

# Acoustic Ecology with Eddie Game

## Ologies Podcast

### May 4, 2022

Oh hey, we just won the 2022 Webby Award for Best Host, which is a weird thing to say as the host of this podcast, especially since I'm recording this in my sister's garage. So, who says you have to be professional to win things? Hi, it's Alie Ward, it's your internet Dad, back with a fresh episode, crafted for you just this week. So, Acoustic Ecology, what the heck is it? It's what sounds in nature tell us about who is living where. This whole episode is just like a nature app, but with much more gossip. And we've got one of the world's best for this.

So, this ologist got his PhD in Marine Science from the University of Queensland and has worked in conservation in over 20 countries, from snow leopard tracking in Mongolia, to big grass munchers in Kenya, and tiny bugs in Borneo. He's co-authored tons of research papers plus a book called *Conservation Planning and* is currently the Lead Scientist and Director of Conservation for The Nature Conservancy's Asia Pacific region. He's been given all kinds of awards for using technology and bioacoustics to help save our flaming, gasping, burning, acid-bath planet. Today, we have this episode for you.

So, it was a recent, scorching hot afternoon in LA, we hopped on the horn, and I thought, "Man this is going to be the easiest thing ever, a remote interview with a mic guy. No tech challenges here." But alas... For some reason, his mic was faltering and was super quiet, can you even believe? I can't. But Jarrett spruced it up in post; we boosted his sound. So what, it's worth a listen anyway, all the other episodes have better sound.

Okay, real quick just a quick thanks to everyone who submitted questions via [Patreon.com/Ologies](https://patreon.com/Ologies). Barrier to entry is \$1 a month, hop aboard. Thanks to everyone who tells friends about *Ologies*, who leaves a review, knowing that I read them all. Such as one that Emily left a few days ago that read:

*I gotta say, lady, I hated science before I listened to your podcast. Now I can't get enough!!*

Emily, welcome to the messy, weird world of nature, let's get gross.

Okay, so let's get on with it. We cover everything from how noisy the ocean is, capturing sonic evidence of rare animals, who is the loudest bird and what do they want? How fish apartment hunt, ghosts and infrasound, how much logging is illegal logging? The types of jobs out there for sound nerds who like science, and a weird thing that I have in my backyard, with Acoustic Ecologist, Dr. Eddie Game.

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**Alie:** Hi! Is this Dr. Game?

**Eddie:** *[laughs]* It is. It's Eddie, please.

**Alie:** Okay, Dr. Game, sounds like a deal. And one thing I will have you do at the start, if you could say your first and last name, and your pronouns that you use?

**Eddie:** Yeah, Eddie Game. He/him.

**Alie:** And where am I talking to you from? Where are you beaming in from?

**Eddie:** I'm talking from Brisbane, Australia.

**Alie:** Ohhh! I hope that it is a reasonable time there.

**Eddie:** Oh yeah, it's quarter past 9 in the morning, so it's halfway through my workday, pretty much.

**Alie:** *[laughs]* Do you have to get up really early for what you do?

**Eddie:** You know what, I get up early because I am so often connecting with people in the US. That's the bulk of our organization, is in the US.

**Alie:** And now, you've been working with The Nature Conservancy, right? How long have you been with them?

**Eddie:** Oh goodness... 14-and-a-half years. A long time.

**Alie:** And I have to ask, Acoustic Ecology, I did not know that this was an ology. What areas does monitoring or listening work in? How do you describe what acoustic ecology is to people?

**Eddie:** Oh, it's so cool. D'you know, I don't think many people knew it was an ology until... yeah, probably only five or six years ago, it really started taking off. There were some people in California and Italy doing it. But now, it's sort of exploding, such that I think it's going to be impossible to do even a basic ecology degree in a few years' time without learning something about acoustic ecology. So, I definitely put it firmly in that ecology basket.

I think of it as one of the great new streams of data. When we first started getting satellite images of Earth it was completely transformational in the sort of science we could do and the insights we could get into the planet.

**Aside:** If you're like, was that in 1992 or 1874? I gotcha. So, the first images humans took from space were by the US in the mid-1940s, so see right after the Second World War. And it's gotten better since those base blurs, but in 1999, the US and Japan launched a group project which was public domain images via the ASTER imaging system. The point is, like a rocket with an Instamatic strapped to the front of it, things move fast.

**Alie:** Is some of that rise in acoustic ecology because of... just technology getting faster and cheaper?

**Eddie:** Yes, definitely cheaper. You know, I think that has been a real game changer for the sort of questions you can ask with acoustic ecology because it used to be thousands and thousands of dollars to get a decent microphone. And people realized two things; one is that you can do a lot with cheaper microphones; and also, good quality microphones getting much cheaper, companies starting to make good field, fit-for-purpose things. And because people were able to put out more microphones, really means they could start asking questions that wasn't possible in the past.

And the processing, I think, has changed a bit too, but I don't think that was ever really that limiting. What really happened was you started having computer scientists being willing to engage on this as a topic. Once we started getting computing science engineers involved, that really helped too.

**Aside:** Just a side note, so that programming language he mentioned is called R and I was not familiar with it, and I went to google it and it's like an app that left out all the vowels and most of the consonants... it's just R. But it says it's "An integrated suite of software facilities for data manipulation, calculation, and graphical display." And it's free, that's the important part. Anyone can use it, so go get it, you dirty little nerds.

**Alie:** And what about you, were you an ecologist first who learned to use acoustic equipment? Or did you always have an ear for music and sound recording and kind of blended them together?

**Eddie:** No, definitely the ecologist route. I was a marine ecologist originally, marine biologist and worked in fisheries and then came and did all sorts of things at The Nature Conservancy. I was the editor of a journal and I started seeing manuscripts and research coming in, just little bits of it on acoustic ecology, and I realized this could help solve a problem we have, particularly in Papua New Guinea for surveying in these rainforests where it's really hard for people to know what's happening there because it's so hard to find experts who know what they're talking about. A lot of our traditional surveying methods wouldn't work. So, that's what got me interested in it.

But I don't have much of an affinity for sound actually. I was a terrible musician as a child. [Alie laughs] I loved listening to music, but I think that my passion for listening to music actually damaged my hearing. I spent so long at so many concerts, in my university days, I'm sure there's no value in me buying expensive stereo anymore.

