A Taste of the Arctic

Photo courtesy of Benjamin Burpee

A Travel Log

By Emily J. Rice

Welcome!

The following travel log follows the experiences of Emily Rice, a graduate student who travelled to Greenland with researchers from the University of Maine. Emily shares a wealth of photos and observations about the Arctic, day-to-day fieldwork operations and what remote lakes in Greenland can tell us about the Earth's dynamic climate.

The Adventure Begins

Hello Everyone!
I write from the Stratton ANG in New York. We awoke early, packed, arrived and ready to go at 5am. We passed the check point without issue – but when we arrived at the metal hanger marked "109 ANG Small Aircraft Terminal" the building was dark, the doors were locked and there was no one to be seen. When no one arrived, and no one came, and we sat waiting for the flight crew we began to get nervous. An hour and a half later a blurry eyed man drove by in a red truck. He looked at us with a confused dazed.

As it turns out, budget cuts have led the ANG to cut back on weekend crew – so Monday morning flights have been delayed. They now leave at 10am (instead of 8am). The "Pax" are therefore expected to arrive at 7:30am – not 5am. We seem to be the only team that didn't receive word of the change – it is now 7:18am and only one other person has arrived for the flight.

The ANG crew was very kind to us – they made us a pot of coffee and let us sit in the waiting room with a television, some vending machines and not too shabby chairs. Smith checked us into the room, looking at our passports. He mistakenly read my passport and could find no Emily Jackson on the manifest. I should have corrected him right away– but of course I didn't want to embarrass him so I didn't. He was therefore embarrassed even more when he brought in the polar program coordinator to explore the issue with the manifest – only to eventually have me show him that indeed I was on the list. But then again, it seems I had been awake much longer than he had at this point. I had already had my coffee.

Now we are sitting around in the waiting room - Jasmine is working on her laptop. Ben is reading some giant textbook. Rob is eating snacks from a zip lock bag of goodies. I am breaking in my new hiking boots, typing on my little blue laptop and generally anticipating the flight.

The ANG crew is coming in and out, passing through a metal detector that seems to be more for show than of any real concern. They are wearing gray/green camo uniforms, chatting with each other as they gather around the coffee pot that I now worry must be too small. I paid the full 50cents but only took half a cup of coffee. They are jabbing each other about their military affiliations, sitting at the table, kicking back in the time before we load the plane for our flight to Greenland. The crew appears to be mostly males – but one blonde ANG woman briefly joined the group for a cup of coffee before stepping back out into the hanger.

The flight will leave at 10am. The total air time will be about 6 1/2 hours. If we leave at 10am that would put us in Greenland at about 4 or 5pm EST. Greenland is 2 hours ahead however – so the local time will likely be 6-7pm. It will be a long day – but when it is done I will be sleeping north of the Arctic Circle.

Ah, the rest of the PAX have arrived. More to come!
Emily

Eyes in the Sky

I promised more and this flight is long enough- this day is long enough for me to share plenty more developments of our travel. I am riding in a red mesh jump seat on an Air National Guard prop plane filled with about 20 researchers and two pallets of cargo. We are probably somewhere over northern Canada by now. We left sometime shortly after 10 am and it is now just after 3pm. The ride has just become much more comfortable for me – I had originally been far enough from my carry on that I didn't want to get up and dig in my bag over Jasmine's head. So for the first four hours or so of this flight, I have uncomfortably shifted my eyes over every surface of the plane trying not to creep out the people sitting across from me. Now, thankfully, I have a place my laptop to look at and can report on all the interesting things I have studied so closely.

First, let me tell you about the plane. It is much more spacious and comfortable than I anticipated. Compared to my sources of information (a family member who stands well over 6 feet tall) I am awfully short. So, while I can't reach up into my carry on which is hanging from a bulk head, my knees have plenty of room. The plane vibrates constantly and is loud. We were all issued earplugs before we took off – and I have been wearing noise canceling headphones. I have the ear plugs in, with the headphones covering them and have been blasting music and audio books to myself – which I can barely hear over the plane/through the earplugs. The best part is that the flight crew allowed us to come up to the flight deck. The door is on the left hand side and to get to the flight deck you climb 4 stairs that run horizontally behind the pilots. When I went up we were still over the U.S. – and it was simply BEAUTIFUL! I was thrilled to get the view and to see the four officers hard at work getting us safely to Greenland.

