NSERC Canadian Integrated Multi-Trophic Aquaculture Network

Réseau canadien d'aquaculture multitrophique intégrée du CRSNG

CIMTAN Snippets

Roberto Martínez Espiñeira made the front page of the Faro de Vigo, the newspaper of Vigo, in Galicia, Spain.

Roberto Martínez Espiñeira on Signal Hill in St. John's, Newfoundland (photo credit: Clare Wilcox).

Rober is a professor of economics at Memorial University of Newfoundland. He has worked with Thierry Chopin, Shawn Robinson, Antony Noce, Winnie Yip and Duncan Knowler on estimating the biomitigation benefits of IMTA using both a contingent behaviour method (CBM) approach and a contingent valuation method (CVM) approach. The CBM analysis estimated a lower bound for the benefits that current salmon consumers in Canada would derive from the introduction of IMTA salmon to be about $280 million/year. The CVM analysis estimated that the benefits accruing to households who do not purchase salmon habitually would range between about $43 million/year and about $65 million/year.

Read the article

Jordana Van Geest, a postdoctoral fellow with CIMTAN, just recently published a paper in *Aquaculture* with two other members of CIMTAN, **Les Burridge** and **Karen Kidd**.

Van Geest, J.L., Burridge, L.E., and Kidd, K.A. 2014. The toxicity of the anti-sea lice pesticide AlphaMax® to the polychaete worm *Nereis virens*. *Aquaculture* 430: 98-106.
http://dx.doi.org/10.1016/j.aquaculture.2014.03.044

This study examined the effects of an anti-sea lice pesticide used in salmon aquaculture on polychaete worms, which have been suggested as a commercially valuable co-cultured extractive species for IMTA sites. Polychaetes, *Nereis virens,* were obtained from a hatchery at the University of Maine's Centre for Cooperative Aquaculture Research and held at the St. Andrews Biological Station (Fisheries and Oceans Canada) for laboratory studies. The pesticide studied was AlphaMax® (active ingredient deltamethrin), which is applied in a water-miscible formula to fish cages, but is expected to sorb to organic particles and sediment based on its chemical properties. As a result of chemical partitioning, polychaetes could be exposed to the pesticide via both water and sediment, therefore, we conducted laboratory-based toxicity tests to reflect both routes of exposure. Worms were exposed to the pesticide in water for 48 h to reflect the acute nature of pesticide release for a cage site. Survival and mobility of worms were only affected at more than 2-times the prescribed aquaculture treatment concentration, which suggests negligible risk to worms via aqueous exposure under current treatment scenarios. Worms were also exposed to the pesticide spiked into sand or sediment for 7 or 30 days to examine the effects of longer exposure on survival, growth, and general condition of worms. Low mortality was observed, but sublethal effects, including lack of burrowing into or emergence from sediment and severely impacted body condition (*e.g.* damaged sections, contracted segments which hindered mobility), were observed in most test concentrations. These

sublethal effects are important because the long-term survival and growth of worms may be impacted, including their ability to perform the ecosystem function of processing organic waste. Knowledge of the pesticide concentrations at which effects may occur is useful to evaluate potential risks to polychaetes if present at an IMTA site where pesticide treatment occurs.

Jordana Van Geest enjoying downtown Vancouver on a sunny day (photo credit: Eric Gross).

Jordana finished her CIMTAN postdoctoral fellowship, with the University of New Brunswick and Fisheries and Oceans Canada, in May 2014. The following month, she moved to the other side of the country to start a NSERC Industrial Research and Development Fellowship with the consulting firm Golder Associates Ltd., in Burnaby, British Columbia. Her role at Golder Associates Ltd. involves conducting environmental risk assessments, impact assessments, and environmental monitoring; she also conducts research to provide information and develop tools for these types of projects.

Quote from a past member of CIMTAN: "My CIMTAN experience, designing and conducting research studies, helped build on and demonstrate my research capabilities which contributed to getting this job. CIMTAN provided valuable training, experience and opportunities to interact with people in other fields and served as another stepping stone to move into this new position" (*Jordana Van Geest, past CIMTAN postdoctoral fellow*).

While participating in the **2014 Wando International Marine Algal Symposium**, in the **Republic of Korea**, **Thierry Chopin** was interviewed by **Sunyoung Jeong** of the **Korean TV** channel (KTV). That led to the documentary *Spreading golden seeds under the sea*", which was aired on May 31, 2014. The segment of interest regarding IMTA is between 32:51 and 38:46.

