

TRANSCRIPT

INTERVIEWEE: Charles Randklev

INTERVIEWER: David Todd

DATE: January 24, 2024

LOCATION: Dallas, Texas

SOURCE MEDIA: M4A, MP3 audio files

TRANSCRIPTION: Trint, David Todd

REEL: 4187

FILE: TexasHornshell_Randklev_Charles_DallasTX_24January2024_Reel4187.mp3

David Todd [00:00:02] Okay. Well. Good morning.

David Todd [00:00:04] I'm David Todd, and I have the privilege of being here with Charles Randklev.

David Todd [00:00:08] And with his permission, we plan on recording this interview for research and educational work on behalf of the Conservation History Association of Texas, and for a book and a website for Texas A&M University Press, and for an archive at the Briscoe Center for American History, which is at the University of Texas at Austin.

David Todd [00:00:28] And he would have all equal rights to use the recording as he sees fit as well.

David Todd [00:00:33] I wanted to make sure that's okay with you.

Charles Randklev [00:00:36] Yeah, absolutely. And good morning, and thank you for having me.

David Todd [00:00:39] Good. Well, thank you.

David Todd [00:00:40] Well, let's get started then.

David Todd [00:00:42] It is Wednesday, January 24th, 2024. It's just a little bit after 10:00 Central time in the morning.

David Todd [00:00:51] My name is David Todd. As I said, I'm representing the Conservation History Association of Texas, and I'm in Austin, and we are, fortunate to be conducting an audio interview with, Charles Randklev, remotely. He is based in the Dallas area.

David Todd [00:01:08] Dr. Randklev is a research assistant professor in the Texas A&M Natural Resources Institute, which is affiliated with Texas A&M AgriLife Research and Extension Center in Dallas.

David Todd [00:01:21] His Ph.D. Focused on the ecology and paleobiogeography of freshwater mussels in Texas. And he has been involved for a number of years in surveys and research on the Texas hornshell, a rare mussel known to the Rio Grande basin.

David Todd [00:01:37] Today, we'll talk, about Dr. Randklev's life and career to date, and especially focus on what he can tell us about the Texas hornshell and other freshwater mussels in the state.

David Todd [00:01:49] So, thanks once again for being with us.

David Todd [00:01:53] And I thought we might start by just asking you to tell us about your childhood and early years, and if you might be able to point to any people or events that might have inspired you to be interested in animals and science and conservation.

Charles Randklev [00:02:10] Well, thank you again for having me.

Charles Randklev [00:02:12] Yeah. You know, so I'm not originally from Texas. My family hails from Idaho, southeastern Idaho.

Charles Randklev [00:02:19] And, you know, the earliest memories that I have, in my childhood are really kind of spending time outdoors, hunting and fishing with my family, specifically my grandfather. He was a product of the Depression, had an eighth-grade education. And, you know, he just spent a lot of time outside hunting and trapping. And his gift to me when I was younger, was to share that.

Charles Randklev [00:02:45] And so, I spent a lot, I remember a lot of time of just kind of fishing with him on the Snake River for trout. And then, as I got older, my dad moved around a lot for his job. But, you know, wherever we lived, I always remember having access to wild places and doing things outdoors. And I think that really kind of set the stage for a professional career in wildlife.

David Todd [00:03:14] Do you remember any particular outings with your grandfather to go fishing?

Charles Randklev [00:03:19] Yeah, I mean, a lot of those. So, we owned a farm outside of a place called Rexburg, Idaho. And the Snake River ran through the farm that we had, and, you know, it was just kind of an amazing experience to kind of grow up early in that environment where, you know, you could hop in a pickup truck, drive to the Snake River, and then do either fly fishing or regular bait fishing and then look out on the horizon and see the Teton Mountains. It was just really a kind of a neat experience.

David Todd [00:03:49] I think you mentioned that you also went hunting with some of your family members. Do you recall any of those, particularly?

Charles Randklev [00:03:56] Yeah, I think. So, a lot of the hunting that we used to do is duck hunting, and I still, well, I did that until I had kids. And I'll start that back up as my son and daughters get old enough to hunt. And, we just did a lot of duck hunting.

Charles Randklev [00:04:08] And so, and then I remember also going on hunts with, again, my grandfather and father when they'd go out hunting for elk or mule deer.

David Todd [00:04:18] Very fortunate to be outdoors like that in, really, some of the most beautiful country, imaginable.

David Todd [00:04:28] So was there any sort of message that you received about sort of conservation, or was it more just exposure to the outdoors and to nature?

Charles Randklev [00:04:37] I think it was just an exposure to the outdoors. You know, when I think back and, you know, things that I talk about with my kids, I think it's just having access

to wild places and seeing those wild places unmodified, you know, like the Tetons National Park. I spent a lot of time in Jackson Hole, and visiting Yellowstone. And, you know, those are just, those are wild places. And, and I think I was fortunate to have been able to have access to those.

David Todd [00:05:05] I understand. So, it sounds like your family gave you a great introduction to the outdoors. When you went to school, either in grade school or later in college and grad school, were there teachers or classmates that were also influential for your interest in the outdoors and nature and science?

Charles Randklev [00:05:26] Yeah. So, I think back, you know, where I think I got my taste for science, and specifically biology, was probably my freshman biology class. And, you know, I can't remember this teacher's name, but I can remember distinctly, dyeing an onion peel to look at cells under a microscope. And, you know, I'm 46 years old, and I still remember that experience vividly to this day.

