Truman's duet on 2 August 2019.**

But at the same time, Alma's description of Truman and Violet's audible attempts at sonic and social coordination demonstrates how difficult it is to avoid species-level conventions as the benchmark according to which these unique behaviors are evaluated. Indeed, she framed the conversation by saying, "That's the only pileated [gibbon] I've heard singing that way" (ibid.) On one hand, then, Alma is discussing Truman's vocal ability precisely in terms of a prescriptive, species-specific template. She is concerned with the ideal pileated gibbon duet, successfully realized when the male begins his coda approximately half-way through the trill that concludes the female's great call and continues his alternating short in-breath and out-breath vocalizations for anywhere from five to ten seconds afterwards. Here, Truman's individual vocal performance is contextualized in terms of the species convention, and therefore deemed irregular. On the other hand, however, Alma offers a way to hear Truman's vocal uniqueness as a property that exceeds the reduction to type. In this sense, the existence of Truman's behavior might be understood as the functional opposite—not an ideal representative of a particular taxonomic category but rather a challenge that pushes the boundaries of what gibbon caretakers and taxonomists might understand to constitute a pileated gibbon coda, and possibly even, as I address below, the criteria that distinguish the pileated gibbon from other hylobatid species.

In this next section, I take the way in which Alma listens to both individuals and species as a complication of the critique according to which, as I described in the previous chapter,

endangered species conservation programs like the gibbon SSP are accused of taking the species to be the "foundational ontological unit through which (non-human) life can be calculated and known" (Braverman 2017:136). Whether experienced by those animals whose status as a member of that threatened species comes to demand extraordinary levels of sacrifice (Parreñas 2018), or those of other species whose lives are subordinated to what is perceived as a more important cause (van Dooren 2014; Braverman 2017), the reproduction of the species, put simply, is achieved at the expense of its members (see Chapter 3). At the Center, however, the metaphysical relationship between individual animal and species is not a matter of philosophical debate but rather an issue whose resolution has tangible consequences for the bodies it accounts for.

Acousmatics

When Alma and I were listening to Violet and Truman duet from inside the kitchen, we were guided by solely by our ears; we could not see or otherwise confirm where the sound of their duetting originated. "A sound that one hears without seeing what causes it": this is how *musique concrète* composer Pierre Schaeffer defines "acousmatic" sound (1966:91). Schaffer coined this term, which he etymologically derived from the *akousmatikoi*, the disciples of Pythagoras who apocryphally followed his lectures from the far side of a veil and thus attended to his teachings as disembodied sounds, to describe his use of nascent recording technology to remove various sounds from their original contexts and reassemble them into musical compositions where their immediate materiality obviated the contexts in which those sounds originally occurred. Listening acousmatically ostensibly severs the taken-for-granted relation of indexicality between a sound and its origin, the artifact of a particular ontological orientation that

treats sound, as Martin Daughtry writes, following philosopher Casey O'Callaghan, as "a perturbation that originates with a 'disturbance event'" (2015:169). In its absence, the experience of sonority can stand for itself independent of whatever events potentially set it in motion.

As a listening practice meant to liberate sounds from the circumstances of their production, however, acousmatic listening is saturated with irony. Brian Kane makes this clear in his analysis of Schaeffer's writings on acousmatics, particularly Schaeffer's use of Husserlian phenomenology to define the "sound object," the object of audition. Using Husserl's example of a table as an analogy, Schaefer explains that sound objects are distinct from the listener's experiences of them, just as are experiences of that table from various perspectives. The sound object has an ontologically weighted existence, while individual perspectives on it—what Husserl calls "adumbrations" (*Abschattungen*)—are inherently partial, subjective, and fleeting. The goal of acousmatic listening, as Kane suggests, is to "synthesize[] the stream of adumbrations. As each new percept is connected to the one just past and grasped as a whole, an object emerges that can be identified as the same across a variety of acts of consciousness" (2014:20). "The phenomenologist of sound," he concludes, "does not deny that there is a stream of auditory adumbrations; rather, the focus is on how parts of the stream are primordially grasped as a unity—as a constituted object, or set of objects, transcending any particular adumbration. The transcendent object grounds the possibility of hearing the same thing across the multiple acts of listening by a single subject, despite variations in location, attentiveness, knowledge, or fluctuations in the acoustic signal" (2014:21). Acousmatic listening treats the phenomenological experience of sound as mere stand-ins for sources or causes that are at once more distant, and more weighted ontologically.

Acousmatic listening therefore reinforces the very ontology of sound it is meant to obviate: the acoustic "as a cue to interiority, essence, and unmediated identity" (2018:2) as Nina Sun Eidshem writes. In Eidsheim's writing, acousmatic listening results in an abstraction through which "the thick event—a continuous vibrational field with undulating energies (flesh, bones, ligaments, teeth, air, longitudinal pressure in a material medium, molecules, and much more)—is reduced to socially and culturally categorized and evaluated vocal sounds, such as pitch and voice, as essential markers" (2019:8–9). For Kane this result is not an abstraction but rather more real than the individual events or sounds that populate it: "a purely auditory world . . . turns out to be a world where types or universals, rather than particulars, are primary" (2014:147). In what follows, I show that acousmatic listening can organize the sonic adumbrations that are gibbon vocalizations into a multiplicity of different, incommensurable scales. Attending to those gibbon vocalizations in the Center's kitchen with Alma—a truly acousmatic event, as the room's walls separated us from wherever they originated—have already indicated two possible, incommensurable origins: an individual animal, and a gibbon species.

Listening to species

In a recent book, philosopher Ian Smith (2018) argues that species are objectively real entities with "intrinsic value" and therefore have a right to their own survival. He further proposes that defining species based on synchronic, shared genetic characteristics is not enough—we need to think temporally, to account for the specific histories of how groups of related yet distinct entities evolved into the condition of speciation. And for scientists trying to understand this phylogenetic development of gibbons, vocal sonority figures heavily. In a famous study, primatologist Thomas Geissmann (2002) theorizes the audible differences in the

great calls of various gibbon species in terms of their distance over evolutionary time, implying that species displaying closer similarities in the form and syntax of their great calls are more closely related. From this cross-species acoustic comparison, he constructs a phylogenetic tree estimating the times in which each individual species branched off, thereby foregrounding acoustic behavior as a prime determinant of evolutionary relatedness. Geissmann's is a project of "rendering evolution audible," as Eric Ames (2003) describes the project of comparative musicology, of temporalizing spatial acoustic variation and spatializing temporal acoustic variation (more on this below). In order to do this, Geissmann needs to needs to treat gibbon vocalizations as what he uncritically terms the "stereotypical" properties of species categories so that they may be sorted onto an evolutionary continuum according to their audible similarities and differences (figure 4.3).

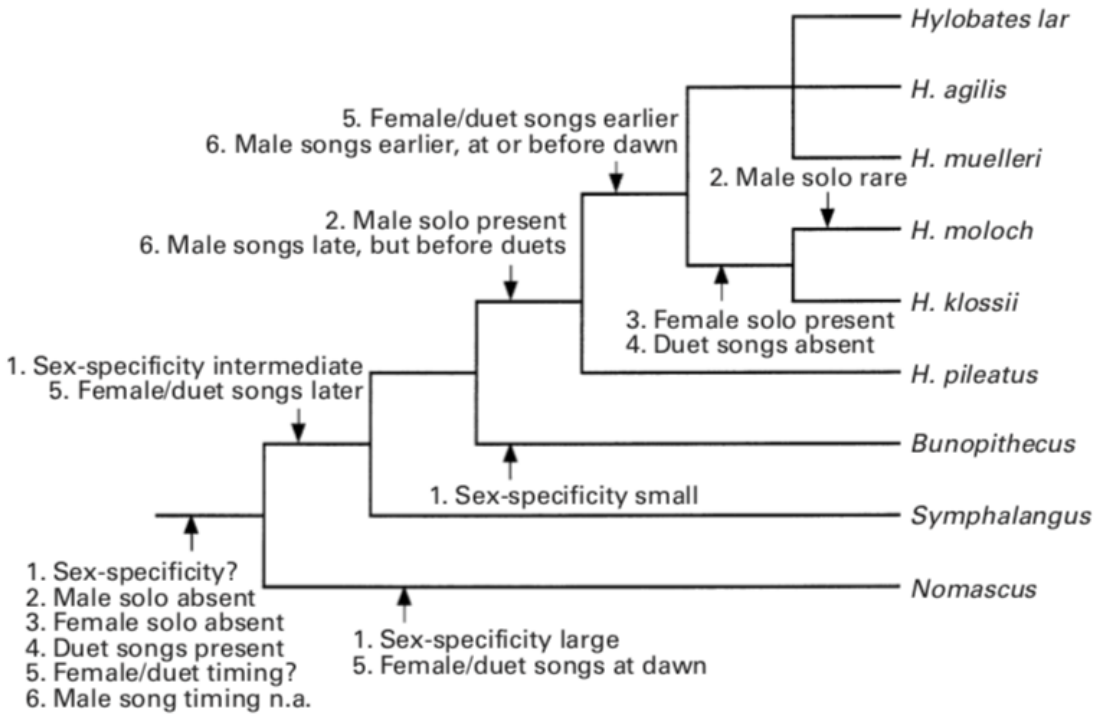

Figure 4.3: Thomas Geissmann's speculative model of gibbon phylogeny (from Geissmann 2002, p.72), used with permission.

In her 2018 monograph *Animal Musicalities*, Rachel Mundy describes the role of the ear in scientifically determining the taxonomic definitions of bird species in a way strikingly similar to Geissmann's auditory treatment of gibbon vocalizations. She traces the emergence of the technology that she calls the "sonic specimen" (2018:43), the adoption of a particular bird's song as an object treated as a representative synecdoche for the collective identity of its natural kind (see Daston 2004). Reinforcing a relation of subordination and normalization between the individual and the type, sonic specimens contribute a distinctly acoustemological dimension to the taxonomic search for species essences and thus an ontological commitment to what Manuel DeLanda calls "taxonomic essentialism." As DeLanda describes it, taxonomic essentialism "starts with finished products (different chemical or biological species), discovers through logical analysis the enduring properties that characterize those products, and then makes these sets of properties into a defining essence (or a set of necessary and sufficient conditions to belong to a natural kind)" (2006:28). Lorraine Daston understands such a defining essence to constitute a species' "specific nature" (2019), expressed through a set of physical characteristics or behaviors that make that species what it is. But as Daston makes clear, the very invocation of nature in this case performs what she calls "the naturalistic fallacy," the slippage from "is" to "ought." The sonic specimen is therefore not just a descriptive tool in the project of typology but also a prescriptive tool for imagining what a gibbon of a particular age, sex, or species should sound like.

Sonic specimens, therefore, reinforce precisely the epistemological mode that Chrulew calls "species-thinking, in which each individual [gibbon – or its song] is only perceived as a token of its inexhaustible taxonomic type" (2011:141). Indeed, "like their biological counterparts," Mundy writes (2018:43), "sonic specimens were compared in order to determine

evolutionary relatedness, mapping development onto sound in the same way that naturalists mapped evolutionary change onto preserved animal bodies. As part of an institution of knowledge, song collections became elements of a broader narrative about evolutionary relationships between cultures, races, and species" (ibid.). But rather than comparing the vocalizations of many gibbons to those of a single individual deemed to be representative, Geissmann's approach is fully acousmatic in the sense that all existing instances are assumed to be expressions of an ideal type, and therefore able to be discussed in terms of relative fidelity to an assumed source.

This reduction to type is not limited to a single academic study; indeed, the treatment of gibbon vocalizations as a property of the species is unavoidable and omnipresent in both scientific publications and public-facing conservation work. As advertised on the public-facing website of the IUCN SSC Primate Specialist Group's Section on Small Apes (a global authority on gibbon conservation), for example, "each species of gibbon has its own distinct song, so there are twenty different gibbon songs to hear across Southeast Asia" (n.d.). Even leaving aside the binary of natural and artificial implied in this geographical distinction between gibbon song in "the wild" and "in captivity" (see Braverman 2014 for a history and deconstruction of this dichotomy), the website's claim leaves no room for the individuality of Truman and Violet's duet that Alma highlights. Rather, the only space for meaningful variation between each instance of a pileated duet, whether measured across time or space, is in evaluation of its deviation from the norm. If you have heard one pileated duet, the statement implies, you have heard them all.

Acousmatic listening, however, complicates the fundamental assumption embedded in the biopolitical critique of endangered species conservation (e.g., Chrulew 2011; Fredriksen 2015; van Dooren 2014; Parrenas 2018): the position that collectives like species and

populations emerge as experimental objects through technoscientific processes of reduction and abstraction—like statistical normalization—applied to ontologically prior individual bodies (see Mader 2011). Alex Blanchette offers one striking example of this process in his ethnography of a Midwestern hyperindustrialized hog farm. As Blanchette shows, hog farming is directly and intentionally invested in "developing technics for turning diverse pigs into 'the pig'; it is striving to transform actual hogs into tokens of an increasingly interchangeable capitalist animality" (2020:17). The result, he shows, is a shift from managing a collection of living animals to a singularity—what the farm's managers call "the Herd"—according to which any given animal is no more than a generic instance.[2] For Blanchette, in comparison to actual porcine organisms, the Herd is "invisible outside of spreadsheets, computer tabulations, scroll charts, and other abstract representations" (ibid.:52), "the abstract capitalist animality that vertical integration portends but one can never see at any given site" (ibid.:24).

At the Center, however, the listening practices that distinguish between a sound's source and its cause render "abstract" gibbon species directly present as at once a unified entity bearing evolutionary responsibility for vocality and a vulnerable body capable and deserving of care's precious resources. Here, the species is not an abstraction but rather an acousmatic specter constantly and inescapably hovering just out of view—but not out of earshot. It may not be immediately visible (despite the taxonomic identifiers hanging outside every enclosure), nor is it tangible in the way that its living gibbons are. The species, however, is fully audible.

[2] But instead of these parts being individual animals, the components that make up this entity are various biological functions capable of individually creating value: artificial insemination, flesh processing, etc. Rather than farm workers engaging with particular pigs, Blanchette argues, the industrial pig is conceived as a set of "distinct and segmentable physiologies" (2020:181); "virtually every nonmanager's labor," he demonstrates, "is embedded in one age grade, working type, biological function, or anatomical part of the porcine species" (ibid.:22).

Listening to individuals

In contrast to biodiversity conservation's general emphasis on the species, for the Center's staff the daily demands of caring for nearly forty individual gibbons, each with distinct dietary preferences, personalities, and social dynamics, often eclipse larger concerns. Indeed, as one of Celia Lowe's interlocutors pronounces in her study of biodiversity conservation in Indonesia, "we are not rich enough to afford conservation of species—species is a Western concept" (2006:15): to care for species demands a level of privilege—what Daughtry describes in a different context as "the luxury of distance" (2014:39)—that allows one not to be affected by the complex and chaotic daily lives of actual animals. Rather than signifying a shared species identity, in this vein gibbon vocalizations are often aurally evaluated as the affective expressions of unique individuals, information that better helps the caretakers to evaluate and manage their quality of life. As Gabi told a UCLA journalist covering my dissertation research, "they are expressing their emotions and fears, their happiness; . . . all these different vocalizations help us understand them, . . . so we know what they are saying" (quoted in Mazzucato 2019). When I followed up on her statement, Gabi reiterated to me that in the day-to-day context of gibbon care, even attention to their species-specific duets recedes under concern and attention for the other classes of subtle, unpredictable vocalizations they produce. "I think to manage the Center and the individuals," she says, "there are many other vocalizations that I pay more attention to. Some of their emotional sounds, feeding calls, and alarm calls—even just how the feeding calls change [depending on the different foods they are given]. And concerned sounds, vocalizations when they are stressed" (Interview, 25 November 2019). This listening practice does not obviate the notion of the species, but rather re-orients it as one element among many that makes the ultimate object of audition—the individual—what it is.

Caring for individuals and species

At the Center, what Matt Chrulew characterizes as "the hierarchy of differential valuation that structures the biopolitics of endangered species preservation, prioritising species over individuals, code over life, genes over bodies" (2011:148) is something that the caretakers perpetually reject as they attempt to care for at once for individual, living creatures and the species they represent. Gabi made this tension clear to me during a discussion about the Center's lone siamang (*Symphalangus syndactylus*), an adult female named Marlowe:

> Marlowe is one of the most important female siamangs for the SSP in the US. But both her parents had inflammatory bowel disease and they died from that. . . . Since she became an adult she started to have symptoms, and there are times that you know she is not feeling well. But I got a request from the SSP: they would like her, they would like to pair her up with a male so she can have offspring. And there are two things. One, I know she's not healthy. That doesn't mean she can't get pregnant, . . . but I'm just not sure if it would be good for her, for her health. And, I don't know if her offspring are also going to have that issue. (Interview, 25 November 2019)

Torn between attending to the welfare of a fragile, mortal creature suffering from a chronic illness, on the one hand, and that of an endangered species—similarly vulnerable, under existential threat—on the other, Gabi articulates an ethical dilemma in her responsibilities as director of the Center. Remarkable here is the antagonism between the individual siamang and her species as potential recipients of such care. The best decision for the future of "the siamang" as a species is to place Marlowe in a breeding relationship. But Marlowe's reproductive potential is directly offset by an inflammatory bowel condition that deleteriously affects her daily health even before the additional physical demands of pregnancy and child-rearing. What is best for the species, therefore, is what is worst for its particular member singled out for her capacity to perform gestational labor in a way that might uniquely keep in circulation a crucial element of genetic diversity lacking from the results of other copulations. As Maria Puig de Bellacasa points out, care "is never neutral" (2017:6). "However well intentioned toward the things at stake," she

writes (ibid.:64–65), “however interesting the kinds of knowledge it enables, care is a consequential practice that does relationalities as much as undoes them.”

Gabi’s dilemma illuminates the dark side of what Michael Carrithers, Louise J. Bracken and Steven Emery characterize as a prevalent rhetorical “trope” in endangered species conservation discourse (2011), in which a non-human biological species as a whole is endowed with the individual personhood typically afforded to an individual human being. “Can a species be a person?” (ibid.) they ask, demonstrating that treating particular species of “unloved others” (Rose and van Dooren 2011), whose members do not capture the imagination and concern of a Western public due to certain physical characteristics or behaviors, as “equivalent to a human person” (Carrithers et al. 2011:662) affords the possibility of forms of conservation advocacy and action otherwise unavailable. When the species is pitted against the individual in a high-stakes competition for fundamentally limited care and attention, the equation “species ≈ person” (2011:662) comes to represent a particularly pithy distillation of the way in which the SSP’s concerns with maintaining a statistically measurable level of genetic diversity have required Gabi to approach the possibility of care through the lens of the utilitarian economic system that underpins its understanding of nature (see the previous chapter). The fundamental emphasis on scarcity that Robin Wall Kimmerer describes as the basic tenet of economics (2020)—the fact that choosing between Marlowe or “the siamang” not only makes care unavailable to, but actively detrimental to, the other—naturalizes what Michelle Murphy calls “the biopolitical equation: ‘some must die so that others might live’” (2018:112).

Ultimately, Gabi decided to refuse the SSP’s request and not breed Marlowe, determining that her individual suffering was not worth the benefit it would provide her species. Alma expressed a similar sentiment when describing the decision to separate Violet’s parents, Tuk and

Domino, once they began fighting (see Chapter 1): "no matter how important they are, as a couple, their day-to-day comfort outweighs one baby" (Interview, 12 August 2020). But it would not be accurate to characterize their approach as one in which individuals are automatically prioritized over the species: during the same discussion of Marlowe's predicament, Gabi emphasized that her concern was for "both" (Interview, 25 November 2019). "To me," as Gabi put it in another interview, "the individual animal is more important [than the species]" (Interview, 6 January 2020), but individual interests do not necessarily conflict with species interests, "because to save a species, you don't need each individual. So you can do both" (ibid.). Here, rather than saving a species by coaxing individuals deemed valuable "to contribute *more* than their proportion to the next generation," as put by no-one less than Francis Galton, the founder of the eugenics movement (Galton 1904:3), Gabi treats individual reproduction and species reproduction as each existing with at least a degree of autonomy.

This tension between individual and species, however, does not take place in a world composed of mutually discrete, autonomous and competing entities, each attempting to maximize their benefits while displacing burdens onto others. Rather, the underlying mutualism connecting the various units of gibbon conservation—the individual and the species—generates a situation in which all potential loci of care become repositories of both kindness and cruelty, instrumentality and expendability, benefitting from acts of care intended for them while simultaneously suffering when care is directed elsewhere. As scholars like Michelle Murphy and Robin James make clear, this collapse of ontological boundaries—the assumed capacity for anything to appropriate and/or consume anything else—is precisely what characterizes extractive capitalism and neoliberalism. "Capitalist biopolitics does not just distribute life and death possibilities between bodies," Murphy insists (2017:140); "it bundles antagonistic arrangements

of life potential and exposure to death as the very terms of living. The[se] antagonisms, violences, and devaluations are constitutive of the very condition of being alive today." James suggests something similar, describing Jacque Attali's sonically inflected understanding of neoliberalism as a "vision," in which "noise or error isn't an impediment to be eliminated (e.g., harmonized away by some sort of invisible hand or perfect authentic cadence) but something that can be accounted for and rendered productive" (James 2019:25).

But the obsolete condition Donna Haraway terms "bounded utilitarian individualism—preexisting units in competition relations that take up all the air in the atmosphere" (2016:49) remains crucial to critiques of endangered species conservation biopolitics; recall van Dooren's powerful and influential notion of "the violent-care of captive life," for example, which emphasizes the differential distribution of kindness and cruelty in which management practices effectively displace the costs and labor necessary for the survival of particular creatures onto others. Describing the case of Scottish wildcats, whose tendency to interbreed with feral domestic cats is seen to threaten the integrity of its species, Fredriksen shows how "species conservation takes on the hygienic task of separating the 'pure' from the 'impure'" (2015:700), sorting out animals deemed valuable and therefore in need of protection from those rendered either unimportant or an active threat to the species, and therefore disposable. The work of scholars like Murphy and James, however, points to the necessity of alternatives to economically informed theories that locate the source of injustice in the displacement of ostensibly necessary costs onto other bodies that are both less valued and ontologically discrete. The relationship between individuals and species equated in Carrithers et al.'s "wiggly" equation (2011:662)—entities assembled in relations of at once interiority and exteriority, affiliation and antagonism—require an equally wiggly theoretical treatment.

I find aspects of Actor-Network Theory (ANT) helpful in clarifying how living gibbons can be at once hyper-individuated under the weight of their extraordinary uniqueness and hyper-abstracted, wholly subsumed and tokenized by the presumptive character of the species. Here, I consider Bruno Latour's proposal to consider "the social" not as a preexisting domain in which humans participate, but rather as the result of a process of assembly in which distinct actors (which may include material objects, nonhuman organisms, and technologies just as easily as individual human beings) collectively form a web of associations in which the removal of one would cause the collapse, or impossibility, of the whole. As Latour argues, sociality is a process of "assembling the collective" (2005:16), that is, of communally negotiating what sorts of entities may make a difference in the context of the situation at hand.

This understanding of Latour diverges from its habitual deployment in ethnomusicological literature in which, for example, Michael O'Brien suggests that a "Latourian" paradigm simply means treating the non-human actor that is a musical instrument as "an ethnographic subject rather than an object" (2018:441).[3] Yet such cases remain instructive. Indeed, for the author of *An Introduction to Actor-Network Theory* (Latour 2005), agency (whether human or non-human) is neither a given nor inadmissible: it is a "controversy" whose presence should push theorists to account for the precise ways in which a thing comes to matter. The theoretical payoff of ANT's approach, Latour argues, stems from its capacity to avoid presupposing the agency, if not the ontological existence, of preexisting taxonomic units and instead observe how particular dimensions of continuity or commensurability represented by kinds or classes emerge and acquire irreducible significance to the constitution of the specific

[3] Latourian Actor-Network Theory has figured prominently in recent ethnomusicological studies of musical instruments (e.g. Roda 2009; Bates 2012; Tresch and Dolan 2013; O'Brien 2018; Yamin 2019), as well as surfacing in a variety of other areas (e.g. Piekut 2014; Born and Barry 2018).

networks in which they are a part. When O'Brien assumes the subjectivity or agency of "the *bomba con platillo*" (a Brazilian double-headed bass drum with a mounted cymbal), he is confusing "the *explanandum* with the *explans*," as Latour himself puts it (2005:100). As Latour argues, the tools of ANT are designed to address not such superficial non-human agencies but rather the ethnographic ways in which such abstract categories are able to acquire that very sense of autonomous agency itself, the processes that make it even possible to assemble a plurality of material forms, themselves each constructed from wood, hide, and metal, into a unitary whole. O'Brien's commitment to the instrument category as a "prematurely unified" (Latour 2017:87) actor (cf. Yamin 2019, Yamin forthcoming) is precisely the sort of situation ANT is poised to account for ethnographically.

"What is . . . at stake" in the assembly of potentially agential assemblages like the instrument category that is O'Brien's bomba con platillo, Latour writes, "is the very topography of the social" (2005:165). In this manner Latour's social topography has much in common with the condition Manuel DeLanda terms "flat ontology" in his Deleuzian-inflected monograph on assemblage theory (DeLanda 2006); for DeLanda, "the ontology of assemblages is flat since it contains nothing but differently scaled *individual singularities*" (2006:28, original emphasis). DeLanda articulates a social theory in which all that exists are "differently scaled assemblages, some of which are component parts of others, which, in turn, become parts of even larger ones" (ibid.:18). And like Latour, DeLanda's insistence upon the fragmentary nature of discrete wholes provides a powerful alternative to both taxonomic essentialism and the ideology of harmony and functionality I explored in the previous chapter; indeed, what DeLanda means to problematize is precisely the assumption that "the function of social institutions is to work in harmony for the benefit of society" (ibid.:8).

Attuning to such processes of assembly offers a way to unpack the fraught situation that has arisen at the Center—the tension is a result of a flat ontology in which individuals and species alike are concepts perpetually assembled and reassembled in practice, rather than constituting pre-existing units of analysis. Indeed, DeLanda insists that biological species are just as much individual entities as living animals, just existing at different levels of reality: "a biological species," he writes, "is an individual entity, as unique and singular as the organisms that compose it, but larger in spatiotemporal scale" (2006:27). I have already shown, however, that although at the Center both individual animals and species do exist as "unique, singular, historically contingent, individual[s]" (ibid.:40), the scalar relationship between the two is far more malleable than DeLanda's approach accounts for. Pitting individuals and species against each other, Murphy's "biopolitical equation" has been updated in line with what Sarah Franklin identifies as contemporary biology's epistemic shift from an ontology of nested scales, in which development proceeds from the simple to the complex, to "a biology that is about reassembly, . . . about using the logic of the system or totality, but applying it to parts, which in turn are being used to make new 'wholes'" (2007:66). Tracing the ways in which each acquires ethical and political significance in the context of captive breeding, what becomes apparent is way the individual and species are at once treated as discrete wholes and the parts—the resources—through which the other is made. For the Center staff, then, listening to gibbons becomes and always remains a scale-making project that holds open a fluid space for the relation between ontological and axiological understandings of individuals and species each as a unit or component of the other. At the same time, we have a concept of species as the abstract result comparatively emerging from a collection of unique, living creatures and a notion of the species

as a concrete entity that consequently abstracts individual lives to subordinate, fungible "adumbrations."

In a 2004 essay, Charis Thompson shows how these mutually inverted understandings coalesced into the very terms of a philosophical and ethical debate over proper elephant management practices in a Kenyan national park. Confronted with an overpopulation of endangered African elephants, the conservationists split into two factions torn between wanting to cull a portion of the herd and respecting each elephant's right to life. And as Thompson shows, each argument rested upon a "competing philosophy of nature" expressed through a particular understanding of the relationship between living, biological organisms and their species; for those opposed to culling, Thompson shows, each elephant is considered a distinct living self with an individual right to life; this atomistic individuality, furthermore, acts as the particular unit of scientific observation for whom conclusions can be extrapolated to generate abstract theoretical models of ecology and elephant behavior. For those in favor of culling, however, the elephant species, as the unit of ecological functionality, was seen as threatened due to its internal discord, its inability to contribute its constitutive role in the park's ecosystem a threat to the survival of both their own species and the park's precarious balance. In contrast to the critiques of conservation biopolitics introduced above, in which the individual and species are understood as conflicting recipients of attention ordered by a unitary scientific epistemology, Thompson's approach rejects the existence of monolithic epistemology of science at work that is able to account for the actions of the actors involved. Just as Matei Candea and Lys Alcanya-Stephens point out, the ontological mode Philipe Descola famously defines as "naturalism" (Descola 2013) acts not as an explanatory device but rather "as an ever-receding horizon, a sort of vanishing point for anthropological arguments about something else" (Candea and Alcanya-

Stephens 2012:37). Unpacking the affordances of listening practices at the Center means accepting that even within a scientific conservation framework there exist multiple, conflicting understandings of what individuals and species actually are, how the two are understood to be related, and the consequences for the various beings involved that each approach demand.

In a more recent study, Fillipo Bertoni (2012) picks up the thread of scientific multinaturalism and develops a philosophy of science attuned at once to its internal ontological plurality and its hegemonic claims to a unitary nature. Specifically, Bertoni follows scientists that study earthworms to argue that what an earthworm is, ontologically, depends on the specific research practices that are used to describe it. An earthworm as a dead specimen, labeled and jarred, indicates a very different ontology (one in which nature is stable and needs to be protected from change) from the earthworm as data point on a map (in which nature is inherently changing and needs to be stabilized). Moving beyond the simple deconstruction of "naturalism" as heterogeneous, Bertoni shows that the true power of positivist research is its ability to coordinate and order these different versions of nature, achieving scientific results—and modernity as a whole—by hiding the ontological discrepancies that are so crucial to their production.

As I have shown, however, those ontological discrepancies swept under the rug in the technoscientific production of the species as the unit of endangered species conservation, what Braverman calls "a regime of fuzzy governance" (2017:146), are swept right back into the open when actual animal lives are at stake. What is so striking about the way this aural indeterminacy manifests at the Center is how the caretakers are able to hold these multiple, incommensurable ontological notions of scale in "ear" simultaneously. It is this ability, I argued, that allows Gabi and her staff to resist the totalizing impulses of conservation biopolitics even as they are bound

up inescapably in its ambitus. Faintly audible in their listening practices—in which the relationship between individuals and species is not linear and unitary but rather plural and multiple—is a practice of biopolitical refusal, of an auditory way to approach the fraught ethical space of endangered species conservation without succumbing to the traps posed by the seemingly inescapable twin economic presuppositions of fundamental scarcity and ontological fixity. Like Dulce Maria, the Guatemalan housewife whose apparent conflation of ground beef and soy meat leads anthropologist Emily Yates-Doer to question the definition of "meat" as a substance derived from animals, Gabi and her staff are "not in the business of serving phylogeny" (Yates-Doerr 2015:313).

Indeed, during our discussions Gabi expressed distaste at being required to rank the Center's gibbons according to value—in particular, a request from the Center's board to determine the order in which the gibbons should be caught and evacuated in the very real advent of a fire or other emergency. Rejecting both the impulse to prioritize the SSP's most genetically valuable females, as well as the elderly animals, Gabi's ideal solution foregrounded values of context, improvisation, and adaptation: "I don't want to base it on that [list] if there is an emergency. I want to base it on the need, which way the fires are coming from, which [gibbon] is easier to catch" (Interview, 25 November 2019).

