



Roberto Martínez-Espiñeira and co-authors Thierry Chopin, Shawn Robinson, Anthony Noce, Duncan Knowler and Winnie Yip published a paper entitled "Estimating the biomitigation benefits of Integrated Multi-Trophic Aquaculture: a contingent behavior analysis" in the January 2015 issue of the journal *Aquaculture*.

Using the contingent behavior method, they estimated the benefits derived from the biomitigative effects of Integrated Multi-Trophic Aquaculture (IMTA) in the farming of Atlantic salmon. They asked a sample of Canadians how their farmed Atlantic salmon consumption choices would be affected by the availability of IMTA products in response to the decreased external costs they would impose on the surrounding marine environment. They used a random-effects negative binomial model to estimate their different demand functions and, from them, measures of increases in consumer surplus arising from the availability of IMTA products. They estimated a lower bound for the aggregate benefit that current salmon consumers in Canada would derive from the introduction of IMTA salmon of about CAD 280 million/year, while less restrictive assumptions such as the representativeness of their sample would lead to an aggregate figure of about CAD 1.5 billion/year. They also found that consumers would benefit from proper labeling of farmed salmon, since conventionally farmed salmon and IMTA salmon are considered non-substitutes, the latter being a normal good and the former an inferior good for the typical consumer. They found that there is room for improving welfare by disseminating information to enhance consumer understanding of IMTA production techniques.

Read the paper:

http://www.researchgate.net/publication/269937490_Estimating_the_biomitigation_benefits_of_Integrated_Multi-Trophic_Aquaculture_A_contingent_behavior_analysis

Thierry Chopin inducted Chevalier in the Ordre National du Mérite of France



Thierry Chopin received the medal of the Order from Mr. Vincent Hommeril, Consul Général of France in the Atlantic Provinces of Canada, at a ceremony at the University of New Brunswick in Saint John, on February 27, 2015. Thierry Chopin was inducted as Chevalier in the Ordre National du Mérite by decree of the President of the République Française, Mr. François Hollande, on November 13, 2014.

Thierry Chopin was Honorary Vice-Consul of France from 2001 to 2010, and has been Honorary Consul since 2011. He has also been Professor of Marine



Estimating the biomitigation benefits of Integrated Multi-Trophic Aquaculture: A contingent behavior analysis

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ABSTRACT

Using the contingent behavior method, we estimate the benefits derived from the biomitigation effects of Integrated Multi-Trophic Aquaculture (IMTA) in the farming of Atlantic salmon. We asked a sample of Canadians how their farmed Atlantic salmon consumption choices would be affected by the availability of IMTA products in response to the decreased external costs they would impose on the surrounding marine environment. We used a random-effects negative binomial model to estimate their different demand functions and, from them, measures of increases in consumer surplus arising from the availability of IMTA products. We estimated a lower bound for the aggregate benefit that current salmon consumers in Canada would derive from the introduction of IMTA salmon of about CAD 280 million/year, while less restrictive assumptions about the representativeness of our sample would lead to an aggregate figure of about CAD 1.5 billion/year. We also found that consumers would benefit from proper labeling of farmed salmon, since conventionally farmed salmon and IMTA salmon are considered non-substitutes, the latter being a normal good and the former an inferior good for the typical consumer. We find that there is room for improving welfare by disseminating information to enhance consumer understanding of IMTA production techniques.

1. Introduction

In the face of rising demand for seafood and declining availability of wild species and stocks, the world is increasingly turning to aquaculture as the key source of seafood supply. However, concerns have also been expressed about the environmental impacts of aquaculture (Taylor et al., 2000; Olsson et al., 2011). These environmental impacts vary extensively and depend on the type of aquaculture activity and the type of species raised. Aquaculture farming activities can range from semi-intensive to hyper-intensive, where intensification suggests increasing stock density and generation of waste products, and a greater potential for the spread of pathogens. Likewise, the type of species farmed also varies widely: there are hundreds of species of fish, invertebrates, and seaweeds that are farmed and the farming of some species can

further burden or contribute to the collapse of fishery stocks worldwide. For example, shrimp and salmon farming have the potential to further deplete wild fishery stocks as a result of damage to ocean and coastal resources through habitat destruction, waste disposal, and large fishmeal and fish oil requirements (Nguyen et al., 2000). By contrast, herbivores or filter-feeding aquaculture species, such as carp and molluscs, can be net contributors to global fish stocks (Nguyen et al., 2000). The development of intensive fed aquaculture such as finfish and shrimp activities that are highly geographically concentrated in localized or suboptimal sites whose assimilative capacity is poorly understood can result in environmental impacts (Chopin et al., 2001; Davis, 2009; Nguyen et al., 1998). Salmon farming in particular, the focus of our study, is believed to be one of the anthropogenic sources of eutrophication in coastal areas. Other environmental effects of salmon aquaculture production include increased water turbidity from effluent discharges, escaped farmed species, diseases (e.g. sea lice), and the increasing presence in waters of various drugs (e.g. antibiotics) used in the rearing or feeding of the farmed fish (Nguyen et al., 2000). Minimizing the environmental damage associated with aquaculture requires the internalization of environmental costs through the adoption of new,

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Biology at UNB Saint John since 1989.