Charles Randklev [00:05:52] And I think, I think what that did for me was just really kind of opened my eyes to how big the world was. I mean, I had, like I said, I'd been exposed to the outdoors at an early age, but I think to be able to have access to, to see kind of some of the complexity beyond just the natural world that we see with our own eyes. I think whether I realized it or not, I certainly looking back, I think that had a had a pretty profound impact on me.

David Todd [00:06:20] Were there any classmates that shared this interest?

Charles Randklev [00:06:24] I don't remember. I just remember, you know, again, it was a pretty amazing experience. And I think that, again, I carry that with me today. I mean, when my kids, were old enough. I mean, it's interesting, right? I mean, I bought them all microscopes and tried to share that experience with them: that the world is much bigger than we think.

David Todd [00:06:45] It's interesting that you've sort of seen the whole gamut from, you know, the microscopic things on an onion peel to the Grand Tetons, which are truly grand.

David Todd [00:06:58] So, for some people, it's influential to read books, magazines, see TV shows, watch movies. Was that the case for you in terms of kind of an origin for your interest in the outdoors and nature and science?

Charles Randklev [00:07:16] I think for me, I mean, you know, so I grew up in a generation that predates cell phone and the internet. And so, you know, when I grew up, we were outside, and we were outside all the time. And, like I said, I was just fortunate enough that wherever my parents ended up moving after we left Idaho, you know, there were always, you know, we were always living in areas that were kind of somewhat undeveloped. And so, there was always access to being out in the woods, hanging out and swimming in creeks and ponds - I mean, probably stuff that people wouldn't allow their kids to do today. You know, we just, we had access to it. And, I think as long as we made it home by the time that the streetlights came on, things were okay.

Charles Randklev [00:07:57] So, I just, I was very blessed I think when I look back at kind of the experience that I had. Because the students that I have now: you know, it's amazing, I'm in a wildlife department. I work for a wildlife institute. And it always strikes me the number of kids who show up that want to, that have a passion for this field, but haven't spent a lot of

time out outdoors, right, in their youth. And so, it's always interesting to me how they get connected to wildlife when they've spent so much of their time in kind of a closed urban setting.

David Todd [00:08:28] Yeah, it does seem like there's a real sort of line, a watershed between those who grew up before the internet and cell phones and those who came along afterwards.

David Todd [00:08:45] Well, let's focus in on the animal of the day, Texas hornshell. Can you take us back to when you might have first seen one of these, and how you ran across it, and what your impression was?

Charles Randklev [00:09:01] You know, so, I think all wildlife biologists have lists of species that they hope to see at some point during their professional career. And for me, Texas hornshell was one of those species. And I think part of it is, you know, it really occurs in a really neat part of the state. It, you know, it basically lives in rivers and streams out in West Texas, northern Mexico and southeastern New Mexico. And, you know, that's beautiful country for folks that haven't seen it.

Charles Randklev [00:09:39] And then just the idea that you have these river systems flowing through an arid environment, I think has always been kind of an interesting kind of dichotomy.

Charles Randklev [00:09:47] And so, I was chomping at the bit to get out there and see that species.

Charles Randklev [00:09:52] And so the opportunity arose in 2013, 2014: we had a project that was funded to help try to figure out its distribution within the main stem of the Rio Grande and tributaries that feed into it. And the reason for that research was really to help inform, you know, a potential listing for that species, because we had some sense of where it occurred. But, because that area is very remote, and there are parts of that river that are extremely difficult to access, and of course, there are safety concerns if you're working in northern Mexico, and so there was just this kind of question as to whether or not, you know, was it, in fact, rare.

Charles Randklev [00:10:34] And so, we spent the better part of 2 or 3 years out there, you know, boating most of the entire length of the main stem, from the Rio Grande, all the way down to, Laredo. And that's where I kind of had my first kind of experience horn shell and it was neat. It was better than I expected.

Charles Randklev [00:10:55] And, you know, and the gentleman that helped us with it, was a man by the name of Tom Miller, who was a long-time resident of Laredo. And, you know, I remember talking with him, and he had found some places where he'd seen shell. And so we started near Laredo, Texas, with his help. And he was a companion on most of our surveys during that time period.

David Todd [00:11:18] And so what would be the typical environment for finding one of these, these rare, elusive shells, mollusks? Yeah.

Charles Randklev [00:11:27] So, the live animals, you know, are ... so freshwater mussels or bivalves, they live on the bottom of streams and rivers. They make their living filter-feeding. So, they feed on algae and bacteria, and they often occur in areas on the stream bottom that

are stable during high flow. So, when you have like floods in rivers, because mussel really can't move around, they tend to occur in spots that aren't mobilized during those high-discharge events.

Charles Randklev [00:11:53] And during like the summer when rivers do get low, they also occur in areas that don't see water. And so, for Texas hornshell, because that river historically, before it was dammed up and had some other issues with it, you know, it used to flood a lot. And part of that was snowmelt that was driven from its headwaters up in Colorado.

Charles Randklev [00:12:16] And so, in any case, there is still flooding that happens. It happens in any river. And so, where you find hornshell are typically in these kind of like crevices between large rocks or travertine shells, and it's like areas where you get fine sediment that is deposited. and the mussels live in those deposits, but that habitat doesn't really mobilize during high-flow events. And so, that's where, that's where we would find it.

Charles Randklev [00:12:39] And so, in some sense, when you look at a river or anywhere you could find like these, see these big like rock outcroppings, they're almost like little islands in the river. And typically, that's where you would you would find Texas hornshell.

David Todd [00:12:50] That's interesting. It sounds like there's sort of a sweet spot. It needs to be an area that doesn't have a lot of scour, but it also has to be an area that doesn't dewater.

Charles Randklev [00:12:58] Yeah.

