Successful Partnerships for a Sustainable Future

Les partenariats réussis pour un avenir durable

Program Guide / Guide de programme

Aquaculture Canada[OM] 2010 & Cold Harvest™ 2010 Conference and Tradeshow

St. John's, Newfoundland and Labrador, 16-19 May 2010

Dr. Joe Brown Student Fundraiser

featuring the first ever

AQUACULTURE CASINO

with proceeds going to the

Student Endowment Fund

Marine Institute, Ridge, Road, St. John's
Monday - May 17th, 2010 - 7:00 pm
Buses Departing from the Delta
starting at 6:00 pm

- Buffet dinner featuring deliciously farmed seafood
- Chances to win fabulous prizes
- Play games of chance, black jack, high or low, 5 card poker, and crown and anchor
- Tours of the MI aquaculture facility, worlds largest flume tank, and much more
- **Tickets: $30!!!**
- Includes: Admission
  Dinner
  5 Joe Dollars
  A Great Time

COME AND "BET" ON A GOOD TIME

MI

Aquaculture Association of Canada
Association Aquacole du Canada

MEMORIAL UNIVERSITY

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Conference Organizing Committee / Comité organizateur

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Tillmann Benfey – University of New Brunswick (Program Co-Chair)
Joanne Burry – Conference Coordinator
Catriona Wong – Aquaculture Association of Canada (Home Office)
Candace Durston – Aquaculture Association of Canada (Home Office)
Susan Waddy – Aquaculture Association of Canada (Home Office)
Ruth Salmon – Canadian Aquaculture Industry Alliance
Laura Halfyard – Marine Institute, Memorial University of Newfoundland
Steve Moyse – Department of Fisheries and Aquaculture, Province of Newfoundland and Labrador
Brian Meaney – Department of Fisheries and Aquaculture, Province of Newfoundland and Labrador
Roberta Collier – Newfoundland Aquaculture Industry Association
Victoria Hamlyn – Newfoundland Aquaculture Industry Association
Carrie Frizzell – Newfoundland Aquaculture Industry Association

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Darrell Green – Newfoundland Aquaculture Industry Association (Co-chair)
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Rod Penney – Canadian Food Inspection Agency (Abstract Chair)
Debbie Martin-Robichaud – Fisheries and Oceans Canada
Danny Boyce – Ocean Sciences Centre, Memorial University of Newfoundland
Caroline Graham – New Brunswick Community College
Tim Jackson – National Research Council Canada
Gehan Mabrouk – Fisheries and Oceans Canada
Laura Halfyard – Marine Institute, Memorial University of Newfoundland
Keith Rideout – Marine Institute, Memorial University of Newfoundland
Chris Hendry – Fisheries and Oceans Canada
Norm Penton – Department of Fisheries and Aquaculture, Province of Newfoundland and Labrador
Ruth Salmon – Canadian Aquaculture Industry Alliance
Joanne Burry – Conference Coordinator

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Miranda Pryor – Executive Director (maternity leave)
Darrell Green – Research and Development Coordinator
Victoria Hamlyn – Office Manager / Events Coordinator (retired)
Carrie Frizzell – Office Manager
Roberta Collier – Regional Coordinator / Events Coordinator
Wanda Howse – Office Assistant

Aquaculture Canada^{OM} 2010 and Cold Harvest^{TM} 2010
Partners and Contributors / Partenaires et Commanditaires

Co-hosts / Hôtes conjoints:

- Department of Fisheries and Aquaculture, Province of Newfoundland and Labrador

Diamond/ Platinum Contributors / Commanditaires diamant ($5000.00+):

- Atlantic Canada Opportunities Agency
- Aquaculture Collaborative Research and Development Program, Fisheries and Oceans Canada
- Aquaculture Management Directorate, Fisheries and Oceans Canada
- Canadian Aquaculture Industry Alliance
- Department of Fisheries and Aquaculture, Province of Newfoundland and Labrador
- Department of Industry Trade and Rural Development, Province of Newfoundland and Labrador

Gold Contributors / Commanditaires or ($1000.00 +):

- Atlantic Provinces Council on the Sciences, Aquaculture Committee
- Genome Atlantic
- Gray Aqua Products Ltd.
- Hoskin Scientific
- Intervet/Schering Plough Animal Health
- Marine Institute
- NL Styro
- Northern Harvest Seafarms
- Novartis Aquatic Animal Health
- Réseau Aquaculture du Québec
- Skretting
- University of Guelph, Aquaculture Center

Silver Contributors / Commanditaires argent ($500 +):

- Canadian Centre for Fisheries Innovation
- New Brunswick Salmon Growers Association
- NorthEast Nutrition
- Wedgwood Insurance

Bronze Contributors / Commanditaires bronze ($300.00+):

- GMG Fish Services Ltd.
- Go Deep International
- Mitchell McConnell Insurance
- RDI Strategies

Aquaculture Product Donors / Commanditaires de produits aquacoles:

- Badger Bay Mussels
- Cold Water Fisheries
- Cooke Aquaculture
- Norlantic Processors
- Northern Harvest Seafarms

Aquaculture Association of Canada / Association Aquacole du Canada
Welcome to Delegates / Mots de bienvenue aux délégués

Welcome to Newfoundland and Labrador for Aquaculture Canada 2010, our 27th annual meeting, and the national forum on the science, technology and business of Canadian aquaculture. We are fortunate to be partnering with the Newfoundland Aquaculture Industry Association and the Government of Newfoundland and Labrador to co-host this event for the 4th time in the past 3 decades. The Province is the focal point of one of the most rapidly growing sustainable aquaculture industries nationally, perhaps internationally. The value of aquaculture in Canada exceeds $2 billion and we have barely tapped the potential. The theme of the meetings is "*Successful partnerships for a sustainable future"* and this reflects on the need to work in partnership among industry, academia, governments and other key stakeholders to provide for long term sustainable socioeconomic benefits for our coastal and rural areas of the country. The year 2010 is a milestone in global aquaculture where more than 50% of the aquatic protein consumed by humans now originates from aquaculture. Aquatic protein is the most important source of a healthy daily diet for over 3 billion people, and the demand is growing. Canada has an increasingly important role to play in meeting this demand. Our conference agenda will provide a good overview of how this challenge will be taken up by this important sector of the Canadian, and global economy. Please enjoy St. John's, the oldest continuously inhabited settlement in North America, with a tremendous history and vibrant culture that I am sure you will remember fondly. We look forward to meeting you.

Cyr Couturier
President, Aquaculture Association of Canada
Président, Association aquacole du Canada

Je vous souhaite la bienvenue à Terre-Neuve et Labrador pour la réunion Aquaculture Canada 2010, notre 27è , et le forum national de la science, technologie et affaires en aquaculture canadienne. Nous sommes fière de nous joindre à la NAIA et la Province de Terre-Neuve et Labrador, nos co-hôtes pour la 4è fois en 3 décenies pour cet évenement spécial. Cette province est le point focal d'une industrie aquacole durable des plus accroissante au Canada, et peut être au monde. L'aquaculure canadienne a une valeur de plus de 2 milliards $ maintenant, et nous en sommes seulement au début du vrai potentiel. Le thème des réunions est *"Les partenariats réussis pour un avenir durable"* et ceci reflète sur la nécéssité pour tous de travailler ensemble – l'industrie, les gouvernements, les chercheurs et le grand publique - pour soutenir un avenir durable dans nos régions côtières et rurales du pays. L'année 2010 représente un point important dans le monde car cette année marque le point ou plus de 50% de la protéine en provenance du milieu aquatique sera d'origine aquacole. La protéine aquatique est la plus importante composante d'une diète de santé de plus de 3 milliards d'êtres humains, et la demande continue d'accroître. Le Canada a un rôle important à combler la demande du future. Le programme des conférences vous donnera un bon aperçu de comment on prend ce défis pour augmenter la production aquacole au Canada, un secteur important de l'économie nationale. S.V.P. passez un beau séjour à St. Jean, T.-N. la plus vieille ville en Amérique du Nord avec une histoire et une culture tout à fait "vibrantes" que vous apprécierai certainement. Nous espérons avoir l'honneur de vous acceuillir

Newfoundland Aquaculture Industry Association
Welcome to Delegates / Mots de bienvenue aux délégués

On behalf of the Newfoundland Aquaculture Industry Association (NAIA) I would like to welcome you to our joint conferences, Cold Harvest 2010 and Aquaculture Canada 2010. This is the fourth time since 1989 that the NAIA has partnered with the Aquaculture Association of Canada (AAC) and the Province of Newfoundland and Labrador (NL) to co-host this national event bringing industry, academics, and government together to discuss progress and future plans for moving our sector forward. We are fortunate in NL to be in a growth position and our production is the third largest among Canadian producers of farmed seafoods, contributing over $150 million to the rural economy of our Province. Several of you will take tours of our farms and we are sure you will be impressed with the level of commitment, environmental stewardship and knowledge our farm operators have concerning the global industry.

The theme for the joint conference is "*Successful partnerships for a sustainable future"* which is a reflection of the close collaboration among industry, governments and the research sector that is needed to bring our industry to fruition and to continue to prosper and remain competitive. Each has an essential role to play in the "partnership", one in which interdependent on the other for our "sustainable future". We believe this partnership will be evident to you as the program unfolds at the conference.

To the attendees from outside our Province and country, welcome to the most exciting Province in the federation, a place where people are optimistic about their future in fish farming. It is also a place where culture and hospitality mesh into one seamless bond, and I hope you will all experience this bond as we meet over these few days in St. John's.

Jennifer Caines
President, Newfoundland Aquaculture Industry Assocation

Canadian Aquaculture Industry Alliance / Alliance de l'Industrie Canadienne de l'Aquaculture
Welcome to Delegates / Mot de bienvenue aux délégués

On behalf of the Canadian Aquaculture Industry Alliance, I am very pleased to welcome all delegates to Aquaculture Canada 2010 and Cold Harvest 2010.

The theme of the meetings is "Successful partnerships for a sustainable future" reflecting the importance of working in partnership among industry, academia, governments and other key stakeholders to ensure long term sustainable socioeconomic benefits for a growing number of rural Canadians.

More than ever before, partnerships have become the cornerstone of aquaculture in Canada. Before farming even begins, farm licensing procedures include extensive consultations with local communities, stakeholder groups and regulatory agencies - well in advance of any plans for production.

But this is only the beginning. Many of our members have formed strong working partnerships with First Nations – based on the principles of working together and respecting aboriginal history and culture. Others are working to improve their relationships with traditional fisheries in their local area, valuing the views of those who share the marine resource with us.

Other industry members, as well as industry associations, are actively engaging stakeholders at the provincial, national and international level. For example, industry continues to dialogue with various levels of government, ENGO's and our industry colleagues from other countries, on the development of aquaculture standards (WWF, GAA etc.) Once in place, these standards and their certification programs will provide greater options for industry to demonstrate their sustainable practices. In addition, CAIA and its members are also working nationally and internationally on collaborative research programs and technology development.

There is a lot of good work being done to improve the sustainability of aquaculture - but there is always room for new programs, initiatives and partnerships. This year's AAC and NAIA conference is about sharing new ideas and options for improving upon those partnerships. The CAIA Board of Directors applauds this goal, congratulates AAC and NAIA for another job well done and wishes all participants a productive and successful conference.

Ruth Salmon, Executive Director, Canadian Aquaculture Industry Alliance

A MESSAGE FROM CANADA'S MINISTER OF FISHERIES AND OCEANS

As Canada's Minister of Fisheries and Oceans, it gives me great pleasure to welcome you to St. John's for Aquaculture Canada 2010 and NAIA Cold Harvest 2010.

Aquaculture in Newfoundland and Labrador, and across Canada, continues to flourish and grow. In 2008, total Canadian production volume of farmed seafood was $773 million. Of that, more than 11,000 tonnes, with a value of $63 million, were produced in Newfoundland and Labrador.

Aquaculture has breathed new life into many coastal communities and continues to be a key driver of Canada's economy. Fisheries and Oceans Canada is proud to support this thriving industry, which employs more than 14,000 people in Canada.

The theme of this year's conference, "Successful Partnerships for a Sustainable Future," is particularly apt, since it is by working together that government, industry and other stakeholders can grow and strengthen Canada's aquaculture industry.

I wish you a successful conference and trade show, and an enjoyable stay in St. John's.

The Honourable Gail Shea, P.C., M.P.
Minister of Fisheries and Oceans

MESSAGE DU MINISTRE DES PÊCHES ET DES OCÉANS DU CANADA

À titre de ministre de Pêches et Océans Canada, j'ai le plaisir de vous souhaiter la bienvenue à St. John's à l'occasion d'Aquaculture Canada 2010 et de NAIA Cold Harvest 2010.

L'aquaculture continue de prospérer et de prendre son essor à Terre-Neuve-et-Labrador et dans le reste du Canada. En 2008, le volume total de la production canadienne de produits de la mer d'élevage s'est élevé à 773 millions de dollars, dont 11 000 tonnes, évaluées à 63 millions de dollars, produites à Terre-Neuve-et-Labrador.

L'aquaculture a insufflé une vie nouvelle dans bon nombre de collectivités côtières et continue d'être un moteur clé de l'économie canadienne. Pêches et Océans Canada est fier de soutenir cette industrie florissante, qui emploie plus de 14 000 personnes au Canada.

Le thème de la conférence de cette année – « Les partenariats réussis pour un avenir durable » - est tout particulièrement indiqué, puisque c'est grâce à leurs efforts concertés que le gouvernement, l'industrie et les autres intervenants peuvent développer et solidifier l'industrie de l'aquaculture au Canada.

Je vous souhaite une conférence et une foire fructueuses et un agréable séjour à St. John's.

L'honorable Gail Shea, C.P., députée
Ministre des Pêches et des Océans

Greetings from the Minister of Fisheries and Aquaculture

On behalf of the Government of Newfoundland and Labrador, welcome to Cold Harvest 2010 and the Aquaculture Association of Canada 2010 annual meetings. The Department of Fisheries and Aquaculture is pleased to be a partner during this year when the theme is *Successful Partnerships for a Sustainable Future.*

A particular welcome to those delegates who have traveled from outside of the province and internationally to be here. Our government is very pleased to have you with us for your annual meetings. I hope you have time to take in the sights and sounds of our beautiful province while you are here.

Aquaculture is a fast growing industry and we are pleased to have reached record levels of production in Newfoundland and Labrador in 2009. The market value for the industry increased to $92 million in 2009, representing a 45.9 per cent increase over 2008. Truly, aquaculture has developed into quite an important industry in this province, supporting economic growth and development in coastal and rural areas.

Congratulations to NAIA on organizing this event which is sure to be a tremendous success. I look forward to attending and encourage you to enjoy your time in Newfoundland and Labrador.

Clyde Jackman, MHA
Burin – Placentia West District
Minister of Fisheries and Aquaculture

Aquaculture Association of Canada – Lifetime Achievement Award / Association Aquacole du Canada - Prix honorifique pour contributions

Tuesday, May 18, mardi 18 mai, 2010
11:20 AM – 12:00 PM
Location: Salon B/C/D
Chair: Cyr Couturier

Al Castledine retired several weeks ago from his position as Director of Aquaculture Policy, British Columbia Ministry of Agriculture and Lands.

A degree in English and a desire to experience some of the world took him to Tanzania, East Africa with CUSO for several years in the early 1970's teaching English and Biology in a boys' secondary school. It was there that the idea came up to come back to Canada to pursue a passion for fish with the hope of some day returning to Tanzania to work on artisanal aquaculture. This was a simple, perhaps naïve, idea that has taken a number of twists over the years given the complexity of marriage, children and work.

After Tanzania, a couple of years of undergraduate courses lead into a Master's Program in fish nutrition at the University of Guelph followed by a year's research on Asian carps in Malaysia compliments of a CIDA scholarship. Then off to the University of Victoria for a PhD in biochemistry focusing on fat metabolism in rainbow trout supported in part by NRC. A year in Ottawa (1981-1982) working with the Department of Fisheries and Oceans producing a report on the fish feed industry, amongst other duties, followed. Then off to Ontario from 1982 until 1987as an aquaculture extension biologist with the Ontario Ministry of Natural Resources. In 1987 the opportunity to return to the west coast came up initially as aquaculture production specialist with the British Columbia government succeeded by various roles including both management and Director positions in seafood and aquaculture development in marine and fresh waters. In 2001, Al worked with DFO in Ottawa in an interchange agreement – it was an exciting time – the federal aquaculture policy framework was being developed, the Office of the Commissioner for Aquaculture Development was in full swing and many other new initiatives were being discussed and implemented.

Indeed, the ten years between 1999 and 2009 saw a lot of engagement by the Provinces with the federal government on aquaculture through the Canadian Council of Aquaculture Ministers Aquaculture Task Group (Al co-chaired the Task Group for a number of years). This Task Group provided an opportunity for the Provinces to shape and to support a number of key federal initiatives such as the National Aquatic Animal Health Program, the Aquaculture Collaborative Research and Development Program, and the significant resources currently deployed within the Department to support industry

development and sustainable management such as the Aquaculture Innovation and Market Access Program among others.

Several years ago, as Director of Aquaculture Policy in British Columbia, Al took the initial first steps toward aquaculture development focused on communities and area and ecosystem based approaches to management. Two conventional industry development positions were re-profiled to focus on social licence issues. These actions are recognition that social licence and not technology (at the moment) is the most important factor hindering further growth of aquaculture in British Columbia (and probably lots of other places).

Al was, for many years a member of the British Columbia Institute of Agrologists, taking the steps to qualify to become a member because of the logical connections between aquaculture and agriculture (the irony of the recent British Columbia court decision declaring aquaculture to be a fishery, notwithstanding). He may have been the first Professional Agrologist in Canada to come from an aquaculture background and was recognized as Agrologist of the year for Victoria and the Islands Branch in 2000.

Al has been a member of AAC for many years and served on the Board in several capacities and as president in 1994-1995.

He would like to recognize the many wonderful and talented people he has met and worked with in what has been a very challenging and rewarding 35 years in aquaculture research, extension and management.

As for Tanzania, Al and his wife Birgit, are heading there in June to explore volunteer opportunities with high hopes that these will concern aquaculture.

NAIA's Aquaculturist of the Year

The Aquaculturist of the Year award honours individuals for outstanding contribution to NAIA and/or the development of the aquaculture sector in Newfoundland and Labrador. Any former or current individual NAIA member engaged in aquaculture-related activities in Newfoundland and Labrador is eligible to be nominated to receive the Aquaculturist of the Year Award.

The Aquaculturist of the Year Award recognizes an individual who best exemplifies the aims and objectives of the Association, which are to promote, assist and foster the development of commercial aquaculture activities in the Province. It recognizes significant achievements or accomplishments realized over time in keeping with the NAIA objectives, and not simply an accomplishment in the past calendar year.

The Association's Mission Statement embodies these concepts in the following "The fundamental purpose of the Newfoundland Aquaculture Industry Association is to assist the Aquaculture Industry to achieve its full wealth creation potential. It is the voice for the industry by ensuring that Federal Provincial legislation, policy and services match the needs of the industry. It delivers programs and services to its members to attain excellence in safety, quality, environmental sustainability, and profitability."

Congratulations to this year's recipient who will be announced at the closing banquet, Wednesday May 19th, 7:00pm, Delta St. John's.

Marine Institute Alumni Award

This is an award that will be presented annually to an alumni/graduate of one of the Marine Institute's programs. It will recognize the contributions of this graduate to the Canadian and/or global industry and economy.

This year a graduate of the MI aquaculture program will be the recipient of this award. The AAC Student Barbeque is being sponsored by the Marine Institute and it will use this evening to celebrate an MI Aquaculture Reunion of its graduates of the past 23 years and to honour one of them with the 1st Marine Institute Alumni Award.

Registration and Information / Inscription et informations

Registration / Inscription
Registration is located in the crush lobby of the Delta St. John's Hotel and Conference Centre and operates daily as follows:
L'inscription est dans le lobby principal, Delta St. John's Hotel and Conference Centre et les heures d'opération sont:

- Sunday May 16th / dimanche 16 mai: 1:00 PM – 9:00 PM
- Monday May 17th / lundi 17 mai: 7:00 AM – 5:00 PM
- Tuesday May 18th / mardi 18 mai: 8:00 AM – 5:00 PM
- Wednesday May 19th / mercredi 19 mai: 8:00 AM – 12:00 PM

All function tickets must be obtained from the registration desk.
Vous devez obtenir les billets pour banquets, barbecue et AGA au bureau d'inscription.

Entrance to Sessions / Accès aux sessions
Entry to a session will not be permitted without your Aquaculture Canada™ 2010 & Cold Harvest™ 2010 name tag.
Vous devez porter votre carte d'inscription pour avoir accès aux salles de conférence.

Trade Show Exhibits / Salon commercial
A list of exhibitors is included in the program guide. Please show your support by patronising the exhibit area during the Health Breaks.
La liste des exposants se trouve dans le programme. SVP veuillez visiter le salon commercial pendant les pauses-café.

Set-Up of Exhibits / Montage des kiosques
Set-up will take place on Sunday May 16th, beginning at 2:00PM and ending at 5:00 PM.
Montage des kiosques doit se faire entre 14:00 et 17:00 Dimanche le 16 mai.

Take-Down of Exhibits / Démantellement des kiosques
Take-down will take place immediately following the end of the show, on Tuesday May 18th, 4:00 PM and booths must be totally removed by 5:00 PM.
Démantellement des kiosques commencera dès la fin de l'expo mardi le 18 mai, 16:00 et les kiosques doivent être complètement démanteller par 17:00.

Program Notes for Speakers and Posters / Notes pour conférenciers et présentations d'affiches

Posters – Crush Lobby, Delta St. John's: Set-up time is Sunday May 16th from 4:00 PM to 6:00 PM. Presenters are asked to be available at their poster during the Poster Session on Tuesday May 18th from 2:00 PM to 4:00 PM as well as during morning and afternoon breaks. Posters should be taken down by 6:00 PM on Tuesday May 18th.

Affiches – Le Lobby Principal, Delta St. John's: Montage dimanche le 16 mai entre 16:00 et 18:00. Les présentateurs sont priés de se présenter dans le salon pour la session des affiches mardi 18mai entre 14:00 et 16:00, et aussi durant les pauses-café. Les affiches doivent être enlever au délais le plus tard à 18:00 mardi le 18 mai.

Speakers: Oral presenters are asked to meet their session chair and AV personnel no less than 15 minutes prior to the start of their session. Should changes occur in the program, these will be announced at the beginning of each session and posted in the foyer next to each session room. Speakers and poster presenters are encouraged to submit extended abstracts by June 1, 2010 to benfey@unb.ca for publication of the proceedings in the AAC bulletin.

***Conférenciers* :** Ceux qui font des présentations orales doivent rencontrer le modérateur de la session et le personnel qui s'occupe du service audiovisuel au moins 15 minutes avant le début de la session. Si il y des changements dans le programme, ils seront annoncés au début de la session et montés près de la salle au début de la journée. Les présentateurs d'affiches et de présentations orales sont encouragés à soumettre des résumés prolongés avant le 1 juin, 2010 à benfey@unb.ca pour le compte rendu dans le Bulletin de l'AAC.

Media Room / Salle de media
A room can be made available for media related activities, please see registration desk if required.

Job Board / Annonces d'emploi et résumés
Notice boards are available for posting résumés and job notices near the poster session.
Il y aura des tableaux disponibles pour les annonces près la session des affiches.

Refreshment Breaks / Pauses-santé
For your convenience, refreshment breaks will take place in the main lobby area.
Les pauses-santé auront lieu dans le lobby principal.

Refreshment breaks are / Pauses-santé:
Monday May 17th / lundi 17 mai: 10:30 AM – 11:00 AM and 3:20 PM – 3:50 PM
Tuesday May 18th / mardi 18 mai: 9:50AM – 10:20 AM and 3:20 PM – 3:50 PM
Wednesday May 19th / mercredi 19 mai: 10:10 AM – 10:40 AM and 3:10 PM – 3:40 PM

Student Affairs and Events / Affaires étudiant(e)s

Student Awards: The AAC is pleased to have sponsored travel for over 18 students to attend the conference. 34 students will compete for Best Oral and Best Poster presentations.

Prix étudiant(e)s : L'AAC est fière d'avoir commanditer plus de 18 étudiant(e)s avec des bourses de voyage pour participer à la conférence. 34 présentations par étudiant(e)s seront faites pendant la conférence.

AAC AGM and Breakfast

This will take place in the Salon G, 7:00 AM - 8:30 AM, Tuesday May 18th. All AAC members are encouraged to attend. Breakfast tickets are available at the Registration desk.

L'AGA de l'AAC se tiendra dans la salle Salon G de 7 :00 - 8:30, mardi le 18 mai. Les membres de l'AAC sont bienvenus de participer. Les billets pour le lunch d'affaires sont disponibles au bureau d'inscription.

NAIA AGM and Luncheon

This will take place in the Salon G, 12:30 PM - 2:00 PM, Tuesday May 18th. All NAIA members are encouraged to attend. Luncheon tickets are available at the Registration desk.

L'AGA de l'NAIA se tiendra dans la salle Salon G de 12 :30 - 14:00, mardi le 18 mai. Les membres de l'NAIA sont bienvenus de participer. Les billets pour le lunch d'affaires sont disponibles au bureau d'inscription. Il y aura plusieurs prix de distribuer pendant le lunch d'affaires.

Social Functions / Évènements Sociaux

We will once again be having a number of exciting social events featuring exceptional Canadian aquaculture products.
Il nous fait plaisir de vous offrir des évenements sociaux mettant en oeuvre nos produits canadiens aquacoles de qualité exceptionnelle.

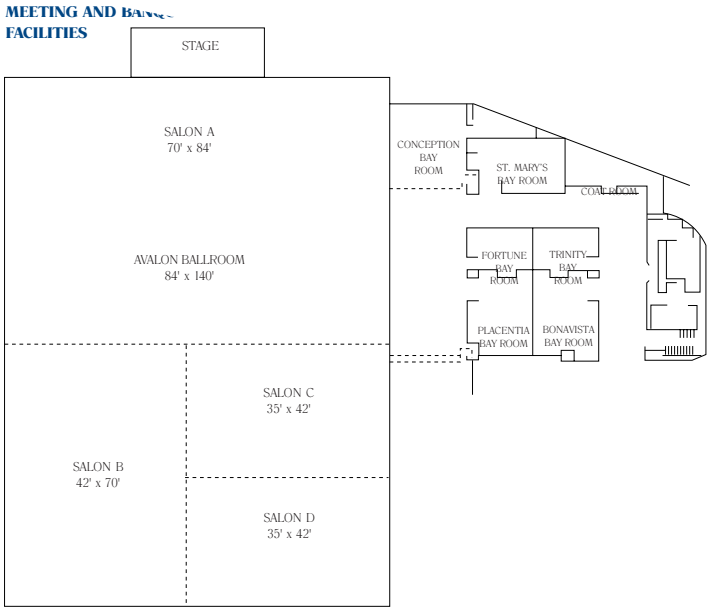
President's Reception / Réception dela présidente
Sunday May 16th, Salon A / Crush Lobby, Delta St. John's, 7:00 – 9:00 PM. Cash bar.
Dimanche 16 mai, Salon A / Crush Lobby, Delta St. John's, 19:00 – 21:00. Bar payant.

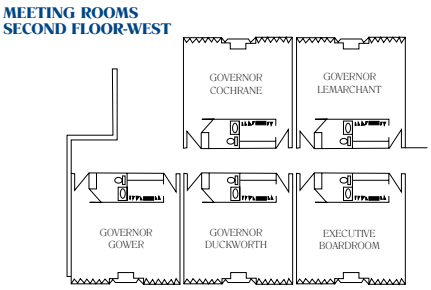
Joe Brown BBQ for Student Endowment Fund / Barbecue aquacole Joe Brown pour fond des étudiant(e)s: The proceeds from the activities at the Joe Brown Student BBQ on Monday May 17th go towards the AAC Student Endowment Fund to support student scholarships and travel to Aquaculture Canada meetings. Students are especially encouraged to attend and participate in the evening's events.
Monday May 17th, Marine Institute, 6:00 – 11:00 PM. Tickets required in advance (includes bus cost to MI from Delta St. John's and return).

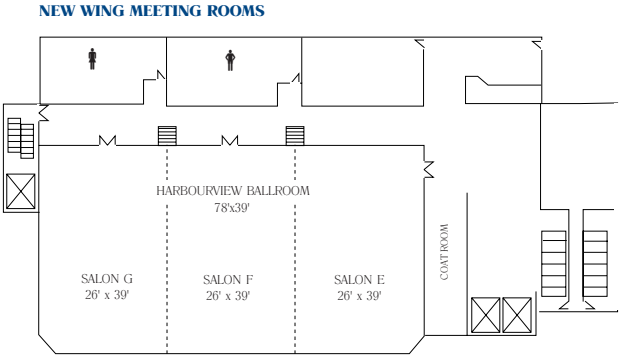
Barbecue Joe Brown pour le fond de support étudiant*:* Les profits des activités au barbecue aquacole lundi le 17 mai sont placés dans un fond de support en forme de bourses pour les étudiant(e)s. On encourage les étudiant(e)s de participer au barbecue Lundi 17 mai, Marine insitute, 18:00-23:00. Billets requis (inclut le coût d'autobus au MI de Delta St. John's et retour).

Banquet – Salon A, Delta St. John's
Wednesday May 19th. Tickets required in advance (from Registration desk). 7:00 PM dinner. Presentation of NAIA Aquaculturist of the Year and Conference Student Presentation Awards.