Back down in our PAX area, I have spent significant time studying the wiring of the plane. The ceiling of the plane looks padded, as if lined with army green pillows. It made me reflect on barrel rolls, falling, and seat belts. Let's just say, I decided that it likely looks much more comfortable up there than it probably is. There is a water cooler in the front of the area (by the door to the flight deck). Behind my jump seat there is a little round window that I can look out of. It has been exceedingly helpful and even beautiful at times. Once, I looked out and could see snow laced mountains, sharp cliffs and beautiful blue waterways decorated with clouds. Also, there is much more light than I expected. I was quite sure that this trip would be beyond miserable. But instead I have enjoyed it quite a bit. Arrival anytime now would be fine. Outside the porthole there is just a sea of clouds. Perhaps soon we will be descending into the Arctic. We are just rounding 4pm EST. Well- that's all for me right now. More later when we are in Greenland!

Emily

Jasmine and Robert during the ANG flight to Greenland. Robert stands to the left while Jasmine sits on the red jump seats.

This was my first glimpse of Greenland. The view made me so excited - the trip became real to me for the first time - and I momentarily got giddy, bouncy, and giggly (all by myself). Luckily, none of the ANG crew seemed to notice my little celebration dance.

On the Ground in Greenland!

After landing in Greenland and riding in a bus over to Kangerlussuaq International Science Support. We settled in, unpacked our bags and gratefully ate. Soon we bustled off to make use of the sunlight (which stays up all night this time of year!) and did some sightseeing.

This is a photo of the plane that we flew over in. I took this from the shuttle bus that came and picked us up when we first arrived in Greenland.

This is the Kangerlussuaq International Science Support building (the red one). It is basically an

old Army barrack that has some offices, lab spaces, and the upstairs is all dorms. I am way down at the end and have a room with a view of the mountain.

Here I am at the top of Sugarloaf (ht. 1,158 ft. or 353 meters). In the far distance behind me you can see Russell Glacier! It is about 20 km to the East. The hike was short and steep- straight up the side of the hill from 100 meters (328ft) to the top! But the view was worth it! :) On the way to hike we saw a juvenile caribou in the road – he was about the size of a small deer and on the hike up the trail I saw my first Lapland Bunting! The tundra is beautiful!

This is a shot of Sugarloaf taken from Kangerlussuaq. I spent some time exploring the town and nearby roads with the telephoto lens and tripod. :) Great day!

Another beautiful view. This place is captivating. I love the feeling of space all around. The air is crisp and cool. It is very dry and there are small dust storms that move across the landscape. I could spend all day just watching the world go by here.

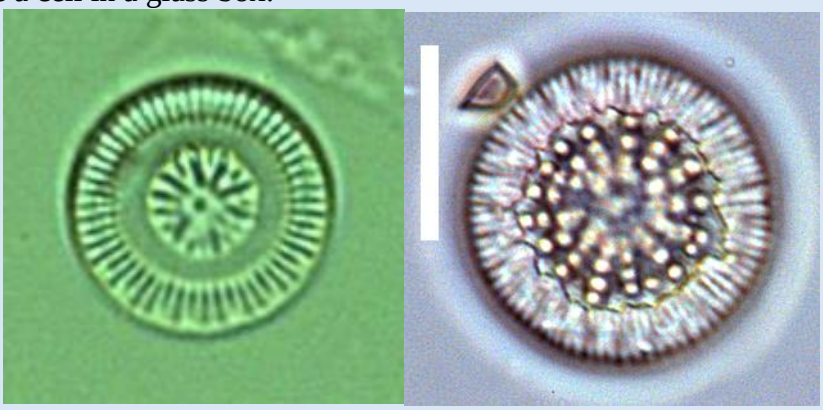
Let the Fieldwork Begin!

