

Intro:

You are listening to Making Waves, fresh ideas in freshwater science. Making Waves is a bimonthly podcast where we discuss new ideas in freshwater science and why they matter to you.

Stephen Elser:

Welcome back to Making Waves. I'm your host for the month, Stephen Elser. Now we talk a lot in this podcast about exciting cutting edge research in aquatic science, but just as important as those interesting results are the avenues through which they come about. For many scientists, field stations serve as that avenue, giving them unparalleled degrees of control and freedom that allow for larger scale manipulations that would not be possible elsewhere. Steve Carpenter and his team, for example, you used whole lake manipulations to illustrate trophic cascades, something that they could not have done if not for the University of Notre Dame's Environmental Research Center.

Stephen Elser:

Some field stations also double as longterm ecological research centers such as Trout Lake, giving scientists highly valuable continuous data over time. Beyond all that, aquatic field stations are also just boatloads of fun, pun intended. I was fortunate enough to spend a lot of my summers growing up at the experimental lakes area in Ontario and spent a few summers of my adult life at the aforementioned Notre Dame Research Center. And in a lot of ways, I think field stations like these are sort of like summer camps for scientists. So today as summer's drawing to a close, I wanted to highlight a prominent aquatic research station here in the U.S. The University of Montana's Flathead Lake Biological Station. I sat down with the director, Dr. James Elser, or as I like to call him, dad.

Jim Elser:

I'm Jim Elser. I'm the Director of the Flathead Lake Biological Station and Professor of Ecology at the University of Montana.

Stephen Elser:

Great, thank you very much. So could you tell us a little bit about the history of Flathead Lake Biological Station? When it started? Its trajectory til now?

Jim Elser:

Sure. Flathead Lake Biological Station is, depending how you count or how you look or whatever, is the oldest year-round biological station in the Western Hemisphere, I believe.

Stephen Elser:

Wow.

Jim Elser:

And was started in 1899 when the university itself was only about five years old. So it's very unusual for something in the state of Montana to be the oldest of anything. And so that's kind of a cool thing about it. It really has been here for a long time doing some great stuff.

Stephen Elser:

Great. Other than its age, what would you say makes FLBS very unique as a research station or maybe just even as an entity here in Montana?

Jim Elser:

Oh, several things. Well, its location is incredible. It's on the shores of Flathead Lake, which is the largest freshwater lake west of the Mississippi River in the United States.

Stephen Elser:

Wow.

Jim Elser:

Beautiful water body, very clear, high quality water, beautiful mountain scenery. It has advanced facilities. Some people think of biological field station as a tent and microscope or something like that. I think it's really a mini campus of the University of Montana. We have resident housing, we have a dining hall, we have advanced research facilities, we have administrative facilities, we even have our own sewage treatment plant. So we really have it all going on here. That's pretty unique about it. And I think another unique thing about it is that because of our long history here and because of the legacy that was put down by the founders and the others that have come since the founding, the station has been very embedded and taken very seriously.

Jim Elser:

Its responsibility to the community and to be the sentinel of the lake, if you will, to watch the lake, to be responsible for studying it and reporting its condition to the people around here.

Stephen Elser:

That's great. So you mentioned the founder. Would you mind talking a little bit about the founder of the station and what his significance is?

Jim Elser:

Well, the founder of Flathead Lake Biological Station was the guy by name, Morton Elrod. He was a classic naturalist of the late 19th century around that time when these things were going on and so he was... Some people don't think he ever slept. Every summer he would come up from Missoula to make collections and to explore the lakes around here and climb the mountains and make surveys. And then he would bring students here and then began to establish the first summer teaching courses where students would come from around the United States. It was really quite amazing because it was an arduous journey to come even from Missoula here, let alone other parts of the country.

Stephen Elser:

So this is beginning of the 20th century he was bringing students?

Jim Elser:

He was bringing here students here in 1904, 1903. They were putting up a wall tents here at Yellow Bay and well, the first biological station was at Big Fork where the Swan River comes into the lake and they were there for several years before the University of Montana was deeded this property during the land settlements of that time and then they moved the permanent location of the station here. So he was a

pretty amazing guy. He taught photography when photography was sort of the gene sequencing or high tech sort of stuff of the day. So he took a lot of pictures, which are still very valuable scientifically now because they give the historical record of what the landscape looked like, including glaciers.

