



NSERC Canadian Integrated
Multi-Trophic Aquaculture Network

Réseau canadien d'aquaculture
multitrophique intégrée du CRSNG

CIMTAN *Snippets*

**Happy
and
Prosperous
New Year
2015!**

**From
the
Canadian
IMTA
Network
(CIMTAN)**



*Crispy skin IMTA Atlantic salmon fillet, organic IMTA kelp wrap, nori dust, ginger-carrot purée, sweet soy drizzle, potato blini, Atlantic salmon caviar and goose tongue greens
(created by Chef Chris Aerni - Rossmount Inn, St. Andrews, New Brunswick)*



CIMTAN met with the Standing Senate Committee on Fisheries and Oceans on November 17 and 20, 2014.

Thierry Chopin and Nell Halse, Michael Szemerda, Randy Griffin, Dwayne Richardson and Lenny Totten (Cooke Aquaculture Inc.) met in Back Bay (southwest New Brunswick, in the Bay of Fundy) with Senators **Fabian Manning** (Newfoundland and Labrador; Chair), **Elizabeth Hubley** (Prince Edward Island; Deputy Chair), **Thomas Johnson McInnis** (Nova Scotia), **Jim Munson** (Ontario), **Don Meredith** (Ontario), **Sandra Lovelace** (New Brunswick) and **Rose-Mary Poirier** (New Brunswick), and **Maxwell Hollins** (Committee Clerk) and **Odette Madore** (Research Officer of the Library of Parliament) on November 17. After a

short boat trip, they were able to see firsthand the Crow Island IMTA site. That triggered a number of questions that Thierry Chopin and Michael Szemerda answered during a fruitful and pleasant discussion with the Senators asking very relevant questions.



Visit of the Crow Island IMTA site by the Standing Senate Committee on Fisheries and Oceans: Senator Thomas Johnson McInnis, Senator Don Meredith, Senator Fabian Manning, Dwayne Richardson, Randy Griffin, Senator Jim Munson, Lenny Totten, Michael Szemerda and Thierry Chopin (photo credit: Nell Halse).

Shawn Robinson met the same group later in the afternoon at the St. Andrews Biological Station of Fisheries and Oceans Canada. They talked about aquaculture in Canada in general, as well as IMTA more specifically.

Thierry Chopin went to Moncton on November 20 to meet the Senate Committee again (Senator **Carolyn Stewart Olsen**, New Brunswick, had joined the Committee), as a witness for the meeting "Study on the regulation of aquaculture, current challenges and future prospects for the industry in Canada". This was an opportunity to talk about regulations, challenges and prospects as they pertain to IMTA.

The principal challenge for the Canadian aquaculture industry is an overly complex, uncertain and confusing regulatory system that restricts its sustainable growth. The industry is regulated by an obsolete, reactive and inefficient Fisheries Act dating back to the establishment of Confederation (1867), at a time when commercial aquaculture did not exist and was certainly not thought out as a modern farming and food production sector. A new Aquaculture Act would provide the Canadian aquaculture industry with a more modern and effective approach to governance – a piece of framework legislation which, while respecting provincial jurisdiction, would harmonize the application of regulations nationwide and enable the development of new practices within an ecosystem/multi-species/multi-activity management approach – to give this industry the definition, clarity, recognition and vision for growth that it requires.

Regulations should contain enough flexibility to allow experimental cultivation with new aquaculture practices and species in order to test their production and market potentials. If not, progress will become impossible, leading to a stagnating aquaculture sector in Canada, while other countries will innovate and be further ahead environmentally, economically and societally. The regulations for experimental cultivation should be clearly articulated, without ambiguity, to facilitate the improvement of aquaculture practices overall.