**Alie:** [laughs] Oh god, oh my god.

**Eddie:** So, no it's not through an eco-musicality of my own that I got involved in this.

**Alie:** You mentioned that you were a marine scientist too. Does acoustic ecology work, obviously, terrestrial and oceanic applications, but how different is the equipment?

**Eddie:** Oh, good question. Really different. The marine side of things actually was where acoustic ecology resided for many years. Acoustic ecology people associated for many... decades even, with listening to whales and dolphins, principally, because that was a really good way to survey them, put down these hydrophones.

**Aside:** Just a quick what's what. A hydrophone is specifically designed to pick up underwater noise because sound travels 4.3 times faster in water than it does in air. And the pressure of a soundwave in water is 60 times that of air. What?! So, like your fin-footed, gill-faced ancestors, the field of acoustic ecology kind of rose from these watery depths and then flopped itself onto land sound also.

**Eddie:** As it started to really expand in the terrestrial, the land space. So, when they went back to the freshwater marine space, people started thinking, "The way that people are applying sound in the forest and woodlands and things like that, I wonder if we could do the same in the marine space." Thinking, instead of just looking for signatures of individual animals, could we tell something about the overall sound that's happening? Yeah, things seemed really promising.

**Alie:** And you mentioned something about the signatures of animals. What kinds of noises are you listening for? I know we're all thinking bird calls [high-pitched alarm call] maybe some bats, [squeaks] high frequency, but what- How do you even figure out in a sound file who's singing what?

**Eddie:** Oh, that's a great question. First of all, there's lots of different animals that vocalize. The biggest group of animals that you hear vocalizing when you make any recording are insects. Insects vocalize at all sorts of different frequencies, at all kinds of times of day, and that's something we can pick up. Sometimes they're really characteristic, sometimes they're completely unknown.

But then you also have amphibians, frogs obviously, mammals, birds... Bats are another good thing to mention because bats were also one of those animals that people had continued to use acoustic ecology to survey just because it's hard to see bats. But it's actually hard to hear them. But if you put out these ultrasonic recorders, they record at very high frequencies, you can hear bats. And I think there's a bit of a separation between a lot of work on bats and a lot of the other things we hear in recordings. So, if you have a microphone that's really good for hearing bats, it's not so good for capturing the differences between most of the sounds that you and I hear with our ears.

**Aside:** So human beings, that's us, can hear in the range of 20Hz to 20kHz. And bats are up there just cute-ing their little cuties in the range of 12kHz to 160kHz. That is 140kHz above our range of hearing. Their conversations go right over our heads in so many ways. Which is why recordings of bat noises are usually [*slowed speech, "Sloowed downwn"*] so our ape ears and brains can hear it. Do you want to hear something else?

**Alie:** Can I tell you a secret?

**Eddie:** Go for it.

**Alie:** I have a bat microphone in my backyard. I was recently selected, two months ago, to have a bat survey from the National History Museum of Los Angeles County...

**Eddie:** Ah fantastic! Oh, that's awesome!

**Alie:** In my yard, and 15 minutes before this call, Miguel Ordeñana, who runs the survey, was coming and checking. We just got the survey back from last month, we have three bats in our yard...

**Aside:** Three species that is, not like three individual bats who just hang out.

**Alie:** They were looking for people and I emailed them within a millisecond [*Eddie laughs*] and said, "Please my backyard, please my backyard!" So, they installed this tiny microphone and they come once a month to come and take the sound cards, and this makes me feel a lot better because there are so many times where I've been talking to my dog in a baby voice, very high frequency, or singing to plants [*Eddie laughs*] being like, "Can they pick this up?" So, they can't pick that up, is what you're saying.

**Eddie:** No, not usually. [*Alie laughs*] I mean, the problem is that the frequency of their calls is so fast, you have to have a microphone that can record incredibly fast in order to capture that. And that means the sort of longer, slower soundwaves at lower frequencies just tend to get a bit blurry in there. So, it's not really good for distinguishing between different frequencies at the lower end of the range.

**Alie:** [*laughs*] That makes me feel so much better. I mean, I was so excited because we already had an interview on the books, I feel like for a while, and then this came up that we got selected to have a bat survey, so I was like, "This is perfect!" But can you tell me a little bit about what animals occupy what frequencies? I feel like it's got to just be all over the map.

**Eddie:** It is all over the map. Most of the frequencies that we're listening to... Human hearing can hear, this is best-case scenario, from 20Hz up to 20kHz (20,000 Hz), and that's actually the range that most animals vocalize in. At the very, very low end of that range, you do get some amphibians down there, quite low calls, some mammals, and there are some birds in the jungles [*jungle sounds swell in background*] of Papua New Guinea, you have these amazing birds called cassowaries, [*very deep grunting sound*] kind of big prehistoric things

that look a little bit like dinosaurs, they vocalize at very, very low frequency so it's sometimes hard to pick out those calls even on our microphones.

As you move up a little bit, you get into the frequencies that we hear the best at, around 3kHz. That's really a lot of birds in that space. In jungles like those in Borneo, you get primates in that kind of space too. [*primate calls, short howls*] And then as you go up higher, you can get birds at slightly higher frequencies, but you certainly get a lot of insects at higher frequencies. You see lots of insects vocalizing at 10kHz, 15 kHz, even up to 20.

**Aside:** Okay, but what does 10kHz [*high-pitched sound*] or 15kHz [*higher pitch, fainter sound*] or 20kHz [*even higher*] sound like? Also, if you were like, "Oh, how embarrassing, you messed up and some sound effects were missing." Congratulations, you're me. As Jarrett and I were editing this, I kept telling him that the 15 and the 20kHz sound effects were missing, and that's when I read his face and I learned that any sound above 11kHz means nothing to my ears, they're gone. So, thanks past me for attending warehouse parties in 2007 with shitty DJs. Let's not do that again.

**Alie:** What are some of the questions that you're trying to answer? Other than, "What is out there?!"

**Eddie:** [*laughs*] Yeah, one of the ways that we use sound is actually kind of not even to ask who is there or who is making sound, but what is all of the sound telling us about the health of the environment? Something that we're learning is that in a really healthy, intact environment, most of the acoustic space, if you like, gets filled up. There are some competing ideas about why that might be the case, but one of the key ones is this idea of something called the acoustic niche hypothesis, which is that there's sort of, acoustic space partitioning. So, because all the animals in the forest want to be heard over each other, they adapt their hearing to a particular frequency, and they adapt their speech to a particular frequency. As a result, evolution of that intact environment means that most of the frequencies get filled up.

