

VIEW to the U transcribed
Season 3: Global Perspectives; Episode #3
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[Intro Music comes in and fades out]

Igor Lehnherr (IL): We're not in polar bear habitat but every once and a while they will travel from one site to another and they'll come through our area, and so two springs ago we saw a mom and two cubs. One of the quirks of going to the Arctic, you're squeezing in as much as you can in a short amount of time that you have available and in this particular instance we were filtering in our lab hut water samples we'd collected and it must've been one or two in the morning, and one of the students stepped out and was like, "Oh, there's a polar bear." And I thought she was having a joke and we stepped out and sure enough there was a polar bear just coming towards camp, and so we roused the others that had already gone to bed, but yeah, there was enough of us that the bear wasn't really interested in coming in too close.

My name's Igor Lehnherr and I'm an assistant professor in the Department of Geography here at UTM.

There's a lot of push to do community consultation and do science that is also relevant to Northern people and Inuit people, and a lot of the contaminant do that we do in the Arctic is certainly motivated by that. We've done projects where we set up monitoring programs at various communities where local people will go out and take, for example, seawater samples that they'll ship down south that we can then use to build a better record, or understanding of how ocean currents are moving. Not just Mercury but also some of my collaborators at Environment Canada look at, but trying to involve more people and trying to address questions that are relevant to Inuit and Northern people is also I think another way that we can try to have a bit more of an impact. That it's not just purely academic and something that only other scientists will care about.

[Theme music fades in]

Carla DeMarco (CD): Arctic anecdotes.

On today's episode of the *VIEW to the U* podcast, which has come out in honor of Earth Day, April 22nd, 2019, we will learn more about climate change and its effects on aquatic ecosystems and indigenous populations with Professor Igor Lehnherr. We also get insight on a few other topics that relate to his work, including how he got interested in this area of research in the first place, the importance of experiential education and connecting with the natural environment, and what it's like being up in the Arctic from someone who has visited there many times over the last 15 years.

CD: With this new third season of the *VIEW to the U* highlighting UTM's global perspectives, Igor discusses his Northern research and though he has seen dramatic changes to the stunning Lake Hazen landscape where he conducts a good portion of his work and, spoiler alert: the picture isn't all doom and gloom.

Hello, and welcome to *VIEW to the U: An eye on UTM Research*. I'm Carla DeMarco at U of T Mississauga. *VIEW to the U* is a monthly podcast that will feature UTM faculty members from a range of disciplines who will illuminate some of the inner workings of the science labs, and enlighten the social sciences and humanities hubs at UTM.

Igor Lehnherr is an assistant professor in the Department of Geography at U of T Mississauga where he has been on faculty since 2014. Prior to coming to UTM he was the W. Garfield Western Post-Doctoral fellow in northern research in the department of earth and environmental sciences at the University of Waterloo.

His research seeks to understand the impacts of environmental stressors such as contaminants in climate change on aquatic ecosystems, and he focuses primarily on the Arctic and Boreal eco regions. His current projects include studying how the recent accelerated melting of glaciers and lake ice has impacted carbon cycling and mercury bioaccumulation in these northern regions.

So I understand that your research broadly focuses on human's impact on the natural world we live in, and this is taken from your website, that you investigate the impacts of environmental stressors and climate change on aquatic ecosystems. Focusing primarily on the Arctic and Boreal regions, or eco regions, and I was wondering if you could tell me a bit about this line of your research, why you focus on these regions and perhaps some examples of current projects you are working on, and also any collaborations that you might want to mention.

IL: Just from my personal history. So I spent a number of years in my childhood growing up in the Yukon. So in North Western Canada, and so from that sense I guess I have a bit of a geographical bias of being interested in Northern landscapes, and from a scientific perspective as well if you're interested in issues that pertain to climate change, or some of these other things. So environmental stressors encompass things like contaminants and pollutants, and climate change. So if you're interested in those kinds of topics Arctic regions and Northern Canada are really very relevant to those issues because climate change is most pronounced in the Arctic. It's warming at a greater pace than the rest of the world, and issues that pertain to contaminants are also very relevant there because of long-range transport of pollutants. So pollutants are emitted down south end up being transported very long distances and end up being deposited in Northern landscapes where they can enter the food chain, and the concern there is that because there's also more indigenous people and more people that live off the land that are eating the fish, or harvesting berries, or eating seals, et cetera.