Jim Elser:

He was involved in laying out the boundaries of a Glacier National Park with Charles Bird Grinnell. He was involved in laying out the boundaries for the National Bison Range south of here and so he was quite fundamental in some of the early conservation efforts in Western Montana.

Stephen Elser:

Great. So you mentioned just a little bit ago about how part of what you see as the mission of FLBS is to sort of work with the community and communicating some of the work that you're doing here on the lake. So I'm just kind of curious if you could speak a little bit about the significance of the lake to the nearby community from what you've experienced so far.

Jim Elser:

Well, I mean the lake is sort of like the recreational vacation lifestyle magnet for people all across the mountain West. I think for people in Montana, going to Flathead Lake is like for people in New England going to Cape Cod. It's this thing you did in your family for many, many, many generations over time and there was a cottage and you went there for the summer and built layers of memories over generations doing that.

Jim Elser:

So it really is a part of the lifestyle of people of this region and it still is. It's also become a broader attractor of people from all over the country and the world who have come here to retire or to have vacation homes or what have you. The economic value of the lake in terms of recreational income and those kinds of revenues is extremely high. The shoreline property values are extremely high and so the Lake is super, super valuable and it's not just the lake itself, it's its quality, which is extremely high, nearly pristine water quality conditions, which are quite unusual where a lot of lakes sit in the country or in the West are degrading in water quality. This lake is hanging on. It's doing pretty well, doing really well according to the records that we have from our monitoring program, which goes back to 1977 in a formal way.

Stephen Elser:

So what would you say is allowing Flathead Lake to hold on as you said and maintain that high quality water?

Jim Elser:

Well, the science was good at the beginning when this basin started to get built up and there was nutrient pollution going on. The bio station sites were here measuring stuff and things were starting to go South I think in the early eighties with algal blooms and such. And they were successful in convincing the larger towns around the area to get advanced wastewater treatment plants for phosphorous removal and that really turned things around. Phosphorus levels have been slowly declining in this lake over the last 25 years. Nitrogen seems to be going up for reasons that are interesting to discuss, but phosphorus levels are slowly going down, which is pretty unique for a lot of lakes in the country.

Jim Elser:

So it's not to say that all concerns are absent, but our main concern now is non-point sources, mainly aging and poorly designed septic systems are our concern right now for nutrient loading to a system. But it really is a lake that's in great condition, partially because science had an effective impact back when it was needed in the early eighties when things could have gone in another direction. And so the bio station played a role in that, the people, the community played a role in that and the state of Montana itself also played a role.

Stephen Elser:

Yeah. So it sounds like a nutrient loading is at least part of the focus of research here at the station. Could you speak on some of the other projects that are going on?

Jim Elser:

Yeah, so we monitor the lake for all kinds of reasons and parameters for nutrients be it biological, ecological, physical, chemical parameters on a regular basis using standard methods. So that's sort of, I consider monitoring to be a form of research. Long term monitoring is a form of research-

Stephen Elser:

Yeah, definitely.

Jim Elser:

And they've published a lot of important papers based on that record here on the specialized research side of things. We have programs in conservation genomics here dealing with, for example, hybridisation between westslope cutthroat trout and rainbow trout, which is going on. We have projects on aquatic microbial ecology, so we don't have yet... I have a very good sense of the microbial diversity and function out there in the Lake so we have a new professor by the name of Matt Church who's come on to doing that. We're doing genomic sequencing and some functional genomic work on the Lake.

Jim Elser:

Right now we have a long-standing program in river ecology and stream ecology, especially work that was done by Jack Stanford and Ric Hauer early on for many years at the Nyack Floodplain in the Middle Fork of the Flathead River, studying these gorgeous, relatively unperturbed gravel bed rivers and how they function and the incredible biodiversity that they support. So that's another research strength. And recently we brought Bob Hall onto the faculty and he's taking over a lot of that legacy. We have work on methane fluxes and methane dynamics. My own work includes work we're doing at Glacier National Park and what we call newborn lakes, lakes that are newly appearing as the glaciers retreat in high elevation in the region. And we're trying to just describe the fundamental analogy of those systems as they appear. And so that's something that we started up. We also have another arm of things that have developed that we've been developing at the station over the sensor technologies.

