

Abbie Gascho Landis: Early on I started writing about muscles. I did so very privately because I didn't feel an authority to do so. So I just started writing down the things that were fascinating to me and doing some research. I attended a gathering of the freshwater Mussel scholars, conservation society, and I just started introducing myself. Hi, I'm abby. I'm writing a book about muscles because I decided I was. Nobody there doubted or questioned that because they are all fascinated by muscles and it, they, they get it. So they all understood why I would be fascinated regardless of my background in the veterinary community. my colleagues definitely seemed pretty, pretty perplexed by what I was. If I said I was writing a book and then said it was about freshwater mussels that would get a lot of furrowed brows, outside of the muscle community, people wouldn't necessarily understand why, why muscles, but, um, why, why not muscles, they're wonderful.

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 Abbie Gascho Landis. Abbie is the author of a book called, "Immersion: The Science and Mystery of Freshwater Mussels." Abbie is not a mussel biologist by trade, in fact her husband is. But in 2008, a series of events with freshwater mussels in Alabama had Abbie entangled in a web of curiosity and responsibility to share their story.

AGL: My interest in animals began when I was born. ever since I can remember wanting to be a veterinarian and one of those kids., in Undergrad I majored in biology and English and biology It took about four years in between Undergrad and veterinary school. and in veterinary school, studied the large and small animals and ended up in emergency medicine for dogs and cats. And that's what I was doing in Alabama when my husband was studying freshwater mussels.

AGL 00:02:06: So he was pursuing his phd in fisheries through the Study of native freshwater mussels. And Alabama is the perfect place to do that because it is the global hotspot for freshwater mussel diversity. It turned out to be a little bit contagious in that, um, as I was having my night and weekend shifts at the emergency clinic and it left me with days where I wasn't working during the day and he invited me to come along and join the field crew, snorkeling a creek for muscles. And it was that day when I pulled a, a wetsuit on over my six month pregnant belly, um, to go in snorkeled a creek that I first really had the sense of these muscles as animals. And I think that, that, um, was the initial spark, my initial infatuation and connection with them, not as just, um, these inner looking things in the lab, but actually I'm seeing muscles wild and alive on the, on the bed of the creek doing interesting things, um, and realizing that they're active and beautiful and have lives that are worth thinking more about. So that was that, that got me hooked.

PS: Abbie felt a very personal connection with the first freshwater mussel she swam by that day. It lead to her source of inspiration for sharing the story of how humans and mussels are very much connected through one very important natural resource.

AGL: I also came to it from the very, for my own immersion in the experience of early motherhood. That very first time when I saw wild muscle, it was a pregnant female muscle, I felt a certain kinship with her. we shared a kind of a vulnerability and I was as a, as a pregnant woman, very, um, present in my own body, I think more than I ever had been before. And thinking about, I'm thinking about offspring and about the future of my kids and the future of the planet.

AGL: I felt as I got to know the muscles stories and in fact I'm really the story of have our own water because that first creek where I was snorkeling was the same creek that

was the city's water supply. So I felt this other intimacy with the environment and urgency about, about communicating that and about sharing this perspective that muscles were giving me on, um, not only who they are as, as this amazing, bio-diverse, a beautiful kind of surprisingly charismatic set of species, but also the insights that they, that studying them gives to, um, to me about our, our water supply.

PS: Rivers and creeks in Alabama, like many waterways in the United States, have fallen victim to pollutants and waste run off . Chewacla Creek, is a waterway that begins south of Opelika, Alabama, which is closer to the Georgia boarder. It flows behind a dam, which forms Lake Ogletree and Ogletree Dam holds back water when levels drop during a drought, leaving Chewacla creek sometimes empty. The creek continues to flow along an undisrupted area, where the mussels have a chance to recover. But from the midpoint of the creek near Chewacla State Park, where the creek is only partially protected, an industrial materials and quarry site called Martin Marietta Materials, poured sediment and other pollutants directly into the creek. Abbie soon found that the impact from pollutants on the creek had a direct connection to the drinking water that she supplied to her family.

