



NSERC Canadian Integrated  
Multi-Trophic Aquaculture Network

Réseau canadien d'aquaculture  
multitrophique intégrée du CRSNG

CIMTAN *Snippets*

**Wishing you great integrated success  
in 2013!**

**from  
the  
Canadian  
Integrated  
Multi-Trophic  
Aquaculture  
Network  
(CIMTAN)**

*Poached IMTA salmon on a bed of IMTA kelp with a julienne of vegetables (carrot, celery and leek), heirloom tomatoes, tarragon, goat cheese-herb drizzle and nasturtium oil  
(prepared by Chef Chris Aerni – Rossmount Inn, St. Andrews, New Brunswick)*

Aquaponics made the front cover of the November 2012 issue of **Fish Farming International**. The interesting design of the front cover was accompanied by a thought-provocative title: "Aquaponics – Is fish the future of agriculture?". Inside, the four page cover article of **Avani Nadkarni**, "Aquaponics – More than just an ideal", developed why this increasingly popular form of IMTA could be going mainstream in the future. **Nick Savidov**, of the Alberta Agricultural and Rural Development Department, and **Thierry Chopin** were interviewed for this article. One of the two new CIMTAN projects is precisely aimed at developing freshwater IMTA, or aquaponics, at some of the salmon hatcheries of our industrial partner Cooke Aquaculture Inc.

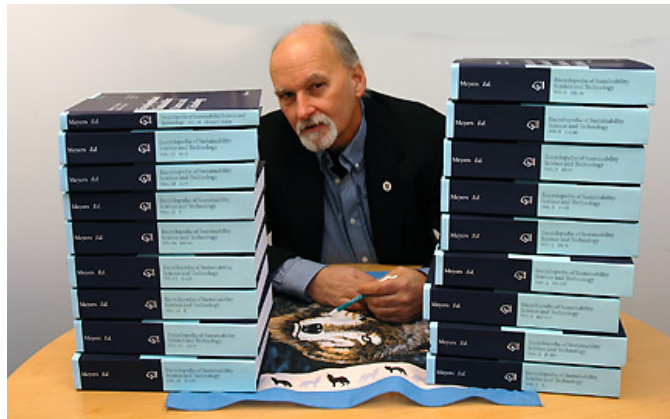
Read the article:

<http://www.unbsj.ca/sase/biology/chopinlab/articles/files/FFI%201211%20cover%2022-25.pdf>





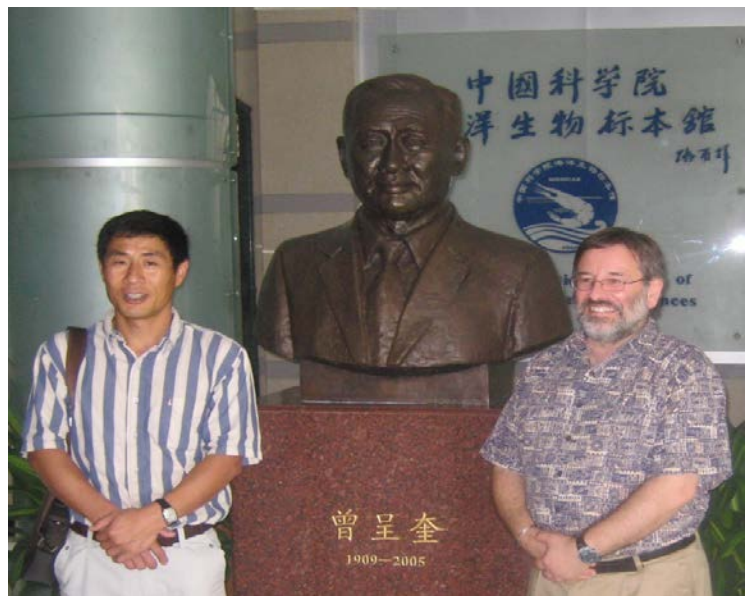
Christmas is over, but do we have a gift idea for you...! **The Encyclopedia of Sustainability Science and Technology** is out! Edited by **Robert Meyers** and published by **Springer**, it is a monumental work



