

CONVERSATION

In the field: an interview with Sandra Binning and Dominique Roche

Sandra Binning is an Assistant Professor at the Université de Montréal, Canada, and Dominique Roche is a Marie Curie Fellow at Carleton University, Canada. Together, they investigate how animals respond to environmental stressors. Binning and Roche completed their undergraduate degrees in Biology and master's degrees at McGill University, Canada, before undertaking their PhDs at the Australian National University, Australia. The pair then moved to the University of Neuchâtel, Switzerland, for a 4 year postdoc period. Binning and Roche tell us about working in field locations ranging from Barbados and Panama to Uganda and the Great Barrier Reef, and discuss scuba diving and safety when working in dangerous conditions.



Have you always been interested in animals and if so which ones and why?

SB I grew up in a suburb north of Montreal, but my father is an avid canoeist, so we were often on canoe trips on rivers in the summer time. I used to love playing with minnows in the sand banks at the side of rivers and I would make little pools for them. Sometimes, we went to the coast of Maine, where I played in the water. My mum put me in swimming lessons from a very early age; I ended up spending an enormous amount of time in and around the water, so I became interested in the creatures that were there, but I didn't get a taste of the coral reef fish and the marine life that I ended up working with until I was an adult.

DR My story sounds very similar, but I got my love of water and fish from my mother. My mother's father was a Polish immigrant and he loved hunting and fishing. He passed that on to my mother and when I was little my mum took me fishing too. After my grandfather died, my grandmother kept their summer cottage on the shores of Lake Champlain in the US. It was easy to snorkel in the lake and I would look for small fish and crayfish under the rocks. I think I have always been fascinated by fish, largely because they are so diverse and such an amazing group of animals.

How did fieldwork come into your lives?

SB We both did our undergraduate degrees in Montreal at McGill University, which has a field station in Barbados, the Bellairs Research Institute. McGill offers a 2 week course there in tropical ecology in May each year. Both of us signed up for it independently. We didn't know each other then, but we found ourselves with 24 other undergraduates in Barbados for 2 weeks. It was our first taste of fieldwork, as the course was essentially based in the field with some theory lessons. There were three modules: a sea grass module, a coral reef module and a terrestrial behaviour module. We fell in love with fieldwork and each other at the same time. Also, we both got scuba certified in Barbados before the course, which allowed us to do some cool diving and explore this new world together.

DR I enjoyed the experience in Barbados so much that I enrolled in an undergrad programme called the 'Panama Field Study Semester' when I got back to McGill. I went to Panama for 4 months and took four different courses, including an independent research project. There, I met Oscar Puebla, who was a teaching assistant for the programme. We got talking and he said, 'I'm looking for people to come and help dive and collect some fish for my PhD'. Because I had done that in Barbados and Sandra had her scuba certification, I said we could join him. Sandra flew in from Canada at the end of my programme and we jumped on the *Urraca*, the Smithsonian Tropical Research Institute's research vessel, in Panama. We went to the San Blas archipelago, which is an indigenous reserve with some amazingly remote areas that are almost inaccessible without a research vessel for 3 weeks diving with Oscar to help with his research.

We went to...some amazingly remote areas that are almost inaccessible without a research vessel

How did you prepare for a dive?

SB After breakfast, we'd kit up in our wet suits. We were diving with full 3 or even 5 mm wetsuits because you can get cold even in the tropics; sometimes we spent 6 h underwater with surface intervals. Before leaving, we had to make sure we had our fins, face masks and everything prepared for the full day. Every diver has a vest with weights, which inflates with air from the tank to help you control your buoyancy, and a breathing device – a regulator – which supplies you with air from the tank. I also had a hard Plexiglas surface to write on with pencils, because I was recording individual fish behaviour, and I also had a 50 m measuring tape with a stake to stick into the sand to measure the distance over which we were counting fish.

What did you both do after your undergraduate degree?

SB We stayed at McGill for our master's degrees and decided that we wanted to continue doing fieldwork on fish. I chose to study African cichlids in Uganda, working with Lauren Chapman. She has been doing research in Uganda for years and has an extremely

Sandra Binning works in the Department of Biological Sciences, The Université de Montréal, Montreal, QC, Canada, H3C 3J7. Dominique Roche works in the Department of Biology, Carleton University, Ottawa, ON, Canada, K1S 5B6. E-mail: sandra.ann.binning@umontreal.ca, dominiqueroche@carleton.ca

good team of local researchers who helped me. They knew the sites, the villages and had connections, which was really critical. We had to walk through people's farms to access some of the lakes and rivers that we wanted to sample. It required knowledge of the language, local customs and culture. I wouldn't have been able to do the work if we hadn't had the infrastructure and those relationships. I went on two trips to Africa; one where I helped with a field semester for undergrads when I did some preliminary work and then I went a second time for 2 months, where I conducted the majority of my fieldwork. We were out in the field every day, interspersed with a day or two of lab work to process the samples.

