



**Best wishes for the
Holiday
Season
and Happy
New
Year!**



from the Canadian IMTA Network (CIMTAN)

Special IMTA session at the Aquaculture Canada conference in St. Andrews, New Brunswick, June 1-4, 2014. As the Aquaculture Association of Canada (AAC) will celebrate 30 years of existence next June, Integrated Multi-Trophic Aquaculture (IMTA) will celebrate its 10th anniversary, as the expression and the acronym were created in Saint John, New Brunswick, on March 26, 2004. Consistent with the general worldview that food and products from aquatic systems, produced in a sustainable manner, will be more and more sought globally by supportive human populations, research and development on more advanced aquaculture practices have been actively engaged. Over the last decade, the IMTA concept has continued to evolve and expand within Canada, as well as in several other countries. It has been applied to open-water or land-based systems, marine or freshwater systems, and temperate or tropical systems. There is, in fact, no ultimate IMTA system. Different climatic, environmental, biological, physical, chemical, economic, historical, societal, political and governance conditions can lead to different choices in the design of the best suited IMTA systems, but all of them are based on the same principles of the IMTA concept. If most of the IMTA developments of the past decade have taken place in the marine (open) water environment, they have also taken place at fresh (open) water operations, and in land-based, most-often freshwater operations (also called aquaponics).

We are looking for presenters for this session who will describe their latest advancements in their own variation on IMTA and share their vision of its environmental, economic and societal potentials for improved aquanomic practices. If interested, please, contact Thierry Chopin (tchopin@unbsj.ca)



and Shawn Robinson (shawn.robinson@dfo-mpo.gc.ca). We hope to put together a session reflecting the diversity of the IMTA systems being developed in Canada and beyond.

More information on the Aquaculture Canada 2014 conference at:
<http://www.aquacultureassociation.ca/>

CIMTAN held its **Third Technical Workshop** in Saint John, New Brunswick, on November 20-21, 2013, with 31 participants from academia, government and industry in attendance.

The theme of the workshop was "**IMTA System Design, Hydrodynamics and Extractive Organism Positioning**" – its overall objective being to examine the optimal placement of extractive organisms within an IMTA site. It focused on the positioning of three major extractive groups: (1) the inorganic extractive component (seaweeds), (2) the finer-particulate organic extractive component (filter-feeding shellfish), and (3) the larger-particulate organic extractive component (deposit-feeders such as sea cucumbers, sea urchins, prawns and worms). The workshop examined how various factors might influence the placement of these three groups including: large-scale hydrodynamics of the site, smaller-scale flow patterns around holding trays/rafts/cages, biology/physiology of the extractive organisms, stocking densities of animals, commercial constraints (*e.g.* access to fish cages), and government policies/regulations. This was accomplished by having presentations from two guest speakers, as well as from various CIMTAN investigators and students (17 presentations and 15 presenters in all). The guest speakers were Dr. Joao Ferreira (New University of Lisbon in Portugal), who gave a presentation on local-scale models to assess production and environmental effects in intensive and extensive culture systems, and Dr. Øivind Strand (Institute for Marine Research of Bergen in Norway), who gave a Norwegian perspective on IMTA configurations. Presentations were followed by break-out group discussions focused on detailing what is currently known about the placement of extractive organisms within IMTA systems and what remains to be elucidated through further research and/or modelling. The proceedings of the workshop are to be published in 2014 in a special issue of the Bulletin of the Aquaculture Association of Canada.



The 2013 workshop demonstrated how much research has been conducted to date (both within CIMTAN and internationally) and how a better understanding of each extractive component of an IMTA system has been gained. There has been a lot of progress in less than a decade. It is interesting to note that more than 400 scientific papers have been published worldwide on IMTA, which illustrates the interest for this ecosystem-responsible aquaculture practice.

One of the non-scientific highlights of the event was the workshop dinner on November 20, 2013, which was turned into a special three-course dinner to celebrate local IMTA products from the Bay of Fundy. Thierry Chopin worked with the Executive Chef of the Saint John Ale House, Jesse Vergen, to develop an elaborate menu integrating sugar kelp (*Saccharina latissima*), blue mussels (*Mytilus edulis*), Atlantic salmon (*Salmo salar*), dulse (*Palmaria palmata*), and Irish moss (*Chondrus crispus*). A lovely meal to top off a very successful CIMTAN workshop!