I had my first field experience with the team today. :) It went well. We just went to one small, shallow lake that is right next to a road. We built a small zodiac (with a motor) and went out onto the lake. The work looks quite do-able (although it will be cold, wet and windy). But it just takes being a little particular about how things are done, obsessive about keeping some of the equipment (computer/devices/contacts) dry, and being consistent with measurements. Honestly – that is so much easier than trying not to step on eggs in the tern colony or not to injure chicks while you band, or not to kill birds in mist nets, or not to fall off a cliff that is covered in guano. So – in short – the work looks great. Plus it's all nice things like: pH, temperature, light readings, depth readings, and zooplankton collection. Today it got quite cold and I realized that I didn't bring enough layers with me to the lake in my bag. Glad we started small - because a different day that would have been a big mistake. Most of the water processing will happen back in the US - so what we did today will be pretty standard for our work here. :) Also, I saw a snow bunting today! :)

Digging the Diatoms!

We have the day off today – so let me fill you in more about what we are doing here in Greenland. We are up here in the Arctic studying lake ecology. We are looking at the interactions between the physical environment and the organisms in the environment with a specific focus on microscopic, single-celled, algae called diatoms. These tiny little creatures float in the waters of the lakes, take up nutrients from the waters, and make food from sunlight using photosynthesis. Diatoms have a number of names - they can be called phytoplankton, algae,

protists, and invertebrates. They build themselves a little hard shell/skeleton made out of silica - the same material as glass. The photos below are of *Cyclotella* diatoms. You can see how these creatures are like a cell in a glass box.



This glass skeleton is helpful to us as researchers. When diatoms die they settle to the bottom of the lake. Their bodies decay - but their little glass skeletons remain. Year after year, the little skeletons are buried as new sediment collects on the bottom. To learn what has happened to diatom populations in the past, researchers can collect a sedimentary "core." A core is a hollow plastic tube that is pushed down deep into the mud at the bottom of the lake. When researchers lift the tube back out they can see a cross section of mud from different times. The most recent deposits are on the top and the oldest mud, the mud that has been buried the longest is on the bottom. Researchers can then look at the different layers of the mud and identify the species of diatoms present using microscopes. These cores allow researchers to see what the diatom populations looked like in the past.

In our research we are trying to learn more about what influences the populations of diatoms. For example, a lake core might show us a dramatic change in diatom populations over time - but if we don't know what can cause diatom populations to change it will be hard to understand what the core tells us about the climate conditions. So we are studying a collection of approximately 30 lakes that are all in the area of Kangerlussuaq, Greenland. These lakes are all quite different from each other. Some have lots of nutrients that can help feed algae - while others have almost no nutrients. Some have lots of light while other have low light conditions. Some of the lakes have lots of plankton that eat diatoms, while others only have a little. The list of differences goes on and on. By trying to understand all the complex factors that can influence diatom populations, we are learning more about how to correlate what we have found with lake cores to environmental conditions.

How does this all connect to current day questions of climate change? One way of thinking about our research is that we are looking at how ecosystems respond to changes in the climate over time. This means we are not specifically studying how or why the earth system fluctuates, but instead we are looking at how the ecology of lakes changes in response to differences in climate. This information helps us to understand the potential implications of climate change in lakes - and it also helps us to understand what has happened in lakes in the past.

To get this information we use a variety of tools. We collect information about the water chemistry using a computerized tool called a "hydrolab." This tool is lowered meter by meter into the lake and provides a read out of information about the water conditions. It gives us the water temperature, dissolved oxygen content, pH, and chlorophyll. In the photo below Ben (on

the right) lowers the hydrolab into the lake while Jasmine (center) reads the data to Rob (left) who records each measurement.

We also collect water samples from the top waters, the middle waters, and the deepest waters using the van Dorn device. We also use a complex (and expensive!) light reader that measures the amount of light as we slowly lower it through the water column and slowly bring it back up again. This device has a light meter that remains on the boat to correlate what light is available and what light is in the lake. We also how clear the water is by lowering a disk into the lake and seeing how far we can lower it before it is no longer visible. Finally, we also collect zooplankton (the bigger plankton that eats diatoms). We do this by lowering a net down into the lake and slowly pulling it back up through the water. Then we pour the contents into a little jar. This is my favorite data collection step because the zooplankton have a lot of character and are often quite cute.

To process the data, we bring the water samples back to the lab where the team preserves the samples using a variety of chemical techniques.

