

Natalie Schmitt: So from individuals from government from, from industry, from NGOs, all saying that this is brilliant, you know, we really need this, uh, we want this technology. But the problem is, is that no one is able to direct you to the funding and for, for technology development, it, it does take a lot of funding because you have to bring on an entire team of people. I can't just work on this myself. I need a team of experts to help me do this.

Priya Shelly: Welcome to From the Field, a podcast logging real life scientists and their efforts to improve the world one study at a time. I'm Priya Shelly.

In this episode, I speak with Natalie Schmitt, a conservation genetic scientist and post doctoral fellow at McMaster University. Nat's focused on developing a new and innovative genetic detection technology for rare and elusive species, like the snow leopard. As the Director of WildTech DNA, Nat's proof of concept DNA kit could identify a species on the spot through field samples in a matter of minutes, rather than waiting months for lab results. Her proof of concept could change the way scientists collect samples in the field, empower local communities and even discourage illegal wildlife trade.

Nat's pioneering spirit for wildlife and conservation all started with a handful of inspirational figures.

NS: my great grandfather was part of Morrison's expedition. So Douglas Morrison, uh, who, uh, went down to Antarctica in the early 19 hundreds, and he was the engineer of the voyage. And as a child, I was always so fascinated by this voyage in the work that he did. And so I, I guess I've always had that sense of adventure in me.

I really think it started off with David Attenborough documentaries and of course Jane Goodall, uh, who could not be inspired by these people. And, and I just wanted to be David Attenborough. I wanted to be Jane Goodall and I just had such, I've always had such a love for animals and, and just always wanting to know why they did certain things. And, uh, I've always had that questioning mind. So I think some of the fondest memories I've had as a child is camping with my family. Uh, that's, that's really what started my interest in, in, in nature and, and studying nature.

When I finished high school, I wasn't sure what area are we really wanted to go into. It was either I was either going to be a vet or I was going to study zoology. And really, luckily for me, I, I flunked out of getting into vet schools. So, uh, I only had one choice and that was to study zoology. But I'm so grateful that I ended up going down that path. So, I did a double degree in, in zoology and botany because I thought the combination of plants and animals would be a perfect fit for me, but more importantly, I was really interested in, in, in studying conservation. So I, this degree set me up for, for doing that.

So I, once I finished university, my focus was actually my interest, uh, was on animal behavior and I was particularly interested, you know, having done my university degree in Australia, I've always been interested in Marsupial's. So I actually started out studying Marsupial's. So I spent, you know, three or four years in that area of research and then I had this incredible opportunity to, to kind of get into the documentary film industry.

And I made the very, uh, very, uh, I guess, drastic, dramatic decision, uh, to leave science and actually going and go into documentary film. Because, you know, I've always been passionate

about making a difference in conservation. I thought that perhaps I could do that. so I actually spent five years, uh, presenting and, and, and also filming in that industry. And, uh, yeah, this was, this was all before I even thought of doing a PhD.

I decided that the documentary film industry was, was a really challenging industry to be in. And particularly in Australia, I found as a presenter that in the Australian industry, they, they really preferred to take on people that already had a profile and weren't that willing to give new people a chance. And back then I didn't really fit a particular box as far as presenters go. Uh, I've, you know, I was a scientist, had the scientific background and I thought that I had something to sell as a presenter, but back then they were more interested in celebrities. I struggled, even though I managed to get a role on a discovery channel in the U S which was, which was incredible. I thought that perhaps I'd given it enough of a go. I, I spent five years, uh, devoted to, to seeing where I could take that and I was missing science. I really wanted to get back into science again. So quit the industry and I spent a year looking into what I would really like to do for my PhD.

PS: Nat jumped back into academia and became a PhD candidate at the Australian National University and the Australian Antarctic Division, researching humpback whale genetics. Nat found herself following the humpback whales of Australia to their feeding grounds - all the way in Antarctica. This trip marked the beginning of Nat's interest in genetic research which would later kick off her idea for the DNA testing kit.