So, if you have a look at a recording and see how many frequencies are full, how many of those spaces are occupied, to indicate how healthy it is, what we are seeing really clearly in our data, and this gets to how we use it, is as environments get degraded, as we use them, we start seeing gaps open up in that acoustic space. You can measure how many gaps there are and use that as an indication of how intact the forest is and how healthy it is. That lets us ask questions like, the way we're currently using... say, the way we're chopping trees, the way we're harvesting, how does that affect this particular forest? Or is this area that we have set aside as a protected area, a national park or something like that, is this big enough, is that sustaining biodiversity or is there something else going on?

That ability to associate sound, the saturation of the sound, with environmental health means you can apply it to all sorts of questions that are really useful for a conservation organization like The Nature Conservancy.

**Aside:** So, imagine a walkie-talkie that has a bunch of different channels and different organisms evolved to occupy those different channels. And when acoustic ecologists run the data and suddenly start to find... [*long pause*] silence in those frequency niches, that's a pretty loud alarm bell that something is missing.

**Alie:** That's so cool. So, you can look at it, say we're missing a lot of noises in this area and this area; that probably belongs to these types of insects, or this type of migratory birds. And then, where do you go from there?

**Eddie:** Yeah, good questions, eh? Where we started this for us, in Papua New Guinea... and New Guinea is a kind of fascinating place because the land is all owned under something called customary tenure. So, the communities that live there essentially have control over their land. But it also means that they have this one area that they get to work in and it's very hard to combine, aggregate those. So, you don't have these vast, forest tracks of national parks; you've got a lot of forest, but it's divided into lots of different people's ownership. And that puts kind of a maximum size on how much area you can set aside for conservation, especially as people need to have areas also to grow enough food to live, harvest enough trees to build their houses, and growing population as well.

So, what we needed to know was, if every community sets aside just a little piece of their forest, is that going to be enough to retain all their amazing species that live in these forests, these jungles of New Guinea? So, what we can do is go and look at the patches of the forest and record sounds and record the sounds in different kinds of forest and compare them.

**Aside:** So, what did they find?

**Eddie:** Actually, we don't see many things missing from forest. But as soon as we start chipping into them, to plant a garden or remove some of the canopy, then we see that loss and we can measure that and continue to kind of track that.

**Alie:** What about other types of acoustic monitoring, like for poaching? Is that used in a completely different way than species monitoring?

**Eddie:** Yeah, that's a good question. So, I guess there's a few things that have been tried in different places. It's a little different because one of the things that was explored a lot with respect to poaching, is whether you can hear things like gunshots [*gun shots fire*] or some illegal harvest, [*machinery running*] bulldozers, chainsaws, things like that. They have very distinctive sounds on recordings, partly because they're also very low-frequency sound. A lot of sounds that people make tend to be low frequency which also means they tend to travel a long way so you can hear them from a long way away. So, microphones are quite good at picking up those kinds of things.

What's tricky is setting a system in place that would allow you to go and respond effectively to that. To be able to pick up a sound and to go and respond in real time, that's tricky. Especially as so many places where this is happening don't have reliable network connection. So, in sort of an ideal situation, you could set up a microphone that is sending a signal back and someone would go out and immediately and say, "Ah! Those are gunshots."

That can happen in a few exceptional circumstances but in general, that's tough to do. Especially also that these rainforests are really tough places on gear, so you have a pretty high burden of just maintaining things and being out there in that kind of presence. And in some ways, when you have that kind of presence in the environment, if you're there that frequently anyway, that can really help deter a lot of this illegal activity.

**Alie:** How do you work with local groups to ensure that it's okay to do the monitoring? And also, from what I understand, with things like illegal poaching, it's such a complicated sociopolitical issue too on who is nancing on who and all of that. How do you interface with some of the communities doing your fieldwork?

**Eddie:** Yeah, that's a great question. One of the beautiful things about this sort of ecology is that it really can get more people involved. It's not nearly as specialist as a lot of previous biodiversity surveys were. So, in most of our projects, it's actually local communities that

go out and do the monitoring. We are certainly helping a great deal in terms of coordinating the processing and analysis of that data and to really honor the people to make sure we're working tightly with them on making sure they get to see the results of that. We're thinking through what the implications are. But in terms of going out and doing, placing microphones, that's something that lots of people can get involved in.

**Aside:** So, Dr. Game says that acoustic ecologists work in really tight partnership with local communities to gather and analyze data so those living in the ecosystem can make these collective decisions on areas to develop, and the species they might hunt. And studies estimate that globally, 15-30% of timber, plucked without permits. And in Indonesia, for example, that rate just goes up to over 80%. 80% of the deforesting there is done illegally.

So, you don't have to live locally to be so pissed about that and just chain yourself to something green. But scientists aren't necessarily in the business of enforcement, so things get kind of tricky there. But ecologists can harvest this useful data using everything from tree DNA to, yes, recording all these critters in the case of acoustic ecologists.

**Alie:** What about gear? Talk to me about gear. Are you using old cell phones that are repurposed? Are you having to get tiny, tiny microphones? [*Eddie laughs*] Is there so much weathering that has to happen? Is there Wi-Fi?

**Eddie:** All good questions. Do you know, there was a little bit of a movement for a while on those old cell phones; everyone pretty much walked away from that in the end just because the reliability is such an issue. The sort of environments you want to do this sampling is tough on gear, and it's certainly tough on cell phones. So, mostly for our gear now, we're using purpose-built gear that's pretty rugged and it's fairly basic in essence; imagine a little pelican case, a rugged box, could be anything. In our gear, we like to have the microphones on the bottom, some people have their microphones sort of sticking out the side. But we find that birds tend to sit on them, [*Alie laughs*] things fall on them, so I like my microphones at the bottom of the box.

But funny stuff happens in the field all the time and there's always a lot of troubleshooting. We were doing these recordings in Borneo where we had microphones out, putting out for a few months at a time and taking regular recordings, often for full days, and then coming back and collecting them. The first time we did it, heaps of the microphones had failed and had water in them, which is unusual because, like I said, these are pretty rugged things. What we realized had happened in the end was we'd strapped the microphones in their housing so tightly to the trees and because it's a rainforest, these trees were growing so fast that they had grown over those three months enough to bend the metal back plate ever so slightly and crack the seal line.