Hiking to Lakes

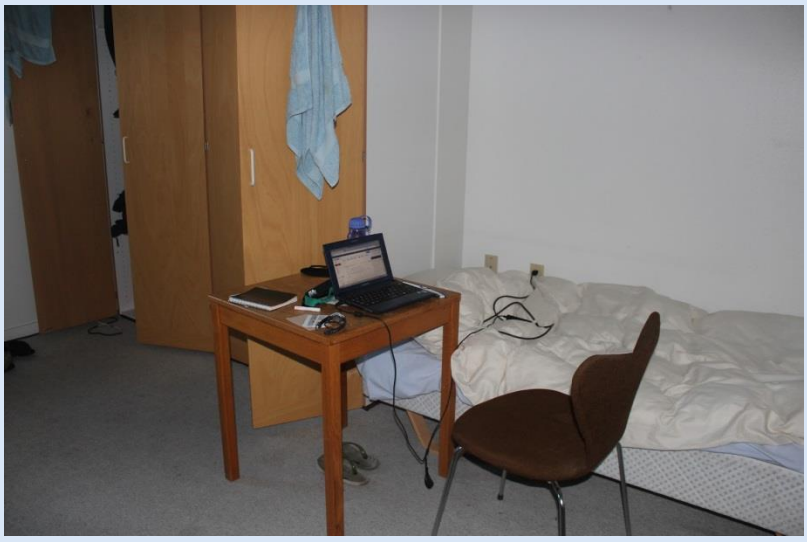
Today we went out to two lakes on our first hike. This was the first time that I went off trail onto the tundra. It was an incredible experience. The land is soft and squishy - like salt marsh peat - but it is extremely dry. The trees are tiny and are more little scrub brush. One

species is a willow and the other is a dwarf birch. There was beautiful cotton grass - with big poofs on the end that look like the puff that Horton found Cindy Lou Who on. There was sage, which down by the lake put up a wonderful aroma. There was also a juniper looking plant - I haven't had time to fully identify everything new I saw today. We also saw some little waterfowl that looked like grebes - but I couldn't get a close enough look to figure it out. We also saw another loon. And there were some geese as well. I got a lovely little lecture from a Lapland Bunting today - I stopped and said hi to him while I caught my breath. Also, I got to hang out with a little Common Redpoll (looks like a sparrow with a red splotch on its head and white near the rump). It wanted to be where we decided to put in to the lake - so it kept coming back.

Again, another photo from the earlier day. Shows a little of what the scrub looks like. I'll try to get some more of the tundra peat and terrain. It is really, quite beautiful. The lakes are beautiful and pristine. The hiking is difficult because the vegetation is thick and the ground uneven with roots, peat, and rocks. But it is absolutely amazing to be out in the isolation of the tundra. Having a blast here!

Life at Base Camp

This is the view out the window of the dorm room that Jasmine and I are sharing. It was taken at 9:45pm. It is really neat how the sun doesn’t set here in the summer. It makes taking lots of footage easy! Sometimes I have to remind myself to rest though – just because there is light at midnight doesn’t make it a great idea for me to be filming 24-7!



This is the dorm room – looks just like college! Note the comfy comforter and pillow! This fieldwork is great! :) Many times in the past I've done fieldwork in remote locations (islands far off shore for example) where we didn't have running water, slept in tents, and had no electricity. While I love that type of work too – I must admit that the fieldwork logistics here are much more comfortable!

A Long Hike

Today was the longest hike of the trip! We went way into the tundra (3 hours of intense hiking) sampled two lakes and then hiked our way back out. The hike was beautiful! We were all thrilled to get back to our comfy dorm life by the end of the day. Hot showers, food, internet, and comfy beds await our tired bodies and beat feet.

Glacier Adventures

I had the most amazing day! Today, we traveled to the lakes that are near the ice sheet. The roads are twisty, bumpy, and made entirely of gravel. I filmed the research team from another boat, walked on a glacier, saw reindeer (caribou), filmed an arctic hare with a telephoto lens, and filmed the research team. I helped lug things, blew up the rubber boats, and used the camera. It was the best work day I have ever had. :) This is my dream job. I am loving it!

