

# Urban Intonation

## Listening to the Rats of New York City

BRIAN HOUSE

ABSTRACT

From urbanization to biomedical science, rats can be found in the foundations of modernity. Communicating ultrasonically above the ~20 kHz frequency limit of human hearing, rats are also well adapted for the human-built environment and its anthropogenic noise. For the sound installation *Urban Intonation*, the author recorded rats on the streets of New York City with an ultrasonic microphone and resampled and remixed the audio for playback over a human public address system. Repositioning rat sounds as something recognizable, if not intelligible, as speech prompts humans to reconsider their relationship to their oft-reviled nonhuman cohabitants.

I'll play you a sound I recorded at the northwest corner of Columbus Park in Manhattan. The clip is from a Thursday afternoon in early summer, and if you've ever been to New York (or any big city for that matter), what you'll hear is unremarkable: the background hum of traffic; the brakes of a truck and its engine revving; some unintelligible shouting; what could be someone sweeping outside of a storefront; and, since it is, after all, a park, the call of birds. The urban soundscape is chaotic, which is not necessarily a bad thing; where there are experiences to be had, connections to be made, truths to be discovered, there is noise.

But let's listen to the recording again. This time, the audio has been run through some digital signal processing. It has come out lower in pitch—24 times lower. Everything you could hear before has become inaudible. What you hear instead is everything that was previously too high frequency to perceive, sounds so high that in the city they reverberate above the din of humans and our machinery. What do they sound like? Undeniably, they are voices, and they are engaged in all manner of social dynamics. There are cries of joy and excitement, and there are shouts of warning, admonishment, and displeasure. Percussive chatter mixes with plaintive questioning, and most relatable of all are the occasional bouts of laughter. The voices are not, however, human. As familiar as

the expressions may seem, the creatures making them are not easily identified, which makes them uncanny and makes us uneasy.

What you hear are rats (Fig. 1). These are not the familiar squeaks that rats make when they are angry and want humans to leave them alone (those are the lowest sounds they can make). Among themselves, rats speak at another—ultrasonic—register. Tuning in to these conversations gives us a chance to hear rats as they are, free from the heavy cultural associations they carry. And in so doing, we might subsequently reconsider the ways in which we are entangled with our urban cohabitants.

This premise is the basis for my work of sound art titled *Urban Intonation* (2017), and this paper describes the work's conceptual and material underpinnings. By situating it within a network of critical, technical, and aesthetic concerns, I speak to art's capacity to hold us in a complex encounter, one that resists the boundaries that have plagued our relationship to the nonhuman world. And as it turns out, this work is not only about listening to rats but also about the realization that rats have been relating to us through sound all along.

### RATS AND HUMANS

It's not by chance that we've encountered rats in Columbus Park. Once known as Mulberry Bend, this was the heart of Five Points, a nineteenth-century tenement neighborhood and notorious slum. The area was made famous by Jacob Riis's pioneering work of photojournalism *How the Other Half Lives* [1]. In it, Riis's descriptions of the adverse living conditions of immigrant families are peppered with references to the ubiquitous rats, including a horrific (and, one hopes, apocryphal) episode in which they devour a sleeping child. This site, now surrounded by Chinatown, remains a hotbed of burrows, and it is emblematic of New York's close association with rats and the oft-cited but exaggerated statistic that the city has an equal number of human and murine inhabitants [2].

Brian House (artist), Amherst College, Department of Art & the History of Art, 220 South Pleasant Street, Amherst, MA 01002, U.S.A. Email: bhouse@amherst.edu. Website: brianhouse.net. ORCID: 0000-0002-0597-1987.