See the web page on the Culinary Celebration of IMTA Products:
<http://www2.unb.ca/chopinlab/imta/news/IMTA%20Dinner/index.html>





Read the article of Barb Rayner in *The St. Croix Courier*:

<http://www2.unb.ca/chopinlab/articles/files/Rayner%20131122%20IMTA%20Dinner%20St%20Croix%20Courier.pdf>

This fall the **University of New Brunswick in Saint John** again offered its **Marine Semester** program: three intensive months (September to November) at the Huntsman Marine Science Centre (HMSC), in St. Andrews, New Brunswick, for third and fourth year students taking the Marine Biology specialization.

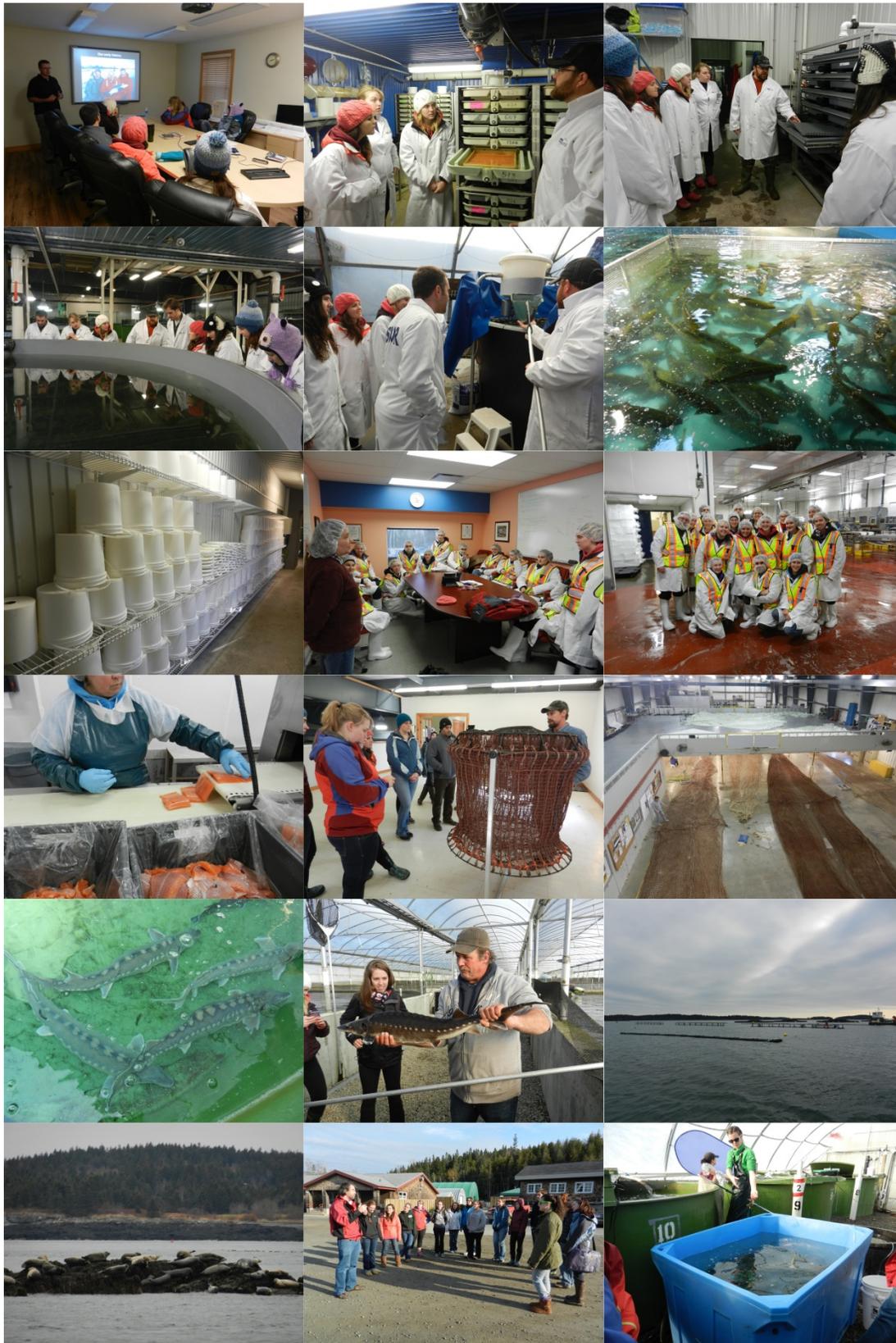
Thierry Chopin teaches the seaweed component in two of the courses (Biol 3903, Diversity and habitats of marine organisms; Biol 3913, Adaptations of marine organisms), and the course Biol 3923 (History and development of marine aquaculture).