Session Rooms / Salles de conférences







Program Outline / Sommaire du programme

DAY 1 – SUNDAY, MAY 16 JOUR 1 – DIMANCHE, 16 MAI

13:00 – 21:00	**Registration Open / Inscription ouverte**
14:00 – 17:00	**Tradeshow setup**
16:00 – 18:00	**Poster Set Up / montage des affiches**
19:00 – 21:00	**President's Reception / Réception de la présidente Delta St. John's**

DAY 2 – MONDAY, MAY 17 JOUR 2 – LUNDI, 17 MAI

07:00 – 17:00	**Registration Open / Inscription ouverte**
10:00 – 16:00	**Poster Session / Affiches**
08:30 – 17:10	**Opening Session, Keynote Speaker, Technical Sessions / Allocutions d'ouverture, session plénière, sessions techniques**
12:00 – 14:00	**Lunch (on own) / lunch (à sois même)**
18:00 – 23:00	**Joe Brown BBQ in Support of AAC Students / Barbecue Joe Brown – Marine Institute**

DAY 3 – TUESDAY, MAY 18 JOUR 3 – MARDI, 18 MAI

07:00 – 08:30	**AAC AGM Breakfast (members only)**
08:00 – 17:00	**Registration Open / Inscription ouverte**
10:00 – 16:00	**Poster Session / Affiches Authors in attendance 14:00 - 16:00 / Auteurs présents 14:00-16:00**
08:30 – 17:00	**Plenary Speaker, Technical Sessions / Session plénière, sessions techniques**
11:20 – 12:00	**AAC Lifetime Acheivement Award**
12:30 – 14:00	**NAIA AGM Luncheon (members only)**
12:00 – 14:00	**Lunch (on own) / lunch (à sois même)**

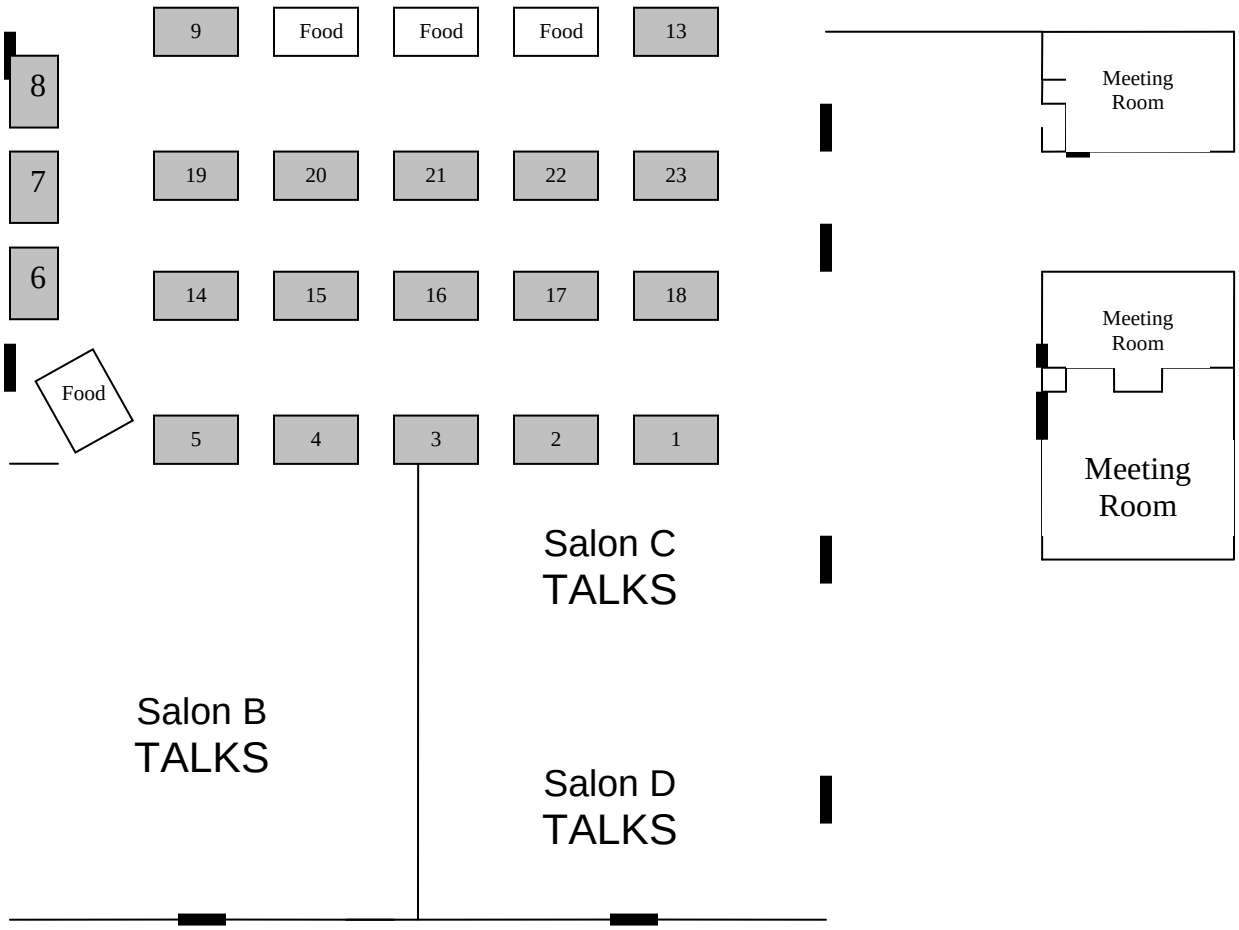
DAY 4 – WEDNESDAY, MAY 19 JOUR 4 – MERCREDI, 19 MAI

08:00 – 12:00	**Registration Open / Inscription ouverte**
08:30 – 17:20	**Plenary Speaker, Technical Sessions / Session plénière, sessions techniques**
11:45 – 13:30	**Lunch (on own) / lunch (à sois même)**
18:30 – 22:00 (cash bar 18:30, dinner 19:00)	**Gala Dinner with NAIA Aquaculturist of the Year Award and Student Awards, Salon A, Delta St. John's**

Shellfish Tour: departs 7:00 AM Thursday May 20th, returns 6:00 PM Friday May 21st

Trade Show / Salon Commercial

Delta St. John's Trade Show Layout – Booths represent 8x10 dimensions. For Illustration Purposes Only



Trade Show Exhibitors and Booth Numbers / Exposants au salon commercial et emplacement

Organization	Booth Space
Biotalent Canada	1
Valox Ltd.	5
Hoskin Scientific Ltd.	9
Department of Fisheries and Oceans	14
Marine Institute, Memorial University of Newfoundland	16
NL Department of Fisheries and Aquaculture	18
The New Brunswick Research and Productivity Council	19
NL Department of Innovation, Trade and Rural Development	20
EMCO Corporation	21
Workplace Health, Safety and Compensation Commission	22
Town of Grand Falls-Windsor	23

Trade Show Exhibitor Profiles

Biotalent Canada **BOOTH # 1**
85 Albert Street
Ottawa, ON K1P 6A4
613-235-1402 Ext.228

Exhibitors: Siobhan Williams

BioTalent Canada helps Canada's bio-economy industry thrive globally.
As a non-profit national organization of innovators leading our bio-economy, BioTalent Canada anticipates needs and creates new opportunities, delivering human resources tools, information and skills development to ensure the industry has access to job-ready people. BioTalent Canada also offers education programs, Canada's premier bio-economy job bank and research on human resource and economic trends.
For more information, please visit: www.biotalent.ca

Valox Ltd **BOOTH # 5**

259 Route 105, Maugerville, NB, E3A 8P1
Tel: (506) 458-5430, Order: 1-800-825-6997, Fax: (506) 458-5431
E-mail: valox@nb.sympatico.ca

Exhibitors: Billy Powers

Valox ltd was established in 1974 to serve the growing number of fish farmers looking for supplies and equipment. Our goal is to service this unique industry, which requires a broad spectrum of instruments in their daily operations.

In the years since, our customer base has broadened to range from small trout pond operators to large commercial businesses as well as universities and Government departments. Although Valox Ltd started in the Aquaculture Industry as an oxygenation equipment supplier, our business has grown and diversified. The increasing variety of requirements has encouraged us to continually source quality instrumentation, shaped our standards and challenged us to find the very best in Aquaculture Technology.

Valox Ltd has a few innovative business assets; a sister company called Valox Inc, a State of Maine corporation which allows us direct access to many American equipment manufacturers. Valox Ltd is a bonded customs broker and this function allows for accurate importing, improved delivery times and reduced cost for our customers.

Today, we are a family owned and operated company, dedicated to our customers and the flourishing Aquaculture Industry. Although serving all facets of the industry, we have focused on water quality, particularly oxygenation and oxygen monitoring and control.

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Aquaculture Centre
UNIVERSITY of GUELPH

Hoskin Scientific Ltd. **BOOTH # 9**

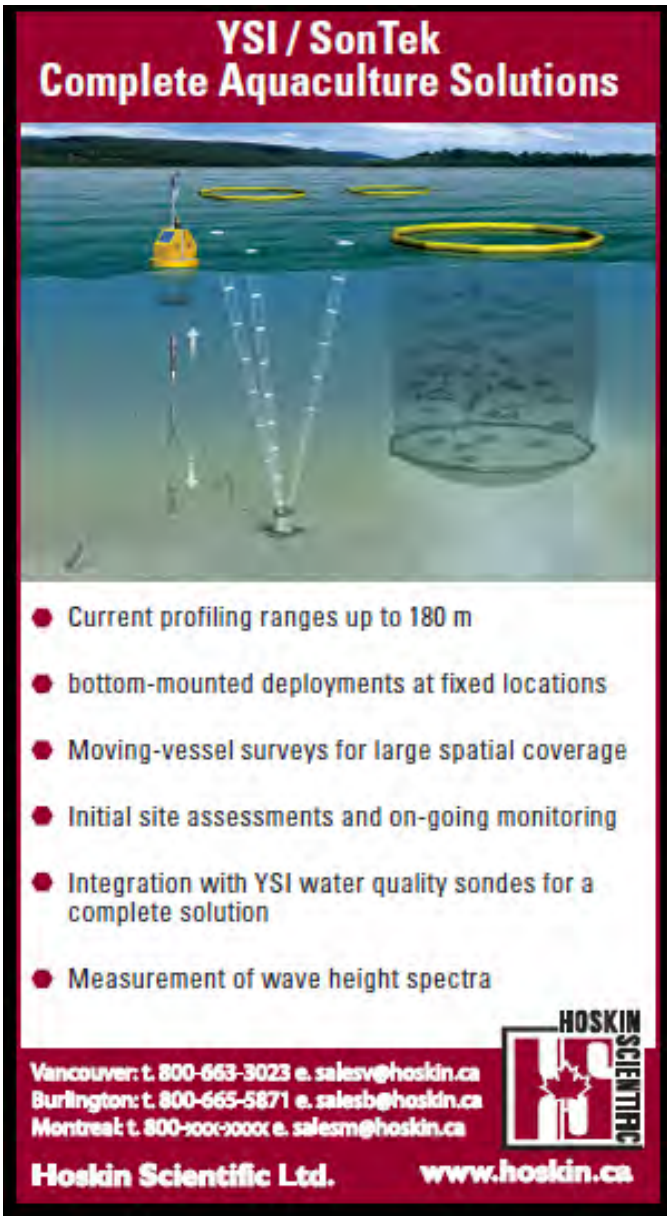
4210 Morris Drive, Burlington, ON L7L 5L6
Ph: (905) 333-5510
Email: jgouthro@hoskin.ca

Exhibitor: Jennie Gouthro

Hoskin Scientific Limited has been supplying testing and monitoring instruments since 1946. Although our range is broad, we focus on three main markets including:

* Environmental Monitoring
* Geotechnical & Materials Testing
* Test & Measurement Instrumentation

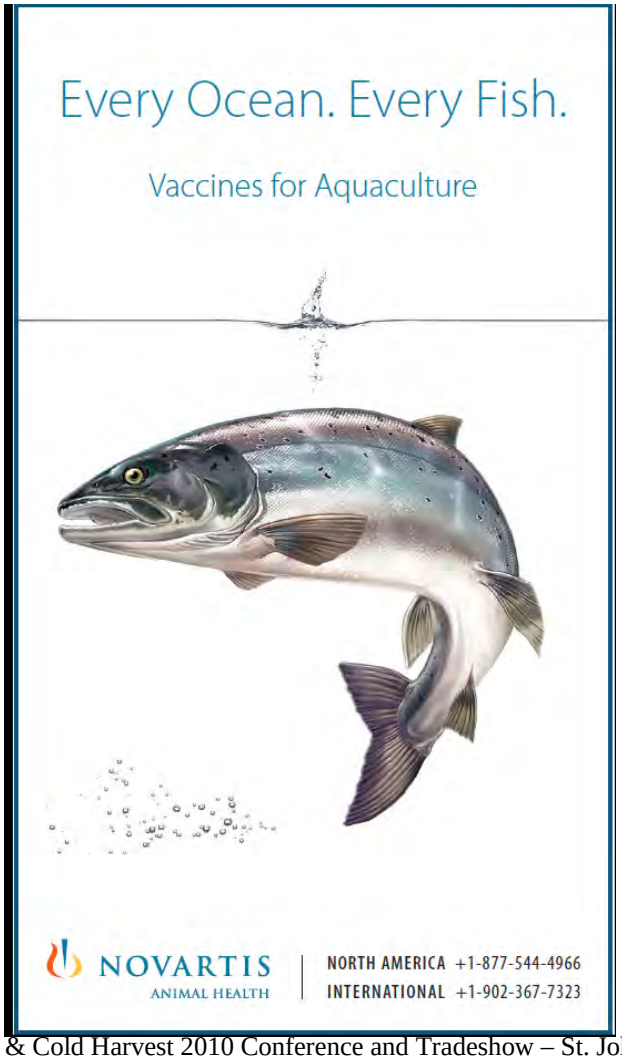
The Environmental Monitoring section - provides sales and service for water quality, flow and level and data acquisition equipment. We are the Canadian exclusive representatives for such products as YSI Instruments (meters and multiparameter sondes), Onset (Inexpensive dataloggers for air, water and soil), Turner Designs (wide sections of Fluorometers for laboratory and field use), SonTek/YSI (acoustic Doppler current meters
and profilers), Sutron (Data Acquisition Loggers and Telemetry (GOES, Satellite, Radio) equipment) and Wildco (Oceanographic and Limnology sampling equipment) etc. Hoskin Scientific is the National Warranty Repair Centre for all YSI instruments. Hoskin services all of Canada with offices in Vancouver, Burlington, Montreal and several satellite offices newest addition NOVA SCOTIA. Website: www.hoskin.ca



Department of Fisheries & Oceans **BOOTH # 14**
PO Box 5667, St. John's, NL A1C 5X1

Exhibitor: Sharon Kenny

The Aquaculture, Biotechnology and Aquatic Animal Health Section is within the Science Branch of Fisheries and Oceans Canada, Newfoundland and Labrador Region. The section has a team of scientists, biologists, technicians and graduate students who conduct research on aquaculture and biotechnology related issues. The section is stationed at the Northwest Atlantic Fisheries Centre located in St. John's. Research conducted by the section is directed toward providing information and advice to the aquaculture industry in support of industry sustainability and developmental requirements as well as advice to Government policy makers as per DFO's Aquaculture Policy Framework. Projects are conducted in close collaboration with major universities such as the Fisheries and Marine Institute (MI) and Memorial University (MUN), the National Research Council (NRC-IRAP), the Newfoundland Aquaculture Industry Association (NAIA), the Provincial Department of Fisheries and Aquaculture (DFA) as well as the members of the aquaculture industry throughout the Province.



Marine Institute, Memorial University of Newfoundland **BOOTH #16**
155 Ridge Road, P. O. Box 4920, St. John's, NL, A1C 5R3
www.mi.mun.ca

The Marine Institute (MI) is Canada's most comprehensive education, training, applied research and technology transfer resource for the ocean industries. MI's Centre for Aquaculture and Seafood Development (C-ASD) offers a complete range of services for seafood processing and aquaculture industries in the areas of applied research, product and process development, technology transfer, advisory services, and education and training. C-ASD is internationally recognized for its applied scientific and technical expertise, facilities and commitment to clients in the seafood processing and aquaculture industries. The Atlantic Canada Fishery Byproducts Research Centre is operated by C-ASD and has the mandate to develop commercial scale production from fishery and aquaculture byproducts. Clients also benefit from C-ASD's attention to quality assurance that comes with the Institute's ISO-9001™ (2000 standards) registration.
The Marine Institute's education programs span the range from on-site short technical courses for fish farm workers (e.g. technician) to junior and high-school aquaculture course content, as well as the post-graduate diploma in aquaculture (Advanced Diploma in Sustainable Aquaculture) and a thesis-based MSc Aquaculture program, the only one of its kind in Canada. New program options for online and business management courses are presently being developed.

Students and clients have access to a wide range of facilities including recirculating tank systems for both fresh and saltwater, quarantine facilities (e.g. vaccine trials), the world's largest laminar flume tank (e.g. testing of cage and longline designs), histopathology and microbiology lab facilities, a CFIA registered marine products facility for pilot scale product development and evaluation, and much more. Faculty work in collaboration with the Ocean Sciences Centre and have access to facilities there (www.osc.mun.ca).

For more information:
Heather Manuel
Director C-ASD
Tel 1.709.778.0345 Email: heather.manuel@mi.mun.ca
URL: www.mi.mun.ca/casd

Laura Halfyard
Chair Aquaculture Programs
Tel. 1.709.778.0363 Email: laura.halfyard@mi.mun.ca
www.mi.mun.ca/aquaculture/

Cyr Couturier
Chair MSc Aquaculture Program
Tel 1.709.778.0609 Email: cyr.couturier@mi.mun.ca
www.mun.ca/science/graduate/AQUA/

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le Réseau Aquaculture Québec RAQ

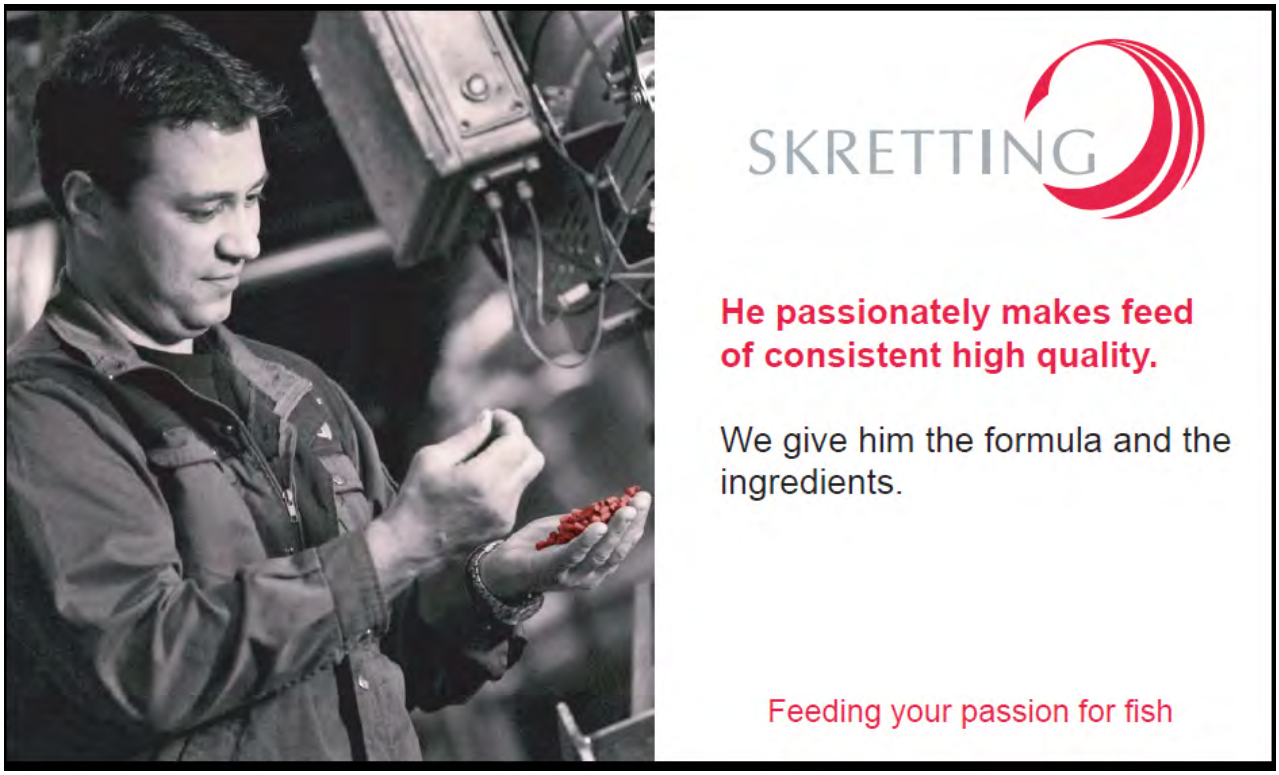
Department of Fisheries and Aquaculture **BOOTH # 18**
Aquaculture Branch
58 Hardy Avenue
Grand Falls-Windsor, NL A2A 2K2
(709) 292-4100

Exhibitor: Rhonda Brennan

The Department of Fisheries and Aquaculture, Government of Newfoundland and Labrador, offers a variety of services to the province's aquaculture operators. The Aquaculture Branch is responsible for the development of an environmentally and economically sustainable aquaculture industry. In order to achieve this mandate, the Branch:

- Acts as the primary point of contact for the province's ***One-Stop Shopping*** approach to aquaculture licensing;
- Works closely with industry to establish new operations and expand existing sites;
- Administers funding programs aimed at supporting sustainable development;
- Promotes industry growth through infrastructure and capacity building;
- Conducts environmental and biological monitoring for the finfish and shellfish sectors;
- Provides a comprehensive aquatic animal health program for the provincial aquaculture industry;

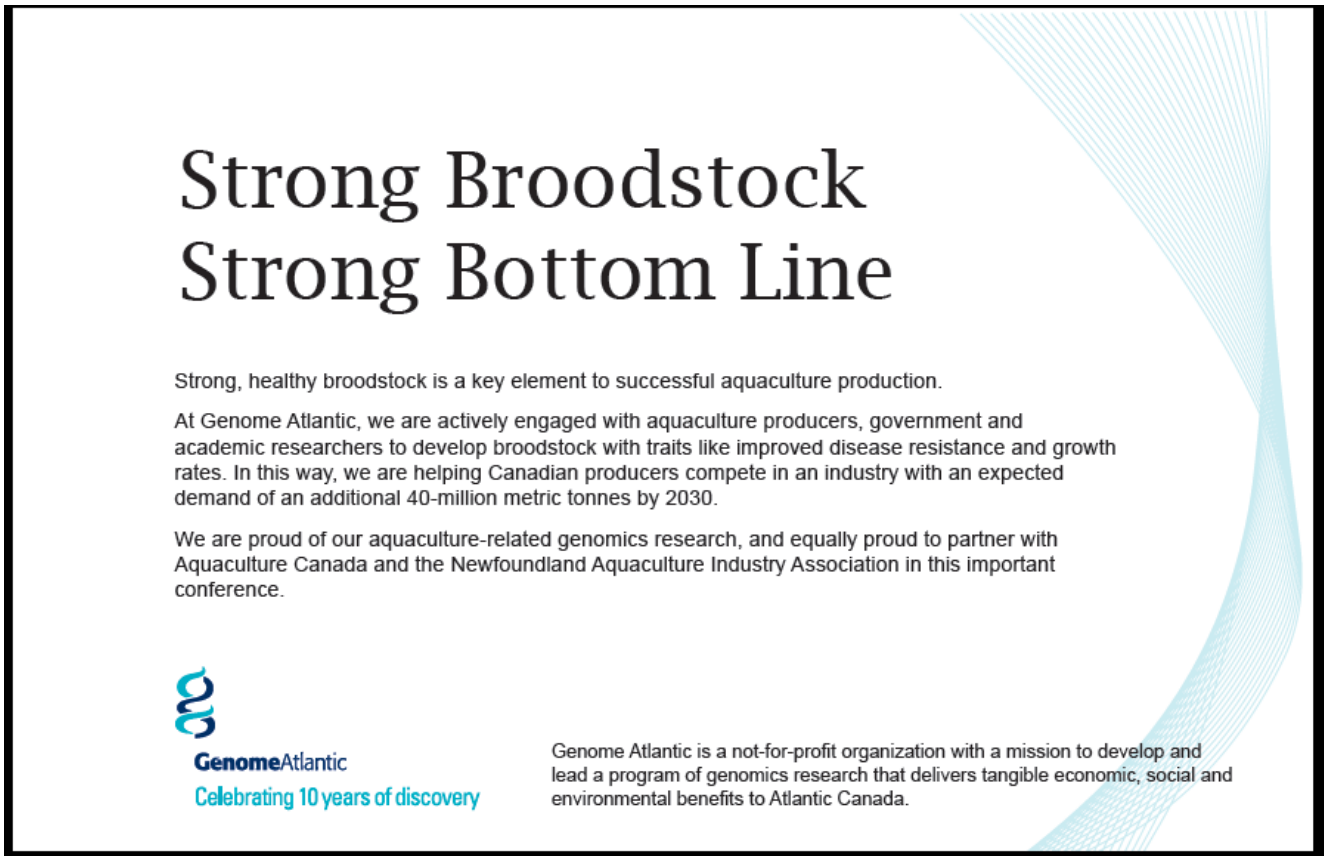
Drop by our booth to speak to a staff member about aquaculture opportunities in Newfoundland and Labrador.



The New Brunswick Research and Productivity Council (RPC) **BOOTH # 19**
921 College Hill Rd Fredericton, NB E3B 6Z9
506-452-1365

Exhibitor: Ben Forward

The New Brunswick Research and Productivity Council (RPC) is a not-for profit New Brunswick Crown Corporation whose mandate includes provision of innovative technical solutions to challenges facing businesses and industries (see www.rpc.ca). RPC's Food Fisheries and Aquaculture (FFA) group has focused its expertise in the development of improved diagnostics related to fish health and production, vaccine development, and more recently been involved in the practical application of marine bacteria with the development of probiotics for use in aquaculture. RPC is registered to the ISO 9001:2008 International Standard for Quality Management Systems. RPC has considerable experience in the commercialization of research involving diagnostic services and treatment products and in transfer of research results to industry. FFA has state of the art microbiology (culture & testing), molecular biology (DNA sequencing, genotyping, Microarray, PCR, real-time qPCR, etc), fish health (fish necropsy, pathogen screening & strain typing), and wildlife forensics (animal identification and prosecutorial support) labs as well as a freshwater quarantine testing facility (vaccine & pathogen challenge testing).



INTRD **BOOTH # 20**
PO Box 8700, A1B 4J6
St. John's, NL
709-256-1483

Exhibitor: Percy Farwell

The Department of Innovation, Trade and Rural Development (INTRD) is the lead agency for stimulating economic and business development and diversification in Newfoundland and Labrador. With 23 offices spread province-wide, its vision is for a diversified, competitive economy with productivity and prosperity in all regions.

To achieve our goals, we have five primary lines of business, as follows:

- Small- and medium-sized enterprise (SME) development;
- Industrial diversification;
- Innovation;
- Investment; and
- Economic intelligence

The department works closely with business, industry, academia, economic development groups, and all levels of government, to develop and implement programs that support the growth and diversification of strategic sectors, ensuring the province remains competitive at provincial, national, and global levels. Sectors include aerospace and defence, agrifoods, crafts, environmental industries, information and communications technology, life sciences, manufacturing, and ocean technology.

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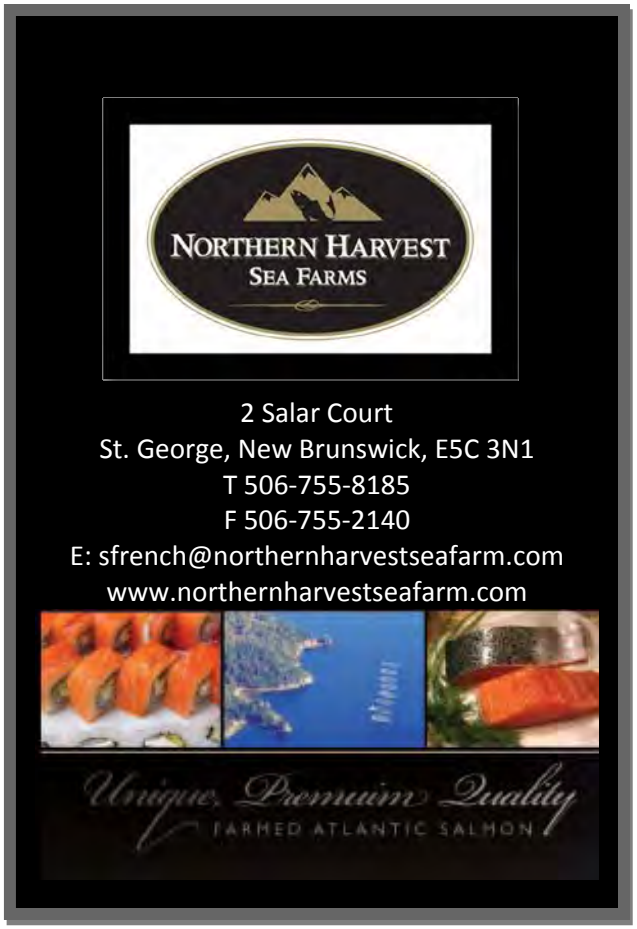
ATLANTIC PROVINCES COUNCIL ON THE SCIENCES
CONSEIL DES PROVINCES ATLANTIQUES POUR LES SCIENCES

EMCO CORPORATION **BOOTH #21**
18 Bruce Street
Mount Pearl, NL A1N 4T4
709-747-2626

Exhibitors: Clarence Brown, Peter Murphy

EMCO Corporation is one of Canada's largest integrated distributors of products for the construction industry. EMCO offers products in the distinct categories of plumbing and heating, waterworks, industrial, oilfield supply and HVAC (heating, ventilation and air conditioning). EMCO strives to satisfy the needs of its customers with a focused product assortment, transported and sold through an extensive network of branches, distribution warehouses and showrooms across Canada.



Workplace Health, Safety and Compensation Commission (WHSCC) BOOTH #22
P.O. Box 9000
St. John's, NL
A1A 3B8
Ph: 1-800-563-9000

Exhibitor: Kathleen Connors

Serving over 16,000 employers and approximately 12,000 injured workers, the Workplace Health, Safety and Compensation Commission (the Commission) is an employer-funded no fault insurance system that promotes safe and healthy workplaces, provides return-to-work programs and fair compensation to injured workers and their dependants. In partnership with provincial workplaces, the Commission facilitates safe and healthy workplaces by assisting employers and workers to prevent accidents and manage workplace injuries/illnesses and return-to-work processes.

Town of Grand Falls-Windsor, NL **BOOTH #23**
5 High Street, P.O. Box 439
Grand Falls-Windsor, NL A2A 2J8
709-489-0483

Exhibitor: Gary Hennessey

The Town of Grand Falls-Windsor is the largest community in Central Newfoundland. Because it is a major service centre, it has developed a strong relationship with the Aquaculture sector on the South Coast of our island. Local businesses in Grand Falls-Windsor are carrying on a healthy exchange of goods and services with the sector that is beneficial to both sides. These businesses include transportation, hydraulics, information technology, electronics and fabrication.