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**Fig. 1.** Entrance to a rat burrow in the Lower East Side. (© Brian House)

The brown rat—*Rattus norvegicus*—showed up in New York just as the port city was emerging as a center of commerce in the eighteenth century; these rats have accompanied capitalism from the beginning. Having originated somewhere on the Mongolian steppe, they were brought via trade routes to Europe as they fed on goods traveling the Silk Road [3]. After displacing their smaller cousins—the black rat of Black Death infamy—in urban centers throughout Europe, they stowed away on ships to North America. Weighing up to 2 pounds and growing as long as 20 inches, the New York City rat has since made itself at home, living in colonies of up to 50 individuals that pick a neighborhood and stay local [4]. Stories of human-rat interaction are legion and can be lighthearted, such as when the video of “Pizza Rat” carrying a slice down subway stairs went viral on social media [5]. But there are racist and classist undercurrents when voracious and fecund rats are linked with impoverished and immigrant neighborhoods. Or as theorist and poet Fred Moten puts it, “The black, the woman, the stranger all move at the place where animality and criminality intersect” [6]. The rat—dirty, cunning, invasive—is an avatar for the anxieties of the privileged classes.

The reality is that the rat has simply found an ecological niche surviving off human garbage, which in New York is left curbside for easy access. Rats therefore especially thrive in areas neglected by city services, taking advantage of inequities built into our capitalist society. In the documentary *Rat Film*, it’s stated succinctly: “There’s never been a rat problem. It’s always been a people problem” [7]. Or according to author Robert Sullivan, who has written extensively on urban rats, “The No. 1 way to take care of rats is to help other people: have a well-financed health department, well-financed sanitation department. It is the perfect barometer to see how your city works” [8]. Instead, New York City’s anti-rat efforts have been described as a “war” at least since the William O’Dwyer administration of the 1940s; Mayor Giuliani appointed a rat “czar,” and city officials have repeatedly referred to the rat “epidemic” and the “crusade” to end it, perhaps as a smokescreen to avoid addressing systemic injustice among humans [9].

In practice, municipal interspecies relations take on the

tone of biopolitics, which for Michel Foucault is the application of “diverse techniques for achieving the subjugations of bodies and the control of populations” [10]. A training guide published by the Center for Disease Control in 1956 begins with an epigraph in this spirit: “Controlling rat populations, not individual rats, is the key to a successful rodent-control program in a community” [11]. Such language, especially to describe extermination, is characteristic of the modern era, arising along with contemporary statistical modeling in World War II and the computers that made it possible. Rats’ connection to information science goes the other way as well; mathematician Claude Shannon, who developed the foundations of digital logic in the 1940s, made one of the first demonstrations of machine learning not with an artificial human brain but with a mechanical rat in a maze [12].

Shannon’s setup reflected the already established role of the rat in the science on which modern ideas of the body depend. With its white fur and red eyes, an albino strain of *Rattus norvegicus*—all the members of which descend from a common ancestor—is synonymous with laboratory research. Whether used for psychological experimentation, anatomical investigations, pharmaceutical development, genetic manipulation, or behavioral studies, these rats have served as “animal models”—that is, proxies for humans through which we might better understand our diseases without putting people at risk. Or as the National Institutes of Health puts it, “Rats . . . are mammals that share many processes with humans and are appropriate for use to answer many research questions” [13]. The comprehensive PubMed database for biomedical research contains over one million publications that reference experimentation on rats because of this affinity [14]. To a significant extent, therefore, what science knows about humans is what it knows about rats. And yet that rats remain distinctly nonhuman is critical to their role as models; exempt from the Animal Welfare Act, tens of millions are killed in the laboratory every year [15].

To understand a lab rat’s reaction to the experiments to which it has been subjected, researchers often turn to sound. For example, one such paper is titled “Shock-Induced Ultrasonic Vocalization in Young Adult Rats: A Model for Testing

Putative Anti-Anxiety Drugs” [16]. It’s well-established that repetitive calls around 22 kHz signify that the animal is in distress; this ultrasonic frequency is inaudible to the human ear and as such avoids triggering human empathy [17]. In contrast, sounds even higher, around 50 kHz, are associated with positive social behaviors such as play and mating [18]. But beyond these basic categories, which are useful for running experiments, the literature on rat sounds is surprisingly sparse. However, one study from Jaak Panksepp and Jeffrey Burgdorf from the late 1990s stands out. They tickled their rats, “cautiously advancing and empirically cultivating the theoretical possibility that there is some kind of an ancestral relationship between the playful chirps of juvenile rats and infantile human laughter” [19]. Panksepp and Burgdorf note that researchers “take pains to deny that we can ever know whether animals have any emotional feelings.” Nonetheless, they continue, “The emergence of a ‘critical anthropomorphism’ may be essential for dealing with certain types of primitive psychobiological processes we share with the other animals” [20].