The full interview of Thierry Chopin by Sunyoung Jeong can also be watched here.

CIMTAN held its fifth Annual Meeting, May 13-16, in Halifax, Nova Scotia.

On May 13, the Scientific Committee had its annual face-to-face meeting to review the progress of the 16 CIMTAN projects distributed among its 3 domains and make recommendations to the Steering Committee. The latter also met face-to-face, on May 16, to review the recommendations and assess the progress of the Network. The Network is in good shape, scientifically and financially, and our funding agency, the Natural Science and Engineering Research Council of Canada (NSERC), has given us a no cost extension. CIMTAN scientists have already exceeded their ambitious Highly Qualified Personnel (HQP) training target. HQPs are undergraduate/summer students, Master and PhD students, postdoctoral fellows, technicians and research scientists. As set out in 2009, the plan was to train 114 HQPs over the full duration of the Network; we have already trained 115 of them and will have a few more before the Network is over. Quite an impressive commitment by CIMTAN investigators and by our HQPs, who will be precious IMTA ambassadors for the dissemination of this concept in Canada and beyond.

It was interesting to note that, as in previous annual meetings, a significant number of the members of both the Scientific and Steering Committees also attended the Annual General Meeting (AGM), on May 14-15, which attests to their keen interest in the progress made by the Network. The AGM was attended by 42 people [24 of them being HQPs]. During the AGM, representatives of the 16 projects made 23 presentations, 19 of them given by HQPs.

At the end of the first day of the AGM, the whole group was invited to move from The Halifax Marriott Harbourfront Hotel to join a Magical Mystery Tour for the CIMTAN Annual Reception and Dinner. After the memorable event of June 2012 in Prince Edward Island, the bar was set very high! However, before she left, our previous Administrative Assistant, Meryl Coes, suggested a tour and dinner not on a Yellow Submarine, but on the schooner Silva (http://www.tallshipsilva.com/tall-ship-silva.php). We had a lovely evening on the Halifax harbour, enjoying a nice meal on board and listening to the entertaining music of *Zulkamoon* (https://www.youtube.com/watch?v=q7IMxefR49k). This band blends genres like cumbia, reggae, ska and traditional Mexican folk music with funk, jazz, blues and rock (a little of everything to put everybody in a great mood!). One of the band members is the cousin of the wife of Adrian Hamer, our CIMTAN Network Manager. The return to the pier, with the sails raised and a full moon, was a great way to wrap up the evening.

At the beginning of the second day of the AGM, Robert Chisholm, member of the Canadian Parliament representing Dartmouth - Cole Harbour (just on the other side of Halifax harbour), gave us a lively presentation on how aquaculture is perceived on "the Hill" in Ottawa, and how politicians and scientists should communicate to understand each other better and make legislative progress. Robert Chisholm is the Official Opposition Critic for Fisheries and Oceans from the New Democratic Party (NDP) and the Vice-Chair of the Standing Committee on Fisheries and Oceans.
















Purportedly faster grow out rates
Multiple annual harvests of various grades
Namgis First Nation's Kuterra Salmon
High capital costs
Environmental issues raised


Study Site
Interviews
Key Findings
Conclusion

IMTA session at the 30th anniversary conference of the Aquaculture Association of Canada (AAC) in St. Andrews, New Brunswick, on June 1-4.

As the AAC celebrated 30 years of existence, IMTA celebrated its 10th anniversary, as the expression and the acronym were created at a workshop in Saint John, New Brunswick, on March 26, 2004. Of course, the practice, under different names, is much older (already in -2200-2100 BC, the document "*You Hou Bin*" detailed the integration of fish with aquatic plants and vegetable production in China).

The IMTA concept has continued to evolve and expand within Canada and beyond over the last decade. During this full-day session, we had:

- 9 presentations by CIMTAN members on their work on the different components of marine IMTA in the temperate cold waters of Canada (both east and west coasts),
- 3 presentations on freshwater and land-based IMTA by aquaponic expert Charlie Shultz and CIMTAN HQPs Hamid Khoda Bakhsh and Stacy Murray,
- 1 presentation by Cyr Couturier on tropical integrated agriculture-aquaculture (a form of IMTA) in Cambodia, and
- 1 wrapping-up presentation by Thierry Chopin comparing the fish/invertebrate/seaweed (FIS) IMTA systems being developed in the western world to the seaweed/invertebrate/fish (SIF) IMTA systems already existing, at a much larger scale, in some Asian countries, and wondering if these FIS and SIF IMTA systems are, in fact, "apples and oranges" difficult to compare biologically, environmentally, economically and societally.