Here is the research team at work on the Zodiac. We are out on lake SS903 which is at the base of the ice sheet. This was our first day out by the ice sheet - so I went a little nuts with my camera! This shot was taken from a second boat. We didn't have a second anchor- so Steve paddled us around in the rubber raft. It was very windy - so he ended up paddling a lot.

This is Steve. He is a British Geographer/Statistician. In this shot he is my crew for filming on the lake. In the background you can see the glacier!

In this shot Ben Burpee prepares to lower the van Dorn (water sampling tool) into the lake. The tool holds open both white flaps (closed in this photo) until the metal messenger hits a button at the top. When the messenger hits, the white flaps snap shut – locking in water from the sampling depth. It is then pulled back up for collection purposes. By a funny coincidence- Ben and I are co-authors on a Toxicology paper with Dr. Julie Gosse. :) Go UMaine!

I loved this view. I took this from where we put into lake SS903.

The land of Tundra and Ice.

My first ever telephoto lens wildlife shot. This is an Arctic Hare posing for me by the glacier. I love my job! The Arctic Hare, *Lepus arcticus*, is the largest hare species. Unlike rabbits, arctic hares are born in open nests on the tundra and are able to run shortly after birth. They are both open eyed and fully furred when they are born in case they need to make a quick getaway. This makes sense considering the rough weather conditions on the tundra and the prevalence of predators. Here in South Western Greenland, their primary predator would be the Arctic Fox. In other regions of the arctic the hares would also be prey to Snowy Owls, Wolves, Ermines, and Rough-Legged Hawks.

Hello from Russell Glacier! :) I learned from a glaciologist here at base camp that while this glacier looks very pretty, it is not very useful to study it because it is actually a place where two ice sheets meet and converge with the river that leads to the fiord. I don't know much about the study of glaciers - so I asked the researcher what questions they are trying to answer. He said that they are looking to answer the question "what makes glaciers slide?" He said we have assumed that we know the answer— but that the more data we collect the less we find we actually know about it. They had just arrived back from a field camp at the base of the glacier. They were supposed to take a helicopter back but apparently their charter fell through somehow so they hiked out - a good 10 mile hike over the squishy tundra with all their gear. They look exhausted!

Load um up! This is our research vehicle.

This was our second lake for the day, SS18. In this shot, Jasmine, Rob and Ben prepare for sampling.

This is the collection of zooplankton - my favorite step! The samples usually have all kinds of interesting little invertebrates to look at. For example, lots of the lakes have little Daphnia that are big enough to see with your naked eye. They swim around the jar in a down right cute way - and the samples look quite different depending on the lakes.
I am having a blast. Can't wait to bring this footage home! :)

Musk Oxen!

Today on our hike we came across this herd of Musk Oxen! I don't know if you can tell from the photo below, but there were babies in the group. They hung closely together and made a run for it over the top of the hill as we approached. Being up here is I think the closest you can come to feeling like you are amongst Wooly Mammoths.

Later in our hike the herd showed back at the top of the hill. They stayed for a while. It felt like

they were watching us make our slow progress to the lake.

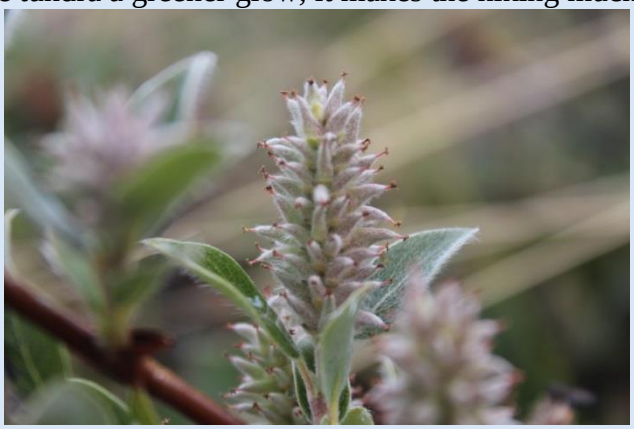
It is difficult to see in this photo- but if you look closely, the researchers are by the lake and the musk oxen are still up on the hill as if overlooking our progress.

Tundra flowers :)

I love these flowers. I think they are some form of Harebell.