We make a cat eat cat food out of a dish, *as if* it were human [21]. But it is the rat that devours the human food thrown out in the trash. The same animal through which we’ve understood our physiology cohabits with us in our cities; the urban rat is neither domesticated nor living off in the wilderness. It burrows through the symbolic divide between us and animals, and if we find them disgusting, it is because they violate—and so reveal—the structure on which our anthropocentrism depends [22]. But as sound theorist Brandon LaBelle writes, “the auditory provides an escape route [from] the representational metaphysics of modernity” [23]. It offers the opportunity, as Moten would have it, to hear “difference materialized not as an other voice, but as the other that always inhabits the voice” [24]. That is, to listen to a rat on its own terms might allow us to “become rat” [25] for a moment, as Panksepp and Burgdorf did, and rather than hear ourselves in their voices, to hear the rat within our own.

### SOCIAL FREQUENCIES

In Columbus Park, I watch as a large rat, maybe a pound and a half, snatches a half-eaten bagel from an overflowing “rat-proof” garbage can and drags it away under the bushes. I scramble to follow, hurdling low park fences, peering between the feet of old men reading newspapers, and shimmying between the branches of an old sprawling tree. I see the rat disappear into a burrow at the base of the trunk, and I stake out the entrance. Although rats are most active just before sunrise and after sunset, a face appears in the hole several times over the next hour, so it seems like an ideal location for recording.

When it comes to audio, it should be noted that the term *ultrasonic* is anthropocentric; these are sounds above 20 kHz, a frequency that is significant only because it is the generally accepted limit of exceptional adult human hearing (for most people, the actual threshold is much lower). That said, traditional microphones are made with this limit in mind, and they quickly become unresponsive once they reach the

ultrasonic range. But rats can hear up to 90 kHz, and they can make noise nearly as high [26]. Therefore, laboratories use USV (ultrasonic vocalization) “detectors,” which process audio downward in real time, to make rat sound audible. This technology does little to preserve the acoustic details in the voices, however. As one researcher puts it, “The effect is sort of like a Geiger counter” [27]. Instead, I used a MEMS (Micro Electro-Mechanical Systems) “mic-on-a-chip,” a relatively recent technology geared toward the mobile electronics industry that, in addition to being tiny, has a flat frequency response up to around 100 kHz. I controlled this with a Raspberry Pi, a small, customizable, and inexpensive Linux-based computer, which ran a custom shell script to save audio to an SD card in one-hour chunks. This setup can be powered with a consumer power bank to run for a few days without recharging.

I put everything inside a rattrap (Fig. 2). Such black plastic boxes (properly “bait stations”) are an inelegant part of urban infrastructure in cities everywhere. They are signifiers of the urban unconscious, and so ignored, they make perfect containers for expensive electronics that one is planning on leaving out on the street for extended periods of time. In other words, I use ratttraps to avoid the humans, not the rats (who seem unbothered by them). While the microphone is omnidirectional, meaning ambient sound is captured from all sides, I place it near the entrance to a burrow because it is when rats encounter each other that they are most likely to make noise.

My approach to field recording is in part inspired by the discipline of acoustic ecology that emerged out of the work of composer R. Murray Schafer and his students in the late 1970s. In this approach, sound is understood as a medium through which relationships between humans, animals, and the geophysical world may be perceived. However, I am somewhat ambivalent about its tenets. On the one hand, acoustic ecology puts into practice *acoustemology*, that is, the idea that “sounding and the sensual, bodily, experiencing of sound is a special kind of knowing, or put differently how sonic sensibility is basic to experiential truth,” one especially conducive to conveying our dynamic ecological interconnections [28]. But on the other hand, many adherents today insist on the need to “conserve natural soundscapes,” a rhetoric that reinscribes a nature/culture divide [29]. Even though



Fig. 2. Rattrap with recording gear. (© Brian House)



such a goal is well intentioned, its neocolonialist overtones encapsulate nature as something that happens “over there” [30]. I wanted to record rats precisely because their “natural world” is the one we live in too. Nevertheless, this realization came after my own experience in the wilderness, which continues to inform my practice.