I wouldn't have been able to do the work if we hadn't had the infrastructure and those relationships.

DR I also switched gear for my master's; I went back to Panama and worked with New World cichlids and an invasive species, the Nile tilapia, in the Panama Canal, looking at whether parasites affected the native and invasive species differently. I was based at the Naos Island Laboratories, an aquatic research centre owned by the Smithsonian right next to the Panama Canal. I wasn't part of a group in the field, so I had to figure everything out on my own and there were lots of challenges. My Spanish was pretty good back then, so I managed to interact with local people and fishermen to get to the fish I needed. Luckily, I managed to get a field assistant, who was also my unofficial Spanish teacher. But I never got to dive or snorkel and look at the fish in their natural habitat, because there are crocodiles in the canal; it's quite dangerous to go in the water.

How did your passion for fieldwork contribute to your decision of where to go for your PhD?

SB At that point, I had decided that I wanted to do something that would bring me in closer contact with fish. I was reading a lot of the literature when writing up my master's thesis and I realised there was little communication between people in the marine and freshwater worlds. A lot of the questions I had been exploring for my master's could be applicable to fishes on coral reefs. Once I had made that decision, the obvious place to go was Australia. We were also lucky as we could apply for funding at the Canadian federal level and to the province of Quebec, so we applied at the end of our master's and were both lucky. That allowed us to go to the Australian National University in Canberra.

I realised there was little communication between people in the marine and freshwater worlds. A lot of the questions I had been exploring for my master's could be applicable to fishes on coral reefs.

How important was fieldwork during your PhD?

DR Fieldwork was a large component of our graduate research. We did most of it at the Lizard Island Research Station, which is probably the world's top spot to do tropical marine ecology. To get there, we flew from Canberra, Australia's capital, to Cairns in the far north and then took a 6-seater plane for an hour to go 300 km north to this magnificent island on the Great Barrier Reef. From the research station, you have direct access to the reef and there is a fleet of small research boats for daytrips to dive and observe or collect

fish from around the island. The station can host up to 37 researchers at any time and it has great lab facilities with lots of aquarium space, temperature-controlled rooms and amazing facilities for experimentation in the field.



Sandra Binning and Dominique Roche returning from a dive on the Great Barrier Reef at Lizard Island. Photo credit: Cayne Layton.

Tell us about a typical day on Lizard Island

DR After getting up and having breakfast in the morning, we would walk to the labs to check on any experiments that were ongoing. Then, we'd go to the shed on the beach where we kept all of our diving gear, sign out a boat and zip around the island to a dive site to observe fish or collect them and bring them back to the lab for experiments. When we were catching fish, we had to be very coordinated, so they wouldn't escape or swim in the wrong direction; a bit like cowboys herd cattle. We've known each other for a long time and we are very good at reading each other's minds, which is handy when you're underwater and can't talk. We use a barrier net to catch fish – it's a monofilament net with fine mesh that is too small for the fish to get stuck in. Fish have nowhere to go when they hit this invisible wall and that's when we scoop them up with a hand net. We each had our specialty when it came to catching different fishes. Sometimes, Sandra knew the behaviour of certain species better than I did, so I let her work her magic. When we'd caught a fish, we'd put it in a large Ziploc bag with enough water to last the rest of the dive. Then, we'd bring our catch back up to the boat, put the fish in a large bin with bubbles from an air pump and transport them to the research station. The whole process could take 1–4 h, depending on how many fish we needed and how smart they were about avoiding our net.

When we were catching fish, we had to coordinate together well...we are very good at reading each other's minds

What risks and dangers did you have to overcome when working on Lizard Island?