Jim Elser:

And so we have a new research faculty member named Cody Youngbull who's come. We have a new facility called the Sensor Space, which is a facility for advanced design and fabrication of environmental sensors. Incredible equipment for producing all kinds of environmental sensors for on a job basis or if users want to come and learn how to use the equipment to make their own sensors, they can and we're

teaching courses in it. But beyond that we are advancing a bunch of sensor designs of our own. The most important of which right now is the world's first portable continuous flow digital droplet PCR instrument. That's a mouthful so we call it the DNA tracker. And this is essentially a digital droplet PCR instrument that fits in a small toolbox that you can fit under the seat in front of you on an airplane, take it in the back country with you, take it on a boat with you. Runs on six watts of power. Does PCR reactions in individual nanometer-size droplets. We are now using that primarily for invasive species screening because Montana is facing the threat of zebra and quagga mussel invasion, but it has many, many, many applications that we're really, really excited about. So sensors, biological sensors, but also, of course, the regular sort of physical chemical sensors that we use in limnology are a big part of what we're advancing here.

Stephen Elser:

Yeah, that piece of technology sounds really, really incredible. I'm sure a lot of the listeners would be interested in hearing about that technology as it develops and using it in their own work. So beyond that, is there anything that you're really excited about that's happening right now at the station?

Jim Elser:

Well, there's lots of things going on. I think I've been told that, well this summer we have 85 people on payroll and the assistant director, Tom Bansak told me that by his estimate he's been here 22 years or something like that, by his estimation, he thinks this is the busiest summer in the history of the biological station, which of course is 120 plus years history.

Stephen Elser:

That's very exciting.

Jim Elser:

And those 85 people include the core staff, graduate students, post docs, some are seasonal researchers and a bunch of great undergraduate REUs and interns that we brought on. On top of all of those, there's about 40 students here taking our summer session classes, which is also exciting.

Stephen Elser:

Yeah. Could you speak a little bit more about those opportunities for our students here in the summer?

Jim Elser:

Yeah, so summer session has been going on here for more than a century, more than 115 years really, not continuously. I think they've missed a few years during World War II or something like that. But it is really truly immersive learning. Morton Elrod was sort of the visionary in that regard. He believed that the best learning takes place when you're immersed in the environment you're studying rather than reading about it. Back in his day, he'd be reading about it. Now he'd be subjected the PowerPoint presentations, so we try to keep that to a minimum. We get students outside as much as possible. We get them hands on learning, doing projects, doing measurements with real research techniques and methods. Generally, the courses are designed for one hand. We have an introductory course that I teach. It's more for a mid undergraduates. They're sort of just starting their ecology trajectory, sort of like a ecology class, but taught outside. Beyond that, all our courses are really good for advanced undergraduates, like juniors, seniors and early grad students who just want to get some more field experience and methodology under their belts.

Jim Elser:

And we offer them in aquatic side and terrestrial side and they're generally two weeks long for three credits and students here sort of eight in the morning til whenever at night for two weeks essentially. And that's a three credit course that generally transfers wherever students need it to transfer. The courses could be used for undergraduate or graduate purposes. So it's fun because the students come from all over the country, all over the world. We have our first students from China this summer here and last summer we had 20 states were represented-

Stephen Elser:

Wow.

Jim Elser:

In the classes and 29 different universities and colleges were here. So it's a really fun thing. So students get to learn a lot about ecology. They learn some practical methods and approaches. They get to experience the incredible Western landscape if Montana and make friendships and collegial relationships with students from around the country that I hope that'll carry with them for some time and during their careers.

Stephen Elser:

Yeah. Speaking from personal experience, I've certainly held onto those connections that I've learned as an undergrad, the summer experiences. So earlier you were talking about the relationship between the station and the community. So I was hoping to hear a little bit about some of the outreach that the station does.

Jim Elser:

Yeah, so our mission is sort of threefold. We have recently advanced research, we've talked about, monitoring, which we talked about that and then education in all levels. We talked about the undergraduate/graduate level in the summer session. We also do graduate training of graduate students and postdocs here of course. But then educational levels means education for citizens as a whole, whatever age they are. And so in the general community, we're closely embedded in the general community around here in telling them what's going on in the lake and interacting. We have close relationship with a large Lake association called the Flathead Lakers, which has 1,500 members in the basin. And we work very closely with them in communicating our science to them and advising them on different sorts of projects and endeavors for conservation and water quality protection that they undertake. Part of that, for example, we co-sponsor a Science on Tap event.