NS: my PhD, uh, was looking at how, uh, the Australian and South Pacific humpback whale populations, how they mix on their Antarctic feeding grounds. Uh, so looking at the genetic differences between these populations and yes. You know, where they go down in the Southern ocean to feed. So when I started this PhD, um, my supervisor actually gave me the opportunity to do this on the proviso that I didn't expect to go down to Antarctica. And so I was like, yep, sure. I, I, I don't think I'd be disappointed if I didn't go. And of course I really did want to go and he surprised me one day and he said, guess what, you're going to Antarctica. And I was just like, Oh my God.

So unbelievably excited. I just can't put into words how phenomenal that experience was because you just, you can't anticipate what a different environment, this is how phenomenally beautiful, uh, I'm just in or of how animals survive down there. So it was, it was an incredible experience and especially, you know, being able to follow in my great grandfather's footsteps was, was very special for me. I guess taking a step back when I was looking into what I wanted to do for my PhD, I, I actually, that's when I discovered genetics and the power of genetic markers and genetics had progressed quite a bit since my undergraduate degree where I was actually, you know, found it quite boring.

Uh, and I started to read some scientific papers and I thought, wow, these genetic markers can tell you a lot about what these animals do. And I became very interested in learning more about it and perhaps doing a PhD on it. And my, my supervisors, uh, actually warned me against doing a PhD, uh, when I've had no experience in genetics. So I set about trying to prove them wrong by working in a lab for six months and kind of learning about these genetic markers and, and um, yeah, how, how, how they're used in, uh, conservation genetic, research. So, specifically we, we were identifying a genetic markers that can allow us to, uh, distinguish between populations. It allows us to identify individuals, but we're really using those markers to answer the question, what, what breeding populations of humpback whales are using these, this

particular part of the Southern ocean to feed. So we can collect samples, we can collect skin samples from humpback whales in a part in the part of the Southern ocean and we can use these genetic markers to determine what populations are within that mix.

PS: With her conservation genetics PhD in hand, Nat focused on her postdoc research topics and did her best to find funding for her projects. She found that her plans in the academic world weren't going her way and she decided to work with a research lab in the interim. This decision ended up being a turning point in Nat's career.

NS: After I finished my PhD, and this is pretty com mon amongst people that finish their PhD and suddenly they're like, okay, now, now what am I going to do? What do I actually want to do for the rest of my life? And so I, I, I scrambled a bit and, and you know, I tried to get a few, what a few other whale projects going with the hope of, of, of doing a postdoctoral fellowship. I really struggled to get these projects off the ground and it was a combination of, of politics and, and, you know, struggling to get funding. And, uh, I, I managed to get some work and this was out of the blue because I needed a bit of money. I got some work in this lab, which, uh, focused on developing new genetic techniques to detect Marine pest species.

So this wasn't whales at all. This was dealing with, you know, really small organisms. I had always been interested in cats, uh, specifically snow leopards. And in fact, when I was exploring what I wanted to do with my, on my PhD, I actually considered doing a PhD on snow leopard. And so I thought, you know what, maybe I should revisit snow leopards again. Maybe, maybe this is where I want, where I want to go. And so I started looking into some of the research gaps. What information do we need, uh, to help conserve snow leopards at the moment. And one of the things that I read was that one of the biggest challenges in detecting snow leopard in the field is identifying them from, from their fecal samples. So often samples, uh, collected, you know, they, they live in the Himalayas in this very, very challenging habitat.

And then those samples are brought back to a lab. Uh, they're analyzed, uh, and then it's discovered that the majority of those samples don't actually belong to snow leopard. They belong to another, uh, another predator in the area. And so I thought, so one of the big, big, um, subject, well, one of the suggestions was that we need to develop new technology to be able to quickly identify a species from fecal samples. And so I spoke to my, my boss, who I was working with and I, and I said, do you think that you could create a device that could do this? And he said, yeah, I think, I think it's possible. And he actually sent me a few scientific papers and I stumbled upon a paper that had been written by this biomedical lab at McMaster university in Canada. And they had developed this incredible paper-based biosensor for the detection of bacteria in food and water samples.