**Alie:** Wow.

**Eddie:** Yeah! Even though we were attaching them with cloth straps, we'd put them on really tight, it's not advantageous to put them on too tight because you need to allow enough room for the tree to grow.

**Alie:** Have you ever had any of your gear stolen? Someone's like, "Oh, that rules," and kind of, slips in behind you?

**Eddie:** You know, we have not. Maybe there's places we're in, we've had trees fall on them and they get broken. Often you have forest rats and things like that eat the foam dampening around the outside of the microphone. They like that. So often you come back and all you see is the kind of bare steel of the microphone. [*laughs*]

**Alie:** Oh no!

**Eddie:** But it's okay, you can still get decent data out of it. Most of the work that I've been involved in has been fairly remote areas and on lands managed by communities, or forestry companies, and there with the blessing of the community or the company.

**Alie:** What about just noise pollution in general? Speaking of humans. How much louder is Earth getting? Or is it getting quieter because we're losing species?

**Eddie:** Good question. I think overall, it's getting quieter.

**Alie:** Really?

**Eddie:** Yeah, yeah. In quite a meaningful way, that's one of the shocking and most consistent things we see in our sampling, especially across the areas that I work in, the Asia Pacific. Usually, environments have these two big peaks of acoustic activity. What we call the dawn chorus, you also have the dusk chorus at the end of the day, and they really are massive peaks of acoustic energy because you've got lots of species vocalizing around that time. Sometimes that's just actually where a lot of species have their peak of activity at those crepuscular moments. At the end of the day, it's also a moment of change over between the nighttime species and daytime species.

So, usually when you look at a spectrogram, a chart of sound energy, you just see a huge peak in those morning and evening sessions and what we see is that as the environments are getting degraded, so consistently you see those peaks diminishing. The more damage you do, the more heavily we use the environments, it sort of flattens them out, dampens them down. So, we talk about the great silent dawn in a way that's covering these environments. So, you're right, there's concern amongst many people about acoustic pollution about increasing the amount of anthropogenic noise you see in these environments and no doubt there's probably some issues there. But overall, I think that it's becoming a quieter place.

**Alie:** Wow. I never, ever would have thought that. I just would have thought that it's just getting more and more cacophonous with cars and beep-beep. That's scarier and sadder than I thought.

**Eddie:** Yeah, it is sad. I think it was a sad realization, we started seeing that too; just how consistent that is and just how striking that is, and how different it is to the day-to-day experience that you and I have in noisy environments where there is a lot of sound. One of the things that blows people away, if they ever get the chance to experience it, is the amount of sound that you hear in really healthy forests, especially if you get the chance to go to a rainforest. Even more so actually, if you get to go to a rainforest and get to take a recording in a rainforest and put headphones on. My goodness, the amount you can hear is just staggering and that's what we're losing.

**Alie:** What are the decibel levels like in a rainforest?

**Eddie:** *[laughs]* Good question. In our microphones, we have a decibel cut-off, just so we are not getting over... So, we have an idea of basically how far away things are calling. Whether it's really loud or not often depends on whether you have a couple of characteristic animals close by; cicadas, or some really loud birds. They can be genuinely noisy.

**Aside:** So, if you listened to Cicadology, you may remember that in North America, there's just a bunch of horny male cicadas that just scream their sexual intentions at nearly 100

decibels, which is about the volume of an ambulance siren, or 20 decibels louder than a Slayer concert. Is there anything more metal than that?

There is. And it's a bird called the screaming piha, [*two high-pitched calls, short then long*] which has been recorded at 116 decibels. But boy howdy, hot damn, hold the phone, something is louder than a South American screaming piha: the Northeast Amazonian white bellbird just busts into the tree party and announces its presence at 120 decibels. [*louder, lower-pitched, klaxon-sounding calls*] White bellbird? How about white loud-as-hell bird? And as someone who has been in the mosh pit at a Ministry show, but never stood in the middle of a rainforest, I now know which one is more hardcore.

**Eddie:** It's not so much the overall decibels, it's just... I guess you'd say almost the acoustic complexity, the amount of sound that's coming at different frequencies, even if each of those is not particularly loud itself. And that's also one of the great things about analyzing sound. If we just listen to it, our hearing tends to get blown away by those loud animals. But the microphone and the data in the computer doesn't, so if you have a really loud animal calling, it's still calling at a discrete set of frequencies.

**Aside:** So, it's the distinct species calls and the bigger trends that they're looking for. And by looking, I mean listening, but also looking.

**Eddie:** So, not just listen but also look at them on the screen on the spectrogram and try and separate individual calls. And even if we don't know what species it is, we can still identify, "Oh hang on, that's something else calling." There's a really good relationship between the number of animals calling and the overall saturation. What that means is that we kind of no longer need to count the animals every time, you can just look at overall saturation which is quite quick to count.

However, there is a really interesting emerging bit of research that I'm sure will get more and more sophisticated which is using algorithms to try to count the animals that are calling, to actually use some sort of machine learning tools to separate out all of the vocalizations into separate calls and say, "There's 200 different animals calling in this half an hour," or whatever it might be. That's kind of a fun, emerging area of research.

**Alie:** So, is AI starting to step in and be able to really do that analysis? Does that mean that there's a bunch of data analysts and computer programmers that can get into this field too?

**Eddie:** Totally. And actually, when I first started getting into this and I would often give talks to people, that's one of the things I was emphasizing: you don't have to be a kind of khaki-wearing ecologist who just loves tromping around the rainforest to make a really meaningful contribution here. In fact, we need all the people that are programmers, and computer scientists, and sound engineers. Those are the sorts of people that could get involved and make contributions that are, hopefully, intellectually stimulating for them.

We are seeing AI and machine learning tools being used more and more. Especially as we build up bigger and bigger data sets, there's a chance to analyze them more thoroughly. Still at the beginning, at these early stages, takes a fair bit of human validation, you've got to provide some training to even the best algorithms. It won't be long until we have some really well-working, automated algorithms that can help a lot of this.

