University of Victoria
Science

ScienceMatters

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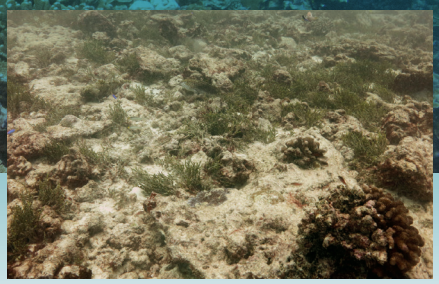
Danielle Claar doing field work at a reef in Kiritimati

Kiritimati comes early for one coral researcher at UVic

– By Angelica Pass



A healthy reef and one impacted by multiple environmental stressors

Photo Credits: Danielle Claar (insets); Kristina Tietjen (main image)

How does a girl from landlocked Idaho come to study coral reefs on the remote island of Kiritimati (pronounced Christmas) in the Central Pacific? For 2015 Vanier Scholarship recipient, Danielle Claar, marine exploration was a passion from childhood. "My parents met SCUBA diving so they introduced me to that at a young age," she says. It was during her undergraduate studies at the University of Hawaii at Hilo that Claar's love of corals truly began, a love that has translated into a PhD project and national recognition in the form of one of most prestigious graduate scholarships in Canada.

The Vanier Canada Graduate Scholarship Program was created to attract and retain world-class graduate students and the scholarships pay $50,000 annually for up to three years. Says Claar on receiving the scholarship, "It was really overwhelming, but in a good way. I'm just so fortunate to be able to have the support to focus on my research and my passion for preserving coral reefs." Her supervisor, Dr. Julia Baum, sings Claar's praises, "Danielle is the whole package: brilliant, motivated, highly skilled at field research and public outreach. Mentoring exceptional young scholars like Danielle is one of the greatest rewards of my career."

After her undergraduate studies in Hawaii and a year in Florida working as an environmental protection biologist, Claar started her MSc at UVic in September, 2013. Now Claar is a PhD candidate in the Department of Biology where she says she "brought corals to the coral reef team." Dr. Baum's team had studied coral reefs for a long time but the work was more focused on the relationship between reefs and fish. "We're studying the entire coral reef ecosystem, from the apex predators down to the microscopic organism to understand how climate change and other human impacts are changing these systems. Danielle is our coral expert," says Baum.

Claar studies how corals react under stressful conditions, including human influence, storms and El Nino. Corals are what are known as holobionts, an entire community of organisms living together as one. Corals are tiny animals belonging to the phylum Cnidaria (which also includes jellyfish and anemones) and they live in colonies. They secrete a hard calcium carbonate skeleton, which serves as a substrate for their colonies. Coral colonies form a symbiotic relationship with *Symbiodinium*, tiny one-cell plants which act as a solar panel for the coral, providing food for it through photosynthesis in exchange for habitat.

In a process called bleaching, corals lose their symbionts. This happens when a coral undergoes stress, particularly due to pollutants or warmer ocean temperatures. If a coral is able to recover its symbionts quickly, it can regain health but otherwise it will die. The purpose of Claar's research is twofold, first to determine what makes a coral resistant to bleaching and secondly to find out what makes them able to recover from bleaching.

Coral reefs host some of the most biodiverse ecosystems in the world. For many coastal populations such as the people of Kiritimati, these reefs are essential to life—sheltering species of fish that are used for food and offering the coastline protection from waves and storms. They also support the island's economy with influxes of tourists eager to explore the reefs.

Claar has been to Kiritimati five times in total and has led field studies there during her last four trips. The teams of field study participants are made up of UVic undergraduate and graduate students as well as diving technicians. Field work consists of two to four week sessions of working 16-20 hour days. In addition to collecting samples to analyze in the lab, corals are tagged with brightly coloured zip-tags to allow for observation over time.

Does Claar have any advice to young people wanting to get into her field? "That's funny, because when I asked the same question to Sylvia Earle, one of the most prominent scientists and explorers in the world, she told me, 'If it doesn't exist, make it up'. So I'll repeat that—don't let anything prevent you from pursuing your goals; there is always a way to make it work." Her journey from Idaho, to UVic, to Kiritimati and her acceptance of the Vanier Scholarship demonstrate that Danielle has indeed found her way.

