GOOD MORNING. IT IS NOVEMBER 21ST, 2014. MY NAME IS GREG SMOAK AND I AM AT THE OFFICES OF THE GREAT SALT LAKE INSTITUTE OF WESTMINSTER COLLEGE TO INTERVIEW JAIMI BUTLER AS PART OF THE GREAT SALT LAKE ORAL HISTORY PROJECT.

GS: Very good to have you with us today.

JB: Good morning.

GS: What I'd like to start with is – as we do with all oral histories – is a brief bio so we know who you are. And if you could tell us a little bit about where you were born, where you're from and also how you got interested in science.

JB: So my name is Jaimi Butler. I grew up right here in the Salt Lake Valley, in Murray, Utah. It's where my family has lived for many generations.

GS: I don't mean to butt in but did they work for the smeltering, the mining industry? Murray has it's own interesting history.

JB: Yeah. Not that I know of. My great grandparents had a clothing store in downtown Murray. And really, I don't recall anything in the smelting industry or the mining industry. They were kind of part of that urban culture in Murray, just right downtown Murray. And they still live where they lived in the 1950s. My mom moved into their home a few years ago after both of them passed away. And we haven't moved—we moved one house.

[both laugh]

JB: So we've always been there. I've always stayed in Utah. I always threatened that I was going to leave. It's what you always—I guess you get that wanderlust. But I never did. I went to school at Utah State University. I have a degree in fisheries and wildlife from Utah State. And I really don't recall what ever—There was no spark that one day the interest in science turned on. It was always there. I always loved the natural world.

GS: Did your family do a lot of outdoor things, camping, and things where you encountered wildlife and got interested in that side of things?

JB: A little bit. We would go camping a lot just in the Cottonwood Canyons. But I think there was something a little bit more innate in myself. They're not huge outdoor enthusiasts. I mean, we went outside and went camping and we'd go on walks and all of that. But we weren't traipsing—we weren't back-country skiing or snowshoeing. It was kind of more of a novel pastime.

GS: Now, what are your earliest memories of the lake? Did your family ever go out there when you were a kid? How did they perceive the lake? Was it something that meant something to you early on?

JB: I don't recall even thinking about the Great Salt Lake when I was young. I didn't have a relationship with it. My parents didn't have a relationship with it. And my very earliest memory of Great Salt Lake was in the 1980s when it was flooding. So I was probably—I was under ten years old. And I remember sitting on I-80. I think my dad purposefully took us out there because he thought that Great Salt Lake was going to swallow I-80 up. And it was going to be our last look. And I remember sitting – he had this really awful, blue Chevette that he drove around for I don't know how many years.

And I remember sitting on the shoulder of I-15 and plinking rocks into the water. And, you know, now when you go out there the water is a couple miles away. I mean, it's receded huge. I remember the water kind of lapping on Black Rock and seeing Black Rock that—it just seemed like it was bobbing in the lake. And, you know, now you can go out there and drive your car to Black Rock and climb on top of it and the water's a couple miles away. So that's my first memory of Great Salt Lake.

GS: Now was that a common experience, do you think, with kids your age in Murray that people just really didn't go out to the lake? Did any of your friends, family?

JB: I don't recall. The first thing I recall about Great Salt Lake, I was in high school and was an AP biology student. It would've been my senior year. So it would've been 1994. I mean, not very long ago, really, I like to think anyway. But I recall my teacher taking us on a trip out to Great Salt Lake. And that was really the first time. It was like a big deal to go out to Great Salt Lake, and this novel experience that we didn't have before.

GS: And where did they take you?

JB: Unfortunately, I was sick that day. I ended up—I think I had the flu or something. I was so bummed, too. I never missed stuff like that. I loved that class. But I was so sick I ended up missing it.

GS: Alright. And so then you went on to an undergrad degree but also a graduate degree, right?

JB: No, no graduate degree.

GS: Oh, no graduate degree. But at Utah State you worked at the Berryman Institute for Wildlife Damage Management. So that's a mouthful. Could you tell us about that institute and what you did there? And I think that's where you first probably worked with the lake very directly.

JB: Yeah. So the Berryman Institute is directed by a man named Mike Conover. And Mike Conover I definitely count as my first mentor. And I blame him for getting me involved in all of this Great Salt Lake mess. [laughs] And I mean that with the warmest and highest regard. But Berryman Institute for Wildlife Damage Management, they were

given a lot of money from the legislature over the years to explore areas of wildlife damage management and how wildlife interacts with humans and some of the economic losses that wildlife cause for humans and how to mitigate that. So examples might be putting up deer fences so that humans don't hit them with their cars and have this economic loss. Another is bird-plane collisions: How do you prevent birds from flying into planes and these planes crashing? How do you reduce that economic damage to humans? And how do you help us get along with wildlife? And so, he had a project where one of his graduate students was exploring eared grebes. And half of North America's population of eared grebes comes to Great Salt Lake every year to rest, refuel, reproduce. Great Salt Lake is critically important. Anywhere from one to three million birds are here every year. And eared grebes, when they come to Great Salt Lake, they lose their ability to fly.

GS: Is it because they're molting?

JB: They molt. And once they land on the lake they just start gorging on brine shrimp. They primarily eat brine shrimp. And once they land on the lake and start eating these brine shrimp they get so fat. I mean, I joke around, but they kind of get cheeks like Donald Duck gets in cartoons. They kind of get these cheeks. And they molt. They lose their ability to fly. But they also get too big. And they put all of their energy into their digestive system. So, I mean, I think they double their digestive system. And all of their wing muscles and their muscles that they use to fly atrophy. So what they do is they swim on Great Salt Lake and they dive to eat brine shrimp, dive and eat brine shrimp off of the surface. But there's a big brine shrimp fishery on Great Salt Lake. And one of the questions was, are brine shrimp fisherman taking too many brine shrimp—are they

leaving enough brine shrimp for these grebes to feed on? So Mike had a grad student that was exploring that interaction of brine shrimp and grebes and how many brine shrimp they needed and were brine shrimp fishermen leaving enough. It was the coolest job I ever had.