These presentations gave an excellent perspective on the many variations these systems represent of the IMTA concept. The local climatic, environmental, biological, physical, chemical, economic, historical, societal, political and governance conditions will lead to the designs of the IMTA systems best suited for the region of implementation.

A new publication of the **Aquaculture Association of Canada**, ***"Profiles in Canadian Aquaculture"***, was released just in time for the 30th anniversary of the Association. In this special publication, the AAC wanted to acknowledge some of the talented and hardworking people of the diverse Canadian aquaculture sector. Being proud of this diversity spawned (pardon the pun!) the idea of documenting personal stories to celebrate our industry. The document contains 34 profiles, of which 6 (18%) are about members of CIMTAN: Thierry Chopin, Chris Pearce, Timothy DeJager, Stephen Cross, Helen Gurney-Smith and Shawn Robinson.
These stories are quite humorous, describing some interesting personal paths that have led to ingenious dedication of careers, and sometimes personal life, to the development of this industry in constant evolution.

These profiles are part of Volume 112-1 of the *Bulletin of the Aquaculture Association of Canada*, available on the website of the AAC.

IMTA kelps served at the St. Andrews Seafood Festival.

The first week of June was a busy one for aquaculture and seafood aficionados in St. Andrews! The Bay of Fundy Seafood Week included the 30th anniversary conference of the Aquaculture Association of Canada (June 1-4), the Lobster & Salmon Academy (June 3-6), the Seafood Forum (June 4-6) and the Seafood Festival (June 6-8).

Thierry Chopin and **Lenny Totten** (Cooke Aquaculture Inc.) provided the IMTA kelp, *Saccharina latissima*, to **Chef Chris Aerni** (the Rossmount Inn) and guest Chef Juan Andrés Morilla, who prepared the annual "*So fresh! Dinner*" on June 6. This was an extravagant fusion of Andalusian, molecular and Fundyan gastronomy over 9 courses using the finest of our local ingredients.

The first molecular cuisine trick of the evening! The "black olives" are not real black olives but whipped cheese in a gelatin coating, blackened with squid ink (photo credit: Thierry Chopin).

Here is the menu:
- Marinated Andalusian bravo olives with crispy cheese cracker
- Andalusian gazpacho shooter, crostini, Breviro caviar and lobster aioli salad
- Foie gras in apple skin on beetroot earth
- Marinated Bay of Fundy mackerel in short escabeche "ajilimojili"
- Scallops in roasted shrimp crust, lobster reduction and duck prosciutto
- Little Andalusian paella, saffron, Spanish olive oil and Atlantic lobster

The second molecular cuisine trick! The mousse of foie gras is inside a flavoured green gelatin "apple" (the only real apple part is the stem) (photo credit: Thierry Chopin).

Seared halibut with a "mountain and sea" salad of cream of Jerusalem artichoke and IMTA kelp (*Saccharina latissima*) (photo credit: Thierry Chopin).

- Seared halibut with a "mountain and sea" salad of cream of Jerusalem artichoke and IMTA kelp (*Saccharina latissima*)
- Slow cooked beef tenderloin, creamed mashed potatoes, mushroom selection, beef reduction and sweet wine infusion
- Hazelnut praline mousse, almond chocolate crunch and raspberry meringue
- Coffee and tea

Are you salivating yet?!

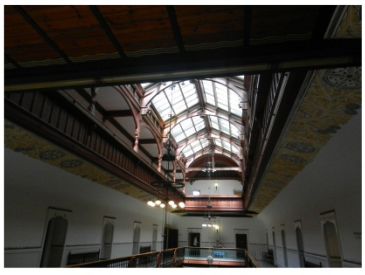
Thierry Chopin, Past President and now Secretary General of the International Seaweed Association (ISA), **Alejandro Buschmann**, President of the ISA, and **Gonzalo Soriano**, Treasurer of the ISA, spent four days, in June, in **Copenhagen**, Denmark, to prepare the next **International Seaweed Symposium** (ISS, in June 2016) with the National Organizing Committee (NOC) led by **Susan Holdt.**

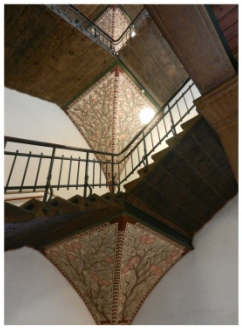
The ISS and NOC are in very good, highly motivated hands enthusiastic about welcoming seaweed experts from the academic, industry and regulatory realms from all over the world, diversity being one of the key characteristics of this conference organized every three years (the last one was in Bali, Indonesia, in April 2013).

