

Project Description

Context – The Ocean has always fascinated me. My childhood dream was to be a deep-sea explorer. As I grew up, I began to consider other career options; however, in high school I rediscovered my initial aspiration. Occupational diving is hazardous and its schooling is expensive. Feeling that I had more to learn about the world, I commenced an undergraduate degree in psychology, where I could pursue my other lifelong interest in animal behaviour. My plan was to complete a degree in psychology and to then begin commercial dive school, reserving a career in psychology as a back up plan.

I became a certified recreational SCUBA diver in high school. I enjoyed diving, but was unable to continue after I got certified because the equipment was too expensive. In my first year of university, a family friend who is a faculty member at the Ocean Sciences Center informed me that Memorial University was planning to offer a course in scientific SCUBA diving. I reached out immediately to the professor who would be in charge of the course, Dr. Patrick Gagnon, to determine when the course would be offered, and what prerequisites I would need. It was not until 2015, two years later, that the scientific diving course was added to the university calendar.

The course had several academic and SCUBA diving requirements. I had selected specific courses in biology to match the prerequisites. The diving requirements required additional effort. Before beginning the course, all students required a full set of diving equipment that they could use every day. Students then had to complete a basic first aid course and an emergency oxygen provider first aid course. Consequently, I learned many new diving skills before the course began, including in-water rescue skills for unconscious divers, first aid training, and extensive diving theory. I spent an entire month preparing for the course to begin.

Only 4 students were accepted into the Scientific Diving course. It was a transformative learning experience that opened my eyes to the research techniques employed by divers. We learned how to map seabed topography, take environmental measurements (*e.g.*, wave activity, currents, temperature, and sedimentation), and how to utilize different methods of sampling, collecting, and videotaping organisms underwater. By the end of the course, I was a certified scientific diver. I had completed 18 dives in 12 days, and spent nearly 12 hours underwater in total.

Upon entering the 4th year of my undergraduate degree in psychology, I applied to the honours program. I finally understood how I could integrate my education in psychology with my interest in diving. Having completed all of the animal behaviour courses offered by the university by the end of my 3rd year, I knew I had the relevant experience and background knowledge to complete an Honours thesis on marine animal behaviour. I researched the animal behaviour professors at Memorial University and ultimately decided to approach Dr. David Wilson, who was a new professor with experience studying animal behaviour in octopuses.

Development - I suggested to Dr. Wilson that I pursue an Honours thesis on marine animal behaviour, with he and Dr. Gagnon as my co-supervisors. Both individuals agreed and were excited about the multidisciplinary nature of my proposed thesis. I also had the full support of both labs, including diving equipment and a wave tank at the Ocean Sciences Center, video analysis equipment at the Department of Psychology, and an invaluable team of graduate students and assistants who could help with my experiments. We developed a very productive working relationship that combined Dr. Gagnon's expertise in marine ecology and scientific diving with Dr. Wilson's expertise in animal behaviour techniques. Together, we developed a novel study that evaluated the effects of environmental stability on the behavioural responses of sea

cucumbers. The project addressed a novel question and employed a novel experimental approach that combined diving in the field with laboratory experiments at the Ocean Sciences Centre.

Diving research involves many challenges that are not encountered in other academic areas. Safety is paramount, so I had to get approval from MUN's diving safety officer. After exchanging emails and describing the diving plans, I was able to prove that my project was safe, and was given approval. However, there was still a lot of work to do before I could start diving.

My original plan relied on cucumbers displaying a consistent feeding behaviour. I went on a pilot dive to the research site early in September, and, to my dismay, discovered that most of the sea cucumbers were not feeding regularly because of the late time of year. I needed a new behaviour to study. I researched the cucumbers and discovered that Memorial University had on its faculty an expert on the species - Dr. Annie Mercier. She provided additional insight about my study species and referred me to her graduate student, Mr. Bruno Gianasi. He was examining stress levels in the animals using certain behavioural measures. From him, I learned that sea cucumbers display a vivid escape response when a particular species of predatory sea star is nearby. I borrowed three predatory sea stars that belonged to the public education program at the Ocean Sciences Centre, and used them to test a sample of sea cucumbers we had collected in the field during the initial pilot dive. To my relief, all of the cucumbers displayed a measurable reaction to the sea stars, which meant that I had could focus on this behaviour for my Honours thesis research. Drs. Wilson and Gagnon agreed that this restored the viability of my research.

