

## CONVERSATION

# In the field: an interview with Holly Shiels

Holly Shiels is a Reader at The University of Manchester, UK, where she investigates cardiac physiology in ectotherms. She completed her undergraduate degree in Biology at University of Western Ontario, Canada, before moving to Simon Fraser University, Canada, to complete her Master's degree and PhD. After postdoctoral studies at Stanford University, USA, and the University of Leeds, UK, Shiels moved to the University of Manchester, UK, first as a Lecturer and then Senior Lecturer. Telling us about her first experience of fieldwork on the coast of New Brunswick, Canada, Shiels describes the highs and lows of research on the ocean in the tropics and North Atlantic.

### Which animals most fascinated you as a child?

I suppose I have always been interested in animals. We had a big backyard where I grew up in Oakville, just outside Toronto, Canada, and I enjoyed watching all the birds and squirrels. Sadly, I am asthmatic and allergic to animals with fur, which is probably why we had a fish tank and I really enjoyed fishes and turtles. I also had a velveteen rex – a hypoallergenic rabbit. Fortunately, the majority of animals on the planet do not have fur, so there is a whole world of zoology that doesn't require nose spray to study it.

### What was your first experience of field work?

I did Biology and Zoology as an undergraduate at the University of Western Ontario, Canada, and my first experience of field work was in the summer before my final year. I decided to enrol for a field course in marine biology. We got on a bus in Ontario, drove out to St Andrews Biological Station in New Brunswick and did a 3 week intensive intertidal zone marine biology field course. It was a complete eye opener for me. I had taken invertebrate biology as part of my second year Zoology course, but it was quite boring until I got into the intertidal zone. Then I was looking at invertebrates, molluscs, annelids and worms on the seashore and suddenly everything took on a very exciting new meaning. Invertebrate biology comes to life when you are at the sea-side.

The field course was also the first time I was in charge of my own scientific experiment. I set up a hypothesis and tested it. It gave me that thrill of discovery and I began thinking that this could be something that I would like to do further. Louise Milligan, the professor from Western who organised the course, realised that I was loving scientific discovery and asked if I was doing a final year project. I had planned to do a written history of science project. She said that sounded fantastic, but if I wanted to change my mind and do a research project she would offer me a place in her lab. I thought, 'Why not?' and so I did a final year project with her on fish swimming and muscle physiology. That project started my career in fish physiology. I moved from fish skeletal muscle to fish cardiac muscle when I went to study with Tony Farrell for my Master's and PhD at Simon Fraser University, Canada, and never looked back.

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## Invertebrate biology comes to life when you are at the sea-side

### Did you do any field work during your PhD?

Some of my work was field based and I spent a few months at Bamfield Marine Station on the west coast of Vancouver Island. For one of my studies, I'd get a fishing rod in the morning and go down to the inlet behind the station to fish. When I'd caught a mackerel my experiments would begin. I'd take out the heart and look at the force/frequency relationship and calcium cycling in the tissue. Probably the most exciting work while I was a graduate student happened after my Master's degree. I had been building up questions that could only be answered in tuna and at that time Rich Brill's lab in Hawaii was one of the best places to work with tuna. I had a chat with Tony and he said that the questions were beyond the scope of my Master's, but if I stayed on for a PhD he could probably organise that I started it in Hawaii. I remember thinking, 'Sign me up!'. So I went to Hawaii to work with Rich at the Kewalo Research station in Honolulu. As part of my 6 month sojourn we went on the Oscar Elton Sette research vessel for a 12 day expedition. That was my first experience of 'expedition style' fieldwork. I loved it and I have tried to maintain a foot in expedition research ever since.

### How did you prepare for that first field trip?

I discussed how to carry out the project with Rich and Tony; the equipment I would need, the number of animals, the contingencies, solution making – all the basics. We designed the project together and planned it thoroughly. When you go on one of these expeditions, you

are on a massive ship and there are many different things that you wouldn't normally have to consider. In this case, the ship was a National Oceanic and Atmospheric Administration (NOAA) research vessel that was part of the military fleet. There was quite a lot of red tape and I had to pass military clearance. When I got onto the ship I realised the size of it, the size of the crew – it was a huge expedition; a lot of the detailed planning was beyond me because I was a graduate student. Now I am responsible for planning big teams and writing the grants to get ship time. These ships can cost thousands of pounds a day to run, so field trips can't fail.