GS: So where did you work mostly? I mean, since they're feeding on brine shrimp, was it at Bear River Migratory Bird Refuge? Or it had to be farther—it had to be away from the fresher water.

JB: Yeah, it was based on Antelope Island. And at the time, I was just a lowly technician. It was really one of the best jobs that I've ever had. [laughs] Because I just worked for his grad students. So I worked for Joe, who was exploring this eared grebe and the connection to brine shrimp. There was also a project on the Bear River where we had radio collared fox, skunks, and raccoons to see—kind of explored their home ranges and how it related to predation of bird eggs and bird nests. So I worked a lot at the Bear River with another graduate student. And I did a lot of random—as you can imagine what a twenty year old technician was...

GS: Right. So how did your perception of the lake change at that point? Was it something that at first you said, "Oh goody, I'm going to go work out on the lake"? Or was it at first something that had to grow on you?

JB: I was stoked to have a job right out of college. And I always wanted to do field biology. And I really like being out in the field and then taking what I learned or taking what I collect in the field and taking it into the lab, taking it from field to lab and to analysis and some kind of a result. And I think I was just stoked to have a job at the time. It didn't have to do with Great Salt Lake. It was like, "Yeah! I got a job!" And I

remember Joe telling—We didn't know how to catch the grebes. It took quite a while to catch these eared grebes.

GS: How do you catch them? How did you figure that out?

JB: So at first, he sent me into Farmington Bay. He's like, "Bring your swimming suit. We're going to use mist nets and we're going to try to catch them." Because they don't fly, you have to catch them underwater. And we were essentially measuring their metabolic rate. We were measuring oxygen consumption. In previous studies, how they had caught these birds is they had chased them with a boat until they were too tired to swim anymore and then scooped them up with a net, which is sketchy if you're trying to measure oxygen consumption.

GS: Right. You skewed your result right there.

JB: Yeah. So we were looking for another way to do this. And we would take our swimming suits. And he would say, "Okay, we're going to put"—You know, normally, people catch birds with mist nets, where you stretch a very fine net between two poles or trees and scare the birds into these mist nets. So we tried to do that in the water. We would stick these poles. And I would be wading out into Farmington Bay, which, Farmington Bay is not pleasant. I mean, I was actually really bummed that I had to go into Farmington Bay. It was stinky. It was buggy. It was all of these things that people have a negative view over Great Salt Lake. And I was kind of bummed about it. And much to my happiness, the birds would see these nets and we never did catch a bird in these nets. And so, Joe liked to say, "We're going to get out our redneck." He was this good 'ole boy.

GS: What is Joe's last name?

JB: Joe [Codell ?]. So Joe [Codell ?] would say, "We're going to get our redneck today." And what we ended up doing is using two-inch gill nets. So gill nets are what fisheries biologists catch fish with. And the fish kind of swim through it and get their gills caught. And then you can pull them up and study them however you want. And that's what we ended up doing. We ended up calling our fisheries biologist friends and asking them how they use these gill nets. And that's how we ended up catching them. It turned out to be very successful, very low mortality rates. You can imagine, you can drown a bird really quickly with a gill net. But essentially, we would just run the boat and as we were running the boat through a circle through a group of these grebes – the grebes forage in very large, I mean, tens of thousands of birds at a time. And we would run the boat through them and let the net out into a U shape. And once the net was all deployed we would pull the boat around and kind of scare them into the net and then pull this net up really quick with all of the birds in it.

GS: And how many would you pull in at a time?

JB: The first time we did this and were successful I think we caught like 73 birds. I mean, it was shocking and scary. And we had this 16-foot open aluminum fishing boat full of net and birds [laughs] flopping around, because we didn't want them to drown. And once we figured that out we were very successful, very low mortality rates. I think under two percent.

GS: So once you have the bird in hand how does the study take place at that point? Do you draw blood? What do you do?

JB: So once we had the birds in hand we would take all of these measurements. Are they male or female? What's their bill length? What's their weight? Eared grebes have

these beautiful eyes. So the juveniles have yellow-colored eyes. Kind of these yearling birds have orange-colored eyes. And adult birds have fire engine red eyes. I mean, they're just striking and beautiful. So we would take all of their physical data. And then we measured metabolic rates. We had a facility that we would take them to up at Utah State where we could measure their resting rates.

GS: I'm kind of envisioning a grebe on a treadmill here.

JB: [laughs] We did try that. Because to get a metabolic rate and a full picture of how much energy it takes to be a grebe, and therefore how much food it takes, how much brine shrimp it takes a grebe to maintain their body weight and reproduce, you have to figure out what's their metabolic rate at resting, what's their metabolic rate while they're just swimming, what's their metabolic rate while they're just preening their feathers, and what is it while they're diving. Because grebes, they dive and can stay underwater for up to almost a minute, so it takes special requirements. So we had to measure all of these things. We would take them back to our facility for a basal metabolic rate. And really all it was was a Home Depot bucket with an oxygen hood so it's sealed, so we knew how much oxygen they were consuming. And this oxygen hood was hooked to a computer.

Other things like swimming metabolic rates and diving rates are hard. I mean, that's a hard thing to do. That took a long time also. And what we came up with was we used hardware cloths, so kind of this metal mesh cloth that would hold a shape. We bent that into a circle that was, oh, I don't know, how big is this? Two and half, three feet in diameter. And at either end we had a little, like a bent, like an elbow that was from irrigation tubing, like this large PVC elbow. So we could catch these birds. And we would put the bird into one side and then we would scare it so that it would dive

underwater. And all the while we're measuring how far they're swimming, how far they're diving. And then the other end had this oxygen hood on it. So once they popped up in here – it was tight because it had the water and then this PVC tube and an oxygen hood on the top of it. And it was mostly, at the time, brine shrimp fishermen that would see us out on Antelope Island doing this. And they thought we were crazy. They called this little setup that we had—It was midsummer. It was hot. And it was dry. And it was solar. There was no shade out there. So we would scare them up in here and then into this oxygen hood that was hooked to a computer. But on this computer cart we had, the brine shrimp fishermen called it my taco cart because it was this handcart that we had strapped a computer and all the equipment that we needed to measure oxygen. And then I needed an umbrella, so I had this funny rainbow umbrella. It totally looked like a taco cart. So it was the strangest thing that you could ever [laughs] that you could ever see. But that's where I met Great Salt Lake was spending—I mean we put a hundred thousand miles that year on our—we called it the chickenmobile, that was the Utah State vehicle, just driving back and forth from Logan to Great Salt Lake.