The four days were spent discussing the logistics, accommodations, meals, budget, sponsoring, session and abstract selection, plenary speakers, awards, publishing of the proceedings, etc. and visiting the different venues for the different events.




Some of the proposed mid-symposium excursions were also "tasted". Thierry Chopin, Alejandro Buschmann and Gonzalo Soriano were in for quite a few surprises! Of course, being in Denmark, a visit to Københavns Pektinfabrik A/S (KPF) was "mandatory" and they had a nice visit with **Brian Rudolph**, Process R&D Manager, Food Gum Innovation. KPF has been one of the key world producers of phycocolloids (carrageenans, agars and alginates) for decades. But, they were also surprised to find seaweeds in quite unsuspected places!






They visited the City Hall, as the Symposium will be welcomed by the Mayor of Copenhagen with a traditional Pancake Welcoming Ceremony. As they were walking through the grandiose halls, Thierry Chopin noticed a mural of ceramic tiles in which some of the people seem to be wearing kelps. To be sure that he was not hallucinated about his preferred marine organisms (!), he asked the guide if what he was seeing was correct. She answered that it was correct and was representing the fact that the City Hall, and the center of Copenhagen, was reclaimed from the sea. As they discussed further, the guide said "if your group is so interested (obsessed?!) in seaweeds, I have another surprise for you in another wing of the City Hall". The group followed her to a part of the building where ceilings, staircases and the arches at the entrance of each office are covered with paintings of seaweeds! This is the remarkable work of Jens Møller Jensen, a Danish architect, artist and painter of the Art Nouveau period.



A gastronomic afternoon took Thierry Chopin, Alejandro Buschmann, Gonzalo Soriano and Susan Holdt to Anita Dietz, a Chef and owner of *Dansk Tang* (*Danish Seaweeds*). After seeing Anita's seaweed packaging, they had lunch with kelp (*Saccharina latissima*) salad and pesto, homemade bread and soya sauce. Anita also introduced them to the chocolates of Peter Svenningsen, chocolatier in Copenhagen. These chocolates have been served to President Barack Obama at the White House.




After taking the opportunity to see Hamlet's Kronborg Castle and a short excursion to Sweden by crossing the Øresund, the quatuor went to the art gallery *Frama*. Nikolaj Steenfatt and Jonas Edvard were exhibiting, as part of *RE form 2014*, their *Terroir* chair, made of the local seaweed *Fucus vesiculosus* (very common in the Kattegat and the Baltic Sea, even at the "feet" of the Little Mermaid). They used lamination with several layers of mashed *F. vesiculosus* and its phycocolloids as natural glue.

Gregor Reid, CIMTAN modeller, participated in the World Aquaculture 2014 conference in Australia. Here are some of his impressions.

World Aquaculture 2014 was held in Adelaide, Australia, from June 7th to 11th, and I was one of a handful of Canadians who attended. The conference showcased a diverse range of subject areas with dozens of sessions totaling over 500 presentations. Many sessions had direct implications for CIMTAN research and IMTA in general. As is often the case, deciding which sessions to attend, with so many exceptional ones running concurrently, was no easy task. An excellent session on *Oceanography and Aquaculture* highlighted some of the recent research on flow fields and drag around fish cages, which has direct implications for our D2P2 project (Extensive versus intensive IMTA systems - hydrographic influences and the implications to infrastructure design and operational efficiency). There was also a fascinating session on *Aquaculture and Climate Change*; the diversity of IMTA's multiple-crop approach has been suggested as one mitigation option to address pending climate change impacts. Then of course, the IMTA sessions proper; in fact two!

Integrated Multi-Trophic Aquaculture (IMTA) ("Extractive Aquaculture") session

Gregor Reid holding a laughing kookaburra at Raptor Domain, on Kangaroo Island, Australia (photo credit: Sheri Reid).