Barry Costa-Pierce with the 18 volumes of the Encyclopedia of Sustainability Science and Technology.

and an amazing database produced by nearly 1,000 scientists and engineers, and captured in 18 volumes and 12,555 pages. An impressive number of 41 editors, including well-known marine biologist **Barry Costa-Pierce**, oversaw the content of 42 topical areas in pioneering and globally important sustainability science and technology. Overseeing the work were 19 senior scientists, including 5 Nobel Laureates and a co-recipient of the Nobel Peace Prize for climate change research. **Thierry Chopin** contributed the chapter entitled "**Aquaculture, Integrated Multi-Trophic (IMTA)**".

**Thierry Chopin** has enjoyed over the years a very productive collaboration with **Shaojun Pang** and his team (**Feng Liu, Suqin Gao, Tifeng Shan, Xiaobo Zhao and Jing Li**), from the Institute of Oceanology of the Chinese Academy of Sciences (IOCAS) in Qingdao, China. They have published three papers on the large green tide phenomenon occurring in the Yellow Sea. This gigantic bloom of the green alga *Ulva prolifera* got international attention in 2008, just before the sailing activities of the Olympic Games took place in Qingdao, but it has been a recurrent event each spring since 2007. Their latest paper "**Understanding the recurrent large-scale green tide in the Yellow Sea: Temporal and spatial correlations between multiple geographical, aquacultural and biological factors**" has been published in *Marine Environmental Research* and offers an interesting explanation for this unique phenomenon, which is, in fact, a case of mis-opportunity for large scale coastal IMTA.



Shaojun Pang (left) and Thierry Chopin (right) posing in front of the statue of the late Academician C.K. Tseng, former Director of IOCAS and grandfather of modern phylogeny and seaweed farming in China.



The coast of Jiangsu Province – where the densely-branched, oxygen-filled, free-floating filamentous green seaweed, *U. prolifera*, has over the past six years always been spotted first, before developing into large scale green tides – is uniquely characterized by a huge intertidal radial mudflat (22,740 km<sup>2</sup>).



Coastal animal aquaculture ponds where rotifers and juvenile freshwater crabs are cultivated. Water from these ponds is periodically discharged to the coastal zone through canals and ditches.

New results show that: (1) the microscopic propagules of *U. prolifera* have been consistently present in seawater and the sediments of this mudflat and varied with locations and seasons; (2) over 50,000 tons of fermented chicken manure have been applied annually from March to May in coastal animal aquaculture ponds for the production of rotifers to feed juvenile freshwater crabs (*Eriocheir sinensis* or Chinese mitten crab); thereafter, the waste water has been discharged into the radial mudflat, intensifying eutrophication; (3) elevated levels of temperature, irradiance and nutrients

in seawater greatly facilitated the growth of the propagules, and filaments of branched *U. prolifera* filled quickly with oxygen and floated within an hour; and (4) free-floating *U. prolifera* could be stranded in any floating infrastructures in coastal waters, including large scale *Porphyra* (nori) farming rafts.



Aerial picture of drifting mats of the *Ulva prolifera* green tide off Qingdao on June 14, 2009.

The paper emphasizes the need for early management actions in the sequence of events leading to the recurrent and massive green tides in the Yellow Sea. For a truly integrated management of the coastal zone, reduction in nutrient inputs, and control of the effluents of the coastal animal aquaculture pond systems, are needed in the land-based operations. If the green tides are to be managed, and, hopefully, reduced or eliminated, their development needs to be stopped at the sources on land, not at intermediate steps on the radial intertidal mudflat, when it is already too late for preventing their massive blooming in the Yellow Sea and perturbing running aground along the shores.