This course covers a broad range of aspects of aquaculture in New Brunswick, Canada and beyond. This year, in addition to lectures by Thierry Chopin on seaweed aquaculture and IMTA (what a surprise!), we had 11 guest speakers from Fisheries and Oceans Canada, the Canadian Food Inspection Agency, the New Brunswick Department of Agriculture, Aquaculture and Fisheries, HMSC and UNB. They covered topics as varied as: the history of salmon aquaculture in southwest New Brunswick; aquaculture and seafood regulations and policies; the role of invertebrates in the evolution of food production systems in the oceans; open ocean aquaculture; freshwater aquaculture; harmful algal blooms; the veterinary perspective on aquaculture; climate change and ocean acidification; and transport and dispersal of wastes, therapeutants and diseases.

One day was dedicated to a visit of aquaculture operations on land: the Oak Bay hatchery, the Fundy Drive processing plant and the GMG manufacturing plant from Cooke Aquaculture Inc.; and the land-based sturgeon facility of Breviro Caviar Inc. One afternoon, the whole class went on the HMSC vessel, *Fundy Spray*, to look more closely at salmon and IMTA aquaculture operations at sea. One morning, the group discovered the other side of HMSC, with a tour of the aquaculture research facilities.

Thanks to all involved! The students learned a lot, enjoyed interacting with you and saw many things they had no idea about before.







The student panel discussion ("The next generation of scientists on why we care") (photo credit: Thierry Chopin).

NSERC's Canadian Healthy Oceans Network (CHONe) hosted a two-day **2020 Vision of Canada's Oceans Dialogue** on the future of Canada's oceans.

The Dialogue was held in Vancouver, December 4-6, 2013, and attracted 75 participants including top international marine scientists, policy makers, scientific directors of other Canadian ocean-related networks and CHONe students. Sessions focused on the importance of ocean life to the economic and social well-being of Canadians; where Canada stands on its international environmental obligations and how we can do better; how

ocean networks in Canada can work together to fill identified gaps in Canada's science goals for the future; and where we need to go as a science community to achieve ocean sustainability, by bringing policy and science together in order to maintain productive oceans that provide maximal benefits to Canadians.

The scientific directors of the other eight Canadian ocean-related networks made short presentations followed by discussion. **Thierry Chopin** gave a presentation entitled "**The Canadian Integrated Multi-Trophic Aquaculture Network (CIMTAN), its raison d'être and its contribution to the sustainable**

use of oceans".

Martha

Crago, Vice-President Research at Dalhousie University in Halifax, and Chair of the Canadian Consortium of Ocean Research Universities, gave a presentation on the findings from the Expert Assessment of Ocean Science Report.

The remarkable design of the Asia Pacific Hall of the Wosk Centre for Dialogue, of Simon Fraser University in downtown Vancouver, was ideal for excellent panel discussions and open dialogues.

Past and present students from CHONe had a panel on "The next generation of scientists on why we care". A mixed panel of scientists and policy makers gave their perspectives on policy challenges in Canada.



During the presentation of Isabelle Côté (Simon Fraser University), entitled "Looking below the ocean surface: the Good, the Bad, and the Ugly" (photo credit: Thierry Chopin).



John Nightingale, President, Vancouver Aquarium and Marine Science Centre, during his Canada Ocean Lecture Public Talk entitled "Collaboration and communication – Two keys to our ocean's future" (photo credit: Thierry Chopin).