David Todd [00:13:00] I see.

David Todd [00:13:03] So I think you touched on this just a moment ago that the Texas hornshell, like other mollusks, feeds on algae and bacteria, filter-feeds. Can you talk a little bit more about its life history and the ecological niche that it fills?

Charles Randklev [00:13:21] Sure. And so, you know, another really kind of interesting part about Texas hornshell, and it's really any freshwater unionid mussel, is that they're, they're, obligate parasites on, ectoparasites on fish. And so, that's really cool because what that means is that mussels need a host fish to successfully turn into a juvenile and then eventually an adult.

Charles Randklev [00:13:46] But, because mussels really don't move around very much, I mean, you know, they can move somewhat on the river bottom, but if they were wanting to move out of harm's way, or move great distances upstream, I mean, they need a mechanism to do that.

Charles Randklev [00:14:00] And they do that through their host fish kind of relationship. So, basically, they hitch a ride on a host fish and where that host fish, you know, moves to, eventually that's kind of where mussels could be found. And so, that's really unique.

Charles Randklev [00:14:14] It also makes conservation a little bit more of a challenge for mussels, because not only do you need to worry about, and focus on, you know, habitat and threats to the mussel itself, but you would also need to consider its host fish.

Charles Randklev [00:14:29] And for hornshell, we do know its, well, we have an idea of what its host fish could be. But that hasn't been broadly tested across its range. And we know

that, you know, fish assemblages change or can vary from stream system to stream system. And so, while we have some idea, I think that's an area where we can maybe look a little bit more.

Charles Randklev [00:14:50] And then in terms of its ecological niche, you know, mussels are kind of considered to be ecosystem engineers. So, because they filter-feed, they play a really important role in linking energy transfer from the water column to the substrate bottom. And then what that does is it provides food for other animals.

Charles Randklev [00:15:08] So, snails, aquatic insects, and then, in turn, you know, those organisms then are food sources for things like fish and so forth.

Charles Randklev [00:15:16] And so, mussels really do play a critical role in how ecosystems kind of function. And they are really important.

Charles Randklev [00:15:24] And so, and that's why, you know, when they start to decline in river systems, you start to see kind of cascading effects.

David Todd [00:15:33] So, I think you used a term that is really intriguing, but I don't entirely follow. You said that they're involved in energy transfer. What do you mean by that?

Charles Randklev [00:15:49] Yeah. So, what I mean by that is, so when mussels are filter-feeding, they're taking, you know, essentially energy or nutrients right out of the water column through food. And that could be either bacteria or algae. And, then they also pull, like, sediment stuff. So, they help kind of polish the water.

Charles Randklev [00:16:07] And so, that food, when they take that out of the water column, when they consume that, and then release basically byproducts as feces or pseudofeces, that stuff in itself then lays down on the river bottom, and that is energy or food for other organisms. So, in some sense they're linking the water column with the substrate.

David Todd [00:16:26] I see, I see you're talking more about sort of transferring nutrition...

Charles Randklev [00:16:32] Yep.

David Todd [00:16:32] From the water column to, I guess, the sediment, mostly. Is that right?

David Todd [00:16:36] Correct. Not so much the energy, maybe the hydrodynamic energy.

Charles Randklev [00:16:43] No.

David Todd [00:16:43] Gotcha.

David Todd [00:16:45] And it also sounds like, as sort of ecological engineers, they are, would you call it a keystone species?

Charles Randklev [00:16:56] Yeah, absolutely. And when I say, you know, ecosystem engineers, I mean they also modify the physical habitat.

Charles Randklev [00:17:01] So, you know, if you were to get into some of the historical literature on mussels (so this is stuff that would date back to the mid-1800s when, you know,

folks were pioneering the West and exploring places like Texas and so forth), you know, it wasn't uncommon for people to come into river systems and see, you know, large, assemblages of mussels, like hundreds of thousands of mussels, basically, you know, in a certain area within the river.

Charles Randklev [00:17:28] And, you know, their physical presence would actually stabilize the substrate. The exterior of the mussel is actually habitat for other animals - again, aquatic insects and so forth. And so, you know, when they're in high numbers, you know, that they do create habitat, and they modify the habitat that they're in.

David Todd [00:17:49] I think that you mentioned that the Texas hornshell is known to New Mexico, northern Mexico, Texas, I guess basically the Rio Grande drainage basin. Maybe you can talk a little bit about the population and range trends, within that kind of universe, for the Texas hornshell.

Charles Randklev [00:18:15] So, I guess first is, you know, so Texas hornshell was listed as endangered by U.S. Fish and Wildlife Service, back in 2018.

Charles Randklev [00:18:25] You know, historically, we know that it occurred throughout much of the Rio Grande basin. And so, and then we know now that it's really been restricted to isolated populations in the main stem. And so, when we say isolated populations, you know, those would be a population that's located in the Big Bend or lower canyons of the Rio Grande. So that's the section of the river above Lake Amistad.

Charles Randklev [00:18:51] You have a population that occurs downstream of Amistad, say, from like, Del Rio to Laredo. We know that there was a population that was discovered maybe within the last 3 or 4 years in the Rio San Diego, which is a tributary on the Mexican side, I think, in the state of Coahuila. And then, you've got a population that occurs in the Black River of New Mexico. The Black River is a tributary of the Pecos. And then, we have what I would consider to be a functionally extirpated population in the Pecos River itself. And so, and then you also have the Devil's River, which is a tributary that flows into the Rio Grande, but now really flows into Lake Amistad, which impounds part of the Rio Grande.