**Alie:** Where do people go if they want this type of job? If they're like, "Augh, I'm a sound engineer, I'm a computer programmer. I so want to work on this."? Where are the jobs?

**Eddie:** Good question. There's a bunch of different university groups, researchers, picking up this space and that's one of the things that they have realized; they need to recruit people with these kinds of skills to do this work. Some research groups have made that their specialty. We've been really lucky, we work a lot with a group at the Queensland University of Technology, who are really computer scientists and sound engineers, that's their thing. They've been really wonderful partners for us.

**Alie:** Yeah, we had a listener, Alex Ertman, wrote in and said, "This sounds like my dream job! I've been studying auditory neuroscience for a few years, but I've been thinking of pivoting into conservation." Yeah, there are people who are like, "Ooo, this is a job you can have?!"

**Eddie:** [laughs] Yeah, it is! I really think there's going to be so many more of this. It's already one of those things that I'm seeing that kind of for-profit environment space getting into it too, so those people that are responsible for doing environmental impact assessments or environmental monitoring, that might be associated with natural resource extraction industry. So, if you run a mining company or a forestry company or something like that, you usually need to pay someone to help you do some of this environmental monitoring. Almost all of those firms doing that are now like, "Oh, wow okay. I got to have the acoustic ecology side of things because it's such a useful tool for us." So, I think the number of jobs in this space are going to really grow to not just be in that research space but a lot of net, for-profit environmental monitoring space as well.

**Alie:** And ethically, does that help the mining company make less of an impact? Or are there ever any ethical concerns like, "I'm taking money from a mining company in the rainforest. Oh no.?"

**Eddie:** Yeah, good question. Hopefully, that's the point of doing this ongoing monitoring. One of the challenges with lots of environmental monitoring in the past, is that it really relies on who is doing the counting. You and I would count differently, even if we were trained almost identically, we would still probably count slightly differently. That would be the same if we went to the forest, we would hear different things and see different things. But microphones, since they're calibrated the same, hear the same thing, no matter if you put it out or if I put it out. It's actually a chance to get some more robust, more pure data in this way that should alleviate some of those ethical principles.

What a mining company does with that information and what the government does, what do the people issuing permits do with that information, can be another question. But I wouldn't have any fundamental concerns about using tools like this in service of understanding the impacts of extracting industries.

**Alie:** Can I ask you some questions from listeners?

**Eddie:** Go for it.

**Alie:** Okay, we'll just, lightning round, we'll go through as many as we can. How does that sound?

**Eddie:** Go for it.

**Aside:** You know what, let's go for it, but first, let's make it *rain*... forest, on a worthy charity this week. So, Dr. Eddie Game said to send it to The Nature Conservancy. They are a global and environmental nonprofit, which is doing tons of good shit. The Nature Conservancy has a diverse staff, they work with over 400 scientists to impact conservation in 76 countries and territories, working also with local partners to tackle the dual threats

of climate change and biodiversity loss. More info is up at [nature.org](http://nature.org) and we'll be making a donation in Eddie's name, thanks to sponsors of *Ologies*.

[Ad break]

Okay, you hollered questions via Patreon, and we listened. So, I've got to say, Eddie says that you all have really good questions, so every time he seems impressed with a question, just feel free to maybe do a very, very tiny imperceptible butt dance that only you know about. Here we go.

**Alie:** Okay, so Jessi and Jess Swann were both interested in, in Jessi's words: Is there a standard way to describe sounds scientifically? Like, are there words that everyone agrees on to describe what something sounds like?

**Eddie:** Oh, that's such a good question! You know, I don't think there is. There was a little bit of a push to do some standardization in the way we talked about sounds and analyzed sounds. I was at a meeting about 4 to 5 years ago where there was a big community of acoustic ecologists around the world. That was all anyone talked about was, "Do we need a standardized way so we can all be talking about the same thing and doing the same thing?" My sense at the time was it was just too early for that; they would be cutting off a lot of creativity. A lot of people are still just figuring out interesting stuff to do and it was kind of growing every day. So, my guess is we'll get to a point where there is some more standardized language, but we're not there yet.

**Alie:** Still emerging, we're listening for more details on that.

**Eddie:** I think that's one of the cool things about acoustic ecology, it's still a field where people say, "Oh, I've got a good idea about how we should talk about sound or use sound," and people are really receptive at the moment.

**Alie:** Yeah. There were several patrons, KellyTheNatureNerd also wrote in and asked: Do you feel like there's a lot of opportunities out there in this field?

**Eddie:** Yes!

**Alie:** Good to know. Conservation nerds, get on it! Okay, great question, Miranda Panda, and Mike Monikowski both asked: Are there animals that people have heard but not seen before?

**Eddie:** Ooo, good question. There probably is some. The ones that really come to mind, though, are ones that we've heard for a long time and took a long time to find. As a great example, here in the deserts of Australia is something called a night parrot, it's almost like a mythical bird that had been only seen a couple of times by sort of, reliable descriptions of it. We knew it was there, and we started hearing it. [*chirping sounds. "Hear that bell? That is the sound of a night parrot."*] People started putting out microphones and recording it. Still took a long time to find it, but we knew it was there in some of these remote desert areas of Australia because we're hearing it. I bet there's quite a few cases like that, where we're using sound to find the presence of animals that then are very, very difficult to actually see.

**Aside:** Okay, so remind me to do an entire episode on this bush-dwelling, night parrot of Australia because there is gossip and it is hot. So first off, this bird has absolutely baller aliases, including the porcupine parrot and the midnight cockatoo, which will be my code names if I am ever a spy. And people thought it was extinct, they were like, "It's so dead." And then a guy saw one in 2013 and photographed it. One ornithological enthusiast named Sean Dooley, called this sighting, "The birdwatching equivalent of finding Elvis flipping

burgers in an Outback Roadhouse.” But people started to debunk that evidence and the whole thing was shady. And then acoustic ecology confirmed some calls and, using leads from Aboriginal knowledge, the bird was confirmed to exist. Everyone was like, “It’s alive. It’s not well but it’s alive.”

**Alie:** Are you a birder on the side? By the way.

**Eddie:** Do you know, I’m not at all.

**Alie:** Oh!

**Eddie:** And in fact, I did my graduate study in a lab that was completely full of birders, [*Alie laughs*] so I think I actually probably purged my brain of birding knowledge so that I wouldn’t have to compete with them in any way.

