North At Trent Lecture Series, March 4, 2022
Dr. Jennifer Provencher
Title: Monitoring Plastic Pollution in the Canadian Arctic: What We Have Done, and Future Planning

Heather Nicol:
So welcome. I'm Heather Nicol, I'm the director of the school for the study of Canada and the director of the Frost Center for Canadian Studies and indigenous Studies at Trent university.

And the Frost Center for Canadian studies and indigenous studies is the host organization for today's talk in the 21-22 north at Trent lecture series.

And the North has been a subject of research and discussion at Trent university for a long time, students and faculty at Trent have examined the north to a number of different lenses and through many different contexts.

The North at Trent lecture series reflects this. The north of Trent lecture series began in 2011 as a way to connect the

Trent community with current research being done elsewhere in Canada in the circumpolar world and also to connect I think researchers within the Trent community as well, so the Frost Center is pleased to work with our colleagues in this particular round of North that Trent.

North at Trent lecture series to bring a scientific focus to this year's lecture series, and you know this will be often focused on on the humanities or anthropological ethnographical film culture.

literature and other aspects of.

The North in our lecture series, and this year we're just delighted that we've had a chance to partner up with Erica Nol and her class and also with the school the.

Environment and the others from the science faculty at Trent to bring a focus on on that science biodiversity pollution environment to our lecture series, so thank you Erica.

and also from Graham for making space in your class curriculum and especially to Erica for helping us connect helping connect us with Jennifer Provencher who's tonight's speaker so i'm going to turn this over to Erica at this point, as she will.

introduce Doctor Provencher and tell us a little bit about her and then of course the main event, so thank you all for being here.

Erica Nol:
Okay, thank you very much Heather and welcome everybody to the second of the North at Trent lecture series.

Dr. Jennifer Provencher is a research scientist with the ecotoxicology and wildlife health division and environment and climate change, Canada.

And she just informed me that that short form is E-triple- C so Dr. Provencher previously worked with our last guest in this live lecture series Dr. Grant Gilchrist.

Along with Dr. Mark Forbes at Carleton University, where she conducted her PhD on contaminant and parasite drivers of health in Arctic birds.

After the completion of her PhD she received two very prestigious.

postdoctoral fellowships the Garfield Western postdoctoral fellow in northern research that she held at Acadia University with Dr. Mark Mallory.

And then the Libra Arrow postdoctoral fellow in conservation again at Acadia University but, including other partners, including birdlife international fisheries and Oceans, Canada and then Nunavut wildlife management board.

Dr. Provencher has collaborated with partners across the Arctic, since the 2007-2008 International Polar Year when there was unprecedented funding for graduate work and research in the Arctic.

So this was a great opportunity and a wonderful time to be a graduate student is when Dr. Provencher visited the Arctic, for the first time.

Her work addresses wildlife health and the Arctic, it currently focuses on legacy and emerging contaminants and plastic pollution, the subject of our talk tonight.

Her work on plastic pollution in the Arctic dates back to the 2000s in a research team works to explore both the fate and the effects of plastic pollution on all all three of Canada's coasts.

She is currently the lead of the long term seabird contaminants project under the northern contaminants Program.

And is also the Co Chair of the litter and micro plastics expert group for Canada under the Arctic monitoring assessment program and given that we've just.

entered an agreement or the UN has just indicated its support for controlling plastics in our globe, this is a timely talk and I welcome you Jennifer.

Jennifer Provencher:
awesome Thank you Erica for such a lovely introduction so welcome everybody it's so lovely to.

be with you today I'm excited to talk about some of the work that we've been doing over the last.

10-15 years and I think.

You know, especially with the Grad students in the class oh sorry in the in the room, you know this all much of this kind of dips into some of my masters and my PhD work that I've done and so.

Hopefully you know I'll try to address that, as I go a little bit, but just you know I think it's interesting to think about kind of where we what we think about undergraduate years doesn't necessarily set us on the right.

You know direct path, but certainly it has those inklings along the way, and thinking about where where that can possibly take you so I'm going to dive into it a little bit and.

see if I can get my screen, going so first of all I work on wildlife health issues in general and so illustrated, a few of them here.

And the ones on the top row are the ones i'm going to have main focus on so in environment and climate change, Canada, we think about plastic pollution, we also think a lot about in my group.

Mass mortality events so For those of you who are looking at the news we think about avian influenza, where we currently have underway, an avian influenza.

outbreak in North America, so we're involved in this, and what that looks like it means for bird populations.

A lot of my work and increasingly so, has to do with oil pollution so again these chronic and acute events where birds are exposed, and so there's a lot of that in my program i'm not going to talk about any of those today.

But in addition to that, we also think about generally kind of entanglement in plastic pollution, so that macro litter side of things.

also have a program that was part of my libra arrow postdoc which is around fisheries by catch this is funny because it's a it's a plastic, but the plastic in use often and so there's an interaction between birds and plastics and fisheries and fisheries effort that.

I have a PhD students who I work with he was still kind of digging in on this in Nunavut in particular.

And then of course harvest is a big one, and so at ECCC we do manage bird harvest several species of harvest in Canada.

And so, all of these things come into play, together, but i'm going to talk about the kind of top row a little bit more today and really focus on it and think about the plastics, in particular, and so this is.

kind of you know there's going to be weaving of other things i'm going to try to stick to the plastics today for this particular talk.

So one of the things to note about the work is often wildlife health is is a loose term health in general is a you know, a cultural construct.

And so, in this context, there are lots of people in environment, Canada and broadly who think about habitat and they think about habitat intactness and conservation of that habitat.

But my job actually sits in the world where your habitat is intact and your harvest is sustainable, but you've got some other problem.