To allow for the efficient development of the inorganic extractive component of IMTA, an enabling regulatory framework has to be established. In Canada, there are regulations in place for fish and shellfish,



Thierry Chopin explaining the growth of kelps to Senator Thomas Johnson McInnis, Senator Fabian Manning, Mrs. Odette Madore and Senator Jim Munson (photo credit: Nell Halse).



but regulations for seaweeds are almost non-existent. The relatively small size of the seaweed business in Canada should not be an excuse for a “let sleeping dogs lie” attitude, too often encountered at both the federal and provincial levels, but which should no longer be acceptable. Regulations for seaweeds need to be developed now, while we are still at the pre-commercial stage, so they are ready when commercialization really occurs. If they start to be developed when commercialization is happening, one can be sure that it will create stumbling blocks and regulatory hurdles, if not nightmares. Moreover, as expertise on seaweeds is admittedly minimal at best in both federal and provincial agencies, these regulations should be developed through consultations including academics and industry with knowledge on the biology, ecophysiology, biochemistry and cultivation of seaweeds so that the regulations end up being robust, well-thought out, practical and based on common sense, instead of being rushed at the last minute and, as is often the case in such situations, become ill-conceived impediments. Consultations in a constructive environment are certainly a much better guarantee for putting appropriate regulations in place.

Regulators, aquaculturists and other coastal stakeholders need to be open to the idea of “seaweed only” aquaculture sites, as “seaweed nutrient scrubbing stations” within an integrated aquaculture bay management area (ABMA) strategy, based on the fact that an aquaculture farm does not function only within the limits of a few buoys on the water, or a few GPS coordinates on a map, but should be managed according to the movement of the different types of nutrients considered:

- Large particulate organic nutrients should be managed within the aquaculture site.
- Small particulate organic nutrients should be managed in the immediate vicinity of the aquaculture site.
- Dissolved inorganic nutrients should be managed at the ABMA scale, as disease vectors and parasites are presently managed.

The value of the ecosystem services provided by extractive species should be recognized and valued properly. If society gives an economic and fiscal value to these ecosystem services, they should lead to the implementation of nutrient trading credits (NTCs). Then, these NTCs could be used as financial incentive tools to encourage mono-aquaculturists to contemplate IMTA as a viable aquanomic option to their current practices.



Discussion between Senator Thomas Johnson McInnis, Senator Don Meredith, Dwayne Richardson, Senator Fabian Manning, Michael Szemerda and Thierry Chopin (photo credit: Nell Halse).

It was also mentioned that the IMTA concept can be extended to land-based, closed containment, freshwater hatcheries, where aquaponic plants replace seaweeds for the development of freshwater IMTA (or FIMTA). Moreover, the IMTA multi-crop diversification approach should be considered as an economic risk mitigation option to address pending climate change impacts.

Increasing responsible aquaculture production through diversification, regulatory reform and new legislation (Aquaculture Act) would also have a positive impact on jobs and economic opportunities in rural/coastal communities.



CIMTAN and the **Universidad de Los Lagos** organized an **international conference and workshop**, entitled "**Integrated Multi-Trophic Aquaculture (IMTA): an aquanomic approach to farming the sea**", in **Puerto Montt, Chile**, on December 2-5, 2014.

This event had been in the mind of **Thierry Chopin** and **Alejandro Buschmann** for quite a while. They met for the first time at the XIVth International Seaweed Symposium in Brest and Saint Malo, France, in 1992. Since, Thierry Chopin became President of the International Seaweed Association from 2007 to 2010 and is its present Secretary General; Alejandro is now the President of the ISA (it is not always a salmon disease!) for 2013-2016. In 1999, Alejandro invited Thierry to the Vth Latin-American Congress of Phycology in Puerto Varas. In 2000, Thierry invited Alejandro to the Annual Meeting of the Aquaculture Association of Canada in Moncton. In 2002, Alejandro invited Thierry to the International Workshop on the Sustainability of the Salmon Industry in Chile and the World, in Puerto Montt. That meeting was quite interesting, with "lively" exchanges between representatives from the salmon industry and representatives from the workers in the salmon industry.

