

Cultivating Diversity and Success

Cultiver le Succès et la Diversité

Program Guide / Guide de programme

Aquaculture Canada^{OM} 2011 Conference



Québec City / Ville de Québec, 8-11 May / mai 2011

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COMITÉ DES AFFAIRES ÉTUDIANTES AC2011***

***Support the AAC Student Endowment Fund
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***Dr. Joe Brown Student BBQ / Barbecue Dr. Joe Brown
L'Aquarium du Québec***

Tickets \$30 (available at registration desk)

Billets 30\$ (disponible à l'inscription)

6:30pm – Tour of aquarium

18:30h – Tour de l'aquarium

7:30pm – dinner featuring local cultured trout & mussels

19:30h – souper – en vedette truite et moules du Québec

(Buses leave hotel at 5:45pm)

(Les autobus partent de l'hôtel à 17:45h)

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Aquaculture Canada^{OM} 2011

Partners and Contributors / Partenaires et Commanditaires

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Aquaculture Association of Canada
Interprovincial Partnership for Sustainable Freshwater Aquaculture
Réseau Aquaculture du Québec
Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec
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- Société de développement de l'industrie maricole du Québec (SODIM)
- Pêches et Océans Canada / Fisheries and Oceans Canada
- National Research Council of Canada / Conseil national de recherches Canada
- Interprovincial Partnership for Sustainable Freshwater Aquaculture
- Canadian Aquaculture Industry Alliance

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| • Skretting | • FishFarming Xpert |
| • University of Guelph, Aquaculture Center | • Université Laval |

Silver Contributors / Commanditaires argent (\$300 +)

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- Atlantic Provinces Council on the Sciences, Aquaculture & Fisheries Committee
- RDI Strategies
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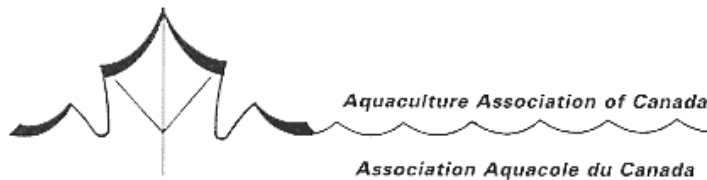
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Aquaculture Association of Canada / Association Aquacole du Canada

Welcome to Delegates / Mots de bienvenue aux délégués



On behalf of the Aquaculture Association of Canada, it is my great pleasure to welcome you to Aquaculture Canada 2011. The theme for our conference is *Culturing Diversity and Success*, a theme that is meant to apply at many levels as we meet in historic Québec City. Aquaculture success is apparent everywhere in Québec, in both freshwater and marine environments, and including fish, molluscs and aquatic plants. The industry is supported by numerous associations, government agencies and a very active research community. Our program includes a diversity of topics that should provide something of interest to every delegate. Particularly noteworthy is our partnership with the Interprovincial Partnership for Sustainable Freshwater Aquaculture Development (IPSFAD) to bring you the Freshwater Aquaculture Symposium running through all three days of the conference. Also, we join with Fisheries and Oceans Canada to celebrate the 10th anniversary of the Aquaculture Collaborative Research and Development Program (ACRDP). And with leadership from the Québec Ministry of Agriculture, Fisheries and Food (MAPAQ), we have an entire session devoted to lobster culture and enhancement. The principal objective of the Aquaculture Association of Canada is to foster a Canadian aquaculture industry by promoting the study of aquaculture and related science, by gathering and disseminating information relating to aquaculture, and by creating public awareness and understanding of aquaculture. Our annual conference is the primary mechanism by which we achieve this goal. Thank you for attending Aquaculture Canada 2011. I hope you learn new things, forge new partnerships, make new friends, and take home memories of this beautiful city.

Au nom de l'Association aquacole du Canada, il me fait grand plaisir de vous accueillir à Aquaculture Canada 2011. Le thème de notre conférence est « Cultiver le succès et la diversité », thème qui prend tout son sens dans le cadre de notre rencontre dans la ville historique de Québec. Le succès en aquaculture est présent partout au Québec, qu'il s'agisse d'environnements d'eau douce ou salée, incluant poissons, mollusques et plantes aquatiques. L'industrie y est soutenue par de nombreuses associations et organismes gouvernementaux ainsi qu'une communauté de recherche très active. Notre programme comprend une diversité de sujets qui devrait permettre à chaque participant d'y trouver son intérêt. Il faut souligner tout particulièrement notre association avec le Partenariat interprovincial pour le développement durable de l'aquaculture en eau douce (PIDDAED) qui tiendra son symposium durant les trois jours de la conférence. Nous sommes également fiers de nous joindre à Pêches et Océans Canada pour célébrer le 10^e anniversaire du programme coopératif de recherche et développement en aquaculture (PCRDA). Grâce à l'initiative du ministère de l'Agriculture, des Pêcheries et de l'Alimentation (MAPAQ), nous aurons une session entièrement consacrée à la culture et à l'ensemencement du homard. L'objectif principal de l'Association aquacole du Canada est de favoriser le développement d'une industrie aquacole canadienne en favorisant l'apprentissage de l'aquaculture et des disciplines scientifiques qui la sous-tendent, en permettant la collecte et la diffusion d'informations relatives à l'aquaculture et en fournissant une information grand public qui permette une meilleure compréhension et une sensibilisation à l'aquaculture. Notre congrès annuel est pour nous le meilleur moyen d'atteindre cet objectif. Nous vous remercions de participer en si grand nombre à Aquaculture Canada 2011. J'espère que ce congrès vous permettra d'apprendre de nouvelles choses, d'établir de nouveaux partenariats, de faire des nouvelles rencontres, et que vous garderez un souvenir mémorable de la magnifique ville de Québec.

Tillmann Benfey, President, Aquaculture Association of Canada / Président, Association Aquacole du Canada

Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec Welcome to Delegates / Mots de bienvenue aux délégués



C'est un grand plaisir pour moi de souhaiter la bienvenue aux participants de la 28^e Conférence de l'Association aquacole du Canada. Je remercie les organisateurs qui, pour la quatrième fois, ont choisi la ville de Québec pour tenir leur conférence annuelle et leur assemblée générale.

Au Québec comme partout dans le monde, la demande pour les produits aquacoles s'intensifie. En 2010, l'industrie aquacole et le gouvernement du Québec ont mis en place un plan de développement sectoriel afin d'établir l'aquaculture québécoise comme une composante importante du développement durable du Québec. Les actions que ce plan contient visent notamment à accroître la présence de nos produits aquacoles sur les marchés.

La tenue de cet événement arrive donc à point nommé. Le thème « Cultiver le succès et la diversité » ainsi que le programme scientifique riche et diversifié font appel aux compétences des participants. Pour votre bénéfice, ils vous garantissent des échanges de vues de haut niveau et l'acquisition de nouvelles connaissances tant dans le domaine de l'aquaculture en eau douce que dans celui de l'aquaculture en eau salée. Nos chercheurs québécois profiteront d'ailleurs de l'occasion pour vous présenter les résultats de leurs plus récentes recherches.

Je vous souhaite une fructueuse rencontre et un agréable séjour dans la ville de Québec.

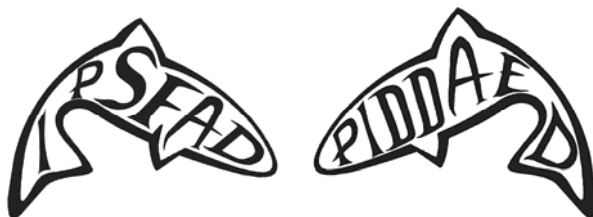
Le ministre de l'Agriculture, des Pêcheries et de l'Alimentation,
ministre responsable des régions de l'Abitibi-Témiscamingue
et du Nord-du-Québec et député d'Abitibi-Est,

A stylized, handwritten signature in black ink, which appears to read 'Corbeil'.

Pierre Corbeil

Québec 

**Interprovincial Partnership for Sustainable Freshwater Aquaculture / Partenariat
Interprovincial pour le Développement Durable de l'Aquaculture en Eau Douce
Welcome to Delegates / Mots de bienvenue aux délégués**



The IPSFAD is a non-profit organisation dedicated to promote technological developments through R&D and commercialization activities with a goal to enhance productivity and sustainable development of the Canadian freshwater aquaculture industry.

On behalf of the IPSFAD Board of Directors and the organising committee of the 3rd National Freshwater Symposium, I would like to welcome all to this year's Aquaculture Canada meeting. With a new Industry Action Plan in place, the IPSFAD and its partners will highlight a number of themes during the Freshwater Symposium that have been identified as challenges to the development of this sector. We invite you to join in on our presentations and discussions and assist in promoting approaches for further sustainable development of the freshwater aquaculture industry in Canada.

Grant Vandenberg

President, Interprovincial Partnership for Sustainable Freshwater Development (IPSFAD) Inc.

Le PIDDAED est un organisme sans but lucratif voué à promouvoir le développement technologique par la R&D et les activités de commercialisation dans un but d'améliorer la productivité et le développement durable de l'industrie canadienne de l'aquaculture en eau douce.

Au nom du Conseil administratif du PIDDAED et du comité d'organisation du 3^{ème} Symposium sur l'aquaculture en eau douce, je voudrais vous souhaiter la bienvenue à la conférence Aquaculture Canada 2011. Avec un nouveau plan d'action de l'industrie en place, le PIDDAED et ses partenaires mettront en lumière un certain nombre de thèmes au cours du Symposium sur l'aquaculture en eau douce qui ont été identifiés comme des défis au développement de ce secteur. Nous vous invitons à vous joindre à nos présentations et discussions et à nous aider à promouvoir des approches qui permettront le développement durable de l'industrie aquacole en eau douce au Canada.

Grant Vandenberg

Président, Partenariat interprovincial pour le développement durable de l'aquaculture en eau douce Inc.

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 2011.

The theme of this year's conference "Culturing Diversity and Success" speaks to the importance of addressing constraints to industry's growth and expanding the diversity of Canada's aquaculture industry.

Today, commercial aquaculture operations exist in every province as well as in the Yukon Territory, and the sector accounts for one third of the total value of Canada's fisheries production. We also culture a variety of aquaculture products (Canada is the fourth-largest producer of farmed salmon in the world and a significant producer of blue mussels, Manila clams, Atlantic and Pacific oysters and rainbow trout). However, after a quarter-century of development, Canadian aquaculture still has considerable untapped potential. In fact none of the major aquaculture species produced in Canada has demonstrated appreciable growth in the last ten years. As a result, we are falling behind on the world stage, and losing investment opportunities to our competitors.

With a vast biophysical resource base, a reputation for quality products, an internationally reputable food inspection system and highly skilled workers, Canada is ideally positioned to be a leading internationally competitive producer of not only farmed salmon, but a wide variety of other farm-raised fish and seafood.

Advancing industry diversification requires many factors to be in place, including streamlined regulations, effective communications and partnerships, as well as strong government investment and support. The wide variety of stimulating presentations and networking opportunities planned for AC 2011 will no doubt help to further clarify the constraints, reinforce the opportunities and focus our efforts. Collectively, we need to harness the ideas and energy coming from this conference – as we must advance this sustainable food producing sector, for the benefit of all Canadians. The CAIA Board of Directors applauds the theme of this year's conference and wishes all participants a productive and successful conference.

Ruth Salmon, Executive Director, Canadian Aquaculture Industry Alliance

Réseau Aquaculture du Québec
Welcome to Delegates / Mots de bienvenue aux délégués



Il me fait grand plaisir, au nom du Réseau Aquaculture Québec, de me joindre à l'ensemble des partenaires pour vous souhaiter la bienvenue à Aquaculture Canada 2011. Le congrès de l'Association aquicole du Canada est un événement d'importance lorsque l'on fait référence au maillage recherche-industrie-gouvernements. Pour nos étudiants aux cycles supérieurs, il s'agit souvent d'une première expérience de présentation de leurs résultats de recherche à un auditoire plus vaste que le seul secteur académique, ce qui est un élément non négligeable de leur formation. Je suis ravie de les voir participer en grand nombre à cet événement. Permettez-moi de vous souhaiter à tous un très agréable séjour dans la ville de Québec et un congrès des plus enrichissants.

Céline Audet, Directrice scientifique

On behalf of the Réseau Aquaculture Québec, it is an honor to join the other members of the organization to welcome you at Aquaculture Canada 2011. The annual meeting of the Aquaculture Association of Canada plays an important role in research-industry-government networking. For our graduate students, it is often their first experience presenting their research results to an audience that goes beyond the academic world and this represents a key training asset. I am very pleased to see that many registered for this event this year. I hope you will have a pleasant stay in Québec City and will enjoy the meeting.

Céline Audet, Scientific Director

Société de Développement de l'Industrie Maricole **Welcome to Delegates / Mots de bienvenue aux délégués**



La Société de développement de l'industrie maricole (SODIM) inc. est un organisme sans but lucratif dont la mission est de contribuer à la création et au développement d'entreprises de mariculture rentables et compétitives. Pour réaliser sa mission, la SODIM dispose de deux fonds d'investissement dont les conditions d'intervention sont complémentaires. Ces deux outils permettent à la SODIM d'agir comme une société de capital de risque spécialisée en mariculture. À ce jour, la SODIM est impliquée financièrement dans une vingtaine d'entreprises des régions maritimes.

Depuis 2002, la SODIM assume aussi la gestion d'un fonds de recherche et développement (R/D) en aquaculture. Doté au départ d'une importante enveloppe budgétaire, ce fonds a permis la réalisation de plus de 225 projets touchant des aspects biotechniques, environnementaux ou économiques en mariculture.

En sus de son implication dans le financement des entreprises ou des projets de R/D, la SODIM assume la mise en œuvre ou la coordination de dossiers d'intérêts communs pour les entreprises maricoles. La SODIM souhaite un bon congrès et un bon séjour à Québec à tous les participants.

Cultiver la mer pour favoriser l'essor économique des régions maritimes

Regroupement des mariculteurs du Québec

Welcome to Delegates / Mots de bienvenue aux délégués



C'est avec grand plaisir que, au nom du Regroupement des mariculteurs du Québec, je vous souhaite la plus cordiale bienvenue chez-nous, au Québec. Que ce congrès soit des plus riches en information et en échanges, et que votre séjour dans la vieille Capitale soit des plus agréables.

Le Regroupement des mariculteurs du Québec, comme son nom l'indique, rassemble les aquaculteurs québécois en eau salée. La presque totalité des entreprises maricoles québécoises sont membres de notre regroupement. Avec les années, notre membership, composé initialement presque exclusivement de producteurs de moule, s'est enrichi pour inclure aujourd'hui des producteurs de pétoncle et de mye. De plus, certaines de ces entreprises expérimentent la culture de l'algue et de l'huître. Cette diversité dans la production, et l'intérêt qui se manifeste chez des personnes désirant se lancer en mariculture, est un gage d'espoir malgré les défis que connaît encore l'industrie.

Le présent congrès offrira, tant aux entreprises aquacole en eau douce qu'aux entreprises maricoles, une occasion privilégiée pour se mettre à jour sur les initiatives en recherche et développement qui touchent notre secteur. Ce sera le moment aussi d'échanger entre nous sur les sujets qui nous tiennent tant à cœur pour le développement de notre industrie.

Toutes nos félicitations à l'Association aquacole du Canada et aux organisateurs de ce congrès et que ce rendez-vous contribue à l'avancement de l'aquaculture.

Merci et bon congrès! Manon Deslauriers



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On behalf of the Regroupement des Mariculteurs du Québec, it is my pleasure to welcome you to Québec City. We hope your stay in the city will be most pleasant and that you will enjoy this conference.

The Regroupement is the provincial association of marine aquaculture businesses of Québec. Most marine farmers of the Province are members. Initially, our membership included mainly mussel farmers. We now include scallop and clam farmers and in recent years, some members are trying oysters and seaweeds. This diversification along with a growing interest in starting new farms is a good indicator that our industry is growing and has a great future despite its initial difficulties.

This meeting will be a great opportunity for all of us to get an update on recent research activities in the area of both marine and freshwater aquaculture. It will also be an occasion for productive exchanges with colleagues on topics related to our industry and its development.

Finally, we would like to thank and congratulate the AAC and the organizing committee for this conference which will without doubt contribute to the expansion of aquaculture.

Thank you, and have a wonderful time at this conference. Manon Deslauriers

Message du maire de Québec

Québec est fière d'accueillir le 28^e congrès annuel de l'Association aquacole du Canada. C'est avec un grand plaisir que je souhaite à tous les participants la plus cordiale des bienvenues.

S'il est une industrie qui a connu une croissance fulgurante au cours des dernières décennies, c'est bien celle de l'aquaculture. Pour répondre à une demande sans cesse grandissante et « cultiver le succès », les intervenants doivent relever le défi de l'innovation et du savoir-faire. Dans cet esprit, le congrès annuel de l'Association porte la promesse d'échanges enrichissants et stimulants qui serviront l'avancement des connaissances et l'efficacité des pratiques.

Avec son décor enchanteur, ses quartiers animés et sa tradition d'hospitalité, Québec constitue le lieu idéal pour joindre l'utile à l'agréable. Bordée par le Saint-Laurent et sillonnée de rivières, elle vous accueille dans toute sa splendeur printanière. Je vous invite à en découvrir les nombreux attraits, où l'art, la culture, le plein air et la gastronomie occupent une place de choix.

Félicitations aux organisateurs de l'événement!

À tous et à toutes, je souhaite un excellent séjour parmi nous!

Le maire de Québec,



Régis Labeaume



AAC Research Award of Excellence / Prix d'excellence en recherché

This award recognizes high quality, innovative and current research that has had a significant impact on the aquaculture industry in Canada.

Ce prix reconnaît la recherche en cours de haute qualité et innovatrice, qui a eu un impact significatif sur l'industrie aquacole au Canada.

Debbie Martin-Robichaud



Debbie Martin-Robichaud, the recipient of the AC 2011 Research Award of Excellence, has been engaged in aquaculture research at the DFO St. Andrews Biological Station (SABS) since the late 1980s. Debbie gained significant experience working as a technician before moving up the ranks to research scientist. She was on the AAC Board of Directors for many years and President of the Association in 2009. Her interest and current focus on sex control in fish started with her research on direct hormonal feminization of lumpfish for her MSc at the University of New Brunswick. Currently she leads the Marine Fish Reproductive Physiology and Broodstock program at SABS. Debbie has been actively involved in research to development alternate species for aquaculture such as Atlantic halibut, haddock and Atlantic cod. Her research has addressed issues pertaining to environmental physiology related to culture conditions, reproductive biology, ultrasonography, molecular genetics and sex control. The most fulfilling aspects of her job involve her close collaborations with industry, supervising graduate students and participating in research collaborations with outstanding colleagues and friends.

Debbie Martin-Robichaud, récipiendaire du prix d'excellence en recherche du AC 2011, a été engagé dans la recherche en aquaculture au MPO, à la Station Biologique à St Andrews (SBSA) depuis les années 80. Debbie a gagné de l'expérience significative comme une technicienne avant de monter les rangs pour devenir une chercheuse scientifique. Debbie était sur le conseil d'administration d'AAC pour plusieurs années et présidente de l'association en 2009. Son intérêt axer sur le contrôle des sexes chez les poissons a commencé avec sa recherche sur la féminisation hormonale directe de la poule de mer pour sa MSc à l'Université de Nouveau Brunswick. Actuellement elle mène le programme de physiologie de la reproduction de poisson marin et stock de géniteurs à la SBSA. Debbie a été activement impliqué dans la recherche pour le développement d'espèce alterne pour l'aquaculture comme le flétan commun, l'aiglefin et la morue. Sa recherche a adressé des problèmes qui rapportent à la physiologie écologique liée aux conditions de culture, la biologie reproductrice, ultrasonography, la génétique moléculaires et le contrôle des sexes. Les aspects les plus satisfaisant de son travail impliquent ses proches collaborations avec l'industrie, surveillant des étudiants diplômés et sa participation dans des recherches concertées avec des collègues remarquables et amis.

In Memoriam
John M. Anderson, PhD
(03.09.1926 – 24.03.2011)



1985: The AAC *pro tempore* Executive known as the “St. Andrews Mafia”
L-R: Dave Aiken (Vice President and President-Elect), John Anderson (President),
Charles (Chuck) Schom (Secretary) (PWG McMullon photo)

John Anderson recently passed away at his home in St. Andrews, New Brunswick, was the Founding President of the Aquaculture Association of Canada. The following text was prepared by Dr. David Aiken, another founding member of the AAC and its second President.

John Anderson’s contribution to the creation of the AAC

The Bay of Fundy is a finalist in the Seven Wonders of Nature contest, and it is justly famous for its world-record tides, its diversity of marine life and its phenomenal geologic history, but in the less rarefied environment of Canadian aquaculture science, it is also known as the place where the Aquaculture Association of Canada got its start nearly 3 decades ago. John Anderson’s name figured significantly in that event. What follows is, as Paul Harvey likes to say, “the rest of the story.”

The year was 1983 and the setting was the ferry from Black’s Harbour to Grand Manan, plunging through an angry sea toward port at North Head some 16 km away. White-topped waves driven by a southwest wind hammered the bow of the big ship, making the journey unpleasant for the passengers. John Anderson was one of a trio of flatlanders on board that day who lacked the sea legs to enjoy such a journey. The other two were Nigel Robbins, a trout farmer from Ontario, and Dave Aiken, a research scientist with DFO at St. Andrews. They were gathered at this unlikely spot to discuss moving ahead with plans for the formation of a national aquaculture association in Canada.

Dave was, at the time, a member of the Board of Directors of the World Aquaculture Society (WAS) and chairman of a committee to develop a global affiliation of national aquaculture societies. He had been specifically asked by the WAS Board to foster the development of such an association in Canada and to encourage its affiliation with the WAS. Nigel, a trout farmer from Ontario, had recently received funding from the federal government to explore Canadian interest in forming a national aquaculture association. His initial enquiries had indicated a strong interest across the country. John, an acknowledged visionary and irrepressible promoter of worthwhile causes, was a research scientist with a deep affection for Atlantic salmon and an unwavering confidence in Canadian aquaculture potential. He enthusiastically endorsed the concept of a national association to promote development of the industry.

Two months later, on July 14, 1983, the Aquaculture Association of Canada was formed by 17 of the attendees at the Canadian National Aquaculture Conference held at the Algonquin Hotel in St. Andrews, New Brunswick. From day-1 there were strong differences of opinion regarding the mandate of the organization. Two opposing factions emerged: Those who felt passionately that the new AAC should be a trade organization, a cohesive producer group run by and speaking for aquaculture growers across Canada. Opposing them with equal fervour were the so-called “academics”, who believed the new AAC would have more credibility if it avoided the vested interest of industry and acted primarily as a forum for discussion of emerging issues and a conduit for information and research of relevance to the aquaculture industry. A *pro tempore* executive nicknamed the “St. Andrews Mafia” (John Anderson, Chuck Schom and Dave Aiken) was established to resolve these philosophical conflicts and move the organization toward incorporation and viability. In March of 1984, the embryonic AAC joined with the WAS to co-sponsor a multinational aquaculture science and technology meeting in Vancouver, British Columbia.

Squarely between the opposing philosophical factions at the lead-up to the founding of AAC stood John Anderson, a biologist, government bureaucrat, academic and researcher long known for his skills in consultation and collaboration. Who better to manage the escalating philosophical differences between scientist and grower as regards the new Aquaculture Association? It is often said that timing is everything in life, and so it was with John and the AAC conundrum. Never intimidated by thorny assignments, John stepped into the breach to soothe inflamed egos on both sides, convincing them that they had more to gain by working together than by going at each other’s throats. His success in this endeavour ensured his nomination and election as the AAC’s first President in 1984. The rest, as they say, is history.

David Aiken, St. Andrews, April 2011

Anyone wishing to make a donation in John Anderson’s memory is encouraged to consider one of these two charities dear to John’s heart: the Huntsman Marine Sciences Centre (<http://www.huntsmanmarine.ca>) or the Fundy Community Foundation (<http://www.fcf.nb.ca>).