**Alie:** That’s so funny because I have heard that birders, there are different lifer lists. If you hear an owl hoot but don’t see it, some people count that, some people don’t. But if you’re an ecologist, you count that, right?

**Eddie:** Totally. I work with a great many birds and many of my close acoustic collaborators are very keen birders. There’s a lot of enthusiasm amongst the birding community for acoustic ecology.

**Alie:** Oh, for sure. I’m sure it’s also like, “Is that cheating? I don’t know.”

**Eddie:** Well, yeah. I mean that there, you could do many podcasts on the ethics of different birding, whether you’re allowed to play back sounds of a bird to get it to come out, things like that.

**Alie:** Ah! We had actually a ton of questions on that. Let’s see, from listeners Elijah and Specs Owl, a few people wanted to know: Is calling back to animals a terrible thing? Is it ethical? Do the animals know that we’re having interspecies conversations? Elijah wants to know. Have you heard anything in acoustic ecology about whether or not calling to an animal to get it to call back is okay?

**Eddie:** It’s something that’s worth considering the ethics of. Whenever you do research or do a study that would involve a playback, that is a good thing that that goes through some sort of ethics consideration; we’re at that stage now. Considering there’s a lot of utility, it really can be very useful to do that. I’m thinking particularly in cases of, for instance, there’s a really rare frog – an amazing thing that listeners get a chance to Google they should Google the corroboree frog in Australia, it’s really difficult to see a small corroboree frog – but they have this feature of liking to call back. So, it’s a really useful way to work out how many are there if you go and do a call and then record a sound and you can maybe hear these callbacks. [*“Hey, frog.” Frog croaks. “Hey, frog.” Frog responds again.*]

So, I think there can be some really good reasons to do those callbacks. But yeah, it’s worth considering whether there is likely to be any behavioral implications to the animals doing that. And it’s funny, we were trying to understand how sound moved through the environment in Borneo because one of the things that we came to realize is that microphones hear different distances from them depending on how dense the environment is; whether you’re on the hilltop or in a valley, things like that.

We wanted to build some statistical models that would allow us to correct for how far a microphone could hear so that we were comparing each microphone the same. So, we’d climb to the top of a tree, and we were pretending to be gibbons, so strapped a big speaker to the top of the tree and played these gibbon sounds. We had microphones at different

distances and we were seeing how strong the gibbon signal was there because we wanted to use it to survey gibbons. And gibbons are an amazing creature, they're the most iconic sound, certainly of the Bornean rainforest. But we were just doing this to record the artificial gibbons. But of course, all the gibbons in the neighborhood suddenly were like, "Who is this new gibbon here?? What are you doing here?" And came over and started calling and saying, "Hey this is our patch. You should get out of here." [laughs]

**Alie:** Wow!

**Eddie:** Yeah, the gibbons probably didn't appreciate suddenly hearing a bunch of new gibbons in their territory. [laughs]

**Alie:** They're like, "Do you mind? Do you mind?"

**Aside:** Okay, just a heads up... So, mimicking calls or playing recorded animal noises, it's kind of a dick move. Now, do some people play owl hooting from a Bluetooth speaker to try and get a glimpse of an owl on their deck? Absolutely. And bird scientists hate those people because the owls show up, they're so ready to get it on. They're either there for a mate or they think they've got to throw wings at a rival, and it's just you there; smelly, in a bathrobe, on your porch, taking pictures of them. So, don't make a bird hate you. Birds are so much cooler than us.

**Alie:** We had a ton of listeners: Carrie Cimo, Garvey's, Karlie V, Shelby Reardon, Euan Munro, KellyTheNatureNerd, and Beth Peluse, first-time question-asker. In Beth's words: What's the biggest surprise you've experienced from listening back to a recording? Or what are just some of the weirdest, eeriest sounds that you've heard?

**Eddie:** [sighs] Good question. You know, this is going to sound funny, but one of the things that's quite eerie when you're listening back is when insects come really close to the microphone. I'm thinking mosquito, even a common mosquito. [Alie laughs] So, most of the time you hear all these wonderful things and then occasionally you hear this, it's like a science fiction soundtrack of the mosquito and it's just getting a little bit closer. When you hear it when you've got headphones on, [mosquito buzzes] it's a very kind of, acute sound you hear, coming and landing on the microphone and then going off again. That never ceases to be a little bit eerie.

**Alie:** Are you ever tempted to sample and make some tracks? Like, Specs Owl asked if you're interested in the work of Chris Watson who makes nature sounds into *avant-garde* music? Are you ever like, "This would make a pretty good beat"?

**Eddie:** Yeah, and you know what, some of our sounds have been used, in lots of different ways too. Some of our recordings from Papua New Guinea got turned into a piece of orchestral music actually for some concerts at one point. And a close colleague of mine has a pretty *avant-garde* group that involves electronic music, a double bass, and fish sounds. They're recordings they've taken in rivers. It's very cool. We even did a live performance once; it was pretty entertaining. [laughs]

**Alie:** What is it called?

**Eddie:** Simon Linke is the person who set it up, he's at Griffith University in Australia so you can look him up. I don't think the group actually have a name, but they performed at a festival, a wonderful sort of live mixing of fish sound recordings taken from their acoustic ecology work and electronic and double bass. [clip of music plays, very upbeat and rhythmic]

**Alie:** You mention fish sounds and we had some questions about COVID and whales. Meryl Stark wanted to know: Tell me more about what happened when shipping was shut down in the North Atlantic during COVID and everything went quiet? And Alannah Wood wanted to know: How much does noise pollution mess with whale and dolphin calls? And Antonia Clark and Aoife Holmes also asked about underwater noise. Because you mentioned that it's getting quieter on land, but are things different in the ocean?

**Eddie:** Ooo! Lots of good questions there. I'm probably not best placed to speak a lot to what happened in that COVID shutdown, what response you saw in the North Atlantic. But certainly, we know that the acoustic interference of cetaceans, whales and dolphins, is a pretty big issue and that it is harder for them to communicate and navigate well in places that are really busy with a lot of acoustic sounds.

I said earlier that those low-frequency sounds travel so far and that's especially true in water. The diesel engine of a ship is one of the lowest frequency sounds you hear. The extent of that pollution is extraordinary. One of the most amazing sonic experiences I've ever listened to was a woman here in Australia called Leah Barclay. What she had done was had microphones that drift down the coast and she had them floating and recording down the eastern coast of Australia.