Jim Elser:

The first Tuesday of every month, we meet in a local pub and there's a very informal science presentation by someone from the station or someone from the community, USGS or park service or other places, and it's great. It's always packed and people have great questions and it's a lot fun. So we do that. We have some public outreach events. Just tomorrow we're having our annual research cruise, which involves scientists and students from the bio station. We go on a commercial tour boat that comes out of the north side of the lake. We get about 50 or so folks in the community to come out. There's a band, there's food, there's a little bit of a beer and wine and also scientific discussion and presentations. I call it a booze cruise, but with data and so it's a little mixture of fun and science and

that's one thing we do. We have an annual open house. We get about 600 people come through the station, a lot of hands on activity in August.

Jim Elser:

We do something called data donuts during the summer session, which are informal talks or semi-formal talks by scientists that take place for our students and for community members on Monday mornings. And then beyond that we really have spun up our K-12 education program. So we now have permanent staff who are trained in pedagogy and education and working with teachers that are working with students and now we have a very large influx of school groups that come in for field trips. Our goal is that everyone, every student in the basin will have come to the bio station at least once before they graduate from high school. I really hope we can actually say that they'll get through twice, once in high school and once in elementary school because our goal is that no one should grow up around this Lake without having a fundamental understanding of what's in there, what's going on and how it affects their life and how their daily activities might impact the lake itself so that they have a good basis for their lifestyle decisions and other decisions they make that impinge on the Lake itself.

Jim Elser:

So we're really excited about that, working with students directly, but also especially working with teachers and giving them curriculum that relates to the lake that helps them do their job in a better way and help the students get a good science education. So that's a big thing we're doing now that the station didn't have the capacity to do before, but now we do. So that's fun.

Stephen Elser:

Yeah, that sounds really incredible. I really love that idea of trying to get every kid in here and teaching them about the Lake. It's great. I don't have anything else for you. Do you have anything that I didn't ask that you'd like to talk about?

Jim Elser:

I don't know. Let me think. Well, sort of, people have this funny idea, but... Well field stations face challenging times, right? Because science in general is facing challenging times with funding levels, agencies and funding declining and the other thing I think that faces field stations that challenges getting students engaged there as well, like in our summer session. It's challenging because students face a lot of pressure to get jobs. They have to pay for their education more and more. They're worried about loans and such and so they don't have the freedom as much as they may have had in the past to go off in the summer and take a field course that just is eyeopening and transformative like the ones we have here because they feel like they've got to take a job in the summer to pay their tuition and many of them really, really do.

Stephen Elser:

Yeah.

Jim Elser:

So that worries me. I think our station is doing very well. The university has invested in it. It's a real jewel of the University of Montana. And I think the people, the community have invested in this station because they see the value that it brings both to the local environment by protecting the Lake but also to the community to raise everyone's awareness of what's around us. So fuel stations are in a sort of a

state of challenge right now. But I think that the more we can do to raise awareness of them, the better. I sort of think that a field station is to... Well, as a supercollider is to a physicist or a telescope is to an astronomer, a field station is to an ecologist. It's sort of an apparatus for scientific discovery. It's sort of where you collide by biodiversity with scientists, and you see what understanding emerges from that.

Jim Elser:

So I think it's sort of a basic investment that society makes in science that's equivalent to things like colliders and telescopes and DNA sequencing equipment and stuff. So I'm very happy that the University of Montana has continued to support this facility, that the members of the community continue to support this facility because I would like to say that this is the best field station in the United States, not just the oldest.

Stephen Elser:

All right. Great. Well thank you so much.

Jim Elser:

Thanks. It was fun.

Stephen Elser:

If you'd like to apply for any of the summer courses that we talked about earlier, you can go to their website at [www.flbs.umt.edu](http://www.flbs.umt.edu) and go to the education tab. Applications are usually available in mid-November and the first round of deadlines is in mid-January. Thanks so much for listening and we'll see you next time.

Outro:

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