IL: They're getting composed to contaminants at a greater rate than people in the south word. Paradoxically even though they live in a relatively pristine environment where

we don't expect to see emission of pollutants and other harmful substances. So really yeah, the answer to that question is two-fold. I have a bit of a preference for remote places personally, and like I said, because of maybe growing up on Northern Canada but also from a scientific point of view. These are really good places to go and do the kind of work that I'm interested in carrying out as well.

But a lot of my work is really more focused on looking at freshwater ecosystems at the moment and so in terms of what we're seeing climate change to these kinds of, again, what we think of as remote and pristine ecosystems that are largely un-impacted or untouched by humans include things like obviously warming, but the questions that we're trying to answer is what impact does that warming cause? And really the ramifications are numerous and sometimes unexpected. So I'll give you an example. So some of the work that we've done in the past few years and this is work that's been carried out in collaboration with other researchers at University of Alberta, and Waterloo, and Queens University so I've been fortunate to work with quite a diverse team of experts as well on some of these issues. And we've tried to take a whole regional, whole watershed approach where we look at what does the warming do to a typical Arctic ecosystem?

And so obviously some of the things include things that we hear about all the time. Like permafrost off and warming of ground temperatures and air temperatures, and also the impact that it has on glaciers, and we see glaciers that for decades now have been in a phase of growth have recently, in the last 10/15 have flipped and now being in state of net melt, or receding, and so the lake that we're looking at called Lake Hazen in Northern Ellesmere Island is a large part of the region is covered by glaciers, and a lot of the waters that feed into the lake are glacier-fed. And so what we're seeing with an increase in warming, the increase rate of melt of glaciers is much larger inputs of water into the lake. So rising lake levels, rising water flow through all the rivers which increase erosion, has dumped a lot of sediment into the lake as well. And that sediment brings along other things with it, including in some cases nutrients that on the surface may be positive for helping biological organisms grow within the lake, but also have brought in increased levels of contaminants like Mercury that are being re-transported from terrestrial environments and now entering the aquatic environment where they can get into the food chain, and the food web.

IL:

And some of the maybe less expected impacts have included ... If you change water quality what kind of impacts does it have on fish? And so if we're thinking about these glacier-fed rivers that for a long time were not quite peaceful little streams, but certainly small rivers that have now become rivers that are much bigger and are carving out new river channels and eroding a lot of material, and dumping a lot of sediment into the lake. It's making the waters a lot more turbid, and the main species of fish, or the only species of fish that live there in the lake is Arctic Char, which is also a very culturally relevant fish species for Inuit people in terms of, as being an important country food. And arctic Char are a visual predator, which means they use their eyesight to capture insect pray, and larvae, and so as the waters become more turbid there's a risk that their ability to hunt for the prey is being impacted, and then there's some hints that we see this happening in terms of body size of the fish. We're

measuring something that's almost akin to body mass index, and they're getting relatively skinnier.

And so that's maybe less an impact of climate change that is less easily predicted or that we don't hear about as often. The ramifications are a lot more diverse and complex than that. They go from a change in the physical environment is impacted, the chemical and biological components of the ecosystem as well. And to give you also a bit of perspective on these kinds of things that time talking about. Lake Hazen is located in national park and even though it doesn't get a whole lot of visitors, and it's nothing like Banff or Jasper, there are still some groups that come every year to do guided hikes and do two week treks across the park, and when I first started working there in 2005 there used to be a very popular hike that would go from Lake Hazen camp, where we do our work, to Tanquary Fiord, which is the main warden station, and the hike would take in the neighborhood of 10 days to two weeks. And it would include fording a large number of rivers that are glacier-fed.

And now it's been a number of years since anyone has done that hike because the rivers are no longer fordable. The flow of the water in these rivers has gotten so big it's no longer safe to cross them by forwarding. So in the space of 10/5 years it's not just us having to measure scientific data to notice change. It's visible in the landscape. So we camp on the beach at Lake Hazen where we set up our tents, and if you look out from our tents towards the middle of lake there's a large island and it's actually the one that I have a painting of in my office, and it's called John's Island. And the nose of it on the end there has been gradually receding as well over time, because of, again, warming and so there's not a lot of plant material holding that in place. So with warming there's more erosion, there's also been a lot of loss of ice cover on the lake during the summer season.