The ability to fluidly reassemble the relationship between individuals and species, then—whether resulting in the intensification or the subversion of biopolitical and neoliberal regimes that exert power over the lives of captive animals—problematizes the assumption of a fixed, pre-existing and unitary model of nature underpinning normative models of endangered species conservation. But the Center's caretakers are not the only actors aurally complicating the pressures of the tense situations into which they are thrown, and in the next section I turn to

examine a set of listening practices through which the natural-ness of taxonomic categories are complicated—if not exactly "on the ground" than in the first dozen meters above it—by the gibbons at the Center.

What do the gibbons think?

So far in my analysis of the gibbon SSP's captive breeding program as encountered at the Center, I have argued that its presumptions to objectively represent, and attempt to reproduce, a certain version of nature defined by pre-existing biological functions and categories whose members are consequently endowed with pre-existing capacity to form reproductive pairings are problematized by the fact that "species," as Eben Kirksey writes, "are enacted, . . . are performed in specific ways" (2015:759). In his article on the subject Kirksey examines a variety of taxonomic techniques used to classify organisms as diverse as microbes, frogs, and fig trees, lending ethnographic weight to the claim that species are not natural kinds but rather that their existence is owed to the particular analytic techniques used by specific actors to produce them. As Yates-Doerr writes, "the power of multispecies scholarship . . . lies not in how it 'centers the animal' but in its challenge to conventional taxonomic formulations of classification and belonging" (2015:309). For the chytrid microbes identified by the biologist Joyce Longcore, Kirksey argues, their species "exist" (2015:762) not in conceptual space but rather the physical location that is a specific refrigerator dedicated to storing isolated cultures of each described class of organism; he shows that without this precarious, material infrastructure, in constant need of maintenance and attention, the criteria and proof used to distinguish between a veritable swarm of heterogeneous microbes would be unavailable.

In addition to characterizing the emergence of species categories as what Stefan Helmreich describes elsewhere as "the result of work, of labor that, when done well, produces a sense of seamless presence, presence we should not take for granted but rather should inquire into as itself a technical artifact" (2015:226), Kirksey raises issues regarding a different sort of taxonomy. Just what sorts of actors may participate in this work of bringing kinds into being? Kirksey is clear in this regard: the enactment of species is not a uniquely anthropocentric endeavor.[4] Using the example of two fig trees historically thought to represent different species due to major differences in their physical form—one with a single trunk and branches; and another that is a banyan composed of an above-ground structure of twisted roots—Kirksey shows how they are instead representatives of a single kind; a species defined not by an internally homogenous or externally consistent form but rather the presence of a particular kind of wasp that acts as their pollinators. "Fig species depend on the other beings involved in producing their existence," he writes (2015:773). "Botanists do not make these species, or construct them. Wasps, not humans, are key agents involved in the doing of fig species. Rather than being a 'natural kind', waiting to be discovered by humans, *Ficus* species are brought into existence by their continual rediscovery by their wasp pollinators" (ibid.).

So far in addressing gharmony and its consequences, whether unpacking the ideas of thinkers from Pythagoras to Dawkins who laid the groundwork for the conjugation of relational ecology and predictive economy that made possible the currently dominant form of captive animal management, or examining the ways in which the listening practices of the Center's staff

[4] Tim Ingold importantly points out that these two criteria (what distinguishes a biological species and what distinguishes the sort of entity capable of conducting taxonomy) were never wholly separated: for Linnaeus, he reminds us, "the distinction" between humans and apes "was . . . to be grasped through introspection rather than observation. Do you ask how a human being differs from an ape? The answer, said Linnaeus, lies in the very fact that you ask the question. It is not one that apes ask of themselves" (2004:25).

complicate and resist the SSP's insistence and demands, I have privileged a distinctly anthropocentric acoustemology of compatibility. Here, I attempt to remedy this myopia by asking: how do the Center's gibbons enact gibbon species?

In animal studies, questions of the form "what do the animals think" are extremely fraught. (Possibly) gesturing to a fundamental incommensurability between human and lion forms of life, Ludwig Wittgenstein famously proclaims that "if a lion could talk, we could not understand him" (1958:223). In a similar vein, Thomas Nagel asks "what is like to be a bat?" (1974), and concludes that the radical differences between the physical, behavioral, and sensory characteristics of humans and bats renders such an investigation futile. Writing against these philosophical inquiries, empirically engaged primatologists and science scholars have suggested that the assumption of incommensurable differences between human and non-human animals is reflective instead of what Haraway calls "species chauvinism" (2008:69), an anthropocentrism that perpetuates, rather than complicates, what Joshua Tucker characterizes as "humanity's self-satisfied self- portrait as the centre of the universe's affairs" (2016:328). Frans de Waal finds what he terms "anthropodenial," the assumption that anthropomorphism is automatically a problem, itself just as problematic (1997); "what would animals say if we asked the right questions?" wonders Vinciane Despret (2016). Particularly relevant here is the result of Haraway's equally generous and critical reading of Jacque Derrida's foray into animal studies (Derrida 2002). Haraway develops Derrida's own critique of human exceptionalism—in which animals are habitually denied the capacity to *respond*, and instead assumed to simply *react* to external stimuli—into the ethical mode of engagement with the Anthropocene she calls "response-ability" (2008, cf. 2016). In her own publications Haraway cultivates a form of response-ability predicated upon remaining open to more-than-human vitality; whether

companion species or environments, the more-than-human protagonists in her stories are never reduced to the mechanistic instruments or passive victims of a uniquely human agency.

Here I follow Haraway's approach by emphasizing that for the gibbons at the Center, the capacity to respond, rather than react, to the vocalizations of others is precisely the mechanism through which they negotiate the affinities and exclusions that constitute their species boundaries.[5] By listening for what sonic criteria each of the Center's gibbons treat as acceptable in a duetting partner—their auditory "ontics and antics" (Haraway 2008:175)—I will show that the gibbons' own practices of enacting species sometimes align, yet sometimes conflict, with the biological and/or acoustic criteria proposed by human scientists like Geissmann (2002, 2015) that I examined above.

The following discussion is based on my analysis of one representative song bout, recorded at the Center on 18 December 2019 and beginning at 11:29 AM. From the dozens of hours of audio footage I recorded at the Center, spanning a time period from September 2019 to March 2020, I chose to analyze this particular example for two reasons. First, I deemed it representative of a typical morning song bout, as it includes all the distinct gibbons who typically participate. Second, this 25:40 recording—which was made in my 360-degree quad-binaural format described in Chapter 2—is (relatively) exempt from the various interferences and/or distractions both to the listener (e.g., sounds of other animals, enclosure maintenance and/or construction, public tours) and to the gibbons (e.g., the presence of animals deemed dangerous, which interrupt the usual singing process). Despite this relative lack of outside interference, the presence of several dozen animals all vocalizing at the same time, in the same frequency range,

[5] Kirksey argues the same for frogs, writing that "frogs enact their own species with their own practices of classification, recognition, and differentiation" (2015:768).

makes visual representation with a spectrogram nearly useless. Instead, I provide detailed written descriptions of the sonic events occurring over the bout's nearly twenty-six minutes.

"Species-specific" interactions

White-cheeked gibbons: Four seconds after this recording begins, a female named Pepper (discussed in Chapters 2 and 3) pierces the Center's soundscape—which for the previous hour had included nothing but the occasional bird and squirrel calls, in addition to the sounds of the caretakers moving about as they distribute feed to the gibbons and rake their enclosures—with a short phrase resembling the first two ascending tones of the white-cheeked gibbon great call (see introduction to previous chapter). But rather than continuing, Pepper falls silent. About twenty seconds later, she repeats this two-note phrase. And this time, it is immediately followed by a vocalization produced by her father Vok, housed in the same enclosure, who utters a short call. Resembling the first utterance of the white-cheeked male "coda" (see, once again, Chapter 3 figure 1), what is normally a smooth, downward-sweeping call here cracks and jumps between pitches as it emerges from the throat of the elderly animal. Then right after Vok finishes, Pepper begins her own phrase a third time. This time, accompanied by her younger brother Dennis, she does not stop after the first two notes but continues, her 30-second sequence of upwardly sweeping notes growing faster and higher in pitch until they reach a climax. Then, she changes to a final sequence of fast chirps that descend in pitch. Several moments afterward, Vok once again produces the first few notes of his coda.

Dennis, who as a juvenile gibbon had not yet reached the point in his adolescence in which hormonal changes are thought to trigger the transition to producing the adult male vocalizations (see below), was still at the point in his development during which he would join

his mother's great calls. Dennis and Pepper's mother, Ricky, had passed away from cancer several years previously, however, and subsequently Pepper had taken over the role of the dominant female in her family group (see Chapter 2). Yet Dennis is not the only gibbon to respond with analogous vocalizations to Pepper's whenever she initiates a great call; rather, every other adult female and juvenile white-cheeked gibbon at the Center does the same. Particularly audible in this recording is Lucia, housed one enclosure away, who begins her own great call about five seconds after Pepper, as well as Astriks, the Center's third adult female white-cheeked, who does as well, immediately accompanied by her juvenile son, Nate.

Over the next ten minutes, Pepper, Astriks, and Lucia take turns initiating the great call sequence while the white-cheeked adult males—Vok, Pierre, and Canter—fill the intervening moments with their own codas. Occasionally, if enough time has elapsed after a great call sequence, the males produce another distinct phrase during with the gibbon inflates his throat sac (a feature only found on the males of this species) to yield a single rising vocalization similar in pitch and timing to the early utterances of the female's great call, followed by a series of conventionally produced short notes of a single frequency.

Hoolock gibbons: The Center's hoolock gibbon chorus, comprising four mated pairs and several additional offspring, begins with the hoolock's distinctive guttural vocalization produced by the females. After roughly a minute of this, one begins the short phrase primatologists call a "bi-phasic hoot," an exhaled lower pitch immediately followed by an inhaled higher pitch, which immediately segues into the hoolock great call. Like the great calls of the other species previously described, the hoolock's version is characterized by an increase in speed, but unlike the others, there is no pitch modulation; rather, there is only the low-high alternation of several bi-phasic hoots before that differentiation gives way to a series of barked vocalizations on a

single pitch. The time frame of this phrase, furthermore, is relatively compressed, with the great call rarely lasting more than twenty seconds. Finally, unlike the rigid sex-specific distinctions between other species' roles in the duet, all adult hoolocks begin producing these great-call vocalizations as soon as any one begins, making it exceedingly difficult to differentiate between the vocalizing animals.

On this recording the hoolocks continue to sing for over sixteen minutes, at first producing great call sequences roughly every thirty seconds before decreasing the frequency of their calling; the last several minutes feature one great call every sixty seconds with silence in between. The first ten minutes of their chorus is marked by the continual production of sound—nearly every moment is filled with the call of one hoolock or another. Spaces between the communal great calls are marked by more bi-phasic hoots that do not lead into great calls, other barks and hoots, as well as a distinctive phrase, only produced by the males, consisting of three or four quick bi-phasic hoots followed by a strikingly high-pitched "eeee."

Siamang: Marlowe, the Center's single siamang, begins 1:45 into the recording, contributing her distinctive vocalizations that are generated in two disparate manners: besides her conventional barks and what Geissmann (2000) calls "ululating screams,"[6] Marlowe can also inflate her large throat sac to produce a loud booming sound. After a lengthy introductory sequence—a collection of phrases that only occurs once at the beginning of each song bout—Marlowe begins her own great calls. She begins by producing two booms in rapid succession,

[6] In the publication that introduces this term, Geissmann offers no insight as to his choice to use the term "ululation" to describe such a vocalization. As Lousie Meintjes makes clear in her rich examination of the meanings and materiality of Zulu ululation, the technique is defined by "a high-pitched trilling by means of oscillation of the tongue" (2019:62). Although I never attempted to investigate the interior of Marlowe's mouth while she was singing (indeed, some siamangs are known to cover their mouths with their hands and/or leaves while vocalizing), I highly doubt that the distinctive modulations that characterize the vocalization in question are achieved by use of the tongue. Rather, my conjecture is that the sound is produced by means of multiple quick exhalations without cutting of the sound in between each, similar to a horse's whinny.

followed by a sequence of alternating booms and barks that begin slowly and gradually pick up speed. After sustaining this rapid alternation for several seconds, during which time the pitch of her barks drops slightly, she pauses momentarily, utters several booms, then inflates her throat sac once more and produces a single, high-pitched ululating scream followed by a fast sequence of barks. And she repeats this great call sequence numerous times, finally falling silent just after the 12-minute mark on the recording.

Javan gibbons: Six minutes and fifty seconds into the recording, Oula, an adult female Javan gibbon, begins singing. She only produces great call sequences, but unlike the great calls of the species described previously, hers contains no smooth acceleration; rather, she begins with a series of fast "wa-notes" (Dallmann and Geissmann 2001) that introduce the great call proper, three slow, sustained notes immediately followed by several quick ones. Notable about the vocalizations Oula produces is that each note ends at roughly the same high frequency; what distinguishes each is the amount of time she takes to arrive—and the fact that the last few fast notes before reaching the three slow notes rise, then dip down slightly before rising again to reach that final pitch. Thus the fact that her final sequence of notes slightly decreases in pitch while decelerating is striking, especially the very end: she produces one more, sustained note that rises only slightly to end on a much lower frequency than the rest.

Oula's mate Medina does not participate in the chorus; Javan gibbons are a non-duetting species. Male Javans instead perform their own chorus independently, but its occurrence is rare—I only heard it a few times during my fieldwork. Nor do the other Javan females join upon Medina's initiation like the other species, but instead Khusus, located on the other side of Center, begins producing her own great calls two minutes later. Oula and Khusus alternate, except for

one notable occurrence—12:40 on the recording—during which they overlap. Oula sounds her last great call seventeen minutes into the recording.

Pileated gibbons: The pileated gibbon great call sequence has already been discussed in detail (Chapter 1). On this recording, Tuk begins at 9:40, her soft grunts signaling the beginning of the increasingly fast cries produced by Tuk and her daughter Boo that culminate in the impossibly fast bubbling sound called the "trill." (Tuk's daughter Iszie is silent in this recording, which was made in the midst of the family drama between the two with which I began this dissertation's introduction. During this recording Iszie was still living in the "shift," a separated part of Tuk's family's enclosure, as her own had not yet been built. Tuk's aggression towards her daughter is audible at 16:50, when at the culmination of Tuk's great call she swings over to their shared chain-link wall and shakes it dramatically.) Then a minute later, Violet begins a great call from her own enclosure, to which Truman responds with his own coda. The two adult females continue this alternation at approximately one-minute intervals for the next nine minutes with the exception of a longer period (13:00–16:00) during which Violet sings twice without alternating with her mother. Violet, furthermore, continues to sing after Tuk has fallen silent, producing two great calls afterwards. Truman also produces solo vocalizations between Violet's last two great calls, and after the last one Violet and Truman begin the alarm call they use to indicate the presence of a terrestrial threat—most likely a (harmless) ground squirrel.

Interspecies interactions

The various vocalizations of these five species, undoubtedly, have distinct and audible differences. Indeed, these differences are precisely what allows primatologists like Geissmann to hypothesize phylogenetic relationships between them, and therefore appear to offer a neat

taxonomy of gibbon species. This argument is strengthened by the fact that, as I showed, members of each species sing and duet internally despite the heterogeneity of male and female parts.

But do these audible criteria a species make? If a species is an "interbreeding population," as renowned biologist Ernst Mayr has proposed, and if, furthermore, gibbons establish their reproductive compatibilities through paired vocalizations, then it stands to reason that we need to pay attention to just who each gibbon is willing to sing with—what vocal criteria afford the conditions for the possibility of such a relationship. Just as Emily Yates-Doerr puts it, "species must not be understood as a naturally ordered essence of blood or genetics but as an occurrence of coherence situated amid ever-transforming divisions and connections" (Yates-Doerr 2015:309). And, I will argue here, these species lines do not necessarily conform to the boundary lines drawn by taxonomists.

The most apparent example of this is the first entrance of the hoolock great call. The hoolocks begin singing not because of a cue initiated by one of their own species, but rather at the culmination of Pepper's white-cheeked great call. And indeed, every great call initiated by a white-cheeked gibbon is accompanied by a hoolock response. Yet the white-cheeked gibbons do not respond in the same way to the times during which a hoolock gibbon begins its own great call; in fact, not one time during the recording does a hoolock-initiated call result in a subsequent white-cheeked sequence. The hoolocks, furthermore, respond in the same manner to Marlowe's great calls, but unlike the white-cheeked gibbon females, Marlowe sometimes follows great calls begun by hoolocks and white-cheeked gibbons.

Meanwhile, Oula and Khusus's Javan gibbon vocalizations evoke little to no response from members of the three species previously mentioned—I hear no attempts by any of those

gibbons to synchronize with their calls, and furthermore their own moments of initiation exhibit no easily discernable or audible relation to the calls of any other species. Yet the one moment in which Oula and Khusus overlap their own calls is characterized by a moment of striking synchronicity: during the introductory phase of their great calls (the fast "wa-notes"), a seeming lack of coordination gives way to a moment during which their wa-notes are fully synchronized; and at that very moment they transition into the low rising notes of their great call proper.

Tuk and Violet, the adult female pileated gibbons, demonstrate a similar degree of intra-species coordination with their (nearly) strict alternation of great calls. And while they at no point synchronize their calls with those of other species, this does not mean they are ignoring them (as the Javan females seem to do). Rather, these gibbons are attempting to avoid overlapping with the vocalizations of other gibbon species, just as they do with their own. Tuk and Violet do not begin singing until the initial commotion of the multispecies chorus has begun to subside; Tuk begins the soft grunts that signal her desire to sing to her family during the first (relatively) quiet moment of the song bout; Violet does the same. It is exceedingly rare that Violet or Tuk begins a great call while either the white-cheeks or the hoolocks are engaged in their own great calls, but they occasionally start while the Javans are in the middle of their own great calls or, as I describe below, while adolescent male white-cheeks are transitioning from singing along with their mothers to independently producing the adult male codas by loudly "practicing" those latter vocalizations once all the other white-cheeked gibbons have finished their own chorus. For the pileated females like Tuk and Violet, avoiding sonic overlap with other vocalizations is a marker not of rejection but rather coordination; the vocalizations of other gibbons during which Tuk and Violet have no problem initiating their great calls are instead the ones that do not register as formations to be interacted with.

The multiple forms of sonic convergence and divergence exhibited during this multispecies chorus demonstrate that for the gibbons producing them, the possibility of sonic and social compatibility is not a function of likeness, similarity, or conformity but rather established in the process of each gibbon's determination of what counts as a vocalization in need of a response and what does not. The conditions for the possibility of compatibility are not audibly negotiated by two potential partners in a vacuum, but rather against a noisy backdrop of similarity and difference in which possible categories of being, as well as membership within, are established simultaneously.

Effort and ethics

This audible interspecies compatibility is not a function of essential characteristics of each species, nor latent compatibilities, but rather the outcome of a process of negotiation. Attending to the pairings of Canter/Lucia (Chapter 3) and Violet/Truman (above) has already shown that even among members of an ostensibly singular species, the immediate capacity to duet together is not inevitable. No matter the taxonomic compatibility of the singers, it always takes, as Alma put it, "effort." In our discussions, both Alma and Gabi brought up the example of Betty, a hoolock gibbon paired up with a male, Khin Maung (pronounced by the Center staff as "Kee Mao") who, as Gabi put it, initially "didn't get it" (Interview, 25 November 2019); it was as if he "didn't know that he needed to coordinate, . . . [Because] that's the part they actually have to learn, and it was almost like [Betty] had to teach him to actually do that" (ibid.).

It was up to Betty, who "used to kick Khin Maung into his timing," as Alma put it (Interview, 12 August 2020):

> Betty had already been with a partner before so she [already] knew . . . how to coordinate the song with one another, and she guided Khin Maung through his song. . . . She knew

> when he was supposed to chime in, and she wanted to make sure they started together. So she would either kind of kick, or put her arm over his shoulder, and . . . she'd guide him in. (ibid.)

Betty's tactic was successful, and Khin Maung regularly coordinates with her during their duets. Indeed, as Gabi pointed out to me, female hoolocks will not sing their great call sequences if their male partners do not respond after their initial prompt, so at stake in Betty's effort to "teach [him] to actually do that" (Interview, 25 November 2019) was nothing less than the possibilities of both forming an all-important pair bond and participating in the larger gibbon chorus. This example—and the importance that both Gabi and Alma place on it—shows how the ability for two gibbons to duet together is not an inevitability but rather the result of specific, uncertain work, further requiring "a mode of attention," as Helmreich writes "that asks how definitions of subjects, objects, and field emerge in material relations that cannot be modeled in advance" (2007:632).

Even the differences in species-specific song characteristics may be overcome with time and effort. Gabi recalled one example from her time at the Center: a mixed-species couple consisting of a female Javan and a male agile gibbon.[7] "And whenever she was singing the great call, he wanted to stop her, like he would cover her face to stop her singing! . . . Sometimes he would freak out from a great call, especially the first few months" (Interview, 11 December 2019). Gabi told me that not only did this reaction eventually subside, however, but also the male

[7] Mixed species pairings made occasionally at the Center, usually to ensure that individuals for whom no same-species partner is available are not denied the companionship that social animals like gibbons require. These pairings are sometimes explicitly temporary, especially given the extreme lengths of time it takes to work with partner institutions and process the permits necessary to ship endangered animals across state lines. At the time that Iszie, the adult pileated gibbon described in Chapter 1, dispersed from her natal family, there were zero unpaired male pileated gibbons to be found in the entirety of the SSP-approved network of institutions. Gabi began discussions with a zoo in Florida where Iszie would be temporarily paired with a solitary buff-cheeked gibbon, but those plans were delayed first by a miscommunication regarding necessary vaccinations and then finally scuttled by the advent of the COVID-19 pandemic. The animals in question here—a female Javan and male agile gibbon—were eventually paired off with members of their own species. The female, Isabelle, was paired with a male named Ivan at the Center, while the male, Leon, was sent to a zoo in North Carolina.

began attempting to duet with the Javan female despite the fact that Javan gibbons do not sing duets. “She was actually singing with him, eventually a duet” (ibid.).

During the duration of my fieldwork, the Center’s only mixed-species couple consisted of Marlowe, the female siamang, and a male hoolock named U Mynt (pronounced by the Center staff as “Oo-min”). The two interact during the daily choruses, although their coordination is hampered by the very different goals and criteria of their respective species’ duetting mechanics. For example, a typical siamang great call features two important contributions from the male siamang: first, during the period in which the female slowly alternates between booms and barks, it is after an interjection of two booms from the male that she begins accelerating. And after the female has reached her maximum speed, the male produces a vocalization that occurs nowhere else in the species’ vocal repertoire—a “bi-tonal scream”—in response to which the female ends the alternating section and the two together move on to the sequence of ululating screams and subsequent barks. Usually, in fact, it is the male who produces the ululating screams, but that is a role here taken over by Marlowe. Indeed, none of the salient siamang cues are present in the hoolock repertoire; instead, U Mynt participates as a hoolock would: by joining in Marlowe’s great calls with his own bi-phasic hoots followed by fast barking.

Although such interactions between gibbons understood by biologists to represent separate and mutually exclusive kinds are audible daily at the Center, inaudible are the vocalizations of interspecies hybrids, a phenomenon well documented in the primatological literature on captive gibbons (see, e.g., Geissmann 1984; Tenaza 1985). Indeed, Marlowe is fitted with a contraceptive device. While many critical studies of endangered species conservation have made the connections between captive breeding practices and eugenics more or less explicit, the avoidance of hybridity at the Center instead reveals a deep and

knowledgeable commitment to its consequences not as a matter of ideology (Subramaniam 2014), but rather as an ethical concern for the living animals potentially and inescapably confined by matters of biology brought about by human actions (whether deliberate or the result of ill-informed or negligent zoo management).

Here, the decision to curtail the possibility of hybrid vocality is not simply a function of an ideological commitment to maintaining the boundaries between pure types, nor a requirement from the gibbon SSP; more deeply, it is an ethical issue made with sincere concern for the welfare of the hypothetical hybrid offspring. As achieving proper vocal coordination between mated pairs is, for most species of gibbons, a necessary prerequisite for developing and maintaining their pair-bond (see above), the unpredictable results of a hybrid's vocalizations might possibly leave them unable to find compatible duetting partners, and thus condemned to a life "of isolation and exclusion," as van Dooren writes of a failed whooping crane breeding project in which those critically endangered birds, fostered by parents of another species, proved incapable of forming breeding relationships with members of their own species. Just as van Dooren reads Konrad Lorenz's famous experiments in fowl imprinting on human beings as a coercive exercise in anthropocentric and scientific hubris that ultimately robbed those birds of the ability to form social attachments with members of their own species, allowing a mixed-species couple to reproduce might be understood constitute a deliberate act of violence not towards the species-body but rather towards the resultant offspring, its hybrid vocalizations not making audible miscegenation or impurity but rather heralding the trauma of a solitary life agonizing for creatures as social as gibbons.

Wherever two gibbons are cohabitating at the Center, it is not the result of some accident or fluke but rather the deliberate consequence of a decision-making process in which Gabi, as the

director, determined that they would be better off together than alone. Her approach stands in stark contrast to the hypothetical form of animal management I characterized in the previous chapter as "gharmony," in which compatibility is fully predicted and therefore pairs are assigned in advance. Whenever possible, furthermore, her choices are made not with repercussions for the "species" in mind, but rather in the presence of those living animals for whom such decisions might have life-altering—whether life-ending or life-beginning—consequences. Telling me about the various schools of thought regarding gibbon matchmaking, Gabi told me that "there's two ideas [about] putting two gibbons together: one group thinks it's the best, once you have them in the same institution, to just put them in the same enclosure. But once they are in the enclosed area," she said, "they can corner each other and have a serious fight, and I don't believe in doing that" (Interview, 28 September 2020).

Instead, her practice foregrounds the possibility of letting those gibbons participate themselves in the selection process. "I'd rather have them near each other, with a fence between them, and give them a sense of picking each other and just slowly getting to know each other instead of forcing them together" (ibid.). For example, Gabi described a time from before she became Director, when two single hoolock gibbons, Maung and Drew, began calling to each other from across the Center's grounds. "They were housed alone for years," she told me. Then "when Maung became an adult, it was like Drew realized: 'Hey! There is a single male here!' So they started calling back and forth, when nobody else was singing" (Interview, 25 November 2019). And because of this, the Center staff decided to introduce them. "They were very easy to pair up," Gabi said, "Like in a couple of days, we were able to just house them together—no conflict—they were already duetting with each other" (ibid.). The implication is that Maung and Drew began duetting at the precise moment when they were ready to form a pair-bond—no

earlier and no later. Offering this case as an example indicates Gabi's desire not to render living gibbons as the instrumental means to an end that is reproducing a certain idea of their species (van Dooren 2014), nor to occlude human management behind a thin veneer of natural behavior, but rather to respect each gibbon's capacity to respond—and thus to participate in the decision-making process.

In the late morning of 11 December 2019, while I was working in the kitchen, Gabi texted me a short video she had just taken of Nate, the young male white-cheeked gibbon, who had begun to sing quietly by himself just after the morning chorus had subsided. I didn't recognize the sounds at first; Nate was producing neither the great call vocalizations he would sing every morning with his mother, nor the coda phrases sung by adult males. Rather, he was producing short bursts of scratchy, warbling tones. Several minutes later both Gabi and Alma stopped their work; their excitement was palpable as they gathered in the small bathroom attached to the Center's kitchen, whose window provides a vantage point to Nate's enclosure. "He's practicing!" they told me, fixated on the sound. We were observing a special moment in the life of every male white-cheeked gibbon, the beginning of a phase in which he ceases to sing with his mother and instead begins the long, arduous process of struggling to produce the male coda. For Nate, this took over six months, during which time he would spend nearly an hour a day (after an initial several weeks of less regular action) immediately following a gibbon chorus producing, over and over again, phrases that only over time became recognizable as an adult white-cheeked phrase.[8] Watching him, the physical exertion was palpable, expressed not only in his often comical attempts to inflate his throat sac, but more generally through the sheer effort necessary to repeat those phrases again and again. Indeed, although over the course of those six

[8] For a detailed study of this process as it occurred for several males of the vocally similar species *Nomascus gabriellae*, including illustrative spectrograms, see Hradec et al. (2021).

months his vocalizations gradually became more in line with the standard phrases, over the course of each individual day—each "practice" session—his song drifted further and further away from what any of us recognized as an adult male coda.

The timing of Nate's first attempts at practicing was especially noteworthy, as just several hours earlier, Gabi had noticed that Pepper had, for the first time, begun her menstrual cycle. Nate and Pepper, in fact, had already been officially matched, approved by the SSP—their introduction was only waiting on the construction of a new enclosure. Even in the perpetually surprising environment that is the Center, for Gabi this coincidence was remarkable. "As soon as the enclosure is ready, we will introduce them, and I think it's going to be an easy one. . . . But I just felt that it's very special that it happened on the same day" (Interview, 11 December 2019).

I admit that the implications of this occurrence still make me uneasy, and since that day I have struggled with how to include and discuss it in this dissertation. Initially, the simultaneous confluence of Nate and Pepper's individual transitions to gibbon adulthood suggest a truthfulness to the very metaphysical position undergirding gharmony I have complicated at length above: that certain compatibilities and not others do indeed precede acts of pairing and are thus real and innate—that Nate and Pepper belong together. Yet Gabi, once again, provided a different reading on this coincidence: "I wonder if it just happened by chance or [if] there's something that Pepper already hears, [for example that Nate] is no longer involved as much with singing the female song. Or [if] Nate has any way of sensing Pepper next door" (ibid.). Whatever the reason, Gabi implied, the important thing was the fundamental uncertainty it reveals. "We just don't know [the answers to] these questions," she said (ibid.).

Gabi's philosophy of gibbon pairing epitomizes the orientation philosopher of science Isabelle Stengers famously terms "cosmopolitics": a position in which outcomes cannot be

known ahead of time, and thus decisions are made by vulnerable, exposed actors against the backdrop of an unknown cosmos, a cosmos furthermore composed together by the actors present (e.g., Stengers 2005, 2010, 2011). "A common world," Bruno Latour writes in an essay contrasting the power of Stengers' formulation to the standard Kantian notion of cosmopolitanism, "is not something we come to recognize, as though it had always been here (and we had not until now noticed it). A common world, if there is going to be one, is something we will have to build, tooth and nail, together" (Latour 2004b:455). Allowing the gibbons to participate in composing such a common world is one path towards such a cosmopolitical ideal. For Gabi the practice of gibbon pairing—a project, recall, at stake in which is nothing less than the survival of entire forms of life exceptionally threatened by human exceptionalism's orientation towards the larger more-than-human world—is not an act of putting pre-existing and compatible pieces together in previously determined assemblages but rather, a process of "figuring it out," as she put it many times during our conversations, "together."

Conclusion: "Figuring it out together"

In this chapter, I attended to various the forms of effort, expended by members of a multispecies cast of actors at the Center, through which numerous material and conceptual categories are made and remade. Attending to this work, I argue, complicates scholarly accusations that SSPs and other expressions of captive animal management exert hegemonic claims over the lives of the animals it manages. By insisting on the capacity of those gibbons to participate in their own projects of worldmaking, my approach follows Les Beldo's critique of anthropocentric projects that seek to manage animal lives for productive ends. In particular, Beldo proposes the term "metabolic labor" to describe those vital processes essential for the

capitalist extraction of surplus value from living animals, yet unreproducible by those human actors who benefit from the surplus. Quoting Edmund Russell, Beldo points out that "no one has yet figured out how to transform sunlight, carbon dioxide, and a few nutrients into grain—except by subcontracting the job to plants" (Russell 2004:9, quoted in Beldo 2017:115). Recognizing the ways in which such animals are capable of producing value through their own metabolic processes, he argues, is a crucial first step to realizing how the factory farm relies on the exploitation of this labor in order to produce value; "animals . . . made hostage to their own reproductive or metabolic labor," he shows, is a precondition for wringing from them ever more profitability for the meat industry (cf. Blanchette 2020).