And so, this can be parasites pathogens contaminants and plastic, and these are the issues that end up on the wildlife health desk per se.

And so there's a huge vast majority of the conservation world that thinks about that healthy habitat.

But beyond that there's I would say, a smaller group of us who are thinking about what that health means, and so what happens if your habitat is there, but for some other reason you can't take advantage of it.

And a few examples that you might be more familiar with his White Nose syndrome in bats, this has been a big one in Canada, and I know.

One of your previous colleagues at Trent worked on white nose syndrome, so this is an example habitats, not a limiting factor, but the populations being affected by this infection, and so this is a health issue.

Similarly, in my group we actually do a lot of work on Wood Bison in and tuberculosis and brucellosis in Wood Bison, so you've got a critically endangered species.

habitats, not the particular issue for most heards the disease issue, that is, and so this is just a snapshot and just as a.

Tow other things that's currently kind of in the world today, as I mentioned avian influenza and the current outbreak that's happening in North America.

And then, of course, for those of you who are tracking SARS Co-V 2 deer.

we've been testing wildlife, so my group has been working on that for the last couple years and what animals are susceptible to SARS Co-V 2 and could be too and potentially could become a reservoir So these are kind of all the health issues that are swirling around together in in our group.

Today we're going to talk mostly about plastics, though, we do think a little bit in my work where we talk about.

plastics and how they might be vectors for diseases but i'm going to kind of leave that one off to the side a little bit today just focus on some of the work we've done more related to what.

Dr. Nol was just talking about in terms of uni and the agreement on plastics and how do we reduce plastics in the environment, and what that means in terms of monitoring at the Arctic at the pan Canadian scale.

But there's going to be a mini lesson on plastics first so we're all on the same page so first of all Size matters in the world of plastics, and so you can have macro or sometimes it's called mega plastics.

And this is in the larger size range, so this is a you know, a typical scene from a polluted harbor with bottles.

And this is the plastic that you can see, this is often the plastics, that if you're doing a beach cleanup or beach survey you're going to find this type of plastic in the environment.

Where we do a lot of our work and where most wildlife interact with plastic, is that this mezzo micro range and so you know, depending on your definition, it can be 5-20 millimeters or 1-5 millimeters.

And this really can change, and it is a little bit.

You know not defined on the slide on purpose, because it is a discussion point there are not kind of legal standard definitions and so the definition of what the micro plastic actually changes depending on your jurisdiction and your context.

And then we are going to talk a little bit about ultra fine plastics and lower all the way down to nano plastics, which are.

Typically, again depending on who you're talking to is one nanometre or less and so again, this is this is work that's on sorry one micron or less is your nano plastic, and this is work that's really ongoing.

And so, in my lab in the plastics world there are three main things that we think about there's the ingestion and accumulation of plastics.

we have been doing more work on seabirds as a vector for plastics, and then we have plastics, of the vector for contaminants, and these are the things i'm going to talk about tonight.

So we're going to start off by thinking about kind of the probably what most people are really aware of her familiar and so you've probably seen these images, this is actually.

One of the first images, I saw as a Grad student plastics and birds, and this is a Laysan Albatross chick.

And they are born in their parents nest and out on these Hawaiian Atoll islands and the birds are young they're flightless on the island.

And what happens is the parents are out foraging in the north Pacific gyre bringing back items feeding it to their chicks.

And what happened in these cases that the chicks are fed plastics by their parents, because they're basically foraging in the Pacific garbage patch.

Then chicks ingest all these plastics and then unfortunately they die of malnutrition on the island and then of course carcasses rot and expose all the plastics, and so you can imagine, from.

A physiological perspective, the plastics are going in and there are you know their sensors on the outside the stomach that are stretching so they feel full, except that there's no nutrition happening and so.

This is not common in the bird world, but this does happen at this particular site.

And when these we first started finding plastics in the Arctic, everyone wanted the equivalent Arctic picture and that's not really how it works, we don't have this kind of extreme die off of chicks in the Arctic, but it doesn't mean that's not having an effect at all.

And so, just as a kind of primer for marine debris marine litter and plastic pollution is there's two types.

The plastic is a is a fossil fuel derivative so you've got the oil or gas coming into the ground it gets partitioned off into a whole bunch of different types, including what you put in the cars and airplanes.

And there's a partition that goes off for the production of plastic and it first gets formed into these industrial pellets or nurdles and you can see images of these there they're small kind of cylindrical.

shaped and they, these are the raw products and so plastic manufacturers make these into different shapes.

Sorry, different colors and with different additives have different properties and then these get shipped all over the world to plastic factories.

Where they get melted down and reshaped into what we consider everything else is, which is user plastics, and this includes the you know chairs and desks, we were all sitting on our cell phones single use plastics like.

Water bottles and cutlery all things plastic start their life cycle, as these industrial plastics and then into user plastics.

It has been estimated that by the Environmental Protection Agency in Canada, starting in the US up in the US that about 20 billion pounds of plastic actually enter the ocean every year.

And so, just to contextualize that a little bit it's been estimated that it's about a dump truck of plastics entering the ocean every minute so just since i've started talking.

You know, we probably got about 10 dump trucks of beep beep, you know plastic dumping into the ocean that's the equivalent that enter the ocean just while I've started to speak.

So you can imagine, you know if you're a bird your primary kind of Buffet table is the ocean, this is how you get all those plastics and means albatross chicks.

And so, when we think about the ingestion accumulation, we can think about this across a couple of different species, but it leads to all these other questions and effects and i'll get to those a little bit later on.

And so well, we think of plastics is an emerging concern it's actually been around quite a while, and it has been published on, for you know, several decades now.