And so just even going back every year to the same spot and on the same beach that can see over time John's Island shrinking. So there's lots of noticeable changes and some changes that we see require us to look a lot more closely. Kind of literally look under the microscope to spot some of these changes and

IL: so I mentioned that for some of this work we collaborate with researchers at Queens University including Dr. John Small who's a paleolimnologist and together we've looked at how microscopic algal remains in sediments at the bottom of lake have changed over time. We can sample the mud at the bottom of the lake essentially and take a core of that bottom mud, and the mud gets deposited in layers over time so that at the surface we're looking at very recent materials and as you go deeper into the sediment or into the mud it's almost like flipping through the pages of a history book, right? And so we get to observe materials that are progressively older and we can look at these microscopic algal remains.

So some of these algae have cell walls that are made of silica. So similar to glass and they're relatively well preserved for long periods of time. Centuries to longer, to millennial time scales, and we can look at how the species that make up these micro fossils have evolved through time, and so if we go back and look at Lake Hazen high

was 50 to 100 years ago. We notice a few things. So first of all if we go back at least 100 years we see very few of these algal remains because the growing season was really short. Summers tend to be relatively cool and there just wasn't a lot of opportunity for algae to thrive in this lake. And then if we fast forward maybe 50 years then we see a lot more of these micro fossils but they're all of a particular kind of algae that lives in the shallow waters. And in Arctic lakes the reason why we see that is because for people that have a cottage on a lake in Ontario, and if they think about the transition between winter and summer and how ice on the lake usually starts to thaw. It thaws from the shore towards the center.

So the first stage of lake ice melt is you get this moat along the shoreline, and for a long period of time at Lake Hazen, that was the only real open water environment there was, and so a lot of these species that we saw, going back again 50 years or more, these species that live in these nearshore environments, in the shallow waters and they live just at the surface of the mud at the bottom of the lake. So it only in a few meters of water so they can get enough light to carry out photosynthesis, and then if you fast forward to the present day we see all of a sudden somewhere around 15 years ago, the proliferation of the species are actually adapted for living out in the middle of the lake that are free floating in the water column, and that can exist, and not just that attached in the shallow mud nearshore, but that live free floating in the water column of the lake. And they are only able to exist now because the disappearance of lake ice over the summer.

So there's now sufficient open water and a long enough growing season in the middle of the lake that light can penetrate. That kind of habitat wasn't present in Lake Hazen 50 years ago. Some of the changes are very obvious to people, including myself, but also many of the park's people that have worked there for a long period of time, and obviously Inuit people who have a long oral tradition of understanding their land and how things have changed. And so some of these changes are very obvious to the naked eye and some of them require, like I said, literally to look under the microscope to get a little bit of a closer look at what these changes entail and-

CD: You said some of the fish are smaller than what they used to be. How are you measuring that?

IL: Right, so we've worked on different time scales. So when we did this particular study on Lake Hazen we tried to combine as many datasets as we could, and some of them using things, techniques like sediment cores or what we would call paleolimnology techniques, or paleo, you know looking back in time. That allows us to look back a couple centuries. Some of the data that we have is just observation that's relying on just how long have scientists been going to the high Arctic to collect field measurements, and obviously those datasets are a little bit shorter. So our fish dataset doesn't go back nearly as far but it still goes back a few decades, and it highlights the importance of having people on the ground doing this kind of work, because while we can track certain changes like the algae that leave a fossil remain behind that we can look at and that can provide us information. For the fish, we can't do that so we have

to have people that are physically capturing the fish and measuring their length, and the weight to record that data.

And so a lot of the data that we rely on is collected by people on the ground doing this work, going up there every summer or every couple years to revisit these datasets, and create these really valuable long-term datasets that on their own if you only collect these data for two/three years are informative but not as informative, and the real value to these really become apparent once you are able to construct these longer datasets that allow you to look for change through time and so the fish is an example of that. Some of the river discharge data is also the results of a gauging station that's been set up there, and we have some data, but of course, the remoteness of the site means that if a sensor goes down it's not until next summer that somebody can go and replace it.

And then the other approach to tackling some of these questions is to use models, and so one of the collaborators that we work with on these projects is a scientist with NASA in California, and he has constructed the model that looks at glacier melt as a function of climate variables. And so he's calibrated this model for modern time periods, and so we know that it reproduces melt rate because the predicted glacier melt matches well with the river discharge data that we have that's draining out of Lake Hazen. And so we know the model performs well and so what he did was then use input of older meteorological data to go back and estimate what glacial melt was in the 80s, and 70s, and 60s and then now look at that change over time. What has happened to melt rates of glaciers in the area from the 60s to present? So we use a combination of either observational on the ground data, of models and in some cases of paleo technique that are archiving hints about the environment and what it was like 100, or 200, or 300 years ago.

