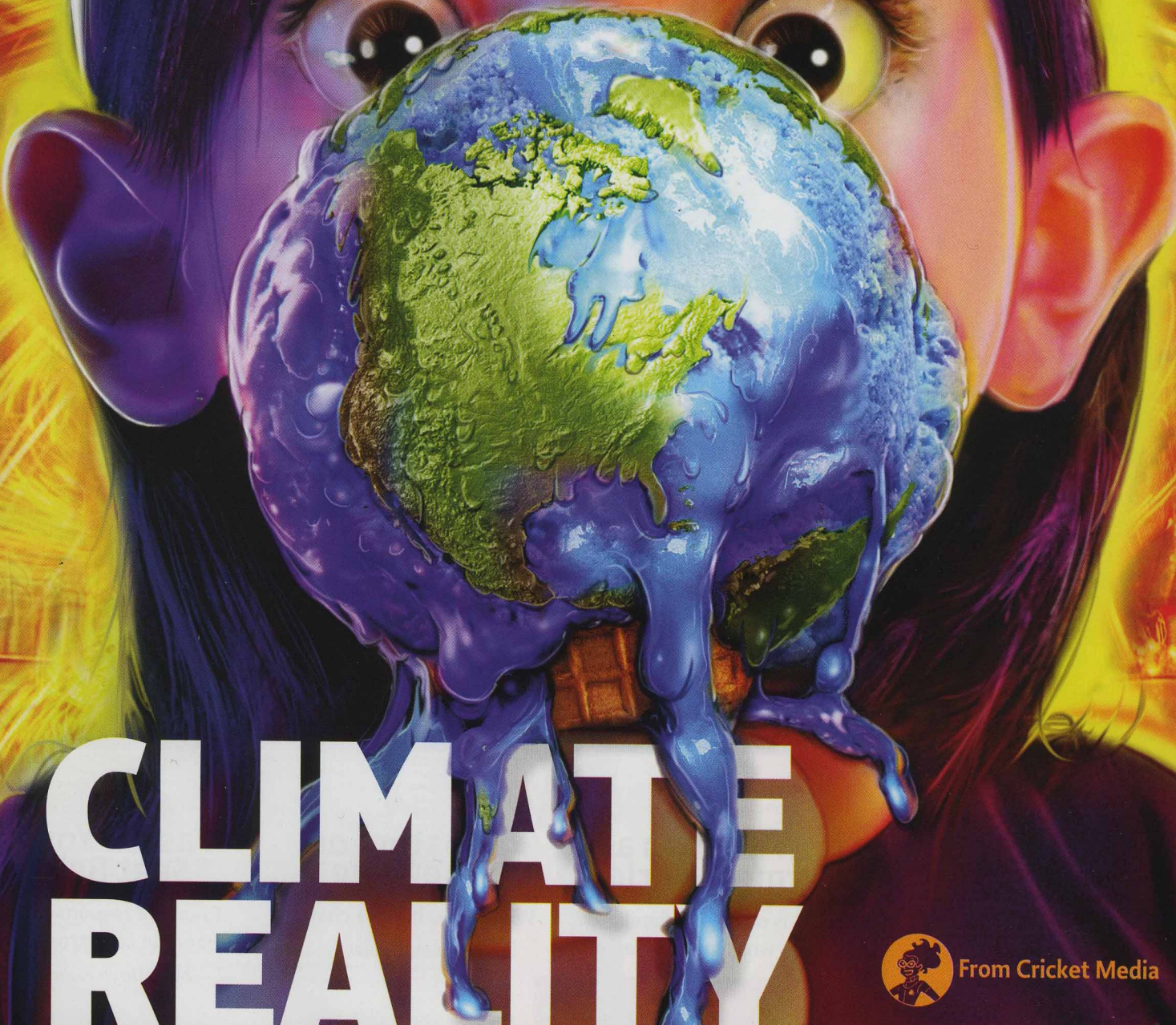


# **muse**®

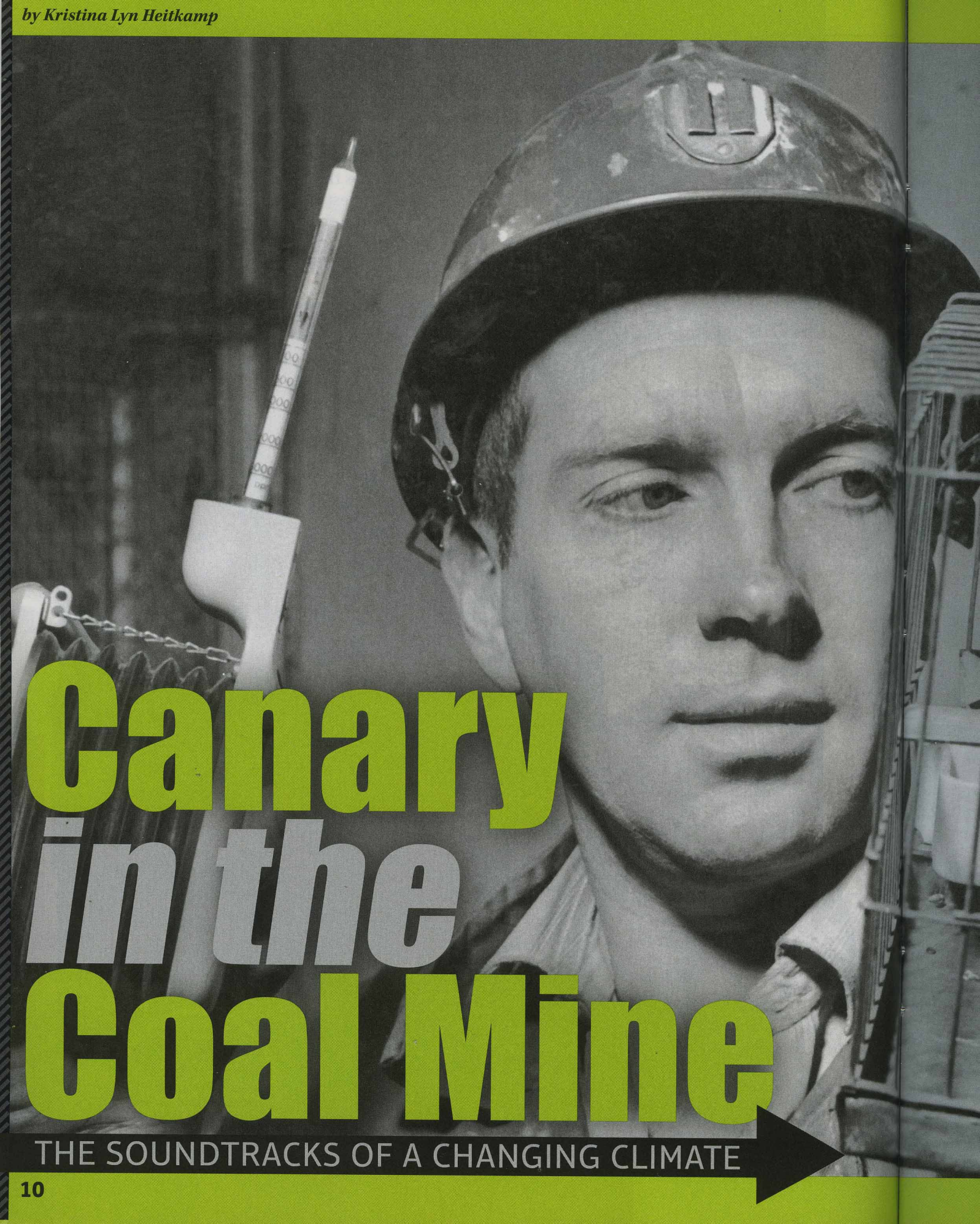
FEBRUARY 2017



# **CLIMATE REALITY**



From Cricket Media



# Canary *in the* Coal Mine

THE SOUNDTRACKS OF A CHANGING CLIMATE

Long ago, coal miners used caged canaries as warning devices. Dangerous gases cause these birds to sicken and die before people do. That practice has ended (phew!), but we still describe some early signs of danger as “canaries in the coal mine.” Today, our world’s soundscapes are changing in ways that may signal danger ahead.