Since then, Thierry and Alejandro have been trying to organize another workshop in Chile (in part because of the well-known adage that "nobody is a prophet in their own country"), but they could not find the funding mechanism until CIMTAN had the possibility to apply to the Strategic Network Enhancement Initiative (SNEI) of NSERC at the end of 2013. CIMTAN got the funding, the workshop in Chile being one of the four initiatives applied for. The funding enabled a Canadian delegation [6 HQP (**Hannah Bradford, Allie Byrne, Mark Carras, Angela Fortune, Stacy Murray and Kurt Simmons**) and 4 Investigators (**Thierry Chopin, Ramón Filgueira, Mark Flaherty and Duncan Knowler**)] to go to Puerto Montt and supported some of the operating expenses of the conference and workshop. Alejandro was able to get funding to support **Shawn Robinson's** travel and to cover the rest of the operating budget for the event.

The conference was a success in part due to the tireless and generous hospitality of Alejandro, with the logistical support of **Sandra Pereda** and **Eduardo Henriquez**. On the Canadian side, **Adrian Hamer**, CIMTAN Network Manager, was very instrumental with the pre- and post-workshop logistics and accounting. Thank you all for helping make the event go so extremely smoothly and for making it particularly memorable for all participants.

All agreed that this exchange went flawlessly and was both fruitful and enjoyable. Moreover, the interdisciplinary make-up of the CIMTAN delegation allowed for very informative discussions when comparing the Chilean and Canadian conditions and situations. The CIMTAN HQP were exposed to real *in situ* international training and Chilean colleagues saluted a network like CIMTAN, and its funding agency NSERC, for being forward thinking enough to bring a mostly "fresh blood" Canadian delegation into the international IMTA community.

The conference and workshop had 3 parts:

- On December 2-3, 72 participants gathered in an auditorium of the Universidad de Los Lagos to listen to 17 presentations (11 from CIMTAN members and 6 from Chilean colleagues). Chilean participants included undergraduate and graduate students from 5 Chilean universities, several academics from these institutions, regulators from the Subsecretary of Fisheries of the Department of Economy of Chile (SUBPESCA), a representative of Intesal (the Technological Institute of Salmon of the Association of the Chilean Salmon Industry, SalmonChile), a representative of Salmones Cupquelan S.A. (the Chilean subsidiary of Cooke Aquaculture Inc.) and several CEOs of salmon and mussel farming companies. At the end of the second day, there was a round table session entitled