Pia Winberg chaired a half-day session on IMTA, with my presentation *Effectiveness of open-water IMTA* as an opener. Quantitative measures of nutrient recovery from representative co-cultured species of the three extractive niches (seaweeds, shellfish and deposit feeders) and the implications for culture objectives were discussed. Artur Rombenso gave an enthusiastic presentation on *Mariculture in Rio De Janeiro, Brazil: an approach to IMTA*, where community IMTA is being explored to promote value-added cobia production. Integrating detritivores into recirculating systems and existing aquaculture was presented by Matthew Slater, who discussed the successes and challenges of a variety of IMTA culture systems; one was particularly fascinating with the cotton spinner sea cucumber, *Holothuria forskali*, successfully reducing carbon and nitrogen waste from European sea bass. Leonardo Zamora presented *Two for the price of one: co-culture of Pacific oysters and Australia sea-cucumbers*, where, despite some escapes, caged sea-cucumbers under oysters grew extremely well, limited only by temperature and stocking density. Finally, Ricky Gimin presented *Optimal abalone Haliotis squamata to Ulva ratios for a small scale IMTA system*. In order to avoid the ecological impacts of harvesting wild beds of seaweeds to feed abalone, this experiment examined the optimal culture ratios of seaweeds to abalone in order to ensure the dietary amount for best growth.

IMTA in China session

A special session on IMTA in China was also held. As China is by-far the largest global aquaculture producer, there are some unique opportunities for IMTA potential in this region. While it was a short session with only four presentations, there was plenty of interesting IMTA research and development that was showcased. The first presentation, by Jianguang Fang, on the *Development of IMTA in China*, discussed the role of IMTA as a means to combat eutrophication and increase economic diversity. In addition to large-scale pelagic IMTA, there was a fascinating example of a 500 ha eel grass bed in Sanggou Bay, where sea cucumbers, manila clams, other species of clams, conchs, seaweeds and oysters were cultured to reach an annual combined production of over 700 MT. *Future prospect of IMTA abalone, kelp and sea cucumber in China* was presented by Zhang Jihong and reported results such as the specific growth rate of sea cucumbers in abalone cages, which averaged 0.33% per day on an IMTA diet with natural sediment. The presentation *The Internet of things for aquaculture in China*, by Daoliang Li, reported on the development of multi-species monitoring, connected through the Internet as a means to distribute environmental information and warn farmers of deleterious effects. Finally, in the *Development of a shrimp-mollusk recirculating polyculture in Eastern China*, presented by Zhihua Lin, a pond-based system incorporating four species of mollusk (*Tegillarca granosa*, *Sinonovacula constricta*, *Cyclina sinensis* and *Ruditapes philippinarum*), resulted in an input-output ratio 3 times that of traditional aquaculture. Session chairs Xiaoxu Li and Jianguang Fang did an excellent job and a number of engaging post-presentation discussions with session attendees ensued. Chinese IMTA can be practiced at culture scale and utilize coastal areas exceeding that which would be typically allowed for production in western aquaculture lease areas. This can allow much more freedom to adjust culture ratios of different species to optimize nutrient uptake. It will be interesting to see what future IMTA developments will continue to occur in China.

The chairs of the session *IMTA in China*, Xiaoxu Li and Jianguang Fang (photo credit: Gregor Reid).

As reported in previous issues of CIMTAN Snippets, IMTA is making its way in different parts of the world. It is also doing the same closer to home, as discovered by Mark Carras, a CIMTAN graduate student with Duncan Knowler at Simon Fraser University in British Columbia. Here are the latest comments from Mark.

I have been able to connect with many IMTA researchers and practitioners working as a CIMTAN graduate student, but coming across reports and studies outside of CIMTAN that espouse IMTA research and development is, to me, one of the surest signs that CIMTAN's efforts are connecting with people. So, as I recently read reports on marine and economic planning for the Northern Vancouver Island region, I was pleasantly surprised to find high-quality mentions of IMTA in non-CIMTAN related documents/research.