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Welcome to / Bienvenu à Aquaculture Canada 2011

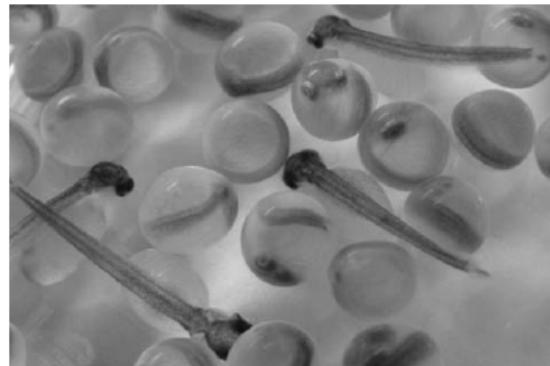
Third National Symposium on Freshwater Aquaculture / Troisième symposium national en aquaculture d'eau douce



*The Canadian Model AquaFarm project—Manitoba
(photo: Dan Stechey, CAS)*

Nous vous invitons à vous joindre à nos présentations et discussions et à nous aider à promouvoir des approches qui permettront le développement durable de l'industrie aquacole en eau douce au Canada.

We invite you to join in on our presentations and discussions and assist in promoting approaches for further sustainable development of the freshwater aquaculture industry in Canada.



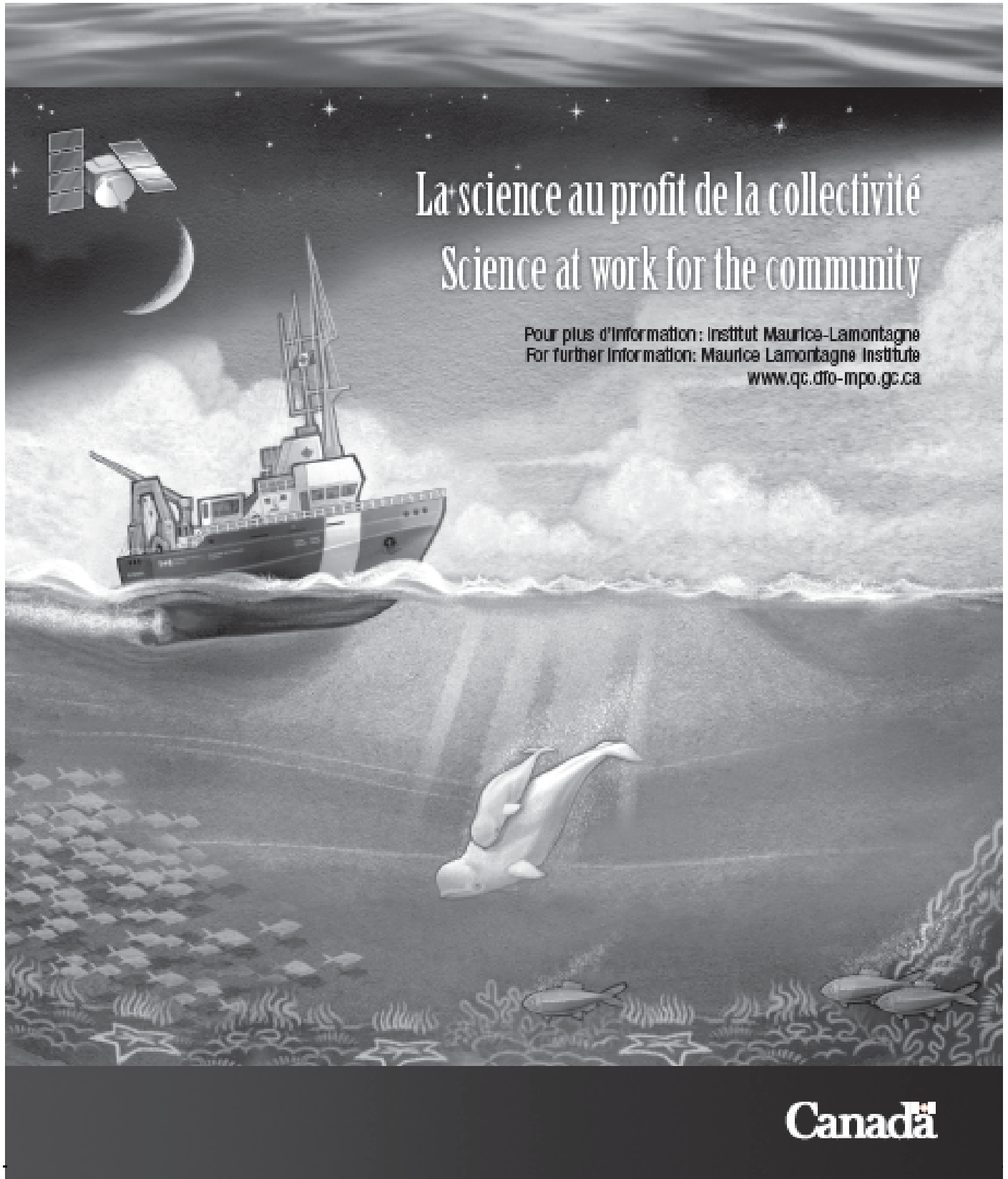
*National Selection and Breeding Program for Rainbow Trout
(photo: Emilie Proulx, U. Laval)*

The Organising Committee / le comité organisateur



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Canada

La Société de recherche et de développement en aquaculture continentale, SORDAC, est une personne morale autonome à but non lucratif créée en 1993 par les intervenants du secteur aquacole québécois. Son conseil d'administration est formé de douze administrateurs, soit onze, avec droit de vote, dont cinq proviennent de l'entreprise privée, quatre des milieux d'enseignement postsecondaire, deux du secteur public, et un, sans droit de vote, du secteur public. Ses 80 membres, représentés majoritairement par des pisciculteurs actifs, contribuent à l'essentiel de la production aquacole québécoise destinée à la consommation et à l'ensemencement.

Mission

La mission de la SORDAC consiste à :

- ✓ établir un consensus sur les priorités d'action à entreprendre;
- ✓ assurer la coordination et le financement d'activités de recherche et de transfert de technologie;
- ✓ susciter la mise en place de programmes de R&D intégrés avec des partenaires institutionnels et industriels;
- ✓ favoriser un maillage efficace entre partenaires de recherche et industriels;

afin d'accroître la productivité et la rentabilité des entreprises québécoises oeuvrant en aquaculture d'eau douce.

Mandats

Dans le cadre de sa mission, la SORDAC a notamment pour mandat :

- ✓ d'élaborer et de mettre en œuvre une stratégie de recherche et de transfert de technologie;
- ✓ de susciter et de financer des activités de recherche exploitables par l'industrie;
- ✓ d'organiser et de financer le transfert de technologie dans les entreprises;
- ✓ d'assurer la concertation des intervenants et la complémentarité des efforts en matière de R & D et de transfert de technologie;
- ✓ de procéder activement à la recherche de fonds pour le financement de ses activités.

The Society for Research and Development for Continental Aquaculture, SORDAC, is a not-for-profit organization created in 1993 by the key players of the Quebec freshwater aquaculture sector. The organization's board is comprised of twelve directors, eleven with voting rights from which five come from private companies, four from post-secondary institutions, and three from the public sector (one director of which does not have voting rights). Its 80 members are represented mainly by fish growers and contribute essentially to the freshwater aquaculture production intended for food consumption and stocking.

Mission Statement

- ✓ Create consensus regarding research, development and the priorities identified by the industry;
- ✓ Provide coordination and funding of research activities together with technology transfer;
- ✓ Create R&D programs with industrial and institutional partners;
- ✓ Create a network among various research partners and fish growers;

Mandate

Within the framework of its mission, the SORDAC has the mandate to:

- ✓ Establish and elaborate research and technology transfer strategies;
- ✓ Create and finance research activities profitable for the industry;
- ✓ Organize and finance the technology transfer expertise in the industry;
- ✓ Assure the cooperation of various players in the freshwater aquaculture sector regarding the R&D and technology transfer for optimal use of the resources.

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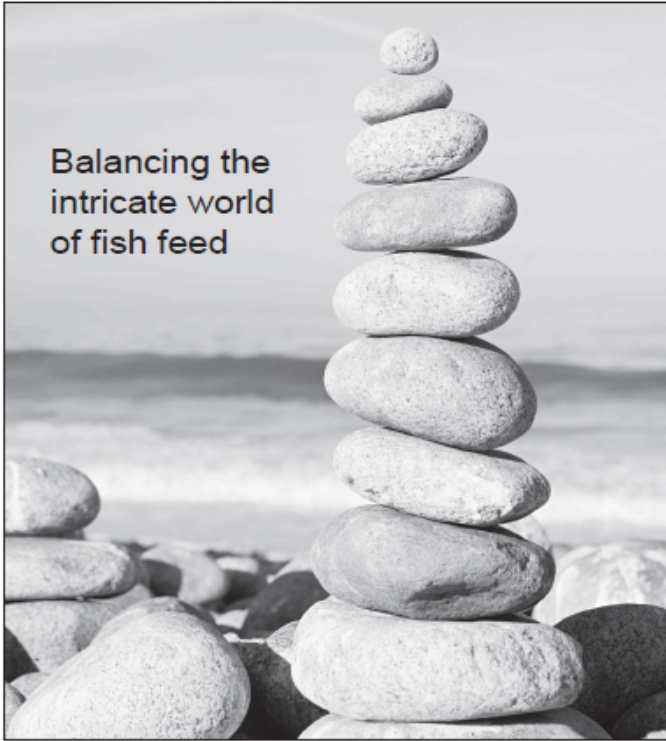


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Registration and Information / Inscription et informations

Registration / Inscription

Registration is located in the foyer outside of the grand ballroom (third floor) of the Loews Hôtel le Concorde Québec and operates daily as follows:

L'inscription se tient dans le foyer à l'extérieur de la salle de bal (troisième étage) du Loews Hôtel le Concorde Québec et les heures d'opération sont:

- Sunday May 8th / Dimanche 8 mai: 5:00 PM – 9:00 PM
- Monday May 9th / Lundi 9 mai: 7:00 AM – 5:00 PM
- Tuesday May 10th / Mardi 10 mai: 8:00 AM – 5:00 PM
- Wednesday May 11th / Mercredi 11 mai: 8:00 AM – 12:00 PM

Tickets for the banquet, barbeque and AGM must be obtained from the registration desk.

Vous devez obtenir les billets pour banquet, 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^{OM} 2011 name tag.

Vous devez porter votre carte d'inscription pour avoir accès aux salles de conférence.

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

Posters – Foyer, 3rd Floor, Loews Hôtel le Concorde Québec: Set-up time is Sunday May 8th from 5:00 PM to 7:00 PM. Presenters are asked to be available at their poster during the Poster Session on Tuesday May 10th from 5:00 PM to 6:30 PM as well as during morning and afternoon breaks. Posters should be taken down by 7:00 PM on Tuesday May 10th.

Affiches – Hall d'exposition, troisième étage, Loews Hôtel le Concorde Québec: Montage dimanche le 8 mai entre 17:00 et 19:00. Les présentateurs sont priés de se présenter dans le salon pour la session des affiches mardi 10 mai entre 17:00 et 18:30, et aussi durant les pauses-café. Les affiches doivent être enlevées au plus tard mardi le 10 mai à 19:00.

Speakers: Oral presenters are asked to meet their session chair and AV personnel no less than 15 minutes prior to the start of the 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, 2011 to Céline Audet (celine_audet@uqar.qc.ca) for publication in the conference proceedings.

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. S'il y a des changements dans le programme, ils seront annoncés au début de la session et affichés près de la salle au début de la journée. Les présentateurs d'affiches et de présentations orales sont encouragés à soumettre des résumés longs avant le 1 juin, 2011 à Céline Audet (celine_audet@uqar.qc.ca) pour le compte rendu de la conférence.

Media Room / Salle de media

A room can be made available for media related activities. Please see registration desk if required.

Une salle peut être disponible pour des activités relatives aux médias. SVP voir le bureau d'inscription s'il y a lieu.

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 de la session des affiches.

Refreshment Breaks / Pauses-santé

For your convenience, refreshment breaks will take place in the main foyer area.

Les pauses-santé auront lieu dans le foyer à l'extérieur de la salle de bal.

Refreshment breaks are / Pauses-santé:

Monday May 9th / Lundi 9 mai: 10:15-10:45AM and 3:20-3:40 PM

Tuesday May 10th / Mardi 10 mai: 9:40-10:00 AM and 3:20-3:40 PM

Wednesday May 11th / Mercredi 11 mai: 9:40-10:00 AM and 3:20-3:40 PM

Student Affairs and Events / Affaires étudiant(e)s

Student Awards: The AAC is pleased to have sponsored travel for over 14 students to attend the conference. 35 students will compete for Best Oral and Best Poster presentations.

Prix étudiant(e)s : L'AAC est fière d'avoir commandité plus de 14 étudiant(e)s avec des bourses de voyage pour participer à la conférence. 35 présentations par des étudiant(e)s seront faites lors la conférence.

AAC Annual General Meeting / Assemblée générale annuelle

The AGM will take place in the Suzor-Coté room, 6:30-7:30 PM, Tuesday May 10th. All AAC members are encouraged to attend.

L'AGA de l'AAC se tiendra dans la salle Suzor-Coté de 18h30-19h30, mardi le 10 mai. Les membres de l'AAC sont bienvenus de participer.

Social Functions / Évènements Sociaux

President's Reception / Réception de la présidente

Sunday May 8th, Suzor-Coté/Krieghoff, Loews Hôtel le Concorde Québec, 7:00-9:00 PM. Cash bar.

Dimanche 8 mai, Suzor-Coté/Krieghoff, Loews Hôtel le Concorde Québec. 19h00-21h00. 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 9th 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 9th, l'Aquarium du Québec, 6:30-11:00 PM. Tickets required in advance (includes bus cost to l'Aquarium du Québec from Loews Hôtel le Concorde Québec and return).

Barbecue Joe Brown pour le fond de support étudiant: Les profits des activités du barbecue aquacole lundi le 9 mai sont placés dans un fond de support sous forme de bourses pour les étudiant(e)s. On encourage les étudiant(e)s à participer au barbecue

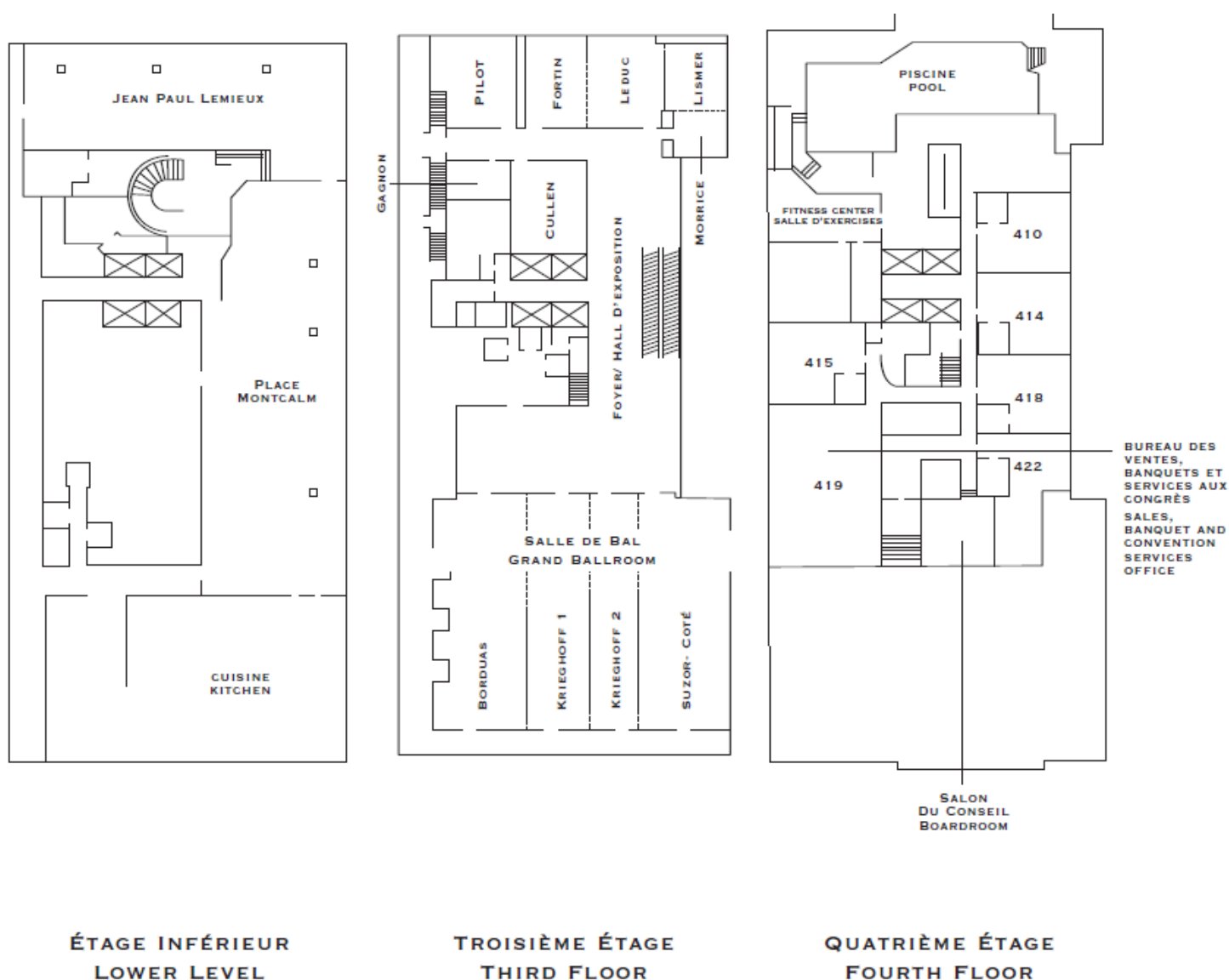
Lundi 9 mai, l'Aquarium du Québec, 18h30-23h00. Billets requis (inclut le coût d'autobus du Loews Hôtel le Concorde Québec à l'Aquarium du Québec et le retour).

Banquet

Wednesday May 11th, Suzor-Coté/Krieghoff, Loews Hôtel le Concorde Québec, 6:30pm cash bar, 7:15pm dinner. Presentation of AAC Research Award of Excellence and Conference Student Presentation Awards. Tickets required in advance.

Mercredi 11 mai, Suzor-Coté/Krieghoff, Loews Hôtel le Concorde Québec. 18h30 bar payant, 19h15 dîner. Présentation du prix d'excellence en recherche de l'AAC et des prix pour les meilleurs présentations par les étudiant(e)s.

Session Rooms / Salles de conférences



Program Outline / Sommaire du programme

DAY 1 – SUNDAY, MAY 8

JOUR 1 – DIMANCHE, 8 MAI

08:00 – 17:00	CAIA Board of Directors meeting (4 th floor Board Room)
12:00 – 13:30	AAC/CAIA lunch (Board members only) (Room 410)
14:00 – 17:00	AAC Board of Directors meeting (Room 410)
17:00 – 21:00	Registration Open / Inscription ouverte
17:00 – 19:00	Poster Set Up / Montage des affiches
19:00 – 21:00	President's Reception / Réception du président (Suzor-Coté)

DAY 2 – MONDAY, MAY 9

JOUR 2 – LUNDI, 9 MAI

07:00 – 17:00	Registration Open / Inscription ouverte
09:00 – 17:00	Poster Session / Affiches
08:00 – 17:20	Opening Session, Keynote Speaker, Technical Sessions / Allocutions d'ouverture, session plénière, sessions techniques
12:25 – 14:00	IPSFAD AGM/AGA (members only / pour les membres) (Room/Salle 410)
12:25 – 14:00	Lunch (on own) / déjeuner (libre)
18:30 – 23:00	Joe Brown BBQ / Barbecue Joe Brown (Aquarium du Québec)
Buses 17:45	

DAY 3 – TUESDAY, MAY 10

JOUR 3 – MARDI, 10 MAI

08:00 – 17:00	Registration Open / Inscription ouverte
09:00 – 18:30	Poster Session: Authors in attendance 17:00-18:30 (cash bar) Affiches : Auteurs présents 17h00-18h30 (bar payant)
08:00 – 17:00	Plenary Speaker, Technical Sessions / Session plénière, sessions techniques
12:20 – 14:00	RAQ AGA/AGM (pour les membres / members only) (Place Montcalm)
12:20 – 14:00	Lunch (on own) / déjeuner (libre)
18:00 – 19:00	AAC AGM/AGA (members only / pour les membres) (Suzor-Coté)

DAY 4 – WEDNESDAY, MAY 11

JOUR 4 – MERCREDI, 11 MAI

08:00 – 12:00	Registration Open / Inscription ouverte
08:00 – 17:00	Plenary Speaker, Technical Sessions / Session plénière, sessions techniques
12:20 – 14:00	Lunch (on own) / déjeuner (libre)
12:20 – 14:00	AAC Board of Directors meeting (Room 410)
18:30 – 22:00 (cash bar / bar payant 18:30, dinner/dîner 19:15)	Banquet (Loews Hôtel le Concorde Québec) AAC Research Award of Excellence and Student Awards / Présentation du prix d'excellence en recherche de l'AAC et des prix pour les meilleurs présentations par les étudiant(e)s.