**L**OSE YOUR EYES AND OPEN YOUR EARS. What do you hear? If you’re camping in Montana, you might hear the rap-tap-tapping of a pileated woodpecker or the piercing yip-howl of a nearby lone coyote. Or perhaps you’re sitting in a school classroom in New York. You might be eavesdropping on the chatter of a neighboring classmate or registering the distant hum of traffic. If you listen closely, you might even hear the cooing of pigeons dining on lunch scraps outside on the playground.

Whether you hear the bustling sounds of a city or the birdsongs of a forest, soundscapes are a normal component of our environment and everyday lives. Occasionally, in a plug-in and tune-out world, we are oblivious to the sounds all around.

But with climate change altering our landscapes, our soundscapes are changing too. Audio snapshots uncover valuable scientific knowledge. Soundscape ecology is a growing field of research that uses sounds from a given location, such as rainforests in Zimbabwe or glacier tops in Alaska, to study the ecosystem there. Soundscape ecologists listen to humans, wildlife, and even weather systems. Here’s how—and why—they’re keeping an ear to the ground.

### ➔ JAM SESSION

Human sounds, or “anthropophony,” include any sound produced by people, like laughter, and sounds from human-made objects like planes and cars. Some anthropogenic sounds are purposeful (like music), but most common in the anthropophony is random and loud, or what we would call noise. Animal sounds are part of the “biophony”—any sound made by an organism, such as crickets, canaries, or howler monkeys. Earth sounds, or “geophony,” are nonbiological sounds that come from weather-related sources, like wind in the trees, waves at the beach, or the rumble of thunder. Soundscape ecologists listen to the full score of sound to gauge the health of an ecosystem and work toward soundscape conservation.

Experts capture soundscapes using sophisticated, automated digital recording systems. (The amateur soundscape enthusiast can record sounds using a smartphone.) Using the data collected, scientists create and examine a sound recording called a spectrogram. A spectrogram is a graphic illustration of sound, read from left to right, and with measured frequency represented lowest to highest from bottom to top. Soundscape ecologists measure frequency in hertz (Hz). They also track the intensity of sounds using colors or shades of gray to represent loudness, often in decibels (dB). They note acoustic diversity with different colors representing different sounds created in the environment. Reading the



