Ophidiomyces ophiodiicola, Etiologic Agent of Snake Fungal Disease, in Europe since Late 1950s

[Announcer] This program is presented by the Centers for Disease Control and Prevention.

[Sarah Gregory] Hello, I'm Sarah Gregory, and today I'm talking with Dr. Francesco Origgi, a veterinary microbiologist and pathologist at the University of Bern in Switzerland. We'll be discussing the presence of *Ophidiomyces ophiodiicola* infection in free-ranging snakes in Europe.

Welcome, Dr. Origgi.

[Francesco Origgi] Thank you very much, Sarah, for this opportunity. It's a true pleasure.

[Sarah Gregory] This is a very unusual topic. Let's start off with a basic. What is *Ophidiomyces ophiodiicola*?

[Francesco Origgi] It's a fungus which belongs to a big group of fungi within the group of the so-called Onygenales. And within this group, interestingly enough, we have different fungi which actually may in fact may cause disease in reptiles. As a matter of fact, *Ophidiomyces* somehow seems to be specific for snakes, and whereas there are other Onygenales where it can infect the other reptilian taxa, including lizards and actually also chelonians. So this is really a big group of fungi, really relevant for reptile medicine in general.

[Sarah Gregory] And how do snakes get it?

[Francesco Origgi] It looks like contact, probably. It's enough, in the sense, this...the fungus can be present in the environment (commonly, physically) or can be carried, for example, by another infected snake. So it seems that essentially the contact between an infected snake or an infective snake, or actually a naïve snake (so, an uninfected snake) and, let's say, a contaminated environment, is enough. Apparently, when the skin has already some damage, like it would be a wound like a laceration—so basically, when the skin is not, let's say, fully intact in a way—that can also, let's say, maybe promote the infection or actually make the infection easier. But essentially a contact seems to be enough for the fungus to colonize the skin of the snake and eventually to cause disease.

[Sarah Gregory] And do snakes show any signs of infection?

[Francesco Origgi] Yeah. As a matter of fact, in fact the snake's nose (which actually develops the disease) show pretty obvious clinical signs, pretty obvious changes in the skin, especially. And so, the skin can show folding; can show ulceration; can show crusts; can show lacerations. Basically, what we have is a dermatitis. And, let's say, in the acute stage when the disease is actually just occurring, we have, as I said, basically open wounds, we have crust. And the snake is able to heal—so basically, somehow survive the infection. Then what actually would remain are scars which appear actually as, as I said, folded skin or, let's say, irregular pattern of the skin (of the integument). And actually, the snake itself can be really disfigured by, let's say, some of these lesions, especially when they, for example, they occur...I don't know...on the head, let's say, around the eye. I mean, it could be very, very, very severe lesions, actually.

[Sarah Gregory] Since it’s a fungus, can it be treated with an antifungal medication?

[Francesco Origgi] There has been some experimental approach, so different antifungal compounds actually have been used, and there's really not a current, I would say, treatment protocol proven and established. However, independently of this, when we talk about free-ranging snakes or wild animals, it's always a little bit complicated to think about to a real treatment that eventually all infected snakes or, let's say, infected snakes of a population, could be provided with. So this is actually really a complicated topic and a real problem, because this is always, you know, the big difference that we have, for example, when we talk about individual medicine and population medicine.

When we talk, for example, about a pet snake who, actually, that they can be brought to the veterinarian and so the veterinarian can actually make the diagnosis and provide a therapy or a chance at therapy; when we talk about instead a population of free-ranging snakes (wild snakes, in this case), we're not talking anymore, let's say, of individual medicine but population medicine. And so, we really need to try a way to manage, maybe, the infected population in a way that, for example, I don't know, the fungus doesn't spread to other naïve populations, and so forth and so on. So I think, let's say, know that when we talk about wild animals, we really need to think in a different way than when we think about specifically pets. So...and this is, I think, is really going to be one of the challenges of the future—how really to intervene in wild populations, not necessarily thinking to traditional treatment in terms of a drug or a vaccine, but in terms of really management of a population in order to...at least in the beginning, to minimize the problem and eventually try to avoid the problem spread or actually, ideally, completely resolve it.