Outline of Presentations / Résumés des présentations

POSTER PRESENTERS / PRÉSENTATIONS D’AFFICHES:

Set up Sunday May 8 (5-7PM), take down Tuesday May 10 (6:30PM)
Montage dimanche 8 mai (17h00-19h00), enlever mardi 10 mai (18h30)

PRESIDENT’S RECEPTION / RÉCEPTION DU PRÉSIDENT:

Sunday May 8 (7-9 PM) / Dimanche 8 mai (19h00-21h00): (Suzor-Coté)

MONDAY, MAY 9, Morning

LUNDI 9 MAI, matin

07:00 - 17:00	Registration / Inscription		
08:00 - 09:15	Opening session / Allocutions d’ouverture (Suzor-Coté/Krieghoff): Tillmann Benfey, President, AAC TBD, MAPAQ Richard Nadeau, Regional Director General, Fisheries and Oceans Canada, Québec Region (Directeur général régional, Pêches et Océans Canada, région du Québec) Grant Vandenberg, President, IPSFAD / PIDDAED Ruth Salmon, Executive Director, CAIA Céline Audet, Directrice scientifique, RAQ Stéphanie Houle, SORDAC Jean-Claude Dufour, Président, SODIM Manon Deslauriers, RMQ		
09:15 - 10:15	Conference Keynote / Session plénière: Gavin Gibbons, National Fisheries Institute (Suzor-Coté/Krieghoff): The Message, The Media and The Market: changing how we communicate about seafood		
09:00 - 17:00	Posters up for viewing		
10:15 - 10:45	BREAK / PAUSE		
	Borduas	Krieghoff	Suzor-Coté
	Bivalves	ACRDP 10th Anniversary / PCRDA après 10 ans	Freshwater Symposium / Symposium en eau douce – 1
10:45 - 11:05	Chevarie: Ensemencements de myes aux Îles-de-la-Madeleine, Québec: un bilan	Busby: Celebrating ten years of success with the Aquaculture Collaborative Research and Development Program (ACRDP)	Gilbert: National aquaculture strategic action plan initiative in Canada: an integrated policy approach
11:05 - 11:25	St-Onge: Population genetic structure and spatial analysis of the softshell clam (<i>Mya arenaria</i>) across their natural geographic distribution	Afonso: Soft-flesh suppression technology: Inhibiting the post-harvest effects of <i>Kudoa thyrsites</i> infection in farmed Atlantic salmon	Vandenberg: The Inter-Provincial Partnership for Sustainable Freshwater Aquaculture Development: past, present and future

11:25 - 11:45	Cyr: Essais d'élevage en suspension de l'huître américaine (<i>Crassostrea virginica</i>), en lagune versus milieu ouvert aux Îles-de-la-Madeleine en 2011	Chabot: Effect of chronic sublethal hypoxia on growth of juvenile spotted wolffish (<i>Anarhichas minor</i>) and of the hybrid <i>A. minor</i> x <i>A. lupus</i>	Thomsen: Danish freshwater industry: sustainable production in challenging times (30 min: 11:25-11:55)
11:45 - 12:05	Mallet: Recent advances in bay scallop aquaculture (<i>Argopecten irradians irradians</i>) in New Brunswick: a promising species for diversification	Fréchette: Self-thinning in suspension-cultured mussels and organic matter input to the bottom	
12:05 - 12:25	Nadeau: Characterization of the dynamics of predators following a large scale scallops seeding: approaches and field tools	Page: An overview of ACRDP sponsored studies concerning the interactions of salmon netpen culture with the benthic and pelagic coastal marine environment of southwest New Brunswick	Naylor: From retrogressive obstructionism to abundant potential: Why isn't Canada's freshwater aquaculture sector a world leader? (30 min: 11:55-12:25)
12:25 - 14:00	LUNCH ON OWN / DÉJEUNER LIBRE		
12:25 - 14:00	IPSFAD AGM / PIDDAED AGA (members only / membres seulement) – Room/Salle 410		

MONDAY, MAY 9, Afternoon

LUNDI 9 MAI, après-midi

	Borduas	Krieghoff	Suzor-Coté
	Bivalves	ACRDP 10th Anniversary / PCRDA après 10 ans	Communications
14:00 - 14:20	Thériault: Culling small size oysters: Is it a winning strategy?	Chang: Exploratory analysis of sediment sulfide data collected in the annual monitoring program at salmon farms in southwestern New Brunswick, Bay of Fundy	Langlois: Overview of recent NSERC initiatives for the aquaculture sector / Survol des initiatives récentes au CRSNG dans le secteur de l'aquaculture
14:20 - 14:40	Gionet: Production performance of the bay scallop (<i>Argopecten irradians irradians</i>) grown in suspended or bottom culture at five densities at two sites in New Brunswick	Sarker: A review of sustainability issues related to feeding salmonids: a Canadian perspective	Roberston: Communicating aquaculture research through video: Lessons from the field, laboratory and public forums

14:40 - 15:00	Kitchen: An economic analysis of shellfish production associated with the adoption of Integrated Multi-Trophic Aquaculture in British Columbia	Green: The industry perspective on ten years of ACRDP initiatives in the NL region	Cross: Commercialization of IMTA – what and how scientific research is used in the corporate decision-making process
15:00 - 15:20	Gauthier-Clerc: A predictive approach to assess the potential safety of whole scallops from harvest areas affected by paralytic, amnesic and diarrhetic shellfish poisoning in mussels	Salmon: ACRDP's role in the development of the Canadian aquaculture industry	Ben Khemis: Coursus international et potentiel d'impact au profit du pays d'origine : témoignage illustratif
15:20 - 15:40	BREAK / PAUSE		
	Borduas	Krieghoff	Suzor-Coté
	Contributed Papers / Sujets autres	Genetics / Génétique	Freshwater Symposium / Symposium en eau douce – 2
15:40 - 16:00	Nelson: Sea cucumbers in aquaculture: Taking care of business	Chiasson: Quantitative trait loci (QTL) for body weight and condition factor in Fraser strain Arctic charr in fresh and brackish water	Rose: Aquaculture certification schemes
16:00 - 16:20	Dupont-Cyr: Sex-related growth dimorphism in wolffishes (<i>Anarhichas minor</i> and <i>A. lupus</i>)	McGowan: Pedigree-free estimation of heritability in Arctic charr (<i>Salvelinus alpinus</i>) using genetic markers	Eastman: The World Wildlife Fund sponsored Freshwater Trout Aquaculture Dialogue: Canadian industry perspectives
16:20 - 16:40	Glebe: North American Arctic charr aquaculture: History and current research	Quinn: Identification of genes associated with heat tolerance in Arctic charr exposed to acute thermal stress	Tracey: Certification activities for the Ontario trout industry
16:40 - 17:00	Prussin: Use of a commercially viable kelp (<i>Saccharina latissima</i>) for mapping the nutrient plume from an integrated multi-trophic sablefish farm (IMTA)	Bourret: Temporal change in genetic integrity suggests loss of local adaptation in a wild Atlantic salmon (<i>Salmo salar</i>) population following introgression by farmed escapees	Salmon: A Canadian-based certification scheme: application to the Freshwater sector
17:00 - 17:20	Genard: Probiotics selection methods for bivalves larvae production in hatchery	Lamaze: Evaluating the genetic impact of stocking on brook charr (<i>Salvelinus fontinalis</i>) by means of SNP population genomics	Hicks: Organic aquaculture standards for Canada
18:30 - 23:00	Joe Brown Student BBQ: Aquarium du Québec (buses depart hotel at 17:45)		

TUESDAY, MAY 10, Morning
MARDI 10 MAI, matin

08:00 - 17:00	Registration / Inscription		
09:00 - 18:30	Posters up for viewing		
	Borduas	Place Montcalm	Suzor-Coté/Krieghoff
	Lobsters / Homards	Ecosystems / Écosystèmes	Freshwater Symposium / Symposium en eau douce – 3
08:00 - 08:20	Browne: Lobster stock enhancement in Ireland and collaborative efforts to improve lobster rearing techniques under an Aquareg Project (Interreg IIIC project) involving co-operation between Spain, Ireland and Norway	Piot: Shellfish farming in the intertidal zone and its effect on ecosystem functioning	Were: National Aquaculture Genetic Improvement Strategy
08:20 - 08:40	Beal: Field-based lobster (<i>Homarus americanus</i>) nurseries: Experimental trials using cultured juveniles in Eastern Maine, USA	Arsenault: Size matters: Characterizing particle depletion by the blue mussel (<i>Mytilus edulis</i>) at open-water, Integrated Multi-Trophic Aquaculture sites	Picard: Sélection génétique, assainissement et mise en place d'un programme de collaboration multi-entreprises en matière de génétique chez l'omble de fontaine
08:40 - 09:00	Burton: Marking juvenile lobsters (<i>Homarus gammarus</i> L.) for stock enhancement and fishery studies	Bungay: Assessment of the benthic impacts of finfish aquaculture sites on hard bottom substrates with the application of a benthic index on the south coast of Newfoundland	Audet: Interactions génome-environnement pour des traits d'intérêt commercial chez l'omble de fontaine
09:00 - 09:20	Mallet: Lobster resource enhancement in Atlantic Canada through stage IV larvae seeding: The Homarus Inc. experience	Diep: Dissolved oxygen dynamics of an embayment of the Great Lakes: 1998 – 2010	Sauvage: Genetic mapping of SNP markers reveal QTL linked to reproduction, growth and response to stress in the Brook charr, <i>Salvelinus fontinalis</i>
09:20 - 09:40	LeBreton: Return on investment for a lobster (<i>Homarus americanus</i>) enhancement project in Atlantic Canada	Reid: The usefulness of ecological efficiencies to assess open-water Integrated Multi-Trophic Aquaculture (IMTA)	Bernatchez: Genetic impacts of stocking on the genetic integrity of wild brook charr (<i>Salvelinus fontinalis</i>)
09:40 - 10:00	BREAK / PAUSE		
10:00 - 11:00	Conference Plenary / Session plénière: Jack Rensel, Rensel Associates Aquatic Sciences (Suzor-Coté/Krieghoff): Changing adverse impacts into beneficial effects: Enrichment of west coast freshwater and marine aquatic food webs with aquaculture wastes		
	Borduas	Place Montcalm	Suzor-Coté/Krieghoff
	Lobsters / Homards	Ecosystems / Écosystèmes	Freshwater Symposium / Symposium en eau douce – 4

11:00 - 11:20	Côté: Mise à l'échelle de la production en éclosérie de larves de homard américain (<i>Homarus americanus</i>) aux fins d'ensemencement pour soutenir une pêche durable	Robinson: The role of 3-dimensional habitat in the establishment of integrated multi-trophic aquaculture (IMTA) systems	Summerfelt: Rainbow trout and Atlantic salmon performance in circular tank-based closed-containment systems
11:20 - 11:40	Redjah: Cryptic behaviour of hatchery-reared American lobster larvae fed different lipid composition diets	Fredriksson: AquaModel software application to understand the regional effects of multiple marine fish farming sites in the Gulf of Maine, USA	Thomsen: Current status of the Denmark Model Farm Program
11:40 - 12:00	McGaw: Feeding and digestive physiology of decapod crustaceans: Importance of basic research for aquaculture		Stechey: The Manitoba-Canadian Model Farm Initiative
12:00 - 12:20	Discussion		Losordo: Comparison of biofiltration technologies for RAS
12:20 - 14:00	LUNCH ON OWN / DÉJEUNER LIBRE		
12:20 - 14:00	RAQ AGA (membres seulement) – Place Montcalm		

TUESDAY, MAY 10, Afternoon
MARDI 10 MAI, après-midi

	Borduas	Krieghoff	Suzor-Coté
	Mussels / Moules	Certification	Freshwater Symposium / Symposium en eau douce – 5
14:00 - 14:20	Byette: Exploitation of <i>Mytilus edulis</i> byssal threads for material production	Koonse: The new US Food Safety Law – and how traceability plans are going to be required for farmed seafood imports	Kaiser: Generic marketing opportunities for aquaculture
14:20 - 14:40	Toupoint: <i>Mytilus edulis</i> L. recruitment and food quality: trigger and match-mismatch	Couturier: Farmed shellfish safety and the aquaculture supply chain in Canada	Rose: A practical guide to the identification of value creating and value destroying activities in marketing niche fresh water aquaculture products
14:40 - 15:00	Tremblay: Factors affecting byssus structure of blue mussel (<i>Mytilus edulis</i>) from suspended culture, in the Magdalen Islands	Rose: Key traceability issues and audit tools for aquaculture	Hicks: Marketing organic fish – opportunities and challenge

15:00 - 15:20	Wyatt: The effect of long term holding on the physiology of the blue mussel, <i>Mytilus edulis</i>	Salmon: FAO certification for aquaculture – A Canadian approach	Roy: TBD
15:20 - 15:40	BREAK / PAUSE		
	Borduas	Krieghoff	Suzor-Coté
	Mussels / Moules	Certification	Freshwater Symposium / Symposium en eau douce – 6
15:40 - 16:00	Gilmore Solomon: Influence of seston lipid quality on physiological condition of <i>Mytilus edulis</i> grown in heterotrophic lagoon	Smith: Traceability and sustainability initiatives in Fisheries and Oceans Canada	Latremouille: The case for modernization of the Canadian feeds regulations
16:00 - 16:20	Duffy: Predator-prey interactions between the blue mussel <i>Mytilus edulis</i> and zooplankton: A case of intraguild predation	Panel Discussion / Discussion générale	Dagenais: The current status of fishery and aquaculture resource utilization in Canada
16:20 - 16:40	Bartsch: A prickly alternative to combat biofouling	Panel Discussion / Discussion générale	Dumas: Preliminary nutritional evaluation of a Canadian shrimp process residue meal and its potential to replace expensive sources of nutrients in aquafeeds
16:40 - 17:00	Richman: Sea duck predation on mussel farms: developing conservation-friendly and cost-effective solutions for mussel growers	Panel Discussion / Discussion générale	Harding: The use of whole cell algae as a sustainable omega-3 DHA source in aquaculture diets
17:00 - 18:30	Poster session, authors in attendance (cash bar) / Session d'affiche, auteurs présents (bar payant)		
18:00 - 19:00	AAC AGM/AGA (members only / membres seulement) – Suzor-Coté		

WEDNESDAY, MAY 11, Morning
MERCREDI 11 MAI, matin

08:00 - 12:00	Registration / Inscription		
	Borduas	Place Montcalm	Suzor-Coté/Krieghoff
	Health / Santé	Engineering / Technologie	Freshwater Symposium / Symposium en eau douce – 7
08:00 - 08:20	Bakker: Mixing within salmon aquaculture netpen tarps and skirts: Preliminary results from commercial therapeutant bath treatments conducted in South-west New Brunswick	Sclodnick: Demonstration of shark proof aquaculture containment nets	Dupont-Cyr: Integration of simple zootechnical improvements for pairing and early-stage operations in the management practices of a commercial Arctic charr facility
08:20 - 8:40	Page: Mixing, flushing and effluent dispersal of sea lice therapeutants within and from aquaculture well boats: preliminary results	Robertson: Development of shark resistant aquaculture containment nets	Henry: Advances in sturgeon culture in Canada
08:40 - 09:00	Page: Transport and dispersal of sea lice therapeutants from aquaculture net pen bath treatments: preliminary results	Couturier: Hydraulic model for large diameter tanks	Gaudreau: From Atlantic salmon to striped bass cultivation: conservation and resources enhancement perspectives and opportunities
09:00 - 09:20	Leadbeater: Impact of oxygen level on feed consumption, body composition, growth and resistance to ISA in Atlantic salmon (<i>Salmo salar</i>)	Chase: Stationary bed filter for the removal of fine solids in RAS	Therrien: Maintien et reproduction de géniteurs de doré jaune en élevage: échelle pilote commercial
09:20 - 09:40	Webb: Can filter-feeding bivalves ingest planktonic sea lice larvae?	Huyben: The evaluation of membrane filtration as an alternative disinfection system in recirculating aquaculture systems and its comparison to UV irradiation	Summerfelt: Walleye cultural technology from fingerling to food fish
09:40 - 10:00	BREAK / PAUSE		
10:00 - 11:00	Conference Plenary / Session plénière: Brett Koonse, USFDA Consumer Safety Office (Suzor-Coté/Krieghoff): Change and Opportunity		
	Borduas	Place Montcalm	Suzor-Coté/Krieghoff
	Health / Santé	Engineering / Technologie	Freshwater Symposium / Symposium en eau douce – 8
11:00 - 11:20	Beattie: Provincial approach to mitigating sea lice infestation in Atlantic salmon aquaculture: New Brunswick Department of Agriculture, Aquaculture and Fisheries R&D overview	Steinke: Assessment of the structural integrity of finfish aquaculture sites in hurricanes through finite-element analysis and measurement	Foss: Integration of submersible iCages into an existing freshwater trout production site

11:20 - 11:40	Boutin: Antagonistic effect of indigenous skin bacteria of brook charr (<i>Salvelinus fontinalis</i>) against <i>Flavobacterium columnare</i> and <i>F. psychrophilum</i>	Bergeron: A new tool for estimating loads induced by currents and waves on submerged shellfish aquaculture longlines	McNamara: Réalisation de réservoirs d'élevage en coffrage de PVC
11:40 - 12:00	Braden: Real time gene expression analysis in salmonid skin: site-specific inflammatory responses elicited by the ectoparasite <i>Lepeophtheirus salmonis</i>	Saunders: Validation of co-oximetry for the measurement of methemoglobin in rainbow trout, <i>Oncorhynchus mykiss</i>	Marcotte: Un nouveau concept d'étang d'élevage en béton
12:00 - 12:20	Lewis: Interactions between salmon macrophages and pathogenic bacteria in the presence of <i>Lepeophtheirus salmonis</i> secretions		Domingue Gauthier: Identification of anti- <i>Saprolegnia parasitica</i> compounds from Pseudomonads
12:20 - 14:00	LUNCH ON OWN / DÉJEUNER LIBRE		
12:20 - 14:00	AAC Board of Directors / Conseil d'administration – Room/Salle 410		

WEDNESDAY, MAY 11, Afternoon
MERCREDI 11 MAI, après-midi

	Borduas	Krieghoff	Suzor-Coté
	Health / Santé	Fish Production / Production piscicole	Freshwater Symposium / Symposium en eau douce – 9
14:00 - 14:20	Novak: <i>Lepeophtheirus salmonis</i> (Caligidae) as a potential vector of <i>Aeromonas salmonicida</i>	Neil: Cryopreservation of Atlantic cod (<i>Gadus morhua</i>) sperm in large-volume straws: applications for commercial production and gene banking	Podemski: Validation of DEPOMOD for freshwater cage aquaculture
14:20 - 14:40	Filion: Qu'en est-il de la perte du plasmide pAsa5, impliqué dans la virulence d' <i>Aeromonas salmonicida</i> , sous l'effet de la chaleur?	Whitehead: Using gynogenesis to elucidate the sex determining mechanism of Atlantic cod (<i>Gadus morhua</i>)	Podemski: Impacts and recovery from freshwater aquaculture: water chemistry and lower trophic levels in Lake 375 before, during, and after cage aquaculture
14:40 - 15:00	Dallaire-Dufresne: Un facteur de virulence d' <i>A. salmonicida</i> méconnu: à la recherche de l'identité d'Ati2	Lin: Sex control of Atlantic cod (<i>Gadus morhua</i>)	Mills: Enhancement of native fish populations as a by-product of cage aquaculture
15:00 - 15:20	Gagné: The National Aquatic Animal Health Program: a laboratory perspective	Peruzzi: Production of sterile Atlantic cod: A way to satisfy industrial and environmental criteria?	Milne: Monitoring and modeling phosphorus contributions in a freshwater lake with cage-aquaculture
15:20 - 15:40	BREAK / PAUSE		
	Borduas	Krieghoff	Suzor-Coté
	Feeding and Nutrition / Alimentation et nutrition	Fish Production / Production piscicole	Freshwater Symposium / Symposium en eau douce – 9

15:40 – 16:00	Granier: Leptin and ghrelin concentrations in Arctic charr (<i>Salvelinus alpinus</i>) raised either in fresh water or brackish water	Morin: Production d'omble de fontaine et d'omble chevalier monosexes femelles stériles et évaluation de leurs performances en conditions d'élevage commercial	Ouellet: La stratégie de développement durable de l'aquaculture en eau douce au Québec : le point après six ans d'application
16:00 - 16:20	Yossa: Interactions between biotin and avidin in zebrafish <i>Danio rerio</i> : Effects on growth, survival, feed conversion, biotin status and gene expression	Pelletier: Overview on the Arctic charr (<i>Salvelinus alpinus</i>), Fraser strain, performance from eggs to market size	Comeau: Extensive technologies for phosphorus removal from fish farms
16:20 – 16:40	Fraboulet: What kind of challenges young microalgae producers have to deal with?	Hamoutene: Fish distribution of two strains of Arctic charr in sea cages in Bay d'Espoir, Newfoundland	Snow: The use of a constructed wetland for the treatment of concentrated effluent from a salmonid raceway fish hatchery
16:40 – 17:00	Plante: Combining nutrition and physiology studies to evaluate the performance of alternate protein and lipid sources in aquaculture	Haché: Does high density production system for rotifers really work? Trial on cod (<i>Gadus morhua</i>) larvae	Auffret: Detection of geosmin and MIB synthesis genes in closed-circuit aquaculture system, using quantitative PCR
18:30 - 23:00	Cash bar / Bar payant: Suzor-Coté/Krieghoff		
19:15 - 23:00	Banquet (Awards/Honorifiques): Suzor-Coté/Krieghoff		

Posters (Foyer, 3rd Floor), Authors in attendance: Tuesday, May 10, 2011 (5:00-6:30 PM)
Affiches (Hall d'exposition, troisième étage), Auteurs présents: Mardi 10 mai, 2011 (17h00-18h30)

Anderson: Evaluation of Maxi-Gen[®] as a feed attractant for first feeding rainbow trout (*Oncorhynchus mykiss*) fry

Barkhouse: Mussel seed quality based on survivorship and growth at 6 sites in New Brunswick and Prince Edward Island: A reciprocal transfer experiment

Ben Khemis: Comparative study of pikeperch (*Sander lucioperca*) eggs and larvae from wild or captive females

Boily: Analytical tools and experimental limits for assessing mussel immunocompetency during *in vivo* bacterial challenge

Boudreau: A novel treatment against the infectious salmon anemia virus using RNA interference

Camarillo-Sepulveda: Measurement of some sperm parameters of wild and farmed Atlantic salmon (*Salmo Salar*) in Newfoundland

Chen: Evaluation of hull-less oats processed in different ways in practical diets for rainbow trout (*Oncorhynchus mykiss*)

Chiasson: The production of all-female populations of Fraser strain Arctic charr

Deschamps: Bone tissue responsiveness to prolonged dietary phosphorus deficiency in rainbow trout, *Oncorhynchus mykiss*

Doucet: Novel approach for recombinant DNA vaccine against Infectious Salmon Anemia Virus (ISAV)

Fournier: Mise à l'échelle d'un procédé d'alimentation en phase de la truite arc-en-ciel par contrôle du phosphore (P) alimentaire pour réduire les rejets en P

Fredriksson: Investigation of the tension distribution in aquaculture nets with a finite element model and laboratory tests

Granados: The contrasting differences in zooplankton community composition and abundance between aquaculture (farm) and control sites in the Havre-aux-Maisons lagoon, QC

Gutierrez: Genetic mapping of quantitative trait loci (QTL) for body weight in Atlantic salmon (*Salmo salar*)

Hamoutene: Effect of diet on some sperm biochemical parameters in hatchery reared cod (*Gadus morhua*) broodstock

Hennebicq: Measurement of mechanical properties, metals and amino acid composition of *Mytilus edulis* byssal threads in relation to reproduction

Jauvin: Seasonal variations of *Mytilus edulis*'s immunity in harvest areas/ étude des variations saisonnières de l'immunité de la moule bleue *Mytilus edulis* en région conchylicole

Khodadadi: Effect of salinity on survival and cortisol levels in fingerling grass carp (*Ctenopharyngodon idella*)

Lafille: Expression de gènes reliés à la croissance et au métabolisme lipidique en période de métamorphose chez la plie rouge

Laplante: Taux de recapture optimal pour assurer une viabilité de la production de larves de homard américain (*Homarus americanus*) en éclosérie aux fins d'ensemencement pour soutenir une pêcherie durable dans la Baie des Chaleurs

Le François: Evaluation of the stress response of the wolffishes (*Anarhichas minor*, *A. lupus* and reciprocal hybrids): acoustic and handling stress

Martel: Utilisation d'extraits de plantes, un avenue envisageable dans la prévention et le traitement de la saprolegniose chez les alevins de truite arc-en-ciel

Pilote: Strategies to prevent off-flavours in fish raised in closed-circuit aquaculture systems

Plante: Determination of optimal protein and lipid levels in American lobster (*Homarus americanus*) larvae nutrition

Sarker: Effects of dietary biotin restriction on growth, deficiency syndrome and biotin dependent hepatic gene expression of juvenile tilapia *Oreochromis niloticus*

Savoie: Pilot-scale cultivation of spotted wolffish (*Anarhichas minor*): a progress update on growth performances including family and strain comparisons

Séguin Heine: Metal content and isotopic enrichment of the byssus of the blue mussel, *Mytilus edulis*

Webb: Effects of broodstock diet on egg lipid content in farmed Atlantic cod (*Gadus morhua*) broodstock

Opening and Welcome / Allocution d'ouverture et de bienvenue

Monday May 9, 2011 – lundi 9 mai, 2011

8:00 AM – 9:15 AM

Location: Suzor Côté Krieghoff

Chair / Président: Tillmann Benfey (President, Aquaculture Association of Canada)

Tillmann Benfey (President, Aquaculture Association of Canada)

TBD (MAPAQ)

Richard Nadeau (Regional Director General, Fisheries and Oceans Canada, Québec Region / Directeur général régional, Pêches et Océans Canada, région du Québec)

Grant Vandenberg (President, Interprovincial Partnership for Sustainable Freshwater Aquaculture)

Ruth Salmon (Executive Director, Canadian Aquaculture Industry Alliance)

Céline Audet (Directrice scientifique, Réseau Aquaculture du Québec)

Stéphanie Houle (SORDAC)

Jean-Claude Dufour (Président, SODIM)

Manon Deslauriers (Regroupement des mariculteurs du Québec)

Keynote Speaker Session / Session plénière

Monday May 9, 2011 – Lundi 9 mai, 2011

9:15 AM – 10:15 AM

Location: Suzor-Coté/Krieghoff

Chair / Président: Tillmann Benfey (President, Aquaculture Association of Canada)

Keynote Speaker: Gavin Gibbons, Director of Media Relations, National Fisheries Institute

As NFI's spokesman, he has been featured in everything from the Wall Street Journal and the Washington Post to USA Today and has been the voice of fisheries issues on CNN, NPR and the Fox Business Network. Gibbons joined NFI in 2007 after more than a decade as an award-winning television news producer that saw him work for a variety of local television affiliates, as well as MSNBC and the Fox News Channel.