CD: I know you did touch on this a little bit already. There's this great video on your website and you talk about methyl mercury, which again, is another area I know that you touch on contaminants. So I was wondering if you could talk a little bit about what methylmercury is and what these contaminants do to the environment.

IL: Sure, absolutely. So people are probably pretty familiar with the idea of mercury being a toxic pollutant and we use the term mercury very generally. If you hear about mercury in the news we don't usually talk about methylmercury specifically, but the reason why I focus on methylmercury is there's many different chemical forms of mercury that exist in the environment, and methylmercury is the toxic form that has the ability to get into the food chain and get bio accumulated in living organisms, and gets passed on from prey to predator, and humans being at the top of the food chain were actually integrating all the contaminants that enter into the very bottom of the food chain, and they get funneled up to us.

And so as you go up the food chain with each level in the food chain contaminant concentrations tend to increase, because of something called bio magnification and mercury is one of those pollutants that is bio magnified. Meaning that when you go from algae to zooplankton these small shrimp-like invertebrates you increase the levels

of methyl mercury, and then you do into fish and that gets even higher, then the people eat the fish and so methyl mercury gets even higher and as an example of quote-unquote power of bio magnification, when people hear that we're concerned about methyl mercury in Arctic ecosystems they always ask, "Is it safe to drink the water? And we say, "Well, yeah." As I mentioned we camp on the shores of Lake Hazen and that's our source of drinking water, and the water there is so clean we'll dip our water ball into the lake and drink it directly, and even though there is mercury present there it's present and infinitesimally small concentrations.

But if you were to then measure, let's say mercury in polar bear fur, or some of these organisms at the top of the food chain the mercury's become at least 1,000,000 fold more concentrated because of bio magnification. And so we focus, or I focus a lot on methylmercury because, again, that's the toxic form of mercury that gets into the food chain and becomes bio magnified, and really when we're concerned about human health impacts that pertain to mercury what we're actually concerned about is methylmercury. So it just happens to be a particular chemical form of mercury where the mercury has been attached to a carbon molecule and that gives it certain properties that make it more easily retained within biological tissue.

So methylmercury toxicity. We've known about that for quite a long time because of well-known incidents like Minamata Bay disaster. So in this case it's a very specific example but we're a local, industrial facility was discharging a fluid that contained high levels of methylmercury because they were using mercury as a catalyst in their industrial process into a local bay which was also used intensively by local fisherman, and providing food for the town, and because of this large input of methyl mercury a lot of the local people were exposed to very high doses, and we saw the impacts of acute methylmercury exposure which include things like loss of fine motor skills, and tremors and methyl mercury's primarily a neurotoxin. So it attacks the brain and the nervous system.

IL: That's a very extreme example, because it was so extreme it really brought the issue forward and made us aware of the potential risks of methylmercury. For the vast majority of people globally and certainly in Canada there isn't much concern and there's a few at-risk populations, and they tend to be very young children and pregnant women because you can have transfer of mercury in the womb to the fetus, and at the time when the nervous system is developing and growing so rapidly, that's when relatively lower levels of methylmercury can have an impact. We devote a lot of attention to understanding mercury, how it is emitted from human activities, and so we know things like cold fire power plants release mercury to the atmosphere. And because mercury has these really intriguing properties it can remain volatile and stable in the atmosphere for six months and even longer, and that's why we end up seeing elevated mercury in the Arctic. Because it can be emitted at lower latitudes and remain in the atmosphere long enough that atmospheric currents will bring and deliver that mercury to the Arctic.

And so that's why we're interested in looking at mercury in the Arctic, but we're also interested because if you were to compare blood mercury concentrations of the

average Canadian living at southern latitudes, and as we often hear, most of the Canadian population lives really close to the US border, et cetera. Our blood mercury levels down here tend to be lower than the blood mercury level of indigenous and Inuit people in the north, and part of that, again, is because of the importance of traditional country foods to their diets. And so whenever I talk about this I always want to stress that we're never advising people not to eat traditional country foods because of the numerous, not only nutritional benefits, but also because of the cultural importance of traditional country foods.

But they are a vessel that result in greater contaminate exposure in northern populations compared to people in the south. Say if you're concerned about your exposure or if you're one of those potentially at-risk populations then there's some smart choices you can make to minimize your exposure, and that's true for everyone, but again, if we think about the alternatives. In a lot of northern communities they don't have grocery stores in the same way that we think of. They usually will have general store that will carry everything from snowmobile oil, to clothing, to food and most of the food that is delivered to Arctic communities comes once a year on the sea lift in the forms of dry goods, and fresh produce is scarce because it's all flown in and by the time it gets there it tends to not be that fresh anyways, and it's just prohibitively expensive.