SB Some of the sites that we were working on were very rough and wavy, so we had to be accomplished divers. During our PhDs, we compared fishes on wave-exposed habitats versus fishes in calm

lagoon habitats to look at their swimming performance and their morphological adaptations. This meant that we were out in all weather and sometimes in wind conditions that were quite intense, so we really had to be comfortable diving when it was like that. However, some of our field assistants felt uncertain about working in rough conditions. Sometimes, we went diving in areas that had extreme currents, so we became skilled under water very quickly and learned to assess environmental risks early in our careers. We also had to learn how to drive a boat in extreme wave conditions. Luckily, Dom is a very good boat driver, so on hairy days when the winds were very high, I let him drive. When it was like that, we also had to be very careful that the anchor was properly set, because it can get pulled, especially if you are not paying attention to the tide. If you go out at low tide and stay for a long time, the tide will come back in and you can find yourself in a dangerous situation where the rope can snap if you haven't left enough slack. We also had to make sure that we were paying proper attention to the air in our tanks, so that we didn't run out while swimming hard against strong currents. In addition, we were aware of sharks, especially when we were collecting fish. Fish that are struggling in a net can sometimes attract predators. We would often see sharks, so knowing their behaviour was really important. Some species are just curious and not threatening, but others would start displaying behaviours that would mean they were getting interested and potentially dangerous. Then, we would abort the dive. Nothing is more important than keeping both of your hands!

How did you learn the skills you needed to work on the Barrier Reef?

SB The team on Lizard Island was primarily responsible for making decisions about what was safe and what was unsafe and Anne Hoggett and Lyle Vail, the directors of the Lizard Island Research Station, are excellent. They are absolutely concerned about the researchers' safety. They do an extremely good job of making sure that everyone is aware of the risks. Lyle goes out in the boats and runs through how to drive and manoeuvre them with everyone, to make sure that everyone feels comfortable. Getting permission from Lyle to access some of the sites was on a case by case basis. He was aware of Dom's driving skills and sometimes gave him permission to access areas where most people wouldn't be allowed to go. Still, occasionally he would say, 'I'm sorry, the conditions are too dangerous, I am not letting you go'. No matter how often we had gone to the research station or how many days we had spent there, every time we went back, Lyle would go through the safety protocols for working on boats with us again; that was excellent. You always benefit from a refresher, even if you have done it before. I don't think that scuba diving is necessarily any more dangerous than any other kind of fieldwork as long as you know the risks and you know how to mitigate those risks as best as possible with the equipment that you have and the researchers that you are working with.

No matter how often we had gone to the research station or how many days we had spent there, every time we went back, Lyle would go through the safety protocols for working on the boats with us again.

Has having a family changed how you work in the field?

DR We take our children with us. Emeric, our 3 year old, was born in Switzerland when we were at the University of Neuchâtel during our postdocs. The university had grants to help women in science do fieldwork with their children, to pay for a carer to come to the field site with them. That was one of the most wonderful things that happened to us. Sandra applied for one of the grants and got 6000 Swiss francs. That paid for my mother to come to Lizard Island for a month to care for Emeric, who was 8 months old at the time, while Sandra and I did fieldwork. My father joined us as well and worked as a volunteer at the research station. It was amazing; we would come back from being out on the reef and Emeric was there waiting for us, playing in the puddles at low tide with my mother. We also took him to a field station in Sweden for 3 weeks in 2017, where we did some experiments with colleagues. Sandra and I shared the childcare. That's a big benefit of being a couple doing research: when we join field trips, one of us takes care of the kids while the other does work and we just trade like that.

SB We also did a field season at Lizard Island when I was pregnant with Emeric. The pregnancy prevented me from diving, so I had to modify some of my plans. That was when having a partner who knew my project and could pick up some of the slack was really critical. Now that I am a professor at the Université de Montréal, I work at our field station called the Laurentians Biology Station, located between three lakes about 1.25 h north of Montreal. My students do both lab and fieldwork there. Last summer (2019), I had two master's students with an assistant each, so there was a team of 4 people working while I was on maternity leave with our daughter Elodie. She was still pretty young at that point, so, when I needed to go and visit for a day, I usually took her with me.

That was when having a partner who knew my project and could pick up some of the slack was really critical.

What is the plan for your next field trip?

SB We'll see what happens with COVID-19, but at the moment I am planning our annual field trip to the Laurentians Biology Station. My group is working on pumpkinseed sunfish, a very common species native to North America. There are lots of sunfish in the field station lakes with very different incidences of certain parasites. We are trying to understand how the parasites affect the physiology and behaviour of their fish hosts, including things like whether parasites influence the temperature preference of the fish. Also, I want to understand why there is such variation in the types and numbers of parasites across the lakes, which are connected and very close together. My students should be there from June to the beginning of September 2020, if we are allowed to go. They will be snorkelling and counting the fish that are infected with a parasite that causes black spots on the fish's fins and skin, as well as catching fish in baited traps and seine nets before running experiments in the lab. I have my fingers crossed that we can get out there and work!

Sandra Binning and Dominique Roche were interviewed by Kathryn Knight. The interview has been edited and condensed with the interviewees' approval.