**Domain 3 organized the second CIMTAN Technical Workshop**, which took place on December 4-5, in Vancouver. The workshop was hosted by Duncan Knowler (Domain 3 co-leader) at the superb Simon Fraser University Morris J. Wosk Centre for Dialogue, right in downtown Vancouver, and conveniently located adjacent to the Delta Vancouver Suites Hotel, where workshop participants stayed.

The workshop focused on the social science aspects and research associated with CIMTAN and was also an opportunity to reinforce the cohesion and cooperation among Domain 3 members. Fourteen participants - including researchers, graduate students and managers from Simon Fraser University (SFU), the University of Victoria (UVic), Vancouver Island University (VIU), the University of New Brunswick (UNB), Memorial University of Newfoundland (MUN), and Fisheries and Oceans Canada (DFO) - engaged in lively discussions and debates on the economic and socio-cultural aspects of IMTA over the two days.

The first morning, the workshop commenced with introductions from the leaders of the two projects comprising Domain 3 [Duncan Knowler (SFU), Mark Flaherty (UVic) and Grant Murray (VIU)], followed by a review of the IMTA concept and an overview of CIMTAN and its *raison d'être* presented by Thierry Chopin (UNB), the Scientific Director of the Network. Gregor Reid (UNB/DFO) made a presentation on the various modelling activities underway as part of CIMTAN, in anticipation of future modelling that will link up its social and natural science components and will require an integrated inter-disciplinary approach. Saleem Rahman, the new co-leader of Domain 3 from DFO, followed with a presentation on recent developments in aquaculture policy and governance. Wolfgang Haider (SFU) talked on assessing market acceptability for new seafood products, based on several case studies and methods he developed, with his students, over the years.

After an excellent networking lunch, Duncan Knowler made a presentation on the market implications of the adoption of IMTA in British Columbia, based on the research projects of two of his previous CIMTAN students, Patrick Kitchen and Winnie Yip. Then, Roberto Martínez-Espiñeira (MUN) presented his work on estimating the non-tangible benefits derived from the biomitigation effects of IMTA by Canadian salmon consumers, using the contingent behaviour method, and non-consumers, using the contingent valuation method. Graduate student Kim Irwin (SFU) followed by explaining her research project design using a choice model to value the environmental impacts of British Columbia salmon farms and how IMTA would fit in this valuation. The afternoon concluded with a wrap-up session and discussion.

In the evening, a very nicely catered gathering and dinner took place on the upper level of the Water Street Café from where there was an excellent view on the famous Gastown steam clock, which was heard several times while networking was ongoing.

After the first day on the economic and market implications of IMTA, the second day of the workshop focused on integrating livelihood, First Nations and governance issues associated with IMTA.

Postdoctoral fellow Linda D'Anna (VIU) presented her ongoing study on understanding the impact of shellfish aquaculture on community well-being in British Columbia and the implications for the introduction of IMTA. Graduate students Katie Tebbutt and Erin Latham (UVic) presented the information they are gathering on First Nations perspectives on aquaculture and the implications for IMTA.

After another excellent lunch, also conducive to more exchanges, graduate student Anna Belanger (UVic) took the group through the legislative and policy aspects of the evolution of aquaculture governance and their implications for IMTA. A general wrap-up session for the whole workshop followed. Outputs and outcomes were discussed and the workshop should provide some of the material for the social science chapter in the up-coming book on IMTA. Future research directions were also discussed.

This workshop proved to be a worthwhile exercise, facilitating cooperation among social science participants, who noted a lot of convergence in their approaches and the possibility of sharing techniques to acquire data.