IL: The alternatives to country foods are usually not great. They usually end up being highly processed. As I say, we always stress that things like eating Arctic char which have great source of omega three fatty acids are going to be healthier even though you're taking in some contaminants but the benefits outweigh the risk, and even also from a cultural perspective. Preserving the traditional way of life, going out on the land and being physically active as well. There's tremendous benefits to traditional country foods that have to be taken into account when we look at contaminants as well.

CD: Is there any findings though that you've come across over the course of your work that you really were surprised by?

IL: Oh, that's a good question but I think sometimes the surprise is the rate at which things are occurring, or the magnitude at which things are occurring. So I explained that with some of the increased flow in these glacial-fed rivers, and all the erosion that's occurring. What we saw was a 10 time increase in a sediment delivery which is a lot. Science is always driven by hypothesis. You always are making an educated, not necessarily a guess but you have an idea of what may be occurring and you're trying to see if that's true. If that's supported by your observations and your data, and so I don't want to say that everything was a surprise, but again, I think sometimes the scale of the impact or the rate at which things were changing is a little bit surprising.

I guess one of the things that environmental scientists is often accused of is we're all doom and gloom, right? And we're very good at pointing out what things we've destroyed or are negatively impacting, and it's easy to get lost in that and not convey a reason for optimism which I think is very important for action to take place as well. You want to show that taking action will work, will reap benefits. And so in the context of

mercury pollution in the Arctic we're certainly seeing reasons for optimism and mercury emissions will obviously vary regionally, between different continents but places like Europe have seen reduced emissions in the past couple of decades, and that's translated into populations of either reindeer or various fish populations are knowing seeing mercury levels are going back down.

And so it's showing the value of cutting emissions. There are benefits and ecosystems will recover, and I think that's a very powerful message. And along those lines the Minamata convention on mercury is coming to force in 2017, and that's a UN agreement that 128 countries have signed on to. That makes a number of provisions for tackling mercury emissions to the atmosphere, for using best practices in industrial processes that use mercury or trying to replace mercury uses in various manufacturing processes. So for example, the polymer industry that manufactures PVC in one of the initial steps in vinyl chloride monomer production. They use mercury in that process and so there's now development of alternative industrial ways to manufacture that without using mercury.

IL: And so the Minamata convention is really a way of promoting those best practices, and having countries that are able to provide financial support also to other nations in South America, or Africa in terms of also having better mining practices. So moving away from using mercury to process gold containing ore, to using other processes as well. So we are doing something about cutting our mercury emissions, and I think it may take maybe a few decades before we really see drastic declines, but we're heading towards that and I think that's very encouraging to see, and it's also, it makes it a very exciting time to be someone studying mercury pollution in the Arctic because now we get the chance to have our science addressed and provide information on what's the timeframe that we can reasonably expect mercury and fish to be going back down to lower levels, or to see what are the impacts of reduced emissions? Which regions are seeing more benefits and how fast are we seeing declines? And things like that.

I'm not always working on projects of how things are getting worse, but getting sometimes the chance to see and work on projects where we're looking at the recovery of ecosystems.

CD: One of the questions I had was just about why you were in this area but I think that you've already answered that because you said you grew up in the north, right?

IL: I have to put a lot of credit to not just being exposed to natural places as a young child, which I think had probably a big influence on why I went into environmental science. As a family growing up our typical Sunday activity was to go on a family hike, and so things like that are certainly important, but I think also from an education point of view sometimes it's just the opportunities that are offered to students along the way.

And when I was in high school in Whitehorse, in grade 11 I participated in a program called Experiential Science where a small group of students, there was only 13 of us, took all our courses together with a single instructor and we had biology and chemistry, and environmental studies but we also had Phys Ed and visual arts, and all

together where the art component was often times doing sketches of specimens or whatever. So it was tied into the biology of it, but because it was this own program carried out outside of the rigid structure of school we didn't have chemistry period that lasted for 45 minutes Tuesday mornings between 10 and 11. We had tremendous flexibility in the program and so we had access to the labs at the Yukon college. So we would spend a whole day once a week in the chem lab, a whole day once a week in the biology lab and some of the Phys Ed curriculum was doing outdoor activities while we were out collecting samples, and so as part of this program which was really, for me it was big eye opener and solidified my interest in science.