[Sarah Gregory] Are there certain snake species that are more susceptible to this infection?

[Francesco Origgi] There has been different publications which have tried to explore this topic, this aspect which is actually extremely interesting. And technically, we think that probably all different species of snakes are probably susceptible. What we know is that about 62 different snake species so far have been documented to have been infected (so, technically susceptible to the infection), and probably we will see many more. There have been papers trying to explore if there is some kind of pattern that could explain the existent or more susceptible snake species than others. However, it looks like that it doesn't really appear that...or at least, let's say, there's...we need more data on this, I mean, to really understand this and to really understand if there are really more susceptible snakes than others.

What actually appears is that maybe, let's say, the environment can play some role in the sense that snakes, for example, which live in relatively humid environments might be a little bit more susceptible to the infection. But I think that another aspect is not just looking at the susceptibility to the infection, but also eventually the resistance to developing disease because there's always, you know, a big difference between becoming infected and developing the disease. So maybe what it may have occurred is that we may have that large number of native species that actually can be susceptible to the actual infection, but not necessarily all of them might develop really a severe disease. And I think that this is actually something that probably we will need to try to figure out in the future.

[Sarah Gregory] Snakes are very popular pets. What's the risk of a pet contracting it since you said it was a contact kind of infection?

[Francesco Origgi] Contact is definitely a way that can be considered a way of transmission of the fungus. Well, I would say exchange of snakes (selling snakes), very often what happens is that, you know, enthusiasts who actually own pet snakes...I don't know...wants to breed them, and so maybe let's say...I don't know, I have a female and my friend has a male and so we exchange the snakes. And so for a relatively amount of time, they will stay in contact (they will stay in the same enclosure), and clearly if one of these two snakes actually is infected, then the possibility that the fungus is going to be transmitted also to the other happens.

And so, essentially, I would say that probably a way to avoid this would be to quarantine, okay, any new snake that comes into a collection. And the question is always how long the quarantine should be, and the answer is we don't really know. However, technically the longer the better. And anyway, within this period of time when actually the snake is quarantined, the best way would be to perform a diagnostic test, which are available. And so, in this way, the risk of getting an additional snake infected probably is going to be definitely limited. It's going to be, let's say, preventable at least. That's one other way to do it.

[Sarah Gregory] What are the environmental implications of this infection?

[Francesco Origgi] There's really a series of questions. I think that one of the most important questions, in my opinion, in terms of environmental implication is, "What does this fungus mean for a snake population?". So we know that it can cause a severe disease, we know that this is very compromised and sick snakes can die. And we have evidence that this fungus has somehow or is somehow contributing to the decline of some populations of snakes, although it's really not clear yet in the sense that this is actually an aspect that needs to be really worked out a little bit better.

But… so what are the actually long-term implications in the sense that, for example, we tend to consider a pathogen a very significant pathogen when it kills. This is true because the obvious, of course, this is actually the worst that can happen. But when we talk about free-ranging snakes—when we talk about wildlife, in general—I think another aspect that we need to consider is that, does this agent impact the well-being of wild snakes (and so, of an entire population), specifically in the sense that it killed it? Or, let's say, it doesn't kill snakes but actually compromises them to a certain level. I'll make an example—let's imagine that an infected snake, although it is not going to die, will have, for example, an impaired reproductive activity. In this case, probably you may not see die-off; you may not see dead carcasses of snakes here and there.