GS: And so most of this is all taking place on Antelope Island or around Antelope Island.

JB: Yes.

GS: And did you keep a boat at the marina at the north end there? Is that where you operated out of?

JB: Yeah, we operated up just out of that marina at the north end of Antelope Island. It was easy access. I mean, one of the things about Great Salt Lake that I'm sure you're hearing is there's very few places that you can access Great Salt Lake. And to put a boat

in at Great Salt Lake is even harder. So, I mean, really, I think there's three or four places that you can really put a boat in. So we mostly did all of that out there. It's where I met the spiders. You know the spiders of Great Salt Lake?

GS: I've heard about this. This is right up at the north end of Antelope Island, right? Massive spiders. What type of spider is it?

JB: They're called western spotted orb weavers. And they're not poisonous. But, I mean, they do get very large. I would say they're abdomens get about the size of the tip of my index finger. And then they have long, spindly legs that come out from their body. And they're very large and, I mean, so numerous that—you know, one time I counted over a hundred of these orb weavers on the sides of a bush that was about the size of a washing machine. I mean, they're just feasting on the countless brine flies that are lining the shoreline. These brine flies, they almost catch too many. They almost catch more than they need I suspect, at times. And that's where, you can imagine, if you go down to the marina at Antelope Island or even at the south shore at the Great Salt Lake Marina, these brine flies that live on the shorelines and that eat the algae and detritus, underneath these, all of the docks, is a prime location for spiders. And I remember just hanging off these docks trying to either put grebes into our tubes or hanging the tubes was even worse. When we were trying to hang these tubes I would have these giant spiders crawling into my hair. That's where I met the spiders. I would go home and spiders would crawl down my neck from my hair.

GS: So you would take them home with you.

JB: Oh man. I took so many home. That's where I met the spiders.

GS: And, not to jump too far ahead, but you take students and public school kids out there now to introduce them to the spiders, right? That's one of the things that the institute has done.

JB: I do. The spider project is one of my very favorite projects that we've introduced here at Westminster and Great Salt Lake Institute. And it comes from meeting the spiders, having the crawl up me, and wondering—I mean, the biomass of spiders at Great Salt Lake is incredible. I mean, it's unbelievable. And there just really hasn't been a lot of studies on who are they, who eats them, what is their life cycle like. Nothing. And a couple of years ago a student came to me who was interested in research. And I said, "Okay, spiders. How do you feel about spiders?" And Jim just head-on took this project on. And that same year we got this biogeochemist, a faculty member here at Westminster, that came. And he had studied mercury in his post-doc and in his PhD. And so, he got here and Jim and I literally handed him a whole tray full of frozen spiders and said, "Let's figure out what's going on here." Because we knew that the spiders were eating the flies. And we knew that flies at Great Salt Lake have been shown to have high levels of methyl mercury, this mercury that can bioaccumulate through food chains. But not a lot of work has been done on methyl mercury leaving Great Salt Lake and going into this terrestrial part of the ecosystem. And so we handed him these spiders and said, "Hey, here you go." And it turns out to be a very interesting story.

So Great Salt Lake spiders, this first year, we had very preliminary data. We had collected some of these orb weavers from Utah Lake, some from Great Salt Lake. And these western spotted orb weavers had 60 times the amount of methyl mercury when they lived near Great Salt Lake than they did at Utah Lake, when they were collected at the

same time. And this very interesting story of mercury leaving Great Salt Lake started to emerge, and is something that I'm very proud that we started here at Westminster, like, let's look at these.

GS: And so eats the spiders? Where does it go from them?

JB: Well we don't really know. So very early on in this whole project we had had this interview with the *Salt Lake Tribune*. And they had printed something I said about we don't know what eats them, we don't know where it's going, how does it transfer. And a photographer, named Ron Dudley, who you should get in touch with, Ron Dudley, he sent me an email and said, "Well I know who's eating them." And he sent me a picture of some loggerhead shrikes that were feeding these giant spiders to their nestlings. And that spurred another project through our urban bird ecologists, looking at what's going on with these loggerhead shrikes. Is mercury accumulating in them? What are they eating? How is it affecting their nestlings?

GS: Now once you left the Berryman Institute you worked then for several years for the Utah Strategic Alliance, which is the brine shrimp industry, right?

JB: I did.

GS: Could you describe the Utah Strategic Alliance and how your work then impacted or how it was used by the brine shrimp industry?

JB: So backing up from Utah Strategic Alliance and thinking about the brine shrimp industry, when the brine shrimp industry started in the 1950s it was kind of this hodgepodge group of local people that had boats and would go out and collect the cysts of brine shrimp. And I believe it was in the mid '80s, when the water levels were very high and the salinity of Great Salt Lake was lower because of all the water, they noticed

that brine shrimp populations were declining. And a lot of people thought that it was because people were harvesting brine shrimp. And the brine shrimp fishermen got together and said, "Hey, dear State of Utah, we think that we need to be managed and watched because we're not really sure what's going on but we're seeing this decrease. And we want to make sure that this is a sustainable fisheries." So the State of Utah, in the 1980s they started monitoring what was going on and trying to figure it out and eventually put a permit system into place where fishermen had to buy a permit every year to have the right to fish brine shrimp cysts, and then started really studying Great Salt Lake and the population dynamics of brine shrimp and just the biology. We didn't know very much about them.

So when I started working for them—I started working for the industry in... Gosh, I can't even remember.