#### How did you catch tuna?

We set long lines, which is a mode of open water fishing that allows you to catch fish at different depths. As we knew the depth of the hooks, we could anticipate what we should catch and then we wanted to look at the thermal sensitivity of their cardiac function. Usually we set the lines the night before, pulled them up in the morning and hopefully had a fish. It takes a crew of maybe six really experienced fishermen to launch an industrial-sized long line and it was pretty impressive when they brought the fish on board. We were after big eye tuna, which is one of the larger ones that live really deep, they can be about 100 kg, sometimes more. When we were fishing at the surface, we looked for skipjack or yellowfin tuna, which are smaller (10–30 kg) and we used hook and rod behind the boat to catch them.

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#### Can you describe the challenges of performing experiments on a ship?

We'd leave Honolulu harbour and transit all the way across to the lee side of Kona, to work in the shadow of the big island of Hawaii, about 200 miles offshore. The transit across open sea to the location where we worked was very rough, but once we got there the weather was quite calm, so it allowed us to work on the boat. To overcome the problems of measuring muscle force in rough seas, Rich organised a force transducer that had an empty hook, which felt the force as the boat moved, so we were able to take that signal and subtract it from the signals that had muscle contractions on top. Our question was, does the thermal sensitivity of the heart affect where the animal can live? We basically changed the temperature of a strip of heart muscle, looked at the effect on contractility and then we used pharmacological agents to try and look at the key mechanisms that would be maintaining contractility as we changed the temperature.

#### How often do you go out into the field now?

Not as much as I would like! Locally around Manchester, we are involved with river trusts and projects in the Ribble catchment looking at microplastics and fish. But in the last three years I have also been involved in Greenland shark expeditions with John Steffensen in the Arctic, wearing survival suits on research vessels with reinforced hulls. Initially, I got involved because Rich Brill couldn't go in 2017 and he recommended me. John called and asked if I'd be willing to lead the cardiac perspective. Of course, I said yes. I have now been on two of these expeditions; one in May 2017 and



Holly Shiels on the deck of the RV Sanna in the southern fjords near Qaqortoq, Greenland. Photo credit: Holly Shiels.

another in summer 2019. We had a third trip planned for this September [2020], but we cancelled it because of the COVID-19 pandemic.

#### Take us through how you catch a Greenland shark

We use long-line fishing again. First, we talk to the native communities in Greenland and buy a dead seal to use for bait; we've also used a beached whale. The bait is pretty stinky and the sharks are also quite foul smelling, so it can be pretty unpleasant on the fan tail of the ship. We drop the lines down to 400–700 m in the evening, then pull them up at dawn the following morning and hopefully catch a shark. Greenland sharks are fascinating because of their longevity. For years, they've been this elusive, inedible, large, slow but predatory shark in the Arctic waters. In 2016, John Steffensen and his PhD student Julius Nielsen published a paper showing that these are probably the oldest vertebrates on the planet, living at least 270 years and maybe as long as 500 years. They live in the dark depths and they taste foul, so nobody wants them. In fact, they're considered pests by local fisherman, although there was an enormous fishery for them at the beginning of the 1900s; their livers were used to make machine oil. We think the fishery was taking anywhere between 50,000 to 150,000 animals each year for more than 50 years. We didn't understand until recently why we don't find many juveniles or pups. Their longevity and life history suggests they take up to 150 years to reach reproductive age; essentially we have a population of teenagers up there – even if they're 150-year-old teenagers.

#### What is it like being on board ship in the Arctic?

We board the ship where it last docked and then we take it to where we want to set our lines. In this case, it means that we have to travel through the North Sea, which is pretty rough, to get to the southern fjords. There can be 6 m swells. When we went in 2017, we knew how bad the weather was going to be while we were still in the port at Nuuk, the capital of Greenland, so we had to tie everything down; the equipment is precious. We had packed all of it three and a half months before we were due to arrive in Nuuk, then it was shipped to Copenhagen, where it got loaded into a crate and then onto a tanker, which brought it to Greenland to where it was unpacked and loaded onto the ship. In that situation the worst thing you can do is take all your expensive equipment out to sea and get it smashed by the waves.