And suddenly this light just went off in my head and I thought, Oh my gosh, this is brilliant. I wonder if this could be adapted to species detection. And you know, long story short, I contacted the professor, he said, why don't you come and see if you can develop a proof of concept? And suddenly this whole new world opened up for me and the potential that the applications to this type of technology just grew and grew in my head. And I thought, this is something that I have to follow. I have to see if I can do this because this, this could potentially be huge for conservation.

The traditional path that you take after a PhD is, you know, if you want an academic career that is, is that you, you, you go and do a post doctoral fellowship. And that usually involves working on someone else's project. And I, after my PhD I thought stuff this, I'm, I didn't, I didn't insure a

PhD to work on someone else's project. I have a great idea and I'm damn well going to make this work myself. But little did I realize just how difficult that would be.

But you know, as difficult as it has been, it's been so rewarding. It really is a rewarding path to, to know that you have a great idea to see the application to conservation and to, and to devote your time and effort to making this work. Uh, so yeah, I'm, I'm, I guess you would call me an independent scientist, but, uh, um, I'm for McMaster university. I'm considered a, a postdoctoral fellow on their books.

PS: During her time at McMaster University, Nat has been busy developing her proof of concept DNA test kit which could identify rare and elusive species in a much easier way than the traditional methods. Typically, species identification is done through genetic analysis where samples are sent to a lab, processed and the results are returned sometimes months later. It isn't always the most efficient for scientists in the field who are looking for rapid results. The immediacy of the test kit, however, has the potential to open many informational doors for scientists, locals and agencies which is what fuels Nat's passion for her project.

NS: The device that we're trying to develop is just a simple paper based biosensor. So I always describe it, it's like a pregnancy test. It gives you like a yes or no answer, like a color change. So if, if, if your target species, if the DNA of your target species is present, so I just say you're looking for snow leopard, uh, you put that material onto the device and if it changes color, then you have a piece of snow leopard. This device, because it's made a paper, it's, it's really easy to use. Uh, it's very, very cheap, which means it's affordable for everyone I communities developing countries, so it really in the hands of customs officers, it enables them to know whether they have an illegal product in their hands very quickly, which then gives them the grounds to be able to detain a person temporarily until more tests can be done. It is huge. And this is, this is part of the frustration. It's just like, I know, I know how huge this is. I know how important this is. And, and, and so many people have been supportive of that. But yes, it, it, it's been crazy to me just, just how difficult it's been to find the funding to develop this considering just the applications and the importance of it.

My goal for the proof of concept was, you know, can we take a small piece of snow leopard DNA? Can we, can we immobilize it onto this paper device and then concentrate it, uh, you know, via these chemical reactions and then link it to a color change. And so we were, we were able to do that. And now that we've done that, we know that this is going to work. It, it will work. And we can develop this for a multitude of different species, both terrestrial Marine, uh, aquatic plants, animals, it, it, anything containing DNA can pretend this, this device can potentially detect.

You know, even in developed countries that that can afford or have access to these laboratory facilities and, and can afford to spend money on very expensive technologies, this will still save a lot of time and money. And what I like about it is that, uh, we, we kids could use this. I mean, it's, it's a device that will be simple enough that we can use this in schools to teach kids about conservation and, uh, you know, kids can become detectives of conservation and that just that, that, that application is really exciting to me.

to be able to empower communities with a technology like this that can enable them to quickly identify what animal has killed their livestock. So they can take a saliva sample, for example, from a livestock that has been killed, uh, an animal that has been killed.