The Ordre National du Mérite was founded on December 3, 1963, by Président **Charles de Gaulle**. It is an Order of State and is awarded by the President of the French Republic, Grand Master of the Order, on the advice of his Ministers (the Minister of Foreign Affairs and International Development, Mr. **Laurent Fabius**, in the case of Thierry Chopin). Général **Jean Louis Georgelin** is the present Chancellor of the Order, which has about 190,000 members.

French citizens, as well as foreign nationals, men and women, can be received into the Order, for distinguished civil or military achievements. It is France's second highest honour for civilians, after the Légion d'Honneur.

For Thierry Chopin, this is a proud moment. "I have been involved with the French and francophone communities of New Brunswick for 15 years. I have been at the University of New Brunswick for 25 years, and this month, I will have spent as much time in my adoptive Canada as in my native France."

"What a wonderful way to mark this milestone with such an honour, reflecting both the services rendered and a profound attachment to my roots!"

See web page on the event:

<http://www2.unb.ca/chopinlab/consul/Ordre%20National%20du%20Merite%20of%20France/index.html>

Read newspaper articles:

- ["Saint John professor awarded one of France's highest honours"](#)
- ["Un professeur de Saint Jean décoré de l'Ordre National du Mérite"](#)

Dawn Chafe, the Editor of *Atlantic Business Magazine*, published the article "**The age of Algae**" in the January-February 2015 issue. In a survey last fall, IMTA and organically certified kelps were voted the best story from academic institutions in Atlantic Canada.

Read the article: <http://www.atlanticbusinessmagazine.net/the-age-of-algae/>

Thierry Chopin published a paper entitled "**Marine aquaculture in Canada: well-established monocultures of finfish and shellfish and an emerging integrated multi-trophic aquaculture (IMTA) approach including seaweeds, other invertebrates and microbial communities**" in the January 2015 issue of the journal *Fisheries*.

Read the paper:

http://www.researchgate.net/publication/272181768_Marine_Aquaculture_in_Canada_Well-Established_Monocultures_of_Finfish_and_Shellfish_and_an_Emerging_Integrated_Multi-Trophic_Aquaculture_?28IMTA%29_Approach_Including_Seaweeds_Other_Invertebrates_and_Microbial_Communities



Marine Aquaculture in Canada: Well-Established Monocultures of Finfish and Shellfish and an Emerging Integrated Multi-Trophic Aquaculture (IMTA) Approach Including Seaweeds, Other Invertebrates, and Microbial Communities

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INTRODUCTION

Worldwide aquaculture is among the fastest growing food sectors, accounting for nearly 50% of the total fish and invertebrate production and 80% of the total seaweed production (Chopin 2014). The production sector has gained several advantages: consistent coastal geography, abundance of cold and clear water, favorable climate, rich marine and filter-feeding, established trade relationships with the United States, Asia, and Europe, and a commitment to sustainable and responsible fish practices. However, during the past decade, production has begun to be regulated (25% increase in aquaculture in the United States 2008, Aquaculture 2013) and several major environmental challenges, including only 1.2% among aquaculture producing countries (Canadian Aquaculture Industry Alliance 2014), the most recent source for which complete statistics are available. There is also a developing freshwater aquaculture sector, but it will not be part of this article. In 2012, Canada produced 752,000 tonnes of farmed seafood valued at C\$192.6 million. In 2011, 10% of Canada's total fish production was in aquaculture products and accounted for 17% of the total value. Canada exported more than 60% of its aquaculture production to over 22 countries across the world, more than 90,000 tonnes valued at more than C\$260 million. C\$15.2 billion of farmed fish and shellfish were produced in 2011 (1.1%). Canada's primary aquaculture export markets include the United States (over 80,000 tonnes valued at over \$400 million), Japan (C\$281.1 million), Taiwan (C\$285 million), Singapore (C\$283.5 million), China (C\$262 million), and Hong Kong (C\$243 million) (DFO 2014). Canada is the most seafood supplier to the United States. Other suppliers include Chile, Thailand, Indonesia, Chile, and Vietnam (Aquaculture and Agri-food Canada 2014). Aquaculture offers diverse sources from aquaculture (National Aquaculture and Invertebrates Administration 2011, 2014). Aquaculture provides a diverse range of products to the market, including fish, shellfish, seaweeds, and other invertebrates. New Zealand, New Zealand, New Zealand, and other countries have developed a strong industry and the fish species, but emerging, novel species, mostly centered on the development of integrated multi-trophic aquaculture (IMTA), a combination of finfish, invertebrates, and seaweeds for environmental sustainability, economic diversification, and social acceptability of aquaculture practices (Chopin et al. 2015).