The announcement in the last issue of CIMTAN Snippets of Exsymtal®, a new cosmetic product based on the IMTA seaweed *Alaria esculenta* from the Bay of Fundy, triggered quite a lot of media interest:

- 1 TV interview  
[www.cbc.ca/player/News/Canada/NB/ID/2306640424/](http://www.cbc.ca/player/News/Canada/NB/ID/2306640424/)
- 2 radio interviews  
[http://www.radio-canada.ca/emissions/Libre\\_echange/2012-2013/chronique.asp?idChronique=258294](http://www.radio-canada.ca/emissions/Libre_echange/2012-2013/chronique.asp?idChronique=258294)
- 1 newspaper article  
<http://stcroixcourier.ca/fullnews.php?view=834>
- 2 articles in professional magazines
- 7 mentions on news websites  
<http://www.cbc.ca/news/canada/new-brunswick/story/2012/11/20/nb-seaweed-cosmetics.html>
- 24 mentions on cosmetics, skin care, fitness Internet websites and blogs.



Lindsay Orr filtering samples to analyze the organic content during her east coast research exchange in St. Andrews, New Brunswick (photo credit: Emily Nelson).

Lindsay Orr completed her BSc degree in the Department of Biology at the University of Victoria, where she developed her passion for all things marine, invertebrate and algal. She joined CIMTAN in the spring of 2010 as an MSc student to study the organic particulate extractive component of IMTA on the west coast. Her recently completed degree was through the Department of Geography at the University of Victoria (with Dr. Stephen Cross), but she did her research out of the Fisheries and Oceans Canada Pacific Biological Station in Nanaimo, British Columbia, under the supervision of Dr. Chris Pearce. During her work she was lucky enough to participate in two CIMTAN east/west coast research exchange trips

in St. Andrews, New Brunswick, and in Nanaimo. For her MSc project, Lindsay studied aspects of feeding physiology in candidate IMTA invertebrate species [*i.e.* basket cockle (*Clinocardium nuttalli*), blue mussel (*Mytilus edulis*), green sea urchin (*Strongylocentrotus droebachiensis*), California sea cucumber (*Parastichopus californicus*), and spot prawn (*Pandalus platyceros*)]. One advantage of IMTA is the potential for bioremediation by these organic extractive organisms. Whether they can remove organic material from aquaculture wastes was tested by measuring ingestion rate or clearance rate and absorption efficiency when they were fed a diet of cultured sablefish (*Anoplopoma fimbria*) waste, relative to those fed a natural control diet. Results from the laboratory feeding trials demonstrated that most of the tested candidate species were capable of both



A green sea urchin (*Strongylocentrotus droebachiensis*) feeding on sablefish (*Anoplopoma fimbria*) faeces during Lindsay's laboratory feeding experiment in Nanaimo, British Columbia (photo credit: Lindsay Orr).

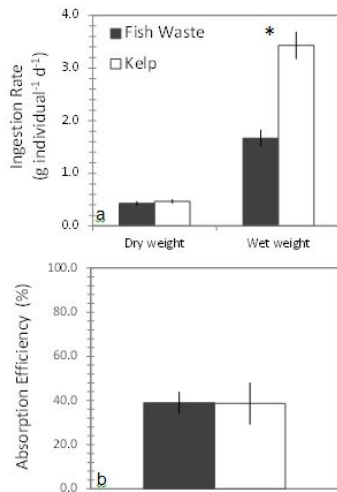


Figure 1. (a) Ingestion rate (g individual<sup>-1</sup> d<sup>-1</sup>) and (b) absorption efficiency (%) in green sea urchins (*Strongylocentrotus droebachiensis*) fed a diet of sablefish (*Anoplopoma fimbria*) waste ( $n = 12$  for a and  $n = 10$  for b) or kelp (*Macrocystis pyrifera*) ( $n = 9$  for a and  $n = 8$  for b). Data are mean  $\pm$  SE. \* = significant difference ( $P < 0.05$ ).