Guest speakers from the policy sector in other countries and regions (Australia, USA and Europe) shared some encouraging case studies about how much can be accomplished when people come together with passion, a shared vision and determination to make changes for the sake of ocean sustainability. The ocean has a lot to give us but we must be good stewards!



Paul Snelgrove, Director of the Canadian Healthy Oceans Network (CHONe), celebrating his 51th birthday on December 6, 2013. This could almost be an IMTA cake! (photo credit: Thierry Chopin).

On the evening of December 5, Dr. John Nightingale, President of the Vancouver Aquarium and

Marine Science Centre, gave the Canada Ocean Lecture Public Talk entitled “Collaboration and communication – Two keys to our ocean’s future”.

The afternoon of the second day was dedicated to a panel and open dialogue among scientists, politicians and conservationists discussing the path forward to achieve ocean sustainability. The participation of two members of parliament (Robert Chisholm, Dartmouth, Nova Scotia, and Fin Donnelly, Coquitlam, British Columbia) and one senator (David Wells, St. John’s, Newfoundland) was duly noted and appreciated.

CHONe will produce a convenor’s report in January 2014 and will work with participants on action items arising from the meeting to ensure that the vision and ideas shared in Vancouver are not lost.



The “Path forward” panel discussion amongst scientists, politicians and conservationists (photo credit: Thierry Chopin).



The population of the kelp, *Ecklonia maxima*, harvested by Nelson Mandela. In the background, Table Bay, Cape Town and Table Mountain (photo credit: Thierry Chopin, who visited Robben Island in January 2001, before attending the 17th International Seaweed Symposium in Cape Town, South Africa).

"One morning, instead of walking to the quarry, we were ordered into the back of a truck. It rumbled off in a new direction, and fifteen minutes later we were ordered to jump out. There in front of us, glinting in the morning light, we saw the ocean, the rocky shore, and in the distance, winking in the sunshine, the glass towers of Cape Town. Although it was surely an illusion, the city, with Table Mountain looming behind it, looked agonizingly close, as if one could almost reach out and grasp it.

The senior officer explained to us that we had been brought to the shore to collect seaweed. We were instructed to pick up the large pieces that had washed up on the beach, and waded out to collect seaweed attached to rocks or coral. The seaweed itself was long and slimy and brownish-green in color. Sometimes the pieces were six to eight feet in length and thirty pounds in weight. After fishing out the seaweed from the shallows, we lined

it up in rows on the beach. When it was dry, we loaded it into the back of truck. We were told it was then shipped to Japan, where it was used as a fertilizer.

The work did not seem too taxing to us that day, but in the coming weeks and months, we found it could be quite strenuous. But that hardly mattered because we had the pleasures and distractions of such a panoramic tableau: we watched fishing ships trawling, stately oil tankers moving slowly across the horizon; we saw gulls spearing fish from the sea and seals cavorting on the waves; we laughed at the colony of penguins, which resembled a brigade of clumsy, flat-footed soldiers; and we marveled at the daily drama of the weather over Table Mountain, with its shifting canopy of clouds and sun.



The entrance of the Robben Island prison (photo credit: Thierry Chopin).



The prison yard at Robben Island (photo credit: Thierry Chopin).

In the summer, the water felt wonderful, but in winter, the icy Benguela currents made wading out into the waves a torture. The rocks on and around the shore we jagged, and we often cut and scraped our legs as we worked. But we preferred the sea to the quarry, although we never spent more than a few days there at a time...

... The atmosphere at the shore was more relaxed than at the quarry. We also relished the seaside because we ate extremely well there. Each morning when we went to the shore, we would take a large drum of fresh water. Later, we would bring along a second drum, which we would use



to make a kind of Robben Island seafood stew. For our stew we would pick up clams and mussels. We also caught crayfish, which hid themselves in the crevices of rocks. Capturing a crayfish was tricky; one had to grab it firmly between its head and tail or it would wiggle free.

Abalone, or what we call *perlemoen*, was my favorite dish. Abalones are mollusks that cling tenaciously to rocks, and one has to pry them loose. They are stubborn creatures, difficult to open, and if they are the slightest bit overcooked, they are too tough to eat. We would take our catch and pile it into the second drum. Wilton Mkwai was the chef among us and he would concoct the stew.