And when you listen to these in a dark room with speakers all the way around us, it was this sonic journey as you come down from the Great Barrier Reef and as you get closer to the cities that have big ports, [*deep grumble, growing louder*] Sydney, things like that, it just, the sound even when you're tens, hundreds of kilometers away you hear this sort of grumbling sound... Growing, growing until it takes over the entire soundscape and then fades away again as the drifting microphones went past these cities. Extraordinary experiences: gave me such an insight into how altered that sonic environment is in the marine space.

**Alie:** And does that interfere with echolocation? Mia Manzer wanted to know: Are mammals like dolphins, whales, bats... are they using acoustic ecology? And do those human-made acoustics really mess with them?

**Eddie:** Yeah, good question. I think there is quite a lot of evidence supporting the idea that those human anthropogenic sounds, let's say, that they do interfere with the ability of whales and dolphins to communicate. What's probably less clear is how that manifests, in terms of behavioral changes. But I think there's definitely an impact. One of the things we're learning, what I said about underwater sounds, is that there's a lot of things other than whales and dolphins that are using sound cues. So, there's a hypothesis even that fish on the Great Barrier Reef, for instance, use the sound of reefs as a cue to find them. They're drifting around in the plankton in the vast ocean and the reefs are actually very small compared to the vast ocean.

**Aside:** And these tiny, baby fish larvae are drifting around the ocean, just looking for some slice of reef to call home. And acoustic ecologists think that they're using sound to find them, like the tiniest, most critical game of Marco Polo with, like, a new landlord.

**Eddie:** We're certainly seeing evidence that when you see things like coral reefs get degraded either through coral bleaching, climate-driven events, or through other forms of degradation; pollution, sediment, things like that. They are getting quieter because it's the same thing you're seeing happening on land, you're just losing some of the vocalizing diversity from those environments. And that is probably having a bigger impact than we

realize on the overall ecology of this, how animals navigate their way around those environments.

**Alie:** And are all of these animals actually hearing or are they sensing the vibrations? Like Batman Flight, who is a chiropterologist, asked if any animals use infrasound to send messages further? How much of this is so, so low that it's in kind of another realm for us?

**Eddie:** Good question. I mean... possibly lots. I guess if you go back to the very early ideas of how sound is involved in communication, probably the earlier versions were just vibrations that we felt, vibrations that we made and were felt as vibrations. There's a book out recently by an American author, David Haskell, I think it's called *Sounds Wild and Broken*, and he talks a lot about the origins of sound. There are still lots of animals that are communicating through the vibration. They're not hearing it, certainly not in the way that we hear sounds. We're fairly unique, hearing through the ear the way we do. But hearing through things like water is a way of really feeling. Lots of animals are essentially hearing vibrations in the water.

**Alie:** Have you ever heard the thoughts about infrasound and the roar of a lion and why that's so terrifying to some mammals? Does that ever come up in your work?

**Eddie:** Oh no, I don't know that.

**Alie:** It's apparently some really low frequency that just, hackles go up. [*very deep and slow roars*] Some ghosthunters, or people who are looking into ghosts, have found that just a low, low rumble from a fan will give us the same eerie feeling, so something that we can't hear but we're like, "I got really spooked with I went in that basement." It's just because there's like a fan that's going too low for them to hear but they can kind of sense it.

**Eddie:** Oh, fascinating. Do you know, that's interesting because one of the things I'd read in David's book, he was describing how the way that we often hear sounds of dinosaurs in films are nothing like what their anatomy would suggest they made. [*Alie laughs*] And in fact the sounds that they use for tyrannosaurus in things like *Jurassic Park* [*Tyrannosaurus screeches*] are a combination of really slowed down baby elephant trumpets and lion roars because it induces the response they want the tyrannosaurus to produce in us. [*laughs*]

**Alie:** I wonder what they actually sounded like, if they were like, "Hiiii."

**Eddie:** [*laughs*] Well, the reptiles hear differently so they certainly were able to make sound but probably quite different than sounds that we think are sort of characteristic to our current hearing and the way that we hear.

**Alie:** Yeah, I mean just based on how a chicken sounds, not too scary.

**Eddie:** [*laughs*] Exactly.

**Alie:** Last listener question, one sent in from Celeste who said: Have you ever listened to or studied a creature who is on the brink of extinction or who has since become extinct? I find this notion to be incredibly depressing and yet, it is the question I have. And Timothy Hwang said: How to feel less shitty about the world losing rainforests? Cry face emoji. Any hope? Any way that you deal with things emotionally?

**Eddie:** Yeah, you know, that is a good question and it's something that I have to deal with really frequently. What gives me hope is how thriving I see even small patches of rainforest. We've given a lot of abuse to this planet but if we can even just save some small pieces, it's just astounding how much biodiversity can be protected.

One of the places I've been lucky enough to work in is Borneo, and there's this one patch of forest, it's not particularly big, it's certainly a decent size by built-up standards, so 50,000 acres or so. When you look at a map it seems tiny, but when it's a dense rainforest that's hard to walk across. It really wasn't that long ago that we rediscovered a species of primate even, a langur, a monkey, that was thought to be extinct, that has a troop of them in this area.

When you go places like this and you see what has been left intact, there's hope that we're not going to wreck it all and if we could just find a way to stop the hemorrhaging of these forests... which I really do think is going to happen and I just think that's going to be untenable and a lot of people are starting to realize that on lots of levels. Then nature will come back.

**Aside:** Also, if you listen closely, you can hear morning birds just chirpity cheepin' right behind him. So, what this episode lacks in microphone quality, makes up for with bird cameos. We did it.

**Alie:** Do movies and TV... do they get rainforest sounds right? If you go to the Rainforest Café ever in Las Vegas are you like, "This is so wrong"?

**Eddie:** No, sometimes they do actually... Sometimes it's pretty good. They're the sort of people often... the people that are collecting the "atmos" for these recordings, they're often people that go into sound recording and sound ecology. We've been lucky in the ecology space to recruit people who were already interested in rainforest sound recordings. What we often don't have is a way to play it back to ourselves that can mimic an actual rainforest environment because you need to have a whole pile of different speakers, almost 360-degree immersion and the ability of speakers that can really reflect those different frequencies. So, it's probably less about actually what the recording is than how we get to listen to it again.