But actually, looking at a population maybe in 10 years, you're going to see that the population has crashed in the sense that you have, let's say, 50 percent or, actually let's say, or less of the original population. And maybe this is just because, for example, as I said, there has been an impact in terms of the reproductive activity. Also, we know that infected snakes change their behavior, meaning that they become a little bit less secretive. For example, they are seen basking probably at a time or a season what wouldn't occur. And so this, for example, may expose them more to predators. And so, although the fungus actually doesn't necessarily kill them in that occasion, however, let's say it's going to promote or it's going to favor somehow a deadly event like this one. So there are several, really, aspects that need to be considered in terms of impact of this fungus on snake populations, and I think that this is really what we need to focus on in the future. What are the environmental aspects? What are...is really the disease ecology, okay,

associated to this agent? And so, what does that mean for snake populations and the long-term implications?

[Sarah Gregory] And let me just clarify here, snakes are important for the environment, right? We need to keep these snakes, yes?

[Francesco Origgi] Absolutely. Snakes historically have always looked probably not as—I don't know, for whatever reason—the most attractive, the most...I don't even know the kind of term to use...

[Sarah Gregory] Appealing? Cute? Friendly?

[Francesco Origgi] Exactly, you're probably right. Exactly right, exactly right, okay. And for a number of reasons. However, they do have really a significant role in the environment. For example, one of their primary prey are actually rodents. And so, they really are very important in terms of balancing, for example, the exponential number of rodents, which we would have in the environment if they wouldn't be there. And so, a rodent, if you think about it, they could cause a bunch of problems and they could eat crops. We know that rodents carry significant infectious agents. And so, this could be a problem for, let's say, other animals and for the human population and so forth and so on. So they really have a role within the whole ecosystem, and we really don't know, honestly, what would happen if snakes would be pulled out from the ecosystem. We don't really know what kind of domino effect this could have or not. However, evolutionary speaking, they have a specific role, they have a specific niche. And so, I think it's important that the general public knows this...they're not an enemy, although have a... particularly, it's an iconographic history, in fact.

[Sarah Gregory] In what regions of the world has this pathogen been found?

[Francesco Origgi] This fungus has been found, or actually, had been documented for the first time originally in the US in the first decade of the new century. However, the more people actually have started to pay attention and actually to look for it, it has been found now in different continents besides the United States and especially, let's say, the East Coast where it has been documented initially. Now we know that this fungus is also, let's say, in other continents like in Europe and also in other areas of the world. So it looks like a well-distributed fungus infectious agent. As concerning the US, the distribution appears to be pretty prevalent on the East Coast, but it is also true that those are the areas where the main investigation actually went on. As concerning the West Coast, probably in the future we will know a little bit better about the actual distribution of the snake in those areas.

However, this brings me back to, really, my early years in research. Actually, I did my PhD at the University of Florida in Gainesville, and one of my lab mates was working on a fungal infection in pygmy rattlesnakes. And the lesions that these pygmy rattlesnakes had was absolutely overlapping with what we know now are lesions associated with snake fungal disease, which is the common name which is attributed to the disease which actually is caused by *Ophidiomyces*. And back in those days, *Ophidiomyces* not identified, okay? So we really don't know another fungus was actually found. So we really don't know if *Ophidiomyces* was there or not. So what I'm saying is that this fungus...and now we have really the evidence it has been around for far longer than we originally thought. And I think that we are going to have more and more surprises in this direction in the future years, absolutely, and the more people that have interest in it.

[Sarah Gregory] When was it first documented in Europe?

[Francesco Origgi] In Europe, the first paper that came out...which actually the first article that came out which documented the presence of *Ophidiomyces* was in 2017 and basically described the presence of *Ophidiomyces* in free-ranging snakes—I'm talking about, actually in this case, wild snakes. I think that the samples, if I remember correctly, were collected starting from 2010. So basically, I think that from 2010 to 2016, something like that. So let's say, about five, ten years after the first documented presence in the United States. However, as I said, this concerns wild snakes. If we talk about pets, it appears that there's documented infections occurring also in the 80s, so it looks like it has been there also prior than when it was documented in free-ranging snakes.