GS: 2001 it says on your—

JB: Yeah, it couldn't have been '99, that's when I graduated. So in 2001, when I started working for them there had been this kind of push with the industry to streamline. It was very expensive overhead to have facilities—every permit holder to have a facility that they dried the cysts and did all of their industry stuff with. And so they started forming these cooperatives. And the Utah Strategic Alliance was one of those. It was one of the biggest ones. The parent company was a Belgium-based company that had their feet in agricultural feeds and aquaculture. So they hired me. It was very early on in this time when the Utah Division of Wildlife Resources was monitoring. And you can imagine there was a little bit of head butting going on between the industry and the managers over what was the real biology, what were these cutoff points that they were

going to use to stop them from fishing, and even things like how are you counting the brine shrimp were a little bit—they were just untested. It was methodology that needed to be streamlined and tested. And I came in at a good time. There actually wasn't a lot of head butting and competition and stuff. But they needed somebody to check what the state was doing and verify their results. So I worked with the state and worked with them on their methodology of how they were sampling brine shrimp, how they were counting them, how they were preserving—all of that stuff. And we had our own sampling program that was very similar to what the Utah Division of Wildlife Resources was using. And they just used my numbers to verify the state's. And there was also a lot of other things that they wanted to know, like, what was the quality of brine shrimp cysts, how did they behave in the water.

GS: So to back up a little bit, what was your sampling technique? I don't want to get into too deep of technical information here but it is helpful for researchers down the road to know that aspect of it. So how would you sample? Because it was a fascinating story talking about how to measure the metabolism of the eared grebe, right? So how do you work this out?

JB: So when I got there what we had figured out is that we used a plankton net. It's just a round net that hangs into the water with a permeable cup at the bottom of it. And we would take a boat around to various locations on Great Salt Lake and we would lower our plankton net into the water and just raise it up. And once you do that—you know the depth of the water. We had this little system of finding the depth. So once you know the depth and you know the diameter of the net you essentially sample a cylinder of water is what you assume. And so everything that ends up in your little permeable cup that you

count or subsample or however you estimate what's in there, you know how many shrimp and cysts are in every liter of water, at least at your site. Which is a hard thing. Great Salt Lake is very large. And brine shrimp aren't evenly distributed through Great Salt Lake. The cysts congregate in what looks like an oil streak. And it was very hard to get a statistically relevant sample. And us, the Utah Strategic Alliance, at the time, and the Utah Division of Wildlife Resources, went back and forth a lot about what was appropriate numbers of samples and how to do this. But I think to get statistically significant and relevant samples of how many shrimp per liter of water at Great Salt Lake you would have to take 120 samples on one day. And that's no possible.

GS: From widespread locations.

JB: Widespread locations. I think our boat would travel almost a hundred miles in our sampling circle. So it was very hard just to take 12 samples or something.

GS: What were some of the variables that really determined brine shrimp populations? Salinity's probably the number one, right?

JB: Salinity. Salinity and therefore food availability because the microbes and phytoplankton at Great Salt Lake respond very quickly to changes in salinity. And that's what the brine shrimp are eating are the microbes and the little photosynthetic phytoplankton that are in the water. So that's what happened when the brine shrimp fishermen said to the state, "Hey, we're seeing this decline in our fisheries and we need some help," what they were really seeing is there was a decrease in salinity at the time, which allowed different microorganisms to take over Great Salt Lake. And a lot of these were called diatoms. And diatoms are often these very large green algae that are covered with a silica shell. And they are beautiful. But they just simply don't—a lot of them don't

fit into the mouths of brine shrimp. And if they fit into their mouths, the brine shrimp often can't digest them. It's like us swallowing a donut covered in glass. I mean, it's an awful picture. [laughs]

GS: And so you worked there for three years. And did you see changes or developments in the industry that your science actually impacted – the way that it was harvested? Were there real management changes? Or can you? Or was it really just a matter of these external forces changing the salinity in the lake? Or are there ways that the brine shrimp industry can actually manage the resource and the state can to increase numbers? Or do they even try?

JB: Well I don't think we realized at the time. You know, three years is a very short amount of time when you're working in a natural ecosystem. So I wouldn't say my research necessarily contributed a ton to the changes and practices in the industry. Because there were lots of changes that were going on even before that, in how they stored the cysts, in how they processed the cysts. But I think during that time and the time that the Great Salt Lake Ecosystem Program has been around we have seen a lot of changes in the populations of brine shrimp at Great Salt Lake. And they've not only seen high water years with very low salinity but they've also seen very low water years with very high salinity. So they've gone everywhere from the fisheries not necessarily even being able to harvest to huge years of 35 million pounds of raw cysts being taken off the lake. And it turns out that – and I don't think anybody realized this at the time – but it turns out that the way they were managing it is—they kind of tripped upon this really awesome recipe and have been able to optimize brine shrimp harvests. Because how it works is brine shrimp, they hatch out of the lake in the springtime. And this first

generation of brine shrimp, it's pretty low population. And they do affect the ecosystem: they eat the algae, they eat the microbes. But then they reproduce. And that first generation has awesome resources. They've got this great salinity. They've got tons of food. The water's warming up. I mean, they've got this really great recipe for just reproducing. And that first generation, it does. So then you start seeing the second generation. And so if you have this low first generation that is able to have tons of resources in the lake, has plenty of everything, they then create this very large second generation. And that affects the whole year of brine shrimp population dynamics. So by brine shrimp fishermen taking a lot of cysts off the lake and only leaving a few left, it optimizes the harvest because there's just this very small population that then creates a large population and then they can do their thing throughout the rest of the year.

GS: And if the resources then are less advantageous, they produce cysts. There can also be the live birth of brine shrimp, right? It depends on how much food is there, right?

JB: It depends on how much food is there. I think it depends on the females, too. Female brine shrimp can have multiple broods throughout their life cycle. And I think towards the end they'll put their energy into creating cysts rather than live birth. But those first generation, I mean, really, you'll see brine shrimp that have 300 brine shrimp, wiggly, live brine shrimp nauplii in their brood sacks. I mean, they're amazing. I can't even imagine putting 300 into my brood sack.

[both laugh]

JB: But we're different.

GS: Yes, we are. It takes us a little bit longer.

JB: It takes us longer. We put a little more energy into our little larva.