Beldo's theorization of nonhuman metabolic labor is meant as an ethical intervention not only in the meat industry but also in an academic tradition of critiquing industrial farming that still "erases the generative capacity of nonhuman vitality from the equation of production" (2017:125). Specifically, Beldo takes aim at Cary Wolfe's influential theorization of animal exploitation through the Foucauldian lens of biopower. Under such a continuous and inescapable expression of power, Wolfe reasons, the only expression of agency can be the refusal that is death itself; such a theory generates "a situation wherein resistance, disruption, and death become the only forms of agency available to animals" (2017:110). Yet as Beldo convincingly argues, this totalizing conception of biopower rests on a mistranslation—the conventional Anglophone treatment of biopower as the power to "make live," he suggests, "elides the connotation of maintenance and support that is better captured by rendering the French idiom *faire vivre* as 'to foster life'" (2017:116). The ontological distinction between an independent animal vitality, on one hand, and its human nurturing, on the other, is key to understanding the ways in which the former is capable of at once exceeding and being exploited by the latter.

In the context of the gibbon SSP, Beldo's focus nicely accounts the fact that rather than intervening in the reproductive processes meant to produce or safeguard future gibbon lives directly (a practice conducted by other endangered species conservation programs by means of invasive reproductive techniques like genetic cryopreservation and artificial insemination [see Chrulew 2011; van Dooren 2014]), at gibbon facilities like the Center tasked with implementing the pairing recommendations from SSPs, this management instead takes a form curiously removed from direct intervention in the proximate mechanics of sexual reproduction. In fact, during the entirety of my fieldwork at the Center (from June 2018 to September 2021; see Appendix A), the various pairs matched by the SSP yielded only a single offspring—a female named Anastasia Jolie (naming rights were auctioned off as part of a fundraiser to support the Center's relocation efforts [see Chapter 5])—resulting from the aforementioned pairing of Astriks and Pierre.[9] The fundamental distinction between the distinct capabilities and roles of human and non-human vital labor, expressed in the contrast between those capable of performing relevant forms of metabolic labor and those tasked with its fostering, explains the fact that at the Center, active involvement with gibbon breeding ends precisely where the gibbons' own metabolic and reproductive labor is presumed to begin.

But such an underlying commitment to the fundamental independence of gibbon vitality from the human fostering of gibbon species in captivity is precisely what makes the gibbon conservation's vast set of material and conceptual demands and constraints seem not to be agentive acts of interference or intervention in the life processes of the species it manages. Even the term "metabolism" itself connotes what Haraway calls "bounded utilitarian individualism," a

[9] Lucia, the gibbon with whose resistance to the SSP's matchmaking decision I began this analysis of gharmony, gave birth to a daughter named Winkie in October 2021, as I was drafting this chapter. In late March 2022, Astriks, another white-cheeked gibbon, had a daughter named Little Ms. Roderick in honor of Chris Roderick, a longtime Center board member who passed away unexpectedly in July of 2021.

"theory of relations" (2016) composed of discrete, self-contained units each with a distinct essence. Autopoiesis, the biological self-making process of "changing to stay the same" (Rose 2006:68) that the SSP facilitates at the level of the gibbon species, is predicated upon the presence of such containments—of not only the interior/exterior boundaries of individual organisms whose maintenance is the task of metabolic processes, but also an ontological distinction between the sorts of labor performable by humans and non-human animals, and further a trust that given the proper conditions living non-human entities will perform like automata, predictably inputting resources and outputting products. The notion of immunity, here, becomes not only a biological principle but also an ethical excuse through which captive breeding program managers can avoid responsibility for the consequences of their pairings by stressing their objective inevitability.[10] Tracing Beldo's argument has brought us full circle.

And as I have shown, the material and conceptual enclosures of autopoiesis and essential natures collapse in practice: what such a commitment to gibbon metabolism and reproduction as processes fundamentally distinct from its human intervention elides is the staggering amount of human effort perpetually necessary to sustain the conditions in which it may occur. Just as this "enclosed apparatus," as Amy Zhang writes in her study of attempts to capitalize upon the metabolic labor of the black fly, "shields from view the labor of care that ensures the reproduction of the insect life cycle" (2020:92), the argument against biopolitical domination mobilized through attention to metabolic labor might here be better understood as a rhetorical

[10] As the major theorist of immunity and biopolitics Roberto Esposito reminds his readers, the very concept of immunity emerged in Ancient Rome as the civic status of exemption from the obligation of reciprocating a form of gift called the *munus* (which provides immunity's etymological root). As Esposito writes, therefore, "immunity refers [both] to a condition of natural or induced refractoriness on the part of a living organism when faced with a given disease, . . . [and] a temporary or definitive exemption on the part of the subject with regard to concrete obligations or responsibilities that under normal circumstances would bind one to others" (Esposito and Campbell 2006:24). Eliding notions of resistance and responsibility, immunity "links the sphere of life with that of right" (ibid.).

strategy that calls attention *away* from the way in which essential boundaries are rendered porous even through the very metabolic processes that establish them (see Yamin 2019). Although committed to maintaining natural biological processes and the purity of the object of conservation (the species), these goals of the gibbon SSP are thus only achievable—conceivable, even—through the constitutive addition and contributions of human labor and knowledge. Even if individual gibbons are able to be managed in a hands-off way (e.g., as they would live "in the wild," [see Palmer and Malone 2018]), the species that the SSP cares for, like Alex Blanchette's "herd" that, rather than individual animals, is the object of intervention by hog farm managers (2020), cannot be said any more to consist solely of gibbon biology; as Blanchette writes of the industrial pig, an animal whose "biology . . . is not contiguous with its body," rather, "it requires expanding arrays of labor to survive" (2020:124). If a species is a form of life capable of being sustained over multigenerational time, then the material and semiotic infrastructure that affords its continuity is as much a result of human labor as it is of gibbon labor—and both realized by means of sounding and listening.

Throughout this chapter I have foregrounded the Center staff's understandings and descriptions of the gibbon pairings to complicate those problematic convictions, but here I want to emphasize that this strategy is more than narrative. The intensely "naturalcultural" (Haraway 2008, esp. p. 147) character of gibbon conservation means that no matter how much conservationists might attempt to manage gibbon lives in captivity so that they mirror the way gibbons are understood to behave "in nature" (Palmer and Malone 2018), the human contributions to the state of both gibbon species and captive individuals are constitutively, inextricably entangled in gibbon biology and sociality. But rather than the result being, as in Foucault's theorization of human biopolitics, a situation in which the managed subjects have

been disciplined to internalize these mechanisms of power to the point that active surveillance is no longer necessary, at the Center this continuous concern for gibbon welfare requires caretakers to achieve a staggering degree of understanding of the minutiae and nuances of the animal lives they are responsible for. The caretakers' investment in understanding the audible dimensions of gibbon pair-bonds is not a quirk or a byproduct of their skill, but rather a necessary technique to ensure gibbon flourishing. In the introductory chapter, I described a situation in which the duetting coordination of a mated pair of pileated gibbons broke down in parallel with their pair-bond, leading to a potentially lethal situation only prevented by the caretakers' aural ability to hear its approach ahead of time. Vocal coordination requires continuous attention because the social relationship it constitutes is equally precarious, never assured. Precisely those categories, structures, and functions taken by the SSP to be natural, and therefore in need of preservation, are those assembled and reassembled in the very processes of gibbon conservation.

Instead, both living gibbons and their species are dependent on nothing less than complex and painstaking acts of multispecies audition both physical (as the practical work of placing living animals in particular reproductive configurations and monitoring their daily wellbeing, of teaching and practicing) and conceptual (as the intellectual work of developing and implementing the analytical techniques through which genetic resources can be understood and pairings calculated, or determining just what sorts of vocalizations deserve a species-specific response). At the Center, the perpetuation of gibbon lives and species in the face of existential threats to their survival is, just like the state of "liberation" Paolo Freire describes in *Pedagogy of the Oppressed*, "not a gift, not a self-achievement, but a mutual process" (2000:7).

And so even the biopolitical concept of "fostering," with all its connotations of an autonomous object nurtured by yet ontologically distinct from the subject performing the action,

itself occludes the fact that in practice, the SSP's project of matchmaking proceeds by bringing together the labor and contributions of heterogeneous entities its own justification presents as mutually exclusive. In this sense the mistranslation of Foucault might be closer: not *making live*, however, in the sense that its object is hooked up to life support upon which it wholly relies, but rather collaboratively *making life*. In the context of a program whose raison d'être is enforced procreation, perhaps this insight is banal. But by "making life" I mean not only the biopolitics of "making more gibbons the old-fashioned way," as one Center board member put it in a memorable scene cut from *The Center*, yet screened multiple times in an earlier form entitled *Violet is Blue: A Tale of Gibbons and Guardians* (2019). In her ethnography of protein crystallography laboratories, Natasha Myers poses the question, "what is life becoming in protein modelers' hands?" (2015:5). Myers' answer is that rather than representing a set of objective facts wholly distinct from their representations, models of proteins emerge from affective and embodied collaboration between humans and nonhumans (molecules) in which the former are "molecularized" (2015) as much as the latter are anthropomorphized; biology itself, in other words, is perpetually transformed in the very process of attempting to pin down its details. And what I have emphasized here is the way in which the gibbon SSP—at once a reactionary project of containment and a radically innovative venture reliant upon the contributions of multi-species labor, technoscientific expertise, and auditory culture that are anathema to its own purported ambition—mobilizes both these convictions simultaneously. The species as both a biological concept and a material collection of organisms is remade through the very strategy designed to prevent its remaking.

Postscript: gharmony as shaggy dog story

Multispecies theorist Karin Bolender recognizes the pun's power as a vehicle for making (and unmaking) nothing less than the world itself. In her profound, moving account of an intimacy developed between herself and a particular member of the species *Equus asinus* over the course of what she appropriately calls their "long-ass journey," Bolender argues that "to embrace the 'low' pun is to harness the power of its precarity and radical possibilities for rethinking the hold of language on material, epistemological, and political matters" (2020:89). And indeed, puns have proven surprisingly crucial not only for translating to the public the work of conservation projects like the gibbon SSP, but also the intellectual project of multispecies ethnography itself, in which scholars have called upon animal puns to do a hefty amount of intellectual work. Particularly relevant throughout this dissertation is Sarah Franklin's "scholar-sheep" (2007:9) on Dolly, the first cloned sheep, in particular her monograph, *Dolly Mixtures*, whose punning reference to a British confection nicely captures the work's overall thesis on cloning as an act of material and semiotic recombination rather than technoscientific progress.

Yet Bolender goes beyond simply invoking animal puns to offer an explanation for their efficacy: for Bolender, a pun's "radical possibilities for rethinking the hold of language on material, epistemological, and political matters" (2020:89) are a function of its ability to flatten the topology of a multispecies playing field distorted by the implicit superiority of a uniquely human *logos*, by subverting a phoneme's conventional meaning in favor of its purely material affinities and sympathetic resonances with other sonorities. "Oh, those associative assonances!" Bolender writes (ibid.) in stunningly apposite prose. The efficacy of a pun like "gharmony," according to Bolender's approach, thus turns on its capacity for association, its ability to reveal a

clear, if fleeting, latent *compatibility* between a multiplicity of ostensibly separate, alienated terms. The very claim that motivates puns and captive breeding programs alike, that matches (whether between concepts or bodies) are found rather than made, shows that the use of "gharmony," in the articulations it makes between the sonic and the social, animal breeding programs and human dating services, and the law of acoustics and evolution, follows precisely the same epistemology of compatibility of reproductive matchmaking as does the physical pairing of two living animals.

Considering the pun to represent the consummation of a pre-existing, natural affinity is but one approach, however, and in a forthcoming autoethnographic essay on a repatriation project involving an extinct Balinese musical instrument, I experiment with another: the genre of joke known as the shaggy dog story. "Essentially a trick which is pulled on the listener after he has endured a drawn-out, ridiculous, seemingly pointless narrative," writes folklorist Jan Harold Brunvand, shaggy dog stories end with an "outrageous" (ibid.:44) pun, "a verbal double-cross . . . usually resulting in a perversion of a proverb or other popular saying which is used as the punch line" (ibid.). "By laying down connections," I write, by "weaving a web of captivating plotlines, and building in complexity and scale, shaggy dog stories draw the listener deeper in by promising a resolution commensurate in scale with the complexity of the narrative—before abruptly terminating in an anticlimax whose meaningless impact is made only more powerful by the intricacy of its setup" (forthcoming). By attending to a profoundly anticlimactic moment in which a major interlocutor rejected the repatriation project's results and premises, my essay explores the capacity of shaggy dog writing to put critical pressure on the values and assumptions that motivated the project, opening a space in their collapse for a self-reflexive critique of both theoretical justifications and their potential repercussions. Moreover, those

problematic values are revealed to be precisely those that make possible the shaggy dog story: an investment in accumulation and the pathologization of loss burst in the meaninglessness of the punchline. I theorized that process as what anthropologist Roy Wagner, discussing myths told by the Daribi people of Papua New Guinea, calls "obviation" (1978), a narrative process through which over the course of the story, the underlying commitments of the original premises are turned inside out, their natural underpinnings exposed as artifice. Shaggy dog stories are self-obviating narratives.

(g)harmony, too, might be considered a sort of shaggy dog story. In this chapter and the previous one, I took critical aim at both the general notion of harmony itself and its metaphorical presence in the captive gibbon breeding program as both an ideological formation and the source of its algorithmic calculations, in particular problematizing the assumptions that both reflect something about the natural order of things and are therefore above, or exempt from, issues of politics. But by focusing ethnographic and theoretical attention on the material and conceptual processes that constitute programs of compulsory reproductive matchmaking among captive animals, I highlighted harmony's complicity in performing what philosopher Mary Beth Mader calls a "sleight of reason" (2011), in particular what Pierre Bourdieu describes as the slippage from a descriptive "model of reality" to a prescriptive "reality of the model" (1990:39).[11] Yet this ontological subterfuge was exposed by attending to the practices through which that ostensibly natural model is implemented, revealing instead that the very categories, units, and scales taken by gibbon conservation to be prior to intervention and in need of defense are precisely what are

[11] Although Bourdieu's famous phrase seems to perfectly characterize the situation I have addressed over these past few chapters, a closer reading makes this suitability questionable. Bourdieu characterizes the "model of reality," the value-free description, as "what recurs with a certain statistically measurable frequency" (1990:39). In the previous chapter, I made it clear that such statistical normalization has its own history and as such is not purely descriptive but rather imposes demands and erasures on the data it processes.

created in the process, even more ironically by the sorts of collective affiliations that cut across various material and epistemological categories that gibbon conservation attempts to keep separate. That which harmony takes not only to be natural, given, and prior to involvement, but also to be preserved and protected from exterior influence, is precisely that which is made over the course of its implementation.

In this chapter and the last I have shown that rather than constituting the realization of a latent harmony composed in advance upon something like Uexküll's "score of Nature," at the Center, compatibility, and the species continuity it engenders, is instead achieved through perpetual effort exerted by human and gibbons alike. Whether demonstrated through the effort each gibbon pair exerts in order to develop and maintain their pair-bond, or through the auditory struggles of both gibbons and human conservationists to establish the nested categories through which particular bodies or sounds might be deemed compatible, the possibility of the various forms of reproduction crucial to the survival of gibbon lives and species is nothing but "the result of *work*," as Stefan Helmreich writes, "of labor that, when done well, produces a sense of seamless presence, presence we should not take for granted but rather should inquire into as itself a technical artifact" (2015:226). The justification for the "violent-care of captive life" (van Dooren 2014)—the ideology of harmony in which certain forms of suffering come to be seen as not just necessary but natural and inevitable—collapses. Instead, I have sought to make audible something that the Center staff know intuitively: that rather than ontologically pre-existing its realization, at the Center sonic and social compatibility is something always in the middle of negotiation between heterogeneous actors: a process, in other words, of gibbon take.

Chapter Five

"GIBBONS GO AWAY!!": Sonic NIMBYism in Theory and Practice

On 17 April 2021, a protest made the local news. A short segment on KSBY 6, the television station covering California's Central Coast, devoted a few moments to replaying shaky smartphone video of the event: a handful of adults, standing on the side of a public road in the Parkhill neighborhood of Santa Margarita, displaying their hand-made signs.[1] "KEEP PARKHILL PEACEFULL [*sic*]" is written on one in capital letters, surrounded by drawings of hearts and peace signs. Another, however, is less positive. "APE = Biohazard," it reads, with smaller text beneath: "STOP the LIES." "NO APES in CAGES," reads a third. Finally, the camera pans across the protest to reveal one more, direct in its message: "GIBBONS GO AWAY!!"

As the news anchor explains, these individuals had gathered to protest the imminent arrival of the Gibbon Conservation Center ("the Center"), which was in escrow for a nearby property and planned to relocate there from Southern California. "Not in my front lawn," as one of the signs reads. This statement, and its more popular variant "not in my back yard" (NIMBY), has become a widespread term that characterizes local resistance to change. In a 1992 essay, Michael Dear, who introduced the term to sociology in 1982 in a monograph co-authored with S. M. Taylor, writes that "NIMBY is the motivation of residents who want to protect their turf. More formally, NIMBY refers to the protectionist attitudes of and oppositional tactics adopted by community groups facing an unwelcome development in their neighborhood" (Dear 1992:288). Focusing on the treatment of sound in such occurrences, in this chapter I explore

[1] This television segment is viewable online here: https://www.ksby.com/news/local-news/community-members-protest-proposed-gibbon-conservation-center-in-santa-margarita.

what I call the "sonic NIMBYism" enacted by the Parkhill residents. I focus on the situation's multiple layers of irony, in which precisely the property of gibbons most loved by caretakers and emphasized in popular conservation discourse—their songs—became the justification for the Center's rejection. Considering the use of acoustic criteria to justify such exclusion, I examine the presence and consequences of sonic NIMBYism in theory and practice: not only in the context of the Center's relocation, but also in several areas of scholarship located at the intersection of sound and ecological justice. Whereas each of the previous chapters has explored ways in which sound and listening have conditioned various aspects of gibbon conservation, from affective multispecies engagements to the conceptualization and enforcement of compulsory reproductive biopolitics, here I consider sound's potential to frustrate the very possibility of gibbon conservation.

But first, some backstory: the Center's planned relocation was forty-five years in the making. Gabi told me that Alan Mootnick, the Center's late founder (see Chapter 2) had purchased the current site in Saugus, now part of the city of Santa Clarita, for a specific reason. In the 1970s, Alan had established a small zoo in the San Fernando Valley, but his neighbors began registering complaints about the gibbon vocalizations (Interview, 6 January 2022). As a result,

> he needed to find a place very quickly. And he was, you know, driving around, [and] found this piece of land where there's nothing. No one's here. The land was developed; it was probably like a car shop, [with] a house and a well. Everything was here, but there were no neighbors. (ibid.)

Alan did not deliberately choose to found a Gibbon Conservation Center in Saugus, but rather only purchased that location out of expediency while under pressure.

For Alan, the appeal of 1970s Saugus lay in its emptiness.[2] Gabi clarified, however, that he never intended for it to be the Center's permanent home. In particular, Saugus's climate is far from ideal for both gibbons and human caretakers, with temperatures that swing from below freezing to well above 100 degrees Fahrenheit. Some of the issues are addressable; for example, the arid climate is countered with a misting system that keeps the gibbon enclosures cooled and humidified (at least when the pump is running, well water is available, and the plumbing is not broken). Others, like the seasonal Santa Ana winds that bring down trees and power lines, or the nearby brush fires that require a near-constant readiness for evacuation, are less manageable. Alan, as Gabi recalls, was perpetually in search of a more suitable location. She remembers accompanying him on visits to locations in Ventura County, but a combination of affordability, location, and more pressing concerns prevented him from ever going through with a purchase.

Then, in 2011, Alan passed away suddenly with an undiagnosed heart condition. Although he left detailed instructions for the management of the Center's gibbons in case of his death, as well as minutiae such as the provenance of various pieces antique furniture he collected, Alan had not made a will. Ownership of the property consequently reverted to Alan's next of kin, who promptly began charging the Center rent. While this financial imposition added to the plight of an organization struggling to continue after the heartbreaking loss of its central figure, the Center's leadership found a way to offset the costs—in particular, by opening the Center to the public (something Alan had never done) and charging admission. Yet the terms of

[2] Numerous scholars (e.g., Tsing 2012; Lempert 2021; Franklin 2007; Liboiron 2021) have commented on settler colonialism's treatment of land as "*terra nullius*"—empty space ripe for resource extraction, often achieved by displacing its Indigenous inhabitants. Saugus is located on the unceded territory of the Tataviam-speaking people (see Champagne and Goldberg 2021), whose lifeways were irrevocably affected by the establishment of the San Fernando Mission in the late 18th century. Yet Alan, as far as I understand, was not attempting to claim ostensibly empty space as much as he was trying to find an accessible location in which the inevitable gibbon sounds would be the least imposing on others.

the lease were clear: after negotiating one successful extension, if the Center wished to continue its mission past July 2021, it would need to do so at a different location.

At the same time, the rural setting Alan had originally found so appealing had changed; in 1987, Saugus was incorporated into the new city of Santa Clarita in the midst of residential construction that expanded closer and closer to the Center. This development is mentioned in a major work of sound studies scholarship—in *Acoustic Territories* (2012), Brandon LaBelle uses the nearby community of Valencia's planned neighborhoods, each designed to accommodate occupants with specific and distinct lifestyles (e.g., one for nuclear families, another for elderly residents), as a case study of the way in which strict noise abatement policies attempt to "eliminate the chance for confrontation or disruption" (2012:58). The city also surfaces in Kyle Devine's examination of the environmental impact of the record industry (2019), as located just six miles down the road from the Center from 1957 to 2003 was one of the country's largest facilities manufacturing PVC for pressed vinyl records. In a petrocapitalist industry already notorious for its toxic emissions, the Keysor-Century Corporation opened directly across the street from Saugus High School (whose alumni were subsequently enrolled in a study testing adolescents' exposure to known airborne carcinogens [Ziskind et al. 1981]). A "felonious pollutant" (Devine 2019:109), Keysor-Century habitually discarded its contaminated wastewater into wells connected to the city's aquifer, until they were fined and shut down by a joint EPA and FBI taskforce for falsifying their environmental reports (Holt 2017). During my fieldwork in 2019 and 2020, construction noises from nearby housing projects were omnipresent, and Gabi told me of a city plan to extend a water pipeline several miles past the Center, which was designed intentionally larger than necessary to accommodate future high-density housing in the area (Interview, 6 January 2022).

During this period of growth, however, the Center became increasingly seen in the eyes of the city as an imposition. Indeed, their conditional use permit was amended during a renewal process to prevent any expansion or construction, thereby denying the Center's hope to build in the large area zoned as a parking lot housing for volunteers, a library, and classrooms (ibid.). As they reached the end of their lease, then, the leadership of the Center understood their relocation to be at once compulsory and desirable, necessary for the flourishing of the gibbons, their caretakers, and the surrounding community. But with little income beyond the tours and several small grants, the Center had nowhere near the funds necessary to purchase property elsewhere in California.[3] To remedy this, the Center began a grassroots crowdfunding campaign.

Only several months into fundraising, the COVID-19 pandemic began. The statewide lockdown, amplified by concerns over the virus spreading to the gibbons, meant not only closing the Center to the paying public but also losing the labor contributed by volunteers like myself. Granting agencies withdrew their support, while California real estate prices skyrocketed. Potential relocation sites—requiring a rare combination of proximity to the Pacific coast, size, and zoning options—were sold before the Center could put together enough money for a down payment. In one memorable occurrence, the Center managed to make an offer on an appealing site north of Santa Barbara, but despite the owner's interest in the Center's mission it was turned down in favor of a higher offer, and then listed for sale again only several months later at an unattainable price point.

A year into the pandemic, the Center had raised nearly $300,000, which was enough to make an offer that was accepted on a location in San Luis Obispo County, roughly one hundred

[3] Licenses to operate research facilities like the Center are granted by agencies operating at the state level; the decision to remain in California was based on a desire to avoid the complexities of applying for the various permits and licenses in a different state.

miles north of their Saugus location. The Center staff's enthusiasm was palpable: the property had everything they were looking for. The presence of two kitchens meant that the gibbons could have a dedicated space for the preparation of their food. No longer would the entire staff need to share a single bathroom. "While it has taken a lot of searching the perfect property has finally been found in Santa Margarita," the Center announced in an email message to its mailing list, citing "26 Acres (plenty of space for the gibbons), Workshops for building and repair, Housing for Interns, 2 Greenhouses, Fruit Orchard (27 trees on a drip system), Solar power, [and] Numerous storage sheds" (email to mailing list subscribers, 9 March 2021). As Alma, the Center's operations manager, put it in a virtual interview for a KSBY piece announcing their escrow, it "seems just perfect" (Bertola 2021).

Sonic NIMBYism version 1: "Like roosters on steroids"

The response from the nearby residents, however, was less enthusiastic. As one member of the local community makes clear in an opinion piece for a local newspaper, they took issue not only with the nearby presence of an animal facility in general, but more specifically with the gibbons' vocalizations.:

> Imagine that a new neighbor moves in with an obnoxious rooster that crows night and day without stop. Now imagine that your neighbor moves in with 40 obnoxious roosters with the intent to breed more of them. Well folks, it turns out there is an animal louder than a rooster and it's called a gibbon. . . . They are the loudest animals on planet Earth! They greet the sun each day and begin to howl. This continues throughout the day and night. . . . These animals are like roosters on steroids. (Hobbs 2021)

In this article and other expressions of the community's concern, the volume of the gibbons' vocalizations serves as an inflection point around which other accusations, with varying degrees of spuriousness, are leveled. The Center is described as an "exotic animal roadside attraction" (Hobbs 2021), the gibbon enclosures as "glorified bird cages" (ibid.). Another

resident's open letter, published in the Santa Clarita Valley news outlet *The Signal*, phrases this concern with slightly less vitriol. "Residents of Parkhill Road make many compromises and adjustments to reside in the beauty and country quiet that is an attraction of this area, . . . not to reside next to a zoo of screaming gibbons, increased traffic, trash and dust" (LeBoeuf 2021).

Replying in the *New Times* to the letter entitled "Roosters on Steroids" (Hobbs 2021), the Center expressed its desire to have "an honest conversation" with the Parkhill community. This short piece, authored by Gabi, clearly and concisely addresses their concerns about noise, congestion, and animal welfare with only a minimum of snark ("For someone who claims to have the interests of the animals at heart, this concerned citizen certainly seems to have a great deal of disdain for them" [Skollar 2021]). Gabi, however, did not have the final word—public comments on the letter's *New Times* webpage proliferated, making clear what was at stake. "The real issue," writes a user the same day as the letter was published, "is the noise that the apes generate. . . . Ms Skollar may prefer to describe the noise as 'songs' or 'singing', but like the heavy metal rock coming through my wall from my neighbor's place, it is not something that most of us want to listen to" (John Donegan, 22 April 2021; *sic* throughout). Gibbon song is unwanted noise, according to this position; its dissimilarity to music requiring the use of scare quotes.

The next day, a post from a user with the handle "Silence Dogood" reiterates this negative evaluation of gibbon song: "I know! Let's play loud heavy metal music to the gibbons while they 'sing'. Slayer and Megadeth with gibbons screeching along with the songs" (23 April 2021; *sic* throughout).[4] The post immediately continues with a statement that makes clear its

[4] The fusion of heavy metal and animal vocalizations mocked in this sarcastic proposal has already been explored by the grindcore bands Hatebeak and Caninus, which respectively feature parrots and pitbulls as their vocalists. This just proves David Novak's argument that noise is "not really a kind of sound but a metadiscourse of sound and its

author's political leanings: "We can record it and play it during Joe Biden speeches about climate change and peaceful immigration and social justice. Bet you that's something that will 'unify' all of us" (ibid.). The pseudonym Silence Doogod was famously used by Benjamin Franklin in 1722 to express his opinions in a local newspaper; at once advocating for the absence of noise (silence), and grounding this reactionary politics with reference to one of the United States' founding fathers, this choice of username is particularly apt.

In a subsequent comment, the 21st century Silence Dogood continues infusing gibbons into a litany of right-wing talking points. Replying to another commenter "wish[ing that] this area was more open-minded" (Dave Pecci 24 April 2021), they write, "Soon in California you will be able to cohabitate, enter into the sacrament of marriage, plan a gender-neutral family and protest against organized religion with your gibbon. Joe Biden will fund all of this on the backs of those closed minded, working, traditional thinking bastards that brought you this country and the freedom to be so 'open minded' without persecution" (26 April 2021). And although this statement, which quickly devolves into anti-trans hate speech, was rebutted by other posters and eventually received a high ratio of dislikes to likes (6 likes and 22 dislikes as of 21 April 2022), claims equating gender transition surgery with mutilation apparently did not qualify according to the *New Times*' comment policy, specifically that "comments that are irrelevant or incendiary will be deleted."

Incendiary, definitely. But not irrelevant. Rather, this pseudonymous user's elision of sonic values and reactionary politics is perfectly indicative of the way sound is conceptualized, and justified, by activists and scholars committed to working towards ecological justice through

social interpretation" (2015:126). "The aesthestics of noise," he emphasizes, "correspond to different cultural valuations of sound, and reflect historical shifts in discourses of musical innovation" (2015:127).

attention to the acoustic. The two positions seem as though they could not be more different. Justifications for gibbon conservation are habitually grounded in aesthetic descriptions of gibbon song; one recent field report from Laos, for example, characterizes white-cheeked gibbon song as "beautiful and informative" (Association Anoulak 2021). But in this chapter, I argue that what comes across as a clash of subjective interpretations regarding the value of gibbon song highlights instead the problematic slippage between the aesthetic and the prescriptive that characterizes acoustic ecology and zoömusicology, two approaches to more-than-human sound in which gibbon song is regularly invoked. What the Parkhill residents' reactions to the Center's relocation make clear is not only the fact that gibbon song poses a problem for the ability to practice gibbon conservation, but also that sonic justifications for gibbon survival are grounded in the same concerns: what Banu Subramaniam describes as a "xenophobia rampant in a changing world" (2014:121). To demonstrate this point, I pause the story of the Center's relocation and interrogate the widespread concept of the "soundscape."