DEAN'S MESSAGE

Welcome to the Fall 2015 edition of Science Matters. I am pleased to be writing to you from my new position as Acting Dean of the Faculty of Science. As a long-term member of the faculty, I have enjoyed watching our reputation for leading-edge research and outstanding academics grow and flourish. I look forward to working closely with our academic units to continue to build on these successes over the coming year.

In addition to my role as Acting Dean, we have several other new faculty appointments to leadership positions. Welcome to new Department Chairs, Perry Howard in Biochemistry and Microbiology and Barbara Hawkins in Biology. Also welcome to Stan Dosso, Acting Director of the School of Earth and Ocean Sciences.

Students in the Faculty of Science continue to be recognized on a national level. This year, two out of UVic's five Vanier Scholarship recipients are in Science. Congratulations to current PhD student, Danielle Claar in Biology and incoming PhD student, Dylan Breitkreutz in Physics. You can read more about Danielle on our cover and Dylan on page 3.

Finally, in December, we will acknowledge our annual excellence awards recipients. These awards celebrate exceptional achievements by our faculty and staff members. This year's recipients will be:

Dr. Eileen van der Flier-Keller, School of Earth and Ocean Sciences, Faculty of Science Award for Teaching Excellence;

Dr. Boualem Khouider, Department of Mathematics and Statistics, Faculty of Science Award for Research Excellence; and

Sean Adams, Department of Chemistry, Faculty of Science Award for Staff Excellence.

Our students, faculty and staff are grateful for your continued support and engagement with the university. I hope that you enjoy this newsletter and will continue to keep in touch with the Faculty of Science. We welcome your feedback and hope to see you on campus soon!

Kathy Gillis

Welcome to newest schulich leader, **Wylee Fitz-Gerald**

Congratulations to Wylee Fitz-Gerald, recipient of the UVic Schulich Leaders Scholarship in the field of Science, Technology and Math. Fitz-Gerald comes to UVic from Frank Hurt Secondary School in Surrey, where she received many awards for both academic performance and community service. Fitz-Gerald enters the School of Earth and Ocean Sciences this Fall.

The Schulich Leaders Scholarship program is one of the largest in Canada. Created in 2011 by entrepreneur and philanthropist Seymour Schulich, the scholarships are awarded to 40 students in Canada pursuing undergraduate studies in STEM subjects: Science, Technology, Engineering and Mathematics. The scholarship for Engineering is $80,000 and $60,000 for the other areas of study.

Says Fitz-Gerald, "Receiving the Schulich Scholarship felt surreal, especially coming from UVic, which was my first choice of university and in a field I am passionate about. It was the greatest pay-off for days I spent after school tutoring, early morning studying and passing up opportunities to spend time with my friends."

In addition to pursuing academic excellence, Fitz-Gerald has also indicated that she seeks to be a role model for Aboriginal students, by embracing her Metis identity and "raising the profile of successful Aboriginal youth."

Photo Credit: Larry Toth

Fitz-Gerald's many accomplishments have been realized while working part-time throughout her school years, given that her father has not been able to work for many years and her mother has been the sole provider of a family of five. Given her outstanding record—as an academic, role model, community builder, and leader, there is no question that Fitz-Gerald is destined for future success in Earth and Ocean Sciences and will be a change maker and model future leader.

UVic research challenges modern tectonic theory

– By Erin King

Some 250-million-years ago, our planet was a very different place indeed, with the continents we know today clustered together in one large supercontinent known as *Pangea*. But what processes were involved in the construction of Earth's most recent and renowned supercontinent? A new study led by recent PhD grad, Jessica Shaw, raises some questions about the geological processes involved and challenges a major tenant of modern plate tectonic theory.

Across Spain and Portugal, the ancient Variscan mountain belt of Western Europe bends back on itself in a tight S-shape. Most earth scientists agree this mountain belt was constructed through the continental collisions that formed Pangea. "A fundamental assumption of plate tectonic theory is that tectonic plates are internally rigid and deform only at their margins—where, for example, they collide to create mountain belts," says Shaw.