We did a month long road trip where the whole 13 of us plus two instructors piled into a van we drove down from Yukon to British Columbia, and Alberta and along the way we stopped at various places to talk to marine biologists, and we did sampling in intertidal pools, and then we traveled inland and towards Alberta and we talked to people in the forestry industry, and conservation biologists in Jasper, and that kind of exposure and that kind of experience was very formative for me as well. And so I think that there's a big role to play for educational institutions to put the bug in people and really make them passionate, and really make them connect because I think if you don't have that connection to the natural environment it's really hard to be an environmental scientist, right?

IL: And a lot of us in Canada live in big cities, right? Like I grew up in a small town but I live in a big city now and so it's increasingly harder to connect with the natural environment, but at the same time I think it's increasingly important to get your dose of nature one way or another to develop that passion and for me, those various experiences were really huge in dictating where I ended up and doing science that is relevant for the environment, and working in those remotes areas as well.

So when I started looking around for places where I could do my PhD and potential projects that various professors were working on, and I was drawn to working in Alpine and in mountain environments, because I mentioned the Yukon but the other half of the story is that for the first 12 years of my life I lived in Switzerland. So it's either been mountains or vast northern landscapes, and so I think I've always had an affinity for that as well, but I didn't necessarily seek out to get into Arctic science. It was more the opportunity that was offered to me through my PhD research involved Arctic research and I really liked the project, and as I said, I was initially trying to build a bit of an alpine parallel to the Arctic work that was proposed, but once I went there then it was game over. I can't really emphasize just how much I've connected with the landscape as well, and going back every summer is one of my favorite things about the job, and I've gone to Lake Hazen since 2005 for most years and every year I still see something different or something new. So it seems like the potential to explore and discover is phenomenal and for a scientist, I mean, what else can you ask for?

[interlude music fades in]

CD: Coming up: Global perspectives.

Igor talks about what it's like being in the Arctic environment, the impact of his work and his plans for Earth Day.

[interlude music fades out]

CD: I think that there's a lot of people, myself included, who've never been to the Arctic and maybe we'll never be there in our lifetime. So I was wondering though, if you could describe what it's like to be there.

IL: Absolutely. So I think maybe the first thing that will strike people when you arrive is just the quiet. We get dropped off by twin otter and then we unload all our equipment, and then the pilots get back in the plane. They take off and the plane is a super load but then that hum just disappears in the distance, and then it's nothing, right? So the chirp of the shorebirds and that aside. The wind and that's about it and it's intriguing that even though in some aspects when you go there it made almost feels like winter because it's a lot colder. There's a lot of snow and ice everywhere. Obviously, the birds haven't migrated there yet so things are even quieter, and all the sounds are even dampened by the snow, but yet you still get these really bright, really sunny days and the sun is always there. It's this very interesting take on winter in some ways.

As you might imagine, there's not a lot to do once your work day is over and one of my favorite things to do is to do these late night hikes, and of course, they're only late night in quotations because it's 24 hours of daylight. And so there's lots of hills in the area and it's really nice to just climb a hill, and find a good viewpoint and sit and listen to the silence, and listen to the sound of nature around you. And if you have never been to a place where there's 24 hours of daylight that tends to have a big impact on people too. For some, it's very energizing.

So again, I find makes me want to go, go, go and it could be late at night and I'm still feeling like, "Oh, I should go for a walk and the most of this." And for others I know that it really messes with their sleeping, and so after a couple weeks our tents that we sleep in are yellow. So they don't block out the light. They tend to be quite bright as well. So that can have an impact, but just sitting there and soaking it all in and realizing how vast everything is, and thinking for a moment that on this whole island that's bigger than some countries there's maybe at that very moment in time less than 200 on that very island is humbling in some ways, but it makes you appreciate the power of nature as well, and the beauty of it.

And the way that you also get to interact with being immersed there over time is what's really interesting, because the first few days you still carry some of your habits from your day to day life in the south, and as the days go and transition into weeks I find you can become even more immersed in the landscape, and the area and that's really neat.

Something that probably most people can relate to. It's almost when you go on vacation and it takes you a couple days to really like-

CD: Get in vacation mode.

IL: Get in vacation mode, and it's the same thing. It takes a little bit of time and then you get in full Arctic mode a little bit, and you start to notice all the little things and the blooming of the flowers, or that herd of musk ox that's passing to and for behind camp every couple days, or typical visit from the wolves as well. When we get there they usually sense our arrival and within a couple days will come and check out what we're all about and then leave us alone, and check in on us maybe once a week. It almost seems like every once in a while they just come by and see what we're up to, and keep an eye on things and so-

CD: And there are flowers that are blooming?