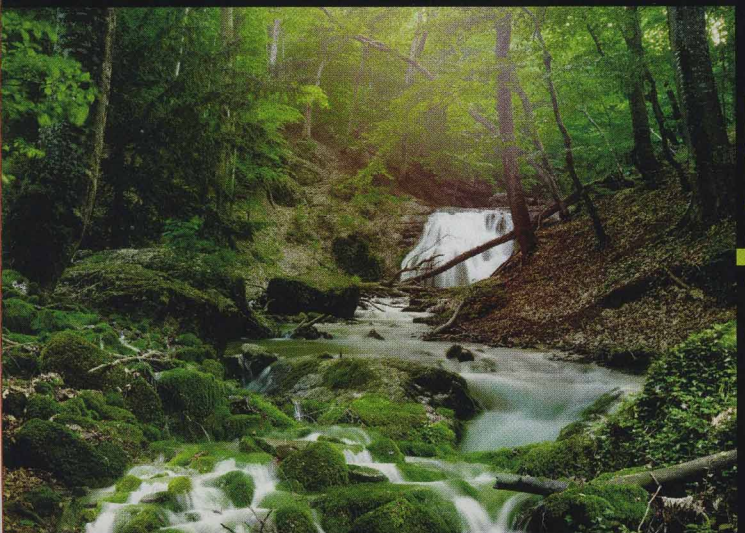
**anthropophony**



**biophony**



**biophony**



**geophony**



## FIT AS A FIDDLE

Imagine getting a lecture from your parents before you've even left the womb. Well, one little feathered friend knows what it's like to have parents chirping orders before birth. In 2016, researchers at Deakin University in Australia found that Australian zebra finches prep their chicks for a warming world by giving them a lesson before they've hatched. Scientists discovered the songbirds make special calls when alone with their eggs. Turns out these calls happen when it's hot outside, specifically when temperatures rise above 78.8° Fahrenheit (26° Celsius). But chicks don't feel temperature changes before they hatch. Parents keep the internal egg temperature at a consistent 99.9°F (37°C). So researchers decided to experiment. They played the recorded "it's hot outside" call to incubating eggs, while a control group didn't get any such warning. They discovered that chicks born from these eggs weighed less and grew more slowly in warmer temperatures than chicks in the control group. Smaller bodies are easier to keep cool. When the chicks grew up, the smaller ones had more offspring than the larger ones. Plus the small chicks passed the heat tolerance down their lineage to the next generation. Finch parents gave eggs the "hot talk" when the unborn chick's temperature-regulation system was beginning to develop. Could the parents' calls be altering their baby chicks' temperature systems? If this is the case, Australian zebra finches may face the music of climate change with bells on.



visual representation is almost like reading a sheet of music. Spectrograms are a great way to zoom in on the variety of sounds and study each bird chirp, raindrop plop, or plane engine roar.

## → CHANGE YOUR TUNE

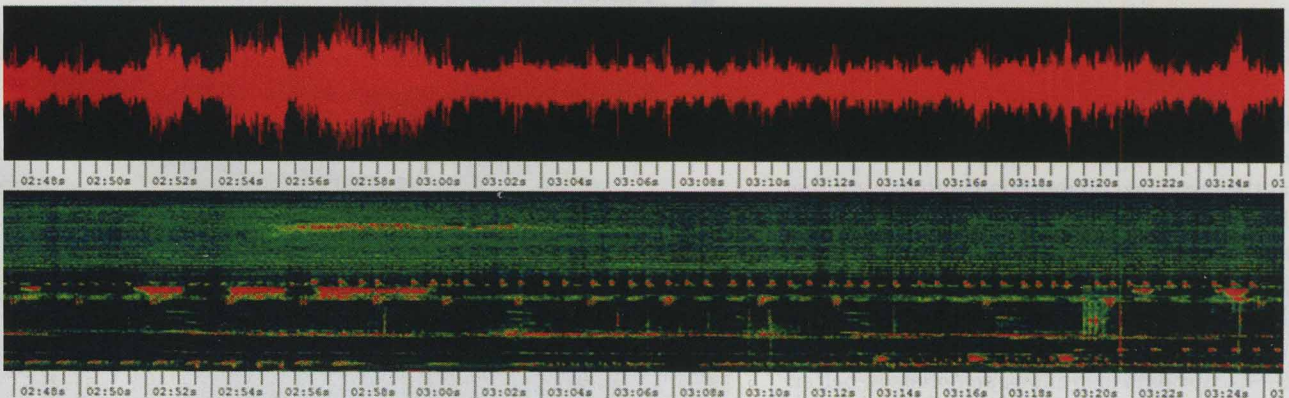
Bioacoustician and musician Bernie Krause has been recording soundscapes for more than 45 years. Traveling around the world, he's recorded and archived the calls of trumpeting elephants, songs of humpback whales, and the screams of mountain gorillas. He has catalogued and used those materials to produce art installations, music albums, and an audio archive on his website, [wildsanctuary.com](http://wildsanctuary.com). Krause's research shows what the eyes cannot see.

In 1988, Krause recorded the soundscape of Lincoln Meadow, located high in the Sierra Nevada in California. His first recordings were rich with sounds of spring. He heard sparrows, sapsuckers, corvids, mountain quails, and several frog species. Later that year, a timber company used

a method to extract timber called selective logging. Because they cut only a few trees here and there, the company's leaders assumed the environmental impact would be slim to none in Lincoln Meadow. Krause returned to the same spot a year after the timber harvest and kept going back. He has recorded there 15 times since 1989. Although the landscape looked undisturbed, he says, the soundscape told a different story. The biophony was nearly silent.

"While photographs, videos, and detailed studies of ecosystems provide us some valuable information, soundscapes are by far the most revealing. They tell us immediately and in detail how well a particular habitat is thriving. If we have a good understanding of what a habitat sounds like when it's healthy, then we can pretty easily figure out ways to deal with the problems when the habitat is suffering," he says.