AGL: where we lived in Alabama, Chewacla creek was about a 10 minute drive, And in the book I really had a good time kind of describing this creek almost as it's own character, um, and, and learning more about it as I did that, I'm looking at where it kind of starts flowing and how it changes as it flows. It is located on the Piedmont region. and that Lends, Chewacla Creek, a lot of its character. Parts of it are very, parts of [inaudible] creek are very disturbed, shall we say. It flows beside on the very edge of, uh, uh, some state lands. And on the other side of the creek is a quarry that has greatly impacted the creek just because of sedimentation that's come from the quarry. And when you query out stone, which can change the flow of water, can open up sinkholes, especially in a limestone region. The creek, also goes through the city of Auburn and I'm past golf courses and past agricultural runoff. And there's, um, you know, chemicals, water, wastewater treatment. So it receives all of these insults which are typical, the typical insults that creeks receive these days. Chewacla creek has a, it's dammed and from the dam, when you put an a dam, it stops up the creek. And behind it forms a reservoir. And in that section of the creek is not a creek. It's a lake. And that's where the water supply for the city comes from.

But below all of that, below the dam and the reservoir below the city, the creek, um, is able to recover. And that was really compelling to me as well because if you go half mile down, you actually find that the muscle community is incredible, incredibly diverse. Again, um, where it has taken some major hits. So it gives me both concern and hope when you look at this one single creek.

PS: In the year 2000, eight years prior to Abbie's arrival in Alabama, a mussel biologist name Mike Gangloff had discovered fine lined pocketbook mussels in the creek. This particular mussel is recognized as a threatened species by the US government and they are protected by the Endangered Species act. Unfortunately, in the summer of 2000, approximately 80% of Chewacla Creek disappeared due to drought. The threatened mussels were dying and Gangloff hurriedly documented the event. As it turned out Martin Marietta Materials had been closing off a public road and access to that portion of the creek's watershed and claimed it as use for the Quarry only. Needless to say, the locals wanted access to their drinking water.

AGL: As I got to know to Chewacla Creek and heard some more stories or some more of it story, I decided that it would, the story have to off the creek would be a good example for the beginning of the book. So in the first chapter I talk about and describe

what I, what I just described of the creeks journey, but I also talk about some of the, some of the local drama surrounding the creek.

This too, is just, uh, an example of that matches many examples all over the place of conflict over water and over natural resources. And Chewacla Creek became the center of a local dispute over the creek itself. Um, it started as a dispute over a roadway that the quarry was taking over, um, and, and the locals resented and then, um, it grew into a concern for the health of the creek itself. Um, and it became hinged on freshwater mussels because there were, um, muscles protected by the endangered species act that lived in that creek. And so lawyers came involved and, um, and the federal government became involved and the, uh, the federal government in the sense of, you know, the fish and wildlife service and the state state naturalists came and one of the people who ended up called on the carpet to testify about this or is, was, um, a muscle biologist working on his graduate degree at Auburn University. So here you had this, this very significant kind of drawn out, um, dispute over the creek. And at a time of drought when the water supply was, was low and then contested, um, you also had muscles at the center of this conflict.

As I learned more about muscles now seems at first it seemed startling that these little clam light creatures would, would be embroiled in community wide conflicts that involve all these different groups and factors. But, but really muscles are, they live at the intersection of so many things

They burrow into the sub straight into the creek, bottom or river bottom and with their bodies. And so they are very effected by the changes to the river bottoms and the characters, the character of the robot on whether it's rocks or mud or whether it's movable or whether it's stable, whether it's, you know, it's eroding or, um, whether it's being dredged, uh, for, for channelizing. They're also, you know, part of their bodies and in the river bottom. And then, and then the other part is sticking up into the channel. And so they are affected, of course, by the water. They're constantly filtering the water through their bodies, they're affected by quantity of water and quality of water in all the ways, and then their life cycles are connected to fish. They are unable to reproduce without fish and often without a specific fish species. So, they really ended up tied into everything about a river. And so any, any dispute that involves any part of a river could easily relate to muscles.

PS: Freshwater mussels have existed on this earth for a long time. Their evolution seems somewhat rudimentary but Abbie explains how their composition plays a delicate role in filtering water that ultimately enters our water sheds.

AGL: Freshwater mussels are in, they're mollusks and under the group mollusks, they're bivalves. They're about 500 million years old as far as we know. So by valves have to valves or shells and inside those shells is the animal and the animal doesn't have any bones.