[Sarah Gregory] But your study says something about...the title is in Europe in 1950. What's the 1950?

[Francesco Origgi] We're talking about among the specimens that we had the opportunity to investigate. The oldest one was actually from 1959 (the oldest one which actually turned out to be positive). And so, this actually really appears to be the oldest record so far of *Ophidiomyces* in Europe, which actually brings back the clock of approximately 50 years or more. And the oldest samples that we had the opportunity to investigate were from 50s. So clearly, we don't know if the fungus was here prior. However, at the moment, what we can say, it was present at least from the late 50s.

[Sarah Gregory] In 2021, *Emerging Infectious Diseases* published a journal on a study on snake fungal in a museum specimen from 1945 in North America, and I also did a podcast about that article. How was your study influenced by their findings?

[Francesco Origgi] When we saw this paper coming out, we knew that we had to push a little bit more because we had already started our study, as well. And so, this was kind of interesting, because probably we had exactly the same idea. So the paper that was published in 2021 actually investigated the presence of the fungus in museum specimens, which is actually a relatively standard procedure when you would like to understand if the pathogen (so basically, if a disease) is something new—so like something that just appeared in that specific region, country, or whatever it is—or instead, if this agent has been there for an extended amount of time but simply has been not detected, has been, essentially, not seen or also not investigated (who knows).

And so, together with Dr. Sylvain Ursenbacher, who is a scientist that we share this work together, we basically decided to investigate here in Europe, looking in museum specimens if we actually could find an evidence of the presence of *Ophidiomyces*. And when we read the paper, we realized we were on the right track, and actually that had us convinced that we're actually really doing the right thing. And so, we were very much excited also when we found a presence of this fungus, and most of all, in samples which, from a timing standpoint, was pretty close. Because, I mean, the oldest samples...preserved sample that they had in their study was from 1945, and ours from 1959, which is relatively close. And so, this was actually very exciting.

[Sarah Gregory] Tell us more about your study. Where did you collect your samples from?

[Francesco Origgi] We went in different natural history museums here in Switzerland, and our choice was the Natural History Museum of Geneva, of Bern, and Lausanne. And Geneva and Bern basically had the largest collections of snakes in Switzerland. So this was actually a good spot where to start from. And in Lausanne, they have instead a large collection

of *Natrix* and *Vipera* which are actually two different genuses which, talking about susceptibility, frequently actually have been documented as infected. And so, this was actually the location that we chose. And then what we did, we looked at all the specimens that were available (and we're talking about more than 1,000), and we checked for the presence of any sign that microscopically was suggesting the presence of lesions consistent with those which are known to occur with *Ophidiomyces* infection. And once we found those, we collected a very small portion of the affected skin because, as I said, these are museum samples. We need to try to preserve them as much as we can, not just for our investigation, but also, for example, for investigations that will come later on (which we don't know when may be), so it was very important to preserve this.

So we collected a little piece of skin, and each of these samples were split in two. So what we did...one sample was analyzed morphologically. So basically, we looked under the microscope to see if there were presence of fungal organism in the tissue. And this concerned the other half of the tissue, that was instead used to extract DNA. And once we extract DNA, we performed PCR reactions. PCR, or polymerase chain reaction, is a very important and actually very useful tool for amplifying DNA. So essentially the way it works, we have to think about a copy machine, okay? So with this PCR, we can make billions of copies of the same portion of DNA starting from a single unit. So after a number of cycles, which are part of the whole process, we can go from one single copy of our target DNA, which in this case was a portion of the genome of *Ophidiomyces*—actually, we had three portions because we wanted really to have solid data. And so from a single unit, after 35 cycles, theoretically you get almost up to a billion copies, and this makes the fungus detectable. And so we had essentially two lines of evidence, because we had the morphologic line with the presence of the fungus, which we could recognize morphologically under the light microscopy. And this was complemented by the molecular information (so, by the genomic information) that we could access thanks to this technique (thanks to this polymerase chain reaction). And so, our data were supported, as I said, by two independent lines of evidence, and this was actually very important to really demonstrate that the fungus was actually there, and for example...I don't know, that this was not just a coincidental presence.