What do soundscapes reveal about the health of a habitat? A flourishing ecosystem is rich and diverse in sound. Krause says healthy habitats produce a soundscape



Top: A red image of a sound recording that soundscape ecologist Bryan Pijanowski made. Bottom: Colors in a spectrogram represent diverse sounds in the same recording.



## STRIKE A CHORD

Author, international speaker, and sound consultant Julian Treasure advises businesses across the world on how to use sound. During his 2009 TEDGlobal talk, he said there are four major ways that sound affects human. What do fire alarms, sirens, and alarm clocks all have in common? Their sound affects us physiologically—they make our bodies react. Heart rate increases and breath quickens as the body prepares to fight the possible threat or flee for survival. But a physiological response to sound isn't always distressing. The rhythmic frequency of ocean waves roughly matches the rhythm of a sleeping person's breathing. When we hear the ocean tide, the sound relaxes our bodies.

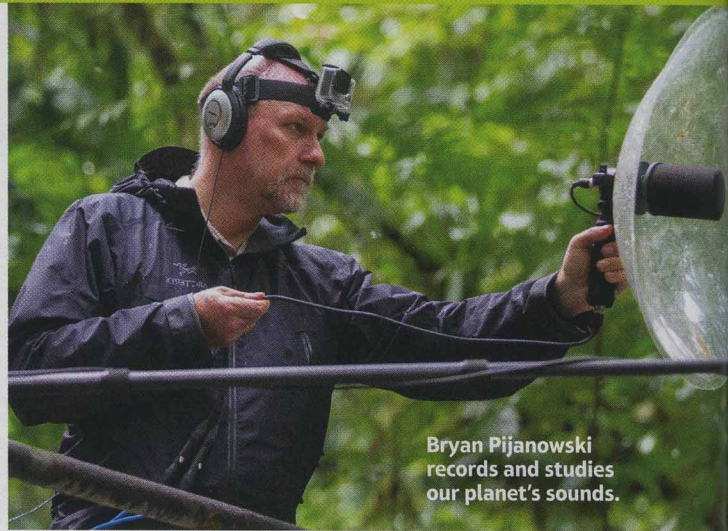
The second way sound affects us is psychological—it makes us feel. Have you ever heard a melody that makes you sad? Whether it's a soundtrack that evokes a tear or a catchy jingle that makes you giggle, music can make us feel a range of emotions. Birdsong also affects us psychologically. When we hear the comforting chirp of birds, evolutionary instincts tell us things are good and safe.

The third way sound affects our brain is cognitively—how we think. The brain tries to extract meaning from the words and sentences we hear. When your mom, dad, and little brother are all talking at once at the dinner table, the competing voices make it hard to focus. Our brains have a very small bandwidth for processing auditory input, says Treasure. No wonder it's irksome when someone keeps jabbering on during a movie! Finally, sound may cause behavioral changes. Drivers who listen to fast-paced music may speed up. People tend to walk away from loud or annoying sounds and toward pleasant sounds.

Next time a fire engine screams past, birds start chirping, or you hear a sorrowful pop song—stop, listen, and think about the many ways soundscapes influence you.

that resembles an orchestra. The sounds produced collectively by all organisms at one time are structured so that they work in collaboration with one another. Vocalizations from insects, frogs, birds, and mammals all play a part in the chorus of health. "But in habitats under stress, the biophony sounds unmusical or dissonant. Usually, stressed habitats are a direct result of human encounters such as logging, mining, or oil extraction."

Soundscape data also allows scientists to better understand how organisms interact with each other and



Bryan Pijanowski records and studies our planet's sounds.

the changing climate, and how they are either adapting or suffering. Rising temperatures increase the risk of drought, for example. Habitats affected by drought are nearly silent and static.

Krause hopes that listening to Earth's soundtrack will help recalibrate our sensitivity and connection to the natural world. His advice is to get outside and attempt to record one of the most common birds in the United States, the American robin. Sounds easy enough. But here's the catch: record the birdsong without interfering noise—no background noise like airplanes overhead or cars driving by, no people talking, no doors slamming or music playing. He thinks that noticing the biophony over the dominant anthropophony may prove to be difficult.