Mark Carras on the day of his wedding, June 14, 2014. Congratulations, Mark, from the CIMTAN family! (photo credit: Adam Mahoney and Marine Chéné)

The 2014 Northern Vancouver Island draft Marine Plan, a collaborative effort between the Province of British Columbia, the Nanwakolas Council and the Marine Planning Partnership for the North Pacific Coast, is working towards ecosystem-based marine planning and management. The plan defines IMTA at the outset in its glossary, calls openly for more demonstration projects, and frames IMTA as a strategic opportunity for the region. Further, while addressing the varying levels of public support for aquaculture, the document points to interest and potential for alternative species development (shellfish, seaweeds, and invertebrates) in the region. As this partnership effort is concerned with developing recommendations and an implementation plan for ecosystem-based marine management in British Columbia, it is great to see IMTA being brought into the conversation independent of, but surely related to, CIMTAN's direct advocacy efforts.

The 2009 consulting report, Regional Economic Analysis on Vancouver Island and Central/Sunshine Coasts, by the VanStruth Consulting Group, examined regional economic sectors, trends, and strategic development opportunities. Their analysis noted IMTA as an aquaculture innovation, a technology that can add value to existing sites through intensification, and an important opportunity for salmon farmers to consider as they deal with opposition to industry expansion. Coupled with recommendations to diversify fish processing efforts and increase the value of seafood products from the region, new technologies and growing techniques were at the top of the list of recommendations to industry.

All these reports note the important role that aquaculture plays in the region, and both explicitly mention IMTA. IMTA's cost savings, potential to add value through the intensification of existing sites and higher-value processing, nutrient recycling, and the site-specific nature of the technology are all noted. Aquaculture is described as an important economic contributor to the region that can help sustain rural communities through direct, indirect, and induced employment.

As Mark concluded… "Well, gosh, it's nice to hear someone else say it".

Allie Byrne checking out her Pacific oysters on a sunny day in the Broughton Archipelago. Stacks of oyster trays are hanging at 1, 3, and 6 m around three salmon pens at one end of the farm and at a nearby control site. Oyster growth is being measured and their digestive tracts are preserved bi-monthly to analyze for evidence of louse ingestion (photo credit: Devan Johnson).

Allie Byrne obtained her Bachelor of Science in biochemistry from Mount Allison University, New Brunswick, in 2012. After graduating, without any big plans, she moved home to Prince Edward Island with her parents (the day after their youngest had moved out, selflessly delaying their misery as empty-nesters). It was not long before her mother handed her an ad for an exciting Master of Science opportunity with CIMTAN – on the other side of the country. Allie is now working on that Master's degree (through the University of Victoria) in Dr. Chris Pearce's sustainable invertebrate aquaculture laboratory at the Pacific Biological Station of Fisheries and Oceans Canada, in Nanaimo, British Columbia.
The project is examining whether cultured filter-feeding bivalves (Pacific oysters, *Crassostrea gigas*) can help decrease sea lice populations at a commercial salmon farm. Bivalves may provide natural, preventative control of the damaging parasites by filtering sea lice larvae (which are free-swimming) out of the water column. This filter-feeding mechanism is often exploited in IMTA designs to help recycle fish-waste nutrients; intercepting fish pathogens like sea lice might be an additional benefit of culturing bivalves with salmon. Preliminary results show decreased numbers of sea lice larvae in fish pens surrounded by bivalves, compared to control pens without bivalves. In addition, oysters at the salmon farm are showing improved growth over those at a control site located approximately 100 m away from the farm. When she is not at the farm or in the laboratory, Allie is often found knitting or exploring Vancouver Island. Once her MSc journey is over, she hopes to continue working in the Canadian aquaculture industry on either the east or west coast (she is still undecided which is better!).

Sea lice larvae from a plankton sample collected inside a salmon cage: nauplius (left), the first stage of the louse life cycle, and copepodid (right), the subsequent infective stage. Larval and attached sea lice counts are being compared in bivalve and non-bivalve surrounded salmon pens monthly (photo credit: Allie Byrne).

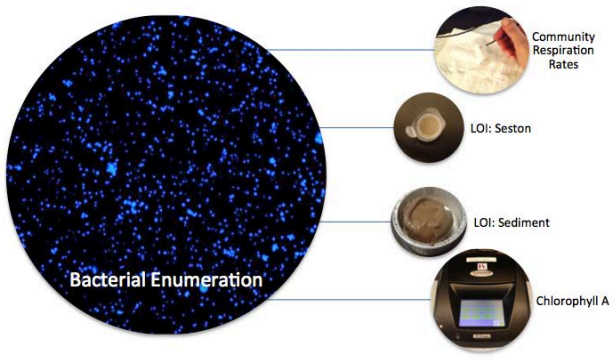
First CIMTAN member quote of the month: "I love going out to the farm, which is located in a spectacular part of Canada. The practical skills and new perspectives I've gained from the farmers and local residents are a nice complement to my experiences thus far in academia. Important field lesson: Work smarter, not harder!" (*Allie Byrne, CIMTAN MSc candidate*).