When it was ready, the warders would join us and we would all sit



One of the Robben Island prison towers
(photo credit: Thierry Chopin).

down on the beach and have a kind of picnic lunch. In 1973, in a smuggled newspaper, we read about the wedding of Princess Anne and Mark Phillips, and the story detailed the bridal luncheon of rare and delicate dishes. The menu included mussels, crayfish, and abalone, which made us laugh; we were dining on such delicacies every day.

One afternoon, we were sitting on the beach eating our stew when Lieutenant Terblanche, who was then head of prison, made a surprise visit. We quickly pretended to be working, but we had not fooled him. He soon discovered the second drum containing a mussel stew bubbling over the fire. The lieutenant opened the pot and looked inside. He then speared a mussel, ate it, and pronounced it "*Smaaklik*," Afrikaans for "tasty".



The cell in the Robben Island prison in which Nelson Mandela lived for 18 of his 27 years in prison (photo credit: Thierry Chopin).

Nelson Mandela (1918-2013) – Long Walk to Freedom

In Hamburg, Germany, you can now visit the **Algae House**. It is the first building in the world having a bioreactor facade. Microalgae are cultivated in the glass elements that make up its "bio skin". These are used to produce energy, and can also control light and provide shade. Strategic Science Consult GmbH is one of the initiators of this project.



More information on the building can be found at:

<http://www.iba-hamburg.de/en/themes-projects/the-building-exhibition-within-the-building-exhibition/smart-material-houses/biq/projekt/biq.html>



Constanza Chianale collecting the red alga *Palmaria palmata* at Letete, New Brunswick. Constanza has become an expert at recognizing reproductive tetrasporophytes and male gametophytes (photo credit: Thierry Chopin).

Constanza Chianale is an aquaculture engineer from Santiago, Chile. After working with a few salmon companies, she realized that it is necessary for Chile to diversify its aquaculture. She decided to go back to university to obtain a MSc degree specializing in seaweed aquaculture. Her interest in applied research and the existence of an enormous potential for the development of aquaculture integrating biological, ecological and economic aspects of algal cultivation, specifically in Chile, motivated her to move from Chile to Canada to join CIMTAN in 2010. Currently, she is a PhD candidate at the University of New Brunswick in Saint John, under the supervision of Dr. Thierry Chopin. Since 2001, a number of IMTA sites have been in operation in the Bay of Fundy, Canada, co-culturing salmon (*Salmo salar*), mussels (*Mytilus edulis*) and seaweeds (the two kelps *Saccharina*

latissima and *Alaria esculenta*). The understanding of the life cycle of these algae and their cultivation methods generates seasonal crops that are cultivated at the IMTA sites from mid fall to early summer. Consequently, there is presently a period of the year (summer) when seaweeds are absent from the IMTA sites. The overarching goal of Constanza's project is to develop the cultivation of red alga, *Palmaria palmata* (dulse), in order to increase the biomitigative performance of the inorganic extractive component of IMTA in the Bay of Fundy during summer when kelps are absent. The life cycle of *P. palmata* is complicated and was only elucidated recently (1980; see <http://www2.unb.ca/chopinlab/S...S...S/index.html>). Little is known about the occurrence of its different phases in nature, especially during fall and winter. Because of this, Constanza decided to forget about those beautiful warm winters in Chile and bravely ventured into the field during the frigid Canadian winters to observe and identify the different stages of the life cycle of *P. palmata*.

Reproductive tetrasporophytes and male gametophytes can be identified by the presence of sori, paler in male gametophytes than in tetrasporophytes and with single gametes instead of the tetrad arrangement of spores. Constanza has been monitoring the timing of the occurrence of male gametophytes and tetrasporophytes on a year-round basis. She has also developed protocols for the massive release of spermatia (*i.e.* the sexual male gametes) and tetraspores (*i.e.* the asexual spores). Presently, Constanza is defining the laboratory conditions and methods for cultivating the different phases of *P. palmata* before their transfer to IMTA sites.