Drop by our booth to explore the opportunities that exist for your company with the Town of Grand Falls-Windsor.
www.grandfallswindsor.com

Speakers Outline & Abbreviated Titles / Résumés des présentations

MONDAY, MAY 17, Morning **LUNDI 17 MAI, matin**

07:00 - 17:00	Registration (Crush Lobby)		
08:30 - 09:30	**Opening Session** (Salon B/C/D) Cyr Couturier (President, Aquaculture Association of Canada) Jennifer Caines (President, Newfoundland Aquaculture Industry Association) Ruth Salmon (Executive Director, Canadian Aquaculture Industry Alliance) Honourable Clyde Jackman (Minister of Fisheries and Aquaculture, Newfoundland and Labrador) DFO representative		
09:30 - 10:30	**Conference Keynote: Jose Villalon, Director of Aquaculture, World Wildlife Fund – US** (Salon B/C/D): Responsible aquaculture through measurable standards: Stakeholder partnerships		
09:00 - 17:00	Tradeshow (Salon A) and poster session (Conception Bay Room)		
10:30 - 11:00	**BREAK** (salon B/C/D will be separated into B and C/D)		
	Salon B	**Salon C/D**	**Salon E/F**
	Aquaculture Sustainability – 1 Industry Performance Panel	**Contributed Papers – 1**	**Training and Education – 1**
11:00 - 11:20	BC Salmon – Mary Ellen Walling (BC Salmon Farmers Association) BC Shellfish – Roberta Stevenson (BC Shellfish Growers Association) East Coast Salmon – Pam Parker (NB Salmon Growers Association) East Coast Shellfish – Cyr Couturier, (Newfoundland Aquaculture Industry Association) Northern Ontario Trout – Karen Tracey (Northern Ontario Aquaculture Association)	**Appleton, P**: Oxygenated nanobubbles as a means to increase growth rates and profitability of finfish and shellfish	**Galway, L and Tucker, R.**: Advancing workplace safety: How far have we really come?
11:20 - 11:40		**Sykes, P**: An alternative method for the overland transport of Atlantic halibut (*Hippoglossus hippoglossus*): Effect on post transport mortality and economic efficiency	**Vinette, D**: The Canadian Agricultural Human Resource Council: Industry and government working together to address employment and training issues facing Canada's agricultural sector
11:40 - 12:00		**Shapira, Y**: Growing sea bream *Sparus aurata* in rough marine conditions at offshore farm in the East Mediterranean, based on SUBflex technology	**Rivet, C**: Putting HR to work for your organization: what you need to know
12:00-14:00	**LUNCH (ON OWN)**	**LUNCH (ON OWN)**	**LUNCH (ON OWN)**

MONDAY, MAY 17, Afternoon **LUNDI 17 MAI, après-midi**

	Salon B	Salon C/D	Salon E/F
	Aquaculture Sustainability – 2 Sustainability Panel	**Aquatic Invasive Species – 1**	**Finfish Aquaculture – 1**
14:00 - 14:20	Jose Villalon, Director, WWF Aquaculture Dialogues Jamie Smith, Aquaculture Management Directorate, DFO Mike Rose, Global Trust Ruth Salmon, Canadian Aquaculture Industry Alliance	**Pederson, J:** Risky Business: Managing Invasive Species with Changing Climate	**Parrish, C**: Variation in lipids and amino acids in Atlantic cod (*Gadus morhua*) during ontogeny from unfertilized eggs to fully weaned larvae
14:20 - 14:40			**Clarke, M**: Lipids, fatty acids and free amino acids as indicators of egg and larval viability in Atlantic cod
14:40 - 15:00		**Gill, K**: Overview of AIS in PEI: Current infestation and management strategies	**Granier, S**: Egg quality in Arctic charr (*Salvelinus alpinus*)
15:00 - 15:20		**Ramsay, A**: Freshwater treatment as a management tool to control the spread of colonial tunicates	**Revie, C.: TBA**
15:20 - 15:50	**BREAK**	**BREAK**	**BREAK**
	Salon B	**Salon C/D**	**Salon E/F**
	Aquaculture Sustainability – 3	**Aquatic Invasive Species – 2**	**Training and Education – 2**
15:50 - 16:10	**Were, K**: Development of the NASAPI Action Plan Toward Sustainable Development of the Canadian Aquafeed Sector	**Ma, K**: Non-indigenous and indigenous ascidians of Newfoundland and Labrador	**Rideout, K**: Aquaculture training for the NL salmonid and mussel industry
16:10 - 16:30	**Robinson, S**: What will an aquaculture site look like in the future and what do we have to do today?	**Lowen, J**: Life-history, population dynamics, diversity, and abundance of *Botryllus schlosseri* in a sub-arctic environment (Arnolds Cove, Placentia Bay, NL)	**Flimlin, G**: The power of the volunteer in community based shellfish restoration
16:30 - 16:50	**Burton, A**: OFFSPRING: An integrated approach for "egg to plate" traceability in Atlantic salmon using natural DNA barcodes and bioinformatics	**Pilgrim, B**: The control and management of an invasive colonial tunicate *Botrylloides violaceus* in Newfoundland	**Benfey, T**: Pros and cons of graduate studies in aquaculture
16:50 - 17:10	**Cross, S**: Sustainable Ecological Aquaculture (SEA) Systems – the path from concept to commercialization	**Pickering, T**: Prey preferences of European green crabs on three commercially grown bivalves	
18:00-23:00	**Student BBQ**		

TUESDAY, MAY 18, Morning **MARDI 18 MAI, matin**

07:00 - 08:30	AAC AGM (members only) (Salon G)		
08:00 - 17:00	Registration (Crush Lobby)		
09:00 - 16:00	Tradeshow (Salon A) and poster session (Conception Bay Room)		
	Salon B	**Salon C/D**	**Salon E/F**
	Finfish Aquaculture – 2	**Environmental Impacts – 1**	**International Mussel Forum – 1**
08:30 - 08:50	**Prickett, R**: Successful partnerships for a sustainable future – Cod juvenile production at the Dr. Joe Brown Aquatic Research Building (JBARB) 2009-2010	**Moccia, R.**: Monitoring and modeling phosphorus contributions in a freshwater lake with cage-aquaculture	**Representatives from AAC, NAIA, IRAP, CCFI**: Delegate Welcome
08:50 - 09:10	**King, N**: Newfoundland commercial scale Atlantic cod hatchery production technology project – Live feed component	**Podemski, C**: Effects of a rainbow trout (*O. mykiss*) farm on whole-lake phosphorus and nitrogen annual budgets	**Linda Duncan or Cyr Couturier**: Canada
09:10 - 09:30	**Audet, C**: Flatfish production in North America: biological issues	**Podemski, C**: Modelling the solid waste dispersion of rainbow trout farming in freshwater environment: a preliminary test of DEPOMOD	**Jianguang Fang**: China
09:30 - 09:50	**FitzGerald, R**: An economic assessment of cod farming in Ireland		**Executive Director, New Zealand Mussel Producers Council**: New Zealand
09:50 - 10:20	**BREAK** (salons B and C/D will be opened up to make B/C/D)		**BREAK**
10:20 - 11:20	**Conference Plenary Speaker** (Salon B/C/D)		
11:20 - 12:00	Lifetime Achievement Award (Salon B/C/D)		**President – Chile Mussel Producers**: Chile
			Jaap Holstein (TBD): Netherlands
12:00 - 14:00	**LUNCH (ON OWN)** (salon B/C/D will be separated into B and C/D)		**Manuel Franco Leis (TBD)**: Spain
			12:30 – 14:00 **LUNCH (ON OWN)**
12:30 - 14:00	NAIA AGM (members only) (Salon G)		

TUESDAY, MAY 18 Afternoon **MARDI 18 MAI, après-midi**

14:00 - 16:00	Poster session (Conception Bay Room), authors in attendance		
	Salon B	**Salon C/D**	**Salon E/F**
	Finfish Aquaculture – 3	**Moving Aquaculture Forward - 1**	**International Mussel Forum – 2**
14:00 - 14:20	**Le Francois, N**: Pilot-scale cultivation of the spotted wolffish (*Anarhichas minor*) in Québec, Canada.	**House, N**: The Program for Aquaculture Regulatory Research	**Bonardelli, J**: Effective technologies increase mussel yields
14:20 - 14:40	**Desjardins, M**: Hybrid wolffishes and aquaculture considerations	**Busby, C**: Aquaculture Collaborative Research and Development Program (ACRDP)	**Lindell, S**: Pilot-scale commercial offshore mussel farming in New England
14:40 - 15:00	**Deslauriers, D**: Implications and applications of exercise-trained sturgeon	**Struthers, A**: The Aquaculture Innovation and Market Access Program: Program Update	**Granter, T**: Enhancing sustainable mussel industry production and growth through assessment and removal of constraints in seed supply
15:00 - 15:20	**Burt, K**: The effect of intermittent hypoxia on Atlantic salmon (*Salmo salar*): Preliminary results on fish growth and immune response	**Brown, C**: Industrial Research Assistance Program Overview	**Arsenault, J**: Spatial characterization of particle depletion by the blue mussel (*Mytilus edulis*) at open-water, integrated multi-trophic aquaculture sites
15:20 - 15:50	**BREAK**	**BREAK**	**BREAK**
	Salon B	**Salon C/D**	**Salon E/F**
	Finfish Aquaculture – 4	**Moving Aquaculture Forward - 2**	**International Mussel Forum – 3**
15:50 - 16:10	**Manning, T**: Melatonin monitoring as a tool for assessing light therapy efficacy in sea cage Atlantic salmon	**Deveau, G**: ACOA Program - The Atlantic Innovation Fund (AIF)	**Reid, G**: Absorption efficiency of Atlantic salmon (*Salmo salar*) feed and fecal particulates by blue mussels (*Mytilus edulis* and *M. trossulus*): implications for integrated multi-trophic aquaculture
16:10 - 16:30	**Feindel, N**: Triploid Atlantic cod (*Gadus morhua*) as a potential candidate species for the diversification of the marine finfish aquaculture industry	**Vardy, C**: NSERC Programs – Encouraging Academic-Industry Collaborations	**Reid, G**: Preliminary investigation of current flow through a 'Polar circle' mussel raft, at an Integrated Multi-Trophic Aquaculture site
16:30 - 16:50	**Whitehead, J**: Gynogenesis and the genetic basis of sex determination of Atlantic cod (*Gadus morhua*)	**Epelbaum, A**: Aquaculture potential of the basket cockle (*Clinocardium nuttallii*) in British Columbia, Canada: nursery and grow-out production phases	**Bakker, J**: Variation in shell strength among cultured and natural *Mytilus* populations in the Quoddy region, NB
16:50 - 17:10	**Lin, S**: Sex control of Atlantic cod (*Gadus morhua*)	**Podemski, C**: Effects of net pen aquaculture on a lake ecosystem: results from the ELA Aquaculture Project	**Panel Discussion**
17:10 - 17:30	**Sultan Singh**: Early breeding of *Catla catla* by early maturity	**Video Premiere** Fisheries and Oceans Canada: Aquaculture Science Research	**Panel Discussion**

WEDNESDAY, MAY 19, Morning **MERCREDI 19 MAI, matin**

08:00 - 12:00	Registration (Crush Lobby)			
	Salon B	**Salon C/D**	**Salon E/F**	**Salon A**
	Aquaculture Genomics & Genetics – 1	**Moving Aquaculture Forward – 3**	**International Mussel Forum – 4**	**Integrated Multi-Trophic Aquaculture**
08:30 - 08:50	**Garber, A**: Overview of the Atlantic Cod Genomics and Broodstock Development Project (CGP)	**Frechette, M**: Production dynamics, self-thinning and profitability of blue mussel populations reared in suspension culture in Cascapédia Bay	**Robert, P**: How much is too much? Dose-dependent response of the benthic environment to biodeposition from suspended blue mussel (*Mytilus edulis*) culture	**Blair, T**: Evolution of IMTA: Is salmon feed enough?
08:50 - 09:10	**Bowman, S**: Applying genomics to the analysis of traits in Atlantic cod	**Sonier, R**: Research in support of shellfish farm management	**TBD (Mussel Industry Council of North America)**: What are sustainability indicators for mussel production?	**Both, A**: Physical and biochemical properties of particles released from an onshore Atlantic cod *Gadus morhua* aquaculture facility in the context of integrated multi-trophic aquaculture
09:10 - 09:30	**Booman, M**: Development of an Atlantic cod (*Gadus morhua*) oligonucleotide microarray and its validation in a study of cod spleen global gene expression responses to stimulation with formalin-killed atypical *Aeromonas salmonicida*	**Glebe, B**: Phototherapy: applications for growth enhancement and maturation delay in farmed Bay of Fundy Atlantic salmon (*Salmo salar*)	**TBD**: The European view of mussel farming sustainability	**Lander, T**: The use of tracer, biological and biochemical techniques to evaluate the use of salmon farm derived particles by blue mussels at IMTA sites
09:30 - 09:50	**Hori, T**: Red spot, green spot: Using DNA microarrays to investigate the immune and stress responses of Atlantic cod (*Gadus morhua*)	**Hamoutene, D**: The Cod Broodstock Nutrition Study: Effect of 3 diets on fish general physiology and reproductive performance	**TBD**: The view from South America on mussel farming sustainability	**Reid, G**: The biomass ratios of seaweeds required to sequester the soluble inorganic nutrient load per unit growth of cultured Atlantic salmon in an open-water, Integrated Multi-Trophic Aquaculture (IMTA) system
09:50 - 10:10	**Mirimin, L**: Development and application of genetics and genomics tools to the EIRCOD project: a breeding and broodstock programme for Atlantic cod in Ireland	**Pearce, C**: Assessing potential habitat impacts of geoduck clam (*Panopea generosa*) aquaculture and harvesting in British Columbia	**Panel Discussion and Forum Conclusion**	**Hagen, N**: Mussels on the IMTA-menu: the pale urchin advantage
10:10 - 10:40	**BREAK** (salons B and C/D will be opened up to make B/C/D)		**BREAK**	**BREAK**
10:40 - 11:40	**Conference Plenary Speaker** (Salon B/C/D)			
11:45 - 13:30	**LUNCH (ON OWN)** (salon B/C/D will be separated into B and C/D)		**LUNCH (ON OWN)**	**LUNCH (ON OWN)**
11:45 - 13:30	AAC BOD Meeting (Salon G)			

WEDNESDAY, MAY 19, Afternoon **MERCREDI 19 MAI, après-midi**

	Salon B	Salon C/D	Salon E/F	Salon A
	Aquaculture Genomics & Genetics – 2	**Moving Aquaculture Forward – 4**	**Socio- economic Impacts**	**Contributed Papers – 2**
13:30 - 13:50	**Chiasson, M**: Quantitative trait loci (QTL) for body weight in Fraser strain Arctic charr (*Salvelinus alpinus*) reared in different environmental conditions	**Kearney, E**: Evaluation and further development of the iCage ™ Fish Containment System as a technology platform to meet sustainability and cost reduction targets	**Paju, M**: Socio-economic impact of aquaculture in Canada	**Forward, B**: Development of probiotic bacteria for use in the culture of American Oyster (*Crassostrea virginica*)
13:50 - 14:10	**Keuttner, E**: Genetic architecture of economically important traits in aquaculture strains of Icelandic Arctic charr	**Perry, G**: Increased sustainable production through modification of the hydraulic systems used to handle blue mussel seed to increase productivity and reduce production costs	**Tracey, K**: Economic impact of the cage culture industry in Ontario	**Mallet, A**: Integrating the Brite-Box, an algal photo-bioreactor, into a shellfish hatchery for the production of the bay scallop, *Argopecten irradians irradians*
14:10 - 14:30	**Norman, J**: The genetic basis of salinity tolerance in Arctic charr (*Salvelinus alpinus*)	**Stevenson, R**: Technology transfer, adaptation and implementation of Washington State mechanical clam harvesting technology to the BC shellfish farming sector	**Foster, C**: The socioeconomic impacts of the aquaculture sector on the communities of the Coast of Bays Region	**Mallet, A**: Advances in the technology used to glue the Eastern oyster to ropes for final grow-out
14:30 - 14:50	**Seghouani, H**: Selection on brook charr (*Salvelinus fontinalis*): impact on reproductive success?	**Morissette, S**: Amélioration de la productivité par la mécanisation et l'automatisation des opérations maricoles	**Halfyard, J:** Mussel farming in NL and their socio-economic impacts	**Myrand, B**: Dispersal of clams seeded in a medium-sand substratum seems to be minimal during the ice-free period
14:50 - 15:10	**Braden, L**: Differences in immune gene expression due to *Lepeophtheirus salmonis* adult infection in Atlantic (*Salmo salar*), chum (*Oncorhynchus keta*) and pink (*O. gorbuscha*) salmon	**Mallet, A**: Optimisation de la technique d'élevage des huîtres collées à l'horizontale	**House, B:** The Socio Economic Impact of Salmon Aquaculture in New Brunswick	**Tamigneaux, E**: Seaweed farming in Chaleur Bay (Québec): results from 4 years of R&D activities
15:10 - 15:40	**BREAK**	**BREAK**	**BREAK**	**BREAK**
	Fish Health	**Contributed Papers – 3**	**Environmental Impacts – 2**	
15:40 - 16:00	**Novak, C**: Differences between male and female *Lepeophtheirus*	**Lucas, J**: Optimizing fish oil supplementation in the feed of commercially grown Arctic charr	**George, M**: Organic footprint and composition of particles from marine finfish	

	salmonis (Copepoda: Caligidae) as vectors of *Aeromonas salmonicida*		aquaculture operations	
16:00 - 16:20	**Hynes, N**: The immunological effects of recombinant bacterial flagellin on Atlantic salmon	**Colombo, S**: Evaluation of *Calanus* copepod and *Euphausia* krill meal and oil as the dietary protein and lipid supplements for juvenile Atlantic halibut (*Hippoglossus hippoglossus*)	**Mabrouk, G**: Preliminary assessment of remote video survey methodology for use in monitoring benthic impacts from aquaculture in Newfoundland	
16:20 - 16:40	**Leadbeater, S**: Salmonid immunological response and genetic resistance to Infectious Salmon Anemia virus isolates	**Enyidi, U**: Comparative effects of sesame seed meal and bambara nut meal on the growth and nutrition of African catfish (*Clarias gariepinus*) (Burchell 1822)	**Chang, B**: Temporal variations in sediment sulfide levels under salmon farms in southwestern New Brunswick, Bay of Fundy, during the annual environmental monitoring period	
16:40 - 17:00	**Brewer-Dalton, K**: AlphaMax® and Salmosan®: sea lice environmental control trials in New Brunswick	**Parashar, A**: Breeding and culture of murrels in India	**Chang, B**: Changes in the benthic macrofaunal community associated with organic enrichment under salmon farms in southwestern New Brunswick, Bay of Fundy	
17:00 - 17:20	**O'Brien, N**: Biosecurity in NL Aquaculture	**Sharma, J**: Rehabilitation and conservation of treatened fish in India	**Chaudhary, N**: Sultan Fish Farms	
19:00 - 21:30	**Closing Banquet (Salon A) – NAIA Aquaculturist of the Year and Student Awards**			

Opening and Welcome / Allocution d'ouverture et de bienvenue
Monday May 17, 2010 – lundi 17 mai, 2010
8:30 AM – 9:30 AM
Location: Salon B/C/D

Chair: Cyr Couturier (President, Aquaculture Association of Canada)

Cyr Couturier (President, Aquaculture Association of Canada)
Jennifer Caines (President, Newfoundland Aquaculture Industry Association)
Ruth Salmon (Executive Director, Canadian Aquaculture Industry Alliance)
Honourable Clyde Jackman (Minister of Fisheries and Aquaculture, Newfoundland and Labrador)
DFO Representative

Keynote Speaker Session

Monday May 17, 2010 – lundi 17 mai, 2010
9:30 AM – 10:30 AM
Location: Salon B/C/D

Chair: Cyr Couturier (President, Aquaculture Association of Canada)

Keynote Speaker: Mr. Jose Villalon, Director of Aquaculture, World Wildlife Fund – US

Presentation: Responsible aquaculture through measurable standards: Stakeholder partnerships.

Biography: Jose Villalon is the managing director of the World Wildlife Fund-US Aquaculture Program. His primary role is to oversee eight multi-stakeholder roundtables, collectively called the Aquaculture Dialogues, which are creating global standards that will help address the environmental and social impacts associated with aquaculture.

Villalon is a 27-year veteran of the aquaculture industry. During his career he has operated a Mexico-based consulting firm that worked with private industry on technical shrimp production protocols and farm accounting systems; managed a shrimp farm in Mexico; overseen new product development and market penetration in Europe and Japan for AquaNova, the wholly-owned subsidiary of Desc; and been in charge of Marine Harvest International's shrimp hatchery, feed mill, and farm operations in Guayaquil, Ecuador.

Villalon holds a Master of Science degree in fisheries biology from the University of Washington in Seattle and a Bachelor of Science degree in biological sciences from Florida International University.

Abstract: This presentation will provide a general description of the novel Aquaculture Dialogue process and approach used by the World Wildlife Fund to bring a broad and diverse set of stakeholders together to openly discuss the issues and impacts of aquaculture. The Aquaculture Dialogue Steering Committee, which is its governing body, will use the information gathered through this process to negotiate and develop measurable global standards to minimize key environmental and social impacts associated with aquaculture production. This presentation will highlight how the Aquaculture Dialogue process sets a framework whereby institutional and personal relationships can forge working partnerships between industry, environmental and social NGOs, academia and retailers to jointly create something bigger than can be achieved by just one of these sectors working alone.

Plenary Session I / Session plénière

Tuesday, May 18, 2010 - mardi 18 mai 2010
10:20 AM – 11:20 AM
Location: Salon B/C/D

Chair: Tillmann Benfey

Plenary Session II / Session plénière

Wednesday, May 19, 2010 - mercredi 19 mai 2010
10:40 AM – 11:40 AM
Location: Salon B/C/D

Chair: Darrell Green

Sessions and Abstracts – Aquaculture Canada^{OM} 2010 and Cold Harvest^{TM} 2010

Aquaculture Sustainability

Monday, May 17, 2010 – lundi 17 mai, 2010
11:00 AM – 12:00 PM
Location: Salon B

Industry Panel
Perspectives on Industry Performance – SWOT analysis of industry sectors

Chair: Ruth Salmon

11:00 Panel: BC Salmon – Mary Ellen Walling, BC Salmon Famers Association
BC Shellfish – Roberta Stevenson, BC Shellfish Growers Association
East Coast Salmon – Pam Parker, NB Salmon Growers Association
East Coast Shellfish – Cyr Couturier, Newfoundland Aquaculture Industry Association
Northern Ontario Trout – Karen Tracey, Northern Ontario Aquaculture Association

Today, aquaculture takes place in all ten provinces and the Yukon Territory. Production of Atlantic salmon, Chinook salmon, trout, Arctic charr, blue mussel, oyster and clam are well established, while several other species including halibut, sturgeon, tilapia, sablefish and scallop are at various stages of development. This rich diversity – in species and growing region – often makes Canada a challenging place to find national commonality and focus. While some challenges and opportunities are national in scope, many issues are unique to the region and species. Come listen to a panel of Executive Directors present a SWOT analysis of their industry sector, highlighting differences as well as looking at ways we can collectively chart the course forward together as a national industry.

Contributed Papers

Monday, May 17, 2010 – lundi 17 mai, 2010
11:00 AM – 12:00 PM
Location: Salon C/D

Chair: Caroline Graham

11:00 Appleton, P.
Oxygenated nanobubbles as a means to increase growth rates and profitability of finfish and shellfish

11:20 Sykes, P.
An alternative method for the overland transport of Atlantic halibut (*Hippoglossus hippoglossus*): Effect on post transport mortality and economic efficiency

11:40 Shapira, Y.
Growing sea bream *Sparus aurata* in rough marine conditions at offshore farm in the East Mediterranean, based on SUBflex technology

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award.

Oxygenated nanobubbles as a means to increase growth rates and profitability of finfish and shellfish

P. Hamilton[1] and P. Appleton*[2]

[1] Professor and Director, Lois G. Britt Agribusiness Center, Mount Olive College, 652 R.B. Butler Drive, Mount Olive, NC
[2] President, US-Mexico Chamber of Commerce, Southeast Region and Associate Professor of Agribusiness, Mount Olive College, Lois G. Britt Agribusiness Center, 652 R.B. Butler Drive
Mount Olive, NC 28365

Oxygen supply is an economically important limiting factor for aquaculture production. Commercial catfish population densities can be increased if more oxygen is available. Fixed costs of aquaculture ponds are normally spread on a cost per unit of production basis dependent on the mass of catfish produced per cubic foot of water. If more oxygen can be made available to growing fish, higher production rates can occur. In order to increase population density without increasing production costs, nanotechnology can be utilized by injecting O_2 in tiny bubbles into the water using a pump utilizing nanotechnology. "Nanobubbles" of oxygenated water reaches the bottom of the water body more efficiently and effectively than other systems since the smaller bubbles rise to the surface less quickly. This paper presents the results of research trials and focuses on the economic benefits to the aquaculture producer in utilizing nanotech bubbles in water oxygenation. The experimental (oxygenated) group had an average weight that was 59.25% higher than the control group. For a finfish or shellfish farmer, the pond investment payback can be decreased from five years down to three years and a negative Net Present Value (NPV) will become positive for catfish by injecting O_2 via nanobubbles.

An alternative method for the overland transport of Atlantic halibut (*Hippoglossus hippoglossus*): Effect on post transport mortality and economic efficiency

P.J. Sykes*[1], C.A. McClure[1], D.J. Martin-Robichaud[2], C.G. Caraguel[1], and K.L. Hammell[1]

[1]AVC Centre for Aquatic Health Sciences and Department of Health Management, Atlantic Veterinary College, University of Prince Edward Island, 550 University Avenue, Charlottetown, PEI, Canada C1A 4P3
[2]Fisheries and Oceans Canada Science Branch, 531 Brandy Cove Rd St. Andrews NB, Canada E5B 2L9

Canada's sole supplier of Atlantic halibut juveniles is located in southern Nova Scotia, necessitating the overland transport of live juveniles to growout farms which are now

located in all three Maritime Provinces. However, locally available transport equipment is optimized for the transport of neutrally buoyant salmonids (e.g. Atlantic salmon) that are capable of occupying the total water column. The lack of transport equipment designed specifically for negatively buoyant flatfish often results in costly post transport mortality and reduced stocking densities, both substantially increasing the cost of transport. The objective of this study was to evaluate a convenient, low cost modification of conventional salmon smolt transport tanks that are currently used to transport juvenile Atlantic halibut. A quasi-randomized control trial was designed to compared the post transport mortality of Atlantic halibut transported using an experimental Stratified Transport System (STS) to the traditional Unstructured Transport System (UTS). The STS utilized wire mesh cages stacked within the transport tanks to increase the horizontal surface area for settlement and distribute the halibut homogenously in the water column. Post transport mortality was significantly reduced by 21.3% in the STS compared to the UTS. A stochastic cost benefit analysis was used to consider the economics of the STS. Investment into a STS was shown to be cost effective, with a mean benefit-cost ratio (BCR) of 1.25 (SD = 0.49) after two years of use with a mean five year net present value (NPV) of $63,557 (SD = 42,283). In conclusion, this study suggests that the implementation of a STS is technically and economically feasible method to improve efficiency of overland Atlantic halibut transport.

Growing sea bream *Sparus aurata* in rough marine conditions at offshore farm in the East Mediterranean, based on SUBflex technology

Y. Shapira*
yechiam@subflex.org

SUBflex has developed flexible and submersible systems of fish cages, based on a single point mooring, which allow controlling their buoyancy to avoid rough conditions when forecasted. The first SUBflex system (350 tons/year) was successfully deployed in the Mediterranean on 2006, 12 km offshore the Israeli coast. In 2007 two additional similar systems were installed in the same site, withstanding storm of 10 meter at January 2008. The 4th full-scale system (720 tons/year) was launched in late 2008. The cages were first stocked on September 2006 with Gilthead Sea bream (*Sparus aurata*) at an average size of 3 gr., at a density of 170,000 fish/cage (25Kg/m^3). The growth rate up to 380 gr. was 11 months, and the temperatures were 15.5-30.5^{0}C. The oxygen levels kept showing around 100% saturation, obviously correlated to the constant current. No disease has been shown, even though at no point was there any administration or use of any form of medication. The fish vitality, the shape of the fins and the red color of the liver demonstrates the excellent water quality at offshore. Continuous monitoring by professional operational stuff provides an efficient maintenance procedure, saving money and preventing damage.

Training and Education

Monday, May 17, 2010 – lundi 17 mai, 2010
11:00 PM – 12:00 PM
Location: Salon E/F

Co-Chairs: Tillmann Benfey and Caroline Graham

11:00 Galway, L. and Tucker, R.
Advancing workplace safety: How far have we really come?

11:20 Vinette, D.
The Canadian Agricultural Human Resource Council: Industry and government working together to address employment and training issues facing Canada's agricultural sector

11:40 Rivet, C.
Putting HR to work for your organization: What you need to know

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award.

Advancing workplace safety: How far have we really come?

L. Galway and R. Tucker

Workplace safety has come a long way in this province. The lost-time incidence rate has decreased from 3.2 claims per 100 workers a decade ago to just 1.8 claims per 100 today. That is a tremendous improvement – one of the best in the country. But are we really as safe as we want to be? The answer is, unfortunately, no. Many sectors are just as risky today as they were 10 years ago. Some industries, such as the offshore fisheries, experienced a spike in fatalities last year. Others saw their incidence rate increase. If we examine how far safety has come since the days of no seatbelts, no hardhats and no safety management committees, we can get an idea of how much farther we can progress in the coming decades. Commission CEO Leslie Galway provides a dynamic, entertaining presentation, complete with surprising video clips and aquaculture industry-specific data that will keep your audience thinking about workplace safety and saving lives long after they leave the room.

The Canadian Agricultural Human Resource Council: Industry and government working together to address employment and training issues facing Canada's agricultural sector

D. Vinette*

Canadian Agricultural Human Resource Council, 202 - 1283 Algoma Road, Ottawa, Ontario, Canada, K1B 3W7

The presentation will focus on challenges in agricultural human resources. Some of these include increased competition for appropriate skilled labour, an aging and declining agricultural work force, difficulty in recruiting and retaining both seasonal and full time workers, lack of awareness about agricultural career options, poor image of employment in the agriculture sector, training needs that are difficult to satisfy and the lack of training at the management/leadership level. CAHRC will also review priority activities, such as the collection of basic labour market information to establish baselines and identify needs; the facilitation of best practices for sound HR management in the sector, and ways to address them; the identification of new sources of labour and ways to access them; the development of comprehensive inventory of learning opportunities and skills development programs; the definition of core skills applicable to the majority of the sector; the development and implementation of training programs and materials; and communications to producers and the educational community. Current projects that will be discussed are: Communications and Outreach, Identifying On-Farm Occupations, New Markets and Future Skills in Agriculture, Compendium of Agriculture Associations and their Learning Programs, Labour Market Information (phase II) and Agriculture Going Global.

Putting HR to Work for Your Organization: What You Need to Know

C. Rivet*

Join Colette Rivet, Executive Director of BioTalent Canada as she leads you through the human resources and skills development tools that can benefit aquaculture organizations. As more and more sectors of the economy rely on biotechnology including aquaculture, a growing number of jobs are being created through public research institutes, universities and private industry all of which are creating opportunities and benefits for Canadians. To fill these positions employers need access to job-ready talent. In partnership with industry BioTalent Canada has developed many resources to help with HR capacity. BioTalent Canada is a national non-profit focused solely on human resources (HR) and skills development issues for Canada's bio-economy. This session will include:

- the latest bio-economy Labour Market Information;
- HR challenges and skills requirements in the industry;
- identify tools to help employers with their HR challenges *such as The PetriDish*™ free job bank, the *BioTalent HR Tool Kit*, *Bio-economy Skills Profiles*, the *Career Focus* wage subsidy program and other valuable employer resources; and
- discuss future efforts to help the industry with their HR capacity.

Colette Rivet is the Executive Director of BioTalent Canada, a national non-profit focused on human resources and skills development issues for Canada's bio-economy. She is responsible for the overall management, operations and strategic development of BioTalent Canada, including financial and managerial duties, external relationships and administrative duties. Colette has several years of senior management experience in such positions as Director of Strategic Operations for the Canadian Centre on Substance Abuse, Strategic Resource Alignment Associate of the Canadian Institutes of Health Research, Manager of The McLaughlin Centre for Evaluation at the Royal College of Physicians & Surgeons of Canada, Professional Liaison at Cangene Corporation, Director of Scientific Resources at the Canadian Blood Agency and Manager of Component Quality, Laboratory Services at the Canadian Red Cross Society. Colette holds an MBA from the University of Ottawa and National Certificate in Voluntary and Non-Profit Sector Management. She is also a Certified Health Executive, a Clinical Laboratory Scientist, an Advanced Registered Technologist, and a General Registered Technologist.

Aquaculture Sustainability

Monday, May 17, 2010 – lundi 17 mai, 2010
2:00 PM – 5:10 PM
Location: Salon B

Co-Chairs: Ruth Salmon and Rod Penney

2:00 Panel: Jose Villalon, Director, WWF Aquaculture Dialogues
Jamie Smith, Aquaculture Management Directorate, DFO
Mike Rose, Global Trust
Ruth Salmon, Canadian Aquaculture Industry Alliance

3:20 HEALTH BREAK

3:50 Were, K.
Development of the NASAPI Action Plan Toward Sustainable Development of the Canadian Aquafeed Sector

4:10 Robinson, S.
What will an aquaculture site look like in the future and what do we have to do today?

4:30 Burton, A.
OFFSPRING: An integrated approach for "egg to plate" traceability in Atlantic salmon using natural DNA barcodes and bioinformatics

4:50 Cross, S.
Sustainable Ecological Aquaculture (SEA) Systems – the path from concept to commercialization

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award.

Panel Discussion

Certification, government and industry representatives will a) address their particular role in aquaculture sustainability and b) explore the sustainability challenges and opportunities facing the aquaculture industry today and into the future.

Development of the NASAPI Action Plan Toward Sustainable Development of the Canadian Aquafeed Sector

K. Were* and É. Gilbert

Fisheries and Oceans Canada – Aquaculture Management Directorate, 200 Kent Street, Station 14S020, Ottawa, Ontario, Canada, K1A 0E6

The National Aquaculture Strategic Action Plan Initiative (NASAPI) is a cooperative Federal/Provincial/Territorial initiative that has been endorsed by the Canadian Council of Fisheries and Aquaculture Ministers (CCFAM). Under the leadership and direction of DFO, and with the support of the Provinces and Territories, the National Aquaculture Strategic Action Planning Initiative (NASAPI) has been launched to develop targeted action plans to facilitate sustainable development of the aquaculture sector in all regions of the country. Feed is the single largest input to finfish aquaculture operations from the perspective of both cost and environmental impacts associated with feed inputs. We will present the planned aquafeed specific actions that are in development as part of the NASAPI that will contribute to the economic and environmental sustainability of the aquafeed and finfish aquaculture sectors in Canada.

What will an aquaculture site look like in the future and what do we have to do today?

S. Robinson*[1,2], T. Chopin[2], and G. Reid[1,2]

[1]Biological Station, Fisheries and Oceans Canada, 531 Brandy Cove Road, St. Andrews, NB, E5B 2L9, Canada
[2]University of New Brunswick, Canadian Integrated Multi-Trophic Aquaculture Network , P.O. Box 5050, Saint John, NB, E2L 4L5, Canada

As the aquaculture industry responds to the demands of society to become more sustainable, there is a need to look at new management structures to facilitate these innovations. One of the more advanced forms of aquaculture, Integrated Multi-Trophic Aquaculture (IMTA), is exploring new designs for aquaculture systems and also working closely with the industry, resource managers and policy makers to evolve the current management structures. This talk will focus on two aspects of future management for aquaculture: reconfiguration of aquaculture sites and the concept of ecosystem services and benefits to society provided by extractive aquaculture. If we are to balance the fed

portion of aquaculture with extractive components, then there will have to be spatial and temporal changes to the current site structure and beyond to accommodate additional extractive modules. This change will have direct effects on the leasing policies and interactions with several government departments and the coastal stakeholders. There is an evolving global recognition of the economic value of ecosystem services to society. Those provided by extractive aquaculture should be included in a framework that remains to be developed and implemented. This talk will highlight a few options that may have relevance within the IMTA approach and possibly to other extractive sectors of the aquaculture industry.

OFFSPRING: An integrated approach for "egg to plate" traceability in Atlantic salmon using natural DNA barcodes and bioinformatics

A. Burton[1*], J.A.K. Elliott[1], P. Evans[2], R. Ritchie[3], and B.S. Forward[3]

[1]Cooke Aquaculture Inc., Oak Haven Road, St. George, NB E5C 3H8, Canada
[2]The University of New Brunswick, Fredericton, NB E3B 5A3, Canada
[3]The New Brunswick Research & Productivity Council (RPC), 921 College Hill Road, Fredericton, NB E3B 6Z9, Canada

Cooke Aquaculture has been involved with a family based breeding program for over 15 years as an industry partner in the Atlantic Salmon Broodstock Development program. In the last 5 years, they have taken this program in-house and developed elite broodstock to serve as the nucleus for the over 10 million salmon produced annually. In response to continuing public demand and global focus on food safety, the Offspring Traceability Project is a new and innovative program designed to develop superior broodstock and improve the safety and quality of aquaculture food products. The project is focused on the development and integration of bioinformatics with DNA marker information to enable the tracking of fish throughout their entire lifecycle, from egg to plate. This new system will represent a significant enhancement over conventional marking systems while enabling access to complete life history information from a single software platform. This comprehensive system, when completed, will be an invaluable tool permitting immediate access to the location of specific fish groups, rapid response to food safety issues, QA/QC verification, compliance with environmental regulations and contribute to the enhancement of economic value in the market place.