The Message, The Media and The Market: changing how we communicate about seafood

In 2007 the National Fisheries Institute (NFI) made a decision to fundamentally change how we communicate with the media about seafood issues. We decided the long-held strategy of agreeing to disagree with reporters and activists on certain hot button issues no longer served as an approach that was tenable. Sound science and independent peer-reviewed publications were increasingly and publicly bolstering our arguments and backing up the assertions on nutrition and sustainability that we had been promoting for years. Insisting that ours wasn't simply another view but rather the right, fact-based, view became a tactic that targeted journalists. Promoting ourselves as an authority on seafood and not just a last call before publication to get "the industry's" take became an important job. Benefiting NFI's membership by changing the way the media approaches reporting on seafood was our mission. But to promote the message, influence the media and benefit the market we were going to have to challenge reporters, producers and editors and hold them accountable. It was a strategy that made some uncomfortable, not the least of whom were journalists. Four years later we still butt heads with misguided activists and take rogue journalists to task for misreporting. We are by no means out of the proverbial woods when it comes to defending the seafood community in the media. But we have turned some important corners and won significant rhetorical battles that have laid the groundwork for some essential changes in how the media reports on seafood. The climate, created in part by that groundwork, allowed a single, positive, heavily-promoted seafood nutrition storyline to make news in 378 U.S. media outlets in front of 41.5 million sets of eyes over a 10 day period in February. In 2007, in the midst of beginning an aggressive and much needed new media strategy, such an impact was almost unthinkable.

Plenary Session I / Session plénière I

Tuesday, May 10, 2011 - Mardi 10 mai 2011

10:00 AM – 11:00 AM

Location: Suzor-Coté/Krieghoff

Chair / Président: Gregor Reid (Fisheries and Oceans Canada)

Speaker: Jack Rensel, Rensel Associates Aquatic Sciences



Jack Rensel is a leading expert in aquaculture research and environmental issues. He was responsible for much of the basic research and analysis that led to the first federally-sanctioned state permits for net pen aquaculture in the U.S. Dr. Rensel conducts research on current aquaculture and food web topics, including the beneficial food web aspects of optimally sited commercial net pens, which constitutes a new frontier for further exploration using promising tools such as stable isotope analysis. With NOAA, USDA and industry support, he and his partners at University of Southern California and other leading academic organizations have developed a comprehensive water column and benthic effects GIS-model for salmon or other fish species net pens that may be used for a single farm or array of farms throughout an entire coastal region (www.AquaModel.org). Dr. Rensel is a recognized international expert on harmful algal bloom dynamics in North and South America and Southeast Asia, and has been involved in development and testing of mitigation strategies for farmed and wild stocks. He was lead author of a 2010 publication explaining how harmful blooms were strongly linked to extreme interannual variation of Fraser River sockeye salmon marine survival over the past 20 years. As principal of Rensel Associates Aquatic Sciences, he has written more than twenty peer-reviewed articles or book chapters and hundreds of articles and technical reports. His clients include the largest seafood processing and distribution firm and the largest fish farming companies owned and operated in the US.

Changing adverse impacts into beneficial effects: Enrichment of west coast freshwater and marine aquatic food webs with aquaculture wastes

Site selection for floating aquaculture is crucial to successful commercial development by maximizing production and limiting adverse impacts. As scientists, we have a fairly good understanding of the near field impacts of aquaculture, but another aspect of aquaculture development is rarely considered: what are the beneficial aquatic food web effects of aquaculture waste? How may these effects be measured, why have they been elusive to measure in the past and how substantial or extensive can the positive effects be? Fish farms in the fast-flowing but nutrient starved Mid-Columbia River reservoirs, fish and shellfish farms in the nutrient-replete temperate marine waters of western Washington State and an offshore farm in the Gulf of Maine are subjects of this talk. I discuss these settings and the use of stable isotope analysis, GIS-based computer modeling and other methods in combined research and monitoring efforts to quantify both beneficial and adverse environmental effects of aquaculture. Knowledge gaps that impede our understanding of these effects will be highlighted as well as governments' role in promulgating meaningful monitoring protocols and performance standards to help fill those gaps.

Plenary Session II / Session plénière

Wednesday, May 11, 2011 - mercredi 11 mai 2011

10:00 AM – 11:00 AM

Location: Suzor Côté Krieghoff

Chair / Présidente: Ruth Salmon (Executive Director, Canadian Aquaculture Industry Alliance)

Speaker: Brett Koonse, Consumer Safety Office, USFDA

Brett has been working for thirty years in seafood and seafood safety. After graduating from the University of California at Santa Cruz with a major in Marine Biology in 1980, Brett went directly to work for the State of Texas. He worked for almost ten years there traveling up and down the Gulf of Mexico collecting and analyzing aquatic samples for environmental contamination and monitoring. In 1991 Brett joined the U.S. Food and Drug Administration. He has served in a variety of positions there including the lead National Shellfish Processor Inspector, Chief of the Programs and Inspection Branch, and for the last 10 years as FDA's aquaculture food safety expert. In that position, he led the development of Good Aquaculture Practices and has worked in over 40 countries conducting a variety of aquaculture food safety activities including research, training, inspections, and assessments.



Change and Opportunity

With the decline of wild caught seafood, the ever increasing world population, the growing middle class in Asia (the worlds leading seafood consuming region), the clear health benefits of consuming seafood...and consequent support of seafood consumption by government and public health promotion associations such as the U.S. and Canadian Heart Associations...There is a real opportunity for growth within the aquaculture production community.

But to make the most of this opportunity the consuming public needs to be reassured or the perception altered about aquaculture, the aquaculture "brand" strengthened, and food safety in particular addressed by the aquaculture community....and it's not necessarily through certifications.

This talk will address these issues and present some ideas for how the aquaculture producing industry can move forward in addressing "perception".

Sessions and Abstracts – Aquaculture Canada^{OM} 2011

Bivalve Aquaculture / Aquaculture des mollusques bivalves - 1

Monday, May 9, 2011 / Lundi 9 mai, 2011: 10h45-12h25

Location: Borduas

Chair / Présidente: Julie Pariseau (SODIM: Société de développement de l'industrie maricole)

10h45-11h05 L. Chevarie: Ensemencements de myes aux Îles-de-la-Madeleine, Québec: un bilan

11h05-11h25 P. St-Onge: Population genetic structure and spatial analysis of the softshell clam (*Mya arenaria*) across their natural geographic distribution

11h25-11h45 C. Cyr: Essais d'élevage en suspension de l'huître américaine (*Crassostrea virginica*), en lagune versus milieu ouvert aux Îles-de-la-Madeleine en 2011

11h45-12h05 A.L. Mallet: Recent advances in bay scallop aquaculture (*Argopecten irradians irradians*) in New Brunswick: a promising species for diversification

12h05-12h25 M. Nadeau: Characterization of the dynamics of predators following a large scale scallops seeding: approaches and field tools

12:25-14:00 LUNCH / DÉJEUNER

(This session continues after lunch / Cette session continue après le déjeuner)

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Ensemencements de myes aux Îles-de-la-Madeleine, Québec : un bilan

L. Chevarie^{*1}, B. Myrand² et R. Tremblay³

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Plusieurs ensemencements de myes ont été réalisés aux Îles-de-la-Madeleine au fil des ans. Trois ensemencements réalisés en 2007 ont été suivis jusqu'à l'automne 2010. Les pertes ont été de l'ordre de 20 % pendant la première saison même si les parcelles ensemencées avaient été recouvertes d'un filet (mailles de 4 mm). Ce niveau de pertes est régulièrement observé. Les myes dont la taille à l'ensemencement était de 20 mm ont atteint une taille moyenne variant entre 38,4 et 44,4 mm en octobre 2010, ce qui correspond à un taux de croissance annuel de l'ordre de 6,1-7,7 mm, avec une moyenne générale de 6,9 mm/an. La croissance fut linéaire au cours de ces trois années. Ce patron de croissance a déjà été observé avec d'autres ensemencements. Les myes ensemencées à une taille moyenne de 20 mm auront besoin d'environ cinq ans pour atteindre les 50 mm aux Îles. Le taux de récupération obtenu à l'automne 2010 a varié entre 10 et 20 %, ce qui est trop faible pour atteindre le seuil de rentabilité. Il est difficile d'améliorer le taux de croissance qui est influencé par les conditions ambiantes. Il faut donc impérativement améliorer le taux de récupération pour espérer atteindre la rentabilité.

Population genetic structure and spatial analysis of the softshell clam (*Mya arenaria*) across their natural geographic distribution

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The softshell clam (*Mya arenaria*) is a broadcast-spawning and a potentially long-distance dispersing species of bivalve found in several temperate regions of the globe. However, the state of genetic diversity of *M. arenaria* across global scales and varying oceanographic regimes is still poorly understood, mainly because of the lack of proper genetic markers. The first step of this study consisted in developing highly polymorphic microsatellite markers specifically for *M. arenaria*. These microsatellites were then used to characterize 13 *M. arenaria* populations (N = 323; sampled between 2001 and 2010) originating from both coasts of North America and Europe with an emphasis along the western coast of the Atlantic and the Gulf of St. Lawrence (GSL). Genetic differentiation amongst populations was shown to be partitioned in four distinct populations: (1) upper GSL, (2) inner GSL, (3) eastern and western American coasts, and (4) Europe. The population genetic structure of *M. arenaria* will be discussed in terms of the relation between the biological characteristics of the species and the different oceanographic factors that may influence such a structure. The implications of the study for connectivity at smaller geographical scales will also be presented.

Essais d'élevage en suspension de l'huître américaine (*Crassostrea virginica*), en lagune versus milieu ouvert aux Îles-de-la-Madeleine en 2011

C. Cyr*¹ et J-F. Laplante¹

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L'huître américaine est une espèce aquacole commercialement viable dans les maritimes ce qui n'a pas encore été démontré aux Îles-de-la-Madeleine. Vu l'intérêt des mytiliculteurs madelinots à diversifier leur production et des résultats prometteurs observés au Nouveau-Brunswick, il est intéressant de tester l'élevage en suspension de l'huître collée sur corde. La lanterne, utilisée en pectiniculture, semble également intéressante. La présente étude vise à évaluer le potentiel bio-technico-économique du développement de l'ostréiculture en lagune versus milieu ouvert. L'étude a débuté en juin 2010 avec des huîtres provenant de la ferme L'étang du ruisseau au Nouveau-Brunswick. Les huîtres de taille initiale de $30,33 \pm 4,07$ mm ont eu une croissance moyenne de 20,3 mm en lagune et de 8,8 mm en milieu ouvert entre juin et octobre. La survie a été de 99% dans la lagune par contre, en milieu ouvert, la mortalité a été élevée (30% à 60%). Cette mortalité est principalement attribuée à l'augmentation importante du poids des lanternes, due aux organismes fixés, ce qui a diminué la flottabilité de la ligne porteuse et entraîné les structures d'élevage vers le fond marin. Dans les prochaines années, il faudrait porter une attention toute particulière au nettoyage des structures et vérifier régulièrement la flottabilité des lignes porteuses.

Recent advances in bay scallop aquaculture (*Argopecten irradians irradians*) in New Brunswick: a promising species for diversification

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The bay scallop *Argopecten irradians irradians* was introduced to Prince Edward Island in 1980. Attempts to develop commercial aquaculture throughout the Maritimes failed for a variety of reasons, but several small-scale ventures eventually led to the naturalization of this species in certain bays along the northern shore of Nova Scotia. The New Brunswick company, L'Étang Ruisseau Bar Ltd., has invested considerable effort in the development of this species since 2001. In 2010, a group of four New Brunswick companies decided to co-invest in an R&D project as a means of filling the knowledge gaps and bringing this species closer to commercial development. Research results will be presented on methods to improve yield and size of bay scallop seed, commercial production trials using the OysterGro™ technology, wet holding trials at two commercial facilities and trials to extend the shelf-life using Modified Atmosphere Packaging and the Aqualife technologies. An economic analysis based on stocking densities and field trial yields will be presented. This species is a promising candidate for diversification but challenges remain in the marketing of the whole live bay scallop and the reduction of production costs.

Characterization of the dynamics of predators following a large scale scallops seeding: approaches and field tools

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There has been a continuous interest in Atlantic Canada in seeding juvenile sea scallops (*Placopecten magellanicus*) to enhance natural scallop populations or as an aquaculture approach. However, predation by sea stars and crabs has been a major constraint in this endeavour. We thus wanted to investigate in the field the predation responses (numerical and functional) of multiple predators on juvenile scallops during large scale seeding conducted off the coast off the Îles-de-la-Madeleine, Québec. To reach this goal, we developed and validated various measurement tools that could be use at our water depth (<32 m). First, to characterize the predator assemblage and the seeded scallops, we used a video camera system mounted on a sleigh. In parallel, we quantified the predation potential of juvenile scallops using frames on which scallops were previously tethered and that could be easily handle from the boat. The bias of prey's tethering on predation behaviour was previously assessed in lab. Finally, the collected data were used in a predation model to validate the independent impact of the multiple predators that occurs on the sea floor. Our approaches and tools used to survey large scale scallops seeding will be presented. Recommendations to improve the working process will also be discussed.

Looking Back and Towards the Future: Highlights and Lessons Learned after 10 Years of the Aquaculture Collaborative R&D Program - 1

Regard sur le passé et le futur: faits saillants et leçons apprises après 10 ans d'application du Programme coopératif de recherche et développement en aquaculture - 1

Monday, May 9, 2011 / Lundi 9 mai, 2011: 10h45-12h25

Location: Krieghoff

Co-Chairs / Co-Présidents: Nancy House & Charley Cyr (Fisheries and Oceans Canada / Pêches et Océans Canada)

10h45-11h05 C. Busby: Celebrating ten years of success with the Aquaculture Collaborative Research and Development Program (ACRDP)

11h05-11h25 L.O.B. Afonso: Soft-flesh suppression technology: Inhibiting the post-harvest effects of *Kudoa thyrsites* infection in farmed Atlantic salmon

11h25-11h45 D. Chabot: Effect of chronic sublethal hypoxia on growth of juvenile spotted wolffish (*Anarhichas minor*) and of the hybrid *A. minor* x *A. lupus*

11h45-12h05 M. Fréchette: Self-thinning in suspension-cultured mussels and organic matter input to the bottom

12h05-12h25 F.H. Page: An overview of ACRDP sponsored studies concerning the interactions of salmon netpen culture with the benthic and pelagic coastal marine environment of southwest New Brunswick

12:25-14:00 LUNCH / DÉJEUNER

(This session continues after lunch / Cette session continue après le déjeuner)

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Celebrating ten years of success with the Aquaculture Collaborative Research and Development Program (ACRDP)

C. Busby*¹, I. Burgetz¹, and G.J. Parsons¹

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The Aquaculture Collaborative Research and Development Program (ACRDP) is commemorating its tenth anniversary in 2011. This successful Fisheries and Oceans Canada (DFO) Oceans and Science Sector program was designed to foster improved competitiveness, increase collaboration with industry, facilitate technology transfer, and increase scientific capacity for aquaculture related research and development. Since 2001 and in partnership with industry, over 320 projects have been funded through ACRDP along three research themes: (1) Best Performance in Fish Production; (2) Optimal Fish Health; and (3) Industry Environmental Performance. In ten years over \$70 million has been invested in collaborative aquaculture R&D with approximately \$32.5 million from ACRDP and \$37.5 million from DFO, industry, and other partners. In this retrospective analysis of the program, consideration will be given to the factors which have made this applied biology program a national success, the impact that the program has made and how, moving forward in a changing industry, we can continue to ensure that aquaculture R&D continues to build collaborative efforts and provide the R&D necessary for a vital aquaculture industry in Canada.

Soft-flesh suppression technology: Inhibiting the post-harvest effects of *Kudoa thyrsites* infection in farmed Atlantic salmon

L.O.B. Afonso*¹, A. Eaves¹, T. MacWilliam², D. Morrison² and S.C. Johnson³

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Soft-flesh syndrome presents a significant challenge to the fish-farming industry by compromising product quality and lending to a negative consumer stigma of farmed fish products. In farm-reared Atlantic salmon (*Salmo salar*) the most common cause of soft-flesh is a parasitic infection caused by *Kudoa thyrsites*. *K. thyrsites* infection can result in substantial economic losses to the finfish aquaculture industry as infected fish have no signs of disease. There are no available treatments for *K. thyrsites* infection and a technology is urgently needed to suppress the damage caused by this parasite on fish flesh after harvesting. In this study two alternative technologies were tested to control manifestation of myoliquefaction in Atlantic salmon: high hydrostatic pressure and application of food grade sodium bicarbonate buffer solutions. Whole fish and fillets were subjected to several pressure intensities (different pressures and times) or different concentrations of sodium bicarbonate solutions. Myoliquefaction manifestation (presence and number of pits formation) and fish fillet quality parameters (colour, texture, flesh integrity, and smell) were evaluated daily for 5 days. The results demonstrated that both technologies were not effective at suppressing myoliquefaction, and they adversely affected product quality, including colour and texture of salmon flesh.

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

D. Chabot*¹, A. Savoie^{1,2} and N.R. Le François^{2,3}

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The spotted wolffish (*Anarhichas minor*) is a fast-growing cold water species which is under consideration for marine aquaculture diversification in Québec. The hybrid *A. minor* x *A. lupus* has also been produced and is under investigation for potential advantages over the parent species in an aquaculture context. It has been suggested that shallow raceways were the most cost-effective rearing method for on-land facilities. However this type of tanks is susceptible to fluctuations in dissolved oxygen (DO) or even to chronic low levels of DO (hypoxia) because of the low ratio of water to fish biomass. We tested the impact of 3 levels of constant non-lethal hypoxia on the growth of juvenile spotted and hybrid wolffish. Juvenile wolffish were reared for ~3 months at 40, 50, 60 or 100% air sat. (3 replicates per DO level, using 12 tanks with 2 baskets for spotted and hybrid wolffish). These fish were fed ad libitum several times each day, 5 days per week. A further treatment, also in triplicate, consisted in 100% sat. and food intake limited to that the average food consumption at 40% sat. to distinguish between the impact of hypoxia and that of the reduced food intake observed in hypoxia.

Self-thinning in suspension-cultured mussels and organic matter input to the bottom

M. Fréchette*¹

¹Ministère des Pêches et des Océans, Institut Maurice-Lamontagne, 850 Route de la Mer, Mont-Joli, Québec, CP. 1000, G5H 3Z4.

It is expected that in the future mussel culture grounds are located increasingly further offshore, with ensuing limited working time at sea. This will create an incentive for bypassing population density adjustment, which is bound to exacerbate mussel fall-off rate. I use Dynamic Energy Budget theory and self-thinning theory to model consequences of bypassing sleeving operations on biodeposit input to the bottom and mussel fall-off. I focus on mussel populations grown on collector ropes (autocollectors) in Cascadépédia Bay, Québec, an open body of water. With autocollectors, fall-off of mussel biomass over a complete growth cycle was three times as high as the quantity harvested. Mussel fall-off accounted for over half the total input of organic matter to the bottom. Biomass fall-off exceeded that expected with sleeving methods by one order of magnitude. The relative contribution of mussel fall-off increased in a step-like fashion with initial population density, indicating that in any given location, either mussels or biodeposits may dominate the organic input to the bottom, unless year-to-year variability in spat abundance is very high. Assessment of each fraction is required for forecasting the consequences of a shift in culture methods, as they have different, spatially structured, effects on benthic environments.

An overview of ACRDP sponsored studies concerning the interactions of salmon netpen culture with the benthic and pelagic coastal marine environment of southwest New Brunswick

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Salmon netpen culture has been conducted in southwest New Brunswick for more than 30 years. Over the past ten years the ACRDP program has helped support research focused on the interactions of the salmon culture operations with water column nutrients, dissolved oxygen and phytoplankton, benthic sulphides, evaluation of organic deposition models, investigations of the potential for the spread of disease pathogens by water currents and the development of Aquaculture Bay Management Areas as part of an ISA disease management strategy. This presentation will give a brief overview of the objectives and findings of these research undertakings.

3rd National Symposium on Freshwater Aquaculture – 1: Is there a Future for Freshwater Aquaculture in Canada?

Troisième symposium national en aquaculture d'eau douce – 1: Y a-t-il un futur pour l'aquaculture d'eau douce au Canada?

Monday, May 9, 2011 / Lundi 9 mai, 2011: 10h45-12h25

Location: Suzor-Coté

Chair / Président: Grant Vandenberg (Université Laval)

10h45-11h05 É. Gilbert: National aquaculture strategic action plan initiative in Canada: an integrated policy approach

11h05-11h25 G. Vandenberg: The Inter-Provincial Partnership for Sustainable Freshwater Aquaculture Development: past, present and future

11h25-11h55 B. Thomsen: Danish freshwater industry: sustainable production in challenging times

11h55-12h25 S. Naylor: From retrogressive obstructionism to abundant potential: Why isn't Canada's freshwater aquaculture sector a world leader?

12:25-14:00 LUNCH / DÉJEUNER

The Symposium on Freshwater Aquaculture resumes at 3:40PM.

Le symposium national en aquaculture d'eau douce recommence à 15h40.

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National aquaculture strategic action plan initiative in Canada: an integrated policy approach

É. Gilbert*¹

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Department of Fisheries & Oceans 200 Kent, Ottawa K1A 0E6 CANADA

Once viewed as a small-scale, localized, low-technology use of marine or freshwater resources, aquaculture has emerged as a substantial national industry in its own right that now generates over a billion dollars in sales annually. Once composed of a large number of small-scale operators, the sector has undergone considerable consolidation to the point that it now includes several very large companies as well. Government stewardship of the industry has evolved in an equally ad hoc manner, with the result that the sector is now governed by a complex range of laws, regulations, policies and operational guidelines. In short, despite the fact that aquaculture now accounts for close to 30 per cent of the total value of fish and seafood production and landings in Canada there was no national overarching strategic approach to ensure its ongoing sustainable development. The National Aquaculture Strategic Action Plan Initiative (NASAPI) has been designed to address this situation. The initiative sets out a comprehensive strategic vision for the sector as well as a series of specific actions needed to achieve it. It represents the combined views of federal and provincial/territorial agencies as well as those of a wide range of aboriginal groups, industry, and other public stakeholders. It includes an overarching document and a set of five more detailed strategic action plans focussed on the east and west coast finfish and shellfish aquaculture sectors, as well as the freshwater sector at the national scale. The overarching document provides a context for the plans, sets out a vision for the sector, and summarizes the key actions and is a roadmap that charts a path toward a more environmentally, socially and economically sustainable aquaculture sector in Canada.

The Inter-Provincial Partnership for Sustainable Freshwater Aquaculture Development: past, present and future

G Vandenberg*¹

¹Dép des sciences animales, Université Laval, President, IPSFAD Inc.

The Interprovincial Partnership for Sustainable Freshwater Aquaculture Development (IPSFAD) is a private not-for-profit organisation dedicated to promoting technological developments through R&D and commercialization activities with a goal to enhancing productivity and sustainable development of the Canadian freshwater aquaculture industry. With a new Industry Action Plan in place, the IPSFAD and its partners will highlight a number of themes during the Freshwater Symposium that have been identified as challenges to the development of this sector. In pursuit of its Mission to promote sustainable development of freshwater aquaculture in Canada, a new Action Plan has been adopted which will be an important tool that will guide the IPSFAD toward meeting its Objectives for 2011-2015. This new Plan will reflect a consolidation from industry and stakeholder consensus regarding those research, development and commercialization issues requiring priority attention. It will facilitate the implementation of RDC initiatives in the freshwater aquaculture sector.