Um, and it has just kind of a visceral mass basically. And a couple of large muscles. Um, they, the, there are two main muscles are a foot, so they have one foot that they can stick out from their shell and use to move around, which is a fascinating process of locomotion. The other muscle is a muscle and abductor muscle that holds their shell closed. So staying closed is an active function for a muscle. So if they're gaping open, um, they've lost that muscle tone and typically a wide open muscle is a dead muscle.

Their connection with, with the river comes when they're underwater, they opened their shells a bit and they have two siphons or to apertures and one is the incurrent. Um, so

they draw in the water and that one has little finger like villa, little fingers that help to sort of begin the filtration process and keep out the big stuff. Water goes into that aperture and across their gills. So when you look into a muscle, I mean there are just these large gill leaflets that look, um, you know, not unlike the gills of a mushroom that, you know, there are these fine leaflets of tissue and they're very specialized for sorting. Um, so they sought out edible particles like algae or plankton. They sort out the oxygen from the water, so they, uh, across the membranes, oxygen can be absorbed and that's how they breathe.

PS: The relationship between mussels and our drinking water, is undeniable. Give mussels some space and non polluted water and they're like a little underwater factory, keeping the natural world healthy.

AGL : So a mussel about the size of a chicken egg can filter a half a one liter per hour. So a single mussel can, can filter 12 to 24 leaders in a day and a bed of mussels. I mean you could have a lot of mussel and mussel bed on the river, on the riverbed and they can really, um, actually filter through your body's, um, a large percentage of the water flowing past them. And so some of those particles and they really make it cleaner. Some of the particles they, they eat and some of the particles, they actually just, if it's not an edible particle, they package it up and mucus and excrete it in a little blob called pseudo feces, but either way they kind of bind it and lay it on the river bottom so they're pulling it out of the water channel. And so they do significant work and um, what we call ecosystem services. So they, they do a service for the water to improve the water quality.

PS: But mussels are indiscriminate about filtering particles and they'll also filter polluted water, which is a cause of decline for mussels today.

AGL: So their connection, their intimate connection with both the riverbed and the water means that, their greatest strength is their greatest weakness because they're drawing the water through their bodies constantly. So they're, they really are very sensitive to changes in the water. They can be affected by excess nutrients like nitrogen and phosphorous. They are affected by excess sedimentation, so near a construction site or after heavy rains, if the water gets really cloudy and turbid, that's going to affect muscles. They are exquisitely sensitive to heavy metals and certain, you know, pesticides, toxins, chemicals, they are also sensitive to and, and we're still learning about this kind of thing. Um, other contaminants that find their way into, into our water supply and into rivers from our wastewater. So things like pharmaceuticals, whether it's antibiotics or um, or antidepressants, they're are things that we pass through our bodies that get into our water system.

PS: With these impacts on the freshwater population, it's no surprise why many are imperiled and endangered. Not to mention, freshwater mussels were often harvested for their versatility and beauty.

AGL: So they are in trouble and it's not them, it's us. So they, early on a couple things started affecting them. There were damages to river quality, water quality pollution there were dams put in. Only two percent of streams are freely flowing in the United States. So that means over the last century or so, we have effectively damned 98 percent of streams. So it's been kind of a wholesale process. So early on muscles were harvested by humans. There's evidence of native people, Indigenous People in North America using muscles for food. I'm using muscles for tools and jewelry. Um, there are big middens, big piles of Mussel shells. I'm typically the, it looks like the larger muscles were used more for, for tools and the smaller ones where we're more tender and edible.

Um, but that was more at a sustainable rate than what happened in the 19th and early 20th centuries until the 20th century with harvesting of mussels. And so we found that Mussel, freshwater mussels, oysters also make pearls. And so there was an industry of that, of harvesting mussels for their pearls. And this was, this was a, a very, impressive industry have of gathering these mussel. Um, there were, it was sort of a pearl rush. The other thing that we did with mussels was we used their shells to make pearl buttons.