And so, plastic pollution really kind of hit its stride post World War II that's where we see in the in the 50s and the 60s, a real increase and kind of single use plastics.

And when we look at the literature, we kind of, we can see that you know really reports are coming out in the 60s and the 70s.

And then really in the 80s and 90s, it really starts to take off a little bit more and seabirds, this is an older kind of review that we've done seabirds at this time kind of in the mid.

Well, up to 2017 was the mass majority of the literature reporting plastic pollution at that time and so fish, while they're much more numerically.

You know taxonomy individual wise there wasn't a lot of data coming on the fish world and so early days was very dominated by seabird.

Studies seabird literature, and so there was a lot of lessons and still a lot of lessons we learn from the seabird literature and studies, as we move forward in this field, trying to understand patterns at a global scale.

I will note because I know there's a few fish people in the crowd that this is a recent work by pisces, which is an international organization working to coordinate science in the north Pacific Region.

And this is work being led by Matt Savoca our of Hopkins and we did a recent review with Matt at the helm, where we looked at the different publications over time.

And you know, as expected, the fish population or the fish papers have really taken off and so really when we look at.

kind of the diversity of species that are dusting and accumulating plastic fish have really kind of come out in recent years as being very vulnerable to this type of pollution.

And, and so this this work is actually just been published, or just been submitted by Matt and so, but I think you know it illustrates how this is a very active field, and these graphs where we're looking at you know papers over time are really changing every single year.

So just to go back to seabirds for a little bit again, this is an old problem and.

Part of it has to do with the ecology of seabirds, and so this is actually the earliest report that we could get of not plastic, but like an anthropogenic material litter was actually in a report.

dating at 1838 and it was a Western Storm Petrel, which is pictured here, and it was found a candlestick kind of stub in his stomach.

And the reason why seabirds were one of the first reported with plastics and, of course.

Still reported heavily is because they do have this ecology, so you can see, this bird is kind of just like tiptoeing on the water and so Storm Petrels are these.

relatively small birds they glide and they can a tip toe across the water they feed at the surface.

And so, one of the characteristics about plastic is often plastic either sink or float because of density it doesn't kind of sit in the middle on the lots of plastic there, right at the top of the water.

And it's exactly we're birds like this feed, and so, when you have a contaminant that's kind of accumulating in the environment in a very specific kind of place, like the surface of the water.

And birds that feed at that interface, this is why we have this kind of interaction between the birds being there and the birds ingesting it.

And so, dating back even to the 70s and the 90s, we had this recognized in policies as kind of an international scale and then.

The London dumping sorry the London Dumping Convention and Marpol are great examples of this.

In '92 in the North Sea, OSPAR was formed, and this was based in part because of the pollution level in the North Sea were becoming really concerning, you can see, the North Sea here is.

You know the UK Northern Europe and then and then Norway, and so what happened under OSPAR is that they identify the Northern Fulmar, which is the seabird.

That is very common in that area and again certain fields, read the surface of the water.

And this is a wordy slide and I apologize, but I think it's important to recognize from a policy perspective.

That in the OSPAR convention, they have very specific wording about around the Fulmar and how it should be used as an indicator for plastic pollution, you can see here.

You know less than 10% of northern silver's having 0.1 grams or more plastic in the birds, you know tells you sample size it tells you your sample period and tells you all those different things different areas.

And so they set up this goal, you know that 10% of these birds having one or more plastics and there's so many there's that that level that threshold level of 10% at 0.1 grams.

And so, this work has continued on since this time it was really started in the 1990's and the Netherlands, and has really expanded to the rest of the North sea's since then.

And because of this long term kind of effort and matching to policy in order to inform mitigation solutions, we have some you know now several years in several decades in now, we have the ability to look at different levels, you can see there's that 10% threshold level.

That we know they want the birds to be down right they want they want 10 you know 10% of those birds kind of maxed out that 0.1 gram.

And you can see, the threshold level they're not really even close to that.

But you can see kind of different patterns in different regions, and so this is by having this this indicator species and being able to track it over time, you can start to see these patterns.

And one of the things that we did recently, and this is the paper by Yon Van Franger who really pioneered or sorry not.

He really going to develop this field and thought about this more is that.

We we've kind of pooled our collective data together and they've actually been able to calculate when they expect those fulmar levels to cross over that 10% threshold and so.

the prediction that it's about 20 I think it's 54 will be the time that on the courage directory or the current mitigation for plastic pollution that's when we're going to cross below that threshold, which is the policy target.

And so, this work is kind of ongoing at an international level.

And one of the reasons why we're involved in that international level at a at a Canadian level is that because we also have fulmar, so far as have us, you know distribution throughout the northern hemisphere kind of the circumpolar levels.

And so we have fulmars and all three coasts and so for part of my master study we actually undertook looking at plastic pollution in fulmar stomachs as part of one of my one of my chapters for my masters.

And so we've been we've been doing this work ever seen to try to figure out what those patterns are, and so you can see, this is a an example, a fulmar from Northern Canada.

nesting upon Cape Vera which is way up here on this top star, and this is an example of the plastic found in a single fulmar stomach in this particular example is actually from baffin island, which is one of these, the star here.

And so what we've been doing and what my program continues to do is try to figure out what this looks like across Canada to think about different patterns.

So this is where i'm actually going to get you all to open up your chat find where it is and i'm going to.

put you on the spot a little bit to do some some predictions, so you know, based on everything that i've told you we've talked about him what you know you know from the media or looking at the news.