Charles Randklev [00:19:35] And that's, that's kind of it, in terms of where we know that it that it occurs today relative to where it occurred in the past, which again, was probably, throughout much of that basin.

David Todd [00:19:46] So, there's live populations that are in those pretty isolated areas. But then there were places where you might find dead shell.

Charles Randklev [00:19:58] Correct.

David Todd [00:19:59] I see. Where they can't sustain.

David Todd [00:20:04] Are there characteristics for those places where they are still found, and then those areas where they are now extirpated?

Charles Randklev [00:20:11] Yeah.

Charles Randklev [00:20:12] So, you know, it's interesting, when you'd asked the question about habitat because it's really those kind of requirements, called kind of the Goldilocks zone

for mussels, which is areas that remain stable during high flows but remain wetted and thermally buffered during low flows, but then also have availability of their host fish when they're reproductively active. Those are the areas where we find hornshell today.

Charles Randklev [00:20:36] So, in areas where they've now been extrapolated, or the population is in decline, what we see are changes to water quantity and water quality. So, maybe flows are now more reduced than they were in the past. Maybe they're more flashy, some more flood-prone. So, what we've done, so what has happened, is really we see a kind of a disruption of their physical habitat.

David Todd [00:21:00] I see. Okay.

David Todd [00:21:03] So, I think you touched on this before, that a lot of the areas where they persist, are remote, difficult to access. You know, they're on large private ranches or they're in Mexico or possibly in areas that are really. I guess could be described as controlled by cartels. Was it difficult to gain a complete census and get us sort of a real grasp on the trends of these hornshell.

Charles Randklev [00:21:35] Well, I mean, Texas in general is huge, right? It's massive. So, I would say that really sampling any river system in Texas can be a challenge, just given the enormity of how big the state is and how big some of these river systems are.

Charles Randklev [00:21:48] In the case of the Rio Grande, that's amplified a little bit because, again, it forms the border between Texas and Mexico. And it's just in a very rugged place. I'm sure that some of the ranches that we had access to, you know, like the landscape probably hasn't changed in the last 500 years. Right? It's just, it's rugged and remote.

Charles Randklev [00:22:07] And so, we've been really fortunate, we've had good relationships with property owners along good parts of the Rio Grande. And so, we were able to access private property and get into sections of the river that otherwise probably wouldn't have been accessible.

Charles Randklev [00:22:24] We've also had really good partners on the Mexico side. So, that would be partners with, you know, some of the universities and then also NGOs like the World Wildlife Fund. Having said all that, I mean, there are still some areas that probably have not been sampled, but what I would say is there's been enough work that has been done since, you know, 2011, '12 all the way up to now, that I think we have a really good idea of where it occurs.

Charles Randklev [00:22:51] You know, are there going to be surprises in the future? Maybe as access to northern Mexico becomes better if it ever does. Sure, we could maybe see, or we might find another population or subpopulation.

Charles Randklev [00:23:03] But I think, on the U.S. Side in particular, I don't see very many changes, to be honest with you.

Charles Randklev [00:23:09] And so, I think we do have a good sense of its distribution and abundance.

David Todd [00:23:13] I see. You know, it's interesting that you had, and I think really valuable that you had, good cooperative relationships with some of these private landowners.

Because I imagine when you're trying to census an endangered species or one that was rare before it was listed, there are some folks who would, you know, feel distrustful, resistant to, like, you know, allowing access. Did you run into any of that?

Charles Randklev [00:23:37] Not really. And I think part of it is, you know, I think part of it is the fact that hornshell occurs in systems that are primarily, they're sourced by freshwater springs. And I, you know, and my sense is, you know, for landowners that have spring-fed systems out in West Texas, you know, having a species like Texas hornshell is actually kind of good for them, right? Because I think they've got, you know, they've got some skin in the game as it relates to having conversations about water availability and stuff like that, because it's not just for basically economic purposes, right? It also serves to benefit, you know, the wildlife and some of the ecology that happens in those systems.

Charles Randklev [00:24:19] So, you know, we had a really good experience with landowners and I think part of it, again, is you've just got an animal that has to be in systems that are sourced by springs, and springs are really the livelihood of anybody that lives out in West Texas that's doing ranching or stuff like that, right? They need they need access to water.

David Todd [00:24:37] I got you. Okay.

David Todd [00:24:41] Well, let's talk a little bit about some of these impacts. I think you've touched on them: that it sounds like there's some water quantity and quality problems that, you know, are a challenge for these Texas hornshell. Could you help us learn a little bit more about some of these problems that the mollusk is facing?

Charles Randklev [00:25:00] Yeah. So, when we say water quantity, really what we're talking about is changes in flow. Either flow becomes too little and then, you know, the ability for the river to then buffer against, you know, extreme temperatures and what we're really talking about are summer temperatures. And that's natural. I mean, in any river system, they get low during the summertime because there's not a lot of rain or surface water contributions.

Charles Randklev [00:25:30] And so, when that becomes a problem though is when flows become reduced, and that thermal buffering is lost. And in our lab, we've done a bunch of thermal tolerance studies to try to understand, like how warm is too warm.

Charles Randklev [00:25:44] And so, when we talk about water quantity, at least from my perspective, when looking at mussels, what we're really talking about is a water availability issue. And then, you know, if you're working downstream of areas where you've got, river impoundments, then that issue with water quantity begins to kind of transition to how that water is distributed. So, like during, during water releases, you know, does that release, does it mimic basically what maybe a natural flood might look like in that system?

