



## The Natural Laboratory Podcast Transcript: Death Cap Mushrooms at Point Reyes National Seashore

### Introduction

This is the Natural Laboratory, a podcast exploring science for Bay Area National Parks. I'm Cassandra Brooks.

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Deathcap mushrooms (also known as *Amanita phalloides*) are found throughout the Point Reyes region and are the most poisonous mushrooms in the world. But they're fairly new arrivals here. They invaded the San Francisco Bay Area in the late 1930s, likely brought over on cork trees from Europe for the wine industry. By the late 1960s, deathcaps were found in Tomales Bay State Park and have since spread throughout the Point Reyes Peninsula.

Benjamin Wolfe, a graduate student at Harvard, is studying the mushroom's invasion here in Point Reyes. He's using genetics to study their abundance and distribution, trying to understand what controls and confines their invasion.

I sat down with Ben in his mushroom lab at Harvard to find out more.

### Benjamin Wolfe Interview

*Benjamin Wolfe: We're pretty much the CSI of mushrooms. We go out and instead of working with criminals and murderers and crime scenes, we're trying to figure out where mushrooms have gone. And we use similar techniques. We use a lot of DNA bar-coding that they use in forensics labs to figure out is this actually Amanita*

*phalloides, or is it a different species. And then we go to herbaria and look back in time at records people have collected to track where it's spread over time. And then we often go into the soil and probe the soil with DNA bar-codes to see does the soil have Amanita phalloides, has it been invaded.*

### Ectomycorrhizal fungi

*Cassandra Brooks: Ben does his fieldwork in Point Reyes because Amanita are incredibly abundant and large here. But it's also a real hotspot for ectomycorrhizal fungi in general, he says.*

*So what are ectomycorrhizal fungi? This tongue-tying term refers to fungi that form a symbiotic relationship with tree roots. Many of the mushrooms you see throughout the forest are ectomycorrhizal fungi, but you are only seeing part of the story. If you could peak below the soil, you would see white cobwebby mushroom roots, called hyphae, snaking out in all directions.*

*On one end, they're grabbing nutrients from nooks and crannies that tree roots can't get to. On the other end they're connected to the trees, sharing their nutrients and stealing sugars produced from the trees photosynthesis. They use those sugars to make the mushroom you see throughout the forest, which are used for spreading spores and reproducing.*

*Amanita phalloides is one of perhaps ten thousand species of ectomycorrhizal fungi, but it stands out, Ben says, because it's managed to move from one part of the world to another and suddenly take over and become very abundant.*

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## Benjamin Wolfe Interview (continued)

BW: *And then when we went into Point Reyes and looked in more detail and actually went into the soil and extracted DNA to see what trees it was growing with it was very clearly picking and choosing from the entire community available just these oak roots. Which is really surprising for one of these fungi to be that specific.*

*We are also just looking at general patterns of how it associates with different hosts. So it's really different on the East coast. So on the west coast it loves the coast oak. But when you come on the East coast it's only associated with pines. And then when you look at the native range where it grows in Europe, it only generally associates with oaks. So it seems like its gone from its native habitat with oaks, moved to North America and on the West Coast where its invading it associates with oaks, East coast only with pines, so its almost like its made a host shift.*

*That's what we are broadly interested in the lab, is fungal symbioses, what controls them ecologically and then from an evolutionary perspective how did they come to be, what genes and processes have allowed them to evolve this symbiotic lifestyle?*

*So its sort of like the human genome project for fungi, you can ask these really broad questions about what genes give me a certain eye color, but in this case we're asking what genes are making this thing associate with an oak versus a pine.*

CB: *Maybe you can talk a little bit about when this mushroom is so well known,*

*its called the death cap, how is its still the most amount of people get poisoned by it?*

BW: *I think the main reason is that the people who have immigrated to North America from other countries get confused. Because there are things in their native range that look like the death cap, but aren't poisonous. So there is a lot of confusion. And unfortunately it's hard to educate people in so many different languages and warn them about it. In areas where it is so abundant, people encounters it very frequently, people pick it and they think it looks like this thing they ate back at home which is really tasty.*

CB: *In your understanding is it the most poisonous mushroom?*

BW: *It is. In terms of the amount of toxin and how toxic it is per amount you eat, it is considered the most poisonous one.*

*Once you get poisoned, once you've ingested about half of a cap it goes in your body and the toxins are really concentrated in your liver and essentially your liver just starts to dissolve, starts to fall apart. The story is that you eat it, you get really sick at first, you're like this does not feel good. And the second day you start to feel a little better and then the third day you die. The other thing about these mushrooms in California, they're really robust, they're huge and you are sort of intrigued by them.*

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## Conclusion

Ben and his colleagues are indeed intrigued by the mushrooms, not for eating of course, but for understanding the ecology and evolution of symbiosis. They've even recently put together a review paper based largely on their deathcap work in Point Reyes, showing that ectomycorrhizal fungi invasions occur across the globe. They have yet

to see if invasive mushroom species act similar to plant and animal invasions, but with more CSI-like investigation, they're sure to find out.

With the Pacific Coast Science and Learning Center, I'm Cassandra Brooks.