[Sarah Gregory] How did you go about selecting which samples you would use from these precious specimens in the museums?

[Francesco Origgi] The selection, as I said, was based on the identification microscopically—so, just looking at them...all the lesions (so, all the signs of disease which we could see on the skin of these infected animals). These animals...the snakes are preserved in alcohol in jars. And so, it is possible to observe them from outside, and so we could manipulate the snake within these glass containers. And so, we could actually check if along the body of the snakes, there was presence of lesions (so, there was presence of dermatitis). And since we know that with snake fungal disease we see characteristic changes, we were actually looking for these changes. And that's actually what allowed us to select out of more than 1,000 specimens, we selected 22 which actually had these lesions. And out of these 22, we were able to demonstrate the presence of the fungus in five of them using both the system that I described before—so, the microscopy (the light microscopy) and the polymerase chain reaction. As a matter of fact, we observed fungi consistent with *Ophidiomyces* also in other specimens. However, in those specimens we could not amplify the specific DNA. And so, to be very conservative, we considered those samples negative. Although, it is reasonable to think that those might also be false negative. The problem

is that the DNA tends to degrade with time, even when it's preserved in alcohol like the snakes were preserved with. So it is possible that this degradation (this fragmentation) of the DNA of the genome of the fungus did not allow the amplification of some of the samples. Although, as I said, the *Ophidiomyces* might actually have been there.

[Sarah Gregory] You explained about the PCR. How were you able to extract DNA from these specimens?

[Francesco Origgi] In order to extract DNA, the tissue has to be processed in a way that needs to be digested. So the DNA is conserved within the nuclei of the cells. And so, in order to extract this DNA, we need to access to it. In order to access to it, we need to essentially remove everything else. And this is done thanks to the use of specific solutions which are called lysis buffers, and these lysis buffers together with digestive enzymes—so, enzymes which are able to break down the protein (so, the constituents of the tissues)—this mixture (so, these buffers and these enzymes) actually are able to literally destroy everything else which contains DNA, but leaving the DNA intact, untouched.

So following this, there is a specific process to remove all this leftover material (all this digested material), holding any way in place the DNA. And so, once this is carried out, we have the so-called purified DNA. And in this case, there's the total DNA, meaning that there's the DNA of the host (so, basically of the infected snake) mixed up with the DNA of the fungus. And this PCR reaction is really very effective in this...in going to detect and, as I said before, amplify only the specific fungal DNA. So it's literally finding a needle in a haystack. And this is actually why this technique is so powerful and so important for these kinds of investigations. And so, if you think of the DNA of the fungus as the needle and as the DNA of the host as the haystack, basically that's really how it worked. We really pulled out a needle in this way.

[Sarah Gregory] You've mentioned several things. Is there anything else about your findings you want to tell us about?

[Francesco Origgi] Yes. Another important finding of our study was that besides finding the oldest record of *Ophidiomyces* in Europe, we actually had a very interesting finding. Basically, the different strains of *Ophidiomyces* which we identified in different snakes turned out to cluster—let's say, group—either with the so-called European lineage of *Ophidiomyces* and the so-called American lineage of *Ophidiomyces*. So bottom line, phylogenic analysis—so basically, analysis which tries to reconstruct the origin, the evolution of the fungus—has shown in the past that there are probably multiple lineages of this fungus. And one of these has been named the American lineage, because the strains which actually belong to this group are predominantly present in the United States and Canada (so basically North America), and instead, the so-called European lineages that would comprise strains instead identified in Europe.