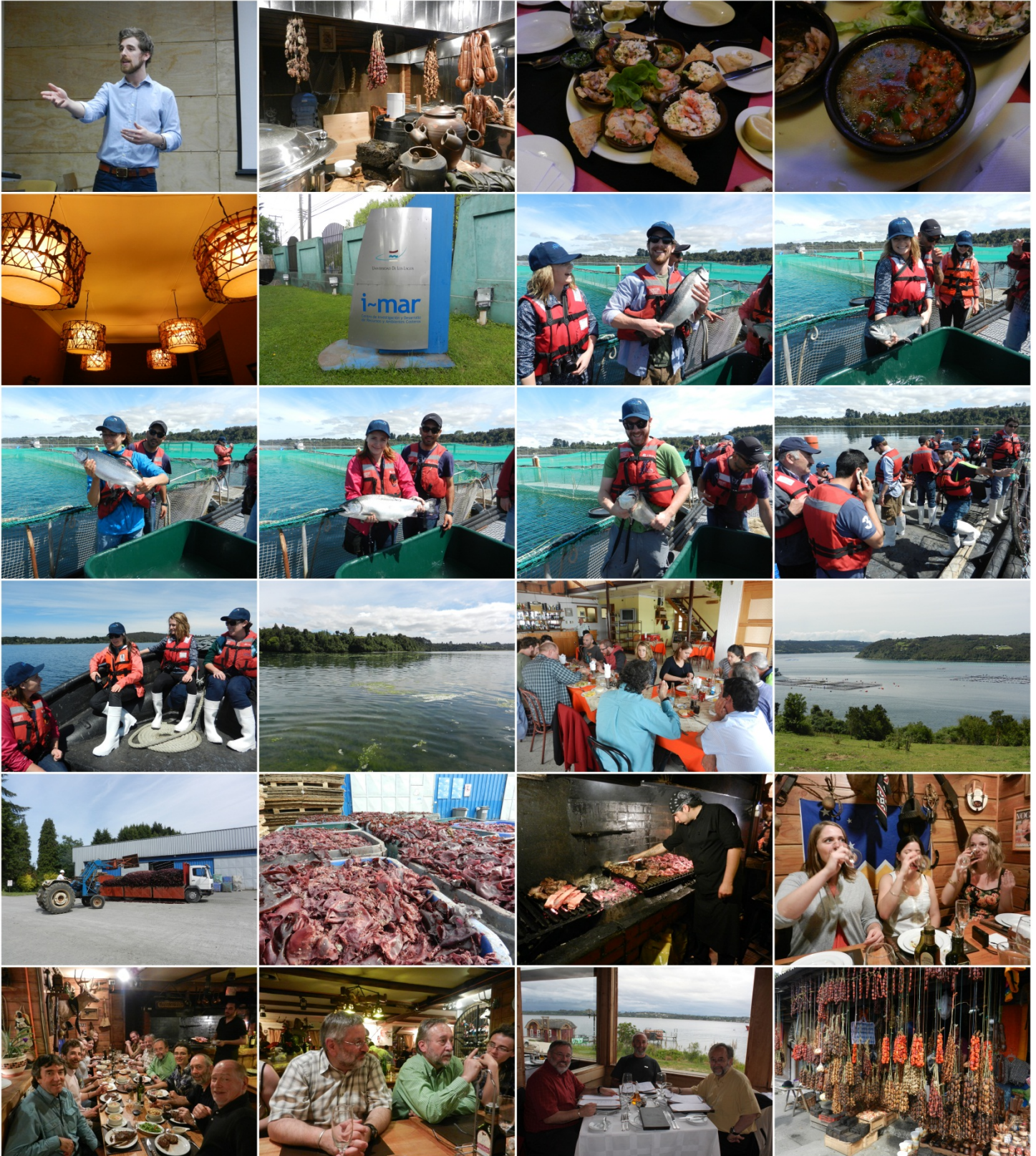




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“Is IMTA feasible within the Chilean and Canadian aquaculture context?”. The answer is yes for both countries; however, it will not happen overnight in either country for both common reasons and reasons particular to each due to different regulatory frameworks.

- On December 4, the Canadian delegation and a few Chilean colleagues went on a full day excursion that took them first to a coho salmon site of the company Salmones Aysén S.A. After a presentation by the company, everybody put on white boots, a company baseball hat and a life jacket in order to sail to the site. That left plenty of time for asking questions and engaging in interesting discussions. A good lunch in Calbuco, with a variety of fish on the menu, was great for the appetites built on the water! The next stop was to Gelymar S.A., a company manufacturing carrageenans and hydrocolloid blends from different species of seaweeds. **Jaime Zamorano**, Project Manager, gave a very comprehensive presentation on carrageenans and their uses in Chile and worldwide. Jaime's position involves the development of new resources and IMTA is of interest to him, as fish aquaculture can be a source of nutrients needed by the seaweeds and fishers would be the people cultivating the seaweeds in coastal Chilean waters.

- On December 5, the day started with a visit of the installations of BAL Chile S.A. on the campus of the Universidad de Los Lagos. **Carolina Camus** gave a tour of the facility and explained that they are now looking at the processing of the biomass of the brown seaweed, *Macrocystis*, with an Integrated Sequential Biorefinery (ISBR) approach. Thierry Chopin, Alejandro Buschmann, Shawn Robinson, Ramón Filgueira, Mark Flaherty and Sara Barrento spent the rest of the day developing the outlines for a primary publication and a publication in a professional magazine, based on the presentations and discussions held during the workshop, which will cover the strategies for moving IMTA from a concept to an aquanomic approach put into practise for farming the sea.