By analyzing hundreds of small folds within rocks of NW Spain, Shaw and her colleagues provide evidence suggesting that the Variscan mountain belt was once linear, and was shortened lengthwise into its modern S-shape after its initial construction.

"Essentially, this means that the tectonic plate containing the Variscan had to deform internally for the mountain belt to reach its current geometry, which would be difficult to achieve at the core of a supercontinent," says Shaw. "Though there are many outstanding questions regarding the mechanisms of such a process, our findings challenge both the long-standing models for Pangea formation, and the assumption that all tectonic plates are internally rigid."

The data imply that construction of the Variscan mountain belt may have predated Pangea, and that the true record of supercontinent formation may be the subsequent deformation of the Variscan itself. The continuing research of Shaw and her colleagues is exploring this possibility.

The study was published this August online in *Lithosphere* a journal of the Geological Society of America.

Image provided by Jessica Shaw

New directions for medical physics at UVic

Welcome to Dr. Magdalena Bazalova, who joined the Department of Physics and Astronomy in July as an Assistant Professor and Canada Research Chair. Dr. Bazalova comes from Stanford University and her research focuses on radiotherapy and novel x-ray imaging techniques.

Goals of her research are tripartite: to improve x-ray imaging in order to diagnose cancer more effectively; to treat cancer more effectively with radiation and gold nanoparticles; and to potentially decrease the costs of radiotherapy by finding a novel cheaper source of radiation. To pursue the final goal, Dr. Bazalova will be building her X-Ray Cancer Imaging and Therapy Experimental (XCITE) Lab this Fall and working with current UVic PhD student Christopher Johnstone and incoming PhD student and Vanier Scholarship recipient, Dylan Breitkreutz.

Dylan Breitkreutz plans to design a cost-effective non-conventional x-ray source for radiation treatments of deep-seated targets. The x-ray source will use lower energies than conventional radiotherapy and is expected to be about 100 times cheaper than existing radiotherapy machines. Upon a successful completion of Dylan's PhD project, the accessibility of radiotherapy will be significantly increased.

Christopher Johnstone, on the other hand, will be improving techniques for the delivery of radiotherapy to laboratory animals. In order to efficiently study the effects of radiation treatments in animals, laboratory radiation delivery techniques must mimic clinical treatments as closely as possible in all labs. The goal of Christopher's PhD project is to investigate the current laboratory radiation delivery techniques and propose tests to assure high accuracy of radiation dose delivery.

Dr. Bazalova is currently the only medical physicist at UVic. The medical physics program is offered in conjunction with the BC Cancer Agency. Medical physicists play an instrumental role in the diagnosis and treatment of cancer —responsible for calibrating medical linear accelerators, delivering radiation therapy, planning treatments to make sure they are delivered properly and in the right dosage, safety monitoring and machine maintenance.

How does Dr. Bazalova feel about her new position at UVic? "As the XCITE Lab name suggests, I am thrilled to be starting my academic career at UVic and I look forward to educating and training talented students and collaborating with outstanding researchers."

Photo Credit: Brett Carter

Frog research at UVic takes a new leap

– By Angelica Pass

Did you know that frogs can play a big role in our understanding of the health of entire ecosystems? Dr. Caren Helbing in the Department of Biochemistry and Microbiology is studying the role of frogs as sentinel creatures.

The Western Enviromics Consortium, of which Helbing's lab is a contributor, has just succeeded in mapping the bullfrog genome, which can provide valuable information about disease and immunity, genetic biodiversity, response to environmental pollutants and habitat and climate change. Bullfrogs—members of the "true frog" or Ranid family—act as a perfect example because of their ubiquity and their direct connection to many different kinds of environmental conditions.

The goal of Helbing's LEAPFROG research is to use the information in the bullfrog genome to develop molecular sensors that can determine the health of the animal without killing it. Non-lethal samples can be taken from frog populations and these sensors can be applied in the lab to determine cell health, almost like a human blood test. From there, the health of amphibian populations can help humans answer big questions about the environment— Are our mining, agriculture, aquaculture, forestry, and oil and gas extraction practices having deleterious environmental impacts? Are the personal care products and pesticides we use innocuous? Are our sewage treatment facilities effective? Is our drinking water safe? What is the impact of disease and climate change on biodiversity?