Sustainable Ecological Aquaculture (SEA) Systems – the path from concept to commercialization

S. F. Cross[*1,2]

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Canada continues to take a leading role in the development of Integrated Multi-Trophic Aquaculture (IMTA) systems. In coastal British Columbia the Sustainable Ecological Aquaculture (SEA) System approach integrates IMTA with other sustainability components in an effort to address a variety of the environmental and socio-economic challenges affecting traditional open netcage (finfish) aquaculture. From concept to commercialization, the SEA-System has evolved from a 9-year path of baseline research and initial performance trials on a pilot-scale. Kyuquot SEAfoods Ltd. – part of our SEA-Vision Group of companies - became the first licensed IMTA producer in the province in 2007 and is currently investing in the commercial development of a vertically integrated SEAfarm operation on the northwest side of Vancouver Island. As the first operating farm site of its kind, it continues to be dedicated to ongoing commercial-scale R&D, and in this capacity represents a west coast industry partner in our national research initiative on IMTA (NSERC-CIMTAN). This presentation provides an update on our SEA-System commercialization path, a brief outline of NSERC-CIMTAN projects currently underway at our farm site, and a look to the future for our *SEA Vision*.

Aquatic Invasive Species

Monday, May 17, 2010 – lundi 17 mai, 2010
2:00 PM – 5:10 PM
Location: Salon C/D

Co-Chairs: Cynthia McKenzie and Darrell Green

2:00 **Pederson, J.**
Risky business: managing invasive species with changing climate

2:40 **Gill, K.**
Overview of AIS in PEI: Current infestation and management strategies

3:00 **Ramsay, A.**
Freshwater treatment as a management tool to control the spread of colonial tunicates

3:20 **HEALTH BREAK**

3:50 **Ma, K.**
Non-indigenous and indigenous ascidians of Newfoundland and Labrador

4:10 **Lowen, J.**
Life-history, population dynamics, diversity, and abundance of *Botryllus schlosseri* in a sub-arctic environment (Arnolds Cove, Placentia Bay, NL).

4:30 **Pilgrim, B.**
The control and management of an invasive colonial tunicate *Botrylloides violaceus* in Newfoundland

4:50 **Pickering, T.**
Prey preferences of European green crabs on three commercially grown bivalves

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award.

Risky business: managing invasive species with changing climate

J. Pederson

MIT Sea Grant College Program, Cambridge, Massachusetts 02139, USA.

Four species of ascidians, a predatory crab and snail, and a green alga have invaded Prince Edward Island (PEI) waters, all of which have deleterious effects on aquaculture. Among other potential invaders to PEI is the ascidian *Didemnum vexillum*, an even more aggressive sea squirt than current ascidian invaders. With climate change, other species are likely to move northward or through the newly opened Arctic passages and become established nuisance species. Can we use biological information, history of spread and establishment of populations, and knowledge about the likelihood of re-invasion to predict potential nuisance species and possibly eradicate new populations? In this presentation, I review the biogeography and life history of current and potential ascidian invaders and discuss monitoring and research needed to predict future invasions and to manage or eradicate them.

Overview of AIS in PEI: current infestation and management strategies

K. Gill*, A. Ramsay, B. Gillis, A. Morrison, and N. MacNair

Prince Edward Island Department of Fisheries, Aquaculture and Rural Development
Montague, Prince Edward Island, Canada C0A 1R0

In 1997, the green crab and the clubbed tunicate were first identified in Prince Edward Island (PEI). Since then, the violet, golden star and vase tunicates have also been detected and have become well established in PEI waters. The arrival of these Aquatic Invasive Species (AIS) has greatly impacted the PEI aquaculture industry. To date, the most impact has been on the mussel industry, although the oyster industry has also been impacted to a lesser extent. PEI is the primary producer of blue mussels in North America. In order to continue producing high quality product, the mussel industry has been developing new strategies to manage tunicate infestations on mussel farms and in processing plants. Innovative technologies have been explored and many new devices have been, and continue to be, fabricated to control tunicate fouling. Several programs have provided the opportunity for growers to develop such devices, such as the Mussel Aquaculture Productivity Improvement Fund. In addition, research into control methods has been conducted by the Department through several Aquaculture and Fisheries Research Initiative (AFRI) projects and in-house.

Freshwater treatment as a management tool to control the spread of colonial tunicates

A. Ramsay *, K. Gill, A. Morrison, and N. MacNair

Prince Edward Island Department of Fisheries, Aquaculture and Rural Development, Montague, PE C0A 1R4.

Successful management of Aquatic Invasive Species (AIS) has become a critical component in the maintenance of mussel productivity in Prince Edward Island (PEI). Much of the mussel seed produced on the Island is located in waters that have been impacted by two invasive colonial tunicates, *Botrylloides violaceus* (violet tunicate) and *Botryllus schlosseri* (golden star tunicate). These two species have proven to be significant fouling organisms to the mussel industry; therefore every precaution has been made to reduce the risk of these organisms being introduced to new areas in PEI. In the past, seed movements from colonial tunicate infested areas to "clean" areas were not permitted by a (PEI) Introductions and Transfers Committee (I&T). As a result, there were seed shortages in some areas and seed producers with unsold product in other areas. A series of field trials were conducted to determine if mussel seed fouled with colonial tunicates could be treated with freshwater before being transferred to an area absent of colonial tunicates to minimize the risk of introduction. A 24hr freshwater treatment was successful in causing 100% mortality in colonial tunicates fouling mussel seed, while also not resulting in high mussel seed mortality. As a result, this information was presented to mussel growers and is now standard practice to allow for the movement of seed from areas impacted by colonial tunicates to "clean" areas, while minimizing risk of introduction into the receiving body of water.

Non-indigenous and indigenous ascidians of Newfoundland and Labrador

K.C.K. Ma[1] *, Don Deibel[1], and Cynthia McKenzie[2]

[1] Ocean Sciences Centre, Memorial University of Newfoundland, St. John's, NL A1C 5S7
[2] Science Branch, Northwest Atlantic Fisheries Centre, Fisheries and Oceans Canada, St. John's, NL A1C 5X1

The non-indigenous colonial ascidians Golden Star Tunicate (*Botryllus schlosseri*) and Violet Tunicate (*Botrylloides violaceus*) are seriously impacting aquaculture sustainability in the Maritime Provinces and Newfoundland. These potentially invasive, encrusting marine animals were only recently reported from several harbours on Newfoundland's south coast (i.e., 2006 and 2007 respectively; Callahan et al. submtd.). They are aggressive invaders that can grow over shellfish (e.g., mussels) and consequently out-compete them for space, and perhaps for food. This warrants a comprehensive checklist of ascidian species to be compiled for Newfoundland and Labrador. A checklist of non-indigenous and indigenous ascidians will provide insight to

the diversity of the local ascidian fauna and provide a basis for faunal comparisons with other marine environments. Based on a thorough literature review, a total of 35 ascidian species have been documented from Newfoundland and Labrador since 1863. A checklist of 27 ascidians of the Canadian Arctic is also compiled for community similarity analyses (Sørensen Similarity Index). In addition, ascidian records from literature and online databases (e.g., OBIS and GBIF) were used to generate ArcGIS maps as visual aids to show spatial and temporal distribution (i.e., invasion history) of *B. schlosseri* and *B. violaceus* in Canada and the United States.

Life-history, population dynamics, diversity, and abundance of *Botryllus schlosseri* in a sub-arctic environment (Arnolds Cove, Placentia Bay, NL).

J.B. Lowen[*], D. Deibel[1,] M.L. Rise[1], R. Thompson[1], K. Ma[1], and C.H. McKenzie[2]
[1]Ocean Sciences Centre, Memorial University, St. John's NL, A1C 5S7, Canada
[2]Fisheries & Oceans Canada, Northwest Atlantic Fisheries Centre, P.O. Box 5667, St. John's NL A1C 5X1, Canada

Botryllus schlosseri and *Botryllus violaceus*, hereafter referred to as SCH and VIO, respectively, are invasive fouling ascidians with the potential to disrupt benthic communities and aquaculture ventures. Alongside the development of genetic probes for rapid identification of SCH and VIO larvae, our objectives are to study the life-history, population dynamics, and genetic diversity of SCH morphs, in a seasonal sub-artic environment. The overarching aim being to mitigate its invasion. Moreover, SCH represents a stepping stone for other highly invasive tunicates. Thus, an improved understanding of SCH will help to predict the potential impact of other invasive tunicates. To achieve our objectives we will be conducting a combination of field and laboratory experiments during March-December 2010. Preliminary dive surveys suggest that distinct colour morphs (n~10-13) of SCH are thriving in and around a sheltered area of Arnolds Cove, Newfoundland. Over winter, colonies either i) died, ii) became senescent, or iii) regressed back to single systems (with evidence of asexual budding in February at -1°C). To our knowledge this is the first time the life-history, and resultant patterns of abundance in SCH, have been investigated in a sub-artic environment that may in turn represent the environmental limit of its distribution.

The control and management of an invasive colonial tunicate *Botrylloides violaceus* **in Newfoundland**

B.B. Pilgrim* and C. Mackenzie

Northwest Atlantic Fisheries Centre, Fisheries and Oceans Canada, St. John's, NL, Canada A1C 5X1

Violet tunicate, *Botrylloides violaceus*, was first detected in Newfoundland in October 2007 in a fishing harbour at Belleoram, Fortune Bay. A rapid response framework was applied and suppression and eradication trials were attempted in 2008 and 2009. This presentation describes the control projects, subsequent surveillance, evaluation of the effectiveness of these efforts, and recommendations on future rapid response to detection of aquatic invasive species.

Prey preferences of European green crabs on three commercially grown bivalves

T. Pickering*, K. Murray, and P.A. Quijon

Department of Biology, University of Prince Edward Island, 550 University Avenue, Charlottetown, PE, Canada, C1A 4P3

The recently introduced European green crabs (*Carcinus meanas)* are emerging as important predators on American oyster (*Crassostrea virginica)* aquaculture sites in estuarine areas of Prince Edward Island, Canada. To address this issue, we conducted prey preference experiments in the lab and field to look at green crab feeding rates when given a choice of similar sized oysters, blue mussels (*Mytilus edulis*), and soft-shell clams (*Mya arenaria*). Specifically, we measured the preferences of small (30-45 mm CW), medium (45-55 mm), and large (55-75 mm) green crabs when given a choice of small (15-25 mm SL) and medium (25-35 mm) bivalves. The experiments lasted three days, but in order to identify the timing of the most intense foraging, records of bivalve mortality were obtained on a daily basis. The availability of the three types of prey offered evidence of predator preference with clams being the most preferred prey, followed by mussels. In most cases, as clam abundance decreased, mussel mortality proportionally increased. Furthermore, as mussel abundance also started to decrease, oyster mortality increased. We discuss these results in the light of the oyster aquaculture industry and the ongoing spread of green crabs along PEI's southern shore.

Finfish Culture

Monday, May 17, 2010 – lundi 17 mai, 2010
2:00 PM – 3:20 PM
Location: Salon E/F

Co-Chairs: Danny Boyce and Debbie Martin-Robichaud

2:00 **Parrish, C.**
Variation in lipids and amino acids in Atlantic cod (*Gadus morhua*) during ontogeny from unfertilized eggs to fully weaned larvae

2:20 **Clarke, M.**
Lipids, fatty acids and free amino acids as indicators of egg and larval viability in Atlantic cod

2:40 **Granier, S.**
Egg quality in Arctic charr (*Salvelinus alpinus*)

3:00 **Revie, C.**

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award.

Variation in lipids and amino acids in Atlantic cod (*Gadus morhua*) during ontogeny from unfertilized eggs to fully weaned larvae

C.C. Parrish*, S.K.M. Westelmajer, M.J.R. Clarke, and N.J. Rowsell

Ocean Sciences Centre, Memorial University of Newfoundland, St. John's, Newfoundland and Labrador, Canada, A1C 5S7

Lipids and free amino acids were quantified in Atlantic cod eggs and larvae during ontogenetic changes from fertilization to 59 days post-hatch (dph), and compared with fertilization and hatching success, growth and post-stress survivorship. Phospholipids, the fatty acid 24:1, and hydroxyproline showed the most potential as markers of viability in the first experiment which ended at yolk-sac absorption. In another experiment, three different live-food enrichment protocols were tested for their effect on growth and stress resistance over the period 3 - 50 dph. Differential enrichment affected the lipid and fatty acid composition of rotifers, *Artemia* and the developing larvae. Differences in growth parameters were seen as early as 7 dph. Our findings emphasized the importance of supplying high dietary DHA, ARA and n6DPA during this period to promote future larval and juvenile performance. A final experiment was conducted over the period 39-59 dph to determine the effect of incorporating a krill protein hydrolysate into the feeding regime. All treatments containing krill protein produced high specific growth rates. These studies underline the importance of a variety of nutritional factors and their interactions during ontogeny from unfertilized eggs to fully weaned larvae with implications for the nutritional management of larvae and broodstock.

Lipids, fatty acids and free amino acids as indicators of egg and larval viability in Atlantic cod

M. Clarke[1*], C.C. Parrish[2], and R.W. Penney[1]

[1] Northwest Atlantic Fisheries Centre, Fisheries and Oceans Canada, St. John's, NL A1C 5X1
[2] Ocean Science Centre, Memorial University of Newfoundland, St. John's, NL A1C 5S7

An understanding of the biochemical factors affecting egg and larval quality can serve as a means to separate poor eggs from high quality eggs in aquaculture, for selection of viable eggs resulting in maximum production. Levels of lipids and free amino acids were traced in Atlantic cod eggs and larvae from fertilization to yolk-sac absorption. A select number of lipids and free amino acids correlated with fertilization and hatching success, and significant differences were found between higher and lower success groups in some lipids and FAA. The phospholipids and the fatty acid 24:1 showed the most potential as markers of viability, with 24:1 correlating with both fertilization and hatching success. Lipids showed conservation throughout development, while FAA was catabolized as a primary energy source. Blastomere morphologies were analyzed in fertilized eggs. Cell symmetry, uniformity, margins and adhesions showed positive correlations with hatching

success. It is recommended that the role of the fatty acid 24:1, as well those free amino acids showing significant differences among Day 0 egg groups (sarcosine, thioproline, hydroxyproline, ornithine, and hydroxylysine), be investigated further to understand their roles in embryo and larval development.

Egg quality in Arctic charr (*Salvelinus alpinus*)

S. Granier*[1], S. Plante[2], and C. Audet[1]

[1] ISMER, Université du Québec à Rimouski, Rimouski, Quebec, Canada, G5L 3A1

[2] Université de Moncton campus de Shippagan, Shippagan, New Brunswick, Canada, E8S 1P6

In Canada, Arctic charr production is not as important as it could be. This is partially due to several factors as heterogeneous and variable growth, early maturation, and variability in egg quality. Good egg quality is the most important point in any animal production but especially in fishes. Eggs must contain all the material the embryo and yolk-sac fry will need to develop and to grow before and after hatching. The objective of the present study was to test if egg lipid content was related to female hatching success. The second objective was to test the influence of temperature incubation conditions on the use of lipid reserves. Half-sib crosses using thirteen females and four males were made and eggs from each family were split in half. Half of the eggs from each family were incubated separately (one tray per half-family) under natural temperature conditions (from 8°C to 3.5°C) and the other half in controlled conditions (6°C). The mother effect will then be analyzed and presented related to lipid reserves incorporated into the eggs.

Training and Education

Monday, May 17, 2010 – lundi 17 mai, 2010
3:50 PM – 4:50 PM
Location: Salon E/F

Co-Chairs: Tillmann Benfey and Caroline Graham

3:50 Rideout, K.
Aquaculture training for the NL salmonid and mussel industry

4:10 Flimlin, G.
The power of the volunteer in community based shellfish restoration

4:30 Benfey, T.
Pros and cons of graduate studies in aquaculture

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award.

Aquaculture training for the NL salmonid and mussel industry

R. Collier[1], K. Rideout*[2], S. George[3], L. Halfyard[2], J. Nichols[2], C. Couturier*[1]

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[2] Marine Institute, Memorial University, St. John's, Newfoundland, Canada, A1C 5R3
[3] Cold Ocean Salmon, Division of Cooke Aquaculture Inc., Harbour Breton, Newfoundland, Canada, A0H 1P0

The Newfoundland aquaculture industry has been steadily growing, with production in 2009 increasing to 13,625 metric tonnes and a market value of $96 million. Over 100 licensed farms employ about 700 people, with many others in the service and processing sectors. In the 90s, NAIA and the Marine Institute conducted a series of training workshops, but technology and employees have changed over the years and an industry needs assessment, completed in 2008-09, identified a need for skills training for existing and new employees. NAIA and MI received support from various agencies (i.e. INTRD, DFA, ACOA, SC/HRSDC, MI, NAIA), as well as the aquaculture industry itself, to initiate a series of workshops/courses to enhance employee skills and farm productivity. NAIA has facilitated communications with funding agencies and industry. Industry has worked closely with MI in the development of the curriculum and has been directly involved in course delivery, which has placed a major emphasis on the relevance of the training for daily operations. Training has been developed in short 2-3 day blocks of time, delivered in the winter months (i.e. reduced farm activity) and offered in different communities to facilitate training to groups of workers from various farms. This joint training initiative has fostered a stronger relationship among industry, NAIA and MI personnel, and an enhanced awareness of industry needs as it continues to expand. This presentation will discuss critical issues in the development of successful industry-focused and community-based aquaculture training.

The power of the volunteer in community based shellfish restoration

G. Flimlin*[1], C.Muscio[1], and R. Bushnell[2].

[1]Rutgers Cooperative Extension, 1623 Whitesville Road, Toms River, NJ 08755; [2]357 North 7th Street, Surf City NJ 08008.

The Barnegat Bay Shellfish Restoration Program (BBSRP) is a jointly run community based shellfish restoration program coordinated by Rutgers Cooperative Extension and the NJDEP Bureau of Shellfisheries. Now in its fifth year, the program educates and trains volunteers in shellfish biology, aquaculture, estuarine water quality, watershed impacts, seafood safety and data collection. It grows both hard clams, *Mercenaria mercenaria*, and the American oyster, *Crassostrea virginica*, from 2-3mm to field plantable size. At face value, the program looks like an attempt to restore the bay with shellfish when in fact, it is designed to use the volunteer to educate the public about

environmental involvement and stewardship. Once the public realizes there are tiny shellfish in the bay, they change their behavior in the watersheds to lessen their impact on the estuary and become part of the public process to improve local and state actions. The program has trained over 200 volunteers of which about 60 very active people are growing shellfish, outreaching at fairs and festivals, and providing hands-on education. The volunteers formed a non-profit organization that raised over $75,000, instituted an award-winning public art and science education program that received a NJ Tourism Award, brought environmental education to lots of summer visitors, and sent the kids home to be "Clambassadors."

Pros and cons of graduate studies in aquaculture

T.J. Benfey

Department of Biology, University of New Brunswick, P.O. Box 4400, Fredericton, NB E3B 5A3

Graduate studies at the MSc and PhD levels allow students to conduct in-depth research that generates new knowledge in their field of study. Although such research is often curiosity driven, this does exclude addressing issues of relevance to the Canadian economy and social well-being. And even if the specific project that a student is focussing on does not appear to have immediate relevance, the training gained through applying rigorous methods of experimentation and data analysis are useful for other endeavours. This presentation will highlight some of the advantages and pitfalls to pursuing graduate studies in aquaculture from my own perspective as well as that of the many graduate students I have interacted with.

Finfish Aquaculture

Tuesday, May 18, 2010 – mardi 18 mai, 2010
8:30 AM – 9:50 AM
Location: Salon B

Co-Chairs: Danny Boyce and Debbie Martin-Robichaud

8:30 Prickett, R.
Successful partnerships for a sustainable future – Cod juvenile production at the Dr. Joe Brown Aquatic Research Building (JBARB) 2009-2010

8:50 King, N.
Newfoundland commercial scale Atlantic cod hatchery production technology project – live feed component

9:10 Audet, C.
Flatfish production in North America: biological issues

9:30 FitzGerald, R.
An economic assessment of cod farming in Ireland

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award

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Successful partnerships for a sustainable future – Cod juvenile production at the Dr. Joe Brown Aquatic Research Building (JBARB) 2009-2010

R. Prickett*[1], D. Boyce[2], J. Monk[2], M. Drake[2], B. Armstrong[2], and C Canning[2].

[1]RSP Services Ltd., 120 Netherton Road, Appleton, Abingdon, Oxon OX135LA, UK.
[2]Ocean Sciences Centre, Dr. Joe Brown Aquatic Research Building, St. John's, NL, Canada

Following low production numbers during the 2008/2009 production run, RSP Services Ltd., a company with several years of commercial cod hatchery experience in Europe, were invited to assist the JBARB team in improving its facilities and protocols. The aim was to train and instruct staff in latest hatchery technology relevant to producing commercial quantities (500,000 +) of cod juveniles per production run for the aquaculture industry in Newfoundland. This presentation describes the measures taken which resulted in a production of over 800,000 cod juveniles; the best production run in the history of the facility.

Newfoundland commercial scale Atlantic cod hatchery production technology project – live feed component

N. King*[1], R. Healey[2], D. Tucker[2], S. Hann Haley[2], and D. Boyce[2]

[1] Skretting, 46 Moore-Clarke Drive, Bayside, New Brunswick. Canada
[2] Ocean Science Center, Dr. Joe Brown Aquatic Research Building, St. John's, Newfoundland. Canada

Hatchery production has traditionally been one of the biggest bottlenecks to overcome in marine fish farming. Early life stages of marine fish larvae are extremely sensitive to environment, nutrition and husbandry practices. As a result, mortality rates greater than 60% are generally realized across the industry. Experienced hatchery managers understand very well how continually optimizing protocols is essential in order to guarantee the health status of their fry and performance of the following farming activities. Indeed hatchery production of marine fish like cod is a perpetually evolving process, and as new solutions to problems arise, the technology to produce marine juveniles is always advancing. With hatcheries in North America so far removed from the nucleus of modern hatchery technology being the Mediterranean and N. Europe, it is critical to extend international collaboration in order to gain exposure to latest information and technology. As an example of this, Skretting Marine Hatchery Feeds (MHF) integrated into a team of professional consultants from abroad to assist Ocean Science Center – Dr. Joe Brown Aquatic Research Building (OSC-JBARB) staff in their effort to scale-up cod juvenile production in support of industrial demonstration of cod farming in Newfoundland, Canada. The successful outcome of this project was in part due to the high quality, high productivity, and stable performance of the live feed production areas. In this presentation we will review the adapted live feed program at

JBARB; the critical equipment and products needed to up-scale this area to support fish production in excess of 1 million juveniles per production run.

Flatfish production in North America: biological issues

C. Audet and R. Tremblay

Institut des sciences de la mer de Rimouski, Université du Québec à Rimouski, 310 des Ursulines, Rimouski (Qué.), G5L 3A1

Turbot production is successfully carried out in many European countries, and important advances have recently been made in Atlantic halibut production both in Europe and North America. However, other flatfish species are being considered for aquaculture production in Europe, Japan, and North America. Because of large variations in terms of life history, egg production, egg size, metamorphic processes, and nutritional needs, each flatfish species presents a specific biological profile that raises different challenges for mass production. Even though there are several on-going research programs occurring in different North American laboratories, a comprehensive overview of these biological issues is still lacking. The aim of this review was to document recent advances in biological studies on flatfish related to aquaculture development that are now in progress in North America and to highlight the main biological issues that are encountered. We were interested in species that raised specific interest either for food production or for stock enhancement.

An economic assessment of cod farming in Ireland

R.D. FitzGerald*, N. Bass, P. Casburn, M. Bolton-Warberg, L. Roche, L. Watson

This talk is based on a report, produced as part of the EIRCOD project, which provides an Economic and Market evaluation of the potential of cod farming in Ireland. Having reviewed the status of the World and EU seafood supply and demand, the disposition of the extant industry and the prevailing technical/ biological issues, it is concluded that the emergence of a (generic) cod farming sector will occur but at a much slower rate than originally envisaged. However, from examination of the empirical data on cod growth in Ireland and by using predictive modeling, it is evident that growth performance of stocks in Irish waters will exceed some of our primary competitors, providing a competitive advantage. Using this growth model, a full financial model for the production of 1,000 tonnes of certified organic farmed Irish cod is developed, elaborated and evaluated: full production and operational costings and profitability are estimated, capital expenditure and cash flows are defined and a minimum breakeven price is calculated. These data demonstrate that such a commercial development is feasible and viable. It would appear that this is a practicable commercial opportunity in Ireland, for the development of a market-led and customer-focused industry, based on producing an organic farmed cod product for a high-end, niche, market. This opportunity could be exploited with significant benefits in terms of jobs, wealth creation and valuable exports for Ireland but

will require, in the short term, the integrated support of industry, State agencies and the R&D sector in two key areas – facilitated entry of operators and a directed marketing strategy – for effective implementation.

Environmental Impacts

Tuesday, May 18, 2010 – mardi 18 mai, 2010
8:30 AM – 9:50 AM
Location: Salon C/D

Chair: Jonathan Kawaja

8:30 Moccia, R.
Monitoring and modeling phosphorus contributions in a freshwater lake with cage-aquaculture

8:50 Podemski, C.
Effects of a rainbow trout (*O. mykiss*) farm on whole-lake phosphorus and nitrogen annual budgets

9:10 Podemski, C.
Modelling the solid waste dispersion of rainbow trout farming in freshwater environment: a preliminary test of DEPOMOD

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award

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Monitoring and modeling phosphorus contributions in a freshwater lake with cage-aquaculture

J.E. Milne[1] and R.D. Moccia*[1]

[1] Aquaculture Centre, Department of Animal and Poultry Science, University of Guelph, 50 Stone Road East, Building #70 Guelph, Ontario, Canada N1G 2W1

This project will address current challenges in water quality risk assessment and risk management of cage-aquaculture in Ontario. A mass-balance modeling approach has been applied to gain an improved understanding of the relative contributions of phosphorus loading from various sources into a freshwater lake with cage-aquaculture in Ontario. Lake Wolsey is located on Manitoulin Island in Lake Huron, Ontario. The lake is connected to the North Channel by a small canal where water exchanges periodically. The farm was established 1986 and has annual production of approximately 400 metric tonnes of rainbow trout. We have estimated total phosphorus loadings from 8 sources of inputs and 3 sources of outputs from the lake. We then applied a sensitivity analysis to establish parameters that require empirical measurement and field validation. Preliminary results show tributaries to be the most sensitive parameter in terms of phosphorus loading followed by the exchange via the canal and then followed by contributions by the farm itself. Information from this project will; 1. provide improved understanding of the relative phosphorus contributions of a fish farm to a freshwater lake in Ontario and, 2. will provide water quality managers with scientific information to aid in the decision-making processes related to determining policy and regulatory approaches to sustainable aquaculture management in Ontario.

Effects of a rainbow trout (*O. mykiss*) farm on whole-lake phosphorus and nitrogen annual budgets

P.A. Azevedo[1], C.L. Podemski[*1], C. Bristow[2], R.H. Hesslein[1], R.A. Anderson [3], K. Beaty[1] and D. Bureau[4]

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[4]Department of Animal and Poultry Science, University of Guelph, Guelph, ON N1G 2W1

The effects of a rainbow trout farm on whole-lake phosphorus (P) and nitrogen (N) budgets were investigated by input-output mass balances of P and N. Additionally, the contribution of nutrient refluxes at the sediment-water interface to the whole-lake budgets was assessed. The farm released an average of 86.7 kg of P and 517.9 kg of N each year,

exceeding annual combined inputs from inflow, runoff, and precipitation. Most of P (95±3%) and most of N (82±9%) added over 5 years were stored in the lake. However, less than 15% of the added P accumulated in the water column and most was assumed to have been deposited to the sediments. Most of the N (>65%) deposited in sediments while less than 35% appeared in the water column. P reflux from the sediments was 10 times higher under the cage compared to fluxes measured at the edge of the cage (1.05g/m^2/d *vs*. 0.10 g/m^2/d, respectively). These fluxes were much higher than at a distant site (0.13mg/m^2/d) where pore water gradients of P were absent and weak. N reflux under the cage was mainly in the form of NH_4^+ (>70% of total dissolved N) and was 10 times higher than reflux at the cage edge. Spatial variability of sediment chemistry, i.e., P fractions, nutrients and metal concentration, will be discussed in view of N and P reflux differences amongst sites.

Modelling the solid waste dispersion of rainbow trout farming in freshwater environment: a preliminary test of DEPOMOD

C.L. Podemski*[1], P.A. Azevedo[1], J. Zhang[1] and D.B.Bureau[2]

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[2]Department of Animal and Poultry Science, University of Guelph, Guelph, ON N1G 2W1
Net pen aquaculture produces settleable solid wastes that are released to the environment and can alter sediment biochemistry and benthic community structure. Predictive modelling tools such as DEPOMOD and field evidence are currently used by several countries, including Canada, to ensure that the degree and spatial extent of benthic change is constrained. The suitability of the DEPOMOD designed for mariculture, in predicting the dispersal of particulate wastes in a freshwater environment was assessed by comparing predicted C fluxes with observed sedimentation around a rainbow trout (*Onchorhynchus mykiss*) farm. Required input data, i.e., bathymetry, farm production, feed and waste characterization, site layout and hydrographic data (water current speed and direction) for DEPOMOD was collected from a rainbow trout commercial farm site in Lake Diefenbaker. Settling speeds of feed and faecal particles were adjusted for the freshwater environment and carbon fluxes in gC/m^2/d were predicted. Sediment traps were deployed for 24-72 hours under and around the cages, within a 100 m radius, and at two reference sites more than 1000m away. Measured sedimentation rates varied from >35gC/m^2/d under cages to < 2gC/m^2/d at sites 100m from cages. Background C sedimentation rates were 25 times lower than sedimentation rates at the cage sites. Agreement between measured and predicted C sedimentation rates will be discussed.

International Mussel Forum

Tuesday, May 18, 2010 – mardi 18 mai, 2010
8:30 AM – 12:30 PM
Location: Salon E/F

Chair:

8:30 **Delegate Welcome: AAC, NAIA, IRAP, CCFI**

8:50 **Couturier, C. or Duncan, L.**
Canada

9:10 **Fang, J.**
China

9:30 **Executive director, New Zealand Mussel Producers Council**
New Zealand

9:50 **HEALTH BREAK**

10:20 **Plenary Speaker (Salon B/C/D)**

11:20 **President, Chile Mussel Producers**
Chile

11:40 **Holstein, J. (TBD)**
Netherlands

12:00 **Leis, M.F. (TBD)**
Spain

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award

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Finfish Aquaculture

Tuesday, May 18, 2010 – mardi 18 mai, 2010
2:00 PM – 5:30 PM
Location: Salon B

Co-Chairs: Danny Boyce and Debbie Martin-Robichaud

2:00 **Le François, N.**
Pilot-scale cultivation of the spotted wolffish (*Anarhichas minor*) in Québec, Canada.

2:20 **Desjardins, M.**
Hybrid wolffishes and aquaculture considerations

2:40 **Deslauriers, D.**
Implications and applications of exercise-trained sturgeon

3:00 **Burt, K.**
The effect of intermittent hypoxia on Atlantic salmon (*Salmo salar*): Preliminary results on fish growth and immune response

3:20 **HEALTH BREAK**

3:50 **Manning, T.**
Melatonin monitoring as a tool for assessing light therapy efficacy in sea cage Atlantic salmon.

4:10 **Feindel, N.**
Triploid Atlantic cod (*Gadus morhua*) as a potential candidate species for the diversification of the marine finfish aquaculture industry.

4:30 **Whitehead, J.**
Gynogenesis and the genetic basis of sex determination of Atlantic cod (*Gadus morhua*)

4:50 **Lin, S.**
Sex control of Atlantic cod (*Gadus morhua*)

5:10 **Singh, S.**
Early breeding of *Catla catla* by early maturity

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award

Pilot-scale cultivation of the spotted wolffish (*Anarhichas minor*) in Québec, Canada.