In the opinion of all, this conference and workshop was a success and allowed a better understanding and comparative analysis of aquaculture developments in both countries, their historical and societal contexts, and where IMTA could fit in their respective strategies for improved practices. It also contributed to one of the key goals of CIMTAN, which is an increased adoption of IMTA, as more ecosystem responsible aquaculture practices are developed and implemented worldwide.

Moreover, it represented an excellent opportunity to cross-cut the three criteria recognized by the SNEI program: 1) supplemental training component by exposing HQP to the development of aquaculture and IMTA in a different set of environmental, economic, regulatory and societal conditions, 2) increased knowledge/technology transfer with expanded Network partners for better exchanges and fruitful cooperation, and 3) improved international linkages with a research group recognized worldwide in the IMTA field and with complementary expertise.

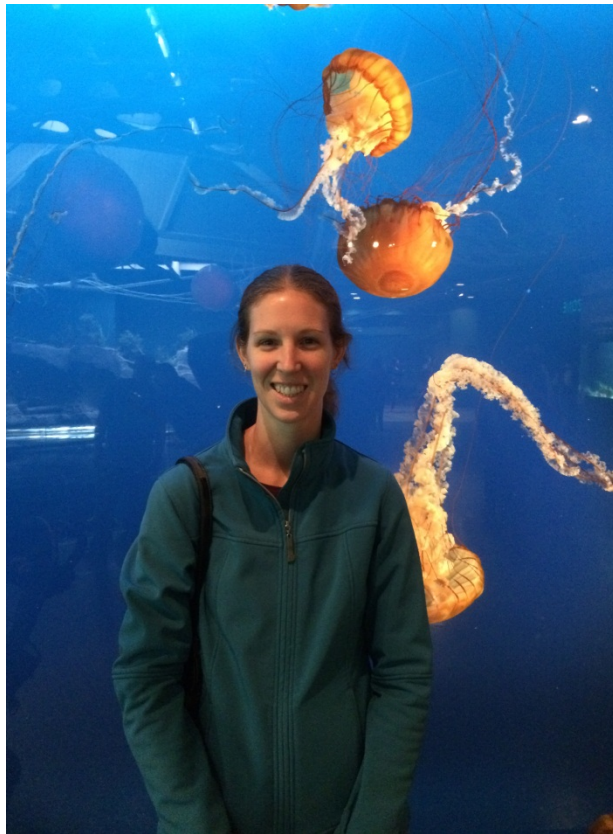
Jordana Van Geest, a former postdoctoral fellow with CIMTAN, just recently published two papers on the toxicity of sea lice pesticides to non-target marine invertebrates.

Van Geest, J.L., Burridge, L.E., and Kidd, K.A. 2014. Toxicity of two pyrethroid-based anti-sea lice pesticides, AlphaMax® and Excis®, to a marine amphipod in aqueous and sediment exposures. *Aquaculture* 434: 233-240.

This study examined the sensitivity of an Atlantic species of amphipod, *Echinogammarus finmarchicus*, to two pyrethroid-based sea lice pesticides. Amphipods were found to be sensitive to



pyrethroid-based anti-sea lice pesticides in water in studies by other researchers that used a Pacific



Jordana Van Geest at the Vancouver Aquarium (photo credit: Eric Gross).