The Project - The research involved five days of diving during the month of October, in addition to the pilot dive I had already done. We dove once a week for a month. I personally found the first day to be the most challenging. The objectives for the first day were to mark two separate areas of the research site (which had different environmental conditions), and to install devices that measured temperature and wave activity. We then had to devise a way to identify individual cucumbers that were part of the study. Since sea cucumbers are generally stationary, we used marking tags on the seabed to identify individuals from one week to the next. I planned all of the dives (with Dr. Gagnon's feedback), and developed work plans that allowed our team to work efficiently. We met at the lab at 7am to begin our first field day. The three dives on the first day required 3 hours and 30 minutes underwater. It was the hardest day of diving I have ever done.

The new design for the project reached a level of complexity I had not initially anticipated. For example, I had to videotape the anti-predator behaviour for later analysis. I also had to measure several environmental parameters, including wave activity, temperature, and water depth. The analysis of the wave data was particularly challenging. Data were collected for long-term analysis by leaving devices in the field for several weeks, and for short-term analysis by deploying one of the devices during each individual trial. The wave monitoring devices were new to Dr. Gagnon's lab, and only one of his students (Ms. Anne Provencher) had experience with them. The analysis of the short-term data had never been attempted, so, with the help of the scientific literature and Ms. Provencher, I had to determine the best way to represent what I wanted to measure.

For a period of one month, lab experiments and diving occurred concurrently, requiring two five-hour lab testing sessions and a full day of diving per week. I had to travel to the Ocean Sciences Centre every day to monitor the temperature in the wave tank. I was spending 25 hours a week on my honours project, and concurrently completing four academic courses in psychology. I also had two part-time jobs. Time management was essential. After finishing the diving and lab experiments, I still had 120 hours of videotape to analyze in order to extract the required data.

Fortunately, I had the help of a MUCEP student and a volunteer to ease some of this workload, but it was my job to supervise them. I had to explain the project to my two helpers and make them understand their role. I trained them to analyze the data just as I would. This experience gave me a deeper appreciation of all those who helped me along the way.

Learning Outcomes - Where to begin? Besides learning how to motivate and train my assistants, I found myself in contact with experts as a result of my efforts to make the project possible. What I learned from them about their subjects, and about academic collaboration, could not have happened in a normal undergraduate program. Another valuable learning outcome was that I was able to combine psychological research principles with what I had learned from the scientific diving course. This was a highlight of my nearly four years at Memorial University. The project enabled me not only to hone my diving skills, but also to learn and practice an essential exercise before entering the water: planning. During the scientific diving course, Dr. Gagnon carefully planned each dive. During my project, planning was my responsibility, and I quickly learned to appreciate Dr. Gagnon's earlier statement that *90% of scientific diving is in the planning*. Every minute spent underwater must be planned and discussed in advance. The dives for my project were complex and necessitated precise collaboration in order to accomplish the necessary tasks on time. Since divers can't speak, all communication has to happen ahead of time. The planning improved my leadership and team working abilities when coordinating with Dr. Gagnon and his team. I became more independent, learned to take initiative, and be more efficient.

The time I spent underwater was the most demanding learning experience. We dove in all kinds of conditions. One of the two research areas was chosen because of its high wave activity, so we were conducting trials while being thrown back and forth in rough waves. The water temperature went from 12°C at the start of the experiment to 4°C at the end. There was no room for error when we went underwater – efficiency and caution were paramount.

The planning, early mornings, transportation and cleaning of gear, and chilly boat rides were all worth it for the time I spent under water. The long hours spent running experiments in the Ocean Sciences Centre were incredibly time consuming, but also very rewarding. I was required to spend many hours on the project, including 13 underwater, 60 in preparation and tear down for diving, and 80 in the Ocean Sciences Centre running experiments in the wave tank. I'm now almost finished the 120 hours of video analysis required to obtain raw data. I was the only undergraduate student in the university conducting a diving project, and the other honours students were astounded to hear that I found a way to combine psychology with SCUBA diving.

The most valuable learning outcome from this honours project is that I now realize that opportunities exist to conduct more of this kind of research. I feel like I now have the skills to pursue a career as a serious research diver. For the first time I was able to marry my two career interests into one. I'm very proud of all that I accomplished, but know that, thanks to this experience, I can do it all again in an even better way. I'm eager to start a new experiment once I have finished with my honours project, and hope to produce a well-planned and valuable contribution to modern animal behaviour research. I am confident that I will be able to use my knowledge and diving experience to investigate environmental stressors and to help conserve precious marine ecospheres. This is my dream, and, after this semester, it seems to be attainable.