N.R. Le François*[1-2], D. Chabot[3], F. Dufresne[1], and A. Savoie[1]

[1] Université du Québec à Rimouski, Rimouski, QC Canada G5L 3A1
[2] Biodôme de Montréal, Montréal, QC, Canada H1V 1B3
[3] Institut Maurice Lamontagne, Pêches et Océans, Mont-Joli, QC Canada G5H 3Z4

A pilot-scale growth trial featuring the spotted wolffish (*Anarhichas minor*) is currently being run at the facilities of the Maurice Lamontagne Institute (Fisheries and Oceans, Mont-Joli, Qc, Canada) in collaboration with UQAR, SODIM, MAPAQ, MDEIE and the Biodôme de Montréal. Spotted wolffish is a cold-adapted bottom-dwelling marine fish species found in the northern part of the Atlantic Ocean (including the Gulf and Estuary of the St-Lawrence). Optimal growth temperatures vary between 6 (broodstock) and 10 °C (early stages). The wolffishes have been identified as group of promising candidates for aquaculture diversification in cold environments (e.g. Quebec, Newfoundland, Norway, Iceland) due to their flesh qualities, robustness, high growth rate at low temperature, density requirement and ‘farming friendly" life-cycle. Research efforts on these species have been conducted in Québec, Canada since 1999 and focused on reproduction, early-life stages and market outlooks of the spotted wolffish. The next crucial step is to demonstrate that it is an economically interesting species and worthy of further development. This project is aimed at applying "state of the art" rearing practices in order to reach optimal growth of the spotted wolffish until commercial size (1.0-1.5 Kg) is reached, while taking into consideration "fish welfare". Our large-scale trial will also be examining family effects and the impact of grading on growth and hierarchy. Our current estimations indicate that our captive population display similar performance than Icelandic and Norwegian growth data.

Hybrid wolffishes and aquaculture considerations

M. Desjardins[1]*, G.L. Fletcher[1], and N.R. Le François[2,3]

[1] Ocean Sciences Centre (MUN), St. John’s (NL), Canada, A1C 5S7
[2] Biodôme de Montréal, Montréal (QC), Canada, H1V 1B3
[3] Université du Québec à Rimouski, Rimouski (QC), Canada, G5L 3A1

The Atlantic wolffish (*Anarhichas lupus*) and the spotted wolffish (*A. minor*) are promising candidates for mariculture in the North Atlantic. The spotted wolffish shows the fastest growth rate, while the Atlantic wolffish has the highest levels of freeze protection (synthesis of plasma antifreeze proteins – AFPs), which could allow its year-long culture in sea-cages despite the presence of ice and sub-zero temperatures. However, the spotted wolffish is preferred by fish farmers for its superior grow rate and farming-friendly behaviour. Why not then consider hybridizing these two interesting species in order to possibly obtain a hybrid that would inherit both high growth rates and adequate

freezing resistance strategies? Following recent production of reciprocal hybrid Atlantic and spotted wolffishes, it was found that the growth rates of these hybrids were the same as in spotted wolffish. However, the present work reveals that the hybrids displayed lower levels of freeze resistance than Atlantic wolffish (plasma freezing point of -1.06 ±0.17ºC and -1.19 ±0.44ºC, respectively). The levels of AFP gene expression in various tissues supported these results. Possible measures to improve hybrid performances for freeze resistance, and the role of environmental variables and ontogeny in the intensity of the antifreeze response will be discussed.

Implications and applications of exercise-trained sturgeon

D. Deslauriers*[1], J.D. Kieffer, and C. Ceapa

[1]University of New Brunswick, Canadian Rivers Institute, Saint John, N.B., Canada, E2L 4L5,

Sturgeons have evolved approximately 200 million years ago and have shown very little morphological modifications since. Their unique features such as the presence of external bony plates allow them to live a predator-free existence. This morphological trait, on the other hand, can significantly limit their swimming capabilities. In the wild, most sturgeon species have a migratory nature and thus need to travel large distances, against a wide range of water velocities, to access spawning grounds. Sturgeons are also of commercial interest (caviar, meat) which has contributed to their world-wide decline. Aquaculture has been implemented to fill this commercial void and act in conservation efforts. The main objective of the present body of work was to investigate the missing gaps about sturgeon swimming performance and to then apply these results in the development of an exercise-training protocol. It was shown that, in agreement with the available literature, sturgeons are poor swimmers but can tolerate a wide range of biotic and abiotic conditions (temperature, oxygen, swimming densities). Based on this, various protocols have been designed to demonstrate the effects of exercise on aquaculture-related parameters (length, weight, FCR). The training effect on swimming performance was also investigated. If training is shown to positively affect development as seen in most commercial Salmonid species, exercise in sturgeons can prove to increase growth efficiency and cut back on production time.

The effect of intermittent hypoxia on Atlantic salmon (*Salmo salar*): Preliminary results on fish growth and immune response

K. Burt*[1], D. Hamoutene[1], J. Perez-Casanova[1], A.K. Gamperl[2], G. Mabrouk[1], L. Lush[1], M. Clarke[1], T. Bungay[1], S. Kenny[1] and K. Hobbs[1]

[1]Aquaculture, Biotechnology and Aquatic Animal Health Section, Department of Fisheries and Oceans, St. John's, NL, A1C 5X1.
[2]Oceans Sciences Centre, MUN, St. John's, NL, A1C 5S7.
To understand the influence of intermittent hypoxia on salmon, a 6 week study mimicking summer conditions observed in sea cages was conducted. Two groups of salmon juveniles (initial mass 200 g) were randomly exposed to hypoxia (<6 mg/L O_2) (6-12°C) for 30 to 150 minutes during the 6 weeks while one group of juveniles remained at normoxic conditions. During hypoxia growers stop feeding the fish; therefore we had three treatment groups: normoxic (N), hypoxic fed (HF), and hypoxic not fed (HNF). Growth and food intake were evaluated, as well as innate immunity by measuring respiratory burst (RB) in blood and head kidney leucocytes. Sampling was performed at 3 weeks and at the completion of the exposure period. At 3 weeks, there were no differences in any of the parameters assessed. After 6 weeks, the HNF group had significantly lower values for wet mass, total length, and condition factor as compared to N and HF fish. Food consumption, as well as food conversion efficiency was in the same range in the N and HF suggesting that intermittent hypoxia did not influence appetite and food intake. The RB of head kidney leucocytes was higher in the N group as compared with the HF and HNF groups suggesting that hypoxia affects white cell immune function independent of food intake.

Melatonin monitoring as a tool for assessing light therapy efficacy in sea cage Atlantic salmon.

A.J. Manning[1], K.P. Ang[2] and B.D. Glebe[3]

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[3] St. Andrew's Biological Station, Fisheries and Oceans Canada, 531 Brandy Cove Rd., St. Andrew's, NB E5B 2L9

Photoperiodic manipulation is currently used by the Canadian aquaculture industry for the reduction of grilsing rates in sea cage populations. The effectiveness of light therapy regimes during the winter is often determined at harvest. Monitoring nocturnal levels of melatonin, a hormone which communicates photoperiodic cues, is a more immediate method of assessing and optimizing light therapy in production settings. The present study examined melatonin levels and grilsing rates in salmon at four sea cage sites in New Brunswick and Nova Scotia. Light treatment was initiated at three different times during the autumn of 2007 (Oct 15, Nov 1, Dec 1) for most sites. Melatonin levels were determined on blood samples taken in March/April, 2008 using an enzyme-linked

immunosorbent assay (ELISA) rather than a radioimmunoassay. Melatonin data showed diverging patterns for light-treated and control fish. Salmon under light therapy, while reacting to night-fall with increased melatonin, showed significant decreases in melatonin as light exposure progressed during the night. Both melatonin and grilsing data confirmed the effectiveness of light treatment initiated as late as December in reducing maturation in sea cages. Melatonin monitoring by ELISA was proven valuable for assessing photoperiod regimes during critical periods for maturation onset in salmon.

Triploid Atlantic cod (*Gadus morhua*) as a potential candidate species for the diversification of the marine finfish aquaculture industry

N.J. Feindel*[1,2], T.J. Benfey[1], E.A. Trippel[2]

[1]University of New Brunswick, Department of Biology. P.O. Box 4400, Fredericton, New Brunswick, E3B 5A3, Canada
[2]Fisheries and Oceans Canada, St. Andrews Biological Station. 531 Brandy Cove Road, St. Andrews, New Brunswick, E5B 2L9, Canada

Historically, Atlantic salmon (*Salmo salar*) has been the primary finfish species farmed in Northwest Atlantic countries. With an increasing demand for finfish, new species need to be considered for large scale culture. Atlantic cod (*Gadus morhua*) is a prime candidate for farming on an industrial scale, but there are a number of problems associated with its culture that are constraining the advancement of the industry. These include pre-harvest sexual maturation, cod spawning directly in sea cages and the escape of fish from sea-cage operations and interacting with wild stocks. Generation of sterile Atlantic cod, by induction of triploidy, is one technique being studied in hopes of addressing these issues. This study examined gonadal development of triploid Atlantic cod, including an assessment of the reproductive potential of triploid males, both *in vivo* and *in vitro*. Qualitative assessment of triploid gonads revealed significant reduction in ovarian development and no difference in testicular development compared to diploid gametogenesis. Triploid males successfully court diploid females and produce functional aneuploid spermatozoa capable of fertilizing eggs, but the performance of their offspring is inferior to that of diploids. Based on these results, triploid cod have the potential to advance the development of the cod aquaculture industry.

Gynogenesis and the genetic basis of sex determination of Atlantic cod (*Gadus morhua*)

J.A. Whitehead*[1,2], T.J. Benfey[1] and D.J. Martin-Robichaud[2]

[1]Department of Biology, University of New Brunswick, P.O. Box 4400, Fredericton, NB, Canada E3B 5A3
[2]St. Andrews Biological Station, Fisheries and Oceans Canada, 531 Brandy Cove Road, St. Andrews, NB, Canada E5B 2L9

Female Atlantic cod typically mature later in the spawning season and reach marketable size earlier than males. These characteristics have encouraged the aquaculture industry to invest in research concerning mono-sex stocks of cod. Before endocrine approaches can be used to produce mono-sex stocks, the genetic basis of sex determination must be identified. The objective of this research is to determine the genetic basis of sex determination of Atlantic cod, by means of gynogenesis. This process manipulates inheritance by eliminating the paternal genome by exposing spermatozoa to UV light. Several sperm dilutions and UV exposure times will be examined and the lowest UV-dose that adequately decreases sperm motility relative to controls will be further utilized. Irradiated spermatozoa will be used to activate development in eggs. Some embryos will be genotyped and the remainder raised until yolk absorption to verify effective elimination of the paternal genome. A pressure treatment will be applied to zygotes shortly after activation allowing the haploid second polar body to be retained, thus restoring diploidy to the embryo. The sex ratio of gynogenetic populations will be examined, if only females result from gynogenesis, then female homogamety can be supported. A 1:1 or female-biased sex ratio supports female heterogamety.

Sex control of Atlantic cod (*Gadus morhua*)

S. Lin[1]*, T. Benfey[1] and D. Martin-Robichaud[2]

[1] Biology Department, University of New Brunswick, Fredericton, NB Canada E3B 5A3
[2] St. Andrews Biological Station, 531 Brandy Cove Road, St. Andrews, NB Canada E5B 2L9.

Early maturation, a major environmental and economic constraint, commonly occurs in both sexes of Atlantic cod (*Gadus morhua*). Production of sterile triploid fish would alleviate this problem. The objective of this project is to develop techniques to produce monosex stocks of fish as the first step to produce monosex triploids. The experiment involves the application of endocrine manipulation by direct hormone treatments. 17β-estradiol (E_2) and 17α-methyldihydrotestosterone (MDHT) were applied to fish diets during the labile period of sex differentiation. In the first year, triplicate treatments of 5, 10 and 20ppm for E_2 and 0.67, 2 and 6ppm MDHT were given to fish between 17 ± 2 and 43 ± 1 mm SL. The highest and lowest dosage of MDHT resulted in a significant higher male ratio compared to controls. The female ratio in all E_2 groups did not differ from

controls. The shift in sex ratio in both hormone treated groups was not proportional to the dosages applied. Histological investigation of gonadal development showed that undifferentiated and differentiated gonads were observed by 11mm and 13mm SL, respectively. Hence, the possible effective dosages of both hormones will be applied starting at 11mm SL in the second year of experimentation.

Early breeding of *Catla catla* by early maturity

S. Sultan*

1. Catla (*Catla catla) (31 March, 2005)*

Start Date: 4 January 05
1st dose: 4-5 mg LRH-A/Kg Body wt for Female Fish
After 20 days
25 January 05
2nd dose: 3-4 mg LRH-A /Kg Body wt for Male & Female Fish
After 20 days
15 February 05
3rd dose: 2-3 mg LRH-A /Kg Body wt for Female Fish
After 13 days
Final dose on 28 February 05:
10 mg PG/Kg Body wt for Male and 7-8 mg Ova tide/Kg Body wt for Female

Dosage for obtaining eggs from fishes after above mentioned treatment: The injection dose is 10 mg PG/kg body wt. for Male to set the proper breeding timing with female (breeding timings depend upon the temperature of the water) and diluting the Milt which is in the solid form in the vas deference. Once it is diluted it can easily travel through the testicles for ejaculation. And after 1 hour later, 5-6mg Ova tide/kg body wt for first injection to female for the proper release of the ova. After this copulation starts generally for 4-8 hours. Male and Female release there milt and ova respectively into the water. They fused to form a zygote which develops into the spawn after 28 hours and it remains into the hatchery. After 72 it is transferred to the nursery.

Feeding composition throughout the experiment:
Pallet food of groundnuts, rice bran, soyabean, mustard along with….
Vitamin C feed supplement for improving healthy growth, feed intake, and weight gain.
Benzal Konium chloride, Formalin and Methanol supplement for unloading gram +ve and gram -ve bacteria and fungi, protozoan from water and preventing bacterial diseases and improving respiration.

Supplement of **Calcium and Phosphorus** for the prevention of weakness and anemic problems and increase weight gain

Mineral supplement: Zn, Mg, Mn, Fe, K, Ca, Cu, Co, B, Mb etc for regulating liver enzymes functions and planktons growth and disease resistance. And low mortality.

Addition to this
Calcium Carbonate and Calcium Magnesium Carbonate treatment for neutralizing acidity.

Moving Aquaculture Forward

Tuesday, May 18, 2010 – mardi 18 mai, 2010
2:00 PM – 5:30 PM
Location: Salon C/D

Co-Chairs: Alistair Struthers and Corina Busby

2:00 **House, N.**
The Program for Aquaculture Regulatory Research

2:20 **Busby, C.**
Aquaculture Collaborative Research and Development Program (ACRDP**)**

2:40 **Struthers, A.**
The Aquaculture Innovation and Market Access Program: Program Update

3:00 **Brown, C.**
Industrial Research Assistance Program Overview

3:20 **HEALTH BREAK**

3:50 **Deveau, G.**
ACOA Program - The Atlantic Innovation Fund (AIF)

4:10 **Vardy, C.**
NSERC Programs – Encouraging Academic-Industry Collaborations

4:30 **Epelbaum, A.**
Aquaculture potential of the basket cockle (*Clinocardium nuttallii*) in British Columbia, Canada: nursery and grow-out production phases

4:50 **Podemski, C.**
Effects of net pen aquaculture on a lake ecosystem: results from the ELA Aquaculture Project

5:10 Video Premiere. Fisheries and Oceans Canada: Aquaculture Science Research

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award

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The Program for Aquaculture Regulatory Research

N. House*

Fisheries and Oceans Canada, 200 Kent St, Ottawa, ON , K1A 0E6

Fisheries and Ocean Canada's Program for Aquaculture Regulatory Research (PARR) is entering the third year of its five year research agenda. This program, the Centre for Integrated Aquaculture Science (CIAS), and the DFO-NSERC Canadian Integrated Multi-Trophic Aquaculture Network (CIMTAN) were created in 2008/09 to provide science support for the Aquaculture Regulatory element of the New Aquaculture Program. The New Aquaculture Program was funded in the 2008 Budget with the purpose of creating the conditions necessary for the success of the Canadian aquaculture industry. PARR is a science funding program internal to DFO with a research agenda designed to support new and emerging priorities and identify those areas that require knowledge in the medium and long term. One of the key objectives of PARR is to increase the relevant science knowledge to support and advise informed DFO ecosystem-based environmental regulation and decision making. The PARR Advisory Committee was formalized this year to establish research priorities and recommend proposals. Research priorities are identified each year following consultation with DFO internal clients: Aquaculture Management Directorate and Habitat Management Directorate.

Aquaculture Collaborative Research and Development Program (ACRDP)

C. Busby*[1] and G.J. Parsons[1]

[1]Fisheries and Oceans Canada, Aquaculture Science Branch, 200 Kent Street, Ottawa, Ontario, K1A 0E6, Canada

The Aquaculture Collaborative Research and Development Program (ACRDP) is an industry driven research and development activity aimed at increasing the level of collaborative research between the aquaculture industry and Fisheries and Oceans Canada (DFO). This program has been running since 2001 and is jointly funded by DFO and industry partners. The ACRDP funding envelope is $4.275 million annually (subdivided regionally), and must include a minimum industry contribution of 30% of the ACRDP amount requested (7.5% in-cash, 22.5% in-kind). There are three main research and development objectives to the program: (1) best performance in fish production, (2) optimal fish health, and (3) industry environmental performance. To date, over 290 projects have been approved and funded totaling $66.3 million in aquaculture research. This includes minimum contributions of $30.4 million in ACRDP funds, $14.8 million from industry contributions, $16.1 million in other DFO funding and $5.1 million from other partners. The ACRDP also supports a number of projects on issues of national importance such as sea lice and BKD, national workshops and communications initiatives, including the development of project fact sheets, the bi-annual R&D Review and most recently, an aquaculture science promotional video, summarizing current DFO

aquaculture research being undertaken in Canada. The program continues to strive for improvement through stakeholder engagement by seeking feedback on key priorities that address solutions for the sustainable development of the sector.

The Aquaculture Innovation and Market Access Program: Program Update

A. Struthers

Aquaculture Management Directorate, Fisheries and Oceans Canada, 200 Kent St., Ottawa, ON K1A

In 2008 the Department of Fisheries and Oceans announced a new grants and contributions program to bolster the Canadian aquaculture sector. Over the next five years $23.5 million will be made available for innovation and market access projects. The goal of this new program, the Aquaculture Innovation and Market Access Program (AIMAP), is to catalyze private sector and other investment in the aquaculture sector that will 1) improve the competitiveness of the Canadian aquaculture industry by encouraging an aquaculture sector that continuously develops and adopts innovative technologies and management techniques to enhance its global competitiveness and environmental performance; and 2) position Canadian aquaculture products as having high value in the market place based on their environmental performance, traceability and other considerations. This presentation will present an overview of program goals and guidelines, in addition to an update on funded activities to date.

Industrial Research Assistance Program Overview

C. Brown*

NRC-IRAP
Fisheries and Marine Institute
Box 4920, St. John's NL. A1C 5R3

The Industrial Research Assistance Program (IRAP) of the National Research Council of Canada (NRC) is a funding and technical assistance program designed to support innovation in Canadian small to medium sized enterprises (SME). IRAP's mandate is to support Canadian firms grow stronger, faster, and bigger through innovation. IRAP provides technical and business advisory services, networking and linkages to other organizations, Competitive Technical Intelligence (CTI) and financial assistance for projects.

ACOA Program - The Atlantic Innovation Fund (AIF)

G. Deveau

Atlantic Canada Opportunities Agency, 644 Main Street, Moncton, NB, E1A 6A3

Launched in 2001, the Atlantic Innovation Fund (AIF) is helping Atlantic Canadians compete in a global knowledge-based economy through the development of new ideas, products, businesses and markets. From the beginning, the AIF has acted as a catalyst for enhanced private-public sector research and development (R&D), investment and collaboration. The AIF is also playing a key role in encouraging the development of emerging clusters, such as aquaculture, information technology, life sciences, biotechnology, renewable and clean energy, oil and gas, and oceans technology. This presentation will present an overview of the AIF program and a summary of aquaculture project activities.

NSERC Programs – Encouraging Academic-Industry Collaborations

C. Vardy

NSERC-Atlantic, Moncton, NB E1A 7R1

The Natural Sciences and Engineering Research Council (NSERC) invests over $1 billion annually in people, discovery and innovation at universities and colleges across Canada. NSERC is one of Canada's largest sources of grants for public-private R&D partnerships. We invest more than $310 million each year to enable industry to work with university and college-based researchers and students to help businesses find solutions, innovate and grow. Our investments in innovation programs support more than 1,500 industry-academic R&D partnerships and the training of approximately 10,000 students. Our programs range from industry scholarships, project grants and Industrial Chairs to various kinds of network funding (e.g. the Canadian Integrated Multi-Trophic Aquaculture Network (CIMTAN). While our track record is strong, we know that we can do more to step up our game. About 20,000 companies in Canada conduct R&D. Many of them are small and medium-sized businesses that could easily double or triple their innovation capacity by engaging in collaborative projects with university and college researchers and students. We hope that you will consider us as your partner to extend your competitive edge. NSERC wesite: www.nserc-crsng.gc.ca.

Aquaculture potential of the basket cockle (*Clinocardium nuttallii*) in British Columbia, Canada: nursery and grow-out production phases

A. Epelbaum[1,2*], C.M. Pearce[1,2], N. Plamondon [1], S.Yuan[1], and H. Gurney-Smith[1]

[1]Vancouver Island University, Nanaimo, BC, Canada V9R 5S5; [2]Marine Ecosystems and Aquaculture Division, Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo, BC, Canada V9T 6N7

The aim of our research was to experimentally assess the feasibility of basket cockle aquaculture in British Columbia with an emphasis on growth performance and qualities affecting product marketability. First, we investigated the effects of stocking density and substratum on cockle seed survival and growth during the nursery phase. A stocking density of 50% monolayer bottom cover yielded a shell length increase from 3 to 7 mm over a 4-week period. A stocking density of 150% negatively impacted seed growth and condition, but did not significantly affect survival. Acclimating seed to the substratum prior to planting in the intertidal zone may increase burrowing rates, thereby reducing the risks of seed dislocation and mortality. We further evaluated *C. nuttallii* growth performance during the first two years in the intertidal and in off-bottom suspended grow-out systems under a range of stocking densities and culture depths. In the first year, *C. nuttallii* demonstrated superior growth and condition in off-bottom suspended compared to intertidal culture, while exhibiting a number of qualities positive from a standpoint of product marketability. However, during the second year in suspended culture suboptimal survival, shell deformities, and heavy fouling were observed. Depending on a grow-out scenario and harvestable size chosen, cumulative harvestable proportion constituted 15.1 to 63.1% of the seed planted.

Effects of net pen aquaculture on a lake ecosystem: results from the ELA Aquaculture Project

C.L. Podemski[*1], P.A. Azevedo[1], P.J. Blanchfield[1], D. Findlay[1], K.A. Kidd[2], M. Kullman[2], K.H. Mills[1], M.J. Paterson[1], R.C. Rooney[3] and M. Wetton[3]

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[3] Department of Entomology, University of Manitoba, Winnipeg, MB R3T 2N2

In Canada, the freshwater cage industry is relatively small compared with the marine counterpart, but future growth is anticipated and regulation of the industry requires an understanding of potential impacts to the freshwater environment. From 2003-2007, researchers operated a 10 tonne/yr all-female rainbow trout (*Oncorhynchus mykiss*) cage in Lake 375, a 23ha lake at the Experimental Lakes Area. Changes in water quality, phytoplankton production, zooplankton, sediment characteristics and benthic invertebrate communities were monitored. Total production of phytoplankton increased but this

increase was largely due to a bloom occurring during spring turnover, and the response was smaller than has been observed to result from similar P loading to other boreal lakes. There was relatively little change in zooplankton, while the benthic community and sediment chemistry near the farm responded rapidly to settling waste. Stable isotopic signatures of zooplankton, benthos and fish indicated that the native foodweb was incorporating waste material, and the abundance of forage fish and the population size, condition and recruitment of lake trout (*Salvelinus namaycush*) show evidence of this subsidy. Escapees from the farm were monitored through the use of acoustic telemetry to determine survival and spatial distribution after release. The presentation will provide an overview of changes observed during five years of farm operation and the first year of recovery.

Video Premiere. Fisheries and Oceans Canada: Aquaculture Science Research

Scientific research plays a key role in sustainable aquaculture development in Canada, and Fisheries and Oceans (DFO) scientists are dedicated to innovative research. On-going research is contributing scientific certainty with respect to aquaculture operations and how they interact with the aquatic environment, and our work with the industry positioning the Canadian aquaculture industry in a more competitive position globally. Research into the environmental effects of aquaculture is providing a solid scientific foundation for the conservation and protection of fish and fish habitat in marine and freshwater ecosystems. In collaboration with industry partners, DFO's efforts have also been directed towards aquatic animal health research to understand how best to prevent, mitigate and treat disease. As species diversification is often seen as a means of increasing Canada's global market share, we have invested research into new species development. Additionally, research into helping to create and define the best performing production systems has resulted in innovative developments that have increased our industry's competitiveness. This video was developed by DFO, with the support of the Aquaculture Collaborative Research and Development Program (ACRDP) National Steering Committee, the Aquaculture Science Branch at DFO and DFO Communications to highlight the research activities of our scientists that have been funded through the ACRDP and the Program for Aquaculture Regulatory Research (PARR). It is only a cross-section of the literally hundreds of projects and people that have contributed to the success of DFO's Aquaculture Science Program.

International Mussel Forum

Tuesday, May 18, 2010 – mardi 18 mai, 2010
2:00 PM – 5:30 PM
Location: Salon E/F

Chair:

2:00 Bonardelli, J.
Effective technologies increase mussel yields

2:20 Lindell, S.
Pilot-scale commercial offshore mussel farming in New England

2:40 Granter, T.
Enhancing sustainable mussel industry production and growth through assessment and removal of constraints in seed supply

3:00 Arsenault, J.
Spatial characterization of particle depletion by the blue mussel (*Mytilus edulis*) at open-water, integrated multi-trophic aquaculture sites

3:20 HEALTH BREAK

3:50 Reid, G.
Absorption efficiency of Atlantic salmon (*Salmo salar*) feed and fecal particulates by blue mussels (*Mytilus edulis* and *M. trossulus*): implications for integrated multi-trophic aquaculture

4:10 Reid, G.
Preliminary investigation of current flow through a 'Polar circle' mussel raft, at an Integrated Multi-Trophic Aquaculture site

4:30 Bakker, J.
Variation in shell strength among cultured and natural *Mytilus* populations in the Quoddy region, NB

4:50 Panel Discussion

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award

Effective technologies increase mussel yields

J. Bonardelli*

Shellfish Solutions AS, *Helping producers grow in value* (www.musseltalk.com)

We are always looking for a better way to increase our commercial yields. For growers to obtain the highest returns, they need to implement grow-out strategies that can maximize yields and quality, in order to satisfy the demands by processors and to minimize post-harvest waste. We hold the perception that more lines should provide more volume, but some European mussel growers are producing more efficiently with less, to maximize their commercial yields. While access to space, water depth and food availability are key factors for increasing production volume and market quality, it's possible to demonstrate, through proper sampling techniques, that production biomass on mussel longlines can be significantly improved with more effective equipment. With a peek at practical examples from Ireland, Norway and Denmark, some field-tested methods highlight how the use of adapted floatation, quality socking, improved declumping and timely husbandry, can pave the way for increased production biomass without excessive effort.

Pilot-scale commercial offshore mussel farming in New England

S. Lindell*, G. Mataronas, M. Marchetti, S. Stephens, R. Karney, B. Silkes, J. Murt, K. Maloney, J. Simmons, and R. Langan

Marine Resources Center, Marine Biological Laboratory, 7 MBL St., Woods Hole, MA 02543 USA

We have completed our first field season to investigate the potential of offshore mussel farming in southern New England while avoiding parasitic infestation by pea crabs *Pinnotheres maculatus.* To mimic longline sites on an economical test scale during this first year, mussels were grown on vertical grow-ropes on single-point moorings at 13 sites in RI and MA. We sampled biweekly in 2008 from September until December (the period of larval pea crab infestation) and again in the April 2009 to test the hypothesis that mussel seed transferred to and grown offshore can escape pea crab infestations. The figure below shows the sites that mussel seed was collected and the final rate of infestation over the 8 months they were monitored. The rate of infestation by pea crabs was low at all sites with only one site more than 5%. Two sites in Massachusetts (Aquinnah and S.E. Chilmark) and two in RI (WHOJ buoy farm and E. Block Island) had less than I % infestation. Past market surveys have suggested than mussels should be marketable if the incidence of pea crabs is less than 5%. Mussels in all offshore locations grew at a rate of 5mm per month suggesting that 15 to 20mm seed transplanted offshore in June could supply a robust market the following summer. Two commercial-scale longlines were deployed in Rhode Island in the summer of 2009 and two more will be

deployed in Massachusetts using novel "stingray" anchors. Results of how these longlines have been managed and their prospective yield will be presented.

Enhancing sustainable mussel industry production and growth through assessment and removal of constraints in seed supply

T. Granter*, C. Dawe, K. Best and T. Brown

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This presentation provides an update on the ongoing project activities for the 2009-2010 field season. The mussel seed project has been ongoing for 4 years in Placentia Bay, Notre Dame Bay and Bonavista Bay. The focus of the 2009-2010 project has been 5 sites in Bonavista Bay and one site in Harry's Harbour area which were selected based on previous results. This past year also included a mussel seed transfer from two Bonavista Bay sites, one Harry's Harbour site, commercial seed and Placentia Bay seed into an existing Placentia Bay farm site.

Spatial characterization of particle depletion by the blue mussel (*Mytilus edulis*) at open-water, integrated multi-trophic aquaculture sites

J.A. Arsenault*[1,2], S.M.C. Robinson[1], B.A. MacDonald[2]

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Integrated Multi-Trophic Aquaculture (IMTA) is an ecosystem-based approach where the waste of one cultured species can become the nutritional inputs for another as a means to promote sustainable aquaculture practices. The purpose of this study is to understand the spatio-temporal dynamics of particle depletion by an extractive species such as *Mytilus edulis* that removes particulate organic matter within an IMTA system. A potentially powerful tool to quantify seston uptake is the LISST-100X (Laser *In-Situ* Scattering and Transmissometry) which measures particle size distributions (2.5 – 500 µm) based on laser diffraction. Laboratory tests were conducted for calibration purposes and revealed that these *in situ* instruments are effective tools in quantifying particles within certain size ranges and concentrations. Some preliminary deployments were done to characterize particles at the inflow, centre, and outflow of mussel cages adjacent to unoccupied salmon net-pens. Although particle biomass was concentrated in the larger size spectrum, particle numbers dominated the smaller size range; therefore, large amounts of non settleable particles are present and readily available for suspension-feeding organisms. Moreover, differing trends were observed between the three fixed positions of the mussel cage. Data will offer valuable insight into understanding the bio-mitigation capabilities of the blue mussel within ecosystem-based aquaculture systems.

Absorption efficiency of Atlantic salmon (*Salmo salar*) feed and fecal particulates by blue mussels (*Mytilus edulis* and *M. trossulus*): implications for integrated multi-trophic aquaculture

G.K. Reid [1,2], M. Liutkus[1,2], A. Bennett [3], S.M.C. Robinson [2], B. MacDonald [1], and F. Page [2]
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Data on the absorption efficiency (AE) of salmon feed 'fines' or salmon feces consumed by blue mussels is limited, but is crucial for determining organic load delivery in open-water Integrated Multi-Trophic Aquaculture (IMTA) systems. The AE of a commercial spat formula (*Phaeodactylum tricornutum*, *Chaetoceros-B*, and *Nanochloropsis oculata*), a commercial diatom diet (*Thalassiosira weissflogeii*), salmon feed, salmon feces, and total particulate matter (TPM) at salmon cages; averaged 87, 81, 90, 86, and 54%, respectively. In the laboratory trials, there were no significant differences ($p = 0.072$) of fecal organic content (OC) between mussel size classes fed the same diet. In the field trials, increases in TPM were accompanied by an increase in TPM ($r^2 = 0.76$), but a decrease in OC ($r^2 = 0.87$), suggesting periods of particle flux with largely inorganic make up (e.g. silt). Consequently, mean values of OC and AE of TPM at salmon cages was less than what would be expected if mussels were ingesting significant portions of salmon particulates. The results of this study emphasize the temporal/spatial variation of 'particle plumes' exiting fish cages is a major consideration for the placement of suspension or filter feeders at open-water IMTA sites. However, the AE data presented suggests that organic material in particulate salmon culture waste can effectively be utilized by blue mussels.

Preliminary investigation of current flow through a 'Polar circle' mussel raft, at an Integrated Multi-Trophic Aquaculture site

G.K. Reid[1,2], C.A. Moore[2], and S.M.C. Robinson[2]

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Blue mussels (*Mytilus edulis)* are commonly cultured with Atlantic salmon (*Salmo saltar*) at Integrated Multi-trophic Aquaculture sites in the Bay of Fundy. Mussel rafts are constructed from 'recycled' salmon cages ('Polar circles'), but little is known about water flow dynamics with this atypical configuration. Three current meters were deployed

between mussel lines (5m depth) within a mussel circle, located between 'open-water' and two rows of salmon cages. The flood-tide entered the mussel circle from the 'open-water' side, and the ebb-tide crossed two salmon cages prior to inflow. Mean current speeds were highest at the 'open-water' side and during flood tides at all locations, suggesting some 'dampening' of inflow water by salmon cages, which occurred in conjunction with a natural reduction in ebb-tide flow. This suggests particles from salmon cages may 'arrive' slower, at less variable rates than natural seston from the 'open-water' side. Directional data suggests current was 'deflected' by mussel socks; facilitating water flow between mussel lines. Further results suggested flow velocity change may be a function of initial flow speeds and number of mussel lines crossed. Implications for site design and directions for further study are discussed.