Danish freshwater industry: sustainable production in challenging times

B. Thomsen*¹

¹The Danish Aquaculture Organisation, Vejlsøvej 51, 8600 Silkeborg, Denmark

According to FAO (State of World Fishery and Aquaculture 2010) aquaculture continues to be the fastest-growing animal-food-producing sector and per capita supply from aquaculture has increased from 0.7 kg in 1970 to 7.8 kg in 2008 corresponding to an average annual growth rate of 6.6 %. Globally, aquaculture accounted for 45.7 % of the world's fish food production for human consumption in 2008, but production in Europe and North America has since 2000 slowed substantially to 1.7 % and 1.2 %, respectively. Hence EU and North America is increasingly relying on imported fish. The potential in Danish aquaculture was initially identified in 1994 but despite many efforts production has not increased. The Danish Institute for Food Resources and Economics has concluded that the main barriers are discharge of nitrogen and industry regulation. Industry growth is further challenged by the implementation of the EU waterframework which calls for further reductions in the discharge of nitrogen into the aquatic environment. The key words for sustainable growth in Danish aquaculture are political initiatives, development and implementation of new technologies and shifting industry focus from production to costumers. A strategy for achieving such objectives are presented and discussed.

From retrogressive obstructionism to abundant potential: Why isn't Canada's freshwater aquaculture sector a world leader?

S. Naylor*¹

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Canada's freshwater resources are the envy of the world. We have the expertise, environmentally sustainable technologies, a well developed supply and services sector, and we are next door to one of the world's largest markets for fish. So why isn't Canada's freshwater aquaculture sector leading the world? This presentation will be a reflection on the last 50 years of freshwater fish culture in Canada, what we've learned, what's stunted the growth of the freshwater aquaculture sector and what the future holds.

Bivalve Aquaculture / Aquaculture des mollusques bivalves - 2

Monday, May 9, 2011 / Lundi 9 mai, 2011: 14h00-15h20

Location: Borduas

Chair / Présidente: Julie Pariseau (SODIM: Société de développement de l'industrie maricole)

14h00-14h20 M.-H. Thériault: Culling small size oysters: Is it a winning strategy?

14h20-14h40 C. Gionet: Production performance of the bay scallop (*Argopecten irradians irradians*) grown in suspended or bottom culture at five densities at two sites in New Brunswick

14h40-15h00 P. Kitchen: An economic analysis of shellfish production associated with the adoption of Integrated Multi-Trophic Aquaculture in British Columbia

15h00-15h20 S. Gauthier-Clerc: A predictive approach to assess the potential safety of whole scallops from harvest areas affected by paralytic, amnesic and diarrhetic shellfish poisoning in mussels

Culling small size oysters: Is it a winning strategy?

M.-H. Thériault¹, A. Mallet², C. Carver² and S. Courtenay³

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Drastic culling techniques are often used to eliminate up to 50% of oysters seeds during early grading because they are seen as genetically inferior in terms of growth potential. Likewise when oyster seed are initially removed from the collectors and then graded to remove the “slow” growers, there is no allowance for differing histories with regard to settlement time or density-dependent effects. Given the known annual risk of spatfall failure in key seed-producing areas, it is important that growers base their culling decisions on scientific information in order not to discard commercially-suitable seeds. The objective of the project was to evaluate the growth performance of three size grades of oysters (<5 mm, 5-10 mm and >10 mm) from the same year class originating from two different New Brunswick seed sources. Growth performance of four size grades of oysters from a single year-class reared using two grow-out systems (floating bags and rope-grown) and exposed to different localized environmental conditions was also evaluated. No significant difference in growth performance was observed among size classes for both years and among seed sources, suggesting that the smaller individuals were not genetically inferior. It was also noted that, the rope-grown oysters grew significantly faster than those in the floating bags, suggesting that oysters grown in floating bags are not achieving their full growth potential.

Production performance of the bay scallop (*Argopecten irradians irradians*) grown in suspended or bottom culture at five densities at two sites in New Brunswick

C. Gionet*¹, C.E. Carver², R. Lovesey³ and A.L. Mallet²

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²Mallet Research Services, 4 Columbo Drive, Dartmouth, NS, B2X3H3

³Allen, Paquet & Arseneau LLP, Bathurst, NB

This study aimed at defining the density and water column position for growing bay scallops in the OysterGro™ technology, a system typically used for oyster culture. Bay scallop seed were produced in the hatchery and transferred to the grow-out sites at a size of 3 mm. Two types of small-mesh cages were compared for growing this seed to a size suitable for transfer into 4-mm VEXAR® bags and then placed in OysterGro™ systems which were deployed at the two positions. At the second grading, the bay scallops were stocked in 9-mm VEXAR® bags at 5 densities either in suspension, on bottom or in suspension followed by on bottom. Significant difference in growth and survival was observed between sites. At first and second grading, the best shell growth and survival was observed in the VEXAR® bags in suspension. The final shell length after the 4-mo grow-out period was approximately 60-mm. Overall survival was high with the lowest value (90%) recorded at Bedec and the highest value (98.2%) at Bouctouche. This species is a good candidate for diversification in aquaculture. Challenges remain in the marketing of the whole live bay scallop and the reduction of production costs.

An economic analysis of shellfish production associated with the adoption of Integrated Multi-Trophic Aquaculture in British Columbia

P. Kitchen*¹ and D. Knowler¹

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Integrated Multi-Trophic Aquaculture (IMTA) combines fed aquaculture (finfish) with extractive aquaculture (shellfish and seaweeds) at one site to recycle nutrient waste while producing marketable seafood products. If finfish monoculture operations adopt IMTA, there could be an increase in the production of extractive aquaculture products. The study explores the potential market implications associated with shellfish production from IMTA adoption by finfish monoculture operations in British Columbia (BC), Canada. The study poses two research questions: (1) on the supply side, by how much could IMTA shellfish production augment current shellfish production from BC; and (2) on the demand side, how do shellfish consumers view the IMTA concept and value IMTA shellfish products? The study considers the case of oyster production associated with IMTA adoption by BC salmon farmers to address these research questions. Results of a production scenario analysis demonstrate that IMTA adoption can augment existing oyster production by varying degrees, depending upon the number of BC salmon farms that adopt IMTA and the production quantity per farm. Results of a consumer intercept survey reveal that oyster consumers in San Francisco have a positive perception of IMTA and the majority of respondents would be willing to pay a premium for IMTA oysters.

A predictive approach to assess the potential safety of whole scallops from harvest areas affected by paralytic, amnesic and diarrhetic shellfish poisoning in mussels

S. Gauthier-Clerc^{*1}, M. Scarratt², N. Moisan³, J.-P. Pipon⁴, W. Rourke⁵, Brodeur⁶ and J.-P. Hébert⁷

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In Québec, scallop growers have targeted the specialty market with the sale of whole organisms. In proposed scallop cultivation areas, harmful algal blooms have been reported for many years and episodes of paralytic, amnesic, and diarrhetic shellfish poisoning (PSP, ASP, DSP) have been reported in mussels. This project compares the occurrence and concentration of biotoxins in cultured whole mussels and scallops from two harvest areas (Baie de Gaspé, Baie des Chaleurs), and correlates these toxins with environmental variables and algal taxonomy. The overall goal is to extrapolate data from harmful algae and mussel toxicity monitoring programs conducted in both bays over the past two decades to assess the commercial viability of whole scallop production in the region. Suspension-cultured mussels and scallops were sampled weekly at four sites from June to November 2010. PSP, ASP and DSP toxins were determined in whole organisms. Samples were collected simultaneously for temperature, salinity, nutrients and taxonomic analysis of phytoplankton. PSP toxicity was detected in June and July in both bivalve species at two sites. It only briefly exceeded the RL in mussels whereas maximum PSP toxicity reached ca. 600 STX eq 100 g⁻¹ in scallops. Two other sites remained non-toxic throughout the study.

Looking Back and Towards the Future: Highlights and Lessons Learned after 10 Years of the Aquaculture Collaborative R&D Program - 2

Regard sur le passé et le futur: faits saillants et leçons apprises après 10 ans d'application du Programme coopératif de recherche et développement en aquaculture - 2

Monday, May 9, 2011 / Lundi 9 mai, 2011: 14h00-15h20

Location: Krieghoff

Co-Chairs / Co-Présidents: Nancy House & Charley Cyr (Fisheries and Oceans Canada / Pêches et Océans Canada)

14h00-14h20 B.D. Chang: Exploratory analysis of sediment sulfide data collected in the annual monitoring program at salmon farms in southwestern New Brunswick, Bay of Fundy

14h20-14h40 P.K. Sarker: A review of sustainability issues related to feeding salmonids: a Canadian perspective

14h40-15h00 D. Green: The industry perspective on ten years of ACRDP initiatives in the NL region

15h00-15h20 R. Salmon: ACRDP's role in the development of the Canadian aquaculture industry

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Exploratory analysis of sediment sulfide data collected in the annual monitoring program at salmon farms in southwestern New Brunswick, Bay of Fundy

B.D. Chang*¹ and F.H. Page¹

¹Fisheries and Oceans Canada, Biological Station, St. Andrews, NB E5B 2L9

Annual environmental monitoring is conducted at all operating fish farms in southwestern New Brunswick, Bay of Fundy, as part of the Environmental Management Program (EMP) of the New Brunswick Department of Environment (NBDENV). The program requires monitoring of sulfide concentrations in seafloor sediments under all operating farms during August–October each year; this annual monitoring is designated “Tier 1”. Sulfide data from the Tier 1 monitoring were obtained for each farm monitored during 2002–2008. Data were also obtained on several parameters related to the monitoring and farm operations: the date of monitoring, farm age, farm lease area, average water depth in the farm lease, average current speed (model prediction) at the farm, year-class of fish present, number of fish on site, and biomass of fish on site. Data were not available for the numbers and biomass of fish at many farms, especially during 2002–2004. There were no significant correlations between sediment sulfide levels and the date of monitoring, lease area, average water depth, and number of fish in most years. There were significant correlations between sediment sulfide levels and the farm age, average current speed, and biomass of fish in most years, but with considerable variability. Additional analyses will be performed on the data to further examine these relationships.

A review of sustainability issues related to feeding salmonids: a Canadian perspective

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The issue of sustainability of salmonid culture has been the focus of considerable media coverage and debate between environmental activists and aquaculture industry stakeholders, particularly regarding the use in salmon feed formulation of ingredients (fishmeal and fish oil) derived from wild fisheries. The National Aqua-feed Working Group, one of the working groups under the NASAPI, is preparing of a peer-reviewed paper that documents and tells the true situation of the Canadian aqua-feed sector and shows an unbiased and science-based review of the state of the art. This study attempts to summarize recent data and compute conversion efficiency of feed resources by Canadian farmed salmon in order to objectively assess the sustainability of this industry. Calculations based on available scientific data reveals that farmed salmonids grow more efficiently and utilize less forage fish (in the form of fishmeal and fish oil) than their wild counterparts. We will present advances that have been made in fish feeding diets, and fish conversion efficiency, and actualize the available information using science-based facts. Evidence demonstrates that production efficiency of farmed salmonids significantly improved over time due to continued improvements in feed formulations. Results from the ongoing work suggest that the Canadian salmon aquaculture industry efficiently converts wild fish resources into high-value fish products.

The Industry Perspective on Ten Years of ACRDP Initiatives in the NL Region

D. Green*¹

¹Newfoundland Aquaculture Industry Association, 11 Austin St., Suite #209, St. John's, NL A1B 4C1

The Aquaculture Collaborative Research and Development Program (ACRDP) has helped increase the level of collaboration between the aquaculture industry and Fisheries and Oceans Canada (DFO) scientists in Newfoundland and Labrador since its inception. This program has fostered the development of many industry-relevant aquaculture research projects, turning industry R&D priorities into action, and has provided industry with good returns in terms of R&D dollars invested. Past projects on topics such as cod broodstock selection and management, gastric dilation in rainbow trout, blue mussel seed supply, and ongoing projects in areas such as visual based environmental monitoring and long term holding of blue mussels are examples of research which increases our scientific knowledge of aquaculture and ensures that our aquaculture industry remains globally competitive.

ACRDP's role in the development of the Canadian aquaculture industry

R. Salmon*¹

¹Canadian Aquaculture Industry Alliance, Box 81100, World Exchange Plaza, Ottawa ON K1P 1B1

The Aquaculture Collaborative Research and Development Program (ACRDP) is a Fisheries and Oceans Canada (DFO) initiative to increase the level of research and development activity between the aquaculture industry and the department. ACRDP is an industry-driven, collaborative program that has produced tangible value for the Canadian aquaculture industry. Collaboration occurs at all levels. In addition to the individual research projects, industry members (together with DFO and provincial government representatives) play a key role in planning and prioritizing how research funds will be spent at both the regional and national level. ACRDP has been a relevant and successful program, contributing a reliable source of research funds aimed at applied projects having direct and practical benefit to industry. Over the past 10 years, projects funded by ACRDP have helped to provide answers to issues of fish health, development of new and better species, and best performance practices. This session will review and contrast the past 10 years of R&D investment in the ACRDP program, along with developments and improvements in industry productivity. Projects that have been particularly helpful in improving industry competitiveness will be highlighted. In addition, a look to the future to forecast industry's upcoming R&D needs will also be considered.

Communicating Science and Involving Canadians in Local and International Aquaculture Development

Comment transmettre l'information scientifique et impliquer les canadiens dans le développement de l'industrie aquacole sur le plan local et international

Monday, May 9, 2011 / Lundi 9 mai, 2011: 14h00-15h20

Location: Suzor-Coté

Chair / Présidente: Céline Audet (Université du Québec à Rimouski)

14h00-14h20 S. Langlois: Overview of recent NSERC initiatives for the aquaculture sector / Survol des initiatives récentes au CRSNG dans le secteur de l'aquaculture

14h20-14h40 P. Roberston: Communicating aquaculture research through video: Lessons from the field, laboratory and public forums

14h40-15h00 S.F. Cross: Commercialization of IMTA – what and how scientific research is used in the corporate decision-making process

15h00-15h20 I. Ben Khemis: Coursus international et potentiel d'impact au profit du pays d'origine : témoignage illustratif

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Overview of recent NSERC initiatives for the aquaculture sector / Survol des initiatives récentes au CRSNG dans le secteur de l'aquaculture

S. Langlois*¹

¹Research Partnerships Programs / Programmes de partenariats de recherche, Natural Sciences and Engineering Research Council of Canada (NSERC) / Conseil de recherches en sciences naturelles et en génie du Canada (CRSNG), Ottawa, Ontario, K1A 1H5

Investments in aquaculture research partnerships by the Natural Sciences and Engineering Research Council of Canada (NSERC) and its partners in industry and government have soared to historic highs in recent years. This has been fuelled by the federal government's current emphasis on addressing the innovation needs of fisheries and related industries. In fiscal year 2009-10, NSERC investments in university-industry aquaculture research partnerships topped \$4.6 million—almost two and a half times more than the average annual outlay during the previous 10 years. This investment leveraged a record \$2.7 million in cash and in-kind contributions from partners in industry and government—a staggering seven-fold jump since the 2000-01 fiscal year. Fisheries and related industries were among four industry sectors identified in *Budget 2008* as priorities for NSERC research partnership investments. To address these priorities, NSERC received an additional \$34 million annually. The presentation will discuss the recent investments in aquaculture, as well as new initiatives and opportunities to benefit the sector and increase collaborations between industry, government and academia.

Les investissements du Conseil de recherches en sciences naturelles et en génie du Canada (CRSNG) et de ses partenaires industriels et gouvernementaux dans les partenariats de recherche en aquaculture ont atteint des sommets historiques ces dernières années. Cette montée en flèche est attribuable aux efforts déployés actuellement par le gouvernement fédéral pour répondre aux besoins en matière d'innovation du secteur des pêches et des industries connexes. En 2009-2010, les investissements du CRSNG dans les partenariats de recherche universités-industrie en aquaculture ont dépassé 4,6 millions de dollars – près de 2,5 fois plus que la moyenne annuelle des 10 années précédentes. Ils ont permis de susciter auprès des partenaires industriels et gouvernementaux des contributions en espèces et en nature records de 2,7 millions de dollars, sept fois plus qu'en 2000-2001. Le secteur des pêches et les industries connexes figuraient parmi les quatre secteurs industriels désignés dans le budget de 2008 comme prioritaires pour les investissements du CRSNG dans les partenariats de recherche. Pour donner suite à ces priorités, le CRSNG a reçu un montant supplémentaire de 34 millions de dollars par an. La présentation portera sur les investissements récents en aquaculture ainsi que sur les nouvelles initiatives et occasions pouvant avantager le secteur et augmenter les collaborations entre les milieux industriel, gouvernemental et postsecondaire.

Communicating aquaculture research through video: Lessons from the field, laboratory and public forums

P. Robertson*^{1,2}, G.K. Reid ^{1,2} and S.M.C. Robinson ²

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Intensive commercial aquaculture is arguably scrutinized more than any other agri-food industry as it is a new industry, occurs in the nearshore, and is perceived by many to be controversial. Consequently industry information and scientific research has to be communicated judiciously. Video is an influential communication tool that is growing in popularity as the medium of choice among the public, and has been increasingly used to communicate findings about developments in the aquaculture industry. If used prudently to report and disseminate scientific research, video has immense potential to reach a vast audience, in addition to updating project stakeholders. While not intended as a substitute for published research, video reporting enables a rapid communication option for anticipated, time sensitive research. Public online forums provide feedback on the number of views, demographics, geographical interest, and search methods, free-of-charge. State-of-art video technology now enables high quality production at nominal costs, without the necessity of a dedicated professional. Not without its drawbacks, video communication may lead scientists to rushed research conclusions based on limited data or may infringe corporate security. Lessons learned through field and laboratory video production of research in Integrated Multi-Trophic Aquaculture (IMTA) and related fields will be presented and discussed.

Commercialization of IMTA – what and how scientific research is used in the corporate decision-making process

S.F. Cross*^{1,2}

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²Kyuquot SEAfoods Ltd. (a SEA-Vision Group company), 2541 Conrad Rd., Courtenay, BC V9N 9N8

Canada continues to take a leading role in the applied research and development of Integrated Multi-Trophic Aquaculture (IMTA). Establishment of the national NSERC/DFO-funded Canadian Integrated Multi-Trophic Aquaculture Network (CIMTAN), with a 5-year commitment of resources among its pan-Canadian scientific collaborators, provides a unique and valuable opportunity to facilitate the transition of R&D results into the commercialization arena. Although partnered with industry, the CIMTAN research projects and scientific objectives for the network have primarily (and necessarily) been formulated by the team of academic and government researchers, anticipating generation of a broad and valuable spectrum of scientific information on IMTA system function/performance, direct and indirect system benefits, impacts on aquaculture management, socio-economic implications, etc. During, and in the wake of this research effort, industry will ultimately decide on whether or not to adapt the IMTA model for seafood production, based on a supplemental suite of business criteria and using the results achieved through comprehensive efforts such as CIMTAN as an important part of this assessment process. This presentation will provide a unique academic-corporate perspective on how Canadian research is being used in the commercialization of IMTA, what corporate objectives are being satisfied, and what parallel initiatives are, or will need to be developed, to address industry-relevant information gaps.

Cursus international et potentiel d'impact au profit du pays d'origine : témoignage illustratif

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La différence de contexte entre les pays économiquement avancés et ceux dits en développement, pose légitimement la problématique de savoir si une formation au sein d'institutions « occidentales » peut effectivement être utile pour travailler au profit du pays d'origine ? En vue d'apporter un éclairage informel, une réflexion est proposée au travers d'un témoignage utilisé à titre illustratif ; en l'occurrence un doctorat en Europe, un post-doctorat au Canada puis un poste de chercheur en Tunisie. Les acquis personnels de ce parcours sont loin de se limiter aux aspects strictement fonctionnels (diplômes académiques, expérience professionnelle, technicité) même si ceux-ci ne sont pas négligeables. Ils s'étendent indéniablement aussi au vécu en termes de diversité et d'intégration, tant sur le plan culturel qu'au sein des équipes d'accueil ; ainsi qu'aux opportunités relationnelles, tant personnelles que via l'accès aux réseaux spécifiques. L'ensemble influence le potentiel d'impact en tant que ressource humaine. Quant à ceux qui choisissent d'immigrer, ils contribuent eux aussi au développement de leur pays d'origine. Ainsi, la question de l'adéquation de la formation reçue ne devrait pas être limitée à l'utilité dans le pays d'origine mais devrait aussi intégrer l'utilité pour le plan de carrière envisagé par le(la) candidat(e).

Contributed Papers / Soumission de résumés dans des sujets autres

Monday, May 9, 2011 / Lundi 9 mai, 2011: 15h40-17h20

Location: Borduas

Chair / Président: Réjean Tremblay (Université du Québec à Rimouski)

15h40-16h00 **E. Nelson**: Sea cucumbers in aquaculture: Taking care of business

16h00-16h20 **B.-A. Dupont-Cyr**: Sex-related growth dimorphism in wolffishes (*Anarhichas minor* and *A. lupus*)

16h20-16h40 **B. Glebe**: North American Arctic charr aquaculture: History and current research

16h40-17h00 **E.A. Prussin**: Use of a commercially viable kelp (*Saccharina latissima*) for mapping the nutrient plume from an integrated multi-trophic sablefish farm (IMTA)

17h00-17h20 **B. Genard**: Probiotics selection methods for bivalves larvae production in hatchery

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Sea cucumbers in aquaculture: Taking care of business

E. Nelson*¹, B. MacDonald¹ and S. Robinson²

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Integrated Multi-Trophic Aquaculture (IMTA) is one approach to aquaculture that has the potential to reduce organic loading into the environment. IMTA combines traditional fed aquaculture (generally finfish) with extractive species, that can remove inorganic (e.g. seaweeds) and organic (e.g. mussels) nutrients. *Cucumaria frondosa*, a benthic suspension feeding sea cucumber, is currently being examined as a potential organic extractive IMTA species. This study aims to quantify this potential by determining: 1) the relationship between absorption efficiency and the quality (organic content) of their food supply and 2) the time it takes for food to be converted to faeces (gut passage time). Preliminary studies have revealed that sea cucumbers appear to be capable of improving their extraction efficiency as the quality of the food increases ($r^2=0.75$). Gut passage time was found to be 39 hours (minimum) within the laboratory. Comparable studies will explore absorption efficiencies when feeding on alternate diets, including field measures where there is potential exposure to a combination of natural and farm-based particulates.

Sex-related growth dimorphism in wolffishes (*Anarhichas minor* and *A. lupus*)

B.-A. Dupont-Cyr^{*1}, R. Roy², G.W. Vandenberg¹ and N.R. Le François³⁻⁴

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In 2006, photoperiodic compression was initiated on the captive spotted and Atlantic wolffish broodstock of the Québec-based wolffish cultivation program to achieve two reproduction periods per year. One component of the project proposed to evaluate the growth performance of common and Spotted wolffish of the size range of 1kg and secondly to evaluate the presence of a sex-related growth difference. Three experimental groups were tested: mature common wolffish, nearly mature spotted wolffish of Canadian and Norwegian strains. During the experiment, fish were subjected to two photoperiods (simulated natural and compressed) and growth was monitored monthly. At the end, a sex-related positive growth dimorphism for males was observed. Males of all species and all strains were 10-20% heavier and 10-15% longer than females. In captivity, the reproductive behavior was very different than wild and captive males were not reproductively competent. In captivity, the observation of a sex-related growth dimorphism seen to be directly linked with the higher investment made by captive females for reproduction. In aquaculture, depending on desired market size, the use of all male stocks and/or approaches to delay maturation could be useful.