Charles Randklev [00:26:18] And then with water quality, what we're really talking about are things like environmental contaminants, nutrient pollution, that really again, become exacerbated when we start to change, you know, the amount of water that's available in the system. I mean, that, you know, that old saying, "dilution is the solution for pollution". I think there is some, a lot of truth to that, you know, when we have reduced streamflow, then those water quality issues become amplified.

David Todd [00:26:51] Yeah, I'd like to learn a little bit more about these sort of thermal issues. Is the thermal problem, is it for the hornshell itself, or is it for the host fish that might help it, you know, maintain its range and spread it and move it.

Charles Randklev [00:27:12] It could be both. And so, you know, my lab, over the last, five, ten years has really focused on, and it's not just for Texas hornshell, but it's also for other mussel species trying to get a better sense of, you know, what are the thermal requirements for mussels? Because, the area that I like to kind of, work in is environmental flows.

Charles Randklev [00:27:38] And really, that's just a fancy way of saying, trying to figure out a happy balance between wildlife needs and human needs. And so, as part of that, as part of that research, you know, stream temperatures are kind of a natural segue into that because, we do have, water temperature information throughout the state that's getting better. And then you can tie that to river discharge which gets that volume within a river. And so, then you can start to have some real evidence-based discussions about how much water do we need in a system to support, you know, ecological and biological activity.

Charles Randklev [00:28:15] And so, for Texas hornshell, a lot of that research initially was trying to understand what are the thermal stresses, like what, you know, what is thermal stress to the adults, to the juveniles and to their larvae? And then, and then we're starting to kind of expand that kind of conversation to its host fish.

Charles Randklev [00:28:33] But like I alluded to earlier, I mean, we have a sense of a couple of its host fish, but I think we don't know them all. Or at least we don't have a good sample of what they could be. And I think, you know, my sense is, you know, whether it's us or some other lab down the road, that will be the next chapter in thermal tolerance testing, will be looking at its host fish, and trying to understand how they cope with warming streams.

David Todd [00:28:59] Well, and, I guess it's some of the variations in that sort of thermal environment have to do with water diversions or impoundments. But, are you seeing some impact from just climate change: that we're having, you know, longer stretches of hotter weather? Is that an issue that you see or actually, you know, some of these, freezes that we've had - the extremes on either end?

Charles Randklev [00:29:29] So, you've got like natural changes that are happening. And so, we have a project in the Devils River where we're trying to figure out, you know ... that's probably one of the most, if not the most, pristine river systems in Texas. You know, there's very little land use development, the river's, for the most part, unimpounded. So, it's free-flowing, very much spring-fed.

Charles Randklev [00:29:51] And so, you know, we've been looking at that is kind of a reference site to compare other locations to begin kind of trying to answer that question. And so, you know, in places like the Black River in New Mexico, which is really ... the population is confined to about 14 river miles. And so, it's bound between two low-head dams. That area has seen a lot of diversion and groundwater pumping, which affects basically flows within the river. And that's where we see a lot of thermal stress.

Charles Randklev [00:30:21] And so, to answer your question, where we start to see thermal stress is where we start to have overuse of basically that water resource. And so, then that's where, you know, hornshell is a really neat research tool because it is sensitive to changes in water quantity and quality, that we can use it to have some really informed discussions that

are not only going to benefit Texas hornshell, but they're going to benefit the other aquatic species that occur in that system, right, whether it's the host fish that it depends on or the other organisms that it depends on for food. When you were asking about the energy transfer and so forth, they're just, again, they're a really neat tool to have those kinds of discussions.

Charles Randklev [00:31:01] Because at the end of the day, too, in my lab at least, I'm, you know, we're really focused on preserving, you know, riverine systems for future generations. I mean, you know, going back to that question about what did I, you know, what experiences did I have in my life that led me to this position? I think it's making sure that those same experiences are available to future Texans and future people that want to experience them.

David Todd [00:31:25] So it sounds like the thermal stresses for these mollusks are, they're more key to kind of local issues of whether aquifers are being pumped or surface water is being diverted rather than, you know, large-scale climate shifts. is that fair?

Charles Randklev [00:31:46] Yeah. And I think part of that, well, the climate change is part of that too. I mean, when you look at, when you look at modeling for Texas, I mean, we're ground zero for, you know, significant changes in air temperatures and, you know, air temperatures and water temperatures are highly correlated. Right?

Charles Randklev [00:32:03] And so, you know, the expectation, you know, when you start to look at forecasting for this area is that there is going to be a trend of increasing water temperatures. And the question really for us is, you know, how does that interact with these localized changes that are happening as well? Right?

Charles Randklev [00:32:21] And in my mind, I think what you see are localized changes that become amplified, right, with those increasing air temps over time.

David Todd [00:32:30] I see. So, it can sort of leverage and amplify things that are going on locally because of, you know, water diversions and so on.

David Todd [00:32:42] Okay. Well, that helps a lot. Thank you.

David Todd [00:32:45] I think that I've noticed that you've researched and written about salinity issues for Texas hornshell. And I was hoping that you could share with us what you've discovered and what that might mean for water management.

Charles Randklev [00:33:00] Yeah. So, that's a really neat study. So, and that actually started again around the same time that we initiated survey work in the Rio Grande. At the time, a colleague of mine, Michael Hart, and I were sampling the lower Pecos with some students, and, Michael happened to get some river water in his mouth. And I still remember to this day, you know, he kind of looked at me, and said, "Man, this river is salty." And, I was like, "Well, that's interesting."

Charles Randklev [00:33:28] And so, because mussels, in general, have a very low salinity tolerance, I mean, they are freshwater organism. And so, at that point, you know, it kind of dawned on us that, you know, maybe the reason that Texas hornshell isn't doing well in some areas is because of issues with salinization.