IL: Yeah, absolutely. Yeah. They're very small but they can be very colorful. So purples and yellows, and whites. So mount haven and dwarf fireweed, and Arctic poppies, and so the tundra does really have a surprising amount of life in many ways, and so a ton of shorebirds and Arctic turns of these A, really annoying because if your sampling site happens to be somewhat close to their nesting area they're very aggressive in protecting their territory, and they'll dive bomb you, but at the same time they're fascinating because they're these birds that will migrate to the Arctic and then when they leave they'll migrate all the way to the Antarctic. So they're always sort of chasing the polar summer, and travel these huge distances and so very intriguing.

And so the opportunities to see wildlife and whether it's snowy owls, or musk ox, or wolves, or even though highly charismatic and I'm sure most people would put that at the top of their list of Arctic animals to have a chance to see, polar bears. We're usually happier when we don't see them so we're pretty far from the coast. So we're not in polar bear habitat, but every once in a while they will travel from one site to another and they'll come through our area. And so, two springs ago we saw a mom and two cubs, again, one of the quirks of going to the Arctic. You're squeezing in as much as you can in the short amount of time that you have available, and because of the cost and the logistics that are involved. We really try to get the most out of things and in this particular instance we were filtering in our lab hut. Water samples we'd collected and it must've been one or two in the morning and one of the students stepped and was like "Oh, there's a polar bear." And I thought she was having a joke and we stepped out and sure enough there was a polar bear just coming towards camp, and so we roused the others that had already gone to bed, but yeah, there was enough of us that the bear wasn't really interested in coming too close.

Yeah, so I mean, those kinds of things are very unique and add a whole other level, I mean, scientifically the work is very interesting but even just from a point of view of a personal life experience it's a very fascinating place to get the chance to visit.

CD: How long are you there for when you go?

IL: It really changes quite a bit. I think I spend as much seven weeks there at a time, and sometimes it's as short as the week. That's not the typical but there's been instances

where we've gone to set up instruments at the beginning of the season and we did all the setup, we left and then came back later in the year to collect all the data from the instruments and do further field sampling as well. If we go in May and early June then the landscape is all snow covered. There's a couple, you know, one and a half to two meters of ice on the lake, and the plane will land on the lake ice, and because usually that means we have to bring more heating fuel, and we'll travel to different sites on snowmobile we have less space on a twin otter plane.

IL: And so we'll usually collect enough samples in a couple weeks to fill the plane for the way out. So they tend to be somewhat shorter trips, and the longer trips tend to be in July when it's the growing season and we're hiking around to all our different sites, and doing transaxle on glacier-fed rivers, or sampling various lakes and ponds, and tundra vegetation, and looking at exchange of greenhouse gases between lakes or tundra and the atmosphere or things like that. So the summer field seasons tend to be a little bit longer because we don't necessarily need to bring as much material equipment with us, and so it allows us to have a little bit more time there.

CD: I think you've touched on this a lot but it is a question that I like to ask, but what do you feel is the biggest impact of your work?

IL: I'd like to think that there's multiple layers to that. There's an academic impact. So trying to produce the best science that we can, and fortunately some of this work and the work I spent quite a bit of time chatting about with respect to climate change at Lake Hazen was published in a higher profile journal, *Nature Communication*. And so in that sense I think we're having a scientific or academic impact getting some of this work to a broader audience and some recognition for the importance of these issues, and providing the kind of data and evidence that highlights the impacts of climate change, and the links between human activities and climate change, and again, how our actions no matter where you are in the world will have impacts in places that we would like to think are perfectly pristine and untouched. Like as I said, I'd like to think that there's also other impacts in terms of using the beauty and charismatic nature of the Arctic to help the general public connect to some of the science as well, right?

To use as examples in the classroom and get students in that, as you say, a lot of will never travel to the Arctic, but to bring some of these concepts and issues to life a little bit and try to influence, or have an impact on students and the broader general public as well and not just work with these academic blinders on in some ways. And in many respects working in the Arctic is great for that because there's a lot of push to do community consultation, and do science that is also relevant to Northern people, and Inuit people, and a lot of the contaminant work that we do in the Arctic is certainly motivated by that. We've done some projects where we have set up monitoring programs at various communities where local people will go out and take for example, seawater samples that they'll ship down south that we can then use to build a better record, or understanding of how ocean currents are moving. Not just Mercury but also some of my collaborators at Environment Canada look at, synthetic, organic chemicals. So things that we use as flame retardants in building materials, or things that are waterproofing agents in clothing, or grease repellents in food packaging and all.