This is a close-up on a dwarf birch. This is an Arctic tree. They don’t grow tall here though – they remain close to the ground like a shrub.

This messy photo is meant to show you how the vegetation of the tundra looks. In this area (quite close to the ice sheet) the vegetation is much closer to the ground than in the areas we did our major hiking in. In this area the scrub grew to maybe 2 feet high. Out in the areas farther from the ice sheet the vegetation can grow more to 3 1/2-4 ft. high in places. While the thicker vegetation gives the tundra a greener glow, it makes the hiking much more challenging.



This is the flower of a dwarf willow. The bugs LOVE these.

Today was the last hiking day of fieldwork. I only get three more field days – the rest of the trip I am going to be around the town of Kangerlussuaq and will take some hikes in the local area with the telephoto. The next field days are helicopter trips! So hold on to your hats! :) I'll bring back some photos.

Most nights we get our dinner form the Polar Bear Inn – it's not really an inn, just a convenience store and small restaurant with a take out menu. We purchase the food with tickets provided by Kangerlussauq International Science Support – so we are always trying to cobble together as much food as we can on each ticket so as not to waste the extra. One of the interesting little tidbits about the food here is that the soda is made with real sugar. So Coca-Cola tastes quite different than it does in the U.S. This is pretty common over-seas – in fact I think some grocery stores in the U.S. carry "Mexican Coke" in their international aisles – it is the same thing, made with real sugar, and usually found in smaller glass bottles. Other interesting things about the food are that you can have Musk Oxen (instead of beef) in almost anything from Arctic pad thai to pizza. Your other option is chicken. While there are a million reasons to come do work in Greenland – pack your favorite granola bars from home – the food is not this beautiful place's best attraction.

Take-out food from The Polar Bear for my supper! This is "Chicken Fried Noodle" and is the best dish on the menu that I've found so far. Sorry it's not musk ox pizza ...

An Elegant Experiment

This evening I helped Jasmine (well - mostly I filmed her but I helped a little toward the end) pull an experiment out of the incubator. This experiment artificially simulates light conditions of a stratified lake and uses nutrient treatments to study diatom population ecology under varying environmental conditions.

Here is a small selection of sample vials from the experiment. The bottles on the right (stacked horizontally) are set up to simulate light differences in the surface, middle, and lowest waters of the lakes. The orange bottles on the left have been preserved using an iodine solution.

See how the top layer of containers has no mesh? These are the High Light water samples. They represent the topmost or surface layer of lake water where light from the sun is bright. The second layer is covered with a light mesh that blocks about 40% of the light. This layer represents the middle waters of a lake with moderate light reaching it. The bottom layer, with the darkest mesh, represents the waters that are so deep that very little light reaches them. This mesh bag blocks 80% of the light - so the sample stays relatively dark even when put in a

chamber that is full of light. Inside each bottle is lake water from a single lake. In this case this water came from Lake SS2. Some of the bottles have been given nutrients (like nitrogen or phosphorus) while others have been kept without nutrients as a control. The bottles are placed in a chamber full of light with good growing conditions for a week. At the end of the week, the bottles are taken out and are treated with an iodine liquid (called Lugol's) that preserves the diatoms - the orange bottles on the left. Then the bottles will be transported back to the lab at the University of Maine. With the help of a microscope, Jasmine and her students can count the number of diatoms in each sample and compare the growth of the diatom populations according to the light conditions and nutrient conditions. The results of this experiment will help to explain how diatom populations grow in lakes and which environmental factors influence them the most.

Why does this matter for climate change? Well, remember that we said that when diatoms die they fall to the bottom of the lake. They stack up there in the mud overtime, becoming layers upon layers of glass-like fossils that we can examine as a biological timeline for the lake. These historical records of the lake can go back thousands of years. They have great potential to tell us about the conditions of the lakes through time – helping us to better understand what we see today and better able to predict climate related changes in the future – but until we understand how environmental factors influence the lives of diatoms, the secrets of their fossils remain a mystery. Studies like this experiment allow us to unlock the lives of these tiny creatures so we can better understand which conditions make them thrive.

Not sure what these flowers are - but I liked the contrast of the flowers and the glacier.