Charles Randklev [00:33:46] And the Pecos is really interesting. There was a guy by the name of Artie Metcalf, who used to be a professor over at the University of Texas in El Paso,

and he had done a lot of work with Texas hornshell like in the late 1960s. And, Dr. Metcalf had reported near Pandale, which is this small little town, like, if you blink, you'll miss it when you're driving. He had reported a massive population of Texas hornshell on that river in the late 1960s.

Charles Randklev [00:34:14] And, we'd seen some of those collections in museums, not just in Texas, but outside of Texas, in some of the big national museums.

Charles Randklev [00:34:23] And so, we knew that it was there, or had been there.

Charles Randklev [00:34:27] And, and so the work that we had in the Pecos, was to try to find that population.

Charles Randklev [00:34:32] And we'd spent, oh man, about a week, paddling that river looking for hornshell. And we found tons of tons of shell, old shell, what we call like "subfossils", so stuff that, like shell that was reminiscent of a population that may have been there 30 or 40 years ago.

Charles Randklev [00:34:50] And then we did find a couple of live individuals. And so, we were trying to find out at that point, you know, so it was like the wheels started turning. We've got a salty river. Could this be one of the smoking guns in terms of a culprit for its decline?

Charles Randklev [00:35:03] And so then that kind of really was the genesis for, you know, a bunch of research looking at salinity tolerance, not just for adults, but also juveniles and then the larvae.

Charles Randklev [00:35:15] And what we've found since is that salinity is a problem in the Pecos. The system is actually kind of an enigma because the Pecos is historically, is naturally salty kind of just because of some of the underlying geology. But it's been amplified over time. And again, this gets at those water quantity issues, where we have reduced instream flows. We've got greater reliance on spring flows which have tapered over time. And so, we're not getting those freshwater inputs that you would, you probably would have had 30 or 40 years ago.

Charles Randklev [00:35:48] And so, even in areas where we do find live individuals from time to time, the salinity is at concentrations that likely negatively affect reproduction, which is probably why we only found adults when we were sampling. And then in the upper part of the watershed, so this would be, say, above Independence Creek to the border with New Mexico, salinity concentrations can reach up to 30 parts per thousand. So, that's like seawater is what we're talking about. And so, clearly that section of the river is no longer habitable for Texas hornshell.

Charles Randklev [00:36:25] And so, as a broader effort, we then kind of did this risk assessment where we were looking not just at the Pecos, but then other parts of the Rio Grande. And, you know, what we found is, you know, in areas where there's what I would consider to be stronghold populations, very robust, highly abundant populations, salinity is not an issue.

Charles Randklev [00:36:44] In areas where we start to see abundance is maybe declining a little bit, or abundances aren't as high as we would expect, you know, either we have issues

with salinity exceeding tolerances for hornshell, or we have, when you look at the data, over ten or 20 or 30 years, what we see is salinity starting to increase over time.

Charles Randklev [00:37:04] And so I think, you know, again, that's part of that larger discussion about, you know, what do changes in water quantity and quality due to hornshell.

David Todd [00:37:14] That's really interesting.

David Todd [00:37:16] It's fascinating how it can be, this little shell, can be an indicator for all sorts of changes in the watershed.

David Todd [00:37:24] So, one thing I'm curious about, it sounds like some of the salinity problems are, I guess, caused by dewatering, but is part of it, return flows from some of these agricultural operations where the salt is leaching out of the soil, and it's coming in as irrigation return flows come back to the to the Pecos?

Charles Randklev [00:37:46] Yeah, absolutely. Yeah.

Charles Randklev [00:37:47] And then, of course, you know, you've got issues too, where we've got groundwater pumping that's reduced the spring inflows. So, like, you know, so you have, you know, a naturally salty river that's starting to lose freshwater basically offsets.

David Todd [00:38:02] I see. Okay.

David Todd [00:38:05] You know, one thing that I, been intrigued by with your research is that you're studying this really rare mollusk, and you're trying to figure out what its tolerances are, whether it's thermally or in terms of salinity. And you don't want to hurt your test creature. How do you go about that, to figure out what its tolerances are. You can't do an LD-50 or something, you know, where you'd have to sacrifice some of these very rare creatures. How do you cope with that problem?

Charles Randklev [00:38:40] So, well, there's a couple of ways. Before hornshell was listed, we were, we did some testing on adults. And so, that required sacrificing live individuals to do the study.

Charles Randklev [00:38:55] Since it's been listed, you know, as with any endangered species, there is a permitting process to allow you to go and work with the animal. And even in those cases, you know, the Service and Parks and Wildlife have been really good partners in terms of identifying studies that are needed to inform actionable research activities that can lead to improved management outcomes. And in those cases, you know, from time to time, you know, we are permitted to go and use live individuals for our experiments.

Charles Randklev [00:39:27] The other nice thing, though, is because mussels require a host fish for reproduction, you can use that as a way to also produce individuals for experimentation. And so, for our work with salinity, our more recent work with salinity and temperature, we were able to take the broodstock from mussels and then produce juveniles in the lab, and then use those juveniles from the lab to then run our experiments. And the nice thing about that is then you don't put any pressure on wild populations, which, at the end of the day, for an endangered species, we certainly, we want to minimize.

David Todd [00:40:07] That's fascinating. So, you've been able to actually, in a sense, breed in captivity some of these Texas hornshell.

Charles Randklev [00:40:16] Yep.

David Todd [00:40:16] Is that a very involved process? So, I guess you have to have the host fish and you have to have the larva, any other sort of conditions that you have to recreate?