In 2015, I was the sound recordist for the National Geographic–funded Okavango Wilderness Project. The Okavango Delta in Botswana is an inland floodplain that eventually dissipates into the Kalahari Desert and is one of the most ecologically diverse environments on the planet. I recorded hippos fighting, lions calling, elephants charging, and even the terrifying rumble of a buffalo herd. But what I found most compelling were the long recordings of the soundscapes. These recordings made clear how different species make sound at different pitch registers, which coherently layer to fill the whole spectrum. This is what acoustic ecologist Bernie Krause calls the “niche hypothesis,” that is, how “birds, insects, and mammals each form their own temporal, frequency, and spatial niches” in the soundscape [31]. As it turns out, this *biophony* is not a cacophony but an organized acoustics that reflects interspecies awareness.

Frequency niches are readily observable in spectrograms, which are visualizations of acoustic data that show energy levels in different parts of the frequency spectrum over time. In my recordings from the Okavango, the acoustic strata of animals are easily separable by the eye as well as by the ear (Fig. 3). Paying attention to the soundscape as a whole, rather than just the behavior of individual species, reveals the capacity for animals to self-organize not only among their own kind but also in relation to others. As Krause puts it, animals evolved to “be able to hear and process the particular sounds that were relevant to their well-being” [32]. Krause notes that the healthier the environment, the more clearly partitioned the sounds. Likewise, environments that may seem to be flourishing can nonetheless be heard to have been disturbed when there are empty or unstructured niches.

Krause’s observation resonates with the philosophical concept of *transindividuation* as articulated in the work of phi-

losophers Gilbert Simondon and Bernard Stiegler. Stiegler explains that “The I, as a psychic individual, can only be thought in relationship to we . . . [in which] a plurality of I’s acknowledge each other’s existence” [33]. In this case, the soundscape is not just a population of animal voices; it is the ensemble through which they have mutually come to be. To the extent that communication reflects an animal’s subjectivity, this implies some sort of identification not only with other individuals of the same kind but also with those from other species.

Yet while acoustics illustrate this process among species in areas where there are few humans, when there are enough of us around, we seem intent on claiming the whole soundscape for ourselves. This is indicative of the ingrained anthropocentrism of modern city life. It’s not that humans can’t be excellent listeners; musicians, for example, simultaneously play their individual parts and lose themselves in collective expression. But we saturate our urban soundscapes with technical ensembles of our own creation—buses, stereos, pneumatic drills. A spectrogram recorded in a busy part of Manhattan finds human voices competing with the whirl of ubiquitous motors that produce broadband fuzz up to around 25 kHz. But above that? An ultrasonic recording reveals something unexpected (Fig. 4).

### URBAN INTONATION

It is my hypothesis that one reason rats have been so successful living in cities is that while other animals might be drowned out by our noise, rats’ social lives unfold in a register of the auditory spectrum that we’ve left silent. And no recording I’d heard from a laboratory prepared me for the vocal richness of those lives. Having reclaimed my rat “trap” from its position next to the burrow under the tree, I sit on a park bench and transfer the contents of the SD card to my computer. Scanning a spectrogram sampling 24 hours of audio, I find a few mechanical sounds visible, along with some bats. The rest is rats. There are 22-kHz alarm calls, starting with a distinctive down-swoop followed by innumerable repetitions, each with a quick upward punctuation at the

end. But present, too, are complex shapes of all kinds, glissandi-like lightning bolts across the image, staggering over wide frequency ranges in both repetitive patterns and unique enunciations. Clusters of vocalizations appear together, with greater or lesser amplitude indicating multiple individuals conversing. Every hour holds surprises, new configurations of forms and patterns. And even in the visual form of a spectrogram, the shape of laughter is unmistakable.