Sonic NIMBYism version 2: Sonic segregation

In his 2012 book *The Great Animal Orchestra*, Bernie Krause credits an experience of listening to gibbons at the famous Camp Leakey in Borneo as formative in the development of his "acoustic niche" theory, which understands acoustic communication to be key driver of evolutionary change. "In biomes rich with density and diversity of creature voices," Krause explains, "organisms evolve to acoustically structure their signals in special relationships to one another. . . . Natural selection has caused the animal voices that occur in many undisturbed regions to appear 'organized'" (2012:97). Elsewhere, he speculates:

> When organisms that could produce and receive sound first appeared, each type evolved to establish a clear bandwidth in the geoacoustic spectrum for its vocal behavior to be functional—these organisms needed sound-free channels in order to exchange vital information. . . . But when living organisms became more numerous and began to fill acoustic niches in their respective habitats, their voices necessarily had to adapt through partitioning, so that each one could transmit and receive signals unimpeded in the specific time or range necessary for their survival. (2015:19, 21)

This is essentially a sociobiological (see Chapter 3) account of bioacoustics: it occurred because "efficient uses and conservation of energy were paramount" (ibid.). Krause emphasizes that this sonic organization does "not happen arbitrarily: each resident species acquires its own preferred sonic bandwidth—to blend or contrast—much in the way that violins, woodwinds, trumpets, and percussion instruments stake out acoustic territory in an orchestral arrangement" (ibid.:97). Making use of a sonogram of the Bornean soundscape that shows how each species' vocalizations occupy a unique range of frequencies, Krause emphasizes that the pitches of the gibbon calls, reaching around 1khz, peak just below the lowest of the Malaysian eared-nightjar's birdsong; the chestnut-winged babbler sings in the 5khz range, while cicadas occupy frequencies that seem almost deliberately placed in the empty spaces between the avian and mammal vocalizations. "Their duets can cover more than three and a half octaves," Krause writes, "yet remarkably the gibbon voices become a perfect fit within the rest of the biophony" (ibid.:93).

The aural corollary to Krause's evolutionary claim is that the degree of ecological organization can be assessed by listening to the relationship between the various sounds occurring in a given location. A healthy, biodiverse environment is one wherein its various sounds stay on their own "acoustic turf" (ibid.); frequency overlap, conversely, is a sign of environmental trauma, degradation, or violation. Such sonic interference is the target of complaint in R. Murray Schafer's influential monograph that introduced the term "soundscape" (1993 [1977]). Speculatively tracing the sounds of the planet Earth from the advent of life to the

present day, Schafer contends that the history of the planet is characterized by a steady increase in decibel levels. This is a unilaterally bad thing: "today the world suffers from an overpopulation of sounds; there is so much acoustic information that little of it can emerge with clarity" (ibid.:71). Such a generalization, supported by claims that run from the reductive[5] to the outright racist,[6] misses what Emily Thompson emphasizes by presenting the title of her book, *The Soundscape of Modernity* (2002), in the singular; namely, that the apparent homogeneity of contemporary global life is a symptom of the very processes Schafer attempts to critique. Reading past the eye-opening statements and charts that reduce the entirety of human history to a statistically measurable increase in volume levels, however, is a profound claim, one seized upon by generations of acoustic ecologists and that work like Krause's (e.g., 2012) seeks to justify. Sounds do not only index undesirable change, Schafer stresses, but also can act as "noise pollution," directly interfering with the processes necessary for the flourishing of life at both individual and global scales.

In a 1984 work dedicated to Schafer, for example, Barry Truax introduces the concept of the "acoustic community." For Truax, this is an inclusive term accounting for "any soundscape in which acoustic information plays a pervasive role in the lives of the inhabitants (no matter how the commonality of such people is understood)" (1984:58). Using the village of Dolar, Scotland, as an example, Truax locates the auditory presence of church bells, train whistles, and industry: their rhythms allow inhabitants to experience the flow of time and develop a sense of

[5] "While listening to stonemasons' hammers . . . in Teheran [*sic*], I suddenly realized that in all earlier societies the majority of sounds were discrete and interrupted, while today a large portion—perhaps the majority—are continuous" (Schafer 1993[1977]:78).

[6] In a section complaining about the noise generated by internal combustion engines, Schafer remarks that the "cities of gems and germs like Istanbul and Isfahan had also become cities of incredible traffic jams. . . . In order for a society to obey traffic codes it must have survived two important experiences: the Industrial Revolution and mechanized warfare. Americans can still drive on the 'belt' road . . . around Washington with great adroitness, but the Asian still drives his car as if it were a camel or a mule" (1993[1977]:83). For more on Schafer's racism, see Robinson (2020).

place. “Sound signals, and the information they convey, bind the community together and contribute to its character. Whether the force of their action is ‘centripetal’ in calling people together, or ‘centrifugal’ in warning them to stay clear of danger, their psychological power is a positive reinforcement to the community” (ibid:61). At stake in the continued availability of these sounds is the very preservation of the acoustic community’s way of life (cf. Post 2021). The parallels with the popularly theorized functions of gibbon song—territorial defense and social bonding—are uncanny (e.g., Chivers 1976; Cowlishaw 1992; Geissmann 2000; Ham 2016).

Sometimes, as is the case for the gibbons of Central Kalimantan, Indonesia, noise pollution and environmental pollution are intertwined. During the island’s annual dry season (September–November), millions of hectares of deforested, drained, and abandoned peatland catch fire and blanket much of Southeast Asia in a toxic haze. Susan Cheyne demonstrates a correlation between decrease in air quality and decrease in the duration and frequency of gibbon song; “reduced singing for several months a year [when singing is normally at a peak],” she concludes, “could be detrimental for territorial spacing/defense, communication and, ultimately, reproduction” (2007:391).

A crucial observation regarding the relationship between noise pollution and environmental pollution was made by Douglas Adams (author of *The Hitchhiker’s Guide to the Galaxy*) on the basis of a visit to China in 1988 (published 1990). Although the plight of marine mammals has been an object of recent ecomusicological attention (e.g., Pedelty 2016), Adam’s reflections on the epistemological and ontological valences of sound and music as a tourist anticipates the theoretical work undertaken in sound studies decades later (e.g., Ochoa Gautier

2016).[7] Here, I simply attend to his reason for visiting the country, which was to experience firsthand the plight of the endangered Yangtze river dolphin, or *baiji*.[8]

Adams frames the issue in Schaferian terms: "Since man invented the engine, the baiji's river world must have become a complete nightmare" (ibid.:155). As he explains, these dolphins, rather than navigating through their river home by sight, obscured as it is by soil erosion, find their way through echolocation. With their echolocation disrupted by the noise of marine engines, "the dolphins are continually being hit by boats or mangled in their propellers or tangled in fishermen's nets" (ibid.:156). In an empathetic move, Adams attempts to inhabit the earpoint of these creatures. Rather than hear what life would be like for the dolphins under "pristine" or "natural" conditions, his goal is to experience what it is like at the current moment, something he speculatively likens to "a deaf man living in a discotheque, . . . all the stroboscopic lights and flares and mirrors and lasers and things" (ibid.).

After a self-deprecating account of an attempt to obtain condoms with which to waterproof his microphones, Adams describes the result of listening to a recording made under the surface of the Yangtze River:

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[7] For example, Adams observes a hotel band in Shanghai's audience seeming to enjoy covers of Western standards in a manner he admittedly struggles to appreciate. Rather than simply dismissing this performance as substandard, Adams remarks that the audience "was obviously hearing something very different than I was hearing and I couldn't work out what it was" (1990:154).

[8] Writing with the same dry sense of humor that characterizes his works of fiction, Adams introduces the situation as follows:

> In the middle of one of the biggest, longest, noisiest, dirtiest thoroughfares in the world lives the reincarnation of a drowned princess, or rather, two hundred reincarnations of a drowned princess. Whether these are two hundred different reincarnations of the same drowned princesses, or the individual reincarnations of of two hundred different drowned princesses, is something that the legends are a little vague about, and there are no reliable statistics on the incidence of princess-drownings in the area available to help clear the matter up. If they are all the same drowned princess, then she must have led a life of exquisite sinfullness to have the conditions of her current lives repeatedly inflicted upon her. Her reincarnations are constantly being mangled in ships' propellers, snared in fishermen's nets full of hooks, blinded, poisoned, and deafened. The thoroughfare in question is the Yangtze River, and the reincarnated princess is the baiji, the Yangtze river dolphin. (1990:145)

> The sound we heard wasn't exactly what I had expected. Water is a very good medium for the propagation of sound and I had expected to hear clearly the heavy, pounding reverberations of each of the boats that had gone thundering by us as we stood on the deck. But water transmits sound even better than that, and what we were hearing was everything that was happening in the Yangtze for many, many miles around, jumbled cacophonously together. Instead of hearing the roar of each individual ship's propeller, what we heard was a sustained shrieking blast of pure white noise, in which nothing could be distinguished at all. (ibid.:166)

Once again echoing Schafer, Adams is describing the ultimate "lo-fi" soundscape, one in which "individual acoustic signals are obscured in an overdense population of sounds" (Schafer 1993 [1977]:43). Lo-fi soundscapes, which are contrasted with "hi-fi" soundscapes characterized by "a favorable signal-to-noise ratio" (ibid.), are undesirable: when "the pellucid sound . . . is masked by broad-band noise," Schafer complains, "perspective is lost" (ibid.). But as much as Adams' insight makes audible how detrimental the anthropogenic loss of auditory perspective is for the baiji (which have gone extinct in the intervening decades), it also lends weight to Andrew Eisenberg's claim that "Schafer's soundscape is deeply problematic as a central figure for sound studies." In part, this is because "it groans under the weight of the irony that it is born of the very modern technologies of sound reproduction that Schafer decries as sources of 'lo-fi' pollution" (2015:198). The only way Adams was able to "access" the sonic world of the dolphin was not by shedding the technological and industrialized baggage of modernity but rather by embracing it; the ticket for his profound, empathetic account of river dolphin suffering included (at minimum) use of one of the boats contributing to the dolphins' dystopian experience, as well as the technological innovations that made possible distinct forms of both sound reproduction and human contraception.

The threatening homogeneity of the white noise Adams hears, furthermore, shows how soundscape ecology is committed to the necessity of isolation in at least two dimensions. Recall that for Krause, the ability for sympatric species to occupy distinct acoustic niches is threatened

by the incursion of human activity; the relationship between the mutually exclusive types of soundings that he terms "anthrophony" and "biophony" is described as "oil and water" (2012:179; cf. Pijanowski et al. 2011). More specifically, sonic belonging itself is conceptualized as the claiming of previously unoccupied space; recall that claiming and defending a certain frequency range was an evolutionary necessity. Jeff Todd Titon offers a similar image in his reparative notion of a "sound commons" (2020:245); which is defined by "copresence in the soundscape, with each species communicating freely in its acoustic niche" (ibid.). Krause writes that "when that partitioning occurs, individual voices can be clearly differentiated from one another, and the benefits of their vocal behavior are maximized" (2012:98–99). Rather than sound being something that emplaces heterogeneous entities in a field of mutual vibration (see Chapter 2), it is precisely what "ground[s] difference as apartheid," in the words of Donna Haraway (2004:73). Gibbon song, here, is valued based on the extent to which it keeps to its own "acoustic turf." Both ecology and aurality are theoretically grounded in the necessity of segregation and discrimination (cf. Keogh and Collinson 2016).

In this sense, soundscape scholars' reliance upon normative judgements of belonging is allied with those Parkhill residents who heard the sounds of the Center as an encroachment on their space. Indeed, for Schafer, the value of soundscape listening is the way in which it helps listeners distinguish between desirable and undesirable sounds, those that belong and those that do not. Soundscape listening therefore rests on an unsteady judgement about sonic belonging—not just as a value judgment, but as an ontological judgement that equates a sound's origin with the place in which it should be heard. In *Ghost Stories for Darwin* (2014), Banu Subramaniam unpacks what is at stake in this distinction, through attention to invasion biology (the field concerned with environments threatened by the introduction of non-native species). She argues

that "so long as the category of 'foreign species' . . . exists in our minds, it is still linked biologically, rhetorically, historically, and philosophically to a binary world of natives/aliens" (2014:104). Pointing out that this binary is itself an artifact of colonial ways of distinguishing (and comparatively evaluating) biological and geographical differences that historically legitimized extractive imperialism and settler colonialism, "it would seem that [both] the political right and left have both inherited and indeed embraced the colonial imaginary" (2014:117).

Subramaniam shows that the issue is not as simple as assigning differential values to particular sounds or species; instead, what comes to matter is the thing's perceived origin. These "invasive" species, consuming everything and reproducing at rates far superior to the "native" species they displace, after all "originated" in a certain environment in which their disposition was precisely adapted to maintain ecological balance. The problem motivating this reactionary response to the degradation of a perceived idyllic nature, Subramaniam reveals, is a mismatch between organism and environment, not a blanket judgement about a particular species' value. In a statement echoing Schafer's critique of what he terms "schizophonia," a characteristic of modernity in which "sounds have been torn from their natural sockets" (1993 [1977]:90), one of the Parkhill residents argues that gibbons are "not native to our area. . . . These creatures need access to the forest canopy" (Hobbs 2021). Once again, Silence Dogood's rejection of progressive social issues in combination with gibbon vocalizations is telling: just like "the battle against exotic and alien plants" that Subramaniam chronicles, Parkhill's battle against gibbons "is a symptom of a campaign that misplaces and displaces anxieties about economic, social, political, and cultural changes onto outsiders and foreigners" (Subramaniam 2014:121). As Subramaniam writes, "what is most disturbing about displacing anxieties attending to

contemporary politics onto alien/exotic plants is that other potential loci of problems are obscured" (2014:122). "Ultimately," she continues, "the campaign against the foreign does not solve species extinctions or habitat degradation" (ibid.). By making audible a perceived mismatch between organism and environment, soundscape ecology only provides the theoretical justification with which to demand the gibbons go away (!!).

Sonic NIMBYism version 3: Soundscape necropolitics

The problems with invoking the soundscape as justification for gibbon conservation, however, are more than Eisenberg's apt insight that it is "grounded in normative ideas of which sounds 'matter' and which do not" (2015:198).[9] This is made most clear on a Parkhill meme that was shared on a private Facebook group for residents of Santa Margarita (figure 6.1). "Help!" the image reads. "The loudest animal on the planet is about to become my neighbor. It wakes up at dawn and crows louder than any rooster and continues to crow all. day. long. [*sic*]" Under an unflattering image of a gibbon with fangs extended (which I assume the creator chose due to its connotation of aggression, but actually only occurs while gibbons are singing), taken without attribution from a National Geographic article likening the vocal mechanics of gibbon vocalizations to those of human opera singers (Eichenseher 2012), it continues: "Let's make more noise than these monkeys and tell the [San Luis Obispo] planning department how we feel." The planning department's publicly listed phone number is provided. Leaving aside the fact that gibbons are not monkeys, this meme adds another level of irony to this conflict: its creator proposes to make productive use of precisely the thing they are complaining about: noise.

[9] Other critiques of soundscape ecology have been made by Tim Ingold (2007) and Stefan Helmreich (2010), who takes issue with the way in which it treats sounds as objects rather than processes.

Figure 5.1: A meme circulated on the private Facebook group "Santa Margarita Community Group" in April 2021.

"And they did!" Gabi told me shortly afterward (personal communication, 23 May 2021). Following up in a later interview, she clarified that during a preliminary meeting with the planning department, city officials "politely mentioned" (Interview, 6 January 2022) that they had already received complaints. "They got a bunch of phone calls and letters and everything—like somebody kept calling the fire department to complain about the sound, but we were not even there yet!" (ibid.). Conceptualizing the Center's gibbon chorus as "noise" simply collapses the intricate sonic affordances of gibbon song described over the course of this dissertation into a competition for volume. The solution can only be more of the same.

Volume, in the sense of "abundance," is a prime value of environmental conservation; as Rafi Youatt indicates through the title of his monograph, "counting species" is the prevalent method for enumerating biodiversity. Indeed, as the prominent sociobiologist E. O. Wilson argued, the "luxuriance of biodiversity" (2002:20) is a function of the volume of species present. Conversely, soundscape ecology invokes volume in the context of undesirability. "Man has always tried to destroy his enemies with terrible noises," writes Schafer, "and it is disconcerting to realize that the ferocious acoustical environment produced by modern civilian life derives from the same eschatological urge" (1993[1977]:28). But Schafer's own prose shows that volume and undesirability are two different things. Gibbons, in fact, help make this distinction; early on in *The Soundscape*, Schafer expresses awe at "hoolack [*sic*] gibbons," and their "peak level of 110dBA outside their cages in the Vancouver zoo" (1990:39). Two minutes of exposure to sounds at 110 decibels, to put it in context, is mentioned specifically by the National Institute of Health's educational initiative, "It's a Noisy Planet," as "likely to damage your hearing" (National Institute 2019). Schafer's positive valuation of gibbon song despite its potentially damaging volume gives away the whole game: amplitude is not the problem. Amplitude, rather, is a socially acceptable excuse with which to designate a source as unwanted. Sound, does not index belonging but rather power, in particular the power to determine what sounds are acceptable and which in need of silencing.

Schafer would agree: throughout *The Soundscape*, he levels complaint at the holders of what he calls "Sacred Noise." The sonic equivalent of the "state of exception" (Nazi jurist Carl Schmitt's legal justification for the Third Reich),[10] "to have Sacred Noise," he writes, "is not

[10] The application of Schmitt's concept to numerous examples of contemporary governmentality has most famously been explored by the Italian philosopher Georgio Agamben (2005). But fitting this chapter's theme of reactionary responses that only compound the problem, Agamben himself has become a vocal denier of COVID-19, applying

merely to make the biggest noise; rather, it is a matter of having the authority to make it without censure" (1993 [1977]:76). Writing of the Industrial Revolution, Schafer laments that "now the industrialists held power and they were granted dispensation to make Noise by means of the steam engine and the blast furnace" (ibid.). Sacred Noise is nothing but authority.

Although Schafer uses the concept of Sacred Noise to critique this authority and its abuses of decibel levels, he writes its presence into the fundamental premise of soundscape ecology. "Which sounds do we want to preserve, encourage, multiply?" Schafer asks in the opening pages of *The Soundscape*. "When we know this, the boring or destructive sounds will be conspicuous enough and we will know why we must eliminate them" (1993[1977]:4). This is precisely Achille Mbembe's definition of "necropolitics," in which "sovereignty," following Frantz Fanon, "means the capacity to define who matters and who does not, who is disposable and who is not" (2003:27). Recall the connection, made in Schafer's own writing, between the production of sounds and the possibility of reproducing of the social and biological systems from which they originate. At stake in the differentiation between signal and noise is nothing less than a eugenic operation: the determination of which forms of life deserve to be encouraged and propagated, and which deserve to be extinguished.[11]

Schafer makes this eugenic position explicit not only in his characterization of the contemporary world, already introduced above, as an acoustic "overpopulation" (1993[1977]:71),[12] but more deeply in his description of his project as "the tuning of the world"

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his 2005 critique of totalitarianism to pandemic lockdowns in ways that have emboldened right-wing politicians and anti-vaxxers (see Kotsko 2021).

[11] For Subramaniam, eugenics is "less about a clear set of scientific principles than a 'modern' way to discuss social problems in scientific terms" (2014:22); at root it is "the logic of which bodies are rendered desirable and worth living, which bodies are controlled or eliminated" (ibid.:61; cf. Murphy 2017).

[12] As Michelle Murphy makes clear in *The Economization of Life*, the analytic of population "offer[s] an epistemological framing of life that was profoundly objectifying and dehumanizing. It facilitated a distanced and managerial gaze toward optimizing the life and death of brown and black bodies as rates over time in need of adjustment. The entwined histories of colonialism, governmentality, and capitalism are very much persistent in

(ibid.). The act of tuning, as Sumanth Gopinath and Jason Stanyek demonstrate in their article analyzing a Nike advertising campaign in which runners are given the option to "tune your run" (2013), is profoundly biopolitical. Just as Foucault writes, the goal is to achieve a state in which "the different parts . . . are in agreement and harmony, when the part that commands and the part that obeys are at one in their recognition that it is proper for reason to rule and that they should not contend for its authority" (1990:87). The problem of "overpopulation" uses quantity (i.e., volume) as a euphemism for quality; it is never just that there is too much volume, but rather that undesirability is out of proportion. Schafer—and Parkhill commenters like Silence Dogood—are advocating for nothing less than an acoustic culling.

"Although Schafer seems to be writing about sound, he is actually talking about listening," Ari Kelman insightfully concludes in his critical history of acoustic ecology (2010:217); "*The Soundscape* is a prescriptive text that is often referred to as a descriptive one" (ibid.:214). While Schafer positions his text against the holders of Sacred Noise, in reality it is he himself who possesses it. If a soundscape, following Emily Thompson, is "simultaneously a physical environment and a way of perceiving that environment" (2002:1), then the acoustic ecology position conflates the two.

Perhaps the best testament to the weaponization of noise implicitly advocated for by Schafer, and enacted by the Parkhill residents, is its success: the Center dropped out of escrow. The gibbons went away. Concerns about the gibbons' immediate future were alleviated when at the last minute before the expiration of their lease, the Center was given the option to purchase their current location, using the funds they had already raised. Although as of October 2021 the

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population as a problem space, manifest in the bodies and places that have had to bear the problem of population" (2017:135; see Chapters 3 and 4 above).

Center owns the Saugus property (email to mailing list subscribers, 11 October 2021), the adverse conditions persist and the Center's goal is still to relocate (Interview, Gabi Skollar, 6 January 2022).

Sonic NIMBYism version 4: Musicality beyond the human

One more level of irony: the slogan "GIBBONS GO AWAY!!," in a descriptive rather than a prescriptive sense, would not be out of place at a climate change protest. Gibbons, as species, are already going away. "One of the tragic ironies of the so-called Anthropocene," as Matthew Chrulew points out (2020:137), "is that we have come to learn about the unique, complex worlds of our animal kin only at the same time as recognising that we are causing them to dwindle and disappear. While nauseated," he continues, "by the modern production of mass slaughter, habitat loss, defaunation, endangerment and extinction, we are dizzied by the proliferation of animal cultures and subjectivities, the great variety of nonhuman emotions and intelligence" (2020:137). One field contributing to this dizzying "proliferation" is zoömusicology, in particular scholarship that devotes analytic attention to the implications of human exceptionalism and supremacy expressed in Silence Dogood's insistence upon putting nonhuman "song" in scare quotes. Conceptualizing music as only "humanly organized sound" (Blacking 1973), following this work, renders music scholars complicit in the reduction of the world beyond the human to resources that precipitated the Anthropocene (or better, imagined a world inherently ripe for exploitation save a privileged category called the "human," which historically has not been coextensive with the biological species *Homo sapiens*). For example, composer and zoömusicologist Emily Doolittle writes that "increased awareness of the fragility of the earth's ecosystems has led us to pay closer attention to the intricacy, complexity, and

beauty of the natural world. . . . Ultimately," Doolittle "hope[s] that increased attention to the songs created by individuals of other species will lead us to greater respect of and caring for the non-human beings with which we share the earth" (Doolittle 2017).

In this scholarship, however, gibbons are not given much more appreciation than in Parkhill. Granted, references to gibbon song surface regularly, whether in general surveys or works focused on the sonic dimensions of a particular animal or species. But only rarely is gibbon song itself the focus of scholarship; rather, gibbons are invoked as a foil in order to establish a contrast by which the actual focus—usually birdsong or whale song—distinguishes itself.

In her landmark monograph of the pied butcherbird, for example, Hollis Taylor suggests that "inventiveness in birdsong could surpass biological necessity" (2017:26) "While a peacock is born with an innate ability to grow an elaborate tail," she writes, "a male bowerbird must learn to sing, dance, construct a bower, and execute the other associated tasks required of him in order to achieve aesthetic and functional success. They are not robots, and the results vary" (2012:21–22). And just a page later, Taylor contrasts this ability with that of gibbons: "songbirds make up about half of the world's approximately ten thousand bird species, so distinguished because they learn their song. Intriguingly, this capacity is rare; our closest primate relatives, for example, are not vocal learners. Even the elaborate song bouts of gibbons are innate" (ibid.:23). David Rothenberg, the author of *Why Birds Sing*, apparently agrees: "Although gibbons sing elaborate duets in their trees at dawn," he writes, "they are born with this ability, they do not learn it. Birds and humans share the ability to learn to sing, something no ape can do" (2005:146).

As Elizabeth Tolbert insightfully recognized in her reading of scholarship theorizing the evolution of music, this position also reproduces the values of the sociobiological understanding

of nature as utilitarian. “For music to be transcendent it must be useless, beyond mundane reality, a link to a metaphysical reality; yet to be meaningful, to reveal metaphysical truth, it must surely have evolved to fulfill some cognitive or social purpose, and must therefore be ultimately useful” (2001:453). But “whether ‘useless’ or essential to human life,” she points out, “music’s presence in contemporary evolutionary theories signals that it is deeply implicated in Western understandings of human uniqueness and claims to knowledge” (ibid.:451). Taking songbirds and whales, with their scientifically demonstrated capacities for inventiveness, creativity, uniqueness, and improvisation, to be exemplar models of posthuman musical subjects reproduces a distinctly European, Romantic valuation of music, an exceptionalism that privileges complexity and the capacity to transcend the mundane world of biological functionality.

The boundless inclusivity Dario Martinelli conjures in his longing for “the time when studies of the musical culture of . . . wolves are as common . . . as are studies of Beethoven’s 5th Symphony” (2009:218) is therefore accomplished by directly excluding gibbons and their vocalizations. The general zoömusicological justification for attending to particular non-human musical subjects is fundamentally exceptionalist; birdsong or whale song is a worthy object of investigation precisely because others are not. Gibbons are consequently not so much ignored as conscripted into a project that privileges a particular combination of creativity, mobility, and flexibility—one that foregrounds a distinct capacity for musicality defined against that of the gibbons they purport to describe. Here, the songs of gibbons can contribute to zoömusicology only in the negative; sonic NIMBYism is reproduced in scholarship that ostensibly has the best wishes for animals and environments at heart.

On musical and planetary universals

Lurking behind the zoömusicological question of whether gibbons are musical—whether or not gibbon "song" requires scare quotes—is the concept of musicality itself, and its long history of excluding entire cultures from personhood on the basis of their perceived musical deficiencies (see Ochoa 2014; Mundy 2018). One strategy for avoiding such a linear hierarchy of musical ability was famously implied in Mantle Hood's original proposal for "bi-musicality" (1960). In this call for ethnomusicologists to develop musical "fluency" in the cultures they study rather than just European classical music, musicality is rendered in the plural. The influence of this methodology on ethnomusicology itself is undeniable—not only in the historical development of the field, but also in the way it continues to provide the material from which Denise Gill, for instance, is able to hear an entrance into "multiple, diverse sonic worlds" (2017:114), and describe a "process of shaping and shifting one's ears to different axes, geographies, and idioms of listening" (ibid.). Extending what Gill calls "bi-aurality" to the world beyond the human, then, might offer a distinctly ethnomusicological way to "challenge," as Joshua Tucker puts it, "humanity's self-satisfied self-portrait as the centre of the universe's affairs" (2016:328).

As much as Hood emphasizes the diverse forms in which musicality can take, however, the conclusion to his famous 1960 article "The Challenges of Bi-musicality" offers a contradictory perspective: after demonstrating at length the physical and aural proficiencies that UCLA students develop over the course of their practical studies, Hood collapses bi-musicality's nominal plurality into a singularity:

> At UCLA there are several advanced graduate students who manage themselves quite capably in several different musical cultures. Here then are we to speak of "tri-musicality" or "quadri-musicality?" Perhaps we shall come close to the heart of the matter if we . . . retitle this paper simply to read: "The Challenge of Musicality." (1960:59)

Hood's prose makes it unclear if this reduction to a singular concept of musicality reflected an actual commitment to a universal musicality or was simply a rhetorical move. Regardless of intention, Hood's words mirror those of François-Bernard Mache, the scholar who coined the term zoömusicology and has argued forcefully for a concept of musicality that extends beyond the limits of the biological human: "music in the singular," as he titles an important book (2001). Mache positions his work as an investigation into musical universals that transcend species boundaries, in which gibbon duets are given the same attention as Georgian polyphony, for example. Mache recognizes that claims to universality have political implications: "from Rameau until well into the 20th century," he writes, "Western music has lived on the belief in its own universality. . . . Anything that deviated from these laws was taxed with exotic barbarism or arbitrary modernity" (2001:15–16). For Mache, the issue was simply a faulty understanding of what constitutes a musical universal, not the concept of universals itself.

Here, I want to hold in mind that reliance upon singulars and universals has been suggested as precisely what is needed to intellectually grasp what is at stake in era of gibbon extinction that is the Anthropocene. In an enormously influential 2009 article, Dipesh Chakrabarty asks us, his readers, to perform the thought experiment proposed by Alan Weisman, the author of *The World without Us* (2007). What would the world look life after the end of humanity? Beyond Weisman's powerful imagery of deteriorating buildings, of forests reclaiming cities, Chakrabarty argues, is a particularly instructive paradox. "We have to insert ourselves into

a future 'without us' in order to visualize it. Thus, our usual historical practices for visualizing times, past and future, times inaccessible to us personally—the exercise of historical understanding—are thrown into deep contradiction and confusion" (Chakrabarty 2009:197–198). Destabilized in this thought experiment is the foundational distinction between social and physical histories—of "globalization and global warming" (ibid.:200)—which problematically "allows us to read climate change only as a crisis of capitalist management" (ibid.:212). If human activity has assumed a place reserved for geological processes, he reasons, then the commonsense notion of human actors as active figures moving across and harnessing the passive ground of the Earth no longer holds. Rather, he argues, we need to take seriously the fact that humanity as a singular species bears responsibility for the fate of all the other organisms and ecosystems with which we share a planet.

As Max Liboiron writes, however, invoking this universal "'We' erases difference and power relations . . . [and] makes a glossy theory of change that doesn't allow specific responsibility" (2021:23–24). "We is rife with . . . assumptions," they argue; "a familiar, naturalized narrative about environmental pollution is that We are causing it. We are trashing the planet. . . . On the other side of the coin, We must rise up, work together, . . . act collectively, and put aside our differences" (ibid.:23). The problem, they show, is that "*We* isn't specific enough for obligation" (ibid.:24). Indeed, "rehearsing a common 'we,'" as Juno Salazar Parreñas puts it (2021:11), at once flattens out the distinct imbalances in responsibility for the advent of environmental crisis, and makes clear exactly what sort of person "we" is modeled after. "The Anthropocene might seem to offer a dystopic future that laments the end of the world," Kathryn Yusoff writes, "but imperialism and ongoing (settler) colonialisms have been ending worlds for as long as they have been in existence. The Anthropocene as a . . . scientific/popular discourse is

just now noticing the extinction it has chosen to continually overlook in the making of its modernity and freedom" (2018:xiii). When Chakrabarty turns Weisman's "us" into a homogeneous, geological force, he writes what Bruno Latour calls "the Anthropos of the Anthropocene" (2017:246) into the conditions for the possibility of post-human knowledge, and perpetuates "the dangerous fiction," as Latour continues, "of a universalized agent capable of acting like a single humanity."[13] Rather than problematizing this reliance upon species-thinking and the collective we, zoömusicology's insistence upon a singular musicality into which non-humans may be welcomed on the basis of comparison to Western European musical aesthetics effects a dual irony. Not only does it "widen the circle of the human" (Holbraad 2011), but ignores the way in which its implicit definition of the human is one in which precisely the orientation towards nature understood to be responsible for its destruction—the capacity to appropriate material and/or semiotic resources—is valorized.