THE FINFISH SECTOR

Finfish aquaculture is the most important foodfish species grown in Canadian aquaculture, with production valued at C\$1,097 million valued at C\$1,097 million, accounted for over 80% of volume and value of total produced in 2012 (Aquaculture 2012). The Newfoundland and Labrador Department of Fisheries and Aquaculture (DFO 2012). Farmed salmon accounted for 90% of the total volume, New Brunswick accounted for 10% (DFO 2012). Newfoundland for 10% (DFO 2012), and Nova Scotia for 10% (DFO 2012). Aquaculture 2012, 2014, 2014).

© Canadian Wild Farmed Salmon Production, 20% (1,779 tonnes) was consumed domestically (Aquaculture 2012, 2014, DFO 2014). An additional 1,236 tonnes were exported. With aquaculture consumed at approximately 71 million, Canada's per capita consumption



Thierry Chopin became **Associate Editor** of the *European Journal of Phycology* for the *Applied Phycology* section in January 2015.

Thierry Chopin was elected to a **5 year term** as a **member of the Senate** of the **University of New Brunswick in Saint John** in January 2015.

Thierry Chopin was invited by **Abby Lunstrum**, organizer of the departmental seminar series, and Dr.



Karen McGlathery, of the Department of Environmental Sciences, at the University of Virginia in Charlottesville (USA), to give a seminar entitled "**Integrated Multi-Trophic Aquaculture (IMTA): an environmentally, economically and societally responsible aquanomic approach to farming the sea**". The seminar was also teleconferenced with the Virginia Institute of Marine Science at Gloucester Point.

The University of Virginia (UVA) is the University of President **Thomas Jefferson**. It was established in 1819, with its "Academical Village" and original courses of study conceived and designed entirely by Jefferson. He succeeded **Benjamin Franklin** as United States Minister Plenipotentiary (Ambassador) to France from March 1785 to September 1789. He was President of the United States of America from 1801 to 1809.

Interdisciplinary aquaculture teaching at the University of New Brunswick in Saint John

In its 5th edition, the course "**History and Development of Aquaculture**", taught by **Thierry Chopin**, has moved from being part of the Fall Marine Semester, taught at the Huntsman Marine Science Centre in St. Andrews, to a course on the Saint John campus of the University of New Brunswick during the winter semester.

Instead of the traditional mono-instruction, the course is integrated (what a surprise!) with a series of guest speakers covering many aspects of the aquaculture sector.

Historically, the teaching, research and management of aquaculture, just like for fisheries, have followed a silo approach in which a discipline has been predominantly advocated as the way to solve issues and develop policies independently, without much consideration for cumulative effects, trade-offs and ecosystem services in changing environments and coastal communities. It is becoming increasingly clear that an interdisciplinary approach, at the interfaces of the environmental, economic and societal concerns, is, in fact, the solution for solving complex issues and the basis for developing the appropriate participatory governance.

Often aquaculture courses are offered with a biology perspective and focus on fish. However, aquaculture is complex, highly diversified, much more than just fish, and occurring under all kinds of climatic, environmental, economic and societal conditions.



Attentive students of the course "History and Development of Aquaculture", offered by Thierry Chopin, are listening to Chuck Brown, Communications Manager at Cooke Aquaculture Inc., and Her Worship Terry James, Mayor of Blacks Harbour, during their presentations at the University of New Brunswick in Saint John (photo credit: Thierry Chopin).

It is, in fact, not surprising that ecology and economy have the same root, "oikos", the "house" in Greek. It is only when the relationships that living organisms have with each other and with their abiotic environment under the same roof, *i.e.* the rules of the house, are clearly understood that the house can be properly managed.

So, the course wants to reflect this interdisciplinary and multisectorial approach. Third and fourth year students are exposed to presentations covering historical aspects and how modern finfish aquaculture started to develop in southwest New Brunswick in the late 1970's (more ancient forms of aquaculture can be dated back to the 17th century Acadian aboiteaux). They hear about how to produce single sex and sterile fish, the veterinarian perspective on aquaculture, the key role of the feed industry, the importance of environmental monitoring and modelling of the aquaculture activities and the potential impacts of climate changes.