Interestingly enough, with this study we showed for the first time that in a single geographical area—in this case, essentially, Switzerland and also a portion of Northern Italy—well, we have shown that we have strains which appears to belong either to the American lineage or to the European lineage. And this is kind of interesting, because let's say there has been and there are major questions concerning the origin of this fungus, if this fungus was originally in one continent or in one geographic area and moved to the other one, and so forth and so on. So we don't really know this, and future studies will hopefully clarify this aspect. But I thought it was actually very interesting to see that we had apparently both representatives of the American and

European lineage in Europe, which really opens up a number of questions about, really, the natural history of this fungus and the origin of this fungus itself.

[Sarah Gregory] Could this fungus have been introduced to Europe from North American then? And if so, how would that happen?

[Francesco Origgi] We really don't know if *Ophidiomyces* has been introduced in Europe from North America, or if it happened the other way around. There's actually a paper that came out recently where the author came to the conclusion that *Ophidiomyces* has been probably introduced in the United States multiple times (the last introduction appears to be relatively recent). So we really don't know if the fungus was introduced from Europe to the United States or basically the other way around. If this fungus was introduced in Europe from the United States, it probably had to have occurred before 1959 (so basically before the late 50s). However, at the moment, we really don't know how this occurred and if occurred, and if instead this fungus was introduced from Europe to the United States. We really need to have more information about this, and this is actually going to be one of the most interesting topics that we will try to answer in the future.

[Sarah Gregory] Why do you think it went so long undetected in Europe?

[Francesco Origgi] There's really many different reasons for this, and it's really interesting when it comes to infectious diseases and wildlife, it's not unusual to have, let's say, a disease that goes undetected for a long time. And it's really difficult to explain why. But for whatever reason, it goes really undetected, or it's just overseen, or we really don't pay enough attention to it. Most likely, the lesions in the skin of the snakes have been seen prior and have been seen for a significant amount of time. But actually, very often it takes also somebody that goes beyond this kind of observation, somebody that may be interested in the topic...generally interested, for example, in snakes and infectious disease. And so, this person...this investigator goes a little beyond what actually would be a normal approach. However, surely you need to have somebody to start the whole process. So once the detection actually occurred in the United States, that clearly started to prime interest also in Europe. And so, at that point, everything became much, much easier. I can make other examples. We also...here at the University of Bern, we discovered two new herpes viruses in frogs and toads. And after we published the article, it turned out that we received phone calls, emails, from essentially all around Europe with everybody saying, "Oh, we saw that as well. We didn't know that was this and that.". So it's really serendipitous somehow, but surely also you need somebody that has a genuine interest and goes really beyond that single observation.

[Sarah Gregory] And you've mentioned further studies a couple of times now. What research do you think is needed?

[Francesco Origgi] Well, the most interesting aspect is really to understand what is the meaning of this fungus for wild population snakes? So what actually is the impact of this fungus, and most of all, how we can manage wild populations of snakes with infection—how we can intervene, how we can minimize the spread, how we can find a way to make this reduce the impact of this fungus on wild populations—and really understand all the ecological aspects which are really associated with it. This is really very, very important. I think that this really is the aspect which we really would need to focus on—what are the environmental factors which somehow favor the infection? Because this is also the other question, which somehow is linked to the one I answered before. So why do we see so much fungal disease all around the world, now? Yes, of course

there's actually a higher attention, as we said, so we're more careful. We check, we look, we investigate. However, did something change that somehow made this fungus more virulent, or let's say, something changed in the environment and so made the snakes more susceptible to the infection and to develop the disease (or both, actually), or something else happened? Or something else happened, let's say, in the snakes...I don't know, has been some change in the population, which...I don't know, somehow made, as I said, these snakes more susceptible.

So I think that these are really the three aspects that we would need to consider—the host, the environment, and the pathogen. Because when we talk about wildlife, these are really the three main players. And I think that a global understanding, a really sure understanding of the significance of snake fungal disease (of *Ophidiomyces*) in wild snakes really has to be based on this. So I think that the important thing will be really to investigate these three aspects in a really interconnected way. And so, hopefully this will allow us to really understand a little bit more what this disease means for free-ranging snakes and how we can manage this population, trying to make this problem less of a problem or actually, ideally, solve it. But who knows?