Conclusion: noise pollution

By examining several cases of gibbon exclusion based on perceived properties of their vocalizations, this chapter has located examples what I have called "sonic NIMBYism" from local land use conflicts to the project of imagining a sustainable planetary future. Whether

[13] Philosopher Quentin Meillassoux conducts a thought experiment that yields similar results in *After Finitude* (2008). In its opening pages Meillassoux entreats his readers to conduct a similar operation to Chakrabarty's—but rather than imagining ourselves past the point in time in which we ceased to exist, we are instructed to remain in the present and contemplate an object—what Meillassoux calls an "arche-fossil" (2008:10)—denoting a time before the advent of contemplating human subjects. Like Chakrabarty, Meillassoux demonstrates that this thought experiment sounds an impossibility: although the sciences are predicated upon Kantian-originated distinctions between the subjective and objective, "ancestral" science (e.g., archaeology) is assumed to be able to do something that should be philosophically impossible—to attribute meaning to a time before there were subjects able to experience it. And what his arche-fossil shatters is the anthropocentric metaphysics inherited from Kant: "the idea according to which we only ever have access to the correlation between thinking and being, and never to either term considered apart from the other" (ibid.:5). Doing so, however, posits a singular category—the human species—within which we are all bounded both spatially and temporally by "our own skin" (2008:11).

surfacing in the context of the Parkhill community's rejection of the Center or in zoömusicology's Anthropocene-inflected discourse, the issue is the same: pressures originating from species extinction and habitat depletion have resulted in gibbon song materializing in physical and conceptual spaces in which they treated as unwelcome. In each, something about gibbon vocalizations—whether its simple presence, its volume, or its instinctual basis—designates it as noise pollution, a phenomenon that represents a potential threat if it is not handled correctly. And I have shown that at each stage, these issues are revealed as proxies for a surprisingly consistent set of anxieties stemming from senses of entitlement and concern over change in a threatened world. As this chapter has focused attention on the perpetrators of sonic NIMBYism, to conclude I reflect on the consequences this antagonistic position has for the gibbons it targets.

In his 2021 podcast "Listening to the Zoo," Tom Rice deliberately chooses not to include a recording of gibbon song. He recognizes that "the people we've spoken to who work at the zoo think that the call of the gibbon is a particularly interesting and beautiful sound. They say it's a privilege to hear it." But he declines to provide his listeners with that same experience: "we're not going to do that; . . . we don't want to just reproduce the sonic highlights of the zoo. After all, the gibbons are quiet most of the time."

Instead, he foregrounds the problem of noise complaints:

> We know from local newspaper reports that these gibbons have actually been the subject of noise complaints from zoo neighbors. . . . Now this raises interesting questions: Zoo neighbors apparently have the right to be protected from noise coming from inside the zoo. But do animals have the same right to protection from sound coming from outside the zoo, or from inside for that matter? (ibid.)

A central theme of this dissertation has been how crucial the capacity to let gibbons vocalize at the Center is for both their welfare and the future of their species. By foregrounding

the individual issue of right to protection from unwanted sounds (and the implied issues of animal rights and personhood), though, Rice shifts attention away from the right to make those life-sustaining sounds. Here is what is skipped in the ellipses in the above block quote: "Those reports have resulted in the gibbons being kept inside their house on some mornings. You see, mornings are when they are most likely to vocalize, and they are less likely to vocalize if they are inside their house." Rights to be protected from sound eclipse, apparently, rights to produce sound, no matter what consequences that suppression has on the gibbons it imposes on.

Attending the 2019 premiere of the documentary that was subsequently re-edited into *The Center* (2021), the elderly gentleman sitting to my right in the theater struck up a conversation as we waited for the film to begin. Cay Sehnert, as I learned, was not only an old friend of Alan Mootnick's, but also found a life-changing experience in his family's adoption of several gibbons in the 1960s and 1970s. Sehnert's accounts of cohabitating with gibbons, an experience he describes as "like knowing a person from another planet who was smarter than you" (Interview, 20 November 2019), deserve far more attention than the scant attention they receive in this dissertation (see footnote 15 in Chapter 3). Here, I only attend to one story he told me as we discussed his own human-gibbon relationships and involvement with the early days of the Center in the 1970s, regarding a female gibbon named Opal that a close relative kept as a pet in their Los Angeles home for over twenty years. After "animal regulation finally woke up," Sehnert recalls, "it was illegal to have a gibbon as a pet." Tears swelled in his eyes as he told me that her owner "had to keep her secret, and he put her . . . in the closet. He put her in there, shut the door, no light." And this was because "he had to suppress her singing . . . and that went on until she died. . . . People were reporting him, and he kept her up in that space in the dark and whenever she started to make noise he put an end to it if he could, however he could" (ibid.).

What this disturbing anecdote distills for me is the ultimate consequence of the various forms of sonic NIMBYism I have examined throughout this chapter: whether materially or conceptually, in terms of individuals or species, the bodies forced to bear the costs of its implementation are ultimately those belonging to gibbons it targets. The forms of sonic NIMBYism encountered in my discussion of Schaferian soundscape ecology and the Parkhill protest deny gibbons the right to vocalize—which, for gibbons, is tantamount to denying their capacity to thrive into the future. The zoömusicological exclusion of gibbon song might similarly lead to harm: as Mache writes, the possibility of music in the singular calls into question "the responsibilities [humanity] has or does not have towards other living species. Just as one does not eat a pet," he continues, "it would become difficult for a musician to treat a bird as prey as soon as one recognizes in him a sort of more or less gifted colleague" (2001:280). Based on the treatments of gibbon song in the zoömusicological work I addressed above, this recognition as musical kindred, and its concomitant protection from consumption, would not be extended to gibbons. Sonic NIMBYism redirects the violence that it purports to hear onto those bodies that come to be blamed for it.

In their recent monograph, Liboiron makes a compelling case that *Pollution is Colonialism* (2021). Pollution, Liboiron argues, refers not only to the presence of contamination, but more deeply reflects an orientation that reduces Land (as in a dense web of relations between heterogeneous entities) to land (an objectified deposit of physical resources). They contend that pollution science is deeply colonial because it starts from the premise of entitlement and access to land, at once denying the validity of Indigenous lifeways and treating land as a sink capable of absorbing a certain amount of waste produced elsewhere.

Noise, as encountered in the various cases of sonic NIMBYism discussed in this chapter, presents a special case of pollution in Liboiron's sense. To be sure, noise pollution imagines certain spaces as capable of accommodating so much noise before a threshold is crossed. This is Schafer's argument, and one implicitly accepted by public noise ordinances that mark a certain decibel level as what Liboiron denotes as "assimilative capacity"—the amount of toxicity a system can bear before its presence becomes actively detrimental. The Parkhill residents ostensibly oriented their protest around the fear of bursting of that assimilative capacity. Colonialism and pollution furthermore draw strict distinctions between bodies worthy of benefit and bodies deserving of extraction and exclusion; this is what zoömusicology does with respect to the instinctual basis of gibbon song.

Demanding that the "gibbons go away!!" does not solve the problem that their relocation was meant to address; rather, it only seeks to absolve the Parkhill residents of accountability for the perpetuation of gibbon lives and species. To be clear, my issue is not with the Parkhill residents' basic right to participate in local politics—an outcome in which they were forced to accept the Center would be no better. Instead, I have concentrated on their particular justification for their inhospitality, in particular their willful ignorance of the circumstances provoking the Center's relocation—whether the Center's own struggles for survival, or the plight of the endangered species the Center attempts to conserve. Indeed, the Center's existence is grounded in the fact that gibbons, most broadly, have lost access to the forest canopy that the Parkhill resident quoted above understands to be so vital. Organizing complaints around the volume of gibbon vocalizations not only dismisses of the validity of the Center's work, but also ignores the fraught conditions in which it is conducted. Rather than placing the Parkhill residents at odds with the environmentalist values of acoustic ecologists and zoömusicologists, both positions

stem from the same judgements regarding the instrumental value of some forms of noise and the unwillingness to accept responsibility for the continued existence of others.

Chapter Six

Conclusion: Sounding Extinction

The previous chapters explored various ways in which the existence of gibbon song has impacted the practice of gibbon conservation. Whether acting as the medium through which gibbons form all-important social and reproductive bonds (Chapters 1 and 4), making possible a form of interspecies relational intersubjectivity I called "involutionary listening" (Chapter 2), inspiring an acoustemological metaphor that exposes the ethical conundrums at the heart of a captive breeding program (Chapters 3 and 4), or justifying various forms of spatial and epistemological exclusion (Chapter 5), gibbon song is never unremarkable or superfluous.

Every morning, the Center—still, at the time of writing this dissertation, at its Saugus location—erupts into song. The gibbon chorus, however, rarely occurs in an acoustic vacuum; instead, it takes place amongst numerous other sounds originating from a variety of sources. Especially at the beginning of my fieldwork, when my physical struggles with habituation were combined with my technological struggles to produce accurate audiovisual documentation of the gibbon chorus (see Chapter 2), the cacophony that often prevented me from producing clear recordings was a reliable source of frustration. My spatial audiovisual setup's panacoustic reach was a double-edged sword: in addition to the vocalizations emanating from all fifteen enclosures it regularly picked up car sounds from the nearby road, the planes and sometimes helicopters flying overhead, the loud pump driving the gibbons' misting system, and welding sounds made by a part-time employee, Jesse, as he fabricated the panels for the future enclosure that would be shared by Pepper and Nate (see Chapter 4).

Spending much of each day preparing the gibbons' food in the Center's kitchen (see Chapter 2), my attempts to listen to the gibbon choruses through the building's walls and open

windows (see Chapter 3) were regularly thwarted by the large refrigerator that held the copious amounts of produce the gibbons consume daily. In particular, the refrigerator's cooling system would periodically kick on with a loud groan that drowned out the sonic and social interactions that were ostensibly the focus of my dissertation project. The rhythm of its on/off cycle became such an omnipresent part of my experience working at the Center that I decided to record it. Figure 6.1 is a spectrogram of a recording that was made from a microphone placed in the kitchen, and demonstrates how the appliance's frequency bandwidth completely obliterates that of the gibbon chorus it interrupts.

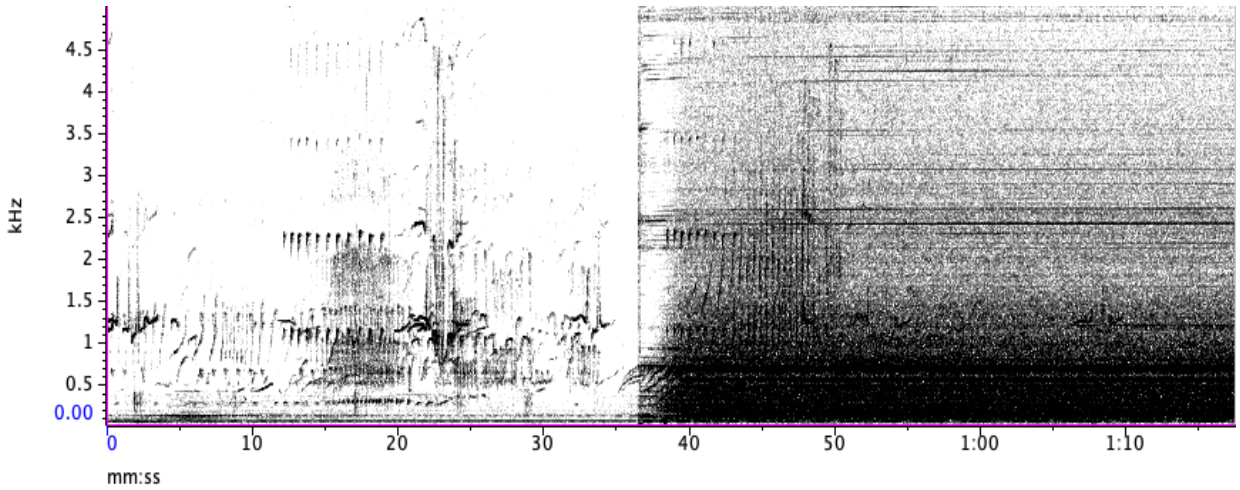

Figure 6.1: A spectrogram of the refrigerator in the Center kitchen kicking on during a gibbon chorus, 6 June 2021. The refrigerator begins at 0:36; the subsequent white-cheeked great call ending around 0:50 is barely visible. While standard scholarly practices for preparing spectrograms (at least of gibbon vocalizations) include removing the overtones (e.g., the black lines seen between the 10- and 20-second marks at the frequencies of 2.5, 3.5, and 4.5 kHz) so that the fundamental frequencies are clear, I have left them in to show how they as well are suppressed by the refrigerator's sonic bandwidth.

The imposition of technologically generated, full-bandwidth noise over the sounds of animals exemplified by this spectrogram: this is precisely what R. Murray Schafer decries in *The Soundscape* (1993 [1977]), and what Douglas Adams (1990) hears, to lethal effect, in the

Yangtze River (see Chapter 5). More recently, Vinciane Despret and Donna Haraway (two of this dissertation's key inspirations) have proposed to take seriously the importance of sound for livability by describing our current global epoch not as the Anthropocene (see Chapters 1 and 2), but rather the "Phonocene." "Living our era by calling it 'Phonocene,'" as Despret writes (2021:144),

> means not forgetting that, if the earth groans and creaks, it also sings. It means not forgetting too that these songs are in the process of disappearing, but that they will disappear all the more rapidly if we do not pay attention to them. And with them will also disappear a multiplicity of different ways of inhabiting the earth, of the inventiveness of life, or arrangements, melodic scores, fragile appropriations, ways of being, things that matter. (ibid.:143)

Most generally, as Despret suggests, invoking the Phonocene emphasizes the possibility of the distinct absence that results from the annihilation of sonorous ways of life (e.g., Carson 1962). The Phonocene casts speculative attention forward in time, to the precarity of what Sylvia Nannyonga-Tamusuza and Andrew Weintraub call "the audible future" (2012), and reminds us that listening to the world makes clear that the sounds of the natural world are on their way out of existence. One morning in the not-so-distant future, the Center may very well *not* erupt into song. Or, even if it continues, its audibility might be drowned out by the sounds of human activity—whether physically from the high-density residential buildings designated for construction just on the other side of the Center's perimeter fence (email to mailing list subscribers, 19 August 2019), or metaphorically by the "noise" made in protest by residents unwilling to welcome the Center into their community (Chapter 5).

Rather than invoking the simple fear of future silence that Andrew Whitehouse characterizes as "the anxious semiotics of the Anthropocene" (2015), the Phonocene treats the current state of the world as what Martin Daughtry, in the context of the US War on Terror, calls "thanatosonics"—the pushing of the acoustic past an auditory threshold into a condition in which

the possibilities of both livability and meaning-making collapse. “While sounds and bodies (*sono* and *bios*) interact in a multitude of ways,” Daughtry points out (2014:39), “there is an extreme edge at which sound can only do harm.” Such thanatosonics have become such a ubiquitous feature of our contemporary moment that the ability for the sounds of the more-than-human world to persist throughout Krause’s “human din” (2015) has become an event worthy of scholarly attention.

In a series of recent talks and dialogues, Despret and Haraway suggest that the Phonocene has taken on a specific tenor during the period that Christian Rutz and colleagues term the “Anthropause” (Rutz et al. 2020:1156), the recent reduction of human activity during COVID-19 lockdowns. “What is multispecies sonic worlding in pandemia?” Haraway asks (2020). “Who has what kind of silence in this time of pandemia? Who has the silence to be able to take in the many sounds of the birds, . . . and some tiny sliver of invitation for us to shut up—to listen?” In a lecture that same year, Despret credits the inspiration behind her call to “trust the musicality of the world (including its rumbles) and try to learn from it” from her experience hearing a blackbird sing outside her window, something precipitated by the pandemic circumstances in which “we were prisoners behind our windows and our balconies and the birds were in fact free to fly” (ibid.). “Something that almost everyone could recognise,” she says, “was that the confinement brought us such quality silence: when human activities stopped, we finally heard something other than the noise of what I call our ‘anthropocacophony’” (ibid.). Indeed, Despret cites Krause’s work in this lecture, positively accepting his “acoustic niche theory” and its concomitant distinctions between “animal songs [and] human din” (Krause 2015; see Chapter 5).

Although a major goal of this dissertation was to put sound studies in dialogue with the animal studies and feminist STS approaches led by Despret and Haraway, I find that their linking of the Phonocene to the imposed reduction of human sound makes *phone* just as much a problematic emblem for our time as is *anthropos* (cf. Latour 2017). Jacques Rancière, for example, builds Aristotle's distinction between *phone* and *logos* into his political philosophy: "the sign of the political nature of humans is constituted by their possession of the *logos*, . . . in contrast to the *phone*, [which is] appropriate only for expressing feelings of pleasure and displeasure. Whoever is in the presence of an animal that possesses the ability to articulate language and its power of demonstration, knows that he is dealing with a human—and therefore political—animal" (Rancière 2010:37).[1] Perhaps the Phonocene's circumvention of the logocentric rationality typically used to justify human exceptionalism can be understood as an attempt to appeal to the lowest common denominator, in the same way that Eduardo Kohn attempts to decenter the human by "provincializing language" and attending to the more fundamental elements of Peircean semiotics (e.g. icons and indexes) that he argues are employed by the entirety of the living world (Kohn 2013).

As should be clear from my discussion in the previous chapter, however, any scholarly approach that can uncritically ally with Schafer's misanthropic position is untenable. Placing the possibility of sonorous livability in opposition to the sounds of human presence reproduces the problematic oppositions of *phone*/*logos*, human/animal, nature/culture—ironically those binaries that feminist STS has done so much work to deconstruct. More specifically, invoking the

[1] For powerful critiques of Rancière's philosophical treatments of sound and voice, see Povinelli (2016) and James (2019). Connecting with my analysis of "gharmony" in Chapter 3, James points out that for Rancière, the political act of "consensus," when people agree to put aside their differences and come together, is a form of "happy harmony" (Ranciere 1999:108, cited in James 2019:60). For more deconstructive insights into the way in which the notion of logical rationality itself relies upon sonic metaphors, see James (2019) and Erlmann (2010).

Phonocene occludes the way the mixing of "biophony" and "anthrophony" (Krause 2012)—the sonic dimension of what Haraway herself has elsewhere called "naturalcultural" to productive effect (2003; cf. Fuentes 2010)—is the means through which the Center carves out a small space of livability in the systematic disaster that Elizabeth Kolbert calls the "sixth extinction" (Kolbert 2016).

One afternoon early on in my volunteer training at the Center, when Gabi was still supervising my interactions with the gibbons, she told me about an idea for a fundraising plan she had. While we were cooling down in the kitchen between rounds of feeding on a particularly hot summer afternoon, she mentioned that she wanted to make a short video that highlighted what might be called the Center's soundscape. Gabi, however, was not referring to the gibbon vocalizations. Instead, she wanted to call attention to the sounds produced in the process of caring for gibbons: not only the aforementioned refrigerator, but also the washing and chopping of vegetables in the kitchen, the regular raking of the gibbon enclosures' dirt floors, the distinct sound of food being tossed into the metal buckets clipped to the gibbons' enclosures, and the welding machinery. Of course, the gibbons would be included. But she specified that they would only be heard in the final moments of the video, after all the other sounds were introduced. Rather than treating the sounds of human activity and gibbon flourishing as mutually exclusive (see Chapter 5), this video would emphasize that the latter is only possible due to the former; that what makes possible the predictable reiteration of Center's gibbon chorus, day after day, is a near-constant exertion of human effort.

The video never materialized. Such is the tenor of life at the Center, after all, where such ambitious plans are regularly abandoned to the constant surprises and demands that arise during the gibbons' day-to-day care. These pressures only intensified in 2020, furthermore, during the

very pandemic-triggered reduction in human mobility that Despret and Haraway welcomed. As a series of mourning doves took up residence in the gift shop (see Chapter 1) during the months the Center was closed to the public (Figure 6.2), the Center staff were not able to share in Despret and Haraway's celebration of silence. Instead, they took on the additional work usually provided by volunteers such as myself amidst the looming existential crisis that was the Center's lease expiration date (see Chapter 5), while voluntarily accepting pay cuts and/or hour reductions to ensure that there was enough money available to purchase the boxes and boxes of produce that the gibbons consume each week.

Figure 6.2: A mourning dove taking off from the nest it had built on a shelf in the Center's unused gift shop during the COVID-19 lockdown. Photo by author, 12 June 2020.

After I was vaccinated and cleared to resume volunteering in the summer of 2020, I tried to follow Gabi's lead and attend to the naturalcultural sonic entanglements she pointed out to me. Focusing on the anthropogenic sounds of gibbon care resulted in my recording of the refrigerator

discussed above, but getting the correct timing in relation to the gibbon chorus took multiple tries to capture. Finally, on 6 June 2021, I excitedly told Gabi that I had managed it. Instead of displaying her usual combination of good-humored curiosity and perplexity towards these recording projects of mine, however, she mentioned that discussion of the fridge's acoustics had come up earlier that very morning: Jodi, a longtime staff member who had been away for the past year attending college (see Chapter 1), had arrived late the previous night for a short visit. Jodi was self-admittedly emotional, being back at a place that meant so much to her. Crucially, what triggered this affective response was not the experience of waking up to the dawn gibbon chorus, like she expected, but instead hearing the refrigerator turn on when she walked into the kitchen first thing in the morning.

As Jodi told me later that day,

> When I lived here I did not notice it. . . . So when it did it this time it jolted me, like, oh my god! . . . I could go on about all the sounds here because they're so unique to the Center: the wind sounds, the sound of the door on the porta potty, that definitely brings me back to quarantine, because we used the porta potty a lot [laughs], the water going, these [chimes], doing water buckets last night, . . . [But] the refrigerator was probably the most specific because it had such a powerful emotional impact. . . . I can't describe how the refrigerator sounds made me feel so happy, or so at home somewhere, but it did, as soon as I walked in the door and I heard it. (Jodi Kleier, interview, 6 June 2021)

In the same manner as Gabi's appreciation of the human effort expended over the course of caring for gibbons, Jodi hears the sounds of the refrigerator not as an imposition, but rather as a crucial element in the sonorous fabric that ensures the continuity of gibbon vitality at the Center. Instead of sounding a threat, the refrigerator was surprisingly what made Jodi feel at home.

Gilles Deleuze and Félix Guattari famously address the role of sound in constructing a sense of home. "Sonorous or vocal components are very important," they note: "a wall of sound, or at least a wall with some sonic bricks in it" (1987:311). Processes of sound and vibration are so relevant, they reason, because for them the cosmos itself is fundamentally a rhythmic

phenomenon. “Every milieu is vibratory, in other words, a block of space-time constituted by the periodic repetition of the component. . . . The milieus are open to chaos, which threatens them with exhaustion or intrusion. Rhythm is the milieus’ answer to chaos” (1987:313). One does not have to accept the existence of an “ontology of vibrational force” (Goodman 2010), however, to benefit from Deleuze and Guattari’s insight regarding the relationship between periodicity and reinforcement, a concept they call the “refrain” (*ritournelle*). The power of sound to produce and defend of that “uncertain and fragile center” (1987:311) that is a home or an animal’s territory, they make clear, comes from its repetition.

Every morning, the Center erupts into song. And as Gabi and Jodi’s comments emphasize, its presence is not opposed to, but rather is made possible by, human inspiration and exertion. Even the refrigerator’s own refrain, the auditory constraints it regularly imposes, cannot be treated as antithetical to gibbon flourishing. Rather than existing in the relation of incompatibility Bernie Krause describes as “oil and water” (2012:179), at the Center biophony and anthrophony are thoroughly emulsified. This dissertation has argued that such emulsifications of the natural and cultural, acoustic and affective, musical and biological, are precisely what shapes the character and practice of gibbon conservation. Making this explicit, as Gabi and Jodi do, I argue, is crucial—not only ethnographically, but further ethically. As I demonstrated at length, unacknowledged slippages between the objective and subjective, prescriptive and descriptive, inform approaches to gibbon conservation that make certain forms of violence, subjugation, and/or detachment seem either morally necessary, or wholly prosaic and therefore unremarkable (see Chapters 3 and 5, in particular).

The biopolitics of the refrain

Invoking Deleuze and Guattari brings together several of the points made (repetitively) throughout this dissertation regarding the Center's gibbon chorus: it is itself a refrain. This chorus is not the sort of aesthetically pleasing but ultimately unnecessary phenomenon that Steven Pinker infamously describes as "auditory cheesecake" (1997:534), however, but rather deeply important for the lives of the creatures that devote so much time and energy to produce it, day after day.

Bruno Latour's reading of Shirley Strum's insights from fieldwork among baboons in Kenya in helpful here: as Strum observes, "it appeared that baboons had to work hard to create their social world" (1987:157). Latour mobilizes this comment in the context of a polemic against sociologists like Pierre Bourdieu who, in Latour's reading, imagine the social as a domain that preexists the actors who might populate it; Latour's implication is that such a theory is better applied to non-human primates than human beings. "If sociologists had the privilege to watch more carefully baboons repairing their constantly decaying 'social structure,'" Latour writes (2005:70), "they would have witnessed what incredible cost has been paid when the job is to maintain, for instance, social dominance with no thing at all, just social skills." Indeed, this is Latour's distinction between humans and non-human animals: the former incorporate material objects into their social networks in ways that cannot be modelled in advance, while the latter do not. The simple existence of the gibbon chorus, however, shows how gibbons do in fact incorporate elements of material reality into their social networks: in particular, sound waves.

Sound, however, is not a particularly durable repository of social meaning: decaying, ephemeral, sound is always on its way out of existence. Although my goal in this dissertation was not to speculate about the "true meaning" of gibbon song but rather observe how contrasting

ideas about its meaning and function come into play in the ethnographic context of gibbon conservation, the inherent ephemerality of sound could be one explanation as to why the gibbon chorus is repeated so often at such great expense.

The constraints that temporality and ephemerality impose also came into play in the theories of biology that shape gibbon conservation's goals and metrics, in particular the theories of genetics and evolution that inform the gibbon Species Survival Plan® (SSP)'s determination of reproductively compatible pairings. In Chapter 3 I demonstrated that kinship coefficient calculations derive from the neo-Darwinian evolutionary theory called sociobiology, developed in the 1970s, that understands the laws of nature to be analogous to the laws of economic exchange. Life, argued proponents like Richard Dawkins, is motivated by competition. The unit of competition, crucially, was understood to be not organisms but rather genes, each "selfishly" competing with one another to maximize the number of copies of itself existing in the world.

Dawkins provided one of the clearest descriptions of this theory in verse, which in *The Ancestor's Tale* he claims to have delivered at an unspecified after-conference banquet dinner:

> An itinerant selfish gene
> Said: "Bodies a-plenty I've seen.
> You think you're so clever,
> But I'll live for ever.
> You're just a survival machine." (Dawkins 2016:72)

While a robust critique of sociobiology, and *The Selfish Gene* in particular, has centered around the way in which it reduces living bodies to such mindless "survival machines" or "temporary vessels" (2016:72) devoid of agency, here I focus on the way this theory resolves an apparent paradox of durability and ephemerality. The paradox is that sociobiology understands evolutionary development to be the consequence of genes competing to occupy successive generations of the mortal bodies whose ability to act as such vessels affords their survival, yet

Dawkins reminds us that "the life of any one physical DNA molecule is quite short—perhaps a matter of months, certainly not more than one [organism's] lifetime" (1989:45). Despite the theorized intergenerational endurance of those genes, there is no timeless physical substance, no piece that never changes, with which to ground the gene's continuity. "But a DNA molecule could theoretically live on in the form of copies of itself," Dawkins continues, "for a hundred million years." Indeed, Dawkins posits this potential for genes to "replicate" themselves, as he calls it, as the ultimate explanation of life itself—which has been shaped over millennia by "selfish genes" competing to maximize the chances that more copies of themselves will be made. Successful continuity over time (what Dawkins calls "immortality") is not a function of individual durability but rather of faithful replication through continual replacement. Life is a refrain.

In *The Soundscape*, Schafer makes this very connection between sounding and living. "We may speak of natural sounds as having biological existences," he writes (1993[1977]:78). "They are born, they flourish, and they die." In contrast to the sounds of nature and their natural decay (something he describes in a diagram as a sound's "extinction" (ibid.:126), "the generator or the air-conditioner do not die; they receive transplants and live forever" (ibid.:78). The prolongation of the sonic/biological, for him, is decidedly unnatural, an index of artificial and deleterious human imposition on the natural order of things.

Pace Schafer, the ability to maintain such continuity indefinitely is what makes possible the sort of immortality Dawkins has in mind. More specifically, however, it features a coupling of the logic of reproduction with the logic of accumulation: the more viable copies of a gene existing at the same time, the higher its durability. "Life, from bacterium to biosphere," as Lynn

Margulis and Dorion Sagan write, "maintains by making more of itself" (1990:4). At stake in the possibility of immortality is the capacity to produce more and more self-reproductions.

Jacques Attali's discussion of sound reproduction technology in in *Noise: The Political Economy of Music*, in particular a social phenomenon he calls "repetition," helps tease out what is at stake in this understanding of life as driven by genetic replication. For Attali, the phonograph made possible the situation he calls "stockpiling," in which the relation between copy and original that was ostensibly the goal of sound reproduction technology is lost. Rather than the copy being linked to its source, "reproduction, in a certain sense, is the death of the original, the triumph of the copy, and the forgetting of the represented foundation" (1977:89). Echoing Karl Marx's famous notion of alienation, the move repetition accomplishes is making the copies seem to stand alone instead of indexing the circumstances of their production (cf. Gell 1998). In stockpiling, what matters is only the number of copies one is able to amass. (Indeed, Attali points out that people now acquire more recordings than there is possibly time to listen to). By causing all attention to be focused on relations of fungibility between commodities, "power is no longer incarnated in men. It is. Period" (1977:88; cf. Anderson 1972). What Attali's insight helps clarify is that the theorized medium of biological survival, the degree to which a gene is able to maximize fidelity among a potentially infinite number of its copies, is entangled with not only the logic of capitalism (*dixit* Graeber 2014) but also colonialism. Perhaps Dawkins would agree with Schafer's contention that "a man with a loudspeaker is more imperialistic than one without because he can dominate more acoustic space" (1993 [1977]:77). The theory of life reproduced through the actions of the gibbon SSP is acoustemological through and through, rendering evolution nothing but a competition for volume (see Chapter 5).