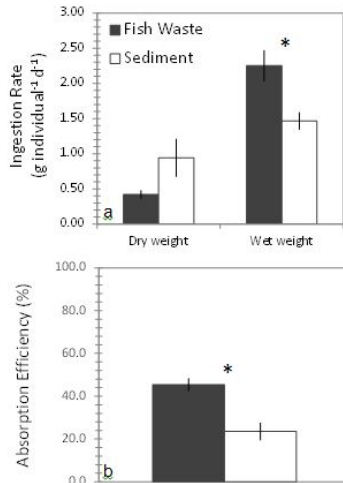


Figure 2. (a) Ingestion rate (g individual<sup>-1</sup> d<sup>-1</sup>) and (b) absorption efficiency (%) in California sea cucumbers (*Parastichopus californicus*) fed a diet of sablefish (*Anoplopoma fimbria*) waste ( $n = 4$  for a and  $n = 5$  for b) or natural sediment ( $n = 4$  for a and  $n = 3$  for b). Data are mean  $\pm$  SE. \* = significant difference ( $P < 0.05$ ).

consuming wastes from sablefish aquaculture and absorbing the organic material. The general conclusion is that, in order to achieve efficient removal of organic material and successful bioremediation, deposit feeders should be included in the organic extractive component, whether alone or in conjunction with suspension feeders. The green sea urchin and the California sea cucumber showed the most promising results, since they absorbed an equal or greater amount of organic material from the sablefish waste relative to the controls (Figs. 1 and 2). The spot prawn showed the least promising results, since it exhibited negative absorption efficiencies when feeding upon sablefish waste. Lindsay acknowledges that CIMTAN has been a great opportunity to be part of a large research network, to meet other

students and experienced researchers, and to travel to new places throughout Canada.

**First CIMTAN member quote of the month:** "Moving to Nanaimo to work on my project for CIMTAN gave me the chance to immerse myself in a new community of people, and there I started playing roller derby, my (now) favourite sport, under the alias Sandra Dee-spicable." (*Lindsay Orr, CIMTAN MSc*).

**Steven Pace** joined CIMTAN as an MSc candidate at the University of British Columbia, in Vancouver. He is originally from Cincinnati, Ohio, but has been going to school in Canada since he graduated from high school in 2005. Steven has been living in British Columbia for the past 3.5 years and has enjoyed every moment of it. He started his MSc degree in September 2010 under the supervision of Drs. Scott McKinley and Shannon Balfry. The majority of his research took place at the UBC Centre for Aquaculture and Environmental Research in West Vancouver, where he looked at the effect of feeding frequency and water temperature on sablefish (*Anoplopoma fimbria*) apparent digestibility coefficients. The data gained from his experiments will be used in an IMTA ecosystem model, which will hopefully aid future IMTA development on the west coast. Steven is just about to defend his MSc thesis and is looking forward to finishing off a very fulfilling graduate experience. When not working on his



Tank system used by Steven Pace for his digestibility experiments at the UBC Centre for Aquaculture and Environmental Research in West Vancouver (photo credit: Steven Pace).



thesis, you can find him skiing, cycling, playing Settlers of Catan, and watching too much football. Steven has thoroughly enjoyed his project and is extremely glad for the opportunity that CIMTAN gave him.

**Second CIMTAN member quote of the month:** "Sablefish is an amazing fish to work with and has an incredible amount of potential for IMTA. It doesn't hurt that it is incredibly easy to cook and delicious as well!" (*Steven Pace, CIMTAN MSc candidate*).

**Meryl Coes**, our CIMTAN Administrative Assistant, is heading out on maternity leave. We will soon have the youngest ever member of CIMTAN! We have been suggesting *Alaria* or *Sporochnus* for baby names, but with no success! We wish Meryl all the best for this exciting upcoming year!

**Natasha Hamilton-Hunter** is Meryl's replacement. Welcome to CIMTAN Natasha! Natasha spent the last week before the December Holidays with Meryl to be brought up to speed on how everything works at CIMTAN Central. She is now ready for this upcoming year, but be patient as she is "baptized by fire" with the Year 3 Annual Progress Report!