**Aside:** I have never thought about that. That kind of surround sound, plus smells, and humidity, and snakes, and bugs, and birds. Augh!

**Alie:** What about those apps that have gentle rainfall or bird sounds? I always want to know, who is out there recording those?

**Eddie:** *[laughs]* That's so funny. I guess you hear a lot of rain when you're in the rainforest. One of the sort of banes of our recordings is filtering out rain. *[Alie laughs]* But you know, I do not find... heavy rain is not relaxing to listen to. When you're listening to gentle rainforest sounds, that's like in the middle of the day when things are the quietest and just hearing a little bit of gentle sound every now and again. If you're actually listening to a rainforest that's at peak activity, I don't think anyone would describe it as calming. *[both laugh]*

**Alie:** Well, you mentioned that you're an early riser. Do you enjoy the sound of birdsong as it becomes dawn, as the sun comes out?

**Eddie:** Yeah, I think I enjoy being in nature. It's a time when nature is really alive, and it is also often a time before people get up and start moving around. So, I think there's something special about being out and about in nature at that time.

**Alie:** What about the hardest thing about your job? What is so frustrating?

**Eddie:** Oh, you know, without question... I'm going to totally botch this quote, but I remember, might have been E.O. Wilson, the price of an ecological education is that you live in a world of wounds. And that's definitely a bit true. You often see things like, "Wow we've given that

up, hiding.” And that’s probably the toughest part. I’m lucky because you get to get up each morning and try to do something about it. But it’s tough also seeing that. And I imagine that’s true for many, many different professions that work in crisis response type situations.

**Aside:** Also, the late E.O. Wilson was a biologist and a naturalist, and I debated leaving that quote in because E.O. Wilson has been criticized for being, hmm, a little racist from what I gather, and I am elated to inform us all that that was actually a quote from Aldo Leopold, who was an ecologist and the granddaddy of wildlife management. The full quote is, “One of the penalties of an ecological education is that one lives alone in a world of wounds.” So, that was an Aldo Leopold quote, and I looked up his history and he was born in the late 1800s and whoops, yup, also, probably also not the least racist person ever. So, all right. So, that’s the worst thing. Now on many levels, let’s look on the bright sides.

**Alie:** What about the best thing about it? What about the thing that you just love and could keep doing forever?

**Eddie:** Well, I just love the fact that all of this is working toward a legacy of something that I have enjoyed and really appreciated; interaction with the natural world, and hoping we can continue that for other people. But on a day-to-day basis, I love the people that are involved in the conservation space and the work, in all sorts of aspects of it. It’s a really, very collegiate and interesting, enjoyable group of people to be on this mission with.

**Alie:** I’m sure that you have so many different people who do so many different things as well, it’s got to be cool to see all these ideas come together.

**Eddie:** It is, it is. Acoustics, it’s opened to a whole new pile of people, as we discussed, who are now getting involved. And new people are interested in it, so I’ve gotten to talk to a lot of people that I wouldn’t have otherwise. So yeah, attracts a great cast of people.

**Alie:** That’s awesome. Thank you so much for talking to me, this has been so illuminating! Illuminating and music to my ears.

**Eddie:** Pleasure Alie, thanks for having the conversation.

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So, ask quiet ecologists, loud, brazen questions. But actually, do it politely because there’s a whole world that you can learn about when you listen. So, ask questions, take a risk, you’re good. Also, thank you to everyone who has just been listening to my secrets at the end of the shows for the last couple weeks and wishing me and my family all the best. I’m really grateful for you and for science as we just keep on keepin’ on, cancer be damned.

Thank you to Dr. Eddie Game and The Nature Conservancy, which you can find at [Nature.org](https://www.nature.org). A ton of links are up on my website at [AlieWard.com/Ologies/AcousticEcology](https://AlieWard.com/Ologies/AcousticEcology), which is linked in the show notes too, you don’t have to write it down.

Thank you to Erin Talbert for adminning the *Ologies* Podcast [Facebook group](https://www.facebook.com/OlogiesPodcast). Thanks Shannon Feltus and Boni Dutch who help out too. Thank you to every patron at [Patreon.com/Ologies](https://www.patreon.com/Ologies) who supports the show and sends in questions. It’s a buck a month to join. Susan Hale does so much behind the scenes including handling merch at [OlogiesMerch.com](https://OlogiesMerch.com). Thank you, Noel Dilworth, for all the scheduling and amazingness. Emily White of The Wordary makes our professional transcripts. Caleb Patton bleeps episodes and those are both up for free on our website at [AlieWard.com/Ologies/Extras](https://AlieWard.com/Ologies/Extras).

Every few weeks we release a new *Smologies* episode, which has been trimmed of sex, and filth, and my swears and made bite-sized for all ages; Zeke Rodrigues Thomas of Mindjam Media makes those happen, with assists from Steven Ray Morris. Kelly Dwyer is the website wrangler; she can make yours too. Nick Thorburn of the band Islands made the theme music and each week the birdsong of my dawn, Jarrett Sleeper of Mindjam Media puts these all together and boosts sounds where it's quiet and he's also helping me and my family out so much. I just want to throw him a parade every day. So, just in case anyone's ever on the fence about marrying their long-time crush who is also a sound engineer, personally, it's worked out great for me. So, five stars on Yelp.

And if you stick around until the end of the episode, I tell you a secret. This week's secret is that today's highlight was pointing out some deer out of the back window for my dad, who loved spotting them from under a blanket in his cozy chair and taking pictures on his iPad. Also, another secret is sometimes I'm really afraid to read the reviews at the top of the show, I'm like, [*nervous tone*] I hope these are nice. So, thanks to everyone who leaves nice ones. For real, makes my day. Okay, thanks for sticking around. Berbye.

*Transcribed by Aveline Malek at [TheWordary.com](http://TheWordary.com)*

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["The Sound of Success: Listening to the birds to measure forest health in the wilds of Maine"](#)

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[Are creepy ghost-y feelings really just infrasound? Here's the science.](#)

[Soundscape: The Journal for Acoustic Ecology](#)

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[Leah Barclay's soundscapes of Australian oceans and ports](#)

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[International Dawn Chorus Day, May 1, 2022](#)

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