Gibbon conservation treats the concepts of sound and life analogously: inherently fragile and entitled, and consequently in need of preservation not by prolonging an inevitable decay, but rather by maintaining the power and resources with which it can be produced again and again in the same way.[2] As a mechanism of maintaining such continuity through repetition, however, the refrain is fraught with ethical and political concerns. Michelle Murphy captures these issues with her notion of "distributed reproduction," the "extensive sense of existing over time that stretches beyond bodies to include the uneven relations and infrastructures that shape what forms of life are supported to persist, thrive, and alter, and what forms of life are destroyed, injured, and constrained" (2017:141–142). Indeed, gibbon conservation's relationship between acoustemology and biosecurity is a central theme of this dissertation—expressed in its usages of sound, in material and metaphorical registers, to biosecure not only individual living creatures but also entire species. "Species-based conservation not only elevates valued species above unvalued individuals," as Aurora Fredriksen points out in the case of the Scottish wildcat (2015:692), "but also seeks to preserve a certain, clearly defined and unchanging version of the valued species." In this sense the goal of gibbon matchmaking is that of "continuously propagating sameness," as Sarah Franklin (2007:66) aptly characterizes the assumptions of biology in general after the advent of Dolly, the first cloned sheep. "Vitality," as she writes, "is the outcome of the successful replacement of cells, and . . . diminished vitality results from the waning of this capacity" (2007:58). While Franklin writes regarding contemporary biology's

[2] Building on Tara Rodger's (2010) analysis of the gendered implications of biological reproduction as a metaphor for electronic music composition, Rebecca Lentjes (2018) takes both sound studies and the discourse surrounding avant-garde music to task for their habitual use of describing sound in a way that, by imagining reproduction as the process by which an original (male) spawns copies on his own, erases the contributions of women to both. But here I find the reverse curiously similar: as Dawkins makes clear, sexual reproduction, in its conjugation of two organisms each competing to replicate their own genomic material, is an inherently imperfect strategy, "centered around," just as Lentjes critically writes, "the replication of 'an original' in the creation of copies" (2018). Sound reproduction and biological reproduction are metaphors for one another.

understanding of the inherent mortality of individual organisms, the same can thus be said of gibbon conservation's treatment of the species it manages.[3]

Especially under the looming threat of gibbon extinction, sometimes the role of listening practices is not to "change the world," *pace* Alfred Gell (1998; see Chapter 1), but conversely prevent—at all costs—its perceived change, corruption, contamination. Here, the species as a bounded biological organism takes on not only life of its own, but furthermore a life conceived in distinctly immunological terms—in which the possibility of an individual existence emerges from its capacity to be maintained in time and defended against threats to its integrity (cf. Sloterdijk 2013). Following Eben Kirksey, for whom a species is not an objectively existing entity but rather something "enacted, . . . *performed* in specific ways" (2015:759) by the biologists taxonomically invested in its existence as an object of knowledge or intervention, each gibbon species might be understood to be enacted through gibbon conservation's worldmaking practices as an inherently precarious, bounded object, its stability perpetually under the twin threats of population decline (see Parreñas 2018) and the genetic contamination of interspecies hybridity (see Fredriksen 2015). Gibbon conservation may be a project of (sound)

[3] As Michelle Murphy reminds her readers, the very term "reproduction" emerged in the eighteenth century, in tandem with an emerging interest in taxonomy (see Tsing 2005), as a way to describe the process of maintaining continuity between disparate individual entities throughout time (although, as Lorraine Daston points out [2019], such notions were present since at least the writings of Aristotle). "Reproduction," Murphy writes, "came to name a process of maintaining a species in time, a process that perpetuates the stability of form in organisms across generations. . . . In other words, eighteenth-century reproduction was a process of replacement, sameness, and consistency that linked generations of embodied individuals together as a persistent common kind over time" (2017:32). And although sexual reproduction's biological function ostensibly inverted to "become a living difference engine" (ibid.) after Darwin's insight into its role in generating the inherited variations that allow for evolutionary change, Darwinian schemata still leave open room for notions of species as bounded, individual entities, with reproduction acting as the force that strengthens those boundaries by encouraging the intensification of a species' internal variation and its external differentiation from other species. In Elizabeth Grosz's contemporary Deleuzian synthesis of Darwin and Luce Irigaray, for example, in which she distinguishes between the evolutionary mechanisms of natural and sexual selection, both are oriented towards concepts of unitary, bounded species—sexual selection serving to encourage internal variation (by generating biological differences between males and females, "the growing differentiation of the sexes from each other" [2011:122]), and natural selection promoting the increasing differentiation, specialization, and isolation of each species from one another as they evolve from a common ancestor.

reproduction—an attempt to prolong what is inevitably going out of existence—but "reproduction is not a good," as Murphy concludes, "rather, it is a process of supporting some things and not others" (2017:142). Elsewhere, Murphy refers to this condition as calls "the biopolitical equation: 'some must die so that others might live'" (2018:112; see Chapter 4). When vitality is inherently finite and scarce, the work of prolonging the continuity of some forms can only be achieved at the expense of others.

The refrain in all its repetitive power, as Deleuze and Guattari imagine it, is an inherently oppressive structure. Performing some etymological gymnastics, they highlight the relationship between a musical "nome" (I think they meant "neume," as it is given in reference to *cantus firmus*) and the production of a *nomos* (Deleuze and Guattari 1987:312). As Peter Berger explains in *The Sacred Canopy*, a nomos results from the imposition of order on society. The fact that these structures are "humanly constructed order . . . projected into the universe as such" (1977:25) are covered up through their repetition and reiteration; "when the nomos is taken for granted as appertaining to the 'nature of things,' . . . it is endowed with a stability deriving from more powerful sources than the historical efforts of human beings" (ibid.). Certain social configurations come to be seen as cosmologically grounded, part of the natural order and therefore unbreakable. The refrain is a trap (see Corsin Jimenez 2018); "everything that has been taken for a labyrinth is in fact a refrain" write Deleuze and Guattari write (1987:347), referring to the labyrinth's associations with deception and imprisonment. Deleuze and Guattari do recognize that sound can provide lines of escape from the refrain's space-claiming impulses—"there is always sonority in Ariadne's thread," (ibid.:311)—but questions of sounding and listening are never neutral. "The ear is itself a refrain," they declare; "it is shaped like one" (ibid.:302).

Sara Ahmed comes to a similar conclusion in her critical reading of inheritance in evolutionary biology, unpacking the way in which the Lamarkian trope of the blacksmith's strong arm, used to describe hereditary increases in fitness, was implicitly reproduced in the field's historical development. Ahmed shows that just like the trope itself, which explains the "relation between the acquisition of form and the lessening of effort" (2019:9), each invocation as an evolutionary description compounded its acceptance as a valid metaphor. Both this trope of reproduction and its reproduction as a trope, Ahmed suggests, can be conceived as a "well-trodden path"—in a stunningly perfect demonstration of her claim, "the more a path is used," she writes, "the more a path is used" (ibid.:40). Reproduction is not the reiteration of the same but rather a process of self-justification and accumulation, one that increasingly imposes material demands and constraints upon its recipients; it is the process through which "a work load is eased but [also] how a work load is acquired. . . . In having stronger arms," she writes, "the blacksmith's son is already equipped to become a blacksmith; his arm has a hand in deciding his future" (ibid.:90).

The extinction-delaying refrains reiterated through the Breeding and Transfer Plans conducted under the auspices of the gibbon SSP, I showed (especially Chapter 3), do not only make possible the reproduction of gibbon bodies and vocalizations but also a make a particular theory of nature increasingly unescapable. As a result, certain forms of domination come to seem not only necessary, but actively desirable. In more meta sense, furthermore, the fundamental necessity of repetition is gibbon conservation's refrain, hardening a nomos in which utilitarian economics and metaphors of sound reproduction are coupled together as the fundamental operation of life and nature.

"Repetition," in Deleuze's reading of Hume (Deleuze 1997:70), "changes nothing in the object repeated, but does change some thing in the mind which contemplates it." Just as importantly, repetition has consequences for the social and/or ecological contexts in which it takes place—because there are also consequences if it does not take place successfully. Whether in the context of the gibbon chorus or the replication of genetic material, there is something at stake in the ability to produce a faithful reproduction. Jonathan Sterne helps clarify this in his cultural history of sound reproduction (2003), in which he demonstrates that the notions of originals and copies emerged together;[4] replication (whether cultural or biological) is the result of a deliberate strategy rather than what naturally occurs in the absence of outside influence or interference. The "sociocultural inertia" that Victor Grauer defines as the "tendency on the part of any human group to retain the most deeply ingrained and highly valued elements of its lifestyle until acted upon by some outside force" (2006:10), and deploys to argue that the music made by "pygmies" and "bushmen" in the twenty-first century represents the unchanging "echoes of our forgotten ancestors" (ibid.) is a fallacy. Instead, the thinkers I have included here—Ahmed, Murphy, and Sterne; Dawkins and Attali; Deleuze, Guattari, and Berger—all help clarify that continuity is an achievement.

Continuity is an achievement

Continuity—and the roles of sound and listening in its production and/or detection—has been a central theme of this dissertation, and not always in positive ways. Michel Foucault built the perpetuation of violence and control through the establishment and intensification of

[4] "'Original' sounds," Sterne argues (2003:219), "are as much a product of the medium as are copies—reproduced sounds are not simply mediated versions of un-mediated original sounds. . . . The possibility of reproduction precedes the fact."

connections, rather than their severing, into his original formulations of biopower and biopolitics. “Effected through an entire series of interventions and *regulatory controls*,” as Foucault puts it (1978:139), biopower is *continuous*—it is the power to maintain continuity. Contrasting it with sovereign power’s expression as distinct, unconnected moments of intervention into the usually unregulated lives of its subjects, Foucault makes it clear that biopower is by definition continually present and indeed makes its lethality explicit in those moments of neglect during which that fostering of life upon which subjects are dependent is denied.

The biopolitics of gibbon conservation, I showed, largely result from an assumption that continuities—whether through time or between bodies—are givens, something to be found and fostered rather than made. Gibbon species, for example, are treated as discrete entities with an independent existence. What this pervasive notion of bounded continuity implies is that conservationists’ labor is conceived of as exterior to the species, in the same way that classical notions of objectivity imagine an observable nature ontologically distinguishable from human interference. “Evolution is . . . ‘exoteleological,’” Banu Subramaniam suggests in an important discussion of Darwinian theory, because “extinction comes from outside” (2014:51); a species’ continuity can only be prevented by exterior intervention or interference. The other end of this spectrum is Juno Salazar Parreñas’ conclusion in *Decolonizing Extinction*: not only do dominant attempts to prevent anthropogenic extinction hypocritically apply the very same colonial forms of management and regulation that caused extinctions, she argues, but furthermore these initiatives are themselves doomed: orangutan rehabilitation centers, for example, are no more than “hospices for a dying species.” In an important passage in *Pollution is Colonialism*, Max Liboiron discusses “the four myths of Nature” (2021:61); the most widespread, and most

damaging, they argues, is a model of nature as "robust within limits," that is, capable of accepting a certain volume of toxicity in a way that reduces it to a resource to be managed and/or potentially depleted. Benevolent human intervention into gibbon vitality, according to this position, is only necessary because of the sort of prior malevolent human interference that has come be characterized as the Anthropocene.

In an important article, Heather Davis and Zoe Todd link locate the origins of this unfolding ecological and social catastrophe in the colonization of the Americas, and further ascribe its advent to a particular way of treating the world: "What settler colonialism, and its extensions into contemporary petrocapitalism, does is a severing of relations," they write. "It is a severing of relations between humans and the soil, between plants and animals, between minerals and our bones. This is the logic of the Anthropocene" (2017:770). Kimberly TallBear, furthermore, offers a similar image in her own scholarship: "Kinship obligations to nonhuman kin were also violated by the settler state" (2016:1). Together, Davis, Todd, and TallBear offer a way to make sense of the violence of settler colonialism and the epistemology of Enlightenment rationality behind it as a form of power that produces and relies upon material and ontological alienations, denials, and impairments.

Matthew Chrulew characterizes the treatment of endangered species in captivity in a similar manner: "in its focus on the anatomical or genetic species body at the expense of emplaced creatures," he writes, "the zoo produces not full, flourishing lives but a wounded life, robbed of vital connectivities and expressions" (2011:139). But here I suggest that it is equally productive to consider gibbon conservation's acoustemological biopolitics is not as the reduction of relational connections and obligations, but rather their amplification. In a recent article, Amy Zhang reflects on the necessity of the concept of "enclosure" to an experimental project designed

to engineer genetically flies into non-human workers capable of metabolizing waste in urban China (Zhang 2020). The sense of containment that enclosure implies is similarly prominent for gibbon conservation: it is the solution to the perceived problem of extinction; through the work overseen by the gibbon SSP (see Chapters 3 and 4), gibbons are enclosed in ways both conceptual and material. Yet this spatial logic of containment deployed to prevent a species' evolution or extinction, I have shown, was accomplished not through separation and erasure, nor alienation and impoverishment, but rather through the accumulation of material and semiotic articulations.

In a well-cited 2004 article, Bruno Latour defines life itself in a strikingly similar way—as the accumulation of articulations. In Chapter 2, I invoked Latour's understanding of articulation (which contrasts with Stuart Hall's usage discussed in Chapter 3) in order to theorize the process through which Center staff acquire their auditory expertise. But for Latour articulations are not just the acquisition of skill; rather, they are the conditions for the possibility of acquiring a *life*, defined by the capacity to be affected by its environment. "Acquiring a body is . . . a progressive enterprise that produces at once a sensory medium and a sensitive world" (2004a.:207, emphasis in original), he writes—selves and their environments are articulated together. Latour defines death as the absence of articulations: "the opposite of being a body is dead" (ibid.:205). For Latour, then, the living body is constituted, given meaning, and motivated in its perpetual struggle to resist the stasis, inertia, and impermeability that is death, the only way to avoid it by perpetually accumulating articulations. "The more mediations, the better," as he puts it, appropriately, twice (ibid.:211, 219).

More recently, Latour has parlayed this distinction into a critique of the ideologies behind both the study of climate change and its denial. He contends that theories assuming individual

actors to exist and interact "*partes extra partes*" (2017:98)—ironically, the condition Ingold understands to be implied through invocations of articulation (2015)—have already denied the conditions for the possibility of life itself, and instead modeled precisely what constitutes "a dead planet" (Latour 2017:98).[5] Latour's conclusion resonates with the evolutionary philosophy of Elizabeth Grosz: "Perhaps the only ethics internal to life itself," according to her reading of Darwin (2011:22), is "to maximize action, to enable the proliferation of actions, [or] movements." Indeed, in a published discussion between primatologists and what Alison Jolly calls "primatologist-ologists" (STS scholars studying primatology; Jolly 1999:146), Latour praises sociobiology precisely for its commitment to epistemological accumulation understood as the antidote to reductionism (2000:312–315).

In the epilogue to his provocative ethnography of industrial hog farming, Alex Blanchette suggests a way to characterize the Anthropocene based on this intensification of extractive and coercive control. Whereas most attempts proceed by looking for the presence of an anthropogenic contaminant (whether microplastics, radiation, or colonialism) in the geological record, for Blanchette what defines the current state of the world is a conspicuous sort of absence. Industrial pig farming today, he shows, is characterized by the simultaneous scale of production and lack of geological traces. The industry's lack of organic waste, he argues, is a perfect figure because capitalism's drive to wring out every drop of value has pushed

[5] Latour offers this image of a lifeless planet in an essay arguing for the recuperation of "Gaia," James Lovelock's influential theorization of the Earth as "as a system in which the organisms are an integral part" (Lovelock 2000:127), as an ethical model for ecological relations. Although Gaia is normally characterized as a "self-regulating system," Latour takes issues with that conceptualization's immunological overtones, arguing that the notion of the Earth as composed of a countless discrete, bounded entities, each engaged in a metabolic project of maintaining the barrier that separates interiority from exteriority, reproduces the fraught logic that precipitated what he calls "the new climate regime." "Facing Gaia," as Latour demonstrates, requires rejecting the sociobiological commitment to autonomous essences in competition and instead accepting that "the problem with the selfish gene is the definition of the *self* (2017:103, original emphasis). "If there is no selfish gene," he continues (ibid.:104), "it is because the self literally has no limit!"

corporations to "use every part of the species." Rather than decomposing in the earth, elements of porcine bodies are instead "in the bone fertilizers in your potted plants, the concrete in the roadways you drive, the glue that seams together your household objects, and the drugs in your medicine cabinet" (2020:243). The factory farm has taken the timeless imperative to keep precious meat from going to waste to an entirely new scale. Everything is consumed, every imaginable part of the pig (except, perhaps, its oink) rendered—sometimes literally—productive.

For Blanchette,

> most problematic is that few . . . would even recognize that this is a problem. Many people would likely feel compelled to treat the pigification of the built environment as a rational story of efficiency, as a responsible use of resources, or even as a signal of an odd kind of respect for the life of the animal by letting little of its body go to waste. But this is the same kind of logic that leads writers to see industrialism as signaling the collective human "domination" of the planet. It is an ideological reading of the world that assumes humanity is a unified agent consciously acting in concert. (ibid.)

The compatibility Blanchette detects between the valorizations of utilitarian efficiency, capitalist extractivism, human exceptionalism, and species-thinking is worth heeding. Blanchette, however, continues by considering what this apotheosis of extractivism means: "a society that is unable to moderate its exploitation of labor; a region of the world that cannot help but pour more and more social energy into doing the same thing" (ibid.). This is, I have argued, precisely how to understand gibbon conservation. Facilitating gibbon survival comes to demand more and more energy, bodies (human and gibbon), sacrifices, all in the hopes of sustaining a certain acceptable threshold of similarity between individual instances of its sonic and biological refrains.

Attending to the implementation of this mandate at the Center, however, has shown that Gabi, Alma, and Jodi do not utilize a uniform or consistent set of ideologies and/or listening practices, but rather remain ontologically heterogeneous—heterophonic, even. Doing so has helped locate the Center and its staff as precariously positioned within networks of authority,

where although they undoubtedly have control over the gibbons they manage, they are also subordinated within larger systems of conservation (i.e., the gibbon SSP) where their values and practices are potentially at odds with dominant approaches. Following Ana María Ochoa Gautier, I have tried to hear the Center as a "contested site[s] of different acoustic practices, a layering of contrastive listenings and their cosmological underpinnings" (Ochoa Gautier 2014:4). And whether in the context of clashes with, and resistance to, positivist research methods (Chapter 2), the gibbon SSP (Chapters 3 and 4), or the Parkhill protest (Chapter 5), I have shown that the remarkable thing about the Center staff's listening practices is that they hear continuity as an achievement, rejecting the prescriptive demands that come with grounding certain compatibilities and continuities in the natural order of things.

Whether by attending to the ways in which gibbons establish their reproductive bonds through collaborative song (Chapter 4), technologies of statistical normalization that place individual, unique gibbons on a communal number line in order to gauge their compatibility (Chapter 3), or the necessity of vocalizing to continued livability (Chapter 5), I have tried to approach material and semiotic continuities and compatibilities through the lens Stefan Helmreich calls "transduction": "the result of *work*, of labor that, when done well, produces a sense of seamless presence, presence we should not take for granted but rather should inquire into as itself a technical artifact" (2015:226, original emphasis). I have argued that the very ideas we use to conceive of a bounded species are themselves artifacts of specific ways of thinking about life and categories, ones that furthermore draw heavily on sociohistorically contingent notions of music and vibration. Taking some forms of continuity to be natural and entitled only obscures the politics and intrigue, the effort and sacrifice, necessary to bring it about.

The Center does not model a sustainable system of gibbon conservation. Rather than a utopian pocket of multispecies harmony, the Center is a site in which the difficulties inherent in preventing a species' extinction are concentrated and palpable. Involving experiences of both intense, multispecies affect, and of precarity, tragedy, and exhaustion, during my time at the Center I experienced moving, affirming moments of exhilaration and camaraderie, on one hand, but also sustained intervals of pressure, frustration, and loss, on the other. The Center does not offer a viable approach for everyone. Those humans swept up into the gibbons' existential plight are not able to enjoy "the luxury of distance," what Daughtry describes as the privilege to be far enough away from a wartime explosion that it registers as heard sound rather than as felt trauma (2014:39). Demanding perpetual exertion, care for gibbons at the Center requires its adherents to bear a degree of personal vulnerability, surrender, and devotion frankly undesirable for most of the world. Characterized by a commitment to the state Juno Salazar Parreñas describes in her ethnography of captive orangutan conservation as "mutual but unequal vulnerability" (2018:160), the simultaneously social and epistemological precarity that distinguishes the Center staff's expertise is what prevents it from being universally applicable.

Indeed, it lasts only as long as staff like Gabi are willing to commit their entire lives to the operation. The intense effort this commitment to the continuity of gibbon species demands shows how sustainability discourse is not opposed to the utilitarian logic of production and consumption encountered in both the theory behind endangered species management programs like the gibbon SSP and extractivist industries like the corporations currently converting the gibbons' southeast Asian forest habitat into uninhabitable palm oil plantations. While the concept of sustainability, especially in music studies (e.g., Grant 2014; Schippers 2016) emphasizes the ability of a musical tradition to "endure" (Grant 2014:12), the challenges faced

by the Center make clear that the "endurance" of gibbon song in suburban Southern California lasts only as long as Gabi and her staff are still willing to shoulder more and more of the responsibility for the gibbons' survival. Only managing, rather than alleviating, the various forms of sacrifice both humans and gibbons affiliated with the Center are expected to endure, what sustainability marks as sustainable is nothing but the possibility of continually outputting value due to a favorable relationship between a system's inputs and outputs. Leah Aronowsky demonstrates how the concept of sustainability was easily appropriated to fuel petrocapitalism's climate change denialism (2021); as tool of corporate finance, as Matthew Archer writes, "sustainability is appreciated, appreciated, and appreciated" (2020:49). The Center is only sustainable in Anna Tsing's sense, in which sustainability simply describes "the dream of passing a livable earth to future generations, human and nonhuman" (2017:51). The work this dream perpetually demands—a form of what Haraway calls "staying with the trouble" (2016)—makes clear just how much effort and sacrifice is necessary to realize it.

Extinction, as Thom van Dooren recognizes, "is never a sharp, singular event—something that begins, rapidly takes place, and then is over and done with. Rather," he continues, "the edge of extinction is more often a 'dull' one: a slow unraveling of intimately entangled ways of life that begins long before the death of the last individual and continues to ripple forward long afterward, drawing in living beings in a range of different ways" (2014:12). Attending to the practice of gibbon conservation on the dull edge of extinction, in this dissertation I showed that one attempt to understand and prevent the unraveling of gibbon lifeways has raveled entirely new sets of bodies and practices constitutively into the object of conservation, including conservationists' and caretakers' ears. As the gibbons and humans cohabitating at the Center have become progressively more involved in each other's lives, so have various other states

typically understood as mutually exclusive: nature and culture, art and science, subjectivity and objectivity. This audible fusing of sounds and concepts across various binary domains, I suggest, is what gibbon extinction sounds like—not a unidirectional narrative of increasing silence or amplitude, but rather a silencing of certain things and the amplification of others.

This "audible entanglement" (Guilbault 2005), and the ethical conundrums it raises, is the condition of gibbon conservation today. Without speculating as to what the future may hold for the Center and the various species of gibbon found there, this dissertation has argued that at the present, not only the lives of particular individual gibbons, but also the very technologies and epistemologies through which their lives can be understood and evaluated, are constitutively intertwined with those of the human beings who care for them. Claire Kim ends her provocative reflection on the racial overtones of political disputes over animal use in the United States by pointing out that "in ecological terms, time is indeed short. But there is still a chance to open ourselves to each other, to see each other" (2015:287). Alternative approaches and aspirations are desperately needed to ensure livable futures, and the willingness of the Center staff to take responsibility at personal expense—to listen—is one worthy of attention.

APPENDIX A: DISSERTATION RESEARCH TIMELINE

June–August 2018

- Sebangau Forest, Central Kalimantan, Indonesia: Participation in a field course run by Borneo Nature Foundation, 6–20 July.
- Gibbon Conservation Center, Saugus, CA: Observational research on gibbon song funded by the Graduate Summer Research Mentorship (GRSM) Program, UCLA Graduate Division.

June 2019–March 2020

- Gibbon Conservation Center, Saugus, CA: Participant-observation research as gibbon caretaker (research approved by UCLA Institutional Review Board [#18-000942]; Gibbon Conservation Center Institutional Animal Care and Use Committee [IACUC]; determined exempt from review by UCLA Animal Research Committee [ARC] approval [8 June 2018]). Research paused after 14 March 2020 due to the onset of the COVID-19 pandemic.

June–August 2020

- Gibbon Conservation Center, Saugus, CA: Socially distanced interviews with staff members.

September–December 2020

- Gibbon Conservation Center, Saugus, CA: Participant-observation research as gibbon caretaker. Research paused 31 December due to rise in COVID-19 cases.

May–August 2021

- Gibbon Conservation Center, Saugus, CA: Participant-observation research as gibbon caretaker.

January 2022

- Gibbon Conservation Center, Saugus, CA: Final interviews conducted.

BIBLIOGRAPHY

Abe, Marié. 2018. *Resonances of Chindon-Ya: Sounding Space and Sociality in Contemporary Japan*. Middletown, CT: Wesleyan University Press.

Adams, Douglas. 1990. *Last Chance to See*. With an epilogue by Mark Carwardine. New York: Ballantine Books.

Adorno, Theodor. 1997. *Aesthetic Theory*. Translated by Robert Hullot-Kentor. London: Continuum.

Agamben. Giorgio. 2005. *State of Exception*. Translated by Kevil Attell. Chicago: University of Chicago Press.

Ahmed, Sara. 2019. *What's the Use?: On the Uses of Use*. Durham, NC: Duke University Press.

Alcayna-Stevens, Lys. 2012. "Inalienable Worlds: Inter-Species Relations, Perspectives and 'Doublethink' in a Catalonian Chimpanzee Sanctuary." *Cambridge Journal of Anthropology* 30(2):82–100.

———. 2016. "Habituating Field Scientists." *Social Studies of Science* 46(6):833–53.

———. 2021. "Thinking in Forests." In *Environmental Alterities*, edited by Cristóbal Bonelli and Antonia Walford, 138–60. Manchester: Mattering Press.

Ames, Eric. 2003. "The Sound of Evolution." *Modernism/modernity* 10(2):297–325.

Anderson, Benedict. 1972. "The Idea of Power in Javanese Culture." In *Culture and Politics in Indonesia*, edited by Claire Holt, 1–69. Ithaca, NY: Cornell University Press.

Anderson, David G., and Eva Berglund, eds. 2003. *Ethnographies of Conservation: Environmentalism and the Distribution of Privilege*. New York: Berghahn Books.

Archer, Matthew. 2020. "Appreciation." In *Anthropocene Unseen: A Lexicon*, edited by Cymene Howe and Anand Pandian, 47–52. Earth, Milky Way: Punctum Books.

Aronowsky, Leah. 2021. "Gas Guzzling Gaia, or: A Prehistory of Climate Change Denialism." *Critical Inquiry* 47:306–27.

Asquith, Pamela. 1996. "Japanese Science and Western Hegemonies: Primatology and the Limits Set to Questions." In *Naked Science: Anthropological Inquiry into Power and Knowledge*, edited by Laura Nader, 239–256. New York: Routledge.

———. 2000. "Negotiating Science: Internationalization and Japanese Primatology." In *Primate Encounters: Models of Science, Gender, and Society*, edited by Shirley Strum and Linda Marie Fedigan, 165–83. Chicago: University of Chicago Press.

Association Anoulak. 2015. “The Beautiful and Informative Gibbon Songs: Progress on Our Gibbon Call Recordings to Study Species Distribution in Nakai – Nam Theun National Park.” https://www.conservationlaos.com/the-beautiful-and-informative-gibbon-songs-progress-on-our-gibbon-call-recordings-to-study-species-distribution-in-nakai-nam-theun-national-park/.

Attali, Jacques. 1983. “An Interview with Jacques Attali.” Edited by Fredric Jameson and Brian Massumi. *Social Text* 7:3–18.

———. 1985. *Noise: The Political Economy of Music*. Translated by Brian Massumi, foreword by Fredric Jameson, afterword by Susan McClary. Minneapolis: University of Minnesota Press.

Azmi, Alex M., dir. 2021. *The Center: Gibbons and Guardians* [film]. Los Angeles, CA, Crystal Sphinx Productions.

Baggs, Edward, and Anthony Chemero. 2018. “Radical Embodiment in Two Directions.” *Synthese* 198:2175–90.

Baker, Geoffrey. 2008. *Imposing Harmony: Music and Society in Colonial Cuzco*. Durham, NC: Duke University Press.

Ballou, Jonathan D., et al. 2010. “Demographic and Genetic Management of Captive Populations.” *In Wild Mammals in Captivity: Principles and Techniques for Zoo Management*, second edition, edited by Devra G. Kleiman, Katerina V. Thompson, and Charlotte Kirk Baer, 219–52. Chicago: University of Chicago Press.

Barad, Karen Michelle. 2007. *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. Durham, NC: Duke University Press.

Bates, Eliot. 2012. “The Social Lives of Musical Instruments.” *Ethnomusicology* 56(3):363–95.

Becker, Gary S. 1962. “Investment in Human Capital: A Theoretical Analysis.” *Journal of Political Economy* 70(5):9–49.

Beldo, Les. 2017. “Metabolic Labor: Broiler Chickens and the Exploitation of Vitality.” *Environmental Humanities* 9(1):108–28.

Bennett, Jane. 2010. *Vibrant Matter: A Political Ecology of Things*. Chicago: University of Chicago Press.

Berger, Peter. 1967. *The Sacred Canopy: Elements of a Sociological Theory of Religion*. New York: Anchor Books.

bergman, carla, and Nick Montgomery. 2017. *Joyful Militancy: Building Resistance in Toxic Times*. Oakland: AK Press.

Berlandt, Laura. 2011. *Cruel Optimism*. Durham, NC: Duke University Press.

Bertola, Alexa. 2021. "Gibbon Conservation Center Planning Move to Santa Margarita." *KSBY*. 30 March. https://www.ksby.com/news/local-news/gibbon-conservation-center-planning-move-to-santa-margarita.

Bertoni, Filippo. 2012. "Charming Worms: Crawling Between Natures." *The Cambridge Journal of Anthropology* 30(2):65–81.

Bessire, Lucas, and David Bond. 2014. "Ontological Anthropology and the Deferral of Critique." *American Ethnologist* 41(3):440–56.

Bonelli, Cristóbal, and Antonia Walford, eds. 2021. *Environmental Alterities*. Manchester: Mattering Press.

Bhaskar, Roy. 1975. *A Realist Theory of Science*. London: Verso.

Biermann, Christine, and Robert M. Anderson. 2017. "Conservation, Biopolitics, and the Governance of Life and Death." *Geography Compass* 11(10):1–13.

Blacking, John. 1973. *How Musical is Man?* Seattle: University of Washington Press.

Blanchette, Alex. 2015. "Herding Species: Biosecurity, Posthuman Labor, and the American Industrial Pig." *Cultural Anthropology* 30(4):640–69.

———. 2020. *Porkopolis: American Animality, Standardized Life, and the Factory Farm*. Durham, NC: Duke University Press.

Blaser, Mario. 2016. "Is Another Cosmopolitics Possible?" *Cultural Anthropology* 31(4):545–570.

Bolender, Karin. 2020. *The Unnaming of Aliass*. Earth, Milky Way: Punctum Books.

Bookchin, Murray. 1982. *The Ecology of Freedom: The Emergence and Dissolution of Hierarchy*. Palo Alto, CA: Cheshire Books.

Born, Georgina, and Andrew Barry. 2018. "Music, Mediation Theories and Actor-Network Theory." *Contemporary Music Review* 37(5-6):443–87.

Bourdieu, Pierre. 1990 [1977]. *Outline of a Theory of Practice*. Translated by Richard Nice. Cambridge: Cambridge University Press.

Brabec de Mori, Bernd, and Anthony Seeger. 2013. "Introduction: Considering Music, Humans, and Non-Humans." *Ethnomusicology Forum* 22(3):269–86.

Braverman, Irus. 2015. *Wild Life: The Institution of Nature*. Redwood City: Stanford University Press.

———. 2017. "Anticipating Endangerment: The Biopolitics of Threatened Species Lists." *BioSocieties* 12:132–67.

Brunvand, Jan Harold. 1963. "A Classification for Shaggy Dog Stories." *Journal of American Folklore* 76(299):42–68.

Bubandt, Nils. 2017. "Haunted Geologies: Spirits, Stones, and the Necropolitics of the Anthropocene." In *Arts of Living on a Damaged Planet: Ghosts and Monsters of the Anthropocene*, edited by Anna Lowenhaupt Tsing, Heather Anne Swanson, Elaine Gan, and Nils Bubandt, 121–41. Minneapolis: University of Minnesota Press.

Buchanan, Brett. 2008. *Onto-Ethologies: The Animal Environments of Uexkull, Heidegger, Merleau-Ponty, and Deleuze*. Albany: SUNY Press.

Bruyninckx, Joeri. 2018. *Listening in the Field: Recording and the Science of Birdsong*. Cambridge, MA: The MIT Press.

Burman-Hall, Linda. 2017. "Only in Mentawai: Unique Primate Vocalisations and Songs in an Isolated Indonesian Island Group." *Shima: The International Journal of Research into Island Cultures* 11(2):116–50.