What I want you to do is think about you know we've been able to sample fulmars at these four sites generally so Vancouver island off of BC Prince Leopold very high Arctic.

we've also been sampling on in the Labrador Sea off the Labrador coast and we've been working at Sable island and Sable and it's one of the most southern.

kind of points on the Atlantic and it's just off the offshore here it's a it's a small island off shore of Nova Scotia.

we've been able to sample the fulmars at all for these coasts and what I'd like you to do in the chat is actually enter in how we know which one of these sites, you would expect to have the most plastics.

all the way down to what's that you expect to have the least amount of plastics, and so, if I can encourage you all to type it i'll see if I can get the chat up as well.

If you can put it into the chat it would be great for you to kind of just think about what of these four sites you think is going to have the most amount of plastics and which of these sites is going to have the least amount of plastics.

So I see a few answers rolling in which is always my favourite part, so we have a few, Vancouver islands as the most we've got some Sable as the most.

I see Vancouver to Sable most at Sable, Labrador the least Arctic the most so we've got all kinds of answers of Vancouver the most PLI the least.

So we've got a few different options here, yeah it's interesting so there's all kinds of things.

So you know, I see a lot of kind of why the most so what I want you to do now is, whatever the most was I want you to type in why, so why do you know I see Sable the most.

Arctic the most I thinkLabrador the most as well as Vancouver, now tell me why, why do you think it's the most and I will tell you the answer I won't leave you hanging.

But I want to kind of think about why these things are actually you know why do we think that they're going to be the most in those particular sites, because there are four very different geographies.

They have different ocean currents, they have different ice patterns and so there's all kinds of different things that can influence it.

Okay, so I see, I see a lot of different answers coming in, which is fun yeah ocean patterns definitely play into it people density is definitely a big one.

yeah and it definitely tourism is another one that we're you know we're very, very aware of so i'm going to put up the answer and.

see if I can do this, put up the answer, and so what most people are shocked about is that actually Sable island had by weight, the heaviest amount of plastic burdens in the northern Fulmars, and if you are, if you are.

If you were a Fulmar you know you can imagine that they have a kind of a ball about the size of your your hands together that's how full their stomachs are.

And, but interestingly, the Vancouver island had has the most numerical pieces but they're lighter they're smaller.

And so it's not necessarily always a straightforward answer, but we do count Sable as the as the most because if you're a bird you're trying to stay light you know hollow bones they're adapted to be light on there, you know feet and wings.

And so, Sable, has the most Vancouver's the next Labrador is seen as intermediate and Arctic is the leaset or Prince Leopold is the least.

And so we see this kind of latitudinal gradient in general, so as we move at that North Atlantic coast we're seeing an increase.

or decrease levels we move North so they're higher and I think one of the big things about sable is, although many of you thought about the Pacific gyre which is great, and it does have a big kind of spin.

The currents that come near the BC coast kind of split off and so there's kind of the North Atlantic and the South Atlantic.

Sorry it's not even it's even split between the North Atlantic there's like a North North Atlantic at towards Alaska there's more of a.

You know, a temperate one.

Whereas Sable Island we have the Gulf Stream, and so you can imagine, all you know, this is a little island off of here, and you can imagine, all of the eastern seaboard including a lot of big cities in the US right.

All are kind of upstream from Sable island, so one of the reasons why we think Sable's, as the biggest is because the.

While the Vancouver birds are kind of you know, potentially feeding in the gyros it's pretty far off shore, whereas we think that Sable island is kind of in the gulf stream jet and so it's going to be it's closer to the source, of a lot of those plastics.

And so, this is work that we're continuing on and we keep doing this with our partners, and this is just gives you a little bit of idea we've done this and we could have three kind of distinct a little.

ocean nation that we've the data that we just looked at, as in the western North Atlantic, so you can see Devon island there's a few Arctic sites here.

And then, as we move South into the Labrador Sea and to Sable island we get these higher levels and of course right here's our ecological quality target from the North Sea.

And so, in Europe, as they go from the Arctic right small bird in Norway as they go down into European waters, you get these higher numbers.

And so we get the same pattern and the you know the North Atlantic on the North American side, the North Atlantic on the European side and we don't have as many samples but it's the same pattern here in the eastern or.

North Pacific so as you go from Alaska down into California, we still get we have the same pattern, and I think one thing about this graph you know, besides these very.

Similar trends across the coastlines is you know the ecological quality target all of the birds in Europe are all above this ecological quality, objective, the only ones that are below it are some of these Arctic birds.

And when I looked at these first Arctic birds, I thought oh there's plastic even here like oh no it's so depressing.

And I showed this data to my Arctic or sorry my European colleagues, and they were like this is amazing your levels are below the ecological quality, objective, that means it's.

Environmentally realistic, and so they still look at this data that same way, and so you know I get depressed what I open up the birds and find plastics.

But they see this as a very low level and and obtainable policy goal.

And, and so I think that's a really interesting you know dynamic when we're thinking about policy and targets of monitoring and what that looks like and it really is only large.

You know ocean based and global scale that you can actually kind of put that all into perspective.

And so you know really quickly i'll go through another a few points you know, there is variation by.

Forging type of seabird is not a seabird is not a seabird, and so the surface feeders Kittiwake's and Fulmars, we find plastics in them.

But these diving birds that few below the surface of the water there in the water column we don't find plastics it's about 1% and you have to sample about 100 birds to even detect that.

And so you know when we, and this is all at one colon are all birds that appeal I Prince Leopold Island.

And so you know, this is one of the things that we're thinking more and more about as we develop a global and pan Canadian monitoring programs is what does that look like, because you know, ecology matters in this context.

Now many of you probably have seen gull's eat garbage, this is a thing that happens we've probably all witnessed it and I had a students Sahar Seif few years ago, who looked at these gull stomachs.

from St john's and St john's actually call the gulls near the dump because it's a hazard to the airport.