Charles Randklev [00:40:26] Yeah. I mean, so you have to understand when it's reproducing. And so, there's parts of the life history for hornshell that still kind of are unknown. And, so you have to understand when the female is brooding larvae for you to go to harvest that broodstock and then, of course, you know, understanding aquaculture and how to aquaculture, you know, animals like Texas hornshell is really important.

Charles Randklev [00:40:54] And so, we're, you know, that in itself is difficult. There's a whole different level of complexity if the goal is to try to grow those out to a size that you could put a tag on and maybe do some sort of like augmentation or reintroduction. And thankfully we don't do that in my lab.

Charles Randklev [00:41:10] So, we focus primarily on early-stage juveniles because that in itself is tricky enough to get to work right.

David Todd [00:41:17] I see. Okay.

David Todd [00:41:20] So, I think you've, you've helped us understand that some of these thermal issues and the salinity issues are tied back to flow problems. And, I think you mentioned earlier that environmental flow analysis is something that really is kind of at the heart of a lot of your study. Is there anything you could tell us more about, you know, how the Texas hornshell is kind of guiding you through this kind of research about flows?

Charles Randklev [00:41:49] Yeah. Right. Yeah. So, I think as I talked about a little bit earlier, I think once you're able to understand temperature or salinity tolerances, or really just water quality tolerances in general, a lot of that is tied to discharge. And, you know, at the end of the day, environmental flows, you know, are looking at preserving available habitat and volume within a river and flow. Right?

Charles Randklev [00:42:12] And what that does is it allows you to have those conversations because you've been able to link a biological effect. Right? In this case, if we're looking at survivorship with, you know, different stages of flow, right, in this case it would be when temperature becomes problematic. And then, you're able to guide those discussions.

Charles Randklev [00:42:31] And, you know for mussels, it's been interesting, not just for Texas hornshell, but in general across the state, they're starting to play a real central role in how the state evaluates environmental flows, not just in the Rio Grande, but other rivers in Texas. I mean, they're in some sense they are kind of the perfect model organism for having that conversation, again, because they don't move, highly sensitive to changes in habitat, and, you know, and you can work with them in the lab and get, you know, some pretty clear-cut data.

Charles Randklev [00:43:06] And I think, you know, that's, that's been kind of neat to see that, and then also see basically the agencies begin to adopt basically mussels as part of their portfolio in better managing rivers.

David Todd [00:43:19] That's great. So, it's sort of an indicator species for whether the lows that might be specified or regulated are really going to support the full suite of species in a river?

Charles Randklev [00:43:35] Yep.

David Todd [00:43:37] So, I think you mentioned that you've been successful in breeding some of these mussels. And that brings to mind this question about relocation and whether, you know, moving an existing population or maybe breeding Texas hornshell might be one route to conserve these creatures. Is that something that you have opinions about or have been involved in?

Charles Randklev [00:44:04] Yeah. So, as part of, when you look at states outside of Texas, propagating mussels for the purpose of either reintroduction or augmenting existing populations, is part of kind of, it's part of the conservation portfolio.

Charles Randklev [00:44:23] However, with any sort of captive breeding program, you know, considering things like genetics and habitat are really important. And so, folks in New Mexico have initiated preliminary studies where they've tried to basically reintroduce Texas hornshell into the Delaware River, which is a tributary of the Pecos. And it's been met with some success.

Charles Randklev [00:44:46] I mean, however, in general, I think, you know, translocation, relocation, augmentation programs, regardless of whether we're talking about mussels or not, just in general for wildlife, you know, they're not really successful when you haven't addressed the underlying threats that are responsible for the animal's decline.

Charles Randklev [00:45:05] And so, I think in Texas with mussels, what you've seen is, research focused on developing capacity to propagate mussels at both federal and state hatcheries. And then you've seen a really kind of thoughtful approach to kind of trying to understand like what a genetic management plan would be if you were deciding to basically reintroduce or translocate mussels.

Charles Randklev [00:45:31] But you haven't seen implementation yet, because I think part of, again, for it to be successful, there needs to be some discussions about underlying threats to habitat and addressing those before, you know, you start to invest a lot of time and resources into putting them back into rivers.

David Todd [00:45:47] I see, so there are these underlying issues of water quantity and quality that are going to be a problem whether it's with the existing populations, or you're trying to augment them and translocate them?

Charles Randklev [00:46:00] Yeah. And we've seen that.

Charles Randklev [00:46:01] I mean, so in places like the southeastern United States, which is really a mussel biodiversity hotspot globally, you know, propagation of mussels accelerated faster than, like, you know, like studies on habitat and life history and ecological

preferences. And so, early on, folks would put mussels out in rivers and then they would do this year after year, but they wouldn't see any success. Right? By success, I mean establishment of a population. Right?

Charles Randklev [00:46:33] And then, you know, as all things with adaptive management, you know, the light bulb went off and folks figured out that, you know, even if we were to augment these things with, you know, augment a reach with a large number of individuals, until the underlying threats are addressed, in some sense, this becomes kind of a, you know, an effort that's not going to be successful.

David Todd [00:46:54] Gotcha.

David Todd [00:46:55] Well, so, you mentioned ... well, I guess we started our discussion talking about Texas hornshell, and then just a moment ago, you mentioned that there are problems with mussels in the southeastern United States. And so, it sounds like there are challenges facing a variety of species in a variety of areas among these freshwater mussels. And I was curious if there's some kind of overarching problem that is affecting all of them, or if it's unique and specific to each of these places and species.

Charles Randklev [00:47:33] So, I think the fundamental drivers, at the end of the day, relate to water quantity and quality. And I think that's the thread that would run through, any of the issues that you might see for a mussel, say, from Central Texas or, you know, a mussel from southeastern United States.