One of Helbing's projects seeks to learn more about hormone disrupting activities. Thyroid hormone triggers metamorphosis of tadpoles into frogs. If there are substances in the water that interfere with the functioning of the thyroid hormone—such as pollutants from pharmaceuticals, personal care products or industrial effluents—metamorphosis won't occur. By using genomics resources, Helbing and her team can identify what tissues in tadpoles are most sensitive to hormonal disruptors and how to rapidly test for their activities. Since thyroid hormone is integral to human health as well, including triggering certain stages of fetal development, an understanding of its role in tadpoles has a direct bearing on our own health.

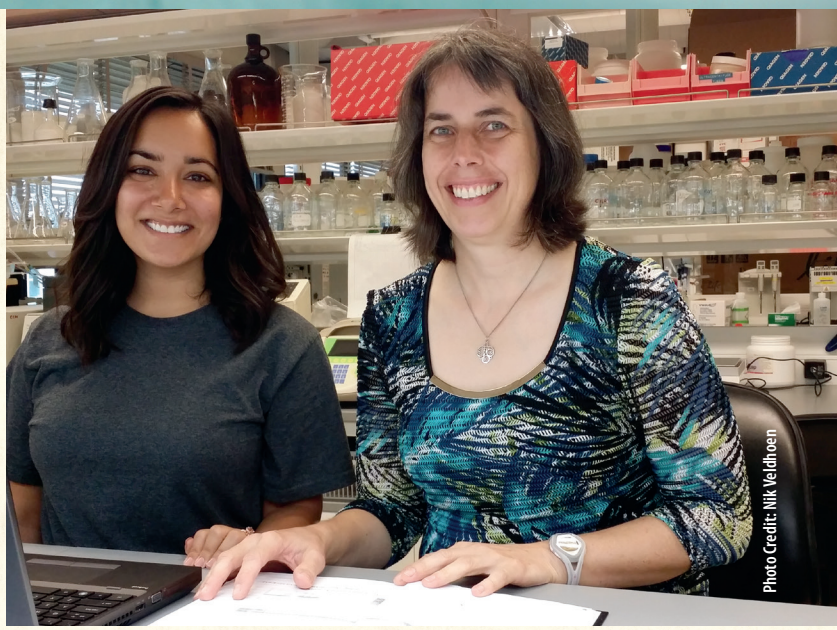


Photo Credit: Nik Veldhoen

Dr. Caren Helbing (r) with graduate student, Shireen Partovi (l)

Helbing's research has just been given a boost by a donation from the Joan Outerbridge Trust. The trust donated $50,000, which matches an NSERC strategic grant, a portion of which will fund graduate student research. Says Helbing, "This generous donation is instrumental in supporting student research and in helping us find better ways of interacting with the environment. Ultimately, my hope is that this research will equate to better human and environmental health."

BC wolf hunting salmon

Photo Credit: Guillaume Mazille

FACULTY AND ALUMNI IN THE NEWS:

Are humans unsustainable 'super predators'?

Want to see what science now calls the world's "super predator"? Look in the mirror.

New UVic-led research has found humans to be at the core of widespread wildlife extinctions, shrinking fish sizes and disruptions to global food chains.

"Our wickedly efficient killing technology, global economic systems and resource management that prioritize short-term benefits to humanity have given rise to the human super predator," says Dr. Chris Darimont (BSc Biology, 2000; PhD Biology, 2007), lead author, Hakai-Raincoast Professor of Geography at the University of Victoria. "Our impacts are as extreme as our behaviour and the planet bears the burden of our predatory dominance."

During four decades of fieldwork on Haida Gwaii, UVic biology professor Dr. Tom Reimchen conceived the idea to look at how human predators differ from other predators in nature. Reimchen's predator-prey research revealed that predatory fish and diving birds overwhelmingly killed juvenile forms of freshwater fish. Collectively, 22 predator species took no more than two per cent of the adult fish. Nearby, Reimchen observed a stark contrast: fisheries exclusively targeted adult salmon, taking 50 per cent or more of the runs.