And so we looked at these gulls and as you can see in this example, you can see all kinds of things plastic and non plastic all litter.

In the birds, and so this has been an interesting to kind of think about what other things we need to be thinking about from a waste management perspective.

And we have followed this up, I think, really, interestingly, because of the covid as though.

it's busy few years and I lab, you know we work on disease in wildlife and we work on plastic pollution.

And we're currently in the middle of a pandemic caused by an animal disease known to go to humans and now back to animals and back to humans again.

and causing more plastic PPE garbage than ever before, and so you know we one of the things that we've kind of capitalized and kind of got going in the middle of covid is.

Trying to look at if we vary the the litter types like having a lot more PPE in the environment, do we actually see this with gulls can we use gulls as an indicator species of PPE in the environment.

And so we have these pre-Covid goals, these are from Sahara's.

work, but we also have these early covid goals that were were collected just happened to be collected right in those early days of Covid and then we've continued on and we actually have 2022 samples.

That have now come in, and so the idea is we have this old data but we've changed the litter, and the environment, and now we want to understand if that is being reflected in the gulls.

And this is work being done by Kerry Schutten she's a student at Guelph university.

and her early results suggest that there's no change in ingestion we don't actually you're not finding PPE in the gull stomach that although we have.

partners in France or finding slightly different things so it'll be interesting, but what Kerry is finding is that we're seeing a large.

level of nesting corporation and entanglement in PPE and in the nest, and this is just an example, so this is a Cormorant nest as a little hard to.

See, but this is a chick here there's one chick here his head and there's another body here and a little face here some eggs and there's actually PPE and so she's been documenting.

Cormorant nests and gull nests with PPE kind of built in, and whether those is getting entangled with a chicks, so this is this is work that's ongoing, but I think you know again thinking about.

kind of current policy landscapes and how do we think about these things is a lot of what again being a government scientists were kind of being.

Really reflective of the the world policy and where where we're going to be asked to input those things.

So we also looked at trophic transfer of plastics, and this is what you know predator is not getting it directly but it's actually the indirectly through its prey, and these are Arctic Skuas.

that my colleague Sjurdur Hammer who's a scientist in the Faroe Islands he's from there, and has this great long term program and Arctic Skuas.

And so, he actually this piece is very conveniently regurgitated bolus and you can collect the bolus' around the nest.

And then you can look at it and you can see if there's bones, you can identify it to species, and then you can actually identify the plastics.

And so what Sjurdur found in the study that we did is that while black-legged kittiwakes and Atlantic puffins are large proportions of the prey of the Arctic Skuas these thick black arrows.

And they actually had very little plastic so when the Arctic Skuas had these species in their bolus' they had very, very little plastic.

But although not a huge portion of the prey when a fulmars we're in the prey in the bolus' there was lots of plastics, and so this.

indicates that again the the plastics are kind of traveling into the into the predator, with the birds.

And so, this is we don't have we don't have a ton of examples of trophic transfer plastic in the literature, but this is one that is very, very nice and Sjurdur did a great great job on this study.

and other piece that we've done is thinking about how we can monitor plastic pollution in birds using.

Using fecal samples, and so this work you know I did in in my post-doc where we looked at micro plastics in the stomach and then we looked at micro plastics in what we call.

Sorry fecal precursors I call it the pre poop used to call the poop and then, when we first or the fecal samples when we first submitted this.

isn't you know technically is not poop yet hasn't left the body, so we take the last little tiny bit of the gastrointestinal tract and we look for micro plastics so it's like the poop before the poop gets out.

And I actually you know funny story, I had to testify in front of the Canadian Senate on micro plastics in the Arctic and I never thought i'd have to say poop so many times.

In a senate testimony, but I think i'd say like 18 times, of course, if there's like a transcript of it.

And you can go back and count how many times i've said poop so just you know, a heads up you never know when you design these studies, where you might have to then like talk about it or testify it and.

never thought i'd be doing, you know, having to talk about poop so much, but here we are.

But this really you know lays the groundwork for some of the work, so it doesn't actually tell us anything micro plastics in the poop doesn't tell us anything about micro plastics in the stomach.

But I want you to hold this one in mind, we do see micro plastics in in the poop it just doesn't actually correlate what's in the stomach.

And so, but this lead us to a whole other area of research within my group that we've been following up with mostly with the Community of Qikiqtarjuaq.

And so the Akpait and Qaqulluit at national wildlife areas on baffin our co managed by the Sululiit area.

co- management committee and this is made up of Community members and Qikiqtarjuaq and ECCC.

And when we showed them our kind of our poop study, one of the things that came up was like well where's all that plastic going, and so we did a follow up work.

This is a picture from our, this is a picture of the colony, and this is a picture of our.

Our co management, you know joint team that went out, it was Community members and the area co-management committee and researchers.

And we went out and one of the things that we did is we looked at again we looked at the birds.

including fulmars and Thick-Billed Murres and we looked at their poop samples, but we also then did some you know back of the envelope calculations about how many times they poop on the colony how many plastics, that would be.

And what we found is that although Thick-Billed Murres don't have a lot of plastics and their stomach.

Because they're so colonial and kind of poop everywhere, you can see, this is the picture you know there's proof on the back of this bird they kind of poop everywhere.

They We estimate that there's about 45 million pieces of micro-plastic being deposited into these national wildlife areas every year because of the birds.

The Fulmars, although they have more plastics in their stomach they don't poop as much and they're not as colonials you can see there's one here there's one over here and there's not a lot of poop I got you know a little.