This is a glacial stream - this water is flowing out of the bottom of a glacial water lake. It meanders its way through the tundra and adds a wonderful water gurgling noise to the tundra.

Here is a glacial lake! :) While the ice touched lakes seem glamorous, they aren't actually useful for the types of research Jasmine and her team are conducting. Diatom population dynamics are easier to study in isolated lakes, lakes that have no major rivers, streams, or glaciers. These glacial lakes introduce extra variables that aren't the focus of Jasmine's work. Therefore, we didn't use them in the studies.

Above: This is where the glacial stream joins other streams and starts to turn into the river that works its way to the Fiord near Kangerlussuaq. Below: Yes - that is a reindeer! Or you can call it a caribou. Seeing one of these for the first time was like seeing Santa.

Air Greenland – The Red Helicopter

Jasmine and Robert wait by the helicopter as the pilot does some paperwork and last minute safety procedures.

Jasmine directs the helicopter pilot to the right lake out of the thousands of lakes that surround Kangerlussuaq.

Above: One of the study lakes as seen from the helicopter as we approached for a landing. In fact this is Lake 2 for the Virtual Fieldwork Experience. Below: Cockpit of the helicopter.

Final Fieldwork Day

Today we completed our last day of fieldwork. I was both sad during the day and very happy when we were totally done. It was another beautiful morning on the tundra. We flew out in "Uniform Alpha" and landed at Lake SS16. There I helped the team unload, then Ben, Jasmine and Rob went out to do the sampling. So I used the telephoto lens and had fun playing photographer for a couple hours. In the afternoon, we disassembled three very large sediment traps. This took hours and was very challenging. Ben and Robert took on the brunt of lifting - I am very grateful because I think I would have ended up in the lake based on the hefty nature of the equipment. As we were negotiating with the second sediment trap, the skies clouded and it began to rain. It rained for well over an hour – and I realized how important it is to have an extra fleece, pair of socks, and extra gloves in a dry bag. The helicopter took most of our gear back to the airport - leaving us alone in the rain for about half an hour. I was soaked and cold through - so I put on my dry clothes and they made a huge difference. Seeing the helicopter come back for us was a wonderful sight. After a hot shower and hot dinner - I was right back to myself. :) We completed the lab work and started packing our gear up. We pack up the rest of the gear tomorrow - and fly home Friday morning. I am terribly sorry to leave but just so happy to come home! I've had the most fun–as you can probably tell!

Greenland Cotton Grass

Epilogue

As I pull together this log, a year after travelling to Greenland, I am cursed by the forgetfulness of time. Greenland and the fieldwork with Jasmine, Robert, Ben, and Steve were some of the best times I've ever had doing fieldwork. While this log aims to share a taste of fieldwork – it comes nowhere close to sharing the squishy spring of tundra grass under tired feet. It cannot capture the wisps of dry wind, the silky warm touch of musk oxen wool, or the triumph of a successful day. Therefore, I find myself only able to offer this one piece of advice.

In an interview with Dr. Saros, I asked her what she would tell a young person who is interested in her type of work. Her response was that they should ***try it***. She said in her experience, many students feel that they cannot do fieldwork. Usually once they get a chance to ***try it*** – they discover an internal strength they never knew they had – they get the taste and they gain confidence. Reflecting on my recent work in Greenland and many past adventures on remote seabird islands, I think Jasmine is right. For me fieldwork is the best of the best. It is the days when no amount of mud, or rain, or fog can stand in your way. You are working hard to learn everything that you can about what you are studying, to work as a team with a challenging task to complete, to do things that no one else gets to do. Those are the days that you are alive.

So to answer my own question – what would I tell a young person who found this work intriguing – I'd say follow your heart. I'd say ***try it***. Fieldwork is rewarding. Fieldwork is challenging. But above all, fieldwork is fun. If it speaks to you, seek out opportunities to volunteer with researchers near you. I started in high school as a volunteer working with birds. That experience taught me more about myself than anything else I have ever done. Since then I have led projects, supported projects, and have come to love communicating research with others. My advice to you – the student who thinks perhaps you are up to this type of crazy adventure—get your feet wet. You'd be amazed what the water can do!