And they can determine what species killed that particular animal because more often than not, the wrong species is persecuted. Um, so for example, in places like Nepal, you know, often snow leopard are persecuted for, um, for, for killing livestock. And yes, they are responsible for a lot of those killings, but they're not the only species that that is. There's many other carnivores, uh, in, in the Himalayan region that could be responsible for this also including domestic dogs. So it, it, it empowers communities. It has the potential to empower customs officers. And, and in, as far as fecal detection goes, and being able to monitor, uh, wildlife more easily by, by using this type of device out in the field. I have a friend who works for WWF in Armenia and he studies Persian leopards in the caucuses region. And he, so in the caucuses there are very few Persian leopards left. And so they're very difficult to find. So he'll spend weeks and weeks collecting samples in this area and they do not have the laboratory facilities within their country that they can send these samples to to be analyzed. So he sends them to Germany. It takes six months for those samples to be analyzed. And the recent results he got back is that pretty much all of the samples he collected don't actually belong to Persian leopard.

And you can imagine the money, the time, the effort, and, and plus waiting six months to get results. I mean, can you imagine what a waste of time, what a waste of effort. And he's just pleading with me, he's just like, we have to find a way of getting this technology developed because it, we really need this.

PS: Not only are Persian Leopards difficult to find but so are snow leopards and it is one species that Nat has been interested in conserving with her DNA Kit. If you've ever seen a picture of a camouflaged snow leopard and try to spot it - no pun intended - it's usually pretty difficult to find even though it's hiding in plain sight. Now imagine trying to study them in the field. Typically, the most that scientists see of the snow leopard while in the field are their tracks or their fecal matter and according to Nat, even those are difficult to find.

NS: By their very nature, rare and elusive species, a difficult to study because they're either largely inaccessible because of the extreme habitats that they occupy or they're nocturnal or they have enormous home ranges or they're migratory or there may be, as I said, so few individuals left that they may be just very difficult to find. So for these animals especially, there is, there is so much we don't understand about their biology and we need to understand their biology so that we can develop effective strategies to conserve them.

So when you're climbing these peaks. So in order to find snow leopard samples. So I spent a few weeks working with um, uh, the center for molecular dynamics, which is a lab based in Katmandu. Uh, spent a few weeks with them in the most stung region of Nepal, which is near the Tibet border in the North. And, uh, trying to find snow leopard fecal samples is a lot more difficult than you think, particularly when you're walking at high altitude and every way you walk seems to be going up. And with the altitude as well, it is absolutely exhausting. And so I thought to myself, this is even more reason to get this thing developed because I don't want to be, if I, if I find a sample, I damn well want it to be a snap in the sample because it is absolutely exhausting. You need to be fit, you need to have everything you need with you.

You just, you don't want to get sick. I mean, I, I got sick while I was there and that wasn't pleasant at all, but it's, it's tough. It's, it's seriously tough and I have enormous respect for the, for the people in the communities that live in these areas.

It's Rocky, it's the vegetation is sparse. You know, the further you, the high you get an attitude, the more sparse the vegetation becomes. But it's also phenomenally beautiful. It is breathtaking. It, it's where I feel most alive in these types of habitats, like, you know, here in an Antarctica where you feel truly alone yet truly a part of nature. At the same time. In fact, this is really interesting, I get the same sensation when I'm standing on top of a mountain where it's deathly quiet and you feel like you can hear all of the universe at once. And I get the same feeling down when I'm in the sea ice, uh, you know, down near Antarctica and the silence is also deafening and you, and you get the same sensation. It's, it's, it's so difficult to describe, but it's like you instantly feel like you're part of this much bigger picture and instead of feeling a sense of isolation and loneliness, you feel that true interconnectedness.

PS: While the Himalayan Mountain Range is a sensational and awe inspiring part of the world, the harsh realities for the local people of Nepal remain when it comes to coexistence between their livestock and snow leopards. The increasing numbers of domestic livestock look similar to their wild counterparts and snow leopards are taking advantage of the quick meal. This creates a massive strain on the local community. As part of her ongoing research, Nat spoke with communities in various regions of Nepal to better understand the hardships of livestock predation and how the DNA kit could aid in creating a space for coexistence.

