# Dr. Jonathan Velotta

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## 1 WHAT INSPIRED YOU TO PURSUE RESEARCH IN EVOLUTIONARY ECOLOGY?

I think just a love of nature. I have always been fascinated by animals, I've always wanted to learn more about them, how they work, where they live, what they do. From a young age I was interested in working in some way with them, understanding them, observing them in their natural habitat. When I was in college I took some classes in physiological ecology- which is the study of how animal physiology is adapted to different environments, and how animal physiology varies across the globe. That sort of solidified my interest. Then I had a professor who told me about grad school- I didn't really know that studying evolution, or physiology, or ecology, was like a job. So after that I just thought, "I think I want to make this my job," and then that was almost 20 years ago.

## 2 WHAT DOES YOUR RESEARCH PROCESS LOOK LIKE?

In general, I think like anyone's, we start with a question. And that question comes from either something that I read in the literature, or an observation in the field, because we work with wild animals. If we're out there observing wild animals, then we might have a question that arises. I can give you an example- we have been studying a native rodent called the deer mouse and how it's distributed across elevation and what adaptations it has due to the conditions of high elevations, so it's low oxygen and cold. In doing that we noticed that there was one site in particular that we were working at where these animals got a parasitic infection only in the fall. It's of a flesh-eating parasite called a botfly, and it's the larvae of the botfly- they go in through the nose and then they migrate to the back of the animal, and then eat a hole into the outside of the animal so they can breathe, and then they feed on the interstitial fluid, and the blood, and necrotic tissue, and then they burst out of the animal like a month later and pupate over winter. We noticed that we only saw those animals at this one site and so that led to a whole bunch of other questions. We knew that they had also been seen at lower elevations, like in Nebraska, where I had seen them a few times before but just sporadically. That led to a whole bunch of questions such as, "How does this infection differ across elevation?" Because what we were observing at this high elevation site was very different from what we found in the literature. So the question generation there came from a direct observation in the field plus looking at the literature. And then the hard part is devising ways to test that hypothesis that is generated from that question. Once that happens, usually I then write a grant to some federal agency to get money- because it costs money to do these things- when I get money I can hire people to actually do it. And then once we do it, it becomes the grad student's or postdoc's project, but it can also become part of an

undergraduate's project. Usually an undergraduate will carve out bits. I have an undergraduate right now working on that particular project- so that came out of this whole observation, hypothesis generation, figuring out a way to test it, and then something comes of that, a question, a sub-question, and an undergraduate works on that. Then a bunch of data gets collected, interpreted, and then they write it up and send it to the DUURJ, or wherever.

**3 CAN YOU TELL ME SOME MORE ABOUT RESEARCH YOU'VE DONE IN THE PAST?**

The lab primarily works at high elevation, on mice and adaptations like I said. We also study migratory fishes. They are what's called a diadromous fish- that's a special term that means fish that breed in one salinity environment but grow in another. These particular fish are a kind of herring, and they breed in freshwater ponds in coastal New England- actually, all across the eastern seaboard- but they migrate to sea when they are just a few months old, and then they grow there for a few years, and then they return to freshwater to breed. And they can do that a few times in their life- they're kind of like salmon, but they're very different than salmon, they're 200 million years divergent. And they have very different evolutionary history. They evolved in the ocean, whereas salmon evolved in lakes and ponds, in freshwater. The way that they migrate is actually kind of opposite, or the way that they evolve. We are studying that behavior- the migration- how it works, how it's different than salmon. We are also studying these special populations that have become trapped in freshwater by dams that were built when colonial New Englanders were modifying the landscape for the first time, and they built a lot of mill dams in New England. These mill dams trapped the baby herrings behind dams and kept them in freshwater, and they've been evolving there for the past few hundred years. We have been looking at those populations, comparing them to the migratory ones, to see how their system of tolerance of that environment- that freshwater pond environment- throughout their whole lifetime differs from an animal that is essentially a marine animal that comes into freshwater just for a month to breed and then leaves. Both of those things are still ongoing in the lab.

**4 WHAT MADE YOU WANT TO BE A PROFESSOR?**

When I took this physiological ecology class in undergrad, I was just really interested in it and my professor was great. I asked if I could do research in his lab and he was studying bird stress hormones- how birds respond to stress. I got involved in his lab, we trapped birds and took their blood, and measured their stress hormones in different conditions. He took me to Central America where we studied birds for a summer, and I kinda thought, "I wanna do this, I want this guy's job, it seems really fun." And you just get to study animals, and like I said I really just wanted to be around animals, and work with them, and understand them, and so I realized then that I could do that as a job. I got the research experience as an undergrad doing that, so I think I decided then. I also remember graduating and asking my English professor- I saw him at the gym or something and I asked him if he thought it was a good life to lead, and he said, "It's the best life to lead." That, plus all my experience, two people I trusted telling me that they loved their jobs, and that I would get to study animals- I just decided then, so I applied to grad school and that was it.

**5 WHAT IS YOUR FAVORITE CLASS TO TEACH?**

I teach a class called Environmental Physiology of Animals- that's the same class as physiological ecology, just different names for the same topic, basically- which is the same class that I took as an undergrad, with some modifications that led me to the place that I am today. Since that class, I've decided that that's also what I want to teach and like to learn about. I teach that class every winter, it's for upper-level students. Mostly biology, ecology, environmental science majors. It's my favorite class to teach because it's the subject that I love the most, but also because we do real hands-on work. We read eight papers in a ten week course- so it's almost one paper per week. Students dissect the papers, and we discuss them in class, they discuss them as groups. I love that, because they get to read primary literature and learn how to really dissect it. The lectures are pretty interactive, we do a lot of team work, and we do a project at the end where they get to create an actual research proposal that I tell them- and this is 100 percent true- could be submitted to the National Science Foundation for their own research fellowship award. So it's not only in the style of this thing called the Graduate Research Fellowship Program, but it literally is a graduate research fellowship award. That's awesome because I read those every year for my students and I also serve on panels where we read them for actual applications, and so it's very practical- I'm actually having them do the proposal, the hypothesis generating, the experimental design generating that I told you was part of the process- and they get to actually do that process. It's two pages, which is awesome because- it's a huge amount of work but it's not a huge amount of actual reading or writing for them, but they get the skills of putting those things together and then I get to read them and figure out what's going on in

their brains. I get to read a lot of cool ideas. I guess the culmination of both the content for that course and also the other skills, like reading, and writing, and proposal generating that we do- that one's my favorite.

**6 IS THERE ANYTHING ELSE YOU WOULD LIKE TO ADD?**

I would encourage all undergraduates to pursue research, even if the topic is not something that they maybe have the most interest in. Because topics don't matter as much as process. In STEM, what matters is the scientific process- this matters everywhere, not just in STEM, to me, but I'm a scientist- the scientific process matters. Critically evaluating data and information, generating a hypothesis. I would encourage all students to get involved in that- writing, reading, making figures, all of that stuff. It doesn't really matter what the content is. It matters that the process is done. That looks good for grad school, med school- I mean, that's just good for your life. Especially now in the age of AI, where AI can do this for us, but it can't do it like us. I think learning those skills actually is more important now than ever- because we can still do that with a real human aspect that's better than AI, I think. That process will help students in their career and just be better observers of the world. I think that all undergraduates should pursue research if they can, and I think that this is a pretty easy place to be doing that.