GS: And so after a couple of years, in another position for another industry, you came back to work on the lake with the Great Salt Lake Ecosystem Project. And this is actually a state organization. This is what you were describing that was founded, essentially, to manage the brine shrimp industry and to understand that ecosystem. Could you talk a little bit about the work that you did there?

JB: Yeah. So I worked for the Utah Division of Wildlife Resources Great Salt Lake Ecosystem Program. And I have to put in a plug for the people who set that up because Great Salt Lake Ecosystem was funded by brine shrimp fishermen, the brine shrimp companies who would give permits to them, who would buy permits from the state for the right to harvest brine shrimp cysts. And all of that money that came from the permits went into the Great Salt Lake Ecosystem Program, which meant research and monitoring of not just the brine shrimp but the ecosystem of Great Salt Lake. And I think that's fairly unique that they had a very resource-rich program of at least 800,000 dollars a year from the permits alone, which has increased since then. And they also got really great scientists and really great people behind them to set up this program. And the first thing that they did was hire people who could understand population modeling, and essentially watching these populations of brine shrimp and giving predictions and creating a model for Great Salt Lake brine shrimp.

But what we did was exactly the same thing that I did with the Utah Strategic Alliance. We would go out on a boat and we would take plankton nets, samples, exactly the same way. We would take them back to the lab. And we would count them. So early on in the game the Great Salt Lake Ecosystem Program had figured out—they needed to figure out how they were going to manage this fisheries because there's not any models

anywhere around the world on how to manage a brine shrimp fisheries. And Great Salt Lake is highly, highly productive. It drives me crazy that people call it a dead sea because, I mean, we can smell it sometimes. That right there means that it's not dead. I always tell people, "It doesn't stink, it smells like biology."

GS: [laughs]

JB: It means there's microbes and there's things that are decomposing, life, the abundant life that's out there. Anyway, so they had to figure out how they were going to manage it. If it's going to be sustainable, you first have to figure out what's going on and how many—there's this harvest that goes on. And thinking about the life cycle of brine shrimp, how do you manage that according to their biology? And what it turns out is that you have to leave a certain number of cysts in the water at the end of the winter, that will over-winter and that will then hatch out the next spring. And so they figured out really quick that they needed this adaptive management strategy. Instead of, a lot of fisheries around the world will say, "Hey, you can harvest x number of pounds of salmon this year. X number of pounds." What the State of Utah said was, "You have to leave a certain amount of brine shrimp cysts in the lake every year." And that takes a lot of monitoring to figure out, when are you approaching that number, and is that number even correct? We already know that it takes too many samples to accurately assess how many cysts on the lake there are. So when is that correct? And it takes a lot of time. And during the brine shrimp harvest, which runs October to January, or until the cysts per liter in the lake get low enough according to their cutoff, we would usually go out twice a week on this—

GS: And that's why population modeling is so essential.

JB: It is.

GS: To take a real guess at how much is there.

JB: Yes. And so now people come and talk to the State of Utah about how to manage brine shrimp populations because they did use a very—this adaptive management strategy that was kind of an emerging field in natural resources at the time. They used this very adaptive strategy rather than a heavy-handed number of pounds per season or whatever.

GS: Now, in addition to doing the brine shrimp side of things, you also were involved in bird counts and other things for the Ecosystem Program?

JB: Yeah, because the brine shrimp are food for 10 million migratory birds that come here to Great Salt Lake. And so, one of the big focuses of our program was the birds and what are populations doing over time? Are they decreasing? Are they increasing? Do they change where they're foraging based on the water level? Because Great Salt Lake isn't just a lake that stays at an average 4,200 feet surface elevation. It can, just within a year, change meters. And so we were interested in all those questions. We don't know anything about what were the birds doing. Who were the important birds? Who were the ones that are going to be very sensitive to change if something happens to fly or shrimp populations?

GS: And did you have much interaction with the mineral extraction industry? How did that play into the ecosystem program? What's that relationship like?

JB: You know, no, I actually didn't have—I had more to do with the mineral companies when I worked for the brine shrimp company because we would cross their dykes to go out to Promontory Point. Sometimes, not all the time. A lot of times it was

the railroad causeway. Towards the end of my time at the Ecosystem Program, Great Salt Lake Minerals put in a permit to expand their operations by lots and lots of acres. And Great Salt Lake Minerals sits in Bear River Bay and just north of Willard Bay. And that whole area is vital habitat for lots of birds. And at the time I wasn't super involved with it because I was the person that was in the mud and in the salt and not necessarily in the office writing letters of support or whatever it was. But we definitely cautioned heavily against that permit that Great Salt Lake Minerals wanted to expand into the Bear River Bay because of birds, because of destruction of bird habitat. And I think our director kind of put that under the rug a little bit. He didn't like that. Utah's a state of supporting industry over environment all of the time. And our opinions on that kind of got brushed under the rug a little bit.

GS: Yeah. Well, it is deeply political.

JB: It is.

GS: Just to change gears a little bit, you mentioned being the person in the mud and the salt. And earlier you mentioned how hot it was and having this umbrella. Could you maybe talk a little bit about the clothing and the equipment and the strategies for dealing with what is a very beautiful place but can also be a very extreme place? And to work out there day after day after day you have to develop certain methods to get by.

JB: Oh yeah. You know, when I first started I would sit on the docks at Antelope Island in the summertime. And it was wicked hot. Not just hot, I mean, it is wicked hot and wicked dry. And I learned to wear giant sunglasses and hats all the time. And I always tell the students I work with that in chemistry you put gloves on and you put safety goggles. And I had to slather up with sunscreen. I mean, look, I have sunscreen

sitting on my desk right here just in case [laughs] just in case I go out there. Definitely in the summertime it's long, cotton, white shirts. And Utah, by the way, is a very great place to find white, cotton, long-sleeve shirts because we have all of these return missionaries that come home and give their clothes that they've been wearing for two years to the DI.

GS: Oh, good technique. See, as river runners we wear the same thing. You get too hot and you wear those.

JB: Yeah. So I would wear those a lot. What's different about river running, though, is I could never really douse myself in the river and cool off.

GS: Right, that's the thing.

JB: You know, at Great Salt Lake we never really swam in the lake to cool off. And I think it just has to do with the salt. You just get so covered in salt you get itchy.