NS: It was a real eyeopener actually, uh, having the opportunity to speak to some of the villages and it was amazing actually, the difference in attitude towards snow leopard between different members of the communities. So I spoke to an old goat herder, for example, who had lived in the area all his life, you know, multiple generations. And,, he wished that the snow leopard was not there. He, he would go, he would be so glad if the snow leopard simply wasn't there because, because his, his goats, uh, his livelihood and he doesn't want to see his goats taken away. And so I really understand where he's coming from. And yet you speak to the younger generation of these communities, the younger generation have access to the internet and they have, have seen just how much the world values and appreciates snow leopards. So they, they're seeing some value in, in the, in the animals that they share this habitat with.

NS: I think it really depends on the area, uh, on, on what community, what village, what, uh, you know, if it's a, if it's an area of high snow leopard density, uh, I mean we're finding that a lot of roads, for example, are being built in Nepal and that's actually driving snow leopards more towards these communities. So, so we're finding a livestock depredation is increasing in, in some of these areas. Uh, but it can vary. You know, in some places this, this goat herder that I spoke to, he, he, he said in the last year he had, he'd lost over 200 goats. Uh, I'm not sure how accurate that is. Uh, but, uh, it, it can be a lot. And, um, and as you can imagine, if, if these communities depend upon these animals for their livelihood, then that, that, uh, that can be quite significant for them.

And often the herders, we'll take their flock, uh, out to graze away from the villages. And that's when, uh, their livestock are most vulnerable. Uh, so usually when the livestock, uh, um, or in the village itself, if they have proper corrals to, to protect the livestock at night, then, then usually they're safe. But the real risk is when the herders actually take the livestock out to graze in fields, um, uh, a distance away from, from these villages.

With snow leopard, uh, we're starting to see common leopard, uh, encroaching on snow leopard territory. So as, as, as the climate is warming, uh, common leopards, uh, moving further and further, um, uh, higher up in altitude. And so we're seeing a lot of common leopards as well as

tigers in areas that we wouldn't normally see them. So this is not great news for snow leopard. It means they've got even greater competition, uh, for food, which pushes them, uh, more and more into these communities.

So they're going to be highly dependent upon livestock to survive. So we're, we're seeing evidence of, of the impacts of climate change on, on biodiversity everywhere. So not just snow leopards, but absolutely everywhere.

PS: Unfortunately the conflict between herders and snow leopards results in hundreds of snow leopard deaths per year in addition to deaths caused by illegal wildlife trade. With as few as 10,000 snow leopards left in the wild, it's not surprising that these big cats have found their place on the vulnerable species list. In an effort to combat snow leopard deaths, Nat has showcased the DNA Kit with CITES - the Convention on International Trade in Endangered species. Interest in the proof of concept could lead to funding and mass production of the kit and further efforts of big cat conservation.

NS: illegal wildlife trade has had phenomenal ecological economic and national security impacts. And it's considered, it's considered as, as really the conservation crisis of our time. It's, it's a \$19 billion industry and that's excluding, uh, uh, plants and, and timber, timber species. And it really is, it really is enormous. And it is a, uh, a huge problem for conservation. And we're, and we're losing species at such an alarming rate. And particularly with the big cats because they're the, they're such an enticing species to trade, you know, largely because of their fur and because of their bone, uh, being used in Chinese medicine. And, and one of the biggest issue and why this is so attractive, uh, to poachers and, and, and illegal traders is because it's so easy to, to, to kind of get away with it because border controls just don't have the technology to be able to identify these illegal products on the spot. So they often, uh, they often go unnoticed. Uh, and so that's one of the biggest issues. One of the biggest issues, uh, with the prosecution and enforcement of illegal wildlife trade is being able to very quickly distinguish between legal and illegally try to products.