North American Arctic charr aquaculture: History and current research trends

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Wild populations of Arctic charr *Salvelinus alpinus* have a holarctic distribution and are highly variable ecologically. In North America, repeated glaciations appear to have resulted in the evolution of three major lineages of charr: Laurentian lineage genotype *Salvelinus alpinus oquassa* (Maine (ME) and New Brunswick (NB)), Arctic lineage (*Salvelinus alpinus erythrinus*) (most northern Arctic distributions) and Labrador lineage (*Salvelinus alpinus erythrinus*) (landlocked and anadromous populations). There has been a recreational charr stocking program using the *oquassa* strain. This stocking only occurred in NB in the 1940's. However, Maine continues to stock a local *oquassa* strain known as the Sunapee or blue back trout. The first importations (both Labrador and Arctic anadromous *erythrinus* strains, Fraser River and Nauyuk Lake respectively) for aquaculture occurred in the early 1980's to Manitoba (MT) and to NB. By 1987, eggs and fingerlings, primarily from the Fraser strain, were transferred to more than 20 private aquaculture hatchery sites in most of the Canadian provinces and the Northwest Territories (NWT). Significant research and development projects which originated from these transfers include the following. A saltwater farm trial comparing the performance of two charr strains with that of Atlantic salmon was completed. A NB breeding program, which received the first imports of Fraser River eggs in 1991, continues to support a small freshwater industry with select seed stock. A unique freshwater lake

cage farm in Newfoundland had superior charr growth compared to land based hatcheries. One commercial salmon farmer continues to grow charr in seawater cages. A project to identify the genetic basis for superior performance of some charr in seawater is ongoing. The major NA producers are land based and are located in the NWT, Nova Scotia, NB and Washington State. Icelandic production of charr continues to grow and this country is currently the world's largest producer. However, Canadian Arctic charr have been recently exported to Chile and there is potential for commercial production there. There has been no growth in Canadian commercial charr production over the last decade.

Use of a commercially viable kelp (*Saccharina latissima*) for mapping the nutrient plume from an integrated multi-trophic sablefish farm (IMTA)

E.A. Prussin*¹ and S.F. Cross^{1,2}

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²Kyuquot SEAfoods Ltd.

The objective of this study was to establish the spatial pattern of the dissolved nutrient plume emanating from an open-water IMTA farm by means of an *in situ* kelp bioassay. The farm was located on the North-West Coast of Vancouver Island in British Columbia. Kelp (*S. latissima*) was grown at three depths (2, 4, & 6 meters) on vertical lines along transects radiating out from the fish pens. Growth rates were monitored over one partial season (May – August 2010). Increased growth was used as a proxy for higher nutrient concentrations and to infer spatial distribution of wastes around the farm. Results indicated a statistical difference in growth with direction and distance from the fish pens (ANOVA, $p < 0.001$). Overall growth ranged from $4\text{mm}\cdot\text{day}^{-1}$ to $20\text{mm}\cdot\text{day}^{-1}$. Results were mapped using GIS software and showed a definite trend in growth rates following known current directions. This method provides a cumulative spatial response, and supplements common techniques of water quality monitoring involving water column profiling and/or sampling. Continued nutrient uptake by the kelp, reflected in relative growth rates, may allow visualization of pulsed nutrients that would otherwise be missed in time-sensitive water-sampling techniques.

Probiotics selection methods for bivalves larvae production in hatchery

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³IUEM, Institut universitaire européen de la mer. LEMAR, Laboratoire des sciences de l'environnement marin. UBO, Université de Bretagne Occidentale. CNRS, Centre national de la recherche scientifique. Technopole de Brest-Iroise, Plouzané, 29280 (France)

In bivalves aquaculture hatchery, massive mortality associated to bacterial pathogens is a recurrent problem which limit larval production. Industry controls generally this problem by use of antimicrobial drugs (mainly antibiotics), which is more and more restricted for reasons of human health and resistant strain selection. Probiotics were proposed as one of alternative methods to antibiotic treatment. In the present works, we described in vitro and in vivo methods used to select putative probiotics which can be used in *Crassostrea gigas* and *Pecten maximus* larval production. More precisely, two candidates (*Lactobacillus* sp (04/023) et *phaeobacter gallaeciensis* (X34)) were selected among 19 putative probiotics for their ability to inhibit development (antibiogram test) of four bacterial pathogen (*V. pectenocida*, *V. splendidus*-like, *V. coralliilyticus* and *V. aestuarianus*). These both candidates were used in *Crassostrea gigas* and *Pecten maximus* larval production and their impact on the growth and survival were estimated. 04/024 induced high mortality on *C. gigas* larvae while X34 demonstrated interesting probiotic properties for *C. gigas* and *P. maximus* larval production.

Genetics / Génétique

Monday, May 9, 2011 / Lundi 9 mai, 2011: 15h40-17h20

Location: Krieghoff

Chair / Présidente: Céline Audet (Université du Québec à Rimouski)

15h40-16h00 M.A. Chiasson: Quantitative trait loci (QTL) for body weight and condition factor in Fraser strain Arctic charr in fresh and brackish water

16h00-16h20 **C. McGowan**: Pedigree-free estimation of heritability in Arctic charr (*Salvelinus alpinus*) using genetic markers

16h20-16h40 N.L. Quinn: Identification of genes associated with heat tolerance in Arctic charr exposed to acute thermal stress

16h40-17h00 V. Bourret: Temporal change in genetic integrity suggests loss of local adaptation in a wild Atlantic salmon (*Salmo salar*) population following introgression by farmed escapees

17h00-17h20 F. Lamaze: Evaluating the genetic impact of stocking on brook charr (*Salvelinus fontinalis*) by means of SNP population genomics

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Quantitative trait loci (QTL) for body weight and condition factor in Fraser strain Arctic charr in fresh and brackish water

M.A. Chiasson^{*1}, H.K. Moghadam², R.G. Danzmann¹ and M.M. Ferguson¹

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Thirty full-sib families Arctic charr were produced at the Coastal Zones Research Institute (NB). At a mean weight of 230g, 120 individuals from each family were PIT-tagged and were transferred to CanAqua Seafoods Ltd. where they were grown communally in four 16m³ tanks under two environmental conditions, fresh (FW) and brackish water (BW) from May 2008 to September 2009. Wet weight and fork length was measured every six months. To test for QTL for variation in body weight (*Wt*) and condition factor (*K*), 10 microsatellite markers were selected from the literature. Survival of charr in BW did not differ significantly from FW counterparts. After 12 months at the commercial site, family 11 had the greatest overall growth in FW while family 30 had the greatest overall growth in BW. A single genome-wide QTL was identified for *Wt* on AC-8 in FW. Chromosome-wide QTL for *Wt* were identified on AC-4, -14 and -19 in both BW & FW. Chromosome-wide QTL for *K* were identified on AC-4, -5, and -20i in FW but QTL for *K* in BW were not found. Knowledge of QTL positions and relative family phenotypic performance is essential for the application of marker assisted selection on a commercial scale.

Pedigree-free estimation of heritability in Arctic charr (*Salvelinus alpinus*) using genetic markers

C. McGowan^{*1}, E. Davidson², J. Lucas¹, J. Rose¹ and W.S. Davidson²

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A critical issue for any commercial finfish broodstock program is the large number of tanks and additional water that is required to employ family-based selective breeding techniques. Under typical conditions, all available resources must be allocated to commercial production. Consequently, most small, or mid-sized, privately owned facilities with selective breeding programs tend to apply mass selection under commercial conditions. Although this practice works well for easily measured traits, such as growth rate or size at maturity, traits that are difficult to measure, such as flesh pigmentation or disease resistance can be problematic. Also, mass selection precludes the calculation of important breeding values such as heritability, information that is critical when assessing the potential, or the success, of a particular selection strategy. To overcome this problem, we are exploring the use of microsatellite markers to establish relationships between individuals within specific populations of Arctic charr (*Salvelinus alpinus*) and use this genetic information to estimate the heritability of commercially important traits. The methodologies and results of this project will serve as a model for other selective breeding programs that are interested in using this technology and will demonstrate how it can be applied to any operation, regardless of its size.

Identification of genes associated with heat tolerance in Arctic charr exposed to acute thermal stress

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Arctic charr is an attractive aquaculture species because it features the desirable tissue traits of other salmonids, and is bred and grown in inland freshwater tanks. We are interested in developing upper temperature tolerant (UTT) strains of Arctic charr to increase the robustness of the species in the face of climate change, and to enable production in more southern regions. We used a genomics approach that takes advantage of the well-studied Atlantic salmon genome to identify genes associated with UTT in Arctic charr. We conducted an acute temperature trial, identifying temperature tolerant and intolerant Arctic charr individuals, which were subject to microarray and qPCR analysis to isolate candidate UTT genes. These were compared with genes annotated in a UTT QTL region that we sequenced in Atlantic salmon. Our results suggest that small heat shock proteins as well as HSP-90 genes are associated with UTT, that hemoglobin expression was significantly down-regulated in tolerant compared to intolerant fish, and that *COUP-TFII* is a candidate UTT gene. Our results highlight the importance of using more than one approach to identify candidate genes, particularly for a complicated trait such as UTT in a highly complex genome for which there is no reference genome.

Temporal change in genetic integrity suggests loss of local adaptation in a wild Atlantic salmon (*Salmo salar*) population following introgression by farmed escapees

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In some wild Atlantic salmon populations, rapid declines in numbers of wild returning adults has been associated with an increase in the prevalence of farmed salmon. Studies of phenotypic variation have shown that interbreeding between farmed and wild salmon may lead to loss of local adaptation. Yet, few studies have attempted to assess the impact of interbreeding at the genome level, especially among North American populations. Here, we document temporal changes in the genetic make up of the severely threatened Magaguadavic River salmon population (Bay of Fundy, Canada), a population that might have been impacted by interbreeding with farmed salmon for nearly 20 years. Wild and farmed individuals caught entering the river from 1980 to 2005 were genotyped at 112 SNPs, and/or eight microsatellite loci, to scan for potential shifts in adaptive genetic variation. No significant temporal change in microsatellite-based estimates of allele richness or gene diversity was detected in the wild population, despite its precipitous decline in numbers over the last two decades. This might reflect the effect of introgression from farmed salmon, which was corroborated by temporal change in linkage-disequilibrium. Moreover, SNP genome scans identified a temporal decrease in candidate loci potentially under directional selection. Of particular interest was a SNP previously shown to be strongly associated with an important QTL for parr mark number, which retained its genetic distinctiveness between farmed and wild fish longer than other outliers. Overall, these results indicate that farmed escapees have introgressed with wild Magaguadavic salmon resulting in significant alteration of the genetic integrity of the native population, including possible loss of adaptation to wild conditions.

Evaluating the genetic impact of stocking on brook charr (*Salvelinus fontinalis*) by means of SNP population genomics

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Salmonids rank among the socio-economic most valuable fishes worldwide, but also among the most affected by genetic introgression as a consequence of a long tradition of stocking with hatchery-reared conspecifics. In this study, we developed and genotyped 280 SNP from transcribed (coding) regions by means of next-generation sequencing in order to: i) investigate the potential adaptation of brook charr (*Salvelinus fontinalis*) to their natural and aquacultural environments; ii) evaluate the consequences of various levels of restocking and resulting introgression rates on the genetic integrity of natural

populations, and iii) test whether introgression occurred in a homogeneous way for all markers or if differential selection at specific markers might be at play. Thus, we sampled 9 natural populations that underwent different intensity of stocking over a period of 15 years as well as a reference hatchery population. Simulations between wild and wild versus domestic populations identified 5 and 6 potential outliers. As previously reported with microsatellites, we observed a positive relationship between stocking intensity and genetic diversity, a decrease in population differentiation, as well as an increase in measure of individual admixture proportions. We also identified SNP for which the rate of introgression has been either more restricted or enhanced relative to neutral expectations. These results suggest that selection has favoured or hampered the introgression of genomic blocks into the introgressed wild populations and that these are not yet fixed in the wild populations. Overall, this study highlights the usefulness of these new SNP markers to investigate the consequences of stocking practices on the integrity of potentially adaptive genetic variation in brook charr.

3rd National Symposium on Freshwater Aquaculture – 2: Certification Issues Facing the Freshwater Sector

Troisième symposium national en aquaculture d'eau douce – 2: Problématique de la certification dont fait face le secteur d'eau douce

Monday, May 9, 2011 / Lundi 9 mai, 2011: 15h40-17h20

Location: Suzor-Coté

Chair / Président: Mike Rose (Global Trust Certification Ltd)

15h40-16h00 M. Rose: Aquaculture certification schemes

16h00-16h20 J. Eastman: The World Wildlife Fund sponsored Freshwater Trout Aquaculture
Dialogue: Canadian industry perspectives

16h20-16h40 K. Tracey: Certification activities for the Ontario trout industry

16h40-17h00 R. Salmon: A Canadian-based certification scheme: application to the Freshwater sector

17h00-17h20 B. Hicks: Organic aquaculture standards for Canada

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The World Wildlife Fund sponsored Freshwater Trout Aquaculture Dialogue: Canadian industry perspectives

J. Eastman*¹

¹Manitoba Agriculture, Food and Rural Initiatives

Certification schemes have been widely adopted by the fisheries industry as a means to demonstrate sustainable practices. However, certification of aquaculture products is still in the relative early stages. The development of viable third-party aquaculture certification programs is urgent to ensure continued competitiveness of aquaculture products in the marketplace. The World Wildlife Fund is leading the establishment of standards for environmentally and socially responsible aquaculture by facilitating species specific “Aquaculture Dialogues”. These multi-stakeholder negotiations bring together all key stakeholders and have the end goal of establishing measurable, science-based standards that are to apply globally. Because of differences in opinion and competing interests amongst the stakeholders and compounded by a diversity of national realities and production methods, there exists many challenges to develop functional standards. The Inter-provincial Partnership for Sustainable Freshwater Aquaculture Development is actively participating in the Freshwater Trout Aquaculture Dialogue. Representatives prepared for and attended the most recent Dialogue meeting and submitted comments on the first draft of the standards. The IPSFAD feels that because of its members’ expertise and familiarity of the trout aquaculture industry in Canada, its contributions are invaluable to the WWF in its efforts to develop credible international standards for environmentally and socially responsible freshwater trout aquaculture.

Certification activities for the Ontario trout industry

K. Tracey*¹

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Clearly there is a global trend toward the requirement for all agri-food sectors to be able to demonstrate their ability to document safe, sustainable, and traceable practices during the production, processing, and handling of food. Consequently, certification programs are recognized as essential and are in-place or under development across virtually all agri-food sectors, including aquaculture. Recognizing this, NOAA members undertook the process of adopting, modifying, or developing a certification scheme that will address industry needs. The first stage was enlisting the services of Global Trust Certification Ltd., globally recognized experts in various certification schemes, to deliver a customized “How to Implement Trout Standards and Certification” program to NOAA members. In the second stage, NOAA employed Global Trust to undertake benchmark audits of several Ontario rainbow trout hatcheries, producers, and processors. Facilities were simultaneously benchmarked against 2 global standards, Certified Quality Trout (CQT) and Global Gap. In addition, the production facilities were also benchmarked against the existing NOAA Best Management Practices (BMPs) and Standard Operating Procedures (SOPs) as another indicator of certification readiness. Individual sites were provided with confidential audit reports, and NOAA received an industry overview. The certification process to-date has been partially assisted by NRC-IRAP.

A Canadian-based certification scheme: application to the Freshwater sector

Ruth Salmon*¹

¹Canadian Aquaculture Industry Alliance, Suite 705, 116 Albert Street, Ottawa, Ontario

The Canadian Aquaculture Industry Alliance is exploring the use of recognized FAO standards to develop a leading edge, internationally recognized, transparent, credible and cost-effective certification model for application across the Canadian aquaculture industry. Among other parameters the model will include identification, implementation and verification of robust traceability standards. The proposed model will also focus on assessment and validation of the overarching management framework in Canada, and whether (or to what degree) it may meet internationally established FAO expectations. This new approach will reassure all stakeholders - markets, the general public, industry and Governments - that the Canadian aquaculture system is being conducted in a responsible manner. A focus on the applicability of this new certification program to the Canadian freshwater sector will be discussed.

Organic aquaculture standards for Canada

B. Hicks*¹

¹B. Hicks and Associates Inc. Langley BC

Organic agriculture has been practiced in various forms for a very long time. In Canada a more formal recognition of organic agriculture practices began to emerge in the 1960 and during the 1980's and 1990's it became a more formal and rigorous practice with certification becoming more and more of requirement. Standard setting organizations and certifiers developed in all regions of the country and in some provinces there were many different organizations setting standards and certifying for the same crops. This led to some overlap and some confusion. The next step in the development of organic standards was to develop a set of national standards which could also be used to facilitate international trade in organic products. This led to the development of a national organic agriculture standard for Canada under to auspices of the Canadian General Standards Board (CGSB). At the time of the development of the national organic standard for agriculture, aquaculture was specifically excluded from the national standard in part because the Agriculture Canada who was sponsoring the development of the agriculture did not consider fish to be part of their mandate. Therefore, independent of this process, a group of fish farmers interested in the development of organic standards for aquaculture worked the development of organic aquaculture standards. In the mid 1990's a group of fish farmers in BC got together to begin discussions on how to farm fish using organic principles. This led to the creation of the Pacific Organic Seafood Association (POSA) in 2002. By 2004 the first set of organic standards was prepared and adopted by POSA. Working with the Certified Organic Associations of British Columbia (COABC) these standards were revised with the input of this umbrella group in BC with the goal of becoming part of the COABC. When the national standards were adopted in 2008-2009 the COABC decided to get out of the standard setting business. This meant that the only route now available for the creation of a national organic standard for aquaculture was with the CGSB. In 2010 using a draft standard based on the POSA standard and the Québec aquaculture standard, a national working group was assembled from across Canada to write the national standard. The draft standard is now written. The standards cover the requirements for organic aquaculture certifications. A brief outline of the main issues covered by the standards; husbandry, fish health and welfare, and feed will be presented.

Lobster Hatchery Production and Enhancement

Production de homard en éclosion et ensemencement

Tuesday, May 10, 2011 / Mardi 10 mai, 2011: 08h00-12h20

Location: Borduas

Chair / Président: Bruno Myrand (MERINOV)

08h00-08h20 R. Browne: Lobster stock enhancement in Ireland and collaborative efforts to improve lobster rearing techniques under an Aquareg Project (Interreg IIIC project) involving co-operation between Spain, Ireland and Norway

08h20-08h40 B.F. Beal: Field-based lobster (*Homarus americanus*) nurseries: Experimental trials using cultured juveniles in Eastern Maine, USA

08h40-09h00 C.A. Burton: Marking juvenile lobsters (*Homarus gammarus* L.) for stock enhancement and fishery studies

09h00-09h20 M. Mallet: Lobster resource enhancement in Atlantic Canada through stage IV larvae seeding: The Homarus Inc. experience

09h20-09h40 M. LeBreton: Return on investment for a lobster (*Homarus americanus*) enhancement project in Atlantic Canada

09h40-10h00 BREAK / PAUSE

10h00-11h00 CONFERENCE PLENARY / PLÉNIÈRE (Suzor-Coté/Krieghoff)

11h00-11h20 J. Côté: Mise à l'échelle de la production en éclosion de larves de homard américain (*Homarus americanus*) aux fins d'ensemencement pour soutenir une pêche durable

11h20-11h40 I. Redjah: Cryptic behaviour of hatchery-reared American lobster larvae fed different lipid composition diets

11h40-12h00 I.J. McGaw: Feeding and digestive physiology of decapod crustaceans: Importance of basic research for aquaculture

12h00-12h20 Open Discussion

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Lobster stock enhancement in Ireland and collaborative efforts to improve lobster rearing techniques under an Aquareg Project (Interreg IIIC project) involving co-operation between Spain, Ireland and Norway

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In Ireland during the 1990's, two lobster hatcheries were established, both using similar production techniques to release over 250,000 post-larval lobsters at a number of locations around the country. In 1994, attention of fishermen turned towards fishery management with the initiation of a voluntary practice of "V"- notching the tail fan of selected wild caught lobsters (adopted from Maine, USA) to identify them for conservation purposes. The following year, legislation was introduced to legally enforce this conservation practice, and governmental support was provided to promote the measure. In 2001, the minimum landing size for lobster was increased from 85 to 87 mm CL (EU Regulation). During the 2000's, as part of an Aquareg project (Interreg IIIC project) involving participants from Spain, Norway and Ireland, work was undertaken to transfer hatchery technologies and investigate novel methods for rearing post-larval lobsters for stock enhancement purposes. As part of this collaboration lobster growth trials, without the supplementation of feed, in sea cages were undertaken in Galicia, Spain and in Ireland. The Irish study involved 250 post-larval lobsters being held individually in mesh compartments at three shellfish farms, where they were periodically measured for growth and survival. Results varied significantly with time and location.

Field-based lobster (*Homarus americanus*) nurseries: Experimental trials using cultured juveniles in Eastern Maine, USA

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Experiments have been ongoing in eastern Maine over the past decade (2001-2010) focused on the efficacy of ocean-based nurseries to enhance survival and growth of cultured, post-larval American lobsters. Nursery units composed of flow-through containers holding single lobsters (stages IV-VI) were deployed at a variety of depths < 20 m. Initial trials determined that lobsters could grow and survive for periods up to 15 months in containers (200-300 cm³) by feeding exclusively on fouling organisms. Survival (0% to 93%) was directly related to water flow that was varied experimentally using different container and aperture designs. Lobsters generally doubled in size from CL's of 4.2 to 8.9 mm. Subsequent efforts over 14 months (August 2009-October 2010) demonstrated a sigmoidal relationship between container size and lobster growth ($r^2=0.68$). Stage IV (3.9 mm CL) animals held in 750 cm³ containers attained a mean CL of 15.2 ± 0.9 mm whereas those held in 4,800-10,000 cm³ containers attained a mean CL of 23.9 ± 1.4 mm. Total length of lobsters held in the largest size containers was 99.9 ± 6.8 mm. These lobsters are large enough to receive a physical tag so that fishers can participate directly in stock assessment activities.

Marking juvenile lobsters (*Homarus gammarus* L.) for stock enhancement and fishery studies

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Marking lobsters for long-term fishery studies is problematic. There are many methods described in the literature, but most tend to be of short duration, rarely lasting longer than one moult cycle, and many of the longer lasting marks are less suited for use with smaller animals (< 35 mm CL). The use of coded wire micro-tags (CWT) implanted internally in to the cephalothorax of juvenile (> 7 mm CL) European lobsters (*Homarus gammarus*) provided a long-term (> 10 yr), durable mark for UK stock enhancement studies. However, the preferred implantation site, coupled with the strong pigmentation and opaque nature of most areas of the exoskeleton, made external recognition or visualisation of the tag almost impossible and sophisticated detection technology was required. In addition, recovery of the tag for data harvest required dissection. The use of some alternative internally placed marks that permit a degree of external recognition or data recovery has been explored with limited success. The UK experience of marking lobsters and the trial results will be discussed. Whilst utilised here for clawed lobsters (Nephropidae), the techniques and methods are likely to be equally applicable to spiny (Palinuridae) and slipper (Scyllaridae) lobsters as well as other crustacea.

Lobster resource enhancement in Atlantic Canada through stage IV larvae seeding: The Homarus Inc. experience

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Decline in lobster (*Homarus americanus*) landings in some areas of Atlantic Canada induced the Maritime Fisherman's Union to create Homarus Inc., a non-profit organization comprised of several partners from the public and private sectors. Its mandate has been to develop strategies for increasing lobster abundance through practical lobster enhancement approaches, increase scientific knowledge of lobster biology, and introduce educational tools to better explain ecological processes to the fishing industry. It is within this initiative that an experimental lobster hatchery project was created at the Coastal Zones Research Institute in Shippagan, New-Brunswick (Canada) in 2002. The aim of this project was to ensure the production of stage IV lobsters for stocking experiments supervised by the Fisheries and Oceans Canada. Another project goal was to develop a simple and cost-effective hatchery technology which would enable community-based fishermen groups to pursue their own stocking efforts. A presentation on the history, organisational structure and R&D results of this project will be given, as well as insight on its future.