GS: And it dehydrates your skin. It pulls the moisture out of your skin.

JB: It's very dehydrating. Days on the lake I would get a whole gallon of water and I would put lemon tea in there with mint. And I would keep it in the cooler with all of our samples. It's full of ice. And as the day wore on I'd have to drink more of my iced tea so that I could fit all of the samples in there.

Winter I think was harder. Great Salt Lake goes from being, I mean, almost body temperature. It can be 90 degrees Fahrenheit, at least on the surface, if not more, if not deeper. But Great Salt Lake doesn't freeze solid because it's saltwater. And so there were times out on the lake that the water was negative 40 degrees. It was very, very cold, and should've been frozen but it wasn't because of the salt. And we were on aluminum boats. And it was almost harder then to keep a decent body temperature. And we would do all sorts of things. We had special boots and we had special hazard suits that we would wear

that just zip up, you know, kind of a big suit that goes from head to toe. And really the wintertime, I think, was more dangerous because if you land in the water, if you fall in the water, it doesn't take very long for hypothermia to set in.

GS: Yeah, and I think you're struck by that when you read the accounts of, say, the Stansbury survey. And they're out there surveying through the winter. And I can't imagine these guys tromping through that mud, dragging those weights, and then having to build fires.

JB: I can't even imagine.

GS: That's a pretty intense experience.

JB: But winters at Great Salt Lake, they're cold, but man are they beautiful. People don't get to see Great Salt Lake in the winter very much. And, I mean, I had to. Isn't that a bad way to say it? I had to. But winters out there are just amazing. You'll come across these days that are just so clear and just calm and beautiful. And there are different birds that live out there in the winter. So there are some birds that come just for the winter because the water doesn't freeze. There's enough cysts or brine fly larvae that still live in the water that they can at least maintain their survival. But they also, a lot of ducks need to be able to – they're called dabbling ducks – and they need to be able to paddle around. They can't stand very well on the surface. And we didn't realize until a few years ago how important Great Salt Lake was to some of these over-wintering birds, like common goldeneyes and northern shovelers. You know, people didn't go out there. It's cold. It's miserable sometimes.

GS: So in 2009 you moved to this position here at Great Salt Lake Institute. And was this something you were recruited to do or had you just heard about the job opportunity and came here? How did that come about?

JB: Well, the Great Salt Lake Ecosystem Program was based in Salt Lake. And they were moving their operations up north, maybe 30 miles or whatever, to Ogden. And I really didn't want to leave the Ecosystem Program. I loved it. I was outside so much. But I had my life here in Salt Lake and I couldn't uproot and move to Ogden. And I was ready for a change. I love doing field biology. But at the Great Salt Lake Ecosystem Program I wasn't able to talk to very many people. And I felt like I had this secret to share of how great Great Salt Lake really was and what the ecology of the lake was doing. And I just didn't really have that opportunity there to do that. And Westminster had just received, it was a nearly half a million dollar grant through the Department of Labor to use Great Salt Lake as kind of a jumping point for undergraduates going into the workforce. And Bonnie Baxter and Brian Avery, faculty members here at Westminster, had decided, hey, we're going to start this institute. We're doing Great Salt Lake research. This is a great place to act like a hub of information and resources about Great Salt Lake. So right as they moved up there this job opened up and I was lucky enough to land here.

GS: And what are your major responsibilities here? What do you do on a day to day basis?

JB: That's a very funny question because it's everything. I'm the only paid employee, paid staff member, except for our students. We do have students that work for us. But I do everything. So I get to connect our students and faculty members with research going

on at Great Salt Lake. I get to show our students how to do fieldwork: How do you collect samples? How do you do things? Where do you go at Great Salt Lake to collect samples? People don't know even where to go to collect different samples. I do a lot of things. We get a lot of grants through different agencies and organizations and so I do all of our grant administration. I do a lot of outreach. I run the summer camp here. I like to work with teachers a lot and help them know how to use Great Salt Lake in their classrooms. I kind of do whatever comes my way. [laughs]

GS: So what are some of the big, as you see it, important studies and projects that the institute has done over the years, obviously the spider one we were talking about, but other things that stand out that you think people should know about?

JB: A lot of the work that we've been doing is concerning the mercury in Great Salt Lake. So not necessarily where the mercury comes from but when it comes into Great Salt Lake, how is inorganic mercury turned into organic mercury that can bioaccumulate in living tissues? And really cool things can come out of that, like, could you use some of those microbes to remediate?

GS: So how does that happen, as a non-scientist?

JB: So at the bottom of Great Salt Lake—So mercury comes in to Great Salt Lake. And from what researchers at the University of Utah have told us, a lot of that comes in through atmospheric deposition, from coal-fire power plants, gold smelting, other metal smelting. So a lot of it comes in through atmospheric deposition. But it comes in as an inorganic form. It's just mercury. It's just an element that comes in. That mercury, if you were to eat the inorganic, elemental mercury, it would just flush through your system. But what happens at Great Salt Lake is we have these microbes that—They have a

different metabolism than we do. They don't breathe oxygen and they don't spit out carbon dioxide. They have a different metabolism. And most of those live in these anoxic places in Great Salt Lake. So the bottom of Great Salt Lake doesn't have oxygen in it, for a number of reasons. But these microbes live in these areas and when they encounter mercury they put this CH3, they put a methyl group onto it. And that carbon is what makes it organic. And that's what makes it so that your body tissues, or living body tissues can accumulate mercury over time. And we could get very in-depth about how it works.

GS: That's enough.

JB: But that's enough.

GS: That's enough. We don't have to get into the chemistry of it.

JB: Yeah. And then, once those microbes have this methyl group onto them, they can bioaccumulate. So these microbes will accumulate a small amount of this methyl mercury. And then brine shrimp or brine flies will come along and eat millions of these microbes that have just a little bit. But the mercury doesn't leave their systems. So they accumulate the mercury that's in millions of microbes. And then these brine shrimp are eaten by birds. And eared grebes, we know from the studies I worked on with Joe [Codell ?] and Mike Conover at Utah State, we know that eared grebes have to eat at least 10,000 brine shrimp a day. A *day*. So if these brine shrimp that are swimming around in the water eating millions of microbes and accumulating what mercury is in their bodies, and then the grebes are eating those brine shrimp with the mercury of millions of algae in them, they're accumulating more and more up the food chain. So we've been doing a lot of research on mercury.