CITES is the convention on international trade in endangered species. So it's a, it's basically an international agreement between governments, um, which is aim to ensure that international trade, uh, in wildlife and plants does not threaten their survival. Every year, hosts a, uh, conference of the parties. So the parties, uh, you know, all the different governments and organizations that are part of, uh, this convention. And so the, the conference of the parties, um, basically, uh, discusses proposals to either increase or decrease the protection of a species.

I was in incredibly privileged to be invited to attend the event as an observer, which means that I can't vote on, on, on these proposals. Uh, but I could at least talk to people and promote the technology that we're trying to develop. So it was an amazing experience. And you know, this is, this is where, uh, big decisions on conservation get made at, at a policy level. And, uh, I, I had interest from, from many of the parties, um, particularly for the detection of the illegal trade in, in big cats. So, you know, ranging from lions to, to leopards to Jaguar, uh, and tiger, uh, many parties were interested in using this device for, for the quick detection of, of illegally traded parts from these species. So I was invited recently to, uh, to give a talk, uh, to the South African delegation who, uh, are really interested in using the technology, uh, for line bone detection for example. And, uh, yes, so many, many other countries and organizations also interested. So I'm, I'm hoping this could lead to funding, uh, because you know, this is, this is where the

funding, I have the best chance of, of getting funding to develop this. So that was a positive outcome for me for sure.

PS: As challenging as secured funding and sponsorship can be in the world of conservation science, Nat's special encounters with nature have been a major inspiration and Nat believes that we can be inspired to make a difference by our own interactions with nature.

NS: governments are so focused on the short term and, and really conservation is more focused on the longterm, uh, protection of species and, and maintaining biodiversity. Uh, these are really longterm goals, which unfortunately most of our government systems are not set up, um, to really deal with those things. And I guess secondly, uh, the other reason why it takes a backseat is because, and not just governments, it's is generally speaking, people don't understand that as, as human beings, we're not disconnected from nature. We're not separate from, from animals, from wildlife, from, from, from nature. We are all part of nature. And our very survival depends upon, uh, the survival of this planet. You know, and we depend upon healthy ecosystem. We depend upon other species. And I think this is the biggest issue is, is that generally speaking, people don't realize that we are so interconnected and in order to save ourselves, we need to save the rest of the planet.

I often tell people the story of a, of a, an experience I had with an Antarctic blue. Wow. That really put things immediately into perspective for me. So it was an, it was on I think the second, my second Antarctic voyage and we would collect skin samples from Antarctic, blue whales from the bow of our ship. Uh, and we were, uh, standing up on the bridge and this blue owl suddenly showed up out of the blue, um, Oh on the bow of the ship. And I was, I was half dressed in the gear. And so the, the, the science leader said, Nat, just go down there, take, take the biopsy gear and just get going and we'll all follow behind you at some stage. So I went to the bow of the ship. We were, we, we were in amongst the CIS and as I mentioned, the CIS is deathly quiet. It's just absolutely beautiful. So it was quiet apart from the, this ginormous blow from the largest animal that has ever lived off the bow of the ship. And for a moment there, it was just me and the whale. And I mean, I get chills now every time I talk about it because it was so profound and so special that it somehow just put everything into perspective for me. All at once. And at that moment, I just thought, I wish, I wish everyone could have this exact experience or something similar that really, really makes them realize just how lucky we are to have such an incredible planet and to share it with these incredible animals and how much they're worth protecting.

People don't have to have, you know, have an experience with an Antarctic blue while, and I talked to [inaudible] to have the same effect. I mean, I think any connection with whether it's sharing with, with a tree, whether it be with, with another animal can, can have the same effect. It's, it's really, it's really having that realization that we are all one in the same, that we all share this planet and that, uh, you know, it's not just us human beings, you, we're not alone and we need to look out for, for one another. And that includes the plants and animals that we share this planet with.