Variation in shell strength among cultured and natural *Mytilus* populations in the Quoddy region, NB

J. Bakker*[1] and S. Robinson[2]

[1]Department of Earth Sciences, University of Ottawa, Ottawa, ON, Canada, K1N 6N5
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The suggested biological mechanism for maximizing growth rates of blue mussels through suspended culture is increased resource allocation toward somatic growth rather than shell growth. The bivalve shell is the primary defense mechanism against predators and allows mussel harvesting and processing activities to occur with minimal damage to the final product. This study examines differences in the shell strength of blue mussels among geographically clustered cultured and natural sites in the Passamaquoddy Bay region of the Bay of Fundy, New Brunswick. Preliminary tests found that shell strength varied with water content for shells of similar size. Shell strength of wet shells (1-6 cm) of a presumed *Mytilus edulis – Mytilus trossulus* complex was tested with a texture analysis system (Zwick Materials Tester). A linear relationship was established between shell size and shell strength. Differences in shell strength were present over a range of shell sizes and shell strength varied significantly among sites, with a tendency for natural sites to have greater shell strengths. Notably, shells strengths at a cultured site with imported spat had significantly weaker shells than all of the other sites. Whether the observed differences in shell strength are important on an industrial scale will be discussed.

Aquaculture Genomics & Genetics

Wednesday, May 19, 2010 – mercredi 19 mai, 2010
8:30 AM – 10:10 AM
Location: Salon B

Chair: Sharen Bowman

8:30 Garber, A.
Overview of the Atlantic Cod Genomics and Broodstock Development Project (CGP)

8:50 Bowman, S.
Applying genomics to the analysis of traits in Atlantic cod

9:10 Booman, M.
Development of an Atlantic cod (*Gadus morhua*) oligonucleotide microarray and its validation in a study of cod spleen global gene expression responses to stimulation with formalin-killed atypical *Aeromonas salmonicida*

9:30 Hori, T.
Red spot, green spot: Using DNA microarrays to investigate the immune and stress responses of Atlantic cod (*Gadus morhua*)

9:50 Mirimin, L.
Development and application of genetics and genomics tools to the EIRCOD project: a breeding and broodstock programme for Atlantic cod in Ireland

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award

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Overview of the Atlantic Cod Genomics and Broodstock Development Project (CGP)

M. Rise[1, 2], A.K. Gamperl [2], S.C. Johnson [3], M.L. Rise [2], A. Robinson[4], K. Culver[5], M. Booman[1,2], T. Borza [1], A. Garber*[6], S. Hubert [7], J. Tosh[4], L. Afonso[8], D. Boyce [2], D. Hamoutene[9], L. Lush [9], S. Neil [10], J. Symonds[11], I. Butts[10,12], C.Y. Feng[2], T. Hori[2], J. Perez-Casanova[2], E. Shine[4], C. Hastings[4], J.R. Hall[2], B. Higgins[1], J. Kimball[13], G. Simpson[1], C. Stone[1], J. Tarrant Bussey[1], J. Elliot[14], J. Moir[15], G. Nardi[16], F. Powell[14], A. Walsh[15], E.A. Trippel[10], S. Bowman[1]

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[12] University of New Brunswick, Saint John, New Brunswick, Canada
[13] Institute for Marine Biosciences, National Research Council of Canada, Halifax, NS
[14] Cooke Aquaculture, Blacks Harbour, New Brunswick, Canada
[15] Newfoundland Cod Broodstock Company, St. John's, Newfoundland and Labrador, Canada
[16] GreatBay Aquaculture, Portsmouth, New Hampshire, U.S.A.

The objective of the CGP (www.codgene.ca) is to develop breeding programs and fundamental genomics tools to supply the developing Atlantic cod aquaculture industry in Canada with improved broodstock. Four and five major spawning seasons have been completed in New Brunswick/New Hampshire and Newfoundland respectively, and the breeding programs have incorporated elite broodstock as parent fish. Evaluations of progeny include assessment of family performance related to growth and overall health. In addition, investigations related to cod physiology and immunology were conducted. Considerable variation among families in growth, tolerance to elevated temperatures and stress has been observed. Preliminary heritability estimates suggest that the breeding programs will be successful at selecting fish for improved performance. In addition the CGP has dramatically improved the availability of genomic resources for this species. Approximately 158,000 sequences have been submitted to GenBank. A 20,000 element oligonucleotide microarray has been printed and tested. Development of gene-linked markers and a high density genetic map has been achieved. In addition, social scientists

have examined ethical, environmental, economic, legal and social issues related to the CGP. Resources developed by the CGP will enable marker assisted selection, and provide valuable tools for Atlantic cod research.

Applying genomics to the analysis of traits in Atlantic cod

S. Bowman[1*], T. Borza[1], B. Higgins[1], S. Hubert[2], G. Simpson[1], C. Stone[1], C. Hastings[3], G.E. Vander Voort[3], A. Garber[4], M. Booman[5], M. Rise[5], E. Trippel[6], M. Rise[5] and A. Robinson[3].

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The "Atlantic Cod Genomics and Broodstock Development" project (CGP) has generated large-scale genomic resources for Atlantic cod, including 158,000 expressed sequence tags, 1,700 validated, polymorphic single nucleotide polymorphisms (SNPs) and a 20,000 element oligonucleotide microarray (www.codgene.ca). The SNP set developed by the CGP has been used to generate a high-resolution genetic linkage map for Atlantic cod. This map has 23 major linkage groups, corresponding to the number of chromosomes most frequently reported for this species, with 924 mapped SNPs. A second-generation Illumina Golden Gate panel comprising 1,536 validated SNPs selected from the original SNP set is currently being applied to the identification of quantitative trait loci in this species. The traits included in this analysis are important for commercially viable aquaculture of Atlantic cod and include growth, disease resistance and temperature tolerance. Fin clips from which DNA was extracted for QTL analysis were collected during large-scale harvest evaluation of three year old fish, with multiple phenotypic measurements taken including weight, length, condition factor, fillet weight, sex and maturation status. Additional samples from temperature and pathogen challenges have also been genotyped for this study. Progress towards identifying markers linked to traits of commercial importance in Atlantic cod will be reported.

Development of an Atlantic cod (*Gadus morhua*) oligonucleotide microarray and its validation in a study of cod spleen global gene expression responses to stimulation with formalin-killed atypical *Aeromonas salmonicida*

M. Booman*[1], T. Borza[2], T.S. Hori[1], C.Y. Feng[1], B. Higgins[2], J.R. Hall[1], M. Rise[1], A.K. Gamperl[1], S. Hubert[2], J. Kimball[3], S.C. Johnson[4], S. Bowman[2], M.L. Rise[1]

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[4]Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo, BC, V9T 6N7 Canada

The Atlantic Cod Genomics and Broodstock Development Project (CGP) has generated a collection of ~160,000 Atlantic cod ESTs (assembled into ~50,000 unique sequences) from 23 normalized and 19 SSH libraries, representing 12 tissues and 4 developmental stages. The SSH libraries were generated using samples from fish exposed to stress or immune stimuli. From this EST collection, representative sequences were selected for the construction of a 50-mer oligonucleotide microarray containing 20,000 elements. Selection criteria included significant BLAST annotation and a high degree of representation. Unannotated cDNA sequences from the SSH libraries were also included to represent unknown genes (i.e. lacking significant BLAST hits) with putative functions in stress or immune responses. Small pilot experiments using tissues from cod injected with viral mimic poly (I:C) or cod with asymptomatic nodavirus infection confirmed there were no systematical errors in array layout and probe design and that different chemistries can be used with the array. Currently we are performing a 40-slide experiment investigating the transcriptome responses of cod spleen to stimulation with formalin-killed atypical *Aeromonas salmonicida.* Results will be compared to an SSH study that used the same cod spleen samples. This experiment will be the definitive validation of the CGP 20K microarray platform.

Red spot, green spot: Using DNA microarrays to investigate the immune and stress responses of Atlantic cod (*Gadus morhua*)

T.S. Hori*[1], M.L. Rise[1], S.C. Johnson[2], M. Booman[1], S. Bowman[3], A.K. Gamperl[1]

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[2]Pacific Biological Station, Department for Fisheries and Oceans, Nanaimo, BC
[3]The Atlantic Genome Centre, Halifax, NS

Stress and disease are among the most important challenges faced in the sea-cage aquaculture of Atlantic cod (*Gadus morhua*). In order to contribute to this economically relevant emerging industry, the Genome Canada funded Cod Genomics and Broodstock Development Project (CGP) has generated tools that can be used to better understand the

biology of Atlantic cod. One of these tools is a 20,000 gene (20K) oligonucleotide (oligo) Atlantic cod microarray platform. The oligos used to construct this microarray were designed based on ~ 150,000 expressed sequence tags (ESTs) generated by the CGP. Here we present preliminary data on how the cod 20K microarray can be applied. These studies were designed to characterize the global gene expression responses of cod tissues (spleen, liver and brain) to environmental stress (e.g. heat stress similar to that encountered by cod at cage-sites during summer) and/or immune stimuli (e.g. intraperitoneal injection of the viral mimic polyriboinosinic polyribocytidylic acid or bacterial antigens). Genes and molecular pathways identified in these 20K microarray studies are likely to play important roles in stress and disease resistance, and therefore, could lead to the development of markers for the selection of elite (i.e. stress and/or disease resistant) broodstock.

Development and application of genetics and genomics tools to the EIRCOD project: a breeding and broodstock programme for Atlantic cod in Ireland

Mirimin, L.*, Carlsson, J., Norris, A., McGinnity, P., Cross, T.F., FitzGerald, R.

The EIRCOD project is a seven years (2008-2014) programme aimed primarily at the establishment and operation of an Atlantic cod breeding and broodstock programme specifically designed for the Irish environment and the developing cod farming industry. Among numerous objectives of the project, the application of molecular technologies plays an important role in the project and will aid (i) the development and validation of novel genetic markers for the study of wild and captive Irish cod stocks, including the employment of novel high throughput sequencing technologies for marker discovery with particular attention to SNPs and microsatellites; (ii) supporting of the breeding and broodstock programme by monitoring survival, health and performance of extant family/strain groups; (iii) and gene and genome analyses to investigate gene/marker association to traits of economical and ecological importance. Progress to date includes the establishment of sampling, storage and routine genetic screening procedures of extant stocks, while discovery of markers suitable to the study of Celtic Sea genetic variability is currently ongoing. While the EIRCOD project focuses primarily on Irish cod stocks, the establishment of links and collaborations to other ongoing cod breeding/broodstock and genomics programmes throughout the species distribution range is paramount to the study of the organism genomic resources and will aid the effectiveness of Atlantic cod aquaculture.

Moving Aquaculture Forward

Wednesday, May 19, 2010 – mercredi 19 mai, 2010
8:30 AM – 10:10 AM
Location: Salon C/D

Co-Chairs: Alistair Struthers and Corina Busby

8:30 Frechette, M.
Production dynamics, self-thinning and profitability of blue mussel populations reared in suspension culture in Cascapédia Bay

8:50 Sonier, R.
Research in support of shellfish farm management

9:10 Glebe, B.
Phototherapy: applications for growth enhancement and maturation delay in farmed Bay of Fundy Atlantic salmon (*Salmo salar)*

9:30 Hamoutene, D.
The Cod Broodstock Nutrition Study: Effect of 3 diets on fish general physiology and reproductive performance.

9:50 Pearce, C.
Assessing potential habitat impacts of geoduck clam (*Panopea generosa)* aquaculture and harvesting in British Columbia

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award

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Production dynamics, self-thinning and profitability of blue mussel populations reared in suspension culture in Cascapédia Bay

M. Fréchette[1], J.R. Wilson[2], F. Bilodeau[2] and M. Lachance-Bernard[1,3]

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[3] Département de Biologie, Université Laval, Québec, QC, G1K 7P4.

Part-time mussel farming might be an interesting way for fishers to diversify activities. This can be achieved by growing mussels on spat collectors, bypassing spat sleeving. However, this implies that population density is no longer a control variable for profit-minded producers, and intraspecific competition is exacerbated. Therefore, we explore the profitability and production dynamics of mussel culture on collector ropes. We randomly sampled 30.5-cm lengths from triplicate collectors sampled at two depths from October 2003 through July 2007. In addition to biomass and population density, we monitored size structure, length-mass relationships of individual mussels, multilayering of mussels, proportions of bare substrate, depth of the mussel lines and water temperature. Production costs were estimated on the basis of information from the mussel growers. Using modifications of Faustmann rotation methodology, we found positive profits at the standard terminal period in Quebec of 36 months, with 2.2 kg/30.5 cm rope. Production dynamics were governed by self-thinning, but this constraint was not as binding on profitability as we thought. At harvest, the macrobenthic community colonising the ropes consisted in mussel monocultures except for bare space on the buoys, which supported anemones and sea stars. A follow-up study showed that individual growth was density-independent.

Research in support of shellfish farm management

R. Sonier, A. Leblanc, L. Comeau and T. Landry

Department of Fisheries and Oceans Canada, Gulf Region,
Aquaculture and Coastal Ecosystems Section, 343 Université Ave. Moncton, N.B., E1C 9B6

The aquaculture industry in eastern Canada is based mainly on two species, the blue mussel and the American oyster. However, with their high market value, alternate species research and development for aquaculture diversification increased during the last decade for species such as the soft shell clam, the quahaug and the bar clam. A sustainable shellfish farm needs scientific input on the benthos as well as the water column. Endobenthic species culture has not yet attained a level of sustainability due to issues such as slow growth and erratic mortalities often attributed to limiting environmental factors and experimental husbandry techniques. Thus it is important to know the

conditions of the site and obtain background information (population distribution, diseases, benthos chemistry). For surface and bottom cultured species, water characterisation using currents, phytoplankton distribution and production, tides and bivalve filtration rates are crucial for assessing carrying capacity. For instance, chlorophyll-a mapping in shellfish farms is a great tool to obtain a snapshot of food availability. These expertises are essential in optimizing farm productivity while minimizing impacts on the environment and other users of the water mass and are the first steps towards a co-management plan of shellfish farms between DFO and the industry.

Phototherapy: applications for growth enhancement and maturation delay in farmed Bay of Fundy Atlantic salmon (*Salmo salar)*

B.D. Glebe*[1], P.R. Harmon[1], R.H. Peterson[1] and A.J. Manning[2]

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Maturation (grilsing) rates in farmed salmon steadily increased from less than 1% in 1978 (average among the first salmon farms) to greater than 30% at some farming sites in 2001. This change resulted in significantly reduced farm gate sales and prompted the industry to give high priority to research into methods to decrease grilsing. In 2001, a study on the effect of artificial photoperiod on grilsing rates was initiated at two commercial salmon farms. During the first month, specific growth rates decreased in the November lit cages. However, by the end of May, November lit cages showed significantly higher growth rates than the control cages. At the first farm, only 1% of the salmon in the November lit cages matured compared to11% and 21% of the fish in the February lit and unlit control cages respectively. On the second farm, 5% of the salmon from the October lit cages matured compared to 17.5% in the control cages. An economic benefit analysis of the improved growth and delayed maturation due to the use of an artificial photoperiod showed a saving of up to $100,000 per cage (based on the November photoperiod adjustment and assuming a cost of lighting equipment purchase and operation of $5,000 per cage). A more recent study (2007), involving four farms, confirmed the effectiveness of light treatment for reducing grilsing in salmon and that initiation of constant lighting as late as December was as effective as initiation in October. Also, melatonin monitoring by ELISA was proven valuable for assessing photoperiod regime effectiveness during critical periods for maturation onset in salmon.

The Cod Broodstock Nutrition Study: Effect of 3 diets on fish general physiology and reproductive performance.

D. Hamoutene[*1] L. Lush[1], J.C. Perez-Casanova[1], K. Burt[1], M. Clarke[1], S. Kenny[1], D. Drover[1], A.Walsh[2], and J. Moir[3]

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[3]Newfoundland Cod Broodstock Company, PO Box 296, St John's, NL, A1C 5J2.

Our project aims to determine the influence of diets on the spawning and growth of first generation (F1) cod broodstock by testing three diets on photomanipulated F1 broodstock hatched in 2006. One group is fed a commercial on-growing pellet, a second group an experimental manufactured pellet formulated for marine finfish broodstock, and the third one is fed the current standard diet of baitfish supplemented with vitamins. Feeding trials commenced in late August 2008. Results already presented show that fish fed baitfish have better growth and condition factor than fish fed pelleted diets. Results of the previous spawning (Feb 2009) revealed no differences in egg quality between diets but higher sperm quality in males fed baitfish. The latest observations show higher fertilization in the groups receiving the baitfish and the broodstock diets while hatch rates are higher in the baitfish group only. Moreover, quick evaluation of sperm performance shows higher quality in both broodstock and baitfish fed males. Our results suggest that the broodstock experimental diet may contribute to increased reproductive performance though the golden standard remains the baitfish diet. Data on synchronicity of spawning and cod blood analyses will also be discussed.

Assessing potential habitat impacts of geoduck clam (*Panopea generosa)* aquaculture and harvesting in British Columbia

L. Sauchyn, J. Blackburn, L. Keddy, S. Williams, and C.M. Pearce*

Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo, British Columbia, Canada V9T 6N7

The geoduck clam, *Panopea generosa*, is the largest burrowing clam in the world and adults of this species live a metre or more below the sediment surface. In order to extract these clams, harvesters use high-pressure water hoses to liquefy the surrounding sediment. High density culture of clams and/or harvesting to a depth of a metre or more could have profound effects on the local benthic environment, but little research has examined this issue. We seeded a small-scale (3 x 20 m) intertidal plot with juvenile clams at a commercial density and harvested them a year later using industry standard techniques. We took sediment samples within the harvest zone and at varying distances from the area of impact (5, 10, 25, 50 m) at various time points (ranging from a month

prior to seed out-planting through to 12 months post-harvest). We examined various sediment qualities (grain size, percent organics, total organic carbon, total nitrogen, sulphide concentration, and redox) as well as infaunal diversity and numbers. Results show that many of the measured variables were not significantly affected by either the culture or harvesting processes. Any significant effects of harvesting were generally short-lived and/or near field. Current research is examining the potential effects of larger-scale harvests – both in the intertidal (15 x 30 m plot) and subtidal (60 x 100 m plot) – on turbidity levels, sediment characteristics, and nearby eelgrass beds.

International Mussel Forum

Wednesday, May 19, 2010 – mercredi 19 mai, 2010
8:30 AM – 10:10 AM
Location: Salon E/F

Chair:

8:30 **Robert, P.**
How much is too much? Dose-dependent response of the benthic environment to biodeposition from suspended blue mussel (*Mytilus edulis*) culture.

8:50 **Mussel Industry Council of North America**
What are sustainability indicators for mussel production?

9:10 **TBD**
The European view of mussel farming sustainability

9:30 **TBD**
The view from South America on mussel farming sustainability

9:50 **Panel Discussion and Forum Conclusion**

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award

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How much is too much? Dose-dependent response of the benthic environment to biodeposition from suspended blue mussel (*Mytilus edulis*) culture.

P. Robert*[1], P. Archambault[1] and C. W. McKindsey[2]

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Bivalves are known to increase sedimentation of organic matter locally when they are concentrated for aquaculture. This enrichment can influence macrofaunal benthic community structure as well as biogeochemical fluxes across the sediment-water interface. The scale of the modifications could vary with the density of bivalves being farmed. An *in situ* experiment was done from May to September 2009 in Havre-aux-Maisons Lagoon, Îles de la Madeleine, Québec, to test the density-dependent effects of the blue mussels *Mytilus edulis* on biogeochemical fluxes and benthic communities. In a site that was never occupied by a mussel farm, scuba divers installed 40 benthocosms that received biodeposition from 8 mussel densities (0 to 1400 mussels/m^2) and compared these to controls (n=5 replicates). Dark benthic chambers where used to measure oxygen consumption and ammonium, phosphate, nitrate and silicate fluxes within the benthocosms. Trends in ammonium fluxes show a decrease as mussel density increases. Results for other biogeochemical fluxes and benthic community structure will be presented. The results will be useful for predictive environmental carrying capacity models and encourage new sustainable aquaculture projects.

Integrated Multi-Trophic Aquaculture

Wednesday, May 19, 2010 – mercredi 19 mai, 2010
8:30 AM – 10:10 AM
Location: Salon A

Chair: Chris Parrish

8:30 **Blair, T.**
Evolution of IMTA: Is salmon feed enough?

8:50 **Both, A.**
Physical and biochemical properties of particles released from an onshore Atlantic cod *Gadus morhua* aquaculture facility in the context of integrated multi-trophic aquaculture

9:10 **Lander, T.**
The use of tracer, biological and biochemical techniques to evaluate the use of salmon farm derived particles by blue mussels at IMTA sites.

9:30 **Reid, G.**
The biomass ratios of seaweeds required to sequester the soluble inorganic nutrient load per unit growth of cultured Atlantic salmon in an open-water, Integrated Multi-Trophic Aquaculture (IMTA) system

9:50 **Hagen, N.**
Mussels on the IMTA-menu: the pale urchin advantage

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Evolution of IMTA: Is salmon feed enough?

T. Blair*[1], T. Lander[1], F. Salazar[2] and S. Robinson[1]

[1] St Andrews Biological Station, Fisheries and Oceans Canada, 531 Brandy Cove Rd, St Andrews, NB, E5B 2L9
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IMTA in Atlantic Canada has proven successful with the co-culture of salmon, mussels and kelp. Mussels and kelp are primarily extractive species which act as biofilters and provide an additional marketable product for the salmon farmer. In order to maximize the environmental benefits of an IMTA system, researchers and aquaculturists are now looking to fill additional niches, such as the benthic environment beneath the salmon cages. Through a comprehensive review, several candidate species have been proposed to fill this niche. However, the nutrient requirements of these candidate species have not yet been considered. What do we know about the nutrient requirements of these species? Can they thrive without additional nutrient inputs into the system?

Physical and biochemical properties of particles released from an onshore Atlantic cod *Gadus morhua* aquaculture facility in the context of integrated multi-trophic aquaculture

A. Both*[1], C. Parrish, R. Penney, R. Thompson.

[1]Ocean Sciences Centre, Memorial University of Newfoundland, St. John's, Newfoundland and Labrador, Canada, A1C 5S7

To evaluate fish effluent as a food source for integrated multi-trophic aquaculture, particles released from an onshore aquaculture facility growing juvenile Atlantic cod (*Gadus morhua*) were collected. Sizes and particle numbers were determined with image analysis and a Coulter Multisizer. Samples for dry weight, lipids, amino acids and dissolved organic carbon were taken. The effluent was filtered into three size fractions >500 µm, 70-500 µm and <70 µm which comprised 38%, 34% and 28% respectively of the dry mass. Particle diameter varied from 1 µm to 2.4 mm and the majority of particles were in the 0.1 to 49 µm range. Particles >500 µm and <70 µm had settling rates of 0.04 cm/sec and 0.02 mm/sec respectively. The top three lipid classes were free fatty acids (35.5±8.5%), phospholipids (21.9±7.7%) and triacylglycerols (15.3±4.9%). The main fatty acids were 16:0, 18:1ω9, 14:0, 16:1ω7, 20:5ω3, 22:1ω11, 20:1ω9 and 22:6ω3 (36.4 – 2.6%). The omega-6 fatty acids AA and DPA were present in trace amounts only. Feeding experiments indicate mussels can survive on effluent alone; however performance will be better on an algal diet. The 28% of effluent available for mussel consumption is that which has a greater potential to spread to surrounding areas.

The use of tracer, biological and biochemical techniques to evaluate the use of salmon farm derived particles by blue mussels at IMTA sites.

T.R. Lander[1,2 *], S.M.C. Robinson[1], T. Blair[1], E. Beleya[2].

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[2]University of New Brunswick, Centre for Coastal Studies & Aquaculture, Centre for Environmental & Molecular Algal Research, P.O. Box 5050, Saint John, NB E2L 4L5, Canada

The ability of *Mytilus edulis* to act as an appropriate biofilter of finfish wastes in an integrated multi-trophic aquaculture (IMTA) system depends on the suitability of farm organic output as a food source for the organism, as well as the degree to which the allochthonous source is selected and ingested compared to autochthonous organic matter. Mussels grown in IMTA systems may gain a more abundant food supply via augmentation of their natural diet resulting in enhanced growth and better condition throughout a grow-out cycle. Satable Isotope (SI) and fatty acid (FA) profiling are two techniques used to determine if organisms in integrated systems are consuming salmon originated food particles. The ability of fatty acid profiling to mark predator-prey relationships is based on the observation that marine primary producers develop certain fatty acid profiles which are transferred conservatively to the consumer and hence prey type will be reflected in the its tissue fatty acid profile. Similarly, organic carbon and nitrogen discharged from salmon farms should have different isotopic compositions compared to those of marine autochthonous matter and the relative contributions of both sources to an organism's diet can be determined via an analysis of the isotopic composition of that organism. Measures of growth and condition in mussels include morphometric measures, quantification of biological storage compounds as well as elemental analyses. The goal of this study was to examine SI, FA, biological, biochemical and elemental indices of IMTA mussels to determine relative use of salmon derived particles over an 18 grow out month period. Findings will be presented and discussed in full during the oral presentation.

The biomass ratios of seaweeds required to sequester the soluble inorganic nutrient load per unit growth of cultured Atlantic salmon in an open-water, Integrated Multi-Trophic Aquaculture (IMTA) system

G.K. Reid[1,2*], T. Chopin[1], and S.M.C. Robinson[2]

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The amount of nutrient mitigation and recovery by co-culture species in open-water, Integrated Multi-Trophic Aquaculture (IMTA) systems depends on many factors and reporting potential mitigation values is often accompanied by significant qualifiers. Such complexities make this information difficult to use for site management and policy development. If it is reasonable to assume that nutrient recovery can be reported as the removal of equivalent soluble nutrients in harvested kelp biomass that have been sequestered from within the culture area *(i.e.* mass of soluble inorganic nitrogen, carbon, and phosphorus), and not necessarily the actual nutrients excreted from the upper trophic level, the use of growth ratios to quantify nutrient recovery enables an easier to understand and potentially more informative approach. The theoretical amounts of soluble inorganic nitrogen, phosphorus and carbon produced per unit growth of Atlantic Salmon (*Salmo salar*) are juxtaposed with the composition and biomass of the two kelps presently cultivated at the IMTA sites in the Bay of Fundy, Canada, *Alaria esculenta* and *Saccharina latissima*. Estimates of the seaweed biomass that would be required to sequester equivalent nutrient loads are presented. Likewise, the ratio of Atlantic salmon oxygen demand and kelp oxygen supply is also presented. These ratios are examined in the context of seasonal production, scale, species selection, acceptable mitigation levels and directions for future research.

Mussels on the IMTA- menu: the pale urchin advantage

N.T. Hagen*

Faculty of Biosciences and Aquaculture, Bodø University College, N-8049 Bodø, Norway

Waste mussels are a potential food resource in integrated multi-trophic aquaculture initiatives where sea urchins are included as high-value herbivores. Urchins feed primarily on seaweed, but do better on a mixed diet that includes a minor carnivorous component such as mussels. The urchins' capacity to feed on mussels is therefore a critical success-factor in such IMTA-initiatives. The green sea urchin *Strongylocentrotus droebachiensis*, and the closely related "pale" urchin *S. pallidus*, have overlapping diets but differ in their natural ability to utilize mussels. Here, I present experimental results showing that the pale urchin is an efficient mussel consumer, whereas the green urchin

has a limited capacity to consume intact mussels and is largely restricted to small mussels with minimal organic content. A superior ability to exploit mussels is a valuable trait which suggests that *S. pallidus* has the potential to become an important contributor to hatchery based sea urchin aquaculture, since only *S. droebachiensis* occurs in sufficient quantities to sustain commercial fisheries for gonad enhancement cultivation.

Aquaculture Genomics & Genetics

Wednesday, May 19, 2010 – mercredi 19 mai, 2010
1:30 PM – 3:10 PM
Location: Salon B

Chair: Sharen Bowman

1:30 **Chiasson, M.**
Quantitative trait loci (QTL) for body weight in Fraser strain Arctic charr (*Salvelinus alpinus)* reared in different environmental conditions

1:50 **Kuettner, E.**
Genetic architecture of economically important traits in aquaculture strains of Icelandic Arctic charr.

2:10 **Norman, J.**
The genetic basis of salinity tolerance in Arctic charr (*Salvelinus alpinus*)

2:30 **Seghouanl, H.**
Selection on brook charr (*Salvelinus fontinalis*): impact on reproductive success?

2:50 **Braden, L.**
Differences in immune gene expression due to *Lepeophtheirus salmonis* adult infection in Atlantic (*Salmo salar*), chum (*Oncorhynchus keta*) and pink (*O. gorbuscha*) salmon.

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Quantitative trait loci (QTL) for body weight in Fraser strain Arctic charr (*Salvelinus alpinus)* reared in different environmental conditions

M.A. Chiasson*[1], H.K. Moghadam[2], R.G. Danzmann[1], and M.M. Ferguson[1]

[1]Department of Integrative Biology, University of Guelph, Guelph, Ontario, Canada N1G 2W1
[2]Vetrinary Medical Center, Cornell University, Ithaca, New York, USA 14853

The identification of chromosomal regions related to commercially valuable traits such as growth are important because such information, when coupled with marker assisted selection (MAS) can be useful to increase productivity. The goal of the present study was to identify QTL for variation in body weight among multiple families of Arctic charr. Thirty full-sib families were produced at the Coastal Zones Research Institute. At a mean weight of 230g, 120 individuals from each family were PIT-tagged and transferred to a commercial facility (CanAqua) where they were grown communally in four 16m^3 tanks in both fresh (FW) and brackish water (BW) from May 2008 to September 2009. Wet weight and fork length was measured on four sampling dates. To test for QTL for variation in body weight, 12 microsatellite markers were selected from salmonid QTL studies. Overall survival and mean body weight of charr in FW tanks had the tendency to be greater than that of BW tanks. Preliminary analysis indicates that QTL for variation in body weight varies among families and environments. This indicates that some families have a genetic predisposition to perform better in different environments. Knowledge of QTL positions and relative family phenotypic performance is essential for the application of MAS on a commercial scale

Genetic architecture of economically important traits in aquaculture strains of Icelandic Arctic charr.

E. Kuettner[1*], H.K. Moghadam[1], S. Skúlason[2], M.M. Ferguson[1], and R.G. Danzmann[1].

[1]Department of Integrative Biology, University of Guelph, Ontario, Canada N1G 2W1
[2]Hólar University College, Sauðárkrókur, IS-551, Iceland

Traditional selection in aquaculture breeding programs is based on phenotype and pedigree information. However, some traits are strongly influenced by environmental effects or have low heritabilities making the estimation of breeding values difficult. Selection response for these traits could be improved through marker assisted selection. As a first step towards the implementation of this approach, we identified chromosomal regions (QTL) that control traits of economic importance, which could be used to increase the rate of genetic improvement in selective breeding programs. Whole genome scans were performed in six families from the Icelandic breeding program at the Hólar University College to identify QTL for body weight, condition factor and age of sexual maturation. About 100 microsatellite loci from known locations on the North American

Arctic charr genetic linkage map were used to detect QTL. Linkage arrangements are mostly conserved between the Icelandic and North American fish allowing comparisons of the genetic architecture between strains. Our data will provide important information on the genetic resources available for the selective breeding programs in both countries.

The genetic basis of salinity tolerance in Arctic charr (*Salvelinus alpinus*)

J.D. Norman[1]*, M.M. Ferguson[1], B.D. Glebe[2], R.G. Danzmann[1]

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Though freshwater (FW) culture is labour intensive and less economically viable than sea water (SW) culture, it is currently the primary means by which Arctic charr (AC) of adequate market size can be produced. Culture of AC in SW has historically been avoided because AC typically struggle to cope with high salinity and thus exhibit substandard growth and survivorship. When subjected to SW, however, a small proportion of individuals can grow and thrive as well as FW kin. Evidence suggests such variation is in part genetically based. The objective of this study was to identify the genomic regions containing salinity tolerance candidate genes in Fraser River strain AC. Identification of such regions will support the implementation of genome-based selection techniques. To this end we employed a genome scan approach, whereby genetic polymorphisms and SW phenotypes were tested for correlation. We found significant associations of multiple genomic regions with multiple SW phenotypes including growth, blood plasma osmolality, and Na^+,K^+-ATPase activity. A thorough search of the associated genetic markers may confirm previously identified candidate genes and potentially identify new candidate genes. Based on these results, the prospect of genome-based selection remains viable.

Selection on brook charr (*Salvelinus fontinalis*): impact on reproductive success?