Detection there, and so they only probably poop out about 3 million pieces a year.

And Madeline Bourdages did this work, and so we you know we took it all the way from morphology from colour and to FTIR so we know what these these polymer types were.

And that you know so that really informs the management of that area thinking about is it's a protected area for birds, but protection area for biodiversity in general.

And so we follow this work up in the same field teams in and Bonnie Hamilton did this work where we actually you know we looked at the bird stomachs we looked at the guano, which is what Madeline did, but then we also also looked at atmospheric deposition surface waters.

plastics in blue muscles, as well as surface sentiments.

And because the question is you know, there are other studies, where the birds kind of create this HALO of plastic around their colonies are of.

contaminants on their colonies, we want to know this happens as well with this with this contaminant.

And so we don't see it in the atmospheric deposition and we can test it was really strong winds in the Arctic it wasn't quite the right sampling that we had.

And, but we see a little bit of a trend in the in the in the rockland sentiments this instead of it's at the top of the shoreline and so we're going to follow up with this work with a little bit.

Of the with the Sululiit area co-management committee.

But this work is ongoing, so the last thing I want to talk about me to try and squeeze in because I know we're getting.

close to the end, is plastics, is the vector for contaminants, and this is what a large majority of my post-doc funded by the Westin.

For northern research post-doc fellowship was forum and so we know we know that plastics, can be a physical Blocker but I was really interested in this idea about chemical effects you've got these plastic, then you have plastic additives leaching out and what does that mean.

To the animal, essentially, and so one thing to kind of contextualize this is that we've we've done this a little bit more recently is like again digging on to the polymer type, and this is an example.

This is work by Mark Drever and Eloise Tebou and so we actually found We actually had phalaropes that were collected off the coast of BC as part of an oil or a diesel spill.

And we took those birds and looked at plastics in them, but the thing that was we did with this work was we actually took it all the way through to FTIR, and so we have these you know different density polyethylene.

polypropylene polyethylene, and so we have these pieces, but then, when we take them through the FTIR, we can see that there's all kinds of different plastic pieces.

And, and there are some you know inconclusive results here because we think that the FTIR is not perfect.

And I think this is important in this context is that we don't think the FTIR can pick these all up because they're weathered plastics, and so the libraries are created often using virgin, not virgin plastics but clean plastic.

Whereas when you when you put them out in the environment and put them into a stomach of a bird they can chemically change, and so this is kind of lead us on a.

couple of different paths.

All that to say, though, is that you know we have probably all eaten things off of plastic today, you know containers food, but those are foods safe plastics and what we know from the the FTIR data that we're continually.

Continually getting into birds, is that the birds are eating all kinds of polymer so it's not just food safe plastics it's all these other things, and with that becomes a real cocktail of contaminants.

So we have looked at chemical contaminants and birds mostly legacy contaminants things like PCBs.

And while we do find that the the plastic particles actually have higher levels in the water, so they're absorbing the plastics sorry the absorbing the additives to the plastic particles.

What happens when we look at the Fulmars we don't see a big difference, and we think that this is because there's these legacy contaminants are in the fish and the prey.

And so the the bits that come in on the plastics it's not it's not a huge amount so it's not it's just a drop in the bucket so they're the plastics are not a significant root of the four PCBs into the bird.

But we have done a lot more work now on chemicals of emerging concern So these are plastic additives they are specific to plastics they're not ones that we often see and so in seabirds.

We see this happening, actually, both in liver and in egg and so these are these are two species or kittiwake and our fulmars, you know, can you accept 10% frequency of occurrence of plastics full Morris have 90.

I expected these to be different, I thought the fulmars would have higher levels, but you can see here that they have very similar levels, but I think that really important take home is that they are in their eggs, and so we get these endocrine destructive.

You know intercepting contaminants is additive being transferred into the eggs and, of course, at a stage of development, it can be a.

Very significant effects and we've done this with seals and we see in this case that.

You know these two bird species at PLI you know, have had much higher levels of these contaminants and seals and so it's not.

So we you know we see this consistently across regions, and so there are some species that have higher levels of these contaminants than other species.

And so, this is all part of the work that we're building up to think about more and more, and so this is work that we continue to do.

But of course we found all these additives in in seals and so there's really begs the question of like well does it do the seals ingest plastic.

And so, this is work that we've kind of continued on and and i'll just stop and mentioned the UV-38;s detection.

Sorry, the UV-328 and and the birds and the seals and so, for those of you kind of follow kind of the.

The the Stockholm Convention contaminants world, the Stockholm Convention is actually listed UV-328.

For consideration and was it was nominated, about a year and a half ago now, by Switzerland, it just went through its first risk assessment.

And so, a lot of this data there's been a big push on us to get data for UV-328 kind of into the works and just in January, the first risk assessment was done, and so this is ongoing.

kind of happening in real time, so this is, you know we're this is, you know part of what being a government scientists is being really.

reactive to some of these policy wheels are kind of turning along, and so we diverted kind of a lot of attention to this particular containment because of its potential listing.

But we have continued on looking at plastic pollution and seals, and this is again work by Madeline Bourdages, and so we went back and worked with harvesters and DFO.

To look at about 142 seal stomachs from Nunavut and we found no plastic over 400 microns, and so this is really shows you that you can be exposed to additives, but not the plastic pollution.

and vice versa right, and so you know when we think about monitoring and the Arctic, this is another things that we were considering we know what are the ideal monitoring species.

Just because you can get it or as part of it a current program doesn't actually mean that it's an adequate monitor for plastic pollution as a new contaminant to be considered.

So, for those of you kind of interested in plastic pollution and policy.