species of amphipod as a standard toxicity test organism. However, the toxicity of these pesticides has not been investigated for an amphipod species from Atlantic Canada, where pesticide treatment in aquaculture occurs. An Atlantic species of amphipod was collected from tide pools near St. Andrews, New Brunswick, and used in laboratory toxicity tests. Amphipods were exposed to two pesticides in both water-only and sediment exposure because of the expected chemical partitioning of these pesticides. Amphipods were exposed to the two pesticides in 1- and 24-h water-only, single pulsed exposures and 10-day spiked sediment tests. In water-only tests, organisms were immobilized at the highest test concentrations and delayed mortality and immobility were observed following exposure to lower concentrations as well. These results suggest that amphipods exposed to a plume of pesticides may be adversely affected, and that delayed effects can occur after pesticide exposure. Mortality was observed in organisms exposed to sediment within 2–4 days, but at concentrations much higher than the limited reports of environmental concentrations in sediment. Overall, these results suggest a low potential for risk from sediment exposures for a northern Atlantic

species of amphipod that inhabits the near-shore environment where cage aquaculture sites are located.

Van Geest, J.L., Burridge, L.E., Frederick, J.F., and Kidd, K.A. 2014. Feeding response in marine copepods as a measure of acute toxicity of four anti-sea lice pesticides. *Marine Environmental Research* 101: 145-152.

Copepods are one of the most abundant zooplankton groups of coastal ecosystems and may be exposed to pesticides plumes from aquaculture sites. This study examined the effects of four sea lice pesticides on copepods from local zooplankton communities in southwest New Brunswick. The goal was to address data gaps in the literature and to develop a laboratory method representative of short-term, environmentally-relevant exposures, with easy-to-assess, robust, and relevant endpoints that relied on staining techniques. Copepods collected from plankton tows were brought to the laboratory and exposed to pesticides for 1 hour and transferred to clean water for 5 hours to look for delayed effects. Neutral Red, a vital stain, was used to identify whether organisms were alive or dead. Carmine particles were added and the proportion of organisms with particles in their digestive tract was used to examine feeding inhibition. Mortality was not observed based on staining with Neutral Red; however, organisms were immobilized within 1 hour at aquaculture treatment concentrations. Feeding inhibition was observed to follow a concentration-response relationship and



as the most sensitive endpoint. Acute exposure to three of the four pesticides affected feeding and mobility of copepods at environmentally-realistic concentrations.

Jordana is a NSERC Industrial Research and Development Fellow with the consulting firm Golder Associates Ltd., in Burnaby, British Columbia. She is involved in conducting environmental risk assessments, impact assessments and environmental monitoring, and conducting research to provide information and develop tools for these types of projects.



Thierry Chopin and Robert MacKinnon celebrating 25 years of services at a 50 years old campus (photo credit: Kathy Robertson).

Thierry Chopin was honored for his **25 years** at the **University of New Brunswick (UNB) in Saint John** during the Vice-President's Holiday Luncheon on December 19, 2014. This year also marked the 50th anniversary of this campus of UNB and Thierry Chopin is very glad to have contributed to half of its existence.

During his speech, **Dr. Robert MacKinnon**, Vice-President of the UNB Saint John campus, stated "Thierry Chopin is the consummate phycologist, living, eating and breathing marine algae... it is also his 25th anniversary of uninterrupted NSERC funding... Thierry has worked very hard at making his research accessible to the

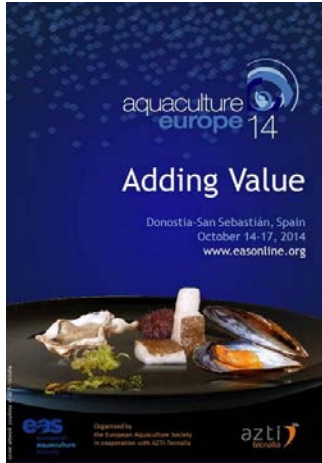
general public, and he has had, over the years, an impressive number of contacts with the media, including an *Alaria*, *Laminaria*, *Saccharina* (ALS) Ice Bucket Challenge on the shore of the Bay of Fundy (https://www.youtube.com/watch?v=-AOGH555GwM&list=UUBOL_IQA8sB5BIVpMWe46lw)".