## → AND ALL THAT JAZZ

Bryan Pijanowski is a soundscape ecologist and the director of the Center for Global Soundscapes at Purdue University in Lafayette, Indiana. He has studied sound in the desert, in the tropics, in oceans and lakes, on top of mountains, and on glaciers.

"Glaciers talk to me. They can make eight or nine different sounds depending on whether or not they are slipping down the mountain or melting, and how they break apart," he says. Pijanowski has used sound as a measure of how climate change is altering glaciers that historically have not melted. He is enticed by the whispers of melting glaciers, but he also loves the booming sounds of a summer storm.

"I love thunder. There are so many different sounds of thunder. And it's different all over the world," he says.

→ **Soundscape ecology**, also known as acoustic ecology, is the study of different sources of sound, such as those made by people, animals, and nature, to learn about ecosystems, environments, or even human behavior.

**“The messages are always present for those of us who are willing to listen.”**

– bioacoustician Bernie Krause

Pijanowski points out that climate change affects the amount of rainfall that occurs. Monsoons, or wind systems that bring rain during a specific season of the year, are already shifting and have become unpredictable. “Rain, temperature, and thunder—all are part of the climate system that I can study using a soundscape approach,” he says. Pijanowski believes our planet’s soundscapes are important to its survival.

“We have become an earbud society,” he says. “We have the marvelous ability to turn on a music track, or a podcast” anywhere, anytime. “But,” Pijanowski adds, “I worry that the human connection to nature is going to be lost because we no longer listen.” Because the biophony and geophony reflect what’s happening to the climate, ignoring the ecosystem’s sound means missing out on valuable information to help heal our ailing planet.

But he tries to remain hopeful. He notes that new technologies can reduce the decibel level of machines. Airplanes are becoming more fuel-efficient, and that means quieter too. Electric cars are less noisy than their gasoline counterparts. But Pijanowski recognizes that there’s a lot of room for new tech, such as robots, to add even more noise pollution to our world. “As we order this and that online, and the drones fly across the landscape, and drop packages on our front porch—I just hope that those drones aren’t in the millions and billions and that they’re not noisy,” he says.

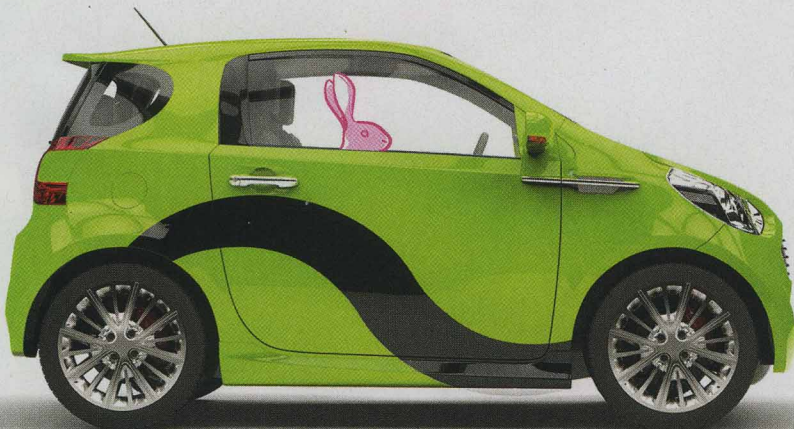
Pijanowski’s advice is to get outside and listen. Then spread the word. During the next thunderstorm, turn

→ **Bioacoustics** is the science of analyzing sound produced by wildlife or humans. These scientists listen to, and analyze, animal communication.



everything off and listen. “Don’t go outside and get struck by lightning, but stay in the house and listen. I think you will be very surprised,” he says.

**Kristina Lyn Heitkamp** is a Montana-based plein air writer, children’s author, and environmental journalist. She prefers to write outside. While working on this article, Heitkamp sat by the Blackfoot River in northwestern Montana, listening to and recording the lush soundscape.



### **Citizen Science Alert!**

Soundscape ecologist Bryan Pijanowski invites you to tell him what it was like to listen to thunder. Ask your parent or guardian to email your notes to [bpijanow@purdue.edu](mailto:bpijanow@purdue.edu).