Over the last couple years we have been developing CaPSA, which is a Canadian Science plastic agenda there's a whole bunch of different themes, including waste management and all those things.

But a lot of our programs have been under these two themes so it's detection in the environment and wildlife and then of course impacts which are both pillars again under lifting things under the Stockholm Convention in the basil.

And, of course, what is being interested, or what you UN the United Nations is interested in.

And so, this work is currently kind of being renewed with treasury board and we'll see how that lands, but as Erica said.

You know, with the renewal, the commitment by the UN to have a binding agreement by 2024, and this is putting us in good stead to to really support what that decision looks like you know with evidence and the science at the table.

And i'm going to talk a little bit about the Arctic plans, the business i'm going to try to wrap it up, but there is a lot of Arctic coordination on this.

For those of you who don't know the Arctic counselled is a state kind of an Arctic coordination science coordination forum, there are several groups that are.

are working on this kind of CAFF and the biodiversity side AMAP which is mostly focused on climate change and contaminants men PAME which is protection of the marine environment.

So I am currently the Co chair for the little micro plastics expert group for.

AMAP and so we've been working on this now, for several years, and so we have some priority recommendations that we've worked with kind of across the globe, or the pan Arctic.

And so we had these this monitoring plan, and it is the first you know ecosystem level assessment globally anywhere, you know there's been lots of assessments on water or shorelines but we took the the lens of having.

A more holistic ecosystem approach and it covers actually 11 different compartments and we ranked kind of how we should be looking at this in the Arctic and.

And, of course, if you want to read it, I encourage you to it's a four page summary you know for the short and quick read that that we have a 266 page technical document so For those of you, you know interested in thinking about how you measure plastic pollution in different.

You know the 11 compartments different matrices this is where it all is.

But you know just interesting to note that you know with the recent aggression by Russia in Ukraine and that unlawful.

War what all of this work is paused in so you know just as an example where this you know world events is is very integral in a lot of our work and so all because the Russian chairmanship is.

is going to add the leadership of the Arctic Council, where we've pause this, for now, and so will will be.

reassessing I know canada's reassessing and the Arctic Council generally is reassessing on where this works goes in the future, and so i'm going to leave it there happy to take any questions and and thank you for for listening and coming on a Friday evening.

Okay, well, thank you very much Jennifer That was a wonderful talk very expansive covering from the basics of plastic all the way to the policy implications, I really appreciate I.

really appreciate it, and I think the audience does as well, and so we will take questions, either in the chat or you can raise your hand.

But I may not see your hand so so you may.

actually see a question from Brendan I think he.

put it in in the in the talk, and so the question is, are plastic particles and poop smaller than the ones that were made in the stomach.

And the answer is yes and no, and so we do think that they grind it down even seabirds have stones in their bellies you know, and they do grind it down so we think that they do go down over time so.

Certainly the the the ones are coming on are much smaller but they're also mostly fibers, and so this is where we didn't think it was a great monitoring tool, because in the stomach it's mostly fragments and the poop it's mostly.

fibers and so when we when we so I can send along bonnie's paper did a wonderful.

Non dimensional like multi matrix or I can't remember the.

Exact methods that she was, but she looked at the similarities of colors and layers of FTIR results in between the water and the shorelines and the and the birds.

And we, there are there are similar kind of polymer types, but they're different morphology between the poop in the in the birds.

But I think also interestingly super different in the water, the water had a totally different type of plastics.

than the shoreline the atmosphere and the birds and so that tells us that the water samples are doing something completely different and we actually think it's mostly ship based paint its bottom paint peeling off of.

boats, so the salt ablating you know for to prevent an invasive species right and, and so we have we actually just got word that we have a three year project that we're going to be doing a little bit more on that ship base micro plastic work and a couple of years.

Okay, can you see the chat there's one from Julian Hearn.

yeah i'll go up I think Emily has hands up, so how do you detect plastic inside the bird, only when the bird dead yeah so there's a couple different ways so.

Sjurdur's work where they did the bolus' they actually get the regurgitation and so those birds regurgitate you know, a couple times a day whenever they feed, so you can do it that way.

You can do poop samples but it's difficult to discuss doesn't really mean anything.

we've actually so last year we bought a little handheld ultrasound like what you do I have it, the vet if you've ever gone to a vet and like ultrasound.

tried to and we we've had carcasses and we've tried to ultrasound see if we could you know figure out how to get the plastic stomachs without have you know killing the bird.

it's not super great you know that something's there but it's really hard to kind of quantify so, unfortunately, it really is dead birds we beach birds, we use bycatch birds, we use.

We use harvested birds, and so this is actually where some of my work on bycatch and plastics intersect so we got the birds from a bycatch and do species, but then we use those who are plastic pollution as well.

And then yeah Julian how well is the atmospheric input quantified the atmospheric input you know I think I think the quantification of atmospheric.

input to the Arctic, you know frankly anywhere is.

very poorly done, and so we don't have that I would say that it's the I know generally the the marine environment has been like the big one, is the easiest to kind of get out in terms of litter, and where there is kind of.

Where we can meet our colleagues kind of the engineers and thinkers of the like the technical side it's really on on the atmosphere side the snow side and Those are some of the methods that are not really as well.

developed and there's lots of people working on them, and you know I think there's a and I know in the.

federal funding, part one of the things that we really need to do is start putting these different methods into place comparing them across labs having lab inter.

Inter lab comparisons and so that's kind of where we're stuck a little bit on some of some of these things, it is happening, but it's slow.

And, and so we actually have projects in the Arctic, we have projects in southern Ontario where we're trying to figure out what that atmospheric deposition but it's a it's a work in progress, as I know you know Julian it's a work in progress.