To hear these sounds is both a technical and an interpretive exercise. The most straightfor-

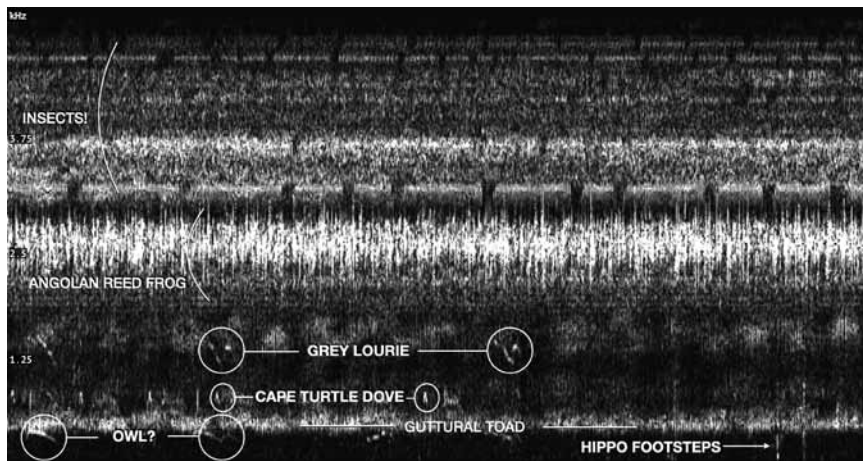
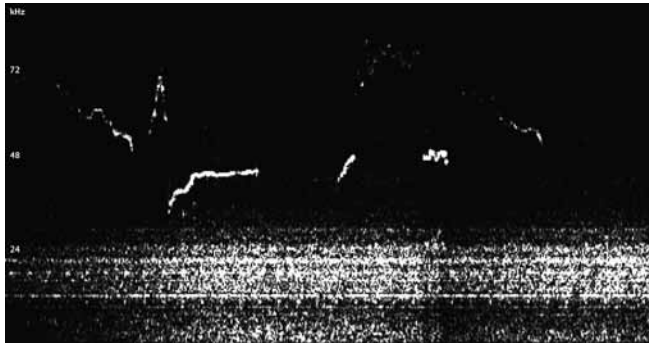


Fig. 3. Spectrogram with author’s annotations of audio recorded in the Okavango Delta. (© Brian House)



**Fig. 4.** Spectrogram of ultrasonic audio recorded in Columbus Park, New York City. (© Brian House)

ward approach is playing them back slower, also known as downsampling. What was recorded at 192 kHz, when played back at 8 kHz, is 24 times lower in pitch (~4.5 octaves) and well within our range of hearing. This can't happen in real time, since the duration of the sound also expands by as much, but the shape of the waveform is preserved. It's nearly impossible not to hear the result as speaking (and singing) voices—because that's what they are. I ended up using a combination of downsampling and pitch-shifting (using an algorithm that changes pitch without expanding time) to fit them into a frequency niche that matched that of the human vocal range, encouraging us to hear them as those of peers. To that end, I also took out the rat sounds that are normally audible to us—the squeaks and cries the rat makes out of fear and that are intended for us to hear—as shifting these would alter a sonic relation that already exists. Finally, I also did quite a bit of audio restoration in the form of noise reduction, spatialization, double tracking, and reverb, which re-situated the processed sounds in an acoustic environment and smoothed over some of the rough edges [34].

I don't view such effects as violating the integrity of the recording, as there is no such thing as technical objectivity. Rather, it's a matter of being intentional about modulating between physiologies. The composer Olivier Messiaen explains that “a bird, being much smaller than we are, with a heart that beats faster and nervous reactions that are much quicker, sings in extremely swift tempos, absolutely impossible for our instruments. I'm therefore obliged to transcribe the song at a slower tempo. . . . [I]t's a transposition of what I heard, but on a more human scale” [35]. If we're to become rat, our ears must relate to the sound in the way it does to theirs.