Charles Randklev [00:47:52] And so, you know how those water quantity and quality issues manifest themselves will probably be unique to some of those river systems. Right? But, you know, if we were to say there are two broad buckets that in general affect basically mussels, those are the two buckets. And then, specifically within those two categories, what is the driver or the factors that are responsible for, say, changing the status of a species, then that tends to be a localized.

Charles Randklev [00:48:24] Okay.

David Todd [00:48:25] Well, since these are really big problems, do you find that, listing the Texas hornshell, or these other mussels that may be in trouble, helps as a tool to try to address those bigger problems that are about quantity and quality, or does it sort of antagonize and polarize and make the problem more difficult?

Charles Randklev [00:48:53] So, I think, when we talk about conservation, I think, you know, being able to prioritize species, in terms of, you know, where do you allocate resources because it's a resource discussion. Right? And resources are limited and they're finite. Then listing I think is very helpful.

Charles Randklev [00:49:12] I think also the listing process helps with codifying, you know, what exactly the threats are. Because, at the end of the day, whether a species is state threatened or federally threatened, I mean, the goal should be, you know, for some or, as many as you can, right, because there are some species that it will be unlikely that you could ever get them off the list. But really, the goal should be then to go in and mitigate or rehabilitate basically whatever it is in the habitat that is driving those impacts, because it's probably not just affecting that one species, it's probably affecting, you know, multiple species.

Charles Randklev [00:49:46] And so I think the listing process is helpful. I think it's effective so long as, you know, there's good stakeholder engagement. And I think when we bring partners along, because I think at the end of the day, you know, my time in Texas has been really unique. And, like I said before, I think I've been blessed, because we've just had really good interactions with landowners, really good interactions with state agencies and NGOs.

Charles Randklev [00:50:11] And, you know, I think when folks work together, they may have different opinions on stuff, but I think when there's good stakeholder engagement, typically the outcome is beneficial because it not only affects the species, but I think if it's done right, I think it also helps basically those folks that are living in wild places that own those private lands.

David Todd [00:50:33] So, can you help me understand what it is that sort of fascinates you or, you know, gives you an attitude of about valuing these, mussels, in particular, Texas hornshell? Is it about sort of curiosity and scientific interest, or is there some sort of a, you know, equitable, ethical issue for you, or is it, you know, a good study model? What do you think is the thing that has drawn you to them?

Charles Randklev [00:51:01] I think two things. I think one is, it goes back to like my experience as a kid. I just, I love being outside and I love being in wild places. And I love being in places that a lot of folks haven't been. And I think mussels have provided that opportunity. Really, I would just say working in stream systems have provided that opportunity because, you know, I work not only in Texas. We've had projects in central Mexico, I've spent time in Oklahoma, Louisiana. So, I've been around and seen lots of different places that most people will never see.

Charles Randklev [00:51:34] I mean, I just think about, you know, my world in Texas. I mean, most people don't really spend any time outside of the major metropolitan areas. And this is such a beautiful state. And I've seen so much of it. So, I think part of it is that.

Charles Randklev [00:51:48] I think the other part of it is, I like to solve problems. And so, mussels, intellectually and they appeal to that, if there's a problem or an issue. And so, I think in general, the scientific process is kind of about solving problems. Right? And having a discussion as we begin to kind of chip away at that, over time.

Charles Randklev [00:52:12] And so, I think that that's really what's kind of drawn me to not just mussels, but in general, you know, being a researcher that works in stream ecosystems.

David Todd [00:52:22] Okay. So I think you said you're in your mid-forties, so you're several decades into being a biologist now. When you look back at your career to-date, you know, what is it that you think you value about that career? You know, it seems like such an interesting mix of idealism, science, you know, applied policy issues, you know, the sort of "ticket to ride", the ability to go and visit really beautiful, remote places. What do you think you've valued in that career?

Charles Randklev [00:53:01] I think I still do, but initially, I think it was contributing to the scientific discourse. I like to publish. I think it's important. And early in my career, I was very hyper-focused on that.

Charles Randklev [00:53:16] I still am, but I think as I've gotten older, I think really my interests have kind of really shifted towards really kind of mentoring and stewarding the next

generation of kind of like natural resource managers, scientists and biologists. I think, you know, that's kind of where I'm at right now professionally, is kind of watching that discovery process and kind of, you know, seeing what I imagine I looked like 15 years ago when I was kind of going through it, right, kind of being a participant in that.

Charles Randklev [00:53:46] And then, you know, taking my experience, things that I've learned, and then sharing that so that I set up, you know, again, the folks that come through my lab for success, so that they can make the next contributions and the next breakthroughs.

David Todd [00:54:00] That's great. Passing it on, passing it back.

David Todd [00:54:06] So, we've covered a lot of ground with your help and kind participation. Is there anything that, would you like to add that maybe we skipped over that you feel that you would like to mention?

Charles Randklev [00:54:19] I don't think so. I just, I really appreciate the time to kind of share kind of my background and, and, talk a little bit about, mussels in general and stream systems in Texas with you. So, I appreciate the opportunity.

David Todd [00:54:33] Well, so do we.

David Todd [00:54:34] Thank you so much. It's kind of you to do this.

David Todd [00:54:38] I have nothing to add, but just gratitude for you doing this. And, if you feel like you've said your piece, then we can call it a day.

Charles Randklev [00:54:48] I believe so.

David Todd [00:54:49] Okay. Thank you so much. I'll cut off the recording right now.

Charles Randklev [00:54:53] Thank you.