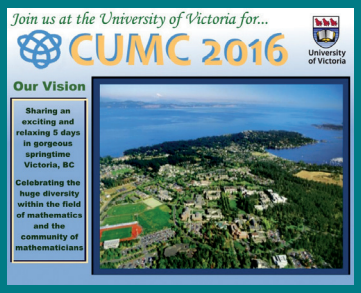
Two of Reimchen's former grad students, Darimont and Caroline Fox (BSc Biology, 2003; PhD Biology, 2013), along with UVic Biology alumna, Heather Bryan (BSc Biology, 2005), and Reimchen himself, build on these observations in a paper out in *Science* this August. The team's global analysis indicates that humans typically exploit adult fish populations at 14 times the rate of marine predators. Humans hunt and kill large land carnivores such as bears, wolves and lions at nine times the rate that these predatory animals kill each other in the wild.

Humanity also departs fundamentally from predation in nature by targeting adult quarry. "Whereas predators primarily target the juveniles or 'reproductive interest' of populations, humans draw down the 'reproductive capital' by exploiting adult prey," says Reimchen.

The data set includes wildlife, tropical meat and fisheries systems from every continent and ocean, except Antarctica. The authors conclude with an urgent call to reconsider the concept of "sustainable exploitation" in wildlife and fisheries management. A truly sustainable model, they argue, would mean cultivating cultural, economic and institutional change that places limits on human activities to more closely follow the behaviour of natural predators.

UVic wins bid to host CUMC 2016

– By Angelica Pass



Poster image provided by Chelsea Lampman

The Canadian Undergraduate Math Conference will be hosted at UVic in July, 2016 for the first time in its over 20 year history. This conference brings undergraduate math students from across the country together in a way that no other event does. Says organizer and fourth year math student, Chloe Lampman, "The conference is really one of a kind in Canada in that it is devoted solely to sharing undergraduate research in a cooperative, non-competitive and fun atmosphere."

Lampman, president of the CUMC 2016 organizing committee, championed the bid to have the conference at UVic. She believes strongly in encouraging more participation and collaboration amongst undergraduate math students. Last year, along with some other students, she re-formed the Math and Stats course union – called SUMS (Students in Undergraduate Mathematics and Statistics).

Lampman hopes that CUMC 2016 will provide another venue for math students at UVic to bond and share their research. Says Lampman, "The CUMC has a powerful legacy of bringing students with a common passion together. Our vision is to continue this tradition, with an emphasis on celebrating diversity at the conference as well. We want there to be something for everyone and plan to accomplish this by ensuring that keynote speakers represent a broad range of topics in both pure and applied math; by encouraging student speakers to tackle topics of all kinds in English and French; and by hosting an evening celebrating gender diversity in math."

Lampman attended and presented at the 2015 CUMC conference, hosted at the University of Alberta this past June. The bidding process started right afterwards and involved preparing a poster and written application. Bids from all universities were posted on the CMS website where undergraduate students from across Canada could vote on them. While the final decision was in the CMS's hands, peer support played a big role in their decision.

The application process also involved getting the administrative and academic support of the department, which will be integral to the conference's success. Fortunately, Lampman has a strong supporter in department chair, Dr. Rod Edwards who says, "The Department of Mathematics and Statistics is thrilled that our undergraduate students are bringing the CUMC to UVic next year. This shows that we have a core of enthusiastic and engaged undergraduate students in Mathematics and Statistics at UVic. Hosting the CUMC will help students here and from across the country to strengthen their experience of the mathematical community."

Giving Back

Our alumni make a difference by volunteering at events, speaking to classes, hiring co-op students or supporting scholarships. To help change the lives of our current students, you can make a donation today at www.uvic.ca/givingtouvic or by contacting the Development Coordinator, at 250-472-4210 or devtcoor@uvic.ca.

Planning a reunion?

The UVic Alumni Association can help by promoting your event to classmates, arranging speakers or providing door prizes. Network and keep involved by exploring the list of groups and upcoming events to find something that's right for you. www.alumni.uvic.ca/events/reunions.php

Alumni Newsletter

Science Matters is published twice yearly by the Faculty of Science to communicate the faculty's goals, strategic direction and activities in order to connect alumni with each other and the university. Send your story ideas and feedback to Chrystal Phan at cmphan@uvic.ca.

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