IL: So there's a whole suite different things but trying to involve more people and trying to address questions that are relevant to Inuit and Northern people is also I think another way that we can try to have a bit more of an impact. That it's not just purely academic and something that only other scientists will care about.

CD: And I am timing this podcast to come out in time for Earth Day [April 22], and I just wondered if there's anything that you do in particular for Earth Day, or anything that's related to Earth Day, or if you have suggestions for what we could do to have less of an impact on the environment?

IL: Right, so, I mean, that's a really interesting question and I think there's a lot of really neat initiatives that are meant to promote awareness, and so you know like turn off all your appliances and like don't use electricity of an hour, or those kinds of ideas I think are neat because, not necessarily because of the impact that that will have for only one hour, but I think because of raising awareness and what I like to think a good use of Earth Day is to use that as a chance to set aside a little bit of time to reflect I think, and everyone is so busy and I'm certainly guilty of that as well, but to take a few minutes and think about what are the small changes we can make that may have a positive influence?

And certainly if we think about climate change and how we're going to tackle that and things like carbon taxes. It's become very much a political issue and so it means there's just a lot of room for public discourse, but also just for people to talk about some of these things amongst each other, and to your neighbors and I think, as I said, for me Earth Day is really the chance to take a few moments and think about what else I can do differently and some of those changes can be really small but it could be no matter how much of a rush I am, rinse my recycling before I head out the door, or just little things like that or think about when I need or don't need to commute in and what my commuting options might be, and sustainability is something that we're more and more interested in, and not only here at UTM actually where there's a whole program on sustainability management, but in general I think we're seeing it as this target to aim for that as a society is something that we need to be striving for and I think that's important.

It's still, as you say, I think for a lot of people it's not necessarily immediately obvious what they can do, but small changes will add up if enough people participate in them. And so some of the things for example, for me as I said, sometimes when I stop and think. Your choice to eat meat for example, now I've had this conversation with multiple people and some people are very passionate about this. That if you care about the environment, the only way that you cannot be dishonest with yourself is to be vegetarian and my argument has also been, "Well, you can make that but how many people are you going to win over?" And that may be one in 20 and is that as big of an impact as if you tried to make the argument that, "How's about you cut down your meat intake by only 30% but we get 90% of the people to buy-in?" That's a smaller incremental change that because there's more buy-in to it can have a bigger impact, and realizing the power of small changes, but also, as I said, realizing the influence that

casting a vote in a federal or provincial election will have as well in terms of the direction that we're heading in.

IL: In some of my courses this kind of thing comes up whereas a scientific community we've decided we should try to limit warming to no more than a degree and a half, and certainly less than two degrees because we think those are the thresholds after which we're really going to start to see large, negative impacts from climate change, but to meet those targets we essentially have to get to carbon neutral scenarios by 2050. The discrepancy between that and where we are now, where we still at a point where we're saying, "Well, we have a long way to go yet." It's like anything else. The sooner you tackle a problem the easier it is and the longer you wait, the bigger of a task you leave for yourself to do, right?

And so, as I said, in some cases it could be small changes like just maybe using an app that tells you about your electricity consumption at different times of day and gives you some tips for how you may reduce your electricity consumption, or it could be about taking a longer think about how you want to cast your vote in an election to make the environment a big enough issue in your priorities.

CD: I just wanted to thank you so much for your time today, Igor. It was great listening to you speak about your work.

IL: Oh, you're most welcome. Yeah, I mean, I hope we got across some of the issues and things that you were interested in, and that through my various ramblings I didn't lose people on the way with various ideas and terminology, but yeah. It was very interesting to chat with you.

CD: Thank you.

[Theme music fades in]

CD: I would like to thank everyone for listening to today's episode of *VIEW to the U*. I would like to thank my guest, Igor Lehnerr, from the Department of Geography at U of T Mississauga for talking to us about his Northern research and for painting a picture of what life is like in the Arctic. For further resources please see his website, which we link to from our website and SoundCloud pages for more information including a video on his work.

I would like to thank the office of the Vice-Principal, Research for their support and those who provided feedback or helped to promote *VIEW to the U*.

CD: Lastly and as always, thank you to the musical Tim Lane for his tunes and support.

Thank you!

[Theme music fades out]