GS: So if the orb weavers have 60 times the amount of mercury, what about the eared grebes in Salt Lake? Do you have a comparative for grebes in other places?

JB: If I would've thought about that question, I could've remembered it earlier. But what I can tell you is we do know that when eared grebes come to Great Salt Lake that the mercury content in their body increases. And same thing with brine shrimp is over the summer, over the year that the brine shrimp are living in Great Salt Lake, we see their mercury levels increase. And we do know that some of those eared grebes do have levels of methyl mercury in their systems that are over what the EPA considers to be safe. So why do we care? Why would we really care? Because Great Salt Lake is so different. People don't eat fish out of Great Salt Lake. But people do shoot ducks. And a couple of years after we started looking at this, somebody had a grand idea of, well we have all these frozen birds up at Utah State that they were kind of studying the foraging habits of these birds. We have all these frozen birds, why don't you just take those and analyze them for mercury? And they did. And that year, they put a "do not consume" advisory on three species of birds at Great Salt Lake because of that, which is very unheard of. Most of the time it's like you can't eat above a certain amount of meat. And the following year they were able to do more research. They had very low numbers and I think of one of the species they only had a few birds. But they had high enough mercury levels that the state said, "Okay, do not eat these birds." And the following year they were able to do more studies and figured out, that they didn't have high enough numbers. We didn't know enough about them. And they changed this consumption advisory to certain amounts of meat or certain amounts of things.

But also, brine shrimp cysts, right? Brine shrimp cysts are sent around the world and they're used for commercial aquaculture. So most of them, at least when I was working for the brine shrimp industry, were going to feed baby prawns that would end up on your table. So what if these mother shrimp that are accumulating mercury over the year are putting that into their cysts? There's kind of this human diet link. It turns out, really cool, that brine shrimp – I mean, brine shrimp are cool on so many levels – but brine shrimp aren't passing that mercury into their cysts.

GS: Wow. I guess that's very good news for the people who like prawns.

JB: They're very cool. Anyway, biologists keep a close eye on that stuff because the brine shrimp industry—I don't know current numbers. At the time when I was working for the industry, we would say that Great Salt Lake had the ability to produce 75 to 90 percent of the world's need for brine shrimp cysts. And that's huge if it's going around the world and is contaminated. It's huge for us on an economic basis, for the state of Utah bringing in 60 to 70 million dollars a season. That's huge if we find out there's mercury in them.

GS: So mercury, spiders. What else?

JB: So mercury, spiders. We do have one of our faculty members, Betsy Kleba, who has been culturing microbes who essentially live on hydrocarbons. So petroleum projects like oil or tar or whatever. So Great Salt Lake does have petroleum reserves underneath the lake. And there are places near Spiral Jetty with some natural seeps.

GS: Right, the Rozel Field up there.

JB: Yeah, some unnatural seeps. And it turns out that there are microbes that specialize on petroleum products, which can have really cool implications for cleaning up

oil spills or remediating petroleum contaminated areas. They're also doing some really cool work on the Bonneville Salt Flats. So a lot of people don't connect Bonneville Salt Flats with Great Salt Lake. And really they are a connected system that came about from the same Lake Bonneville. And when you go out to the Bonneville Salt Flats, I mean, I always feel like I'm on the moon or I'm on Antarctica or something. Because it's just white, sparkly salt from horizon to horizon. And it always seems so sterile. It's white. There's not a lot of bugs that are living out there. It seems so sterile. But it turns out that there are very interesting microbes that live in the salt of the Bonneville Salt Flats. And just getting to know who they are and what they do is very cool. In all of this system, in Great Salt Lake or Bonneville Salt Flats, what if you find some creatures that use hydrogen for their metabolism and you can create hydrogen with these little microbes or something. And there's also, people compare them to what life might be like on other planets. So these Bonneville Salt Flats might be very similar to some salt deposits that we found on Mars. And if maybe we find life in the Salt Flats, it might be analogous to life that's on Mars.

GS: And much of Bonnie's work, right, is focused on the north arm of the Great Salt Lake, which is its own very, very interesting system up there. Have you done much work up there?

JB: It is. You know, that's one of the really cool things that we've been able to do at Great Salt Lake Institute is we love to work with people. We don't just say, "This is our study. This is our institute and we're done and over with." And a few years ago, there was a problem with the lease on Spiral Jetty. And Spiral Jetty is this famous earth art that's in the north arm of Great Salt Lake. And the north arm of Great Salt Lake is cut off

from the rest of the lake by a railroad causeway. And because there's very limited fresh water that goes into the north arm of Great Salt Lake, salt has built up so that it is saturated with salt, meaning that you can't fit anymore salt in the north arm of Great Salt Lake. It's so salty that the main organisms that live in there are microbes. And these microbes are the coolest colors of pink and orange. I mean, they're very sexy is what we call them. Sexy pink. But this whole north arm of Great Salt Lake, it's the color of pink lemonade. It's like nothing that you've ever seen before. And a man named Robert Smithson, in the late '60s, decided he wanted to make some earth art in Great Salt Lake because of the pink water and the white shorelines and the black rocks, the black basalt that characterizes that area. And the State of Utah let him do it. They let him build this large structure. It's 1,500 feet long and extends 1,000 feet from the shoreline into the water of Great Salt Lake and swirls three times. It turns out that Spiral Jetty is one of the main access points for the north arm of Great Salt Lake. So if you study north arm, you go to Spiral Jetty to collect samples, to do what you need to do for your studies. So that's where Bonnie's been going.