H. Seghouani*[1], C. Audet[1] and N. Derome[2]

1 ISMER, Université du Québec à Rimouski, 310 Allée des Ursulines, Rimouski, QC, Canada G5L 3A1
2 Département de Biologie, Université Laval, Québec, QC, Canada G1V 0A6

The objective of this study was to evaluate the effect of selection for growth improvement and absence of early sexual maturation on the reproductive success of brook charr. In females, the seasonal profiles of plasma sex steroids (17ß-estradiol, testosterone), and vitellogenin production was compared between two lines, a control one (obtained from random crosses) and one issued from the selection program. At spawning time, relative fecundity, egg diameter (females), sperm counts and sperm quality (males)

were compared between the two lines. Different crosses were performed and percentage of fertilization, mortalities 24 h after fertilization and at hatch were also noted. For the selected line, we also compared the reproductive success of females raised in an aquaculture facility (Aquaculture Forestville) with constant temperature conditions all year-round and those maintained at ISMER (natural seasonal temperature variations). The selection had little effect on reproductive success. However, females maintained at constant temperature conditions produced smaller eggs containing less energy reserves available for embryo and fry development.

Differences in immune gene expression due to *Lepeophtheirus salmonis* adult infection in Atlantic (*Salmo salar*), chum (*Oncorhynchus keta*) and pink (*O. gorbuscha*) salmon.

L. M. Braden*[1], D. E. Barker[2], B. Koop[3], S. R. M. Jones[4]

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[2]Fisheries and Aquaculture Department, Vancouver Island University, Nanaimo, BC V9R 5S5
[3]Centre for Biomedical Research, University of Victoria, Victoria, BC V8W 2Y2
[4]Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo, BC V9R 5K6

It is widely accepted that there are differing susceptibilities to *Lepeophtheirus salmonis* (Copepoda: Caligidae) infection among salmonid host species that are presumed to involve differences in immune system regulation of the host. Sea lice are thought to suppress an inflammatory response in susceptible hosts by the activity of secretory and excretory products released at the attachment site, such as prostaglandin E_2 (PGE_2) (Fast *et al.* 2004). Differences in reaction to this compound result in the variable inflammatory responses elicited by different salmonid hosts. The aim of the present study was to compare immune gene expression patterns associated with adult *L. salmonis* infection between one susceptible (*Salmo salar*) and two somewhat resistant (*Oncorhynchus keta* and *O. gorbuscha*) salmonid species. Size-matched individuals from each species were experimentally infected with 5 mobile *L. salmonis*. Tissue samples from the louse feeding sites and non-feeding sites were extracted at 24 (n = 90) and 48 (n = 90). Expression levels of four immune-related genes (Interleukin-1β (IL-1β), tumour necrosis-factor α (TNF-α), and MHC I and II) as a function of sea louse feeding were determined and compared to expression of references genes β-actin, elongation factor 1α (eEF1α) and structural ribosomal protein S20 (RPS20).

Moving Aquaculture Forward

Wednesday, May 19, 2010 – mercredi 19 mai, 2010
1:30 PM – 3:10 PM
Location: Salon C/D

Co-Chairs: Alistair Struthers and Corina Busby

1:30 Kearney, E.
Evaluation and further development of the iCage ™ ish Containment System as a technology platform to meet sustainability and cost reduction targets

1:50 Perry, G.
Increased sustainable production through modification of the hydraulic systems used to handle blue mussel seed to increase productivity and reduce production costs

2:10 Stevenson, R.
Technology transfer, adaptation and implementation of Washington State mechanical clam harvesting technology to the BC shellfish farming sector

2:30 Morissette, S.
Amélioration de la productivité par la mécanisation et l'automatisation des opérations maricoles

2:50 Mallet, A.
Optimisation de la technique d'élevage des huîtres collées à l'horizontale

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award

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Evaluation and further development of the iCage ™ Fish Containment System as a technology platform to meet sustainability and cost reduction targets

G. Brown[1] and E. Kearney*[1]

[1] Admiral Fish Farms Ltd., Grand Manan, New-Brunswick, Canada, E5G 1G1

Admiral Fish Farms LTD. (AFF) has identified an innovative fish containment system being developed in New Brunswick that may contribute to the company's quest to reduce its ecological footprint relative to the use of anti-foulants, thereby increasing its sustainability "quotient" while making the company, and the Canadian Industry, more competitive in the marketplace. AFF is evaluating and assisting in the development of two full scale iCage ™ units over the course of 16 months at its farm site near Hardwood Island, New Brunswick. The results of this project will enhance the Company's (and the industry's) ability to grow as a producer of high quality, sustainably farmed seafood.

Increased sustainable production through modification of the hydraulic systems used to handle blue mussel seed to increase productivity and reduce production costs

G. Perry*[1] and G. Simms[2]

[1] Fisheries and Oceans, St. John's, Newfoundland, Canada, A1C 5X1
[2] LBA Enterprises Ltd., Little Bay, Newfoundland, Canada, A0J 1J0

Blue mussel seed collection, stripping, grading, and socking operations are the most costly and labour-intensive activities on a mussel farm in Newfoundland and Labrador. Seed is handled multiple times and is stored on working platforms for extended periods of time while individual pieces of equipment are installed and removed. Typically, each piece of equipment has its own hydraulics package to power the equipment. A new hydraulic system was tested in spring 2009 and had the oil capacity to operate multiple hydraulic motors at any given time. This process enabled automation of the seed collection to seed socking operation and significantly reduced the cost of production.

Technology transfer, adaptation and implementation of Washington State mechanical clam harvesting technology to the BC shellfish farming sector

K. Reid[1] and R. Stevenson*[1]

[1] British Columbia Shellfish Growers Association (BCSGA), Comox, British-Columbia, Canada, V9M 3M6

BC shellfish farmers are challenged by increasing production costs, a lack of available labour force, and low prices for their product on the global market. Mechanization of

farming practices can increase efficiencies and reduce costs – which are anticipated to create a direct and necessary improvement to farmers' bottom line. We propose to 1) transfer existing proven mechanical harvesting technology to BC, 2) adapt it to accommodate local biophysical conditions and to increase efficiencies, and 3) ultimately produce a design for a clean technology commercially viable mechanical clam harvester.

Amélioration de la productivité par la mécanisation et l'automatisation des opérations maricoles

S. Morissette*[1]

[1] Rep. Société de développement de l'industrie maricole (SODIM), Gaspé, Québec, Canada G4X 1T5

L'industrie maricole québécoise est relativement jeune. Le contexte climatique et océanographique particulier des côtes québécoises ne permet pas de simplement importer des technologies utilisées ailleurs. Il nous faut innover pour adapter ces techniques et équipements au contexte particulier du Québec et parfois même en créer de nouveaux. Par ailleurs, l'augmentation de la productivité des entreprises maricoles passe, comme dans bien d'autres secteurs de l'économie, par la mécanisation et l'automatisation de certaines opérations. Ainsi, le projet est novateur dans la mesure où il permet d'améliorer des équipements existants ou d'en concevoir d'autres afin de lever certains verrous technologiques freinant le développement de l'industrie maricole du Québec. Il débouche sur des équipements qui peuvent être utilisés par l'industrie sans attendre. D'ailleurs, des mariculteurs sont mis à contribution pour les essais terrain de chacun des équipements afin d'en évaluer la performance dans des conditions d'opérations commerciales.

Optimisation de la technique d'élevage des huîtres collées à l'horizontale

A. Mallet*[1]

[1] Brantville Aquaculture Ltée, Brantville, Nouveau-Brunswick, Canada, E9H 1M7

L'objectif de ce projet est d'augmenter la productivité et la rentabilité d'une technique unique où des huîtres sont collées sur des cordes et suspendues à l'horizontale. La faisabilité des huîtres collées à la verticale a été démontrée au Nouveau-Brunswick et ailleurs dans le monde, mais cette technique est restreinte aux endroits profonds. Présentement, la méthode de collage des huîtres est laborieuse et exigeante en termes de ressources humaines. L'activité du collage des huîtres est dépendante des conditions météorologiques; si le niveau d'humidité est trop élevé et si la température est trop froide, la surface de la coquille ne sèche pas et il n'est pas possible de procéder au collage des huîtres. L'objectif du projet est d'adapter un distributeur de silicone à air comprimé afin d'améliorer le processus de distribution de la colle, développer un système spécialisé

dans le séchage de la coquille d'huître, évaluer une colle alternative, et, développer les caractéristiques d'un flotteur pour flotter à l'horizontale les cordes d'huîtres collées.

Socio-Economic Impacts

Wednesday, May 19, 2010 – mercredi 19 mai, 2010
1:30 PM – 3:10 PM
Location: Salon E/F

Co-Chairs: Keith Rideout and Laura Halfyard

1:30 Paju, M.
Socio-economic impact of aquaculture in Canada

1:50 Tracey, K.
Economic impact of the cage culture industry in Ontario

2:10 Foster, C.
The socioeconomic impacts of the aquaculture sector on the communities of the Coast of Bays Region

2:30 Halfyard, J.
Mussel farming in NL and their socio-economic impacts

2:50 House, B
The socioeconomic impact of salmon aquaculture in New Brunswick

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Socio-economic impact of aquaculture in Canada

M. Paju

Fisheries and Oceans Canada

Aquaculture generates thousands of direct jobs in Canada, and many more in industries with which it has strong backward and forward linkages. Production figures alone do not reveal the substantial economic and socio-economic contribution the industry makes at the micro level – at the level of the coastal and rural communities where aquaculture actually takes place. Several studies have analyzed the economics and estimated the economic impact of aquaculture at a macro scale, generally at a provincial level and for a specific species. This study provides estimates of the economic impact of aquaculture in Canada, with a focus on impacts at the community or regional level in the major producing areas of: Campbell River/Comox, British Columbia; Charlotte County, New Brunswick; Northern/Eastern Prince Edward Island; and, Manitoulin Island, Ontario. It also examines the challenges the industry faces in achieving its production potential. This information is essential to guide the formulation of policy and strategies for sustainable aquaculture development.

Economic impact of the cage culture industry in Ontario

K. Tracey

Executive Director, Northern Ontario Aquaculture Association

In 2006, NOAA initiated a study to examine the economic impacts of the cage culture industry. The research found the Ontario industry produces economic benefits for rural communities including many in Northern Ontario. Direct economic impacts (sales and jobs) associated with the industry were identified through a review of secondary data and key informant interviews with cage culture operators; Indirect economic impacts (sales and jobs) were identified through a survey of 'aqua-related' businesses (goods and service providers). The cage culture industry makes an important contribution to community and regional economies in Ontario. All of the production jobs and at least 30% of the indirect jobs are located in Northern Ontario. The economic multipliers are substantial, with an employment multiplier of 4.5 and a sales expenditure multiplier of 4. In spite of relative competitive advantages and considerable growth potential, the Ontario industry continues to face ongoing regulatory complexity and uncertainty.

The socioeconomic impacts of the aquaculture sector on the communities of the Coast of Bays Region

C. Foster

Economic Development Officer, Coast of Bays Corporation, St. Albans, NL

The most recent employment numbers released by the Department of Fisheries and Aquaculture show that there are 655 people directly employed in the province in aquaculture, with the vast majority of these positions located in the Coast of Bays. The Coast of Bays Corporation is the Regional Economic Development Board for Zone 13, the Coast of Bays, located on the southern part of the province. Through our day to day work and our Aquaculture Sub-committee, we work very closely with those in the aquaculture industry including growers, service and supply sector businesses, and all levels of government including Federal, Provincial and Municipal. This presentation will be speaking about how this economic prosperity has affected the municipalities and the people who live there.

Mussel farming in NL and their socio-economic impacts

Job Halfyard*[1]

[1] NAIA Past-President & Board Member; Owner/Manager of Sunrise & Connaigre Fish Farms Ltd., La Scie, White Bay, NL A0K 3M0

The Newfoundland mussel industry production in 2009 included 51 licensed sites, about 3700 hectares of water and valued at $5.5 million to the economy. This presentation will highlight some of the regional impacts that this industry has had on direct and indirect employment, other economic impacts, as well as the social benefits to the communities and families. It will also discuss issues to foster the continued growth of this industry.

The socioeconomic impact of salmon aquaculture in New Brunswick

B. House*[1]

[1] New Brunswick Salmon Growers Association, 226 Limekiln Rd, Letang, NB E5C 2A8, T: 506.755.3526, E: b.house@nbsga.com

Salmon aquaculture plays a significant role in Charlotte County New Brunswick by generating both jobs and revenue. As demonstrated in the recent socio economic study commissioned by DFO and a recent economic impact study conducted by the NBSGA production figures alone don't reveal the benefits the industry can have on a community. These benefits are also not confined to just a community or a region but they also have a positive economic and social impact to the province and the country. This presentation

will provide an overview of the contribution salmon farming makes to the rural coastal communities of Charlotte County and to the Province of New Brunswick.

Contributed Papers

Wednesday, May 19, 2010 – mercredi 19 mai, 2010
1:30 PM – 3:10 PM
Location: Salon A

Chair: Céline Audet

1:30 Forward, B.
Development of probiotic bacteria for use in the culture of American oyster (*Crassostrea virginica*)

1:50 Mallet, A.
Integrating the Brite-Box, an algal photo-bioreactor, into a shellfish hatchery for the production of the bay scallop *Argopecten irradians irradians*

2:10 Mallet, A.
Advances in the technology used to glue the Eastern oyster to ropes for final growout

2:30 Myrand, B.
Dispersal of clams seeded in a medium-sand substratum seems to be minimal during the ice-free period

2:50 Tamigneaux, E.
Seaweed farming in Chaleur Bay (Québec): results from 4 years of R&D activities

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Development of probiotic bacteria for use in the culture of American oyster (*Crassostrea virginica*)

B.S. Forward[1*], J. Jones[1] and C. Gionet[2]

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The culture of American oyster (*Crassostrea virginica*) utilizing captive broodstock offers the potential for improving yields and performance through selection for specific traits. However, culture of larvae in intensive hatchery operations has often been plagued by losses resulting from opportunistic bacterial infections. When investigating the source of larval crashes over the course of multiple rearing seasons, several strains of *Vibrio splendidus* were identified using DNA and biochemical profiling. Three isolates were examined in challenge trials and exhibited differences in pathogenicity. In order to address this issue, probiotic bacteria with activity against *V. splendidus* strains were identified in high throughput screening assays and tested in Phase I safety and challenge trials. Those strains showing protection against challenge with *V. splendidus* were then tested in a hatchery setting where differences in larvae survival, competent stage and settlement stage were observed. Different strains showed efficacy at different rearing stages, all with marked improvements in survival over untreated controls.

Integrating the Brite-Box, an algal photo-bioreactor, into a shellfish hatchery for the production of the bay scallop *Argopecten irradians irradians*.

A.L. Mallet* and C.E. Carver

Mallet Research Services Ltd., 4 Columbo Dr., Dartmouth, Nova Scotia Canada, B2X 3H3, Email: amallet@bellaliant.com

The Brite-Box system, an algal photo-bioreactor, is a practical solution for the production of microalgae for hatchery facilities in temperate and cold climates. Growing phytoplankton has long been recognized as a major cost in the hatchery and nursery production of shellfish and finfish. Procedures are typically labour-intensive and algal quality is unreliable. Commonly used culture systems such as fiberglass Kawal tubes and large volume plastic bags rely on processing large volumes of culture at relatively low cell concentrations. More intensive culture systems can generate higher cell concentrations, but serious difficulties are encountered as the scale of production increases. The Brite-Box system is a closed photo-bioreactor designed to maximize algal production with minimal energy input and greatly reduced labour costs. It has been used to sustain the complete hatchery production cycle of the bay scallop on a research scale, from the conditioning of the brood-stock to the rearing of 3-mm juveniles for deploymen

tin the field. Brite-Box performance will be compared with a traditional Kawal-tube system in terms of growth profiles (fluorescence and cell counts), production rates (dry weight per day), quality in terms of Total Bacteria levels (CFU/ml) and TCBS-positive bacteria (CFU/ml), presence of contaminant organisms, and cost of production per unit dry weight.

Advances in the technology used to glue the Eastern oyster to ropes for final growout

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Growing oysters cemented to ropes was first introduced to New Brunswick, Canada in the early 2000's following the technique used in southern France. Substantial modifications were made over the years in order to adapt this grow-out method to shallow bays, in particular, developing a floating structure to suspend the ropes horizontally in the water column. The interest in this approach stems from the better linear growth, higher weight gain and improved shell quality compared to oysters grown in floating bag. Recent advances made with the technology will be presented in order to describe how the oysters are fixed to the ropes and how the ropes are managed in a commercial operation with the improved floating structure. Comparative production performance data between rope-grown oysters and oysters grown in floating bags will be presented.

Dispersal of clams seeded in a medium-sand substratum seems to be minimal during the ice-free period

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At last 4 years are needed for 20-mm seed clams to reach 51 mm in Iles-de-la-Madeleine. Cumulative losses could reach a high level over this period and a commercial clam culture could not be profitable if retrieval rate at harvest is low. Apart from natural mortality, losses come from predation and passive dispersal. This study deals with

possible dispersal of clams during the ice-free period. Throughout the season, the 20-mm clams seeded in medium sand were typically found at 4-6 cm from the surface compared to 6-9 cm for the larger clams. We also measured the dynamics (accumulation/erosion) in this substratum at different stations on the seeding site. The maximum erosion was observed to be about 3 cm. Therefore the sand erosion was seemingly not enough to unbury the seeded clams even during storm events. On six occasions, we measured clam losses directly related to storm events. Minimal or no losses were observed. All these results suggest that clam dispersal is minimal throughout the ice-free period. However, important losses seem to be related to the ice drifting onto the intertidal zone during some years. Predation should be considered as another major cause for clam losses.

Seaweed farming in Chaleur Bay (Québec): results from 4 years of R&D activities

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In Quebec, there are presently 15 companies involved in seaweed harvesting, processing and sales. There is also a growing interest from the mussel industry for diversification and several seaweed cultivation projects have been initiated with mussel producers. In 2006, one kelp harvesting company started a kelp farm in Chaleur Bay and several experiments on *Saccharina longicruris* cultivation were carried out in the lab and on the farm. Through manipulation of photoperiod and water temperature, out of season sporogenesis was induced in *S. longicruris* blades kept in indoor basins. *In vitro* cultivation and multiplication of gametophytes allowed the seeding of culture ropes that were successfully out-planted on submerged longlines. In the kelp nursery, ropes seeded with spores currently gave rise to 4 mm plantlets within 4 weeks and an experiment was carried out to determine optimal plantlets density. During the first attempts to cultivate kelp at sea, it was invaded by colonies of the bryozoa *Membranipora membranacea*, which resulted in the loss of most plants in the autumn. Modifying the culture schedule allowed to avoid the bryozoa. Efforts are now oriented towards the increase of the kelp culture yields and the assessment of new species like *Alaria esculenta* and *Palmaria palmata*.

Fish Health

Wednesday, May 19, 2010 – mercredi 19 mai, 2010
3:40 PM – 5:20 PM
Location: Salon B

Co-Chairs: Caroline Graham and Duane Barker

3:40 **Novak, C.**
Differences between male and female *Lepeophtheirus salmonis* (Copepoda: Caligidae) as vectors of *Aeromonas salmonicida*

4:00 **Hynes, N.**
The immunological effects of recombinant bacterial flagellin on Atlantic salmon

4:20 **Leadbeater, S.**
Salmonid immunological response and genetic resistance to Infectious Salmon Anemia virus isolates

4:40 **Brewer-Dalton, K.**
AlphaMax® and Salmosan®: Sea lice environmental control trials in New Brunswick

5:00 **O'Brien, N.**
Biosecurity in NL aquaculture

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award

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Differences between male and female *Lepeophtheirus salmonis* (Copepoda: Caligidae) as vectors of *Aeromonas salmonicida*

C. Novak*[1], D. Barker[1] & R. McKinley[2]

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The sea louse *Lepeophtheirus salmonis* is commonly reported from farmed Atlantic (*Salmo salar*) and wild Pacific (*Oncorhynchus* spp.) salmon in British Columbia. This species of sea lice has mobile stages that can transfer between host salmonids, with adult males and pre-adults of both sexes more mobile than adult females. Previous and ongoing studies have documented the isolation of bacterial pathogens (*Aeromonas salmonicida*, *Tenacibaculum maritimum* and *Vibrio* spp.) from sea lice externally and internally. This research examines three hypotheses: (i.) *L. salmonis* can ingest *A. salmonicida* from infected salmonids and the bacteria remain viable within the lice; (ii.) infected *L. salmonis* act as a vector and pass the bacteria to healthy salmonids; and (iii.) there is a gender-specific differentiation in disease propagation among *L. salmonis*. Wild pre-adult and adult *L. salmonis* of both sexes were allocated among separate tanks with Atlantic salmon ip-injected with 10^4 cfu ml^{-1} *A. salmonicida*. Standard OIE bacteriological tests, combined with API-20E were used to confirm infection of *A. salmonicida*. This research will give a better understanding of potential differences in *A. salmonicida* infection rates among *L. salmonis* sex and life stage, which will be useful for sea lice management implications in British Columbia.

The immunological effects of recombinant bacterial flagellin on Atlantic salmon.

N. Hynes[1]*, C. Furnes[1], T. Winther[1], A. Larsen[2], B. Fredriksen[1], J. Bøgwald[1], T. Hori[3], M.L. Rise[3], R. Dalmo[1]

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The use of adjuvants in aquaculture has played an important role in increasing the efficacy of vaccines and in turn, decreasing the use of antibiotics. Some side effects have been shown to be associated with the use of commonly used adjuvants including immune reactions and adherations, melanin deposits, effects on growth and skeletal deformities. With the recent discovery of Toll-like receptors and the roles they play in the innate and adaptive immune system, considerable focus has been placed on their possible use as immunostimulants. Flagellin is currently the only known activator of TLR5 and this pattern recognition receptor plays a key role in the activation of various immuno-relevant transcription factors. We were able to produce recombinant bacterial flagellin for use as an adjuvant in Atlantic salmon, and the possible roles of flagellin in activating the

immune system were examined in cell culture as well as vaccine trials. The outcome was determined using various techniques, such as luciferase based reporter gene assay, Q-RT-PCR and microarray. Flagellin is shown to exert stimulatory effects both in cell culture and at gene transcription levels and therefore would be a good candidate for further vaccine trials in Atlantic salmon.

Salmonid immunological response and genetic resistance to Infectious Salmon Anemia virus isolates

S. Leadbeater* and B. D. Glebe

St. Andrews Biological Station, Fisheries and Oceans Canada, 531 Brandy Cove Rd., St. Andrews, NB E5B 2L9

Since it was first reported in 1997 (Canada), the Infectious Salmon Anemia virus (ISAv) has caused enormous economic losses to the salmon aquaculture industry in the Americas and Europe. Subsequent farm surveillance in the Bay of Fundy has identified 20 genetically distinct ISAv isolates of variable virulence. From 2000 to the present, the St. Andrews Biological Station and numerous other collaborating institutions have been investigating potential ISAv control strategies requiring salmon to mount a strong protective immune response or develop genetic resistance. Early lab studies developed trojan cohabitation models to determine the efficacy of conventional ISAv bacterins. Applying these models showed that vaccines (conventional and recombinant) were protective up to 2200 degree days post vaccination with relative percent survival percentages (RPS) of up to 80%. Also, the exposure to non-virulent ISAv isolates provided cross protection against a virulent isolate. Subsequent studies have investigated the relationship between hypoxia and ploidy and resistance to clinical infection. The development of disease resistant stocks is possible. When full-sib salmon families were challenged with ISAV and with the parasite Cryptobia, one family was notably less susceptible to both pathogens with vaccination further decreasing mortality. Another salmonid, Arctic charr, showed no clinical symptoms in ISAv challenges. However, carrier status was confirmed when cohab naïve salmon became clinical. These studies have led to ongoing investigations to discover biomarkers associated with ISAV (and sea lice) resistance at the molecular level

AlphaMax® and Salmosan®: Sea lice environmental control trials in New Brunswick

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[1]New Brunswick Department of Agriculture and Aquaculture, Sustainable Aquaculture and Fish Health, 850 Lincoln Road, Fredericton, NB, E3B 5H1

The New Brunswick salmon aquaculture industry has responded to a number of fish health challenges throughout its history, including the control and management of sea lice (*Lepeoptherius salmonis* and *Caligus elongates)*. Up until June of 2008 SLICE® treatments were proven to be an effective means of sea lice control in New Brunswick. Approval for the limited use of the AlphaMax and the broader use of Salmosan® were received subject to a series of monitoring and surveillance studies being conducted concurrently with treatments. The monitoring and surveillance activities undertaken for both AlphaMax® and Salmosan® were: 1-determination of the dispersal and concentration of the product; 2-determination of vertical mixing of product in treated cage. The AlphaMax® monitoring included these additional surveillance activities: 1-impact of treatments on sentinel organisms (*Strongylocentrotus droebachiensis, Littorina littorea, Mytilus edulis, Nucella lapillus, Asterias rubens, Carcinus maenus/Cancer irroratus*); 2- impact of treatments on mussels (*Mytilus edulis)* from an Integrated Multitrophic Aquaculture site; 3- impact of pulse doses of deltamethrin on lobster (*Homarus americanus)* in a lab setting and in the field on treated sites. Key findings of the AlphaMax® trials indicate that AlphaMax® was effective in treating sea lice with no effect on non-target species. There was no observable disruption to the normal life-cycle of lobster in the field to lobster at all stages of development; lab observations will continue over the next four months. Preliminary Salmosan® results indicate that Salmosan® was effective in treating most stages of sea lice, with the pre-adult and adult stages being impacted the most.

Biosecurity in NL aquaculture

N. O'Brien [1], D. Whelan [1] and T. Rose[1]

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Biosecurity is the management of risks from non-indigenous species and the environment. It is includes practices, policies, or procedures used on the farm to reduce stress of the animals and reduce spread of pathogens should they be introduced. It is comprised of preventative medicine, surveillance, adequate diagnosis, containment of outbreaks and eradication, quarantine, and the controlled traffic of personnel, vehicles and equipment. Biosecurity responsibilities include audit and enforcement of legislation, providing sanitary assurances to trading partners. Biosecurity is a shared responsibility, in that each individual in the process of animal production plays a different but critical role

in the implementation of an overall program. Any failure in the chain of process will undercut the overall effort to establish and maintain biosecurity. The Newfoundland and Labrador Department of Fisheries and Aquaculture (NL DFA) – Aquatic Animal Health Division (AAHD) performs biosecurity and health audits on many components of aquaculture to ensure the health of our industry.

Contributed Papers

Wednesday, May 19, 2010 – mercredi 19 mai, 2010
3:40 PM – 5:20 PM
Location: Salon C/D

Chair: Tim Jackson

3:40 **Lucas, J.**
Optimizing fish oil supplementation in the feed of commercially grown Arctic charr

4:00 **Colombo, S.**
Evaluation of *Calanus* copepod and *Euphausia* krill meal and oil as the dietary protein and lipid supplements for juvenile Atlantic halibut (*Hippoglossus hippoglossus)*

4:20 **Enyidi, U.**
Comparative effects of sesame seed meal and bambara nut meal on the growth and nutrition of the African catfish (*Clarias gariepinus*) (Burchell 1822)

4:40 **Parashar, A.**
Breeding and culture of murrels in India

5:00 **Sharma, J.**
Rehabilitation and conservation of treatened fish in India

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award

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Optimizing fish oil supplementation in the feed of commercially grown Arctic charr

J. Lucas*, C. McGowan and J. Rose

Icy Waters Arctic Charr Ltd., Km. 4.2 Fish Lake Road, P.O. Box 21351, Station Main, Whitehorse, Yukon Y1A 6R7

Arctic charr have the most northerly distribution of any freshwater finfish and have evolved to exploit an environmental niche where other salmonids, such as Atlantic salmon, do not thrive. Consequently, a commercial diet formulated for Atlantic salmon might contain more fat than that required by Arctic charr for healthy growth. The objective of this project was to investigate the dietary fat requirements of Arctic charr and determine whether the amount of supplemented fish oil in their feed can be reduced. Fish were offered either a high fat (26%) or low fat (18%) diet under commercial conditions. After 12 months, no significant difference in growth rate, food conversion ratio (FCR), rate of maturation and mortality was observed between the two groups. The average fat content of fillets was similar in both groups, but more consistent in fish fed a low fat diet. Flesh quality and organoleptic analysis demonstrated a preference for fish fed the low fat diet. Decreasing the level of fat supplementation will lower the cost of production and improve the sustainability of Arctic charr aquaculture by reducing its dependence on fish oils derived from the wild fishery. It might also improve the quality and taste of the final product.

Evaluation of *Calanus* copepod and *Euphausia* krill meal and oil as the dietary protein and lipid supplements for juvenile Atlantic halibut (*Hippoglossus hippoglossus)*

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The *Calanus* copepod (*Calanus finmarchicus*) and Antarctic krill (*Euphausia superba*) are considered potential feed ingredients for marine fish feeds as protein and lipid sources; however, their nutritional value for Atlantic halibut has not been investigated. Two experiments were conducted to determine the suitability of *Euphausia* krill and *Calanus* copepod meals and oils as a protein and lipid source for juvenile halibut. Weight gain was significantly higher ($P<0.05$) when 12, 20 and 30% dietary protein was replaced in a diet based on fish meal and plant protein (soybean and corn gluten meal). The FCR and SGR did not vary significantly between diets; however SGR increased (1.42 to 1.56%) with greater inclusion of *Calanus* protein. Lipid, protein, and energy digestibility of krill and *Calanus* meals ranged from 90-99%. Protein and energy digestibility (90-99%) of *Calanus* meals significantly decreased with increased degree of heat processing. Krill meal had higher lipid digestibility (99%) than *Calanus* meals (90-95%). Heat

processing did not significantly affect lipid digestibility of *Calanus* meals; however the freeze-dried meal was more digestible (95%). Krill oil contained lower amounts of eicosapentaenoic acid (EPA) (6%) and docosahexaenoic acid (DHA) (2%) than *Calanus* oil (10% EPA; 11% DHA). Krill oil was slightly more digestible (>90%) than *Calanus* oil, likely due to the presence of wax esters in *Calanus* lipid. It appears that krill and *Calanus* meal and oil can be utilized as dietary protein and lipid supplements in Atlantic halibut diet.

Comparative effects of sesame seed meal and bambara nut meal on the growth and nutrition of the African catfish (*Clarias gariepinus*) (Burchell 1822)

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Juvenile African catfish (11.65 ± 0.56 g) were fed for 22 days in 16 replicated tanks. The feed were made to vary in percentage of sesame seed (SS) meal and bambara nut (BN) meal from 0 to 35 % and mixed as follows: feed 1: 0% SS 35% BN, feed 2: 11.7% SS 23.3% BN, feed 3: 23.3% SS 11.7% BN and feed 4: 35% SS 0% BN. DFI increased with higher inclusion of bambara nut meal than sesame seed meal. The catfish fed with feed 2 had highest SGR (8.40 % day -1), PWG (538.01%) and AWG (60.80) ($P<0.05$). The catfish fed with feed 1 had lowest SGR (7.60%), PWG (432.45%) and AWG (50.28). FCR of the catfish was generally below zero and lowest for those fed with feed 3, followed by feed 4 and feed 2 but poorest for feed 1. PER was positively correlated with SGR, AWG and PWG, but body protein was not significantly different. Total body lipid positively correlated with AWG and increasing with inclusion of sesame seed meal. Diets mixtures of sesame seed meal and bambara nut meal and fish meal were better than those made from either ingredient and fish meal.

Breeding and culture of murrels in India

A.K.B. Ridhi[1], A. Parashar[2*], and S.K Parashar[3]

Sarojini Naidu Govt.Girls P.G.(Auto.) College
Barkatullah University , Bhopal (M.P.)

Murrels are known for their esteem and good market demand owing to their low fat and few intramuscular spines. Murrels are highly priced fishes all over the India for their good keeping quality, unique flavors, nutritive, recuperative and medicinal properties especially in Punjab, West Bengal, Madhya Pradesh, and Peninsular India. Murrels belonging to the family Channidae, form a unique group of food fishes in fresh water habitats of India. Murrels are commercially cultured in Thailand, Philippines etc.