Return on investment for a lobster (*Homarus americanus*) enhancement project in Atlantic Canada

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An experimental lobster (*Homarus americanus*) hatchery project initiated by a harvesters' association, the Maritime Fishermen's Union, has produced and seeded over 1.2 million stage IV lobsters since 2002 in the southern Gulf of St. Lawrence (sGSL), Canada. Based on a Before-After-Control-Impact approach, the release of over 53,000 stage IV in 2004 significantly increased the 2005 1-yr lobster density in seeded reefs compared to controls, indicative of a good survival over the 1st winter. Furthermore, a significantly higher density for the 2-yr lobster in 2006 was also observed suggesting a good survival over several years of hatchery-reared animals after being released in the natural habitat. Using that information, a bio-economic model has been developed to assess the biological and economic benefits associated with lobster stock enhancement initiatives. The model has been used to calculate the return on investment (ROI) and economic impacts generated by an investment of \$25,000 CDN to seed 100,000 stage IV. Results showed that this investment would on average increase landings by 18,288 kg and generate \$144,471 over 10 years in increased revenues for harvesters, i.e., equivalent to a ROI of 18.4 %. The harvest and process of these lobsters would generate on average about 4.1 person-years of employment locally and 5.4 for Canada as a whole. The Gross Domestic Product generated would amount on average to \$206,200 locally and \$304,400 for Canada. Government tax revenues would, on average, reach \$15,100 locally with an additional \$38,200 for the Canadian government. Hence, simulations have shown significant economical benefits from the seeding of 100,000 stage IV lobsters. With this new information, harvesters' associations can make informed decisions about the profitability of lobster seeding.

Mise à l'échelle de la production en éclosion de larves de homard américain (*Homarus americanus*) aux fins d'ensemencement pour soutenir une pêche durable

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Malgré l'application par les pêcheurs de nouvelles mesures de gestion et de conservation, les débarquements de homard américain (*Homarus americanus*) dans le sud de la Gaspésie n'ont pas retrouvé les sommets historiques de la fin des années 1990. Pour supporter la ressource et assurer la durabilité de cette pêche, le RPPSG et Merinov ont débuté un projet expérimental pour développer et mettre à l'échelle la production de homard américain en éclosion pour des fins d'ensemencement. L'objectif est de produire et semer, d'ici 2012, plus de 100 000 homards de stade IV+ par année. Les résultats obtenus en 2010 sont encourageants, avec près de 20 000 postlarves de stade IV+ produites

etensemencées dans deux sites. Ces postlarves, cultivées en mer dans des cubicules les protégeant des prédateurs, ont démontré une bonne capacité de survie avec des taux $\geq 76\%$. Le suivi de type BACI d'un ensemencement expérimental indiquait d'ailleurs que les jeunes homards de stade VI et VII étaient plus abondants dans la zone ensemencée que dans les zones témoins. Dans les années qui viennent on veut augmenter le nombre de larves produites, améliorer les méthodes de culture et d'ensemencement ainsi que diminuer les coûts de production.

Cryptic behaviour of hatchery-reared American lobster larvae fed different lipid composition diets

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Lobster fishery is an important industry in the St-Lawrence Gulf (Québec, Canada). To maintain the stability of the American lobster recruitment, fishermen are interested in lobster stocks enhancement programs in Gaspé Bay. Larval survival is related to the ability to find shelter, to avoid predators and to forage for food. The main purpose of this study is to identify how a lipid-rich diet affects larval cryptic behaviour and their ability to stick to the bottom. Larvae were kept in individual compartments and fed either a traditional *Artemia salina* diet (low lipid reserves) - ART - or a fresh natural zooplankton diet (high lipid reserves) - ZOO - until post-larvae stage IV. We assessed to measure the general activity of the larvae for each diet (n=5), the interaction between two larvae fed different diets (n=5) and the cryptic behaviour (n=20) in light and dark condition. Results showed that 1) swimming behaviour was greater for ZOO; 2) there was no difference in interactions between ART and ZOO and finally, 3) both ZOO and ART had increased cryptic behaviour during dark phase.

Feeding and digestive physiology of decapod crustaceans: Importance of basic research for aquaculture

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The aquaculture and ranching of crustaceans is growing rapidly; however it can be a high risk venture as stocks may be lost to disease or simply due to lack of knowledge of basic biology. We investigated the feeding and digestive physiology of Dungeness crabs, *Cancer magister*, during hypoxic and hyposaline exposure. Crabs were relatively tolerant of hypoxia and only reduced food intake in oxygen tensions $<3.2\text{kPa}$; they resumed feeding immediately the oxygen tension increased. Foregut contraction rates were reduced in oxygen tensions $<5\text{ kPa}$, leading to an increased transit time for digesta. Despite this, hypoxia had negligible effects on assimilation efficiency. Hyposaline exposure produced more pronounced effects: Crabs reduced food intake in 75% seawater and stopped feeding in 40% seawater. Low salinity reduced gastric processing, leading to an increase in transit rates. In the lower salinities tested digestive processes added an extra stress leading to an increased mortality rate. In the wild crabs may overcome this problem by making short foraging trips into estuaries, retreating to higher salinities to digest. These methods are being applied to our current research on hatchery raised juvenile lobsters investigating how biotic and environmental factors interact to influence feeding and digestion and thus growth.

Ecosystems / Écosystèmes

Tuesday, May 10, 2011 / Mardi 10 mai, 2011: 08h00-11h40

Location: Place Montcalm

Chair / Président: Chris McKindsey (Pêches et Océans Canada / Fisheries and Oceans Canada)

08h00-08h20 **A. Piot:** Shellfish farming in the intertidal zone and its effect on ecosystem functioning

08h20-08h40 **J.A. Arsenault:** Size matters: Characterizing particle depletion by the blue mussel (*Mytilus edulis*) at open-water, Integrated Multi-Trophic Aquaculture sites

08h40-09h00 **T. Bungay:** Assessment of the benthic impacts of finfish aquaculture sites on hard bottom substrates with the application of a benthic index on the south coast of Newfoundland

09h00-09h20 **N. Diep:** Dissolved oxygen dynamics of an embayment of the Great Lakes: 1998 – 2010

09h20-09h40 **G.K. Reid:** The usefulness of ecological efficiencies to assess open-water Integrated Multi-Trophic Aquaculture (IMTA)

09h40-10h00 **BREAK / PAUSE**

10h00-11h00 **CONFERENCE PLENARY (Suzor-Coté/Krieghoff)**

11h00-11h20 **S.M.C. Robinson:** The role of 3-dimensional habitat in the establishment of integrated multi-trophic aquaculture (IMTA) systems

11h20-11h40 **D.W. Fredriksson:** AquaModel software application to understand the regional effects of multiple marine fish farming sites in the Gulf of Maine, USA

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Shellfish farming in the intertidal zone and its effect on ecosystem functioning

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Baynes Sound beaches (British Columbia) have been exploited since the early 1900's for shellfish farming, mainly with the production of epibenthic Pacific oysters (*Crassostrea gigas*) and endobenthic Manila clams (*Tapes philippinarum*). Previous 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, O₂ consumption and fluxes of, NH₄⁺, NO₃⁻+NO₂⁻, PO₄³⁻ and Si(OH)₄ at the water / sediment interface did not differ among treatments. We hypothesize that a greater abundance of benthic diatoms in sediments in shellfish farms may explain these results.

Size matters: Characterizing particle depletion by the blue mussel (*Mytilus edulis*) at open-water, Integrated Multi-Trophic Aquaculture sites

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Integrated Multi-Trophic Aquaculture (IMTA) is an ecosystem based approach which consists of cultivating inorganic and organic extractive species in close proximity to traditionally farmed species to mitigate nutrient loading and create synergies within the ecosystem. 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 matter within an IMTA system. The LISST-100X is capable of measuring particle size distributions on a temporal scale and is proven to be an effective tool in quantifying seston uptake within certain size ranges and concentrations. Data collection was carried out simultaneously at the inflow and outflow of IMTA sites, with various combinations of Atlantic salmon (*Salmo salar*) and mussels (*M. edulis*) in New Brunswick, Canada. Similar experiments were carried out near commercial-scale mussel rafts in Galicia, Spain. Differences in particle concentrations were not apparent on either side of the site solely containing Atlantic salmon. However, evidence of particle depletion was present in the smaller size spectrum for the IMTA sites in New Brunswick and even more so for the mussel rafts in Galicia. This information will offer valuable insight into understanding the bio-mitigation capabilities of mussels within ecosystem-based aquaculture systems.

Assessment of the benthic impacts of finfish aquaculture sites on hard bottom substrates with the application of a benthic index on the South Coast of Newfoundland

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The impact of salmonid mariculture is not well understood on hard bottom substrates. To understand these impacts a study was conducted on multiple salmonid sites on the south coast of Newfoundland. Sites were selected on basis of depth, production stage, and bottom type. Visual sampling using video camera was done in pre-identified stations and in transects at each selected site. Videos and still images were examined and species was identified to lowest taxonomic bracket possible. Species identified in preliminary analysis include various urchins, sea stars, crinoids, cnidarians as soft corals and anemones, euphausiids, and chaetognaths. Sensitive taxa like crinoids, soft corals, and other sessile suspension feeders were found on both non-active (fallowed) and active sites. Large numbers of species was found to aggregate at the peak of rock wall formations where larger currents may have an influence. The diversity and abundance of species was found to be greatly decreased directly under cages where deposition is greatest. The further away from the cages the greater the diversity and abundance of naturally occurring fauna. The key species found through sampling will be used to create biotic index that might be helpful in assessing the impact of salmonid culture on the hard bottom habitat on the south coast of Newfoundland.

Dissolved oxygen dynamics of an embayment of the Great Lakes: 1998 – 2010

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Dissolved oxygen is a critical component of natural ecosystems and severe depletion of dissolved oxygen is a concern as it has the potential to adversely affect local and cultured aquatic organisms. A sensitive freshwater embayment of the Great Lakes is exhibiting severe hypolimnetic dissolved oxygen depletion and this may affect local water uses such as tourism, recreation, cage aquaculture and agriculture. Data from *in situ* depth profiles and discrete real-time continuous sensors were used to characterize the temperature and dissolved oxygen (DO) condition of this embayment both spatially and temporally between 1998 – 2010. This system is sensitive to hypoxia and since 1999, exhibited episodic, near-bottom anoxia. The DO condition has further deteriorated since 2006, with prolonged wide-spread hypolimnetic anoxia, volume-weight averaged DO concentrations below 1 mg L⁻¹ and occurrence of cyanobacterial blooms. Hypolimnetic DO depletion occurs rapidly in this waterbody with anoxic conditions persisting until fall turnover, resulting in loss of cold and cool-water habitat. This freshwater embayment is hydrologically dynamic with fluctuating water levels and hypolimnetic thickness that varies within and between years. The embayment's morphology and its variable and vigorous hydrodynamic connection to the Great Lakes will present challenges for eutrophication modelling.

The usefulness of ecological efficiencies to assess open-water Integrated Multi-Trophic Aquaculture (IMTA)

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If open-water Integrated Multi-Trophic Aquaculture (IMTA) is promoted as *ecological engineering* or *artificial ecosystems*, ecological measures will inevitably be explored as assessment tools. Ecological efficiencies such as *consumption*, *assimilation* and *production* efficiencies are common ecosystem metrics with potential utility. These efficiencies are summated under the overall term, *Ecological Efficiency* or *Trophic Transfer Efficiency* (TTE), which is often simplified as the biomass (production) at one trophic level divided by the food available (production) the next level down. TTE in this form is intuitively appealing, as it does not require diet consumption or absorption data that may be difficult to acquire in ‘leaky’, open-water systems. However, traditional percentages of TTE do not include the uptake of inorganic material, which forms a major portion of the nutrient load, and consequently does not include the role of the inorganic extractive niche (*i.e.* seaweeds). Nevertheless, determination of the individual ecological efficiencies may be a powerful tool for sustainability measures of organic extractive species, such as deposit feeders (*e.g.* urchins, sea-cucumbers) where it can be assumed that most of their diet is farm derived. By applying ecological efficiencies to IMTA deposit feeders, the nutrient load sequestered and transformed may be potentially estimated simply from harvest data.

The role of 3-dimensional habitat in the establishment of integrated multi-trophic aquaculture (IMTA) systems

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The degree to which a particular area of sea bottom can assimilate a flux of organic matter is dependent on the biomass of organisms present and the rate at which they are capable of ingesting the material. Since organisms require space to exist, the biomass present is directly related to the surface area available for colonisation. This bio-physical relationship is one of the reasons why areas that are primarily 2-dimensional (*e.g.* mud or sand bottoms) are less effective in assimilating organic matter than 3-dimensional structures (*e.g.* reefs) per unit square area since a higher biomass can be present on 3-dimensional structures. These bio-physical relationships are utilised in our IMTA ecological engineering program to create structures that can be used to capture excess nutrients being released from aquaculture

operations. An experimental reef was designed to sit adjacent to a salmon cage in the Bay of Fundy on a soft-sediment bottom and was populated with scallops, sea urchins, sea cucumbers and polychaete worms to evaluate their effectiveness as an extractive species. Physically, the reef worked well as a stable structure although the design of the legs needed improvement. Growth and survival of some test species, such as scallops and sea urchins, were very high. The creation of reef-like structures to assist in the conversion of nutrients from organic to inorganic forms will likely play a role in future IMTA developments.

AquaModel software application to understand the regional effects of multiple marine fish farming sites in the Gulf of Maine, USA

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The computer program AquaModel is used to understand the growth performance and water column and benthic effects associated with fish farming operations. It numerically combines the physical, biological and chemical processes and can be used under a wide range of environmental conditions. In this study, long term data sets of thermocline depth, dissolved oxygen (DO), dissolved inorganic nitrogen (DIN), particulate organic carbon, fluorometric chlorophyll, nitrogen from phytoplankton and zooplankton, irradiance and wind speed were developed for model simulations for sites in the Gulf of Maine, USA. The program was also configured to handle a combination of circulation model input superimposed with geostrophic and weather induced effects (from measurements) so that a three-dimensional, spatially and temporally distributed velocity field is represented. Model simulations were then conducted using waste input from several large fish farms (each with an estimated production over 6000 metric tons) for a grow-out cycle of 18 months. Fish growth characteristics, DO and DIN concentrations, benthic effects and farm interactions are presented from the results of the calculations.

3rd National Symposium on Freshwater Aquaculture – 3: Genetics and Broodstock Development

Troisième symposium national en aquaculture d'eau douce – 3: Génétique et développement de stock reproducteur

Tuesday, May 10, 2011 / Mardi 10 mai, 2011: 08h00-09h40

Location: Suzor-Coté/Krieghoff

Chair / Président: Andy Robinson (University of Guelph)

08h00-08h20 K. Were: National Aquaculture Genetic Improvement Strategy

08h20-08h40 L. Picard: Sélection génétique, assainissement et mise en place d'un programme de collaboration multi-entreprises en matière de génétique chez l'omble de fontaine

08h40-09h00 C. Audet: Interactions génome-environnement pour des traits d'intérêt commercial chez l'omble de fontaine

09h00-09h20 C. Sauvage: Genetic mapping of SNP markers reveal QTL linked to reproduction, growth and response to stress in the Brook charr, *Salvelinus fontinalis*

09h20-09h40 L. Bernatchez: Genetic impacts of stocking on the genetic integrity of wild brook charr (*Salvelinus fontinalis*)

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National Aquaculture Genetic Improvement Strategy

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As a follow-up to consultations undertaken as part of the National Aquaculture Strategic Action Plan Initiative (NASAPI), an analysis was performed to assess the current status of Genetic Improvement (GI) and Selective Breeding Program (SBP) development in the Canadian aquaculture sector. Based on the analysis performed, it was suggested that the Genetic Improvement Organizations that have been developed for the terrestrial animal production sectors represent a good model for the Canadian aquaculture sector to use to organize their aquaculture genetic improvement efforts. A preliminary meeting of the relevant stakeholders was organized to validate the accuracy of the analysis that was performed. The primary objective of the meeting was to determine whether the stakeholders, most importantly members of industry, agreed that it would be of value to undertake the proposed organizational process toward enhancing aquaculture genetic improvement. There was general agreement that this organizational process would be of value and would bring benefit to the Canadian aquaculture sector as a whole. Preliminary progress was made in identifying guiding principles, constraints and key considerations toward developing a National Aquaculture Genetic Improvement Strategy. Some preliminary next steps were developed. A Steering Committee is to be formed to lead and further develop this initiative.

Sélection génétique, assainissement et mise en place d'un programme de collaboration multi-entreprises en matière de génétique chez l'omble de fontaine

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L'omble de fontaine est l'espèce la plus élevée au Québec en aquaculture d'eau douce. Un groupe d'éleveur du Québec regroupé autour du Centre de Sélection des Salmonidés (CTSS) Inc. a pris l'initiative de mettre en commun différentes ressources afin de lancer un programme d'amélioration génétique visant principalement l'amélioration de 2 traits, soit la croissance et l'absence de maturité sexuelle précoce. Pour deux des souches en usage au Québec (Rupert et domestique), le projet a permis d'obtenir des géniteurs d'origine connu et exempts de maladie permettant la poursuite des travaux entrepris. Le génotypage des géniteurs a permis d'évaluer la diversité génétique et de réaliser des accouplements performants tout en limitant l'évolution la consanguinité au sein du cheptel. Les premiers résultats obtenus ont d'ailleurs révélé de grande variabilité interindividuelle et interfamiliale compatible avec la réalisation d'un programme de sélection efficace. Ainsi le taux de maturité sexuelle précoce des mâles varie de 0 à 100% selon la famille. Il est également intéressant de noter que toutes les corrélations de performance entre différents sites d'élevage sur les domestiques (2008) se sont avérées significatives. Ceci démontre que quelque soit le site d'élevage, les familles les plus performantes démontrent une forte tendance à être les mêmes et de même pour les familles les moins performantes.

Interactions génome-environnement pour des traits d'intérêt commercial chez l'omble de fontaine

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Utilisant trois souches d'ombles de fontaine, dans trois types d'environnement choisis pour refléter différentes conditions de production piscicole, nous avons mis en évidence l'importance des interactions gène x environnement dans l'expression de la croissance chez cette espèce. En mimant une expérience de transport, nous avons montré la présence de différences de sensibilité au stress entre ces trois souches et montré que les traits reliés aux réponses primaires et secondaires au stress présentaient des héritabilités différentes selon l'espèce. Finalement, nous avons montré des différences importantes entre ces trois souches dans la stratégie d'accumulation d'énergie en période automnale, de même que dans le patron hivernal d'utilisation des réserves énergétiques. Globalement, nos résultats indiquent qu'aucune souche ne performe de façon supérieure pour l'ensemble des traits, mais plutôt que dépendamment du trait à améliorer et de l'environnement, différentes souches peuvent être souhaitables. Nous présentons également des résultats indiquant que l'on peut utiliser des programmes de sélection permettant d'effectuer des améliorations sur plusieurs traits en parallèle pour une souche donnée.

Genetic mapping of SNP markers reveal QTL linked to reproduction, growth and response to stress in the Brook charr, *Salvelinus fontinalis*

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The main goal of linkage maps relies on the mapping of Quantitative Trait Loci (QTL), which allow the localization of genes responsible for the variation of continuous phenotypic traits. Recent advances in genomics now allow the efficient discovery of coding genes SNP markers by means of high-throughput sequencing of transcriptomic libraries especially. Here we used this strategy in order to identify SNP markers in brook charr that were then used to map QTL linked to phenotypes of aquacultural interests. We used RNA-SEQ (454, Roche) to identify SNP markers through an *in silico* approach. Then, a panel of 300 SNP were validated and mapped in association with 65 microsatellites in an F2 pedigree (domestic × wild) selected for an increase in growth and later maturation. The 200 F2 progenies were phenotyped for 23 different phenotypes associated to growth, reproduction and response to stress. As a result, we developed a medium density linkage map (40LG) and identified major QTLs (PVE>25%) and suggestive QTL throughout the genome of the species for 19 of the 23 phenotypes. These results open the door to a genomic selection program in the brook charr for its sustainable production.

Genetic impacts of stocking on the genetic integrity of wild brook charr (*Salvelinus fontinalis*)

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Supportive breeding and stocking performed with domesticated fish produced in aquaculture to support sport fishery industry is a common practice throughout the world. Such practices are likely to modify the genetic integrity of natural populations depending on the extent of genetic differences between domesticated and wild fish and on the intensity of stocking. The main objective of this study was to assess the effects of variable stocking intensities on patterns of genetic diversity and population differentiation among nearly 2000 brook charr from 24 lakes located in two wildlife reserves in Québec, Canada. Our results indicated that the level of genetic diversity was increased in more intensively stocked lakes, mainly due to the introduction of new alleles of domestic origin. As a consequence, the population genetic structure was strongly homogenized by intense stocking. Heavily stocked lakes presented higher admixture levels and lower levels of among lakes genetic differentiation than moderately and un-stocked lakes. A second objective of this study was to assess the relative effect of environmental factors in addition to stocking intensity on the level of hybridization observed in these populations. We found that the level of hybridization significantly increased with: i) the number of stocking events, ii) a reduction in both surface area and maximum depth of lakes, iii) a reduction of dissolved oxygen and an increase of temperature and pH. Thus, increased levels of hybridization were associated with a reduction of lacustrine habitat availability and quality. We discuss the implications of these results for the conservation of exploited fish populations and the management of stocking practices.

3rd National Symposium on Freshwater Aquaculture – 4: Recirculating Aquaculture Systems for Freshwater Production

Troisième symposium national en aquaculture d'eau douce – 4: Systèmes en eau recirculée pour l'aquaculture d'eau douce

Tuesday, May 10, 2011 / Mardi 10 mai, 2011: 11h00-12h20

Location: Suzor-Coté/Krieghoff

Chair / Président: Daniel Stechey (Canadian Aquaculture Systems)

11h00-11h20 S.T. Summerfelt: Rainbow trout and Atlantic salmon performance in circular tank-based closed-containment systems

11h20-11h40 B. Thomsen: Current status of the Denmark Model Farm Program

11h40-12h00 D. Stechey: The Manitoba-Canadian Model Farm Initiative

12h00-12h20 T. Losordo: Comparison of biofiltration technologies for RAS

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Rainbow trout and Atlantic salmon performance in circular tank-based closed-containment systems

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Controlled studies in circular tank-based closed-containment systems (CCS) at the Freshwater Institute have produced over 200 ton of food-size rainbow trout, Arctic char, and Atlantic salmon over the past 10 yrs. In this same period, we never used any chemotherapeutic (other than salt), pesticide, or antibiotic within the CCS. Survival from fingerling/smolt to food size typically exceeded 90-95%. Rainbow trout averaged 900-1400 g at 12 months post-hatch (mean TGC of 1.83 to 2.64) and Atlantic salmon averaged 3,900 g at 24 months post-hatch in freshwater CCS. We attribute this growth to the nearly ideal culture environment maintained in the CCS, i.e., water temperatures of 13-17°C, dissolved O₂ of approximately saturation, CO₂ of less than 20 (salmon) or 25 (trout) mg/L, NO₂-N of less than 0.3 mg/L, TAN concentrations of < 1.3 mg/L, alkalinity controlled at 150-250 mg/L, and tank hydraulics that produce a self-cleaning tank and optimal swimming speeds of 0.5-2 fish body-lengths per second. To achieve this water quality, the culture tank volume was exchanged once every 15-30 minutes, with higher exchange rate applied to nursery systems. At low water flushing rates, however, accumulation of > 100 mg/L NO₃-N in the CCS may create fish health issues.