Beginning in spring 2017, I recorded nearly 150 hours of rat sound, which to my knowledge are the first ultrasonic recordings of urban rats in New York City [36]. Following tips from ecologists Matthew Combs and Michael Parsons, the sites included not only Columbus Park but also a waste treatment plant in Greenpoint, Brooklyn; a maintenance shaft in the subway uptown; and a boarded-up “vacant” lot on the Lower East Side. This process often involved trespassing, which highlighted for me the ways in which rats disrespect

architectural boundaries, and which led to the form of the resulting artwork, *Urban Intonation* (Color Plate D). As a sound installation, the piece consists of eight public address (PA) speakers mounted in a cluster in a corner of a building, whether outside, in a museum gallery, or, ideally, in a subway tunnel or other rat-frequented domain [37]. Above our heads—and attached to the walls rather than boring through them—is precisely the opposite of where we'd expect to find rats in our infrastructure. PA systems are speech rendered as space. And as the PA leaves the source of the voices unseen, visitors look up to hear them. That gesture—looking up to hear rat sounds—means we receive the sound differently. Played back as a constantly varying 8-channel mix of recordings (again using Raspberry Pis together with a series of amplifiers), the voices are placed back into spaces they already inhabit; they are not from elsewhere, but we're no longer insensitive to them.

#### MORE THAN JUST HUMAN

It's clear that humanity is integral to the story of *Rattus norvegicus*. Rats live in a human-built environment often hostile to the nonhuman; nevertheless, they thrive off our refuse, and in relation to us they have found an acoustic niche in which to communicate and make their own meaning of urban life. Like it or not, rats are a part of us, too, as from urbanization to biomedical science, they are found throughout the modern sense of what it is to live as humans. Fulfilling ethical obligations to our own species requires acknowledging our participation in ensembles with these and other nonhuman beings.

Jacques Derrida, after locking eyes with his cat, famously reflected on whether an animal can consciously respond to another being in a way that rises above instinct. While convinced of the cat's singular agency, Derrida nonetheless assumed it lacked language, conceding only that this might be “something other than a privation” [38]. Donna Haraway has chided him for stopping there and not inquiring further about “what the cat might actually be doing, feeling, thinking, or perhaps making available to him in looking back at him that morning” [39]. Given that cats can hear up to 64 kHz, I like to think the cat was listening to the rodents talking in the walls—and wondering why the philosopher wasn't responding. Even if we avert our eyes from those of the rat, expanding our capacity to listen to other voices may be a means of extending our sensitivities.

I've been asked many times what the rats are saying. While the answer is beyond the current science, consider that what counts as speech is fundamentally political. We've been reluctant to recognize the rights of animals, positing language as the dividing line between us and them. But if we're asking this question about the rat, perhaps the division is more porous than we'd like to admit. We may not understand the words, but the intonation is nonetheless compelling, as it carries a commonality that resonates within our own throats. Standing on a subway platform, we listen first; only when we read the placard to learn the source of the sounds do we find it written: “rat.”

## Acknowledgments

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- 34 This audio processing was accomplished using a combination of Audacity and Apple's Logic Pro with iZotope plug-ins.
- 35 Olivier Messiaen, *Music and Color: Conversations with Claude Samuel*, E. Thomas Glasow, trans. (Portland: Amadeus Press, 1994 [1967]) p. 95.
- 36 Jana Winderen, who is well known for her work making ultrasonic recordings of many animals, presented recordings of urban rats in Oslo later that same year. Additionally, the artist Kathy High has an ongoing project recording the ultrasonic laughter of lab rats and playing it back to them as a means of mitigating the stressful laboratory environment—an inspiration for my work.
- 37 To date, *Urban Intonation* has been shown at the Contemporary Arts Center in Cincinnati, the Boulder Museum of Contemporary Art, the International Symposium on Electronic Art (ISEA), and Eyebeam, along with guerrilla installations on the streets of New York. In addition, *The New York Times Magazine* featured the work in a piece produced by Kara Oehler.
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**BRIAN HOUSE** is an artist who investigates the rhythms of human and nonhuman systems. He holds a PhD in computer music from Brown University and is assistant professor of art at Amherst College.



COLOR PLATE D: **URBAN INTONATION: LISTENING TO THE RATS OF NEW YORK CITY**



*Urban Intonation* installed in a Brooklyn subway station. (© Brian House) (See the article in this issue by Brian House)