Thierry Chopin calculated that over 25 years he has been instrumental in bringing a total of CAD\$ 26,191,086.00 in research grant funding for a total salary at UNB of CAD\$2,138,546.13... a 12.25 % return on the investment! Of course, some of this money has benefitted the local economy, another example of how universities are also economic engines of regional development.

In February 2015, Thierry Chopin will have spent as much time in his adoptive Canada as in his native France (with a 10 months postdoctoral fellowship in Florida, USA, at Harbor Branch Oceanographic Institution in 1987).



View of the people attending the Vice-President's Holiday Luncheon on December 19, 2014 (photo credit: Thierry Chopin).



The **summary report** of the **Aquaculture Europe 2014** conference is now available at:

<http://www.easonline.org/component/content/article/39-uncategorised/259-aquaculture-europe-2014>

It contains the summary of the **“Beyond Monoculture”** session chaired by **Thierry Chopin** and **Kenny Black** (Scottish Association for Marine Science and IDREEM project).



Thierry Chopin with astronaut Chris Hadfield at Harbour Station after his presentation in Saint John, New Brunswick (photo credit: Kathy Chopin).

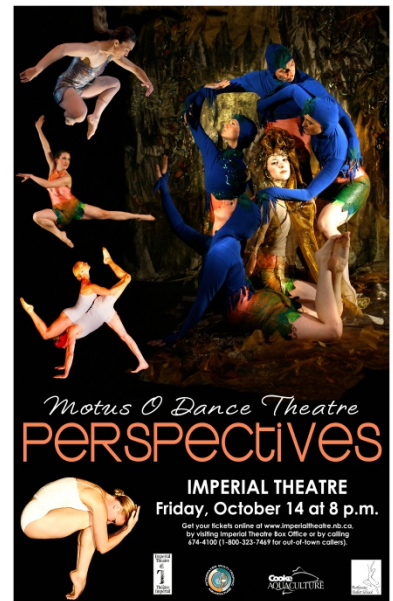
Canadian astronaut **Chris Hadfield** was in Saint John, New Brunswick, for an evening presentation on November 18, 2014.

Thierry and Kathy Chopin attended this very enjoyable evening with wonderful images of our planet Earth (and Sea) in the background, while Chris Hadfield explained his itinerary to being the first Canadian astronaut to walk in space, and command the

International Space Station, and shared many wise opinions on the human Odyssey.

One comment struck Thierry Chopin in particular: “Communicate your work through the Arts; bring people to your work by using the Arts to get your message out.” Interesting reminiscence of the creation of the dance piece “*IMTA*” with the company *Motus O Dance Theatre*.

See http://www2.unb.ca/chopinlab/imta/news/motus_o/index.html



The poster of Motus O Dance Theatre performance “*Perspectives*”, which includes the “*IMTA*” dance piece.



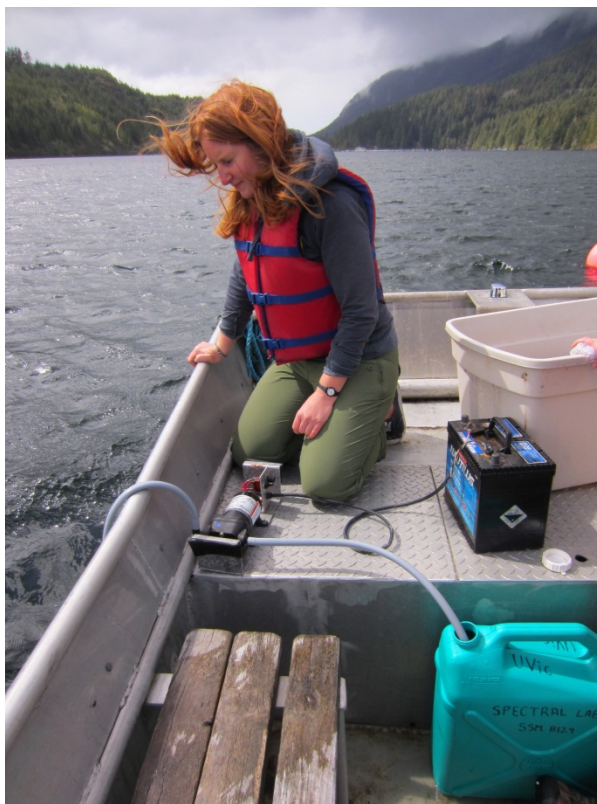
Sound familiar...? From *Fish Farming International*, November 2014 issue:

“Leroy Seafood Group’s (LSG) innovative multi-trophic aquaculture project, Ocean Forest, remains held up by officials in Oygarden County, Norway, the area where the project was set to be launched. Oygarden County Borough has had more than six months to consider this matter.

It’s become a test of tolerance, said Harald Sveier of LSG and head of Ocean Forest. It is hoping to expand its project to other areas in Norway where similar projects are being developed to grow seaweed and mussels alongside farmed salmon. The thrust of the concept is that discharge from salmon farms would be used to cultivate seaweed and mussels, helping both grow new sources of marine protein while cleaning the discharge.

The complex nature of the project has meant zoning for the area is more challenging, but for Sveier the approval process has been far more lengthy than needed. This process has ground completely to a halt. The Borough Council has had its area plan sitting around for over a year, he said.

While the dialogue with the Borough has been positive, and the project has the support of the Directorate of Fisheries, the licensing process has been far too complex. Oyvind Lunde of Oygarden Borough Council, said the delays are simply part of the normal process.”



Sarah Sprague collecting water samples in Kyuquot Sound, Vancouver Island, British Columbia (photo credit: Stephen Cross).

Sarah Sprague obtained her Bachelor degree in Environmental Science, specializing in Aquatic Ecology, from the University of Michigan - Ann Arbor (USA) in 2009. After graduating, Sarah worked as an intern for the Pacific Islands Network on the island of Hawai’i, where she conducted shrimp surveys in anchialine pools. Sarah later moved to Victoria, British Columbia, where she had a chance to meet with Stephen Cross and learn about the exciting MSc opportunities available through CIMTAN. Before applying for graduate school, however, she was accepted into the United States Peace Corps and spent the next two years working in a small Senegalese village. In 2012, she returned to Victoria and began her MSc, working with Stephen and Mark Flaherty at the University of Victoria.

Sarah’s MSc research is being carried out at the IMTA Sablefish farm in Kyuquot Sound on Vancouver Island (Kyuquot SEAfoods Ltd.). Sarah is using analysis of ^{13}C and ^{15}N ratios in scallop and oyster muscle tissues to determine the dietary importance of fish farm waste. By quantifying the ability of shellfish to integrate farm waste into their diet, it is possible to



measure their efficiency within an IMTA system, as well as their placement within the system. Sarah's project has involved the collection of field samples on a bi-monthly basis over the past year, in order to develop an understanding of shellfish filtration abilities on a seasonal basis. Preliminary results show increased consumption at greater depths near the fish nets, with the greatest amount of consumption taking place during the winter months.

When she is not in the lab or doing field work, Sarah can be found playing board games, hiking, or hanging out with her Blue Heeler. She hopes to find a career in aquatic husbandry after graduating, either on Vancouver Island or in the USA.

CIMTAN member quote of the month: "Reaching the end of my time with CIMTAN has allowed me to reflect on the past two years. I am lucky to have had the opportunity to design an exciting project that I hope will be valuable to the goals of CIMTAN. By studying stable isotope analysis as a research tool, and applying it to field research, I have developed my own skill set as well. Having a chance to spend time at Stephen Cross's farm has also been an incredible opportunity. It is an amazing place, in a part of the world that few people ever get to see" (*Sarah Sprague, CIMTAN MSc candidate*).



CIMTAN HQP's IMTA!
(photo credit: Thierry Chopin)