Jars containing solutions of tetraspores released from mature tetrasporophytes of the red alga *Palmaria palmata* (photo credit: Thierry Chopin).

First CIMTAN member quote of the month: "My new family at the Integrated Multi-Trophic Aquaculture laboratory at the University of New Brunswick in Saint John is like my home away from home!" (*Constanza Chianale, CIMTAN PhD candidate*).

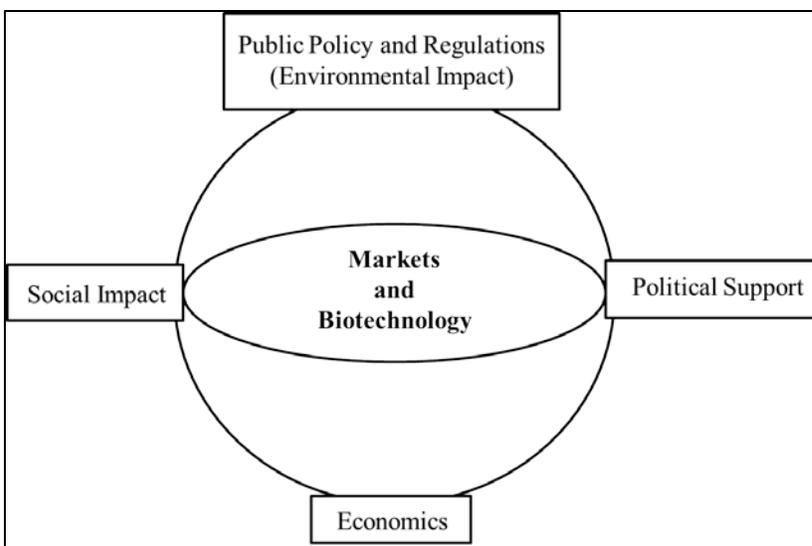


Stefan Crampton at the IMTA site of Kyuquot SEAFoods Ltd. on Vancouver Island, British Columbia (photo credit: Kimberly Irwin).

Stefan Crampton obtained his Bachelor Degree from McGill University, in Montréal, Québec, in 2011, where he studied environmental science and international development studies. Following his graduation, he moved to Burnaby, British Columbia, to work on a Master in Natural Resources Management (MRM) at Simon Fraser University. Working under the supervision of Dr. Duncan Knowler, he joined CIMTAN in January 2013 because he was passionate about how IMTA aquaculture policy could be evaluated and effectively implemented in order to achieve an environmental objective. His research focuses on assessing the conditions under which a conventional aquaculture industry might adopt a new technology, focusing in part on various market-based policy instruments as a means to incentivize the salmon farming industry to adopt IMTA. Currently, IMTA in Canada is still largely in the research and experimental stage. Whereas IMTA has been proven to be technologically and technically viable, as well as commercially profitable, the vast majority of Atlantic salmon farmed in Canada is still produced using the conventional monoculture net-pen method. A widespread shift to commercial scale IMTA production, therefore, will most likely require appropriate government policy initiatives. Nutrient trading credits, taxes, subsidies and other instruments will be modelled. The goal of the project is to

evaluate which policies, or combination thereof, would provide the greatest incentive for private firms to adopt IMTA. Stefan is very excited to get out in the field this winter and talk to aquaculture companies to start collecting the data he will need.

Second CIMTAN member quote of the month: "Working with CIMTAN has made me appreciate the interdisciplinary effort that is required to promote the diffusion of IMTA throughout the industry. It not only requires us to prove its technological, technical and commercial viability, but it also requires us to find new markets and help design policies that will promote its adoption. This means working with a variety of stakeholders - including industry, NGOs, government and scientists - to make it work. This is a truly exciting process to be a part of." (Stefan Crampton, CIMTAN MRM candidate).



A conceptual diagram of an integrated public policy framework (source: Food and Agriculture Organization of the United Nations).



Farewell Natasha! Natasha Hamilton-Hunter was CIMTAN Administrative Assistant for 2013, while Meryl Coes was on maternity leave. To thank Natasha for all her involvement in CIMTAN matters and to wish her farewell, we had a little get together on December 11. Meryl will be back at CIMTAN Central on January 6, 2014. Welcome back Meryl!