Mussels come in many shapes and sizes. They can range from the size of your thumbnail to the size of almost a dinner plate.-And they come in various shapes-so their shells can be smooth, almost glassy on the surface, there's shells can be very rough. They can be lumpy and bumpy. They can have ridges, they can have, um, little horns that stick out. They can be more of a rounded shape, they can be elongated, they can be sort of boxy and they can be yellow, brown, black striped, um, various sort of colors on the. And these are the things that gave mussels their names. And so I'm freshwater mussels have fantastic names, like he'll splitter three horn warty, back fat mucket, snuffbox, pistol grip, rabbit's foot, pig tow. It kind of goes on and on because they were named a lot initially because the initial sort of study of mussels was more of a study of their shells. The shells on the inside, they are always lined with a pearly lining that is the same material that covers pearls. And so that's why I'm, that's why they do make pearls, um, that poorly lining can be white, pink or Lavender, deep purple. It is beautiful. That was the treasure that fascinated people who wanted to use these to make pearl buttons.

Johan Boeple was one of those people. He actually, um, had immigrated from Germany and had done some button making of this sort in Germany, um, and then came to the United States and sought a source for these buttons and he found a source in the, in the Mississippi River. He found a lot of these very large mussels with thick shells and and invented a button punch that allowed him to take a shell and punch out circular button shaped button sized pieces from the shell and they could sand off the outer coating on the shell and they would have just a slice of Pearl, poke some holes in it. And it was a button. This became a big industry for about 75 years. There were a button factories and there were shelters that would go out and harvest these mussels. They used Braille boats and so they would use boats that, that dragged sort of chains with smaller along the bottom and the mussels would, would clamp onto these and they would pull them up just loaded with mussels. They would dive down and just rake in the mussels as many mussels as they could collect. So the Pearl button industry also, um, did a number on mussel populations because they were not harvesting with any foresight for what would, what might allow these, these populations to continue.

We understood actually very little about that and in fact, as they were, as the mussel populations were declining and they were worried about them running out, that actually prompted the beginning of studying mussel biology. Um, so along the Mississippi River they started the Fairport biological station, um, and Johann was involved in that effort because they began to look at how can we get more mussels, will he wanted more, but basically how do they live, how do they, how do you propagate them? And it turned out to be triggered this whole new trajectory for how they were looking at mussels. Reportedly, Johan had a bad twist of mollusk karma. He actually died of a, an infected mussel wound after stepping on and cutting his foot on a heel splitter mussel. So that was kind of a sad irony at the end of his life.

PS: The near devastation of mussels pioneered a curiosity for learning how these strange but beautiful things that look like rocks, functioned.

AGL: And so as the research shifted from just taxonomy, where just trying to identify which muscle was which and, and what they looked like. They started looking inside the shells, will, you know, how do they work, how do they eat and breathe and, and fascinatingly, how do they reproduce. I mean, these are, these are much more recent revelations about mussels, um, in the last 40 years or so. And what we can do with that information is begin to understand how we can, um, rehabilitate creeks and rivers to be more hospitable to mussels. For one thing which is only in our best interest because what mussels need is they need clean water and they need an intact riverbed and they need plentiful water. So they need the water at the river to never run dry. We actually also need those things. So if we look to mussels to guide our, our restoration of creeks and rivers, basically they just help us know how to make so that we will have clean, abundant, fresh water for the future. Um, but the other thing we can do it by understanding muscles and their reproduction is we can actually propagate them and reproduce them. And so there are an increasing number of mussel hatcheries across the United States in various states.

PS : A passage in Abbie's book says "Mussels' peril is our own. We need the same thing - plentiful clean water in healthy creeks and rivers. I think of mussels as I watch the kitchen spigot run. I heed their dwindling and extinctions as a smoke detector piercing the night. Feel alarmed, they insist. Get up and look around. The house just might be on fire." And a lot of mussel biologists have decided to get up and take a look.

AGL: I mean really right around 70 percent of fresh water mussel species are imperiled just over 70 percent and many species are already extinct. It has the potential to be an extremely depressing group of animals to study. And when you hang out with mussel biologists you find that they're an extremely upbeat group of people.