However in India, the culture of Murrel continues to be sparse due to the non-availability and breeding techniques of quality seeds. Murrels breed during monsoon months. Failure of monsoon limits their seed production. Hence induced breeding technique becomes crucial to raise Murrel seed. Among different Murrels which are available in India, the giant Murrel (*Channa marulius*) the stripped Murrel (*Channa straitus*) and spotted Murrel (*Channa punctatus*) are important and commonly available species of which the former two attain a large size and are of economic importance .Besides, a number of Seminars, Workshops, research works and awareness are recognized all over the country to motivate the farmers in diversify fisheries. Experiments conducted on the hypophysation of *Ophicephalus striatus, Ophicephalus marulilius,Ophicephalus gachua* and *Ophicephalus punctatus* at Bandra fish farm Bandra reservoir project, Karnataka state and Induced Carp Breeding centre Thanjavar Tamil Nadu during the Year 1973 are embodied in this communication. The large Murrel *Channa marulis* is a highly priced. The culture of *Channa marulis* is still not common due to the scarcity of quality seed supply and lack of knowledge on their feeding and breeding techniques .Reliable, culture seed production may soon become necessary in India and even in places like Madhya Pradesh. Presently, most of the commercially Murrel culture relies on Wild fry, which are acclimatized to accepting formulated feed. Present study will help in standardizing the induced spawning and seed production techniques of *Channa marulius*. This will further help in production of Murrel seed under controlled condition easy availability of seeds to fish farmers. And also its conservation through artificial propagation besides providing a new candidate species for diversified aquaculture. The study will help to increase the fish growth and popularization of Murrel-culture in Madhya Pradesh (India).

Environmental Impacts

Wednesday, May 19, 2010 – mercredi 19 mai, 2010
3:40 PM – 5:20 PM
Location: Salon C/D

Chair: Jonathan Kawaja

3:40 **George, E. M.**
Organic footprint and composition of particles from marine finfish aquaculture operations

4:00 **Mabrouk, G.**
Preliminary assessment of remote video survey methodology for use in monitoring benthic impacts from aquaculture in Newfoundland

4:20 **Chang, B.**
Temporal variations in sediment sulfide levels under salmon farms in southwestern New Brunswick, Bay of Fundy, during the annual environmental monitoring period

4:40 **Chang, B**
Changes in the benthic macrofaunal community associated with organic enrichment under salmon farms in southwestern New Brunswick, Bay of Fundy

5:00 **Chaudhary, N.**
Sultan Fish Farms

Underline denotes presenter is a student eligible for Best Student Oral Presentation Award

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Organic footprint and composition of particles from marine finfish aquaculture operations

E.M. George* and C.C. Parrish

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Finfish aquaculture operations release food particles and faecal pellets to the benthos. We are studying the particle field associated with finfish aquaculture and how benthic organisms interact with it in land-based and cage site facilities. Measurements were made of dissolved and particulate matter in the inflow and outflow of six 1000-litre land based juvenile Atlantic cod (*Gadus morhua*) tanks. Lipid composition results show significantly more free fatty acid (FFA) in the outflow indicative of lipid breakdown and faecal matter. The fishmeal derived copepod markers 20:1ω9 and 22:1ω11 were also significantly higher in the outflow. There was also significantly more of the essential fatty acid 22:6ω3 (DHA) in the outflow. In a separate study, Atlantic salmon cage sites in Clayoquot Sound and the Broughton Archipelago, British Columbia were sampled by retrieving invertebrates in transects surrounding the farms. Mollusc lipid composition correlated linearly with distance from the farms. Mollusc FFA composition decreased significantly with distance. Fishmeal derived copepod markers were significantly higher in mussels collected within 400 m of the farm than in those collected further away. Among the molluscs, blue mussels had significantly higher proportions of the essential fatty acids which would relate to their potential use in integrated mutli-trophic aquaculture.

Preliminary assessment of remote video survey methodology for use in monitoring benthic impacts from aquaculture in Newfoundland

G. Mabrouk[1*], D. Drover [1], M. Strong[2], M.Buzeta[2], F. Page[3], R. Losier[3] and B. Sweeney[4]

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Aquaculture development on the South Coast of Newfoundland is expanding and there is a need for efficient and appropriate monitoring of the impacts on habitat. Visual sampling methods have been used to describe the pre-cage and post-cage benthic environment and species assemblage in British Columbia. It is essential to validate these methodologies in Newfoundland to ensure suitability for the environmental conditions and biological assemblages likely to be encountered. Three different drop camera systems were used and recommendations for improvements of future video-based surveys were made. These videos were collected on the south coast of Newfoundland, during September and November of 2009. Observations were not only on the benthic

environment itself (e.g. substrate, biota), but also on the quality and quantity of the video and the limitations imposed on identification of organisms. From the drop and transect video taken, several types of biota were classified and this classification method helped distinguish positive and negative aspects of the camera systems. Beggiatoa mats were the most commonly seen near cages. Cerianthids were commonly seen on transects away from cages. Species abundance curves helped determine amount of video needed and the picture quality, which is key in determining environmental conditions/change in the region.

Temporal variations in sediment sulfide levels under salmon farms in southwestern New Brunswick, Bay of Fundy, during the annual environmental monitoring period

F.H. Page[1], B.D. Chang*[1], R.J. Losier[1], E.P. McCurdy[1], J.C.E. Reid[1], A.R. Hanke[1], and J.A. Cooper[1]

[1]Fisheries and Oceans Canada, Biological Station, 531 Brandy Cove Road, St. Andrews, NB, Canada E5B 2L9.

Sediment samples were collected under two salmon farms in the southwestern New Brunswick area of the Bay of Fundy, to determine if there are temporal trends in sediment sulfide levels during the period when annual benthic monitoring of farms occurs (1 August to 31 October). Samples were collected every week during September-October 2008 and every two weeks during August-October 2009 at two salmon farms, both holding fall 2007 Atlantic salmon smolts, and at a reference site. Sediment sulfide levels were measured in grab samples collected at six locations at each site on each sampling date. The reference site had low sulfide levels at all sample locations on all dates. The mean sulfide levels at both farms showed a general increase over time during September-October 2008; during this time, the fish biomass and feeding rates at both farms also increased. The mean sulfide levels at both farms showed a general decrease over time during August-October 2009; during this time, the fish biomass and feeding rates at both farms also decreased, due to harvesting. At both farms, sulfide levels were much higher than at the reference site at all times. At farm site A, sulfide levels remained above those of the reference site at the end of October 2009, a few weeks after feeding had ceased and all fish had been harvested. At farm site B, sulfide levels also remained above those of the reference site at the end of October 2009; this site had begun harvesting, but still had fish and was still adding feed at the end of October 2009. At the two farms, there was considerable variation in sulfide levels among locations sampled at the same site on the same date. Triplicate grab samples collected at each location at the three sites in October 2008 revealed significant differences among replicates in over half of the sample locations.

Changes in the benthic macrofaunal community associated with organic enrichment under salmon farms in southwestern New Brunswick, Bay of Fundy

B.D. Chang[1*], J.A. Cooper[1], F.H. Page[1], R.J. Losier[1], E.P. McCurdy[1], and J.C.E. Reid[1]

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Benthic sediment samples were collected under two salmon farms and a reference site in southwestern New Brunswick, Bay of Fundy in October 2008. Samples were analyzed for sulfide levels (an indicator of organic enrichment) and numbers of individuals and species of benthic macrofaun. Sulfide levels at reference site C were low, averaging 92 µM (ranging from 21–205 µM), while at farm site A, the average was 793 µM (ranging from 109–2 720 µM), and at farm site B, the average was 2 257 µM (ranging from 298–7 360 µM). At reference site C, the diversity and species richness of benthic macrofauna were relatively high. At the two farm sites, macrobenthic diversity and species richness were high in sediments with low sulfide levels, and lower in sediments with higher sulfide levels, although there was considerable variability, especially at intermediate sulfide levels. The abundance of *Capitella* and *Capitelledes* spp. was low (<15 per kg sediment) at the reference site; at the two farm sites, their abundance increased at intermediate sulfide levels, then decreased at higher sulfide levels. The various measures of macrofaunal biodiversity and richness indicated that sediments under both farms were impacted by organic enrichment, but farm site B was more impacted than site A, as was indicated by the sediment sulfide levels. Adverse effects on the macrobenthic community under salmon farms started appearing at sediment sulfide levels of about 500–2 000 µM.

Sultan Fish Farms

N. Chaudhary*

Dosage for obtaining eggs from fishes after above mentioned treatment: The injection dose is 10 mg PG/kg body wt. for Male to set the proper breeding timing with female (breeding timings depend upon the temperature of the water) and diluting the Milt which is in the solid form in the vas deference. Once it is diluted it can easily travel through the testicles for ejaculation. And after 1 hour later, 5-6mg Ova tide/kg body wt for first injection to female for the proper release of the ova. After this copulation starts generally for 4-8 hours. Male and Female release there milt and ova respectively into the water. They fused to form a zygote which develops into the spawn after 28 hours and it remains into the hatchery. After 72 it is transferred to the nursery.

Poster Session / Session affiches

Tuesday, May 18, 2010 – mardi 18 mai, 2010
2:00 PM – 4:00 PM
Location: Conception Bay

Underline denotes presenter is a student eligible for Best Student Poster Presentation Award

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Optimal urchin stocking density for co-cultured green sea urchins and blue mussels
A.M. Bartsch*[1], S. F. Cross[1]

Oceanographic study of the South Coast of Newfoundland (Preliminary results for 2009)
D. Drover*[1], G. Mabrouk[1], F. Page [2] R. Losier[2], and J. Reid[2]

Could naturally occurring Thyasirid bivalves increase the health and resilience of sediments around aquaculture sites?
S.C. Dufour

Biochemical characterization of an ecotype cichlid 'wesafu' endemic to Epe Lagoon, Lagos, Nigeria
H.A. Fashina-Bombata*[1], and A.M. Hammed[1]

Proximate and mineral compositions of common crab species [*Callinectes pallidus* and *Cardisoma armatum*] of Badagry Creek, Nigeria.
H.A. Fashina-Bombata* and I. Elegbede

From lab to market: The birth of NutrOcean, a microalgae industry
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Genetic characterization of potential seed stock source sites in Notre Dame Bay, Newfoundland and Labrador
K.Hobbs[1*], R.W. Penney[1], M.J.R. Clark[1], S. Kenny[1], S. Macneill[2], H.M. Murray[1] and G. Mabrouk[1]

Impact de la teneur en oxygène dissous sur la survie du loup tacheté (*Anarhichas minor*) de souche québécoise
M. Jetté*[1-2], D. Chabot[2], N. Le François[3-4], D. Garant[1]

Effect of chronic sublethal hypoxia on growth and physiology in the wolffish (*Anarhichas minor*) and the hybrid (*A. lupus x A. minor*)
F. Larouche*[1], N.R. Le François[2], D. Chabot[3] & P.U. Blier[1]

From culture to conservation: a workshop to develop advanced reproductive technologies for sturgeon
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Development of a new declumper-grader for the mussel industry in Quebec, Canada
A. Licois[1*], L. Girault[1] and É. Tamigneaux[1]

Evaluation of a mussel seed transfer experiment from two Newfoundland bays to a single recipient site with reference to genotype profiling, shell morphometrics, and growth rate
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Adhesion of *Streptococcus iniae* to gill tissue of rainbow trout *Oncorhynchus mykiss*
A. Nematollahi*[1] Z. Sattari[1], I. Karimi[2]

Oyster aquaculture using the French string technique in the Baie des Chaleurs, New Brunswick
M. Niles[1], S. Doiron[2], L. Comeau[1] and L. Davidson[1]*

Intertidal shellfish farming and ecosystem functioning
A. Piot*[1], P. Archambault[1], C. Nozais[1], C. McKindsey[2], L. Bendell-Young[3]

Strain effect on growth performance of triploid Atlantic salmon, *Salmo salar*
C.F.D. Sacobie* [1], B.D. Glebe [2], S.P. Lall [3], T.J. Benfey [1]

Evaluation of the stress response of the spotted wolffish (*Anarhichas minor*) to density and a stressful event reveal a true farming-friendly species
A. Savoie[1*], S. Tremblay-Bourgeois.[1], R.L. Roy[2], T.J. Benfey[3] and N.R. Le François, [1-4§]

Knowledge transfer and skills development during the transportation and movement of fish
J. Seabi

Effect of finfish aquaculture operations on biochemical composition and growth of algae
P. Zhao* and C. C. Parrish

Optimal urchin stocking density for co-cultured green sea urchins and blue mussels

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In this project, growth rates of co-cultured sea urchins (*Strongylocentrotus droebachiensis*) and blue mussels (*Mytilus edulis*) will be measured at different urchin stocking densities. The experimental nylon net units, containing both species, will be suspended down-current from sablefish net pens. While the urchins feed on the net's fouling, they will simultaneously be cleaning the nets to allow higher water flow to the mussels. The upper limit of stocking density will likely be constrained by urchin growth (less fouling and therefore less food availability to urchins) while the lower limit of stocking density will likely be constrained by mussel growth (more fouling leading to decreased water flow and decreased food availability to mussels). By acting as a biological fouling control, the urchins will allow the mussels to more efficiently remove the suspended finfish waste from the water column and eliminate the need to use harmful antifouling net treatments. This research will contribute to a greater understanding of how to grow multiple species for integrated aquaculture that provide both environmental services and economic benefit. This poster will present the experimental design only.

Oceanographic study of the South Coast of Newfoundland (Preliminary results for 2009)

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Unlike many regions in Canada, total aquaculture production in the NL region has demonstrated continuous growth since 2005 and is expected to increase fourfold in the near future. The fast expansion of aquaculture operations in Bay D'Espoir and Fortune bay present significant challenges in site selection, habitat assessment and the establishment of bay management areas (a necessary approach for the sustainability of the industry). An aquaculture oceanography program was initiated two years ago under the Program for Regulatory Aquaculture Research by DFO Science to address the needs for understanding the oceanography on the South Coast. During summer and fall of 2009, many areas in Bay D'Espoir were mapped through deployment of current meters, CTD and drifters. Preliminary examination of the data indicates that the water column is stratified with a freshwater surface layer in the inner Bay. Currents appear stronger at the surface (upper few meters) while they are weaker in the deeper layers. Drifter data indicates that the motion is consistently in the same direction and that it is not dominated

by tidal movement. Through this study, preliminary predictions of zones of influence will be made to help establish Bay Management areas in the Bay D'Espoir region.

Could naturally occurring Thyasirid bivalves increase the health and resilience of sediments around aquaculture sites?

S.C. Dufour

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Small marine clams (family Thyasiridae) have been found in high numbers in marine sediments around finfish and shellfish aquaculture sites in the Bay of Fundy, Quebec, Scotland, Norway and Australia. In Newfoundland, they have been reported from sites in Bonne Bay and Placentia Bay, but their presence at aquaculture sites is unknown. These clams colonize sediments enriched with organic matter, where they thrive and seem to facilitate community succession following enrichment events. Thyasirids benefit from living in sediments enriched with organic matter because of their symbiosis with sulfur oxidizing bacteria, which are a food source for these clams. Because of this symbiosis, thyasirid clams have a unique behaviour: they use their super-extensile foot to mine for sulphide in the surrounding sediments. Preliminary experiments using 2D optodes have shown that this behaviour can lead to sediment re-oxidation, thereby ameliorating the condition of organically impacted sediments. The presence of thyasirid clams at aquaculture sites in this province could indicate that sediments are on the road to recovery from organic enrichment.

Biochemical characterization of an ecotype cichlid 'wesafu' endemic to Epe Lagoon, Lagos, Nigeria

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The abundance of an unknown cichlid in Epe Lagoon commonly referred to as 'Wesafu' and the large size and weight it attains in the wild elicited interest in the fish for possible species identification and naming. Study on Biochemical characterization was an attempt to identify 'Wesafu' and to compare it with *O. niloticus* which is another species found in the same ecosystem, using polyacrylamide gel electrophoresis (PAGE) to determine gene type relative to *O. niloticus*. Blood sera taken from the two species and electrophoretically run simultaneously on 5.5% polyacrylamide gel at 150V, 54mA for 5 to 7 hours; following the locus and allele nomenclature. The serum electrophoretic banding profiles were obtained by scoring of the visible electrophoretic protein bands stained with 0.06% Coomasie blue and destained in 1:2 (v/v) glacial acetic-methanol-distilled water mixture. The relative mobility of the gel shows that there were distinct bands (genetic markers) between 'Wesafu' and *O. niloticus*. While Wesafu possess between 10 and 11 bands, 9 bands was recorded for the *O. niloticus*. The 11th band in Wesafu was identified as a post albumin band which is totally absent in *O. niloticus*. In *O. niloticus*, bands 1, 3 and 7 were present, but bands 2, 5, 6 and 8 were absent in a few. Some individuals of Wesafu

were found to possess weaker bands 3 and 7. The frequency of bands between the samples studied indicated serum protein polymorphism, which indicated genetic diversity between 'Wesafu' and *O. niloticus*.

Proximate and mineral compositions of common crab species [*Callinectes pallidus* and *Cardisoma armatum*] of Badagry Creek, Nigeria.

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Callinectes pallidus and *Cardisoma armatum* species were obtained at Ojo market, Lagos. The live crabs were transported to the laboratory in clean, partially covered bucket to allow for oxygen consumption and identified as Callinectes pallidus (De Rocheburne, 1883) and Cardisoma armatun (Herklots, 1851) according to Schneider (1990). The proximate and mineral compositions (meats and shell) of *Callinectes pallidus* and *Cardisoma armatum* crabs from Badagry Creek were analyzed, the mean body weight were 145.22+3.39 and 104.47+2.50 respectively. Big cheliped weight, small cheliped weight, visceral weight and leg weight were not significantly different ($P<0.05$) except carapace weight in both crabs. The proximate compositions of meat and shell of both crabs were significantly different ($P>0.05$), both crabs were high in calcium, potassium, magnesium, and manganese. Zinc in meat of both crabs were not significantly different ($P<0.05$), but sodium, iron and copper of meat (both crabs) were significantly different ($P>0.05$), iron and zinc of shell of both crabs were also significantly different ($P>0.05$). The proximate and mineral compositions of both species of crab showed highly nutritious meat to warrant introduction into the culture system of the country to further diversify the aquaculture base of the industry presently dominated by catfish.

From lab to market: The birth of NutrOcean, a microalgae industry

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Today more and more studies are showing the beneficial advantages of using live microalgae as feed for shellfish larvae and zooplankton. Since the late 90's, innovative projects were conducted at Université du Québec in Rimouski, Canada, in order to develop an efficient microalgae production and concentration system for aquaculture purposes. After the proof of concept was validated through a pilot production, Valeo Management, the business arm of university, together with national and provincial agencies, created a spin-off in the name of NutrOcean. Since then, NutrOcean has been

optimizing the production of microalgae and today is able to provide fresh microalgae on an industrial scale to the North American aquaculture industry. NutrOcean has just recently started exploring other markets including nutraceutics, cosmeceutics and pharma. This positive example of transferring a technology from the lab to the market leads us to acknowledge the benefits between academic research and valorisation/transfer agencies to ensure that disruptive technologies do benefit the industrial development in Canada.

Genetic Characterization of Potential Seed Stock Source Sites in Notre Dame Bay, Newfoundland and Labrador.

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A major potential impediment to increased development of the mussel aquaculture industry in Newfoundland is seed availability. Seed stocks currently used by growers consist of varying proportions of *Mytilus edulis*, *Mytilus trossulus* and their hybrids. Variability in performance characteristics between and among stocks is thought to be related to this genotype variability with high *M. trossulus* stocks having lower productivity and poorer quality. Mussel production and seed collection in Newfoundland is currently concentrated in Notre Dame Bay where most known site sources of high-ratio *M. edulis* seed originate. Optimization of seed collection and the evaluation and development of new seed collection sources at or near existing farm sites will increase the supply of high quality seed to the expanding industry. Species composition of samples collected from potential seed stock sources in Notre Dame Bay was determined by two diagnostic markers, Me15/16 and ITS using PCR and Restriction Fragment length analysis. All sites examined had a species composition of greater than 90% *M. edulis* for both markers. Based on the needs of industry, it is recommended that these sites be considered as alternative sources of high quality seed.

Impact de la teneur en oxygène dissous sur la survie du loup tacheté (*Anarhichas minor*) de souche québécoise.

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Le loup tacheté au Québec représente un potentiel novateur en aquaculture. Le système préconisé pour son élevage est celui en circuit fermé. Une telle méthode d'élevage peut entraîner de rapides et importantes fluctuations en oxygène dissous dues, principalement, au faible volume d'eau dans le système et à la densité élevée d'individus. Pour prévenir des mortalités massives il est donc important de déterminer la tolérance du loup tacheté à de faibles teneurs en oxygène dissous (hypoxie). Pour ce faire, deux approches sont comparées. D'une part, la méthode classique en toxicologie appelée CL50, pour concentration létale pour 50% des individus, est utilisée. Cent soixante individus sont répartis dans chacun des 16 bassins dont le niveau d'oxygène dissous est contrôlé par ordinateur. La normoxie ainsi que quatorze niveaux d'hypoxie variant de 14% à 28% de saturation sont étudiés. Le nombre de survivants et de morts après 96 heures d'exposition sert à déterminer la CL50. La seconde approche, appelée PO2 critique, détermine le niveau d'oxygène dissous à partir duquel le poisson ne peut plus soutenir son métabolisme standard. Cette fois, 20 individus sont étudiés. La tolérance du loup tacheté à l'hypoxie selon ces deux méthodes est ensuite discutée.

Effect of chronic sublethal hypoxia on growth and physiology in the wolffish (*Anarhichas minor*) and the hybrid (*A. lupus x A. minor*).

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It is widely known that oxygen is essential for life by playing a key role as the final receptor in the mitochondrial electron system. Except at very high altitude, oxygen availability is stable and high in air. But dissolved oxygen (DO) is at much lower concentration in water and very variable. Hypoxia (low dissolved oxygen) is a common phenomenon in aquatic environments and in aquaculture but this is not the case in the aquatic system, where the oxygen level are expose to variation and low dissolved oxygen (DO) level (hypoxia). Aquatic organisms have consequently developed a large range of physical and physiological adaptations to survive to unfavorable DO level. However, these adaptations are costly for the organism in term of growth, reproduction and health condition. In our study, potential candidates for cold water fish farming, the spotted wolffish and the hybrid *A. lupus* x *A. minor* have be exposed to 4 different levels of DO during 3 months. We studied the impact of hypoxia on growth, fish condition and ingestion rate, the hematocrit, the activity of key enzymes for aerobic and anaerobic metabolic pathways, antioxidant activity and oxidative stress damage.

From culture to conservation: a workshop to develop advanced reproductive technologies for sturgeon.

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A workshop on sturgeon supported by NSERC and ACRDP was held in March 2010 at the **Biodôme de Montréal**. The goal of this activity was to identify major gaps related to reproductive technology in sturgeon and target R&D efforts and groups to address identified needs. The objectives of the workshop that featured industry participation, were to review the current available methods (advantages and disadvantages) in regard to all aspects (morphology, physiology, reproduction) of sex differentiation in sturgeons, target preferred methods that could be useful for the aquaculture industry as well as for wild stock managers and identify the R&D necessary to put in practice the target methods and its commercialization in industry (aquaculture) as well as uses in wild stock management (conservation). Participants included representative from Germany, California, British Columbia, New-Brunswick and Québec.

Development of a new declumper-grader for the mussel industry in Quebec, Canada

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The mussel industry in Quebec is looking for new technologies in order to optimize their operations and reduce their production costs. When harvesting, producers use the standard New-Zealand model of declumper-grader, which has some disadvantages in terms of footprint on the deck and grading accuracy. The design and the test of a new model were undertaken. The objective was to bring together the advantages of compactedness and grading efficiency and the performance of this declumper-grader was compared with the efficiency of the standard declumper-grader. Different parameters like quality of the grading, capacity per hour, final product appearance, easiness installation and maintenance were assessed for each model when harvesting mussel spat and 50 mm mussels. The results show that the capacity per hour of the new declumper grader (705,1 ± 106,3 kg) was slightly less than what was observed when using the traditional model (735.3 ± 40.0 kg) to grade 50 mm mussels. However, one grading operation with the prototype gave the same results, in terms of grading efficiency, than grading the mussel successively in two standard machines. For the mussel producers, this would translate into less operating costs and increased profitability.

Evaluation of a mussel seed transfer experiment from two Newfoundland bays to a single recipient site with reference to genotype profiling, shell morphometrics, and growth rate

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Three mussel seed sites were evaluated for quality and production following transfer during a 15 month period from August 2008 to November 2009. Seed was transferred from two donor sites (Woodfords Arm and Strong Island Sound) to a recipient site (Reach Run) and monitored for growth rate, shell morphometrics, and genotype. Locally collected seed was also evaluated from the recipient site. Wild shore mussels from Reach Run were evaluated for comparison. Genotype data from Woodfords Arm and Strong Island Sound showed a species profile distribution in excess of 90% *Mytilus edulis.* In contrast, local seed from Reach Run gave 13% *M. edulis*, 48% *M. trossulus* and 39% hybrids. Wild shore mussels indicated a genotypic profile composed primarily of *M. edulis*. Morphometrical comparisons of seed indicated that Woodfords Arm and Strong Island Sound consistently gave larger mussels with stronger shells when compared to seed from Reach Run. Growth rates were consistently better for seed collected from the donor sites then from the local recipient site. Considerable variation in mussel size (length and weight) was noted for seed from all sources during the trial. Results indicate that donor sites should be evaluated individually for performance and managed so only the best product is marketed.

Adhesion of *Streptococcus iniae* to gill tissue of rainbow trout *Oncorhynchus mykiss*

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Ability of *Streptococcus iniae* to adhere to the gill tissue of rainbow trout (*Oncorhynchus mykiss*) was evaluated. For that purpose, a gill perfusion model was used offering a number of advantages compared to other *in vitro* and *in vivo* gill perfusion models. The overall objective was to study the interaction between *S. iniae* and rainbow trout during the infection process. Experiments were additionally carried out to assess the influence of temperature and water quality (nitrite, organic material) on the adhesion process of the

bacterial cells. The perfused gill of fish were injected with *S. iniae* strain and incubated in an aerated bath for 60 min at different temperatures. After incubation, samples of the gill were taken for bacteriologic, histologic and electron microscopic examinations. Results showed that the bacteria are capable of adhering to gill tissue of rainbow trout. Bacteriological examination proved that the number of gill-associated *S. iniae* was higher for 22ºC than for 14 and 30 ºC. Indeed, histological samples clearly showed numerous Gram-positive, encapsulated coccus bacteria which were associated with the gill tissue. It was also cleared which adhesion of *S. iniae* was affected by a number of factors. These were immersion of the gill arches in water to which organic material or nitrite were added and elevated temperature. All of them increased the bacteria's adhesion ability.

Oyster aquaculture using the French string technique in the Baie des Chaleurs, New Brunswick

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Since late 1990's, in New Brunswick, oysters have been grown in suspended gear such as floating Vexar™ bags and Dark Sea™ trays. The gear is typically suspended from longlines, which can easily be lowered below thick ice cover during the winter months. Another oyster growing technique from Mediterranean France (Étang de Thau) has recently been explored in northern New Brunswick with interesting results. The technique consists of gluing oysters on strings using a cement mixture and culturing the oyster in suspension by hanging the strings from permanent structure anchored on the bottom. In New Brunswick however, most oyster sites are too shallow for such a set-up; therefore, a modified design of 10 strings held within a steel frame was developed. Where deeper water is available, a multi level steel frame can hold 72 strings. Each string can hold 60 oysters. Preliminary results indicated that when this technique was practice in a sheltered inshore environment, oyster's performance in terms of growth and quality was better when compared to oysters cultured using other suspended techniques. In 2009, a new study was launched to assess the performance of oysters suspended on French strings in an exposed offshore environment compared to a sheltered inshore environment with respect to their ability to rapidly attain market size.

Intertidal shellfish farming and ecosystem functioning

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Beaches in Baynes Sound (BC) have been exploited for shellfish farming since the early 1900's and production there is now concentrated on epibenthic Pacific oysters (*Crassostrea gigas*) and endobenthic Manila clams (*Tapes philippinarum*). Studies have shown that these types of shellfish farming may modify biodiversity and sediment composition locally but little is known about how they may influence the functioning of the intertidal ecosystem. During the summer of 2009, we did a study comparing ecosystem services (sediment composition, oxygen consumption, and nutrient fluxes to the water column) provided by shellfish farms and reference sites. It was predicted that sediment organic matter would be increased in farm locations relative to controls and that this and respiration by farmed bivalves would modify oxygen consumption and nutrient fluxes in farm areas. As predicted, sediments in shellfish culture areas were organically enriched. In contrast, O_2 consumption and fluxes of, NH_4^+, NO_3^-, PO_4^{3-} and SiO_4 at the water / sediment interface did not differ among treatments. At this point of analysis, we hypothesize that a higher abundance of phytobenthos in sediments in shellfish farms may explain such results.

Strain effect on growth performance of triploid Atlantic salmon, *Salmo salar*.

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This study examined the effect of strain on the growth of triploid (sterile) Atlantic salmon post-smolts in a 12-week tank trial. Three strains were used: two domesticated (Canadian-origin "Cascade" and Norwegian-origin "Mowi") and one wild (Canadian-origin St. John River; SJR). These were compared to diploids of two domesticated strains: the same Mowi strain and a top-performing Bay of Fundy commercial strain derived from SJR stock. This is the first time a comparison of North American and European-origin triploids has been undertaken under identical conditions. All fish were individually PIT-tagged and were measured every 4 weeks. Triploid SJR fish consistently had the highest specific growth rate (SGR), even higher than the domesticated diploid SJR fish, and triploid Cascades had the lowest. Ploidy did not affect the SGR of Mowi

fish, which tended to be intermediate between triploid and diploid SJR. This shows that triploid growth performance is influenced by strain of origin, with locally adapted (St. John River) triploids outperforming triploids of Québec (Cascade) and European (Mowi) origin. In the only true within-strain evaluation in this study, it also shows that triploids and diploids grow equally well as post-smolts in tank experiments.

Evaluation of the stress response of the Spotted wolffish (*Anarhichas minor*) to density and a stressful event reveal a true farming-friendly species.

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Spotted wolffish (*Anarhichas minor*) is a benthic species found in the northern Atlantic Ocean and has been identified as a promising species for cold-water aquaculture. Advantages of raising this species are numerous: a high growth rate, a low disease susceptibility, tolerance to large water quality variations and a very calm and non-aggressive behavior in captivity in opposition to their reputation of aggressive fish in their wild habitat. In aquaculture conditions, many stressors can cause imbalances in the organisms and impair growth performances. Consequently, determining the optimal culture conditions and their impact on fish welfare is of primary importance. Juvenile wolfish (n=199) were individually tagged and submitted to 3 different densities 10, 20 and 40 kg/m2 for 120 days and a stressful event was applied (fish were kept out of the water for 1 minute in a fish net). Parameters measured includes: weight and length, haematocrit, hepatosomatic index, muscle and liver water content and plasma concentration of Na+, K+, protein, lyzozyme and cortisol. Results shows that spotted wolffish have a good tolerance to crowding and stress.

Knowledge transfer and skills development during the transportation and movement of fish

J. Seabi

A survey was conducted in the National Zoological Garden of South Africa during the month of September 2009 to January 2010 to assess the transportation of fish in the Aquarium. The purpose was to collect baseline information between the zoo keepers and educators on how to transport or move fish in the Aquarium. Details about the movement

and transportation of fish were given for the wellbeing of fishes being transported, including transportation within institution premises and transfers from one institution to another. Skills, training and experience were shared among the keepers to ensure the wellbeing of fish such as medical requirements, container size, size of the tanks, temperature and life support system. The other changes in an animal's normal behavior could be expected as a result of being moved and transported, and every precaution was taken to ensure the safety of the animals such as recognizing the territorial behavior, ages, sex and health. The implications of these appropriate steps (such as use of tranquillizers), which is taken to reduce the stress levels of fish and water quality is discussed. The major handicap in the development of transporting or moving fish in the Aquarium is skill shortage among workers. In conclusion this paper will discuss how staff interact and share experience and knowledge within the community of zoo keepers, aquarist and zoo educators.

Effect of finfish aquaculture operations on biochemical composition and growth of algae

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Output of nutrients in the effluent from finfish aquaculture operations can lead to various environmental impacts. We are studying the dissolved inorganic nutrients associated with finfish aquaculture and their effects on algae. Three species of microalgae, *Isochrysis* sp., *Nannochloropsis salina* Hibberd and *Chaetoceros muelleri*, were cultured in the effluent from land-based juvenile Atlantic cod (*Gadus morhua*) tanks. Three methods were chosen to sterilize the effluent in preliminary experiments: autoclaving, filtration, and ultraviolet light. The algae grown in filtered effluent had the highest growth rate, followed by ultraviolet light and autoclaving, suggesting filtration and ultraviolet light are practical methods for sterilizing effluent in large scale culture. In a separate study, Atlantic salmon cage sites in the Broughton Archipelago, British Columbia were sampled by retrieving macroalgae and performing 20 μm net tows in transects surrounding the farms. The levels of dissolved inorganic nutrients surrounding cage sites were significantly higher than normal. Total lipid concentrations in net tows were significantly higher than in fucus and eelgrass. Bacterial fatty acids in fucus correlated negatively with distance from farms, while fucus PUFA correlated positively with distance from farms. In addition, principal components analysis suggests different effects of finfish aquaculture on the biochemical composition of different species.

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