Provincial (New Brunswick Department of Agriculture, Aquaculture and Fisheries) and federal (Fisheries and Oceans Canada) regulators explain their role and involvement in the industry. Representatives of the Canadian Food Inspection Agency explain food safety and food regulations, as they pertain to aquaculture. The industry representatives talk about their developments and challenges, from humble family farming to global leading position.

Invertebrate aquaculture (38.8% of world mariculture production) is also covered and the students embark on a world tour of seaweed aquaculture (49.1% of world mariculture production). They also hear about the development of Integrated Multi-Trophic Aquaculture (IMTA) in their backyard, the Bay of Fundy, and its many variations throughout the world.

Freshwater aquaculture is not forgotten with the example of sturgeon aquaculture, right here in the Saint John River. The students complete the array of species being aquacultured by doing a series of oral presentations, in groups of two, at the end of the term.

This year a new perspective was added. After listening to Her Worship **Terry James**, the Mayor of Blacks Harbour, speak as a witness at the Standing Senate Committee on Fisheries and Oceans last November in Moncton, Thierry Chopin asked her if she would be willing to give a presentation to the aquaculture class. She accepted and her presentation was most interesting, giving a perspective on aquaculture from a different angle, that of the grass roots of a small coastal community greatly affected by a major industry partner.



Students enjoying the presentation of Cornel Ceapa, the owner of Acadian Sturgeon and Caviar Inc., and the tasting of caviar and sturgeon terrine at the end of the class: the real egg to plate experience! (photo credit: Thierry Chopin)

Each speaker was asked to also explain how they became involved in aquaculture, as it is important for the students to realize that there are many ways to become involved with aquaculture besides through a classical university curriculum. The itineraries of the speakers to date have not had much in common, but these people all ended up being involved with aquaculture. This is a true reflection of the interdisciplinary and multisectorial approach to understanding this key activity in our coastal environment and economy.

As aquaculture is the largest agri-food sector of New Brunswick, it is both topical and strategic to offer teaching and conduct research in this field of regional, national and international priority, as what is at stake is to expose the scientists, policy influencers, decision makers, regulators and industry leaders of tomorrow to critical thinking about the design and development of the most innovative, efficient and responsible food production systems for an ever increasing human population, ensuring a healthy, productive and resilient environment for all species involved, while also designing profitable operation systems.



Adam Turner hard at work (and well dressed!) in the Supercaravelle XR66 dingy during the CIMTAN HQP workshop, attaching flagging tape to a scale model fish cage. Flagging tape was used as a method to visualize unsteadiness and turbulent structures in the wake of fish cages (photo credit: Justin Del Bel Belluz).

Adam Turner obtained his Bachelor degree in Mechanical Engineering at the University of New Brunswick (UNB) in 2013. Before graduation, an exciting opportunity to get a Master degree with CIMTAN was brought to his attention. After doing some research and learning about the goals and ambitions of CIMTAN, Adam accepted the position without hesitation.

Adam is currently working in Dr. Tiger Jeans' computational fluid dynamics laboratory at UNB in Fredericton. Over the past two years, he has twice travelled to the Fisheries and Marine Institute of Memorial University in St. John's, Newfoundland, to run his experiments at the largest flume tank in the world. He has been studying the hydrodynamic wake properties of scale model fish cages and fish cage arrays, to gain a better understanding of wake velocity, wake topology, wake turbulence and wake



recovery. The results of his study will link flow conditions with patterns of released nutrients, and will be used to better place extractive species for optimized nutrient extraction.

Adam will be presenting his research findings at the 34th International Conference on Ocean, Offshore and Arctic Engineering (OMAE 2015) in St. John's (he can't get enough of Newfoundland!) this coming June. Adam plans to graduate in the spring of 2015, and aims to find work in hydrodynamics or aerodynamics.

When Adam is not working on his thesis, you can usually find him playing hockey, softball or cooking for his roommates.

CIMTAN member quote of the month:

"CIMTAN has given me the opportunity to travel across the country and meet some very interesting people doing some very exciting things. Sometimes during my experiments, I found it hard to stay a-wake; hydrodynamics can be such a drag" (*Adam Turner, CIMTAN MAsc candidate*).



An experimental measurement of wake velocity downstream of a scale model square cage array, using 8 Swoffer current meters mounted to a vertical bar. The vertical bar was traversed across the flume tank to capture a plane of velocity measurements at certain distances downstream of the cages (photo credit: Adam Turner).

When it comes to weeds, the Dutch are the connoisseurs... even of seaweed burgers!

See: <http://dutchweedburger.com/?lang=en>