The Alabama Aquatic Biodiversity Center is one of my favorites and they are doing what many of the muscle hatcheries are doing, which is taking endangered, sometimes nearly extinct mussels and propagating them are making many more of them so they may borrow some pregnant female mussels from a river and bring them into the lab and match them with the fish hosts that they need so that the, um, they can flush out the larval Mussels, the baby muscles and let them latch onto the fish when they drop off the fish, they collect them and they basically, um, nurse these mussels along. And this takes, it can take a lot of trial and error trying to figure out, first of all, which fish does that mussel need? What kind of food the new babies need, and what kind of water quality can we provide? But they're having a lot of success and um, when I visited, I had the opportunity to, to hold in my hand some of the most endangered mussels in the world. It was like a Dodo. They're about to disappear off the face of the earth, but here, here I am holding it in my hand and standing in front of a big old bucket of them, thousands of them. And then the next challenges is finding a river or a creek to introduce those mussels into so that they can live on and so that they don't immediately die in the unsuitable habitat. But there's a lot of science and experience that goes into this and they're, they're having a remarkable success doing this. And it's really exciting.

PS: There's a lot of incentive for humans to protect freshwater mussels. And that sentiment is spreading across the US but the protection of mussels is something that isn't always a guarantee.

AGL 01:08:48: Some exciting things are happening for Mussels in upcoming year or so. The city of Philadelphia is putting a lot of resources into a large mussel hatchery. Um, they have a small educational one. They have a small mussel hatchery that's educational primarily, but they are going to use mussel. They're going to officially use mussels to help filter the city water supply. And so I, I just am so excited about that in

the fact that it's, it's, I think a great idea and draws attention to this fascinating group of animals and I'm really allows us to utilize their amazing ability of filtration.

There are kind of scary things possibly on the horizon for mussels as in a recent bill that's been introduced in Congress to actually remove freshwater mussels from the endangered species act to amend the endangered species act of 1973 and take all freshwater mussels off the list, which is, it kind of leaves me speechless at how short sighted and I'm damaging that can be. But that's, that's something to pay attention to you coming up.

So what we can do just in our daily lives, it's simple stuff, find out where your water comes from. Find out people in your community who are working to protect your local creeks and rivers. Find out where your water goes to, um, and how it's, um, how, what you send down the drain affects the community and the river downstream. You can get out in the creek and river and, and develop relationship with it. Sometimes you have to be careful because muscles are threatened and endangered species. They're still on the endangered species lists. So you don't want to take them out of the creeks and rivers, um, but if you want to find out muscles in your area where you live, there are great resources on the Internet, your state authorities can tell you which muscles you have and which ones are endangered and where they live.

Something that I would love to see in the next 10 years for mussels, um, is also what I would love to see for us. An example of that is in North Eastern Alabama in the Tennessee river basin, there's a river called the paint rock river and 20, 30 years ago it was extremely beat up that mussel populations were low and understand that in the Tennessee river basin, that's really is, um, the jewel in the crown of mussel diverse populations. It is amazing. So this paint rock river, just from land use practices agricultural and I'm logging and pollution had really taken a hit. The Nature Conservancy spearheaded efforts to do stream restoration products and riverbank restoration land use modifications in that whole, um, paint rock river watershed and have completely changed the face of that. The fate of streams and rivers is not, is not yet decided we can still change things. Um, and really improve life for mussels and improve the future for fresh water for us because we are going to need fresh water, with climate change, with increasing human populations and demand for water, for agriculture and for municipal use, we are a real drain on the available fresh water and it is finite.

PS: For Abbie, this journey began with exploration and curiosity and she came out the other side by giving mussels a voice. And sometimes that's just as important as any scientific discovery.

AGL: I would highly recommend to anyone to step outside your own experience. And I think that applies to nature. I think that applies to other people, communities, cultures that when, when you have an immersive experience, literally physically, um, and you know, emotionally for culturally, when you allow yourself to plunge into something completely outside what you normally do, and that can be as simple as just going up two blocks over to a tiny little restaurant you've never been to a tasting flavors that you've never tried. It can be, it can be going into your backyard or, or a park and going on a new path or just sitting really, really still and putting your face down close to the ground. Just allowing yourself to be startled by others' experiences, whether it's the experience of being a mussel under the water or the experience of another animal or human. That's the really juicy, great stuff of exploring nature and the world is that it takes you so far outside your own experience. It transports you and, and it changes the way you see things.