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### Tell us what riding a 6 m swell feels like

Imagine the movie 'Perfect Storm'; that is the best it can be. You go down a trough and you come up the other side; it's hard to eat and work under those conditions. During the transit around Greenland we had cross waves, where you have one set of waves that are going up and down 6 m, but then there is another set of waves hitting you broadside, into the side of the boat. It's the closest thing to being in a massive tumble dryer; your body can't anticipate the motion, you're just being thrown left, right and centre and you don't have any sense of which way the waves are going to hit from. It's really disorientating, it can make people feel extremely sick and it's physically exhausting. I'm impressed with the crew who work under those conditions; it took all my energy just to not cry. When we arrived in the calm of the fjords, all the scientists who had been looking exceptionally green in their bunks below decks for 18 hours were able to emerge and stretch on the deck and see the glory of the Arctic.

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### Who manages the research vessels in Europe?

Eurofleets+ is the organization that hosts about 27 research vessels conducting research at sea for Europe, throughout the Mediterranean, the North Sea and also Antarctica. It is a research council that was put together about 10 years ago as part of an EU project and it has two roles. One is to assess the scientific integrity and probability of success of the applications that come in; I was invited to join that panel about a year and a half ago. Once we have chosen the best scientific projects to use the vessels for, it goes to a logistics panel, which tries to match up the schedules to allow as many people as possible to use the boats full time for research, instead of the vessels sitting in dock. The organisation gets the most people possible onto the sea to conduct their research, and now I help to plan research expeditions and to assign finances and funding.

### If you were advising someone who was planning their first field trip, what are the three most important things you would tell them?

The first thing is plan thoroughly and the second would be to work as hard as you can, because you never know when you're going to get another chance. That fish could be the last fish you catch, you might only get one the whole trip, so make the most of everything.

We work ourselves to the bone, but I think it's the only way forward. And the last piece of advice would be to be flexible. Things change; a key piece of kit might get damaged, even if your experiments were planned fantastically. Then, do you decide to do nothing for the trip, or do you try to be flexible and think of other plans? Flexibility is really important, coupled with heavy planning and hard work.

### What's the most useful tool/instrument that you take into the field and why is it so important?

Obviously, it's going to be a knife; you need a knife because it could save your bacon. You don't ever want to be in a place where you're tied to something and you can't get out, especially on a ship. There are a lot of dangers on board, so everyone always has a knife to hand. The most dangerous time is setting and pulling up the long lines. Not only are ropes and bait and hooks going out and coming in, the line is also attached to large weights and pulleys and the animals that we're pulling up are huge, 4–5 m, and they don't want to be brought out of the water, so they pull the line really tight. If ever the long line snapped, it would really hurt, so we also wear survival suits on deck in Greenland.

## You need a knife because it could save your bacon

### How much training is there when you arrive on a boat?

A lot – in fact, you go through safety training as soon as you get on the boat; you learn how to put on your gear and take it off, you listen to all the different alarms and bells and learn what they mean. There is also training for the different areas on the boat – on deck training, below deck training – it's pretty intense and usually takes about half a day each time you get on the boat. Interestingly, the laws in Denmark and Greenland have recently changed, so now you need to have an official fire and marine safety course. Everyone takes this very seriously.

### How were your preparations for the September 2020 field trip going?

The vessel was due to leave Narsarsuaq on 19 September 2020, but we cancelled it on 1 August. It was a really tough decision for the team but safety had to come first. The decision was made jointly by the Greenland Shark Team: John Steffensen, Peter Bushnell, Diego Bernal and me. As much as we wanted to go, the level of contingency planning was getting insane. And, as the COVID-19 situation in Europe continued to get worse rather than better, we started to feel irresponsible in pushing ahead. We hope we can rearrange the trip for June 2021.

Holly Shiels was interviewed by Kathryn Knight. The interview has been edited and condensed with the interviewee's approval.