Current status of the Denmark Model Farm Program

B. Thomsen*¹

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The first model fish farms were built in 2004 and in 2009 25 farms had been transformed from traditional pond farms to model fish farms. Total production output (2009) was app. 8.200 tonnes corresponding to 26 % of total Danish production in freshwater. The model farm program applies two different technologies: Type 3 technology (semi-extensive) and type 1 technology (semi-intensive). The introduction of new recirculation technology has been successful and the model fish farmers are in general satisfied with the new production form – although they have experienced a steep learning curve. This paper highlights and summarises the most important findings from various perspectives e.g. technology, research & development, economics, veterinary, environment and legislation. Current barriers, possible solutions and new initiatives are discussed. The latter includes a short introduction to intensive recirculation systems (FREA = Fully RE-circulated Aquaculture) which is currently under development.

The Manitoba-Canadian Model Farm Initiative

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The Manitoba-Canadian Model Aqua-Farm (CMAF) is a simple yet intensive recirculating aquaculture system that is intended to introduce a more uniform approach to freshwater aquaculture development. The operation has been specifically designed to fit into conventional agriculture buildings (e.g. hog barns) to capitalize on the availability of latent infrastructure. The first operation, designed to produce 130 tonnes of rainbow trout annually, has been built in Manitoba, Canada. A fundamental objective at this first CMAF initiative is to conduct a comprehensive 2-year assessment of all inputs and outputs establish baseline standards pertaining to the biological, technological, financial and environmental sustainability of the 130-tonne rainbow trout venture and generate regulatory and investor confidence in the system. The Model Farm project is a major initiative of the Inter-Provincial Partnership for Sustainable Freshwater Aquaculture Development (IPSFAD), a national not-for-profit organization representing the interests of the freshwater aquaculture sector in Canada.

Comparison of biofiltration technologies for RAS

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As water resources become increasingly scarce and effluent regulations more strict, the recycling of water within aquaculture is becoming commonplace. There are a few unit processes that must be implemented in RAS designs. These include solid waste capture, ammonia-nitrogen and nitrite-nitrogen removal, oxygenation, and carbon dioxide removal. All of these processes can be accomplished with a variety of components. Biofiltration is essential in most aquaculture systems based on water recirculation. The choice of the biofiltration component is important to the operational and economic success of an aquaculture production facility. While all biofilters are designed to oxidize ammonia-nitrogen to nitrate-nitrogen, the stability of the process and ease of operation and maintenance varies with the design. Some biofilters are more robust and forgiving of operator mistakes than others. Thus, even though a given filter may be more efficient and more compact than another, if the owner does not have the inclination to monitor the process, the simpler, lower tech solution may be best for that operator. Similarly, the cost to purchase and operate filters varies with the design and can have an impact on the economic viability the operation. This presentation will explore these issues as they relate to the most common biofilters used within the aquaculture industry today.

Developments in mussel aquaculture

Développements en production de moules

Tuesday, May 10, 2011 / Mardi 10 mai, 2011: 14h00-17h00

Location: Borduas

Chair / Présidente: Réjean Tremblay (Université du Québec à Rimouski)

14h00-14h20 **F. Byette**: Exploitation of *Mytilus edulis* byssal threads for material production

14h20-14h40 **N. Toupoint**: *Mytilus edulis* L. recruitment and food quality: trigger and match-mismatch

14h40-15h00 **R. Tremblay**: Factors affecting byssus structure of blue mussel (*Mytilus edulis*) from suspended culture, in the Magdalen Islands

15h00-15h20 **J. Wyatt**: The effect of long term holding on the physiology of the blue mussel, *Mytilus edulis*

15h20-15h40 **BREAK / PAUSE**

15h40-16h00 **L. Gilmore Solomon**: Influence of seston lipid quality on physiological condition of *Mytilus edulis* grown in heterotrophic lagoon

16h00-16h20 **S. Duffy**: Predator-prey interactions between the blue mussel *Mytilus edulis* and zooplankton: A case of intraguild predation

16h20-16h40 **A. Bartsch**: A prickly alternative to combat biofouling

16h40-17h00 **S.E. Richman**: Sea duck predation on mussel farms: developing conservation-friendly and cost-effective solutions for mussel growers

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Exploitation of *Mytilus edulis* byssal threads for material production

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Marine mussels are tethered to solid surfaces in the intertidal zone using holdfasts known as byssus. These proteinaceous threads have a core mostly made of collagen-like proteins distributed in different forms as a gradient through the fibre. More than 200 tons of byssus are rejected yearly in Canada before commercialization of farmed mussels. We believe that the biochemical nature of the byssal threads proteins should make them biocompatible and that they should be considered for biomaterials development and fibre exploitation. The scope of our study was to evaluate the film forming ability of protein extracted from byssal threads and to study the effect of curing using metals on the materials properties. To do so, thoroughly washed byssus from *Mytilus edulis* mussels have been partly hydrolyzed in an alkaline potassium chloride (KCl) buffered medium containing ethylene diamine sodium tetracetate (EDTA). The proteins in the extract were precipitated and washed using collagen-based methods before their use in film preparation. Films were formed by solvent casting and evaporation and were further processed using coordination metals of different valences as cross-linking agents. The effect of the cross-linkers on the molecular structure and physical properties will be presented. Optimization of the films' biocompatibility will also be addressed.

Mytilus edulis L. recruitment and food quality: trigger and match-mismatch

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As a result of repeated poor mussel spat collection events in the Îles-de-la-Madeleine (Québec, Canada), we conducted a study to test the match-mismatch hypothesis (Cushing, 1990) between mussel recruitment and quality of the trophic resources. Considering the polyunsaturated (PUFA) and essential fatty acids (EFA) requirements for an optimal larval development, we hypothesized that mussel recruitment relates with the content of fatty acids in food. Within this context, we monitored simultaneously the larval development, the settlement and the post-settlement rates and the seston characteristics in 2007 and 2008. Despite the year-to-year similar concentrations of competent larvae and settlement rates, mussel recruitment was significantly lower in 2007 than in 2008 (9,768 vs 16,066 ind/m). The trophic resources drastically differed between both years and the very low contents of PUFA/EFA measured in the seston in 2007 validated our hypothesis. Moreover, the post-settlement success was always improved by a peak of settlement which did not correlate with the peak of competent larvae but rather matched with a pulse of phytoplankton. For the first time, we have shown that mussel recruitment relies on two uncoupled but complementary phenomenon: i) a match-mismatch with food quality and ii) a trigger effect of a phytoplankton bloom.

Factors affecting byssus structure of blue mussel (*Mytilus edulis*) from suspended culture, in the Magdalen Islands

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The suspension culture of mussels in sleeves is possible because they produce byssal threads that attach themselves to the culture substratum. However, we have observed that mussel's attachment strength is variable in time and could be related to biological and environmental factors. That may lead to passive losses of mussels by fall-offs from the sleeves and thus to substantial decreases in yield. Therefore it is important, for mussels farmers, to understand the factors that might affect this variation. There have been some studies on attachment strength of mussels in the intertidal zone but limited information is available in suspension culture. In this project, we have been interested to identify the potential structural changes in the byssal threads of suspended cultured mussel. Mainly we focus on potential changes related to spawning, season, temperature and turbulence. Thus, a multidisciplinary project have been developed with collaboration of several graduates students. We will present results obtained until now on each aspect of this project.

The effect of long term holding on the physiology of the blue mussel, *Mytilus edulis*

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The mussel aquaculture industry in Newfoundland is expected to grow continually through expansion of existing sites and approval of new harvesting sites, thus increasing the amount of fresh product for the local, national, and international market. Due to the logistics of living on an island transportation complications can arise that can prevent the mussels from going to market immediately. As a result they may need to be held in holding facilities until transportation is possible. Increased time in holding has been observed to affect their condition resulting in decreased meat yield and quality. In order to more precisely evaluate the physiological response of held mussels morphometrical and neutral red assay measurements have been taken for mussels in a commercial holding facility for the summer, fall, and winter seasons. The data shows a significant decrease in mean dry tissue weight and condition index over the holding period for both the summer and fall. The neutral red data shows a sharp and significant decline in neutral red retention time according to the time spent in holding. Preliminary data on expression of oxidative stress genes and innate immune genes will also be discussed.

Influence of seston lipid quality on physiological condition of *Mytilus edulis* grown in heterotrophic lagoon

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Microscopic communities assimilated by *M. edulis*, in a Magdalen Islands (MI) costal lagoon, are mainly dominated by small heterotrophic eukaryotes with low microalgae concentration. Such particular environment is considered to be poor in dietary value and may be deficient in essential fatty acids (EFA). We hypothesized that MI lagoon distinctive lipids classes and fatty acids added with EFA scarcity may affect the mussels' physiological conditions. From May to October 2009, four physiological measurement series (oxygen consumption and clearance rates), were performed on 1 and 2 years old mussels from a MI lagoon under two nutritional conditions. The first set of mussels had no change in their natural diet and a second set was fed microalgae rich in EFA. Relationship between metabolic rates and diets lipids quality (lipids classes and fatty acids components) was verified. Some significant differences between both diets were found for some EFA, precisely for AA and EPA. Even if fatty acid composition differed between natural and microalgae diets, no significant differences were observed between mussels metabolic rates. However, significant changes in mussel's physiological condition during the season were observed. These variations may be due to internal mussel physiology itself or/and to variations in abiotic and biotic component of this environment.

Predator-prey interactions between the blue mussel *Mytilus edulis* and zooplankton: A case of intraguild predation

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Mussels are traditionally viewed as herbivores, competing with zooplankton for algae. However, there is a recent body of literature showing that mussels are also capable of filtering and digesting zooplankton. This study aims to characterize the blue mussel *Mytilus edulis* as an intraguild predator that feeds on its zooplankton competitors. We conducted a laboratory experiment looking at how mussels selectively feed on phytoplankton versus zooplankton and whether food uptake depends on the relative abundance of algal to animal prey. Individual mussels were held in aquaria and offered mixed diets varying in proportion of algae (*Isochrysis galbana*) and zooplankton (*Artemia franciscana* nauplii). Utilization of the two food types by mussels was quantified using electivity indices. Mussels selectively fed on *Artemia* and the mechanisms of this uptake were fixed across diet mixtures, likely due to differences in prey susceptibilities. A field study in the Magdalen islands was also conducted exploring the degree to which farmed mussels prey on zooplankton and whether the strength of this interaction is affected by mussel size. Preliminary results from stable isotope analysis suggest that zooplankton significantly contributed to the mussel's diet. Smaller mussels occupied a lower trophic position than commercial mussels implying that they interact with zooplankton more via competition.

A prickly alternative to combat biofouling

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Green sea urchins were used as an alternative to chemical coatings for the purpose of preventing biofouling on mussel predator nets at an Integrated Multi-trophic Aquaculture (IMTA) farm in Kyuquot Sound, BC. Different stocking densities of urchins (0, 30, 60, 90, 120) were randomly assigned to already fouled nets, where they grazed with no additional food source for five months. At the end of the experiment mussel growth, urchin growth and net biofouling were quantified. There was no difference in mussel growth, but there was a statistically significant difference in both urchin growth and net biofouling based on the stocking density of urchins. Urchins grew larger at lower stocking densities (less competition for food) and the nets became less fouled at higher urchin stocking densities. The results of this experiment suggest that urchins are a viable alternative to control biofouling. However, if the urchins are grown for commercial purposes, there is a trade-off between biofouling control and urchin growth.

Sea duck predation on mussel farms: developing conservation-friendly and cost-effective solutions for mussel growers

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Predation by migrating sea ducks has become a challenge to mussel growers worldwide. Several frightening techniques have been used with limited success. Installation of exclusion nets have been the most successful, but nets are expensive to install and maintain, and can entangle marine animals causing conflicts with conservation and fishery regulators. Our study used captive sea ducks at the Maurice Lamontagne Institute, Fisheries and Oceans Canada, Québec to: (1) quantify mussel consumption and ‘knock-off’ rates; (2) determine preferred mussel size-age classes; and (3) test exclusion nets of varying mesh size, weight and material. Foraging behavior, preferred size, knock-off rates, and interactions with nets were recorded continuously by video cameras. Eiders preferred the smallest mussels (seed <25 mm) which also had the highest ‘knock-off’ rates compared with socked (25-45 mm) or commercial sizes (>45 mm). Video observations of the behavior of eiders in the presence of exclusion nets determined that smaller mesh sizes (<10 cm) had a lower potential for entanglement but are not practical for off-shore long-line farms. As the conflict between mussel aquaculture and migrating sea ducks escalates, there is a pressing need to develop conservation-friendly and cost-effective solutions to protect mussel farms without interfering with international wildlife laws.

Certification, safety and traceability of aquaculture products

Certification, salubrité et traçabilité des produits aquacoles

Tuesday, May 10, 2011 / Mardi 10 mai, 2011: 14h00-17h00

Location: Krieghoff

Chair / Président: Cyr Couturier (Memorial University of Newfoundland)

14h00-14h20 B. Koonse: The new US Food Safety Law – and how traceability plans are going to be required for farmed seafood imports

14h20-14h40 C. Couturier: Farmed shellfish safety and the aquaculture supply chain in Canada

14h40-15h00 M. Rose: Key traceability issues and audit tools for aquaculture

15h00-15h20 R. Salmon: FAO certification for aquaculture – A Canadian approach

15h20-15h40 BREAK / PAUSE

15h40-16h00 J. Smith: Traceability and sustainability initiatives in Fisheries and Oceans Canada

16h00-17h00 Panel Discussion / Discussion générale

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Farmed shellfish safety and the aquaculture supply chain in Canada

C. Couturier*¹ and R. Salmon¹

¹Canadian Aquaculture Industry Alliance, Box 81100, Ottawa ON K1P 1B1

The Canadian aquaculture industry is a relatively new industry, growing from a few thousand tonnes and \$10 million in value in the 1980s to over 150,000 tonnes valued at \$2 billion present day. Shellfish farming occurs in 6 provinces, comprises approximately 35% of annual farmed seafood production by volume, and contributes in excess of \$200 million to the Canadian economy annually. Products are exported globally to over two dozen countries, with 95% of the export volume to the USA and 4 other countries in Asia and the EU. Farming operations are conducted under strict regulatory regimes, favouring food safety and environmental sustainability. Oversight for food safety is based on regular testing and auditing of both the growing environment and products to meet all international trade standards. The standards are science-based, and validated regularly. The aquaculture industry has developed and implemented best practices in farm-based HACCP programs and environmental monitoring programs that exceed regulatory requirements, and these will be discussed briefly. Full traceability from egg to plate is available for all farmed seafood, further enhancing food safety. Many producers have adopted third party certification programs that have a food safety focus in addition to

environmental sustainability, further enhancing the verification of food safety practices. There is a culture of continuous improvement in best practices and systems built into the business models of the majority of firms. Canada's seafood safety system is next to none, and the aquaculture industry is leading the charge in terms of demonstrating food safety, and regulatory compliance. There have been few valid recalls of Canadian farmed seafood and no illnesses related to farmed seafood in decades, further supporting the robustness of the system.

Key traceability issues and audit tools for aquaculture

M. Rose*¹

¹Global Trust, PO Box 4050, Mount Pearl, NL, A1N 0A1

Evolving traceability demands may impose new delivery and performance demands upon the Canadian aquaculture industry. There has been historic EU 'push' on the matter, development of new ISO standards, and chain of custody is a growing aspect of eco-labelling certification programs. Furthermore, in January 2010, the *Food Safety Modernization Act* came into effect in the United States which imposes specific new requirements throughout the supply chain. The possible implications for Canadian seafood exporters will be considered.

FAO certification for aquaculture – A Canadian approach

R. Salmon*¹

¹Canadian Aquaculture Industry Alliance, Box 81100, World Exchange Plaza, Ottawa ON K1P 1B1

The Canadian aquaculture industry is totally committed to continuous improvement as it provides safe, quality seafood in a sustainable manner. An unmistakable trend is ever-growing awareness and market pressure for the industry to ensure it provides safe, sustainable (socio-economic) seafood with minimal (or non-irreversible) environmental impacts. This is a broad global issue and, arguably, is fundamentally changing the direction of all business – not just seafood - toward "objective demonstration" of sustainable practices. Certification programs are becoming increasingly important as a means for industry to objectively demonstrate their commitment and adherence to established standards. However, there are numerous standards and certification programs in existence, with many more under development. Without one global standard, customers, consumers and producers are tasked with deciding which standard or certification method to trust. As the number of standards increase, customers and producers are becoming confused in the entire certification system. Eco-labels, for example, have become shorthand that customers and consumers can read to help them make good buying decisions. But do they merely define individual preferences of one organization from another or are they based on internationally acceptable criteria? Consideration is being given to the use of recognized FAO standards to develop a leading edge, internationally recognized, transparent, credible and cost-effective certification model for application across the Canadian aquaculture industry. Among other parameters the model will include identification, implementation and verification of robust traceability standards. The proposed model will also focus on assessment and validation of the overarching management framework, and whether (or to what degree) it may meet internationally established FAO expectations. This new approach will reassure all stakeholders - markets, the general public, industry and Governments - that the Canadian system is being conducted in a responsible manner.

Traceability and sustainability initiatives in Fisheries and Oceans Canada

J. Smith*¹

¹Aquaculture Management Directorate, Fisheries and Oceans Canada, 200 Kent Street, Ottawa, ON, K1A 0E6

Fisheries and Oceans Canada is actively engaged in supporting the Canadian industry in its pursuit of sustainability certification to programs that are compliant with the FAO Code of Conduct and the new Technical Guidelines on Aquaculture Certification. As industry moves into certification processes, having functioning traceability options will be essential, both in ensuring food safety and in securing product attributes. Jamey Smith will report on DFO involvement in sustainability standards development, including projects being done through the Seafood Value Chain Roundtable. He will also discuss the findings of a major traceability readiness study done to provide aquaculture direction for the Canadian Council of Fisheries and Aquaculture Ministers' Traceability Task Group. In addition, he will report on the progress of new traceability standards for farmed and wild finfish, as well as shellfish, under development through the International Organisation for Standardisation (ISO). Jamey will also provide an update on DFO's new Sustainability Reporting Initiative and an outline of how this reporting mechanism will be further developed.

3rd National Symposium on Freshwater Aquaculture – 5: Marketing Opportunities for the Freshwater Sector

Troisième symposium national en aquaculture d'eau douce – 5: Opportunités de marché pour le secteur d'eau douce

Tuesday, May 10, 2011 / Mardi 10 mai, 2011: 14h00-15h20

Location: Suzor-Coté

Chair / Président: Yves Bastien

14h00-14h20 H. Kaiser: Generic marketing opportunities for aquaculture

14h20-14h40 J. Rose: A practical guide to the identification of value creating and value destroying activities in marketing niche fresh water aquaculture products

14h40-15h00 B. Hicks: Marketing organic fish – opportunities and challenge

15h00-15h20 N. Roy: TBD

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Generic marketing opportunities for aquaculture

H.M. Kaiser*¹

¹Gellert Family Professor of Applied Economics and Management, Cornell University, 349 Warren Hall, Ithaca, NY, USA 14853

Generic marketing involves the collective actions of producers within an industry to promote the overall demand for the commodity the industry produces and sells. Virtually every commodity produced in the United States as well as many commodities made in Canada use these programs with the aim of increasing overall market demand, prices received by producers, and industry profits. Most of these programs are mandatory meaning that if they pass in a referendum by a two-thirds majority vote, then all producers must pay to support them. The compulsory nature of these programs has made them particularly controversial in the United States. In this presentation, Professor Kaiser will provide an overview of the institutional and legal background of these programs, the economic rationale for their existence, and an assessment of how effective they are in meeting these objectives. Numerous examples will be given of actual programs and their measured effectiveness. Professor Kaiser has authored one book and over 70 scholarly articles on generic marketing programs, and is recognized as one of, if not the leading expert on these programs.

A practical guide to the identification of value creating and value destroying activities in marketing niche fresh water aquaculture products

J. Rose*¹, D. Hori¹ and J. Lucas¹.

¹Icy Waters Ltd., KM 4.2, Fish Lake Road, Whitehorse, Yukon, Y1A 6R7

Small or Medium Enterprise (SME) aquaculture business plans will undoubtedly always take into consideration overall market price, and the distribution channels available to their niche products when anticipating success. The plans may even outline whether the firm will be following a low-cost or differentiation strategy. However, few look at the depth of the value chain and the practical and sometimes predictable looming impediments that can drastically limit the meeting of revenue targets. Without recognizing the needs of the value chain, and specifically identifying the firms value-creating and value destroying processes, the organization remains ignorant to its potential competitive advantages and customer value. This undoubtedly limits the firm's ability to drive the maximum price. Companies are forced to exist by altering the one obvious mechanism to reaching volume sales; reducing price. These oversights can dramatically reduce and/or eliminate potential success. We provide a practical view into the very critical yet often overlooked areas that can maximize customer value in various value chain support activities. These areas reduce costs to the producer, increase switching costs for customers, and help drive customer loyalty and sustainable margins.

Marketing organic fish – opportunities and challenge

B. Hicks*¹

¹Taplow Feeds Vancouver BC

The market for organic products has grown significantly in the past decade. Organic sales continue to grow and now account for 2.7% of dairy and 1.5% of eggs in the USA. During the past 10 years' growth of organic products increase about 3 fold in established markets with mass merchandisers now selling about 55% of organic production. The current market for organic aquaculture products has a built in demand. The organic product sector has grown and has a solid customer base who are actively seeking organic products. Current marketers of organic fish are limited by their ability to obtain a secure and constant supply of product. There are also constraints on the marketing of organic fish products. Organic fish products will be expensive because of the feeding restrictions on what is allowed to be incorporated in the diet. The market place has also been spoiled by the availability of fresh salmon at very reasonable prices for many years. For organic fish to have a stable market presence and command a premium pricing the biggest challenge will be for farmers to be able to produce enough product to continually supply the market. Several examples of successful marketing of organically raised fish will be presented.

3rd National Symposium on Freshwater Aquaculture – 6: Fish Nutrition, Feeds and Feeding

Troisième symposium national en aquaculture d'eau douce – 6: Nutrition des poissons, les moulées et l'alimentation

Tuesday, May 10, 2011 / Mardi 10 mai, 2011: 15h40-17h00

Location: Suzor-Coté

Chair / Président: Keith Were (Fisheries and Oceans Canada / Pêches et Océans Canada)

15h40-16h00 J. Latremouille: The case for modernization of the Canadian feeds regulations

16h00-16h20 G. Dagenais: The current status of fishery and aquaculture resource utilization in Canada

16h20-16h40 A. Dumas: Preliminary nutritional evaluation of a Canadian shrimp process residue meal and its potential to replace expensive sources of nutrients in aquafeeds

16h40-17h00 F. Harding: The use of whole cell algae as a sustainable omega-3 DHA source in aquaculture diets

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The case for modernization of the Canadian feeds regulations

J. Latremouille*¹

¹The Animal Nutrition Association of Canada (ANAC) 1301-150 Metcalfe, Ottawa, ON K2P 1P1

The current feeds regulations are incompatible with the realities of modern feed production and modern technologies for the use of nutritional additives, animal health products and other ingredients. The feeds regulations, which have only been slightly amended in a 25 year period, need to be modernized, and also they must be compatible with those of our trading partners. ANAC's vision is of a new regulatory environment that will increase feed safety, foster innovation and make the feed industry competitive. Our ultimate goal is to bring Canada's regulatory system into the 21st century by focusing it more on identifying real safety risks and less on attempting to control nutritional quality.

The current status of fishery and aquaculture resource utilization in Canada

G. Dagenais*¹

¹Fisheries and Oceans Canada (Aquaculture Management Directorate) 200 Kent, Ottawa, ON K1A 0E6

Making use of material that is currently unutilized by fisheries and aquaculture has been identified as an area of opportunity to increase the sustainability of the global aquaculture sector. Indeed, seafood processing by-products represent a particularly attractive option for use in fish feeds. By making use of what is currently unutilized, we can increase the sustainability of the aquaculture sector by increasing the volume of fishery raw materials available to