Cadena, Marisol de la. 2015. *Earth Beings: Ecologies of Practice Across Andean Worlds*. Durham, NC: Duke University Press.

Cadena, Marisol de la, and Mario Blaser, eds. 2018. *A World of Many Worlds*. Durham, NC: Duke University Press.

Calarco, Matthew. 2008. *Zoographies: The Question of the Animal from Heidegger to Derrida*. New York: Columbia University Press.

Candea, Matei. 2010. "'I Fell in Love with Carlos the Meerkat': Engagement and Detachment in Human-Animal Relations." *American Ethnologist* 3(2):241–258.

Candea, Matei, and Lys Alcayna-Stephens. 2012. "Internal Others: Ethnographies of Naturalism." *Cambridge Journal of Anthropology* 30(2):36–47.

Carpenter, C. R. 1934. "A Field Study of the Behavioral and Social relations of Howling Monkeys (*Alouatta palliata*)." *Comparative Psychology Monographs* 10:1–168.

Carrithers, Michael, Louise J. Bracken, and Steven Emery. 2011. "Can a Species Be a Person? A Trope and Its Entanglements in the Anthropocene Era." *Current Anthropology* 52(5):661–85.

Carson, Rachel. 1962. *Silent Spring*. Greenwich, CT: Fawcett.

Carter, Paul. 2004. “Ambiguous Traces, Mishearing, and Auditory Space.” In *Hearing Cultures*, edited by Veit Erlmann, 43–63. New York: Berg.

CBC Radio. 2017. “Meet the Biologist Who Says Trees Have Their Own Songs.” 18 April. https://www.cbc.ca/radio/asithappens/as-it-happens-monday-edition-1.4072865/meet-the-biologist-who-says-trees-have-their-own-songs-1.4072909.

Chakrabarty, Dipesh. 2009. “The Climate of History: Four Theses.” *Critical Inquiry* 35:197–222.

Champagne, Duane, and Carol Goldberg. 2021. *A Coalition of Lineages: The Fernandeño Tataviam Band of Mission Indians*. Tucson, AZ: University of Arizona Press.

Chao, Sophie, and Dion Enari. 2021. “Decolonising Climate Change: A Call for Beyond-Human Imaginaries and Knowledge Generation.” *eTropic* 20(2):32–54.

Cheyne, Susan M. 2007. “Effects of Meteorology, Astronomical Variables, Location and Human Disturbance on the Singing Apes: *Hylobates albibarbis*.” *American Journal of Primatology* 70:1–7.

———. 2020. “Morning Songs of Gibbons (*Hylobates albibarbis*) in Kalimantan, Indonesia.” Presented at British Forum for Ethnomusicology Annual Conference, 8 April, Bath Spa University, Newton Park, Bath, UK (virtual).

Chivers, David John. 1974. “The Siamang in Malaya: A Field Study of a Primate in Tropical Rain Forest.” *Conributions to Primatology* 4:1–335.

———. 1976. “Communication within and between Family Groups of Siamang (*Symphalangus syndactylus*).” *Behaviour* 57:116–35.

Chrulew, Matthew. 2011. “Managing Love and Death at the Zoo: The Biopolitics of Endangered Species Preservation.” *Australian Humanities Review* 50:137–157.

———. 2018. “My Place, My Duty: Zoo Biology as Field Philosophy in the Work of Heini Hediger.” *Parallax* 24(4):480–500.

———. 2020. “Reconstructing the Worlds of Wildlife: Uexküll, Hediger, and Beyond.” *Biosemiotics* 13(1): 137–49.

Chua, Daniel K. L., and Alexander Rehding. 2021. *Alien Listening: Voyager’s Golden Record and Music from Earth*. New York: Zone Books.

Chua, Liana, et al. 2020. “Conservation and the Social Sciences: Beyond Critique and Co-optation. A Study from Orangutan Conservation.” *People and Nature* 2(1):43–60.

Chung, Andrew J. 2021. “Vibration, Difference, and Solidarity in the Anthropocene: Ethical Difficulties of New Materialist Sound Studies and Some Alternatives.” *Resonance: The Journal of Sound and Culture* 2(2):218–41.

Clark, Andy. 1997. *Being There: Putting Brain, Body, and World Together Again*. Cambridge, MA: MIT Press.

Clifford, James, and George E. Marcus, eds. *Writing Culture: The Poetics and Politics of Ethnography*. Berkeley: University of California Press.

Connor, Stephen. 1997. “The Modern Auditory I.” In *Rewriting the Self: Histories from the Renaissance to the Present*, edited by Roy Porter, 203–223. London: Routledge.

Corsin Jimenez, Alberto. 2018. “Spiderweb Anthropologies: Ecologies, Infrastructures, Entanglements.” In *A World of Many Worlds*, edited by Marisol de la Cadena and Mario Blaser, 53–82. Durham, NC: Duke University Press.

Cowlishaw, Guy. 1992. “Song Function in Gibbons.” *Behaviour* 121(1):131–53.

Cruikshank, Julie. 2015. *Do Glaciers Listen? Local Knowledge, Colonial Encounters, and Social Imagination*. Vancouver: UBC Press.

Culp, Andrew. 2013. *Dark Deleuze*. Minneapolis: University of Minnesota Press.

Cusick, Suzanne. 2013. “Towards an Acoustemology of Detention in the ‘Global War on Terror.’” In *Music, Sound and Space: Transformations of Public and Private Experience*, edited by Georgina Born, 275–91. Cambridge: Cambridge University Press.

Dantuono, Rebecca. 2017. “Wildlife World Zoo Announces Birth of Rare Pileated Gibbon.” *azcentral.* 26 January 2017. https://www.azcentral.com/story/news/local/southwest-valley/2017/01/26/wildlife-world-zoo-announces-birth-rare-pileated-gibbon/97119084/

Daston, Lorraine. 2004. “Type Specimens and Scientific Memory.” *Critical Inquiry* 31(1) :153–82.

———. 2019. *Against Nature*. Cambridge, MA: MIT Press.

Daston, Lorraine, and Peter Galison. 2007. *Objectivity*. New York: Zone Books.

Daughtry, J. Martin. 2013. “Acoustic Palimpsests and the Politics of Listening.” *Music & Politics* 7(1). https://doi.org/10.3998/mp.9460447.0007.101.

———. 2014. “Thanatosonics: Ontologies of Acoustic Violence.” *Social Text* 32(2):25–51.

———. 2015. *Listening to War: Sound, Music, Trauma and Survival in Wartime Iraq*. New York: Oxford University Press.

———. 2021. “Call and Response (or Lack Thereof): Atmospheric Voices and Distributed Selves.” *Sensate* 1(8). https://sensatejournal.com/call-and-response-or-the-lack-thereof-atmospheric-voices-and-distributed-selves/.

Davis, Heather. 2019. "Blue, Bling: On Extractivism." *Afterall* 48. https://www.afterall.org/journal/issue.48/blue-bling-on-extractivism (accessed 2 September 2020).

Davis, Heather, and Zoe Todd. 2017. "On the Importance of a Date, or Decolonizing the Anthropocene." *ACME: An International Journal of Critical Geographies* 16(4):761–80.

Dawkins, Richard. 1989. *The Selfish Gene*. Second edition. Oxford: Oxford University Press.

———. 2016. *The Ancestor’s Tale: A Pilgrimage to the Dawn of Life*. London: Orion Books.

de Laet, Marianne, and Annemarie Mol. 2000. “The Zimbabwe Bush Pump: Mechanics of a Fluid Technology.” *Social Studies of Science* 30(2):225–63.

De Waal, Frans B. M. 1999. “Anthropomorphism and Anthropodenial: Consistency in Our Thinking about Humans and Other Animals.” *Philosophical Topics* 27(1):255–80.

———. 2003. “Silent Invasion: Imanishi’s Primatology and Cultural Bias in Science.” *Animal Cognition* 6:293–9.

———. 2016. *Are We Smart Enough to Know How Smart Animals Are?* London: Granta.

Dear, Michael. 1992. “Understanding and Overcoming the NIMBY Syndrome.” *Journal of the American Planning Association* 58(3):288–300.

Dear, Michael, and S. M. Taylor. 1982. *Not on Our Street*. London: Pion Limited.

DeLanda, Manuel. 2006. *A New Philosophy of Society: Assemblage Theory and Social Complexity*. London: Bloomsbury.

Deleuze, Gilles. 1997. *Difference and Repetition*. Translated by Paul Patton. London: Continuum.

———. 2004. *Desert Islands and Other Texts, 1953-1974*. Translated by Michael Taormina, edited by David Lapoujade. New York: Semiotext(e).

Deleuze, Gilles, and Félix Guattari. 1983. *Anti-Oedipus: Capitalism and Schizophrenia*. Translated by Robert Hurley, Mark Seem, and Helen R. Lane, preface by Michel Foucault. Minneapolis: University of Minneapolis Press.

———. 1987. *A Thousand Plateaus: Capitalism and Schizophrenia*, translated by Brian Massumi. Minneapolis: University of Minnesota Press.

DeLuca, Erik. 2016. "Wolf Listeners: An Introduction to the Acoustemological Politics and Poetics of Isle Royale National Park." *Leonardo Music Journal* 26(26):87–90.

Dennett, Daniel C. 2015 "Why and How Does Consciousness Seem the Way it Seems?" In *Open MIND*, edited by T. Metzinger and J. M. Windt, 1–11. Frankfurt am Main: MIND Group.

Derrida, Jacques. 2008. *The Animal That Therefore I Am*, edited by Marie-Louise Mallet and translated by David Willis. New York: Fordham University Press.

Descola, Philippe. 2013. *Beyond Nature and Culture*, translated by Janet Lloyd. Chicago: University of Chicago Press.

Despret, Vinciane. 2004. "The Body We Care for: Figures of Anthropo-Zoo-Genesis." *Body & Society* 10(2–3):111–34.

———. 2005. "Sheep Do Have Opinions." In *Making Things Public: Atmospheres of Democracy*, edited by Bruno Latour and Peter Weibel, 360–369. Karlsruhe, Germany: ZKM/Center for Art and Media.

———. 2008. "The Becomings of Subjectivity in Animal Worlds." *Subjectivity* 23(1):123–39.

———. 2013. "Responding Bodies and Partial Affinities in Human–Animal Worlds." *Theory, Culture & Society* 30(7–8):51–76.

———. 2016. *What Would Animals Say If We Asked the Right Questions?* Translated by Brett Buchanan. Minneapolis: University of Minnesota Press.

———. 2017. "Afterword: It Is an Entire World That Has Disappeared." In *Extinction Studies: Stories of Time, Death, and Generations*, edited by Deborah Bird Rose, Thom van Dooren, and Matthew Chrulew, with a foreword by Cary Wolfe, 217–22. New York: Columbia University Press.

———. 2020. "Phonocene: Bird-Singing in a Multispecies World." Lecture, 17 September 2020. https://www.youtube.com/watch?v=U90M8rhQI6c.

———. 2022. *Living as a Bird*. Translated by Helen Morrison. Cambridge: Polity Press.

Devine, Kyle. 2019. *Decomposed: The Political Ecology of Music*. Boston: MIT Press.

Dilts, Andrew. 2011. "From 'Entrepreneur of the Self' to 'Care of the Self': Neo-Liberal Governmentality and Foucault's Ethics." *Foucault Studies* 12:130–46.

Dooley, Helen, and Debra Judge. 2007. “Vocal Responses of Captive Gibbon Groups to a Mate Change in a Pair of White-Cheeked Gibbons *(Nomascus leucogenys)*.” *Folia Primatologica* 78(4):228–239.

Doolittle, Emily. 2017. “Animal Sounds or Animal Songs?” *Journal of Music*. 9 July. https://journalofmusic.com/focus/animal-sounds-or-animal-songs.

Dooren, Thom van. 2014. *Flight Ways: Life and Loss at the Edge of Extinction*. New York: Columbia University Press.

Dore, Kerry M., et al. 2018. “Ethnographic Approaches in Primatology.” *Folia Primatologica* 89:5–12.

Dove, Michael R., et al., eds. 2011. *Beyond the Sacred Forest: Complicating Conservation in Southeast Asia*. Durham, NC: Duke University Press.

Dowie, Mark. 2011. *Conservation Refugees: The Hundred-Year Conflict between Global Conservation and Native Peoples*. Boston: MIT Press

Edmiston, Paige. 2021. “What’s Behind Match Day’s Algorithm?” *Sapiens*. 16 March. https://www.sapiens.org/culture/match-day-matching-algorithm/.

eharmony Editorial Team. 2021. “Compatibility: It’s Not What You Think.” *eharmony.com*. Accessed via Wayback Machine, https://web.archive.org/web/20211021050932/https://www.eharmony.com/tour/tips/compatibility-think/.

Eichenseher, Tasha. 2012. “Gibbons and Opera Singers Use the Same Voice Tools.” *National Geographic*. 24 August. https://www.nationalgeographic.com/culture/article/120823-gibbon-song-opera-singer-helium-science-environment.

Eidsheim, Nina Sun. 2015. *Sensing Sound: Singing and Listening as Vibrational Practice*. Durham, NC: Duke University Press.

——— 2019. *The Race of Sound: Listening, Timbre, and Vocality in African American Music*. Durham, NC: Duke University Press.

Eisenberg, Andrew J. 2015. “Space.” In *Keywords in Sound*, edited by David Novak and Matt Sakakeeny, 193–207. Durham, NC: Duke University Press.

Erlmann, Veit. 2004. “But What of the Ethnographic Ear?: Anthropology, Sound, and the Senses.” In *Hearing Cultures: Essays on Sound, Listening, and Modernity*, edited by Viet Erlmann, 1–20. Oxford: Berg.

Esposito, Roberto. 2006. “The Immunization Paradigm.” *Diacritics* 36(2):23–48.

Estep, D. Q., and S. Hetts. 1992. “Interactions, Relationships, and Bonds: The Conceptual Basis for Scientist-Animal Relations.” In *The Inevitable Bond: Examining Scientist-animal Interactions*, edited by H. Davis and D. Balfour, 6–26. Cambridge: Cambridge University Press.

Evans-Pritchard, E. E. 1937. *Witchcraft, Oracles and Magic among the Azande*. Oxford: Clarendon Press.

Fan, Peng-Fei, et al. 2014. “Ecological Extinction of the Critically Endangered Northern White-Cheeked Gibbon *Nomascus leucogenys* in China.” *Oryx* 48(1):52–5.

Fanon, Frantz. 1961. *The Wretched of the Earth*. Translated by Constance Farrington. New York: Grove Press.

Feiten, Tim Elmo. 2020. “Mind After Uexkull: A Foray into the Worlds of Ecological Psychologists and Enactivists.” *Frontiers in Psychology*. https://www.frontiersin.org/articles/10.3389/fpsyg.2020.00480/full

Feld, Steven. 2012. *Sound and Sentiment: Birds, Weeping, Poetics, and Song in Kaluli* Expression. 3rd ed. Durham, NC: Duke University Press.

———. 2017. “On Post-Ethnomusicology Alternatives: Acoustemology.” In *Perspectives on a 21st Century Comparative Musicology: Ethnomusicology or Transcultural Musicology?*, edited by Francesco Giannattasio and Giovanni Guiriati, 82–99. Udine: Nota.

Feld, Steven, Dennis Leonard, and Jeremiah Ra Richards. 2019. *Voices of the Rainforest. A Day in the Life of Bosavi Papua New Guinea*, 2nd ed. [film]. Santa Fe: VoxLox.

Fillmore, John Comfort. 1994. *A Study of Omaha Indian Music*. Lincoln, NE: University of Nebraska Press.

Finkel, Eli, et al. 2012. “The Dubious Science of Online Dating.” *New York Times*. 11 February.

Fischer, Jan O, and Thomas Geissmann. 1990. “Group Harmony in Gibbons: Comparison between White-Handed Gibbon (*Hylobates lar*) and Siamang (*H. syndactylus*).” *Primates* 31(4):481–94.

Fortescue, John. 1869. *The works of Sir John Fortescue, Knight, Chief Justice of England and Lord Chancellor to King Henry the Sixth*. London, n.p.

Foucault, Michel. 1978. *The History of Sexuality, Volume 1: An Introduction*. Translated by Robert Hurley. New York: Pantheon Books.

———. 1990. *The History of Sexuality, Volume 2: The Use of Pleasure*. Translated by Robert Hurley. New York: Vintage Books.

———. 2003. *Society Must Be Defended: Lectures at the Collège de France, 1975-76*. Translated by David Macey. New York: Picador.

Franklin, Sarah. 2007. *Dolly Mixtures: The Remaking of Genealogy*. Durham, NC: Duke University Press.

Fredriksen, Aurora. 2015. "Of Wildcats and Wild Cats: Troubling Species-based Conservation in the Anthropocene." *Environment and Planning D: Society and Space* 34(4):689–705.

Freire, Paolo. 2000. *Pedagogy of the Oppressed*. 30th Anniversary Edition, translated by Myra Bergman Ramos. New York: Continuum.

Fuentes, Agustin. 1998. "Re-Evaluating Primate Monogamy." *American Anthropologist* 100(4):890–907.

———. 2001. "Hylobatid Communities: Changing Views on Pair Bonding and Social Organization in Hominoids." *Yearbook of Physical Anthropology* 43:33–60.

———. 2010. "Naturalcultural Encounters in Bali: Monkeys, Temples, Tourists, and Ethnoprimatology." *Cultural Anthropology* 25(4):600–624.

———. 2012. "Ethnoprimatology and the Anthropology of the Human–Primate Interface." *Annual Review of Anthropology* 41:101–117.

Galton, Francis. 1904. "Eugenics: Its Definition, Scope, and Aims." *American Journal of Sociology* 10(1):1–25.

Garland, Elizabeth. 2008. "The Elephant in the Room: Confronting the Colonial Character of Wildlife Conservation in Africa." *African Studies Review* 51(3):51–74.

Geertz, Clifford. 1963. *Agricultural Involution: The Processes of Ecological Change in Indonesia*. Berkeley, CA: University of California Press.

Geissmann, Thomas. 1984. "Inheritance of Song Parameters in the Gibbon Song, Analysed in 2 Hybrid Gibbons (*Hylobated pileatus x H. lar*)." *Folia Primatologica* 42(3-4):216–35.

———. 2000. "Gibbon Songs and Human Music from an Evolutionary Perspective." In *The Origins of Music*, by Steven Brown, Björn Merker, and Christina Wallin, 102–23. Cambridge, MA: MIT Press.

———. 2002. "Duet-Splitting and the Evolution of Gibbon Songs." *Biological Reviews* 77(1):57–76.

Geissmann, T., and M. Orgeldinger. 2000. "The Relationship Between Duet Songs and Pair Bonds in Siamangs, Hylobates Syndactylus." Animal Behaviour 60(6):805–809.

Gell, Alfred. 1998. *Art and Agency: An Anthropological Theory*. Oxford: Oxford University Press.

———. 1999. "Vogel's Net: Traps as Artworks and Artworks as Traps." In *The Art of Anthropology: Essays and Diagrams*, edited by Eric Hirsch, 187–214. London: Athlone.

Gibbon Conservation Center n.d. "Our Founder." Accessed 4 May 2022. https://www.gibboncenter.org/our-founder-alan-mootnick.html

Gilbert, Scott F., Jan Sapp, and Alfred I. Tauber. 2012. "A Symbiotic View of Life: We Have Never Been Individuals." *Quarterly Review of Biology* 87(4):325–341.

Gill, Denise. 2017. *Melancholic Modalities: Affect, Islam, and Turkish Classical Musicians*. New York: Oxford University Press.

Godfrey-Smith, Peter. 2001. "On the Status and Explanatory Structure of Developmental Systems Theory." In *Cycles of Contingency: Developmental Systems and Evolution*, edited by S. Oyama, P. E. Griffiths, and R. D. Gray, 283–297. Cambridge, MA: MIT Press.

Goldenweiser, Alan. 1936. "Loose Ends of Theory on the Individual, Pattern and Involution in Primitive Society." In *Essays in Anthropology Presented to A. L. Kroeber in Celebration of his Sixtieth Birthday, June 11, 1936*, edited by Robert Harry Lowie, 99–103. Berkeley, CA: University of California Press.

Goodman, Steve. 2010. *Sonic Warfare: Sound, Affect, and the Ecology of Fear*. Cambridge, MA: MIT Press.

Gopinath, Sumanth, and Jason Stanyek. 2013. "Tuning the Human Race." In *Music, Sound and Space: Transformations of Public and Private Experience*, edited by Georgina Born, 128–48. Cambridge: Cambridge University Press.

Graeber, David. 2005. "Fetishism as Social Creativity, or, Fetishes are Gods in the Process of Construction." *Anthropological Theory* 5(4):407–38.

———. 2014. "What's the Point If We Can't Have Fun?" *The Baffler*, June 12. https://thebaffler.com/salvos/whats-the-point-if-we-cant-have-fun.

Grant, Catherine. 2015. *Music Endangerment: How Language Maintenance Can Help*. Oxford: Oxford University Press.

Graper, Julianne Laurel. 2019. "Bat People: Multispecies Ethnomusicology in Austin, TX and Chiapas, MX." Ph.D. Diss., University of Texas at Austin.

Green, Lesley, ed. 2013. *Contested Ecologies: Dialogues in the South on Nature and Knowledge*. Cape Town, South Africa: HSRC Press.

Grossberg, Lawrence. 1986. “On Postmodernism and Articulation: An Interview with Stuart Hall.” *Journal of Communication Inquiry* 10(2):45–60.

Grosz, Elizabeth. 2008. *Chaos, Territory, Art: Deleuze and the Framing of the Earth*. New York: Columbia University Press.

———. 2011. *Becoming Undone: Darwinian Reflections on Life, Politics, and Art*. Durham, NC: Duke University Press.

Guilbault, Jocelyn. 2005. “Audible Entanglements: Nation and Diasporas in Trinidad’s Calypso Music Scene.” *Small Axe* 17:40–63.

Ham, Soojung, et al. 2016. “Song Functions in Nonduetting Gibbons: Evidence from Playback Experiments on Javan Gibbons (*Hylobates moloch*).” *International Journal of Primatology* 37:225–40.

Hanson, Katherine T., and Erin P. Riley. 2018. “Beyond Neutrality: The Human–Primate Interface During the Habituation Process.” *International Journal of Primatology* 39:852–877.

Haraway, Donna Jeanne. 1988. “Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective.” *Feminist Studies* 14(3):575–599.

———. 1989. *Primate Visions: Gender, Race, and Nature in the World of Modern Science*. New York: Routledge.

———. 1991. “A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century.” In *Simians, Cyborgs and Women: The Reinvention of Nature,* 149–81. New York: Routledge.

———. 2003. *The Companion Species Manifesto: Dogs, People, and Significant Otherness*. Chicago: Prickly Paradigm Press.

———. 2004. “The Promises of Monsters: A Regenerative Politics for Inappropriate/d Others.” In *The Haraway Reader*, 63–124. New York: Routledge.

———. 2008. *When Species Meet*. Minneapolis: University of Minnesota Press.

———. 2016. *Staying with the Trouble: Making Kin in the Chthulucene*. Durham, NC: Duke University Press.

———. 2019a. “It Matters What Stories Tell Stories; It Matters Whose Stories Tell Stories.” *a/b: Auto/Biography Studies* 34(3):565–75.

———. 2019b. “Donna Haraway and the ‘Chthulu’ Way of Life.” Interview by Catherine Vincent. *Le Monde Idées*. 1 February. https://www.lemonde.fr/idees/article/2019/02/01/donna-haraway-and-the-chthulu-way-of-life_5417974_3232.html.

Haraway, Donna, and Vinciane Despret. 2020. “Phonocene.” Dialogue at Centre de Cultura Contemporania de Barcelona, 16 December. https://www.youtube.com/watch?v=87HzPIEiF78.

Harman, Graham. 2005. *Guerrilla Metaphysics: Phenomenology and the Carpentry of Things*. Chicago: Open Court.

Harrison, Jack. 2020. “From the Horse’s Mouth: Musical ‘Originality’ in Freestyle Dressage.” *Ethnomusicology Forum* 29(2):145–65.

Haskell, David George. 2017. *The Songs of Trees: Stories from Nature’s Great Connectors*. London: Penguin.

Hediger, Heini. 1964. *Wild Animals in Captivity: An Outline of the Biology of Zoological Gardens*. Translated by G. Sircom. New York: Dover.

Heffner, Rickye S. 2004. “Primate Hearing from a Mammalian Perspective.” *Anatomical Record Part A 281A*:1111–22.

Hejnol, Andreas. 2017. “Ladders, Trees, Complexity, and Other Metaphors in Evolutionary Thinking.” In *Arts of Living on a Damaged Planet: Ghosts and Monsters of the Anthropocene*, edited by Anna Lowenhaupt Tsing, Heather Anne Swanson, Elaine Gan, and Nils Bubandt, 87–102. Minneapolis: University of Minnesota Press.

Helmreich, Stefan. 2003. “Trees and Seas of Information: Alien Kinship and the Biopolitics of Gene Transfer in Marine Biology and Biotechnology.” *American Ethnologist* 30(3):340–58.

———. 2007. “An Anthropologist Underwater: Immersive Soundscapes, Submarine Cyborgs, and Transductive Ethnography.” *American Ethnologist* 34(4):621–41.

———. 2009. *Alien Ocean:Anthropological Voyages in Microbial Seas*. Berkeley, CA: University of California Press.

———. 2010. “Listening Against Soundscapes.” *Anthropology News* 51(9):10.

———. 2015. “Transduction.” In *Keywords in Sound*, edited by David Novak and Matt Sakakeeny, 222–31. Durham, NC: Duke University Press.

———. 2016. “Gravity’s Reverb: Listening to Space-Time, or Articulating the Sounds of Gravitational-Wave Detection.” *Cultural Anthropology* 31(4):464–492.

Henare, Amiria J. M., Martin Holbraad, and Sari Wastell, eds. 2007. *Thinking through Things: Theorising Artefacts Ethnographically*. London: Routledge.

Hennessy, Elizabeth. 2018. "The Politics of a Natural Laboratory: Claiming Territory and Governing Life in the Galápagos Islands." *Social Studies of Science* 48(4):483–506.

Hicks, Andrew. 2017. *Composing the World: Harmony in the Medieval Platonic Cosmos*. Oxford: Oxford University Press.

Hight, Christopher. 2003. "Stereo Types: The Operation of Sound in the Production of Racial Identity." *Leonardo Music Journal* 36(1):13–17.

Hobbs, Laura. 2021. "Roosters on Steroids." *New Times San Luis Obispo*. 15 April. https://www.newtimesslo.com/sanluisobispo/roosters-on-steroids/Content?oid=10923490.

Holbraad, Martin. 2011. "Can the Thing Speak?" *Working Papers Series #7*. http://openanthcoop.net/press/2011/01/12/can-the-thing-speak/.

Holbraad, Martin, and Morten Axel Pedersen. 2017. *The Ontological Turn: An Anthropological Exposition*. Cambridge: Cambridge University Press.

Holt, Jim. 2017. "Company's Woes Still Plague SCV." *The Signal*. 3 May.

Hood, Mantle. 1960. "The Challenge of 'Bi-Musicality.'" *Ethnomusicology* 4(2):55–9.

Hradec, Michael, et al. 2021. "The Transition from the Female-like Great Calls to Male Calls during Ontogeny in Southern Yellow-cheeked Gibbon Males (*Nomascus gabriellae*)." *Scientific Reports* 11(1):1–9.

Husson, S. J., et al. 2018. "Biodiversity of the Sebangau Tropical Peat Swamp Forest, Indonesian Borneo." *Mires and Peat* 22:1–50.

Hustak, Carla, and Natasha Myers. 2012. "Involutionary Momentum." *differences* 23(3):74–118.

Ingold, Tim. 2004. "A Circumpolar Night's Dream." In *Figured Worlds: Ontological Obstacles in Intercultural Relations*, edited by John Clammer, Sylvie Poirier, and Eric Schwimmer, 25–57. Toronto: University of Toronto Press.

———. 2007. "Against Soundscapes." In *Autumn Leaves: Sound and the Environment in Artistic Practice*, edited by Angus Carlyle, 10–13. Paris: Double Entendre.

———. 2015. *The Life of Lines*. London: Routledge.

ISIS [International Species Information System]. 2005. *User Manual for Sparks: Single Population Analysis and Records Keeping System Version 1.5*. https://training.species360.org/Documents/Modules/Population%20Management%20-%20Sparks%201_5%20manual.pdf.

IUCN Primate Specialist Group's Section on Small Apes. n.d. "Singing." https://gibbons.asia/singing/ (accessed 6 May 2022).

James, Jamie. 1995. *The Music of the Spheres: Music, Science and the Natural Order of the Universe*. New York: Grove.

James, Robin. 2010. *The Conjectural Body: Gender, Race, and the Philosophy of Music*. Lanham, MD: Lexington Books.

———. 2019. *The Sonic Episteme: Acoustic Resonance, Neoliberalism, and Biopolitics*. Durman, NC: Duke University Press.

Jolly, Allison. 1999. *Lucy's Legacy: Sex and Intelligence in Human Evolution*. Cambridge, MA: Harvard University Press.

Kane, Brian. 2014. *Sound Unseen: Acousmatic Sound in Theory and Practice*. Oxford: Oxford University Press.

———. 2015. "Sound Studies without Auditory Culture: A Critique of the Ontological Turn." *Sound Studies* 1(1):2–21.

Keller, Evelyn Fox. 1995. *Refiguring Life: Metaphors of Twentieth Century Biology*. New York: Columbia University Press.

Kelman, Ari Y. 2010. "Rethinking the Soundscape: A Critical Geneology of a Key Term in Sound Studies." *Senses and Society* 5(2):212–34.

Keogh, Brent, and Ian Collinson. 2016. "'A Place for Everything, and Everything in its Place'—The (Ab)uses of Music Ecology." *Musicultures* 43(1):1–15.

Kepler, Johannes. 1997 [1619]. *The Harmony of the World*. Translated by E.J. Aiton, A.M. Duncan, and J.V. Field. N.p.: American Philosophical Society.

Kim, Claire Jean. 2015. *Dangerous Crossings: Race, Species, and Nature in a Multicultural Age*. Cambridge: Cambridge University Press.

Kimmerer, Robin Wall. 2020. "The Serviceberry: An Economy of Abundance." *Emergence Magazine.* 10 December. https://emergencemagazine.org/essay/the-serviceberry/.

Kirksey, Eben. 2015. "Species: A Praxiographic Study." *Journal of the Royal Anthropological Institute* 21:758–80.

Kirksey, S. Eben, and Stefan Helmreich. 2010. “The Emergence of Multispecies Ethnography.” *Cultural Anthropology* 25(4):545–576.

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

Koons, Ryan A. 2019. “Becoming Avian in the Anthropocene: Performing the Feather Dance and the Owl Dance at Pvlvcekolv.” *Humanimalia* 10(2):95–127.

Kotsko, Adam. 2021. “What Happened to Giorgio Agamben?” *Slate*. 20 February. https://slate.com/human-interest/2022/02/giorgio-agamben-covid-holocaust-comparison-right-wing-protest.html.

Krause, Bernard L. 2012. *The Great Animal Orchestra: Finding the Origins of Music in the World’s Wild Places*. New York: Little, Brown and Co.

———. 2015. *Voices of the Wild: Animal Songs, Human Din, and the Call to Save Natural Soundscapes*. New Haven: Yale University Press.

Kuhn, Thomas S. 1962. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.