[Sarah Gregory] So on a more practical, direct way, what can people do to prevent getting this fungus from snakes themselves?

[Francesco Origgi] As far as we know, there's really no documented cases of infection (of human infection). So *Ophidiomyces* does not appear to be a zoonotic agent, which actually is, of course, good news. I think that probably I would change a little bit the question—I would say that, you know, maybe we may ask ourselves what we can do in order to minimize our role as people eventually promoting the spread of the fungus? What I'm saying is that, very often it happens to be in the woods and reptile enthusiasts collect snakes just to look at them, just to hold them, just to...which, I mean, is something that happens everywhere in the world. And very often, this is done on more snakes during a single day. And this very often is done without, for example, wearing gloves. And let's imagine that one of the snakes that we handle has actually *Ophidiomyces*. And this would end up being on our skin, which most likely is not going to be an issue for us. But then, if we handle another snake, we can actually help the transmission of the fungus to another individual, and so forth and so on. And so, I think that you know it's important that we try to think in a way to minimize our unconscious, involuntary role in promoting the actual spread of the fungus.

So I think that as human beings, probably we are not really those that need to be protected from the fungus, at least as far as we know, considering what we know about the fungus so far. But actually it's the other way around. We really need to think in a way of protecting snakes from us, because we really don't know, you know...a friend of mine used a quote, "Leave wildlife in the wild", because when we intervene, even unconsciously, even with the best of the will (of the intention), we may, you know, involuntarily may damage it. So I think that we really need to try to think of all the ways to minimize our potential negative impact on snakes.

[Sarah Gregory] This seems to be something that people are becoming more and more aware of, that everything we touch touches something else.

Dr. Origgi, tell us about your job and how you become interested in investigating snake infection?

[Francesco Origgi] As a pathologist and microbiologist and veterinary pathologist and veterinary microbiologist, I've always been interested in infectious diseases, and especially in infectious

diseases in amphibians and reptiles. And this has basically been a lifetime passion (a lifetime interest). And all of my career actually has been somehow driven by this interest and all my job opportunities which I followed were all associated to the actual chance of working on these animals. Specifically here at the University of Bern, I had, and I have the opportunity to work with wildlife and with non-conventional animals. And it has been really like following a sort of candy box. And Switzerland actually is a relatively small country but has a very diverse wildlife. And we really have the opportunity to pursue multiple research projects on reptiles, on amphibians, and snake fungal disease is actually the latest one and which actually is a project that really brings me back to the early days of my career when I was working on my PhD at the University of Florida with Dr. Elliot Jacobson. And in the same lab where I was actually working on chelonian herpesviruses, there was a lab mate of mine who was working on a fungal disease in snakes, which actually was very much consistent with what we call and what we know now is snake fungal disease. And so, this has been sort of a closing of a circle, and I hope to be able to keep going with this and opening up closing other circles.

[Sarah Gregory] Well, one last question here. Do you have any pet snakes of your own?

[Francesco Origgi] No, actually I don't have a pet snake, but I had several reptile pets in the past. I had tortoises, lizards, various species. But never really a pet snake. But actually, I had been chasing lots of snakes when I was a kid.

[Sarah Gregory] Okay, well, thank you so much for taking the time to talk with me today, Dr. Origgi.

[Francesco Origgi] Thank you very much, it has been a pleasure. Thank you for having me.

[Sarah Gregory] And thanks for joining me out there. You can read the October 2022 article, *Ophidiomyces ophiodiicola*, Etiologic Agent of Snake Fungal Disease, in Europe since Late 1950s, online at cdc.gov/eid.

I'm Sarah Gregory for *Emerging Infectious Diseases*.

[Announcer] For the most accurate health information, visit cdc.gov or call 1-800-CDC-INFO.