A few years ago, there was a problem with the lease and the state was kind of redoing their comprehensive management plan and asked DIA Art Foundation, that's a New York based art foundation, to have local partners. And we raised our hands very quickly and put in a proposal to DIA to say, "Hey, we're very interested in this and these are the reasons why: We're out there all the time. We love the artwork." I mean, Spiral Jetty is just—it's one of those things that I could go to a million times and not get sick of it because it changes every time you go out there. Anyway, we raised our hand and said, "Hey, we would love to help you steward Spiral Jetty." And the Utah Museum of Fine

Arts did the same thing. So now we have this fun partnership of the stewardship of the Spiral Jetty. But we do that because Bonnie—part of the reason we got into that was because Bonnie studies the microbes in the north arm of Great Salt Lake. So they have this unique pink coloration because they need to protect themselves from this crazy solar radiation, UV radiation. There's no shade out there. It's very extreme. It gets very hot to very cold. They have to protect themselves from the extreme hyper-saline waters. There's lots of things that—They're very special. And they're very cool to study if you're studying DNA repair. Because they do really cool things to repair their DNA after all of this UV and these extreme situations, environmental conditions that they're in.

GS: Maybe tell us a little bit about the outreach you do with schools. You say you bring lots of school kids out there. Where do you take them? What do you do with them? What do you want them to learn from Great Salt Lake?

JB: So actually I'm not set up to do tons and tons of schoolwork. But I do run some pretty intense programs through Westminster where for a week they'll come and stay on campus and be a scientist for a week at Great Salt Lake. And really my goal with all of these outreach programs, working with teachers, doing teacher workshops, or with students, and working with DIA Art Foundation and the Utah Museum of Fine Arts, and taking teachers out to the Spiral Jetty, is just to introduce people to Great Salt Lake and to show them why it's so cool, and why it's not just a stinky, buggy mess that we should avoid at all costs. And I really find that once I can walk with people and once I can kind of explain, "Oh, well, those flies are there because of this. And guess what? There's 300 million fly pupa cases per linear mile of shoreline." It makes people want to go there more, to show people how rich it is. Or being able to pull salt out of the north arm of

Great Salt Lake and explain to people why it's pink. And, you know, guess what? The foam that lines the shoreline isn't because we're dumping all of our soap into there, or whatever. You know, explaining to people what's going on and giving them a reason to love Great Salt Lake is why we do all of that.

GS: I have a couple of questions that I've asked everybody. And one of them is your favorite places on Great Salt Lake. Are there places that are special for you? Even if they're hidden away in places you don't want to—you don't have to tell us any place exactly. But if there are special places that you think really shaped your feelings for the place.

JB: So Genevieve Atwood has a really good answer for that. I asked her that also and she said – and it makes sense to me – she said, "Well, the place that I am right now." And I do feel like that. I'm at the Great Salt Lake Marina and I'm like, "Oh, I love it because of this or that." But one of the places that sticks into my head is the Little Valley Harbor. So the Little Valley Harbor was the base of operations for the railroad when they were filling in the rock-filled part of the causeway that extends across Great Salt Lake. And it's just, I mean, there's something about pink water that, I mean, it's so surreal and otherworldly. There's something about it that I just love. The Little Valley Harbor you can't access—

GS: Is it on Promontory?

JB: It's on Promontory. It's north of Promontory Point on the west side of the Promontory Mountains. And it's like this place that is going back to nature but is kind of being pickled by the saltwater.

GS: [laughs]

JB: And it's this land of contradictions. And there's a big platform that the barges—they had a conveyor belt that would move all of this rock onto this big platform that goes over the harbor. And then they would drive the big barges underneath it. I mean, this is like, oh gosh, like, 40 feet wide. I mean, it's large, large, large. And these barges would come underneath it and they'd dump the rocks onto there. And over the years, you can't get on top of it anymore. It's kind of starting to crumble and come down. And there's a series of piers that had started to—You know, it's pickling in this saltwater but the tops would start to kind of decay and all of the platforms had been either scavenged by people that were working out there or whatever. And there was a great-horned owl that lived amongst there for a while. It's just this very strange and cool place. I took Jeff Nichols there. That's one of my favorite places.

But the Antelope Island Causeway is super cool because it almost seems like a causeway to nowhere as you're driving out there sometimes. And depending on the time of year, there's tens of thousands of birds on either side of the causeway. That's pretty special to me.

But really, being in the middle of Great Salt Lake is one of the most special places to be. And whether it's windy and choppy and you think your boat's going to break apart from the heavy saltwater or it's placid and like a mirror and very calm, there's always a lot of solitude that's involved in that. And you don't find that a lot living in the Wasatch. There's people everywhere and it's a big city. But you kind of get hidden behind Antelope Island and you almost feel like you're alone.

GS: And you're not the only person that's said that. Genevieve, same thing, she rows out there. And Terry Tempest Williams has taken a canoe out into the middle of it. And I

think that's a unique experience that not many Utahans really have, is to actually get out onto the lake.

JB: You know, my son learned to swim in Great Salt Lake because it's so buoyant and it's so not scary to swim in Great Salt Lake. I wouldn't want to be there in the winter. [laughs]

GS: No. And then the last question I've been asking people is sort of – especially the people who are involved in understanding it scientifically and thinking about the future of the place – what do you see is the greatest issue or greatest issues facing the lake and its future and its relationship with the people of Utah?

JB: Well I think that people need to get to know Great Salt Lake. And I think that that will solve a lot of our problems. Great Salt Lake sits on the shores of a major metropolitan area. And there's no way to separate humans from Great Salt Lake. And I just think that people don't understand it, and people have this negative view of it, and that if we figure out how we can live with Great Salt Lake and we can create a balance between industry and recreation and environmental issues that we can learn to live with it in some kind of a really cool balance.

I know right now we're in a drought and Great Salt Lake is at very low water levels and people will say water. Water is definitely—Getting water to Great Salt Lake is a huge issue. And that definitely is an issue. But it's also a people issue and a perception issue that we need to have the gumption to say, "Hey, we need water to get to Great Salt Lake. We need to figure out how to make it work within this balance of living on the shores of Great Salt Lake and our city sitting just a few miles from it."

GS: Alright. Well thanks so much for the interview. And if we come up with other things, if you think of other things, we can always talk again at some point. But thanks.

JB: Thank you.

END OF INTERVIEW