LaBelle, Brandon. 2012. *Acoustic Territories: Sound Culture and Everyday Life*. New York: Continuum.

Lakoff, George, and Mark Johnson. 1980. *Metaphors We Live by*. Chicago: University of Chicago Press.

Latour, Bruno. 1988. *Science in Action*. Cambridge, MA: Harvard University Press.

———. 2004a. "How to Talk About the Body? The Normative Dimension of Science Studies." *Body & Society* 10(2–3):205–229.

———. 2004b. “Whose Cosmos, Whose Cosmopolitics?: Comments on the Peace Terms of Ulrich Beck.” *Common Knowledge* 10(3):450–462.

———. 2005. *Reassembling the Social: An Introduction to Actor-Network Theory*. Oxford: Oxford University Press.

———. 2017. *Facing Gaia: Eight Lectures on the New Climatic Regime*. Translated by Catherine Porter. Boston: Polity Press.

Law, John, and Marianne Elisabeth Lien. 2018. “Denaturalizing Nature.” In *A World of Many Worlds*, edited by Marisol de la Cadena and Mario Blaser, 131–71. Durham, NC: Duke University Press.

LeBoeuf, Edith. 2021. “Gibbon Center Move Questioned.” *The Signal*. 20 April. https://signalscv.com/2021/04/edith-leboeuf-gibbon-center-move-questioned/.

Leighton, D.R. 1987. “Gibbons: Territoriality and Monogamy.” In *Primate Societies*, edited by B. B. Smuts, D. L. Cheney, R. M. Seyfarth, R. W. Wrangham, and T. T. Struhsaker, 135–45. Chicago: University of Chicago Press.

Lempert, William. 2021. “From Interstellar Imperialism to Celestial Wayfinding: Prime Directives and Colonial Time-Knots in SETI.” *American Indian Culture and Research Journal* 45(1):45–70.

Lentjes, Rebecca. 2018. “Hearing Queerly: The Gendered and Sexual Politics of Music Metaphors” *Van Magazine*. 28 June. https://van-magazine.com/mag/hearing-queerly.

Lestel, Dominique, et al. 2006. “Etho-ethnology and Ethno-ethology.” *Social Science Information* 45(2):155–77.

Levitin, Daniel J. 2008. *The World in Six Songs*. Boston: Dutton.

Lezaun, Javier, and Natalie Porter. 2015. “Containment and Competition: Transgenic Animals in the One Health Agenda.” *Social Science & Medicine* 129:96–105.

Liboiron, Max. 2021. *Pollution is Colonialism*. Durham, NC: Duke University Press.

Locke, Piers, and Jane Buckingham, eds. 2016. *Conflict, Negotiation, and Coexistence: Rethinking Human-Elephant Relations in South Asia*. New Delhi, India: Oxford University Press.

Lorimer, Jamie. 2010. “Elephants as Companion Species: The Lively Biogeographies of Asian Elephant Conservation in Sri Lanka.” *Transactions of the Institute of British Geographers* 35:491–506.

Lowe, Celia. 2006. *Wild Profusion: Biodiversity Conservation in an Indonesian Archipelago*. Princeton, NJ: Princeton University Press.

———. 2010. “Viral Clouds: Becoming H5N1 in Indonesia.” *Cultural Anthropology* 25(4):625–49.

Mâche, François-Bernard. 2001. *Musique au singulier*. Paris: Odile Jacob.

Mader, Mary Beth. 2011. *Sleights of Reason: Norm, Bisexuality, Development*. Albany: SUNY Press.

Maples, Ernest. G., et al. 1989. “Development of Coordinated Singing in a Newly Formed Siamang Pair (*Hylobates syndactylus*).” *Zoo Biology* 8(4):367–378.

Margulis, Lynn, and Dorion Sagan. 1990. *What is Life?* Berkeley, CA: University of California Press.

Martin, Aryn, Natasha Myers, and Ana Viseu. 2015. "The Politics of Care in Technoscience." *Social Studies of Science* 45(5):625–41.

Martinelli, Dario. 2009. *Of Birds, Whales, and Other Musicians*. Scranton: University of Scranton Press.

Martínez-Reyes, José Eduardo. 2016. *Moral Ecology of a Forest: The Nature Industry and Maya Post-Conservation*. Tucson: University of Arizona Press.

Marx, Karl. 2007 [1867]. *Capital: A Critique of Political Economy, Volume I—Part I, The Process of Capitalist Production*. Edited by Friedrich Engels. New York: Cosimo Books.

Mazzucato, Olivia. 2019. "Graduate Student Examines Gibbon Conservation Through Song." *Daily Bruin*. 24 September. https://dailybruin.com/2019/09/18/monkey-sing-monkey-do-graduate-student-examines-gibbon-conservation-through-song.

Mbembe, Achille. 2003. "Necropolitics." *Public Culture* 15(1):11–40.

McClary, Susan. 1990. *Feminine Endings: Music, Gender, and Sexuality*. Minneapolis: University of Minnesota Press.

Meillassoux, Quentin. 2008. *After Finitude: An Essay on the Necessity of Contingency*. New York: Continuum.

Meintjes, Louise. 2019. "Ululation." In *Remapping Sound Studies*, edited by Gavin Steingo and Jim Sykes, 61–76. Durham, NC: Duke University Press.

Mitani, John C., and Peter Marler. 1989. "A Phonological Analysis of Male Gibbon Singing Behavior." *Behavior* 109(1/2):20–45.

Mithen, Steven. 2006. *The Singing Neanderthals: The Origins of Music, Language, Mind, and Body*. Cambridge, MA: Harvard University Press.

Mody, Cyrus. 2005. "The Sounds of Science: Listening to Laboratory Practice." *Science, Technology, & Human Values* 30(2):175–198.

Moore, Jason W. 2016. *Anthropocene or Capitalocene? Nature, History, and the Crisis of Capitalism*. Oakland, CA: PM Press.

Mootnick, Alan R. 2006. "Gibbon (Hylobatidae) Species Identification Recommended for Rescue or Breeding Centers." *Primate Conservation* 21:103–38.

Mootnick, Alan R., and Elaine Baker. 1994. “Masturbation in Captive *Hylobates* (Gibbons).” *Zoo Biology* 13:345–53.

Mootnick, Alan. n.d. “Sanctuaries.” *Wisconsin National Primate Research Center*. https://primate.wisc.edu/primate-info-net/career-center/pin-career-areas/pin-careers-sanctuaries/.

Morton, Timothy. 2007. *Ecology without Nature: Rethinking Environmental Aesthetics*. Cambridge, MA: Harvard University Press.

Mundy, Rachel. 2018. *Animal Musicalities: Birds, Beasts, and Evolutionary Listening*. Middletown, CT: Wesleyan University Press.

Murphy, Michelle. 2017. *The Economization of Life*. Durham, NC: Duke University Press.

———. 2018. “Against Population, towards Alterlife.” In *Making Kin Not Population*, edited by Adele E. Clarke and Donna Jeanne Haraway, 101–24. Chicago: Prickly Paradigm Press.

Myers, Natasha. 2015. *Rendering Life Molecular: Models, Modelers, and Excitable Matter*. Durham, NC: Duke University Press.

Nader, Laura. 1990. *Harmony Ideology: Justice and Control in a Zapotec Mountain Village*. Stanford, CA: Stanford University Press.

———. 1997. “Controlling Processes: Tracing the Dynamic Components of Power.” *Current Anthropology* 38(5):711–37.

———. 2001. “Harmony Coerced is Freedom Denied.” *The Chronicle of Higher Education*. 13 July. https://www.chronicle.com/article/harmony-coerced-is-freedom-denied/.

Nagel, Thomas. 1974. “What Is It Like to Be a Bat?” *Philosophical Review* 83(4):435–50.

Nannyonga-Tamusuza, Sylvia, and Andrew N. Weintraub. 2012. “The Audible Future: Reimagining the Role of Sound Archives and Sound Repatriation in Uganda.” *Ethnomusicology* 56(2):206–233.

National Institute on Deafness and Other Communications Disorders. 2019. “Too Loud. Too Long.” https://www.noisyplanet.nidcd.nih.gov/parents/too-loud-too-long.

Novak, David. 2015. “Noise.” In *Keywords in Sound*, edited by David Novak and Matt Sakakeeny, 125–38. Durham, NC: Duke University Press.

O'Brien, Michael S. 2018. “‘El bombo loco’: Sounding Alterity and Populism in Buenos Aires.” *Ethnomusicology* 62(3):439–469.

O'Hagan, Robert. 2013. "Intra- and Inter-Group Communication in the Southern-Bornean Gibbon (*Hylobates albibarbis*) in the National Laboratory for Peat-Swamp Forest, Sabangau Catchment, Indonesia." MSc diss., Oxford Brooke University.

O'Neil, Cathy. 2016. *Weapons of Math Destruction*. Washington, D.C.: Crown Books.

Ochoa Gautier, Ana María. 2014. *Aurality: Listening and Knowledge in Nineteenth-Century Colombia*. Durham, NC: Duke University Press.

———. 2016. "Acoustic Multinaturalism, the Value of Nature, and the Nature of Music in Ecomusicology." *Boundary 2* 43(1):107–141.

Pacciuli, Lisa M., and Kristin Sabbi. 2017. "How Do Pagai, Mentawai Island (Sumatra, Indonesia) Nonhuman Primate Characteristics Affect Hunters' Prey Selection?" In *Ethnoprimatology: A Practical Guide to Research at the Human-Nonhuman Primate Interface*, edited by Kerry M. Dore, Erin P. Riley, and Augustin Fuentes, 122–135. Cambridge: Cambridge University Press.

Palmer, Alexandra, and Nicholas Malone. 2018. "Extending Ethnoprimatology: Human–Alloprimate Relationships in Managed Settings." *International Journal of Primatology* 39:831–851.

Parreñas, Juno Salazar. 2018. *Decolonizing Extinction: The Work of Care in Orangutan Rehabilitation*. Durham, NC: Duke University Press.

———. 2021. "Pronouns for an Apocalyptic Future: Asymmetrical Terms for a New Era." *Tapuya: Latin American Science, Technology, and Society* 4(1):1–14.

Paxson, Heather. 2012. *The Life of Cheese: Crafting Food and Value in America*. Berkeley, CA: University of California Press.

Pedelty, Mark. 2016. *A Song to Save the Salish Sea: Musical Performance as Environmental Activism*.

Piekut, Benjamin. 2014. "Actor-Networks in Music History: Clarifications and Critiques." *Twentieth-Century Music* 11(2):191–215.

Pijanowski, Bryan C., et al. 2011. "Soundscape Ecology: The Science of Sound in the Landscape." *BioScience* 61:203–16.

Pinch, Trevor, and Karin Bijsterveld. 2012. "New Keys to the World of Sound." In *The Oxford Handbook of Sound Studies*, edited by Trevor Pinch and Karin Bijsterveld, 3–35. New York: Oxford University Press.

Pinker, Steven. 1997. *How the Mind Works*. New York: Norton.

Post, Jennifer. 2021. “Threatened Soundscapes in Mongolia.” *Sensate* 1(8). https://sensatejournal.com/threatened-soundscapes-in-mongolia.

Povinelli, Elizabeth. 1995. “Do Rocks Listen? The Cultural Politics of Apprehending Australian Aboriginal Labor.” *American Anthropologist* 97(3):505–18.

———. 2016. *Geontologies: A Requiem to Late Liberalism*. Durham, NC: Duke University Press.

Pratt, Mary Lousie. 1991. “Arts of the Contact Zone.” *Profession* 1991:33–40.

Puar, Jasbir K. 2007. *Terrorist Assemblages: Homonationalism in Queer Times*. Durham, NC: Duke University Press.

Puig de Bellacasa, María. 2017. *Matters of Care: Speculative Ethics in More Than Human Worlds*. Minneapolis: University of Minnesota Press.

Raffles, Hugh. 2010. *Insectopedia*. New York: Pantheon Books.

Rancière, Jacques. 1999. *Disagreement: Politics and Philosophy*. Minneapolis: University of Minnesota Press.

———. 2004. *The Politics of Aesthetics: The Distribution of the Sensible*. Translated by Gabriel Rockhill. London: Continuum.

Rees, Amanda. 2007. “Reflections on the Field: Primatology, Popular Science and the Politics of Personhood.” *Social Studies of Science* 37(6):881–907.

———. 2009. *The Infanticide Controversy: Primatology and the Art of Field Science*. Chicago: University of Chicago Press.

Reisland, Melissa A., and Joanna E. Lambert. 2017. “Flexibility in Javan Gibbon (*Hylobates moloch*) Response to Human Disturbance.” In *Ethnoprimatology: A Practical Guide to Research at the Human-Nonhuman Primate Interface*, edited by Kerry M. Dore, Erin P. Riley, and Augustin Fuentes, 137–153. Cambridge: Cambridge University Press.

Rice, Tom, Alexander Badman-King, et al. 2021. “Listening After the Animals: Sound and Pastoral Care in the Zoo.” *Journal of the Royal Anthropological Institute* 27(4):850–69.

Rice, Tom, Adam Reed, et al. 2021. “Listening to the Zoo: Challenging Zoo Visiting Conventions." *Ethnos*. https://doi.org/10.1080/00141844.2021.1966070.

Rice, Tom, and Steven Feld. 2021. “Questioning Acoustemology: An Interview with Steven Feld.” *Sound Studies* 7:119–132.

Riley, Erin P. 2018. “The Maturation of Ethnoprimatology: Theoretical and Methodological Pluralism.” *International Journal of Primatology* 39:705–729.

———. 2020. *The Promise of Contemporary Primatology*. New York: Routledge.

Riley, Erin P., et al. 2017. “Introduction: Doing Ethnoprimatology in the Anthropocene.” In *Ethnoprimatology: A Practical Guide to Research at the Human-Nonhuman Primate Interface*, edited by Kerry M. Dore, Erin P. Riley, and Augustin Fuentes, 1–6. Cambridge: Cambridge University Press.

Robinson, Dylan. 2020. *Hungry Listening: Resonant Theory for Indigenous Sound Studies*. Minneapolis: University of Minnesota Press.

Roda, P. Allen. 2007. "Toward a New Organology: Material Culture and the Study of Musical Instruments." *Material World Blog*. http://www.materialworldblog.com/2007/11/toward-a-new-organology-material-culture-and-the-study-of-musical-instruments/.

Rodgers, Tara. 2010. *Pink Noises: Women on Electronic Music and Sound*. Durham, NC: Duke University Press.

Roosth, Sophia. 2009. “Screaming Yeast: Sonocytology, Cytoplasmic Milieus, and Cellular Subjectivities.” *Critical Inquiry* 35(2):332–50.

Roquet, Paul. 2020. “Acoustics of the One Person Space: Headphone Listening, Detachable Ambiance, and the Binaural Prehistory of VR.” *Sound Studies* 7(1):42–63.

Rose, Deborah Bird. 2000. *Dingo Makes Us Human: Life and Land in an Australian Aboriginal Culture*. Cambridge: Cambridge University Press.

———. 2006. “What if the Angel of History Was a Dog?” *Cultural Studies Review* 12(1):67–78.

Rose, Deborah, and Thom van Dooren. 2011. “Introduction.” *Australian Humanities Review* 50:1–4.

Rose, Deborah, Thom van Dooren, and Matthew Chrulew, eds. 2017. *Extinction Studies: Stories of Time, Death, and Generations*. New York: Columbia University Press.

Rothenberg, David. 2006. *Why Birds Sing: A Journey into the Mystery of Bird Song*. New York: Basic Books.

———. 2010. *Thousand Mile Song: Whale Music in a Sea of Sound*. New York: Perseus Books.

———. 2014. *Bug Music: How Insects Gave Us Rhythm and Noise*. New York: St. Martin’s.

Rudge, Alice. 2020. “Don’t Make Me Laugh: How Getting it Wrong Shapes Interspecies Entanglements in the Batek’s Forest.” *Allegra Lab*. https://allegralaboratory.net/dont-

make-me-laugh-how-getting-it-wrong-shapes-interspecies-entanglements-in-the-bateks-forest/.

Russell, Edmund. 2004. “The Garden in the Machine.” In *Industrializing Organisms: Introducing Evolutionary History*, edited by Susan Schrepfer and Philip Scranton, 1–18. London: Routledge.

Rutz, Christian, et al. 2020. “COVID-19 Lockdown Allows Researchers to Quantify the Effects of Human Activity on Wildlife.” *Nature Ecology & Evolution* 4:1156–59.

Sahlins, Marshall. 2008. *The Western Illusion of Human Nature: With Reflections on the Long History of Hierarchy, Equality, and the Sublimation of Anarchy in the West, and Comparative Notes on Other Conceptions of the Human Condition*. Chicago: Prickly Paradigm Press.

———. 2013. *What Kinship Is—And What It Is Not*. Chicago: University of Chicago Press.

Saini, Angela. 2019. *Superior: The Return of Race Science*. London: 4th Estate.

Schaeffer, Pierre. 1966. *Traité des objets musicaux*. Paris: Éditions du Seuil.

Schafer, Raymond Murray. 1993 [1977]. *The Soundscape: The Tuning of the World*. Toronto: McClelland and Stewart.

Schneider, David M. 1968. *American Kinship: A Cultural Account*. Chicago: University of Chicago Press.

Schippers, Huib. 2016. “Sound Futures: Exploring the Ecology of Sustainability in Music.” In *Sustainable Futures for Music Cultures*, edited by Huib Schippers and Catherine Grant, 1–18. Oxford: Oxford University Press.

Schroer, Sara Asu. 2021. “Jakob von Uexküll: The Concept of *Umwelt* and its Potentials for an Anthropology Beyond the Human.” *Ethnos* 86(1):132–52.

Schwartz, Jessica A. 2021. *Radiation Sounds: Marshallese Music and Nuclear Silences*. Durham, NC: Duke University Press.

Searle, Adam. 2020. “Anabiosis and the Liminal Geographies of De/extinction.” *Environmental Humanities* 12(1):321–45.

Seaver, Nick. 2018. “What Should an Anthropology of Algorithms Do?” *Cultural Anthropology* 33(3):375–85.

———. 2019. “Captivating Algorithms: Recommender Systems as Traps.” *Material Culture* 24(4):421–36.

Seeger, Anthony. 1992. “Ethnomusicology and Music Law.” *Ethnomusicology* 36(3): 354–59.

Shapin, Steven, and Simon Schaffer. 1985. *The Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life*. Princeton, NJ: Princeton University Press.

Shorter, David Delgado. 2016. “Spirituality.” In *The Oxford Handbook of American Indian History*, edited by Frederick E. Hoxie, 433–52.

———. 2021. “On the Frontier of Redefining ‘Intelligent’ Life in Settler Science.” *American Indian Culture and Research Journal* 45(1):19–44.

Shorter, David, and Kim Tallbear. 2021. “An Introduction to Settler Science and the Ethics of Contact.” *American Indian Culture and Research Journal* 45(1):1–7.

Silvers. 2020. “Attending to the Nightingale: On a Multispecies Ethnomusicology.” *Ethnomusicology* 64(2):199–224.

Skollar, Gabriella. 2017. “The Holiday Gibbon’s Voice.” https://mailchi.mp/gibboncenter/holiday-greetings-from-the-gibbon-conservation-center?e=e1079e549b.

———. 2021. “An Honest Conversation: The Gibbon Conservation Center's Response to ‘Roosters on Steroids.’” *New Times San Luis Obispo*. 22 April. https://www.newtimesslo.com/sanluisobispo/an-honest-conversation/Content?oid=10949256.

Sloterdijk, Peter. 2013. *You Must Change Your Life*. Malden, MA: Polity Press.

Smith, Ian A. 2018. *The Intrinsic Value of Endangered Species*. London: Routledge.

Smuts, Barbara. 2001. “Encounters with Animal Minds.” *Journal of Consciousness Studies* 8 (5–7):293–309.

Solnit, Rebecca. 2014. “Listen Up, Women Are Telling Their Story Now.” *The Guardian*. 30 December. http://www.theguardian.com/news/2014/dec/30/-sp-rebecca-solnit-listen-up-women-are-telling-their-story-now.

IUCN SOS. n.d. “SOS Gibbons.” https://iucnsos.org/initiative/sos-gibbons/.

Staddon, Sam, et al. 2021. “The Value of Listening and Listening for Values in Conservation.” *People and Nature*. DOI:10.1002/pan3.10232.

Steffen, Will, Paul J. Crutzen, and John R. McNeill. 2007. “The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?” *Ambio* 36(8):614–621.

Steingo, Gavin. 2018. “Actors and Accidents in South African Electronic Music: An Essay on Multiple Ontologies.” *Contemporary Music Review* 37(5–6):554–574.

———. 2021. “Whale Calling.” *Ethnomusicology* 65(2):350–73.

Stengers, Isabelle. 2000. *The Invention of Modern Science*. Minneapolis: University of Minnesota Press.

———. “The Cosmopolitical Proposal.” In *Making Things Public: Atmospheres of Democracy*, edited by Bruno Latour and Peter Weibel, 994–1003. Boston: MIT Press.

———. 2010. *The Invention of Modern Science*. Minneapolis: University of Minnesota Press.

———. 2011. *Cosmopolitics I*. Minneapolis: University of Minnesota Press.

Sterne, Jonathan. 2003. *The Audible Past: Modernity, Technology, and the Cultural History of Sound*. Durham, NC: Duke University Press.

Sterne, Jonathan, and Mitchell Akiyama. 2012. “The Recording that Never Wanted to be Heard and Other Stories of Sonification.” In *The Oxford Handbook of Sound Studies*, edited by Trevor Pinch and Karin Bijsterveld, 544–60. New York: Oxford University Press.

Strathern, Marilyn. 1988. *The Gender of the Gift: Problems with Women and Problems with Society in Melanesia*. Berkeley: University of California Press.

———. 2004. *Partial Connections*. Walnut Creek, CA: Alta Mira Press.

Strum, Shirley. 1987. *Almost Human: A Journey into the World of Baboons*. New York: Random House.

Subramaniam, Banu. 2014. *Ghost Stories for Darwin: The Science of Variation and the Politics of Diversity*. Urbana: University of Illinois Press.

Sundberg, Juanita. 2004. “Identities in the Making: Conservation, Gender and Race in the Maya Biosphere Reserve, Guatemala.” *Gender, Place & Culture* 11(1):43–66.

———. 2006. “Conservation Encounters: Transculturation in the ‘Contact Zones’ of Empire.” *Cultural Geographies* 13(2):239–265.

Sykes, Jim. 2021. “Indian Ocean Listening Stations: Governmental Ears, Surveillance Acoustemologies, and the Maritime Silk Road.” *Diplomatica* 3:335–61.

Takasaki, Hiroyuki. 2000. “Traditions of the Kyoto School of Field Primatology in Japan.” In *Primate Encounters*, edited by Shirley Strum and Linda Marie Fedigan, 151–64. Chicago: University of Chicago Press.

TallBear, Kimberly. 2013. *Native American DNA: Tribal Belonging and the False Promise of Genetic Science*. Minneapolis: University of Minnesota Press.

———. 2016. "Failed Settler Kinship, Truth and Reconciliation, and Science." https://indigenoussts.com/failed-settler-kinship-truth-and-reconciliation-and-science.

Taylor, Timothy D. 2007. *Beyond Exoticism: Western Music and the World*. Durham, NC: Duke University Press.

Tenaza, Richard. 1985. “Songs of Hybrid Gibbons (*Hylobates lar* × *H. muelleri*).” *American Journal of Primatology* 8:249–53.

Thomas, Suzanne L., Dawn Nafus, and Jamie Sherman. 2018. “Algorithms as Fetish: Faith and Possibility in Algorithmic Work.” *Big Data and Society* 5(1):1–11.

Thompson, Charis. 2002. “When Elephants Stand for Competing Philosophies of Nature: Amboseli National Park, Kenya.” In *Complexities: Social Studies of Knowledge Practices*, edited by John Law and Annemarie Mol, 166–90. Durham, NC: Duke University Press.

Thompson, Emily. 2002. *The Soundscape of Modernity: Architectural Acoustics and the Culture of Listening in America, 1900–1933*. Boston: MIT Press.

Titon, Jeff Todd. 2013. “The Nature of Ecomusicology.” *Música e Cultura: Revista Da ABET* 8(1):8–18.

———. 2020. *Toward a Sound Ecology: New and Selected Essays*. Bloomington: Indiana University Press.

Todd, Zoe. 2016. “Fish Pluralities: Human-animal Relations and Sites of Engagement in Paulatuuq, Arctic Canada.” *Études/Inuit/Studies* 38(1-2):217–38.

Tolbert, Elizabeth. 2001. “The Enigma of Music, the Voice of Reason: ‘Music,’ ‘Language,’ and Becoming Human.” *New Literary History* 32 (3): 451–65.

Tresch, John, and Emily I. Dolan. 2013. "Toward a New Organology: Instruments of Music and Science." *Osiris* 28:278–298.

Truax, Barry. 1984. *Acoustic Communication*. Norwood, NJ: Ablex.

Truax, Barry, et al. 2006. “World Soundscape Project.” In *The Canadian Encyclopedia*, edited by James Marsh. https://www.thecanadianencyclopedia.ca/en/article/world-soundscape-project.

Tsing, Anna Lowenhaupt. 2005. *Friction: An Ethnography of Global Connection*. Princeton: NJ: Princeton University Press.

———. 2012. “On Nonscalability: The Living World Is Not Amenable to Precision-Nested Scales.” *Common Knowledge* 18(3):505–24.

———. 2015. *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins*. Princeton, NJ: Princeton University Press.

———. 2017. “A Threat to Holocene Resurgence Is a Threat to Livability.” In *The Anthropology of Sustainability: Beyond Development and Progress*, edited by Marc Brightman and Jerome Lewis, 51–65. New York: Palgrave Macmillan.

Tsing, Anna Lowenhaupt, Heather Anne Swanson, Elaine Gan, and Nils Bubandt, eds. 2017. *Arts of Living on a Damaged Planet*. Minneapolis: University of Minnesota Press.

Tucker, Joshua. 2016. “The Machine of Sonorous Indigeneity: Craftsmanship and Sound Ecology in an Andean Instrument Workshop.” *Ethnomusicology Forum* 25(3):326–344.

Turvey, Samuel T., et al. 2019. “Differential Loss of Components of Traditional Ecological Knowledge Following a Primate Extinction Event.” *Royal Society of Open Science* 5:172352.

Uexküll, Jakob von. 1933. *Staatsbiologie*. Hamburg: Hanseatische Verlagsanstalt.

———. 2001 [1937]. “The New Concept of Umwelt: A Link Between Science and the Humanities,” translated by Gösta Brunow. *Semiotica* 134(1-4):111–23.

———. 2010 [1934]. *A Foray Into the Worlds of Animals and Humans, with A Theory of Meaning*. Translated by Joseph D. O’Neil. Minneapolis: University of Minnesota Press.

Viveiros de Castro, Eduardo. 1998. “Cosmological Deixis and Amerindian Perspectivism.” *Journal of the Royal Anthropological Institute* 4(3):469–488.

———. 2004. “Perspectival Anthropology and the Method of Controlled Equivocation.” *Tipití: Journal of the Society for the Anthropology of Lowland South America* 2(1):3–20.

———. 2010. “Intensive Filiation and Demonic Alliance.” In *Deleuzian Intersections: Science, Technology, Anthropology*, edited by Casper Bruun Jensen and Kjetol Rödje, 219–54. New York: Berghan Books.

Viveiros de Castro, Eduardo, and Déborah Danowski. 2018. “Humans and Terrans in the Gaia War.” In *A World of Many Worlds*, edited by Marisol de la Cadena and Mario Blaser, 172–203. Durham, NC: Duke University Press.

Wagner, Roy. 1975. *The Invention of Culture*. Chicago: University of Chicago Press.

———. 1978. *Lethal Speech: Daribi Myth as Symbolic Obviation*. Ithaca, NY: Cornell University Press.

———. 1986. *Symbols That Stand for Themselves*. Chicago: University of Chicago Press.

———. 1987. "Figure-Ground Reversal among the Barok." In *Assemblage of Spirits: Idea and Image in New Ireland,* edited by Louise Lincoln, 56–62. New York: George Braziller.

———. 1991. "The Fractal Person." In *Big Men and Great Men: Personifications of Power in Melanesia*, edited by Marilyn Strathern and Maurice Godelier, 159–73. Cambridge: Cambridge University Press.

———. 2001. *An Anthropology of the Subject*: *Holographic Worldview in New Guinea and Its Meaning and Significance for the World of Anthropology*. Berkeley, CA: University of California Press.

Waters, Siân, et al. 2018. "Understanding Human-Animal Relations in the Context of Primate Conservation: A Multispecies Ethnographic Approach in North Morocco." *Folia Primatologica* 89:13–29.

Weisman, Alan. 2007. *The World Without Us*. New York: Thomas Dunne Books/St. Martin's Press.

Wheatley, Bruce P. 1999. *The Sacred Monkeys of Bali*. Prospect Heights, NY: Waveland.

Whitehouse, Andrew. 2015. "Listening to Birds in the Anthropocene: The Anxious Semiotics of Sound in a Human-Dominated World." *Environmental Humanities* 6(1):53–71.

Whiten, Andrew, Victoria Horner, and Sarah Marshall-Pescini. 2003. "Cultural Panthropology." *Evolutionary Anthropology* 12:95–105.

Willey, Angela. 2016. *Undoing Monogamy: The Politics of Science and the Possibilities of Biology*. Durham, NC: Duke University Press.

Wilson, Edward O. 1975. *Sociobiology: The New Synthesis*. Cambridge, MA: Harvard University Press.

———. 2002. *The Future of Life*. New York: Knopf.

Wittgenstein, Ludwig. 1958. *Philosophical Investigations*. Translated by G. E. M. Anscombe. Oxford: Basil Blackwell.

Yamada, Keisuke. 2017. "Shamisen Skin on the Verge of Extinction: Musical Sustainability and Non-scalability of Cultural Loss." *Ethnomusicology Forum* 26(3):373–96.

Yamin, Tyler. 2019. “One or Several Gamelan? Perpetual (Re)construction in the Life of a Balinese *Gamelan Semara Pagulingan*.” *Ethnomusicology* 63(3):357–92.

———. Forthcoming. “The *Cålåpitå* Past the ‘Dull Edge’ of Extinction: A Shaggy Dog Story of Repatriation and Refusal in Bali.” In *Instrumental Lives: Musical Instruments, Material Culture, and Social Networks in East and Southeast Asia*, edited by Helen Rees. Under contract with University of Illinois Press.

Yates-Doerr. Emily. 2015. “Does Meat Come from Animals?: A Multispecies Approach to Classification and Belonging in Highland Guatemala.” *American Ethnologist* 42(2):309–23.

Yong, Ed. 2017. “Trees Have Their Own Songs.” *The Atlantic*. 4 April. https://www.theatlantic.com/science/archive/2017/04/trees-have-their-own-songs/521742/.

Youatt, Rafi. 2015. *Counting Species: Biodiversity in Global Environmental Politics*. Minneapolis: University of Minnesota Press.

Yusoff, Kathryn. 2018. *A Billion Black Anthropocenes or None*. Minneapolis: University of Minnesota Press.

Zhang, Amy. 2020. “Circularity and Enclosures: Metabolizing Waste with the Black Soldier Fly.” *Cultural Anthropology* 35(1):74–103.

Ziskind, Richard A., et al. 1981. “Health Effects in Children Exposed to Vinyl Chloride.” A report prepared for the United States Environmental Protection Agency. https://scvhistory.com/scvhistory/lw2661.htm.