So julian's next question is an important, I have no idea, to be honest.

Maybe I think it's probably less important in the Arctic than it is in the south, I mean it's really tricky to know that and but you know even even things like water right like I have colleagues who did.

a bunch of water micro plastic samples, and then they got these funky reading sorry, they were doing contaminants in water.

And then they got these really funky readings around the bird colonies.

And they showed it to me and I was like well yeah I actually think what you're detecting is the micro plastic in the water, because the birds are pooping it out.

And so I think there's also some leg differentiation between are we measuring the contaminant or are we measuring the micro plastic because they're getting so tiny and so there's also that kind of interplay as well.

So the next one's from Emily so correlation between wildlife in the Pacific garbage patch, so there is.

And so there and the paper so.

Matt Bavocak just did this, where we pulled all the kind of bird and whale and fish data from across the globe and then we looked at whether the levels were higher in the North Atlantic versus the north Pacific versus the Indian.

across the board, I think all of them except for maybe one group they all had the highest levels in the north Pacific.

And so you know what that means in terms of data gaps, I think you know word of caution for sure, but we do think that the levels in the North Pacific are generally higher for most species and.

You know, and whether that you know, but I think we have to be a little careful because it's it's you know we don't have a ton of species that we actually can sample and multiple ocean basins and really do a good comparison.

And you know the ocean, the we always focus on the Pacific garbage patch but the North Atlantic also has the garbage patch as as the South Atlantic and the South Pacific.

And they've actually talked about the Arctic be another you know garbage patch, especially with the reduction in sea ice, and so I think.

You know I think i'm always a little hesitant to kind of you know peg the garbage patch in the in the Pacific is like the main problem, it is a major problem for sure and but you know, and this is my personal opinion that we.

You know, there are lots of activities that are very cool that want to clean up the garbage patch.

But until we turn the tap off, you know we're not really going to get ahead so you know if you've got a leak in your basement.

You know, getting the bucket and running down, you know and like bailing yourself out it's not going to get anywhere until you literally turn go over turn the tap off, of whatever the broken thing is stop that and then you can deal with clean up.

And so i'm very encouraging, of all the moving pieces and I think we need to do them simultaneously, you know the garbage patch isn't going to go away, until we actually get a handle on on the input.

Okay, so I see one from Graham.

yeah so trying to quantify the strength of the ecological effects of plastic and wild animals yeah growth and behaviour lifetime reproduction, are they doing any work and the experimental legs in the air, and this.

The answer is yes to all of the above, so I didn't give up, we actually have an experimental lakes.

Project that's underway, I think we're in year four of 10 right now where we are doing dosing studies at the experimental lake with micro plastics it's led by Chelsea Rachman.

And there's seven of us who are kind of the core team, including I don't i'm not going to name them all cuz i'm going to forget them one and then i'm going to feel badly about it but it's.

it's a it's a great project so it's in so Graham you're spot on it's really hard to pin down the effects of plastics, because they're one stressor.

And so there's there's you know even just the plastics kind of envelope together, there are lots of studies that try to add plastics.

And plastics contaminants or just the contaminants or they put the plastics behind a screen, so that the there you know the fish are exposed to kind of.

plastics in the area, but they're not getting the physical interaction.

And it's really hard to tease it out, and then you add on top of it that plastics can be many different polymers different shapes different sizes and different colours.

And so, trying to you know control that is really challenging and that's actually been one of our toughest pieces kind of showing things like effects.

Because how do you tease all those things apart, when you have this cocktail of things and then add on top of it other you know non plastic contaminants and pathogens, all the other things that are happening.

And so to answer that question, what we have done is, we have a series of mezzo causes and experiments that have been happening and at Rochester.

Institute of Technology in New York with a colleague Queens University has mezzo chasms and setup and then the experimental lake has a mezzo chasms and set up where we have and they're all collective collective.

And so we have three different polymer types of you know, various sizes and different colors different densities, and we have been dosing corrals in them, we have a lateral corral we have a pelagic set of corrals so we're looking at fate and effects were doing a bunch of kind of.

Bat studies on that we're in birds, you know amphibian studies see if it's like going back up onto the land.

And, and one of the things that we're really interested in we actually have we have like carbon i'm going to get this wrong with that carbon marked plastic with a different carbon.

And so we're also trying to see in one of the mezzo chasms and to see if that carbon is actually being taken by the food web, you know outside of the plastics and so that work is all kind of ongoing.

Graham Raby: crazy amount of work.

yeah i'd love to come back, maybe in the fall and give a talk about that, because the experimental lakes is like a thing in upon itself it's like a beast of a project, but so exciting.

Graham Raby: awesome thanks Jen.

Graham Raby: yeah and.

there's a question but do Erica do i'm just trying to squeeze it in.

yeah sure why don't you squeeze it in and then we'll we'll.

Yes, sign off.

there's a quick way.

So the answer is yes Brendan so we're getting it from the prey, and so we it's always hard to differentiate but that's why looking at pray types known pray levels and then those plastic.

try to get that question, but again it's really difficult to get it so that's some of the experimental stuff that we're doing.

All right, well, I was i'd like to thank the audience first off for.

For wonderful participation in the questions and then I would like to thank Jennifer.

Secondly, for most engaging and informative talk and really appreciate you coming in on this Friday afternoon to give this talk.

Really really thought it was wonderful and also, I would like to thank heather and the rest of the Committee for allowing us to have some science talks for this year is this year's north of Trent lecture series and so again, maybe we'll invite you back again Jennifer so thanks again.

Thank you.

Thank you.

Thanks.

Have a great weekend our first but not last science talk. Thank you.

I have some ideas.