Hannah Bradford holding a benthic core sample collected using an Eckman grab sampler (6"×6"×6") on the *Viola M. Davidson* near an aquaculture site of CIMTAN partner, Cooke Aquaculture Inc., in Passamaquoddy Bay, New Brunswick (photo credit: Leslie-Marie Britt-McArthur).

Hannah Bradford obtained her Bachelor degree in Environment and Natural Resource Management from the University of New Brunswick (UNB) in 2013, specializing in water resources. Hannah's interest in sustainable aquaculture began as a youth in the tight knit fishing community of Beaver Harbour as the daughter of a local fisherman. This interest was fostered with her exposure to aquaculture farms through the Centre for Aquatic Health Sciences and a growing understanding of sustainable resource development and management from her Bachelor of Science at UNB.

Under the supervision of Dr. Shawn Robinson at the St. Andrews Biological Station and Dr. Bruce MacDonald at UNB in Saint John, Hannah's research monitors pelagic and benthic microbial communities on temporal and spatial scales at an aquaculture site of CIMTAN partner, Cooke Aquaculture Inc. This work enables the quantification of microbial aerobic heterotrophic communities' impact on carbon cycling, a process that has historically been an underestimated component to ecosystem modeling. In an Integrated Multi-Trophic Aquaculture (IMTA) setting, the incorporation of microbial influence on nutrient cycling provides an increasingly accurate estimate of the influence extractive species have on the organics generated by aquaculture practices and of environmental assimilation rates. This research has found that benthic communities are mostly influenced by aquaculture practice as the heavier, less soluble organics settle in the benthic environment contrary to the dissolved and fine particulates that easily disperse in the surrounding water column. Findings have also supported that there are seasonal fluctuations in the activity of these communities. The parameters that influence microbial activity are to be incorporated into a model of energy flow around aquaculture sites by Dr. Gregor Reid and will be used to approach the application of IMTA in environmentally specific situations.

In the future, Hannah plans to apply her diverse background in water sampling and analysis to work in water resource management internationally with a goal of working in industrial remediation related to estuaries. Hannah spends her spare time mostly in the outdoor environment canoeing, kayaking or hiking along with her dog as well as practicing yoga, cooking and listening to CBC. This fall, Hannah is proud to be introducing the concept of IMTA to an entirely new audience at the International Symposium of Subsurface Microbiology in Pacific Grove, California, which coincides with the end of her data collection.



Benthic and pelagic microbial communities are analyzed on temporal and spatial scales through comparison of characteristics such as bacterial abundance estimated using 4',6-diamidino-2-phenylindole (DAPI) as an epi-fluorescent stain, filter-based incubation of communities to measure respiration rates, particulate organic and inorganic matter identified comparatively using the loss on ignition method, and fluorometer-derived chlorophyll a levels (photo credit: Hannah Bradford).

Second CIMTAN member quote of the month: "Don't ever settle for the status quo; greatness is achievable if you allow the mind to dream and let others believe that these dreams are only the beginning" (*Hannah Bradford, CIMTAN MSc candidate*).

Canadian musician, singer, and songwriter Sarah McLachlan recently released her new album "Shine On".

On it, a particular song: "Song for my father".
For those who do not know, Sarah's father was a world renowned phycologist who studied micro- and macro-algae at the Atlantic Regional Laboratory (now Institute for Marine Biosciences) of the National Research Council of Canada, in Halifax, Nova Scotia, from 1961 until his retirement in 1991. Jack then moved to Vancouver, where his daughter is based. Jack had a long and significant affiliation with the International Seaweed Association (ISA… and that is not the salmon disease!).

Read Jack's obituary by Eurico C. Oliveira and Thierry Chopin

Hear the interview of Sarah McLachlan talking grief, loss and hope in her new album:
http://www.cbc.ca/news/arts/sarah-mclachlan-talks-grief-loss-and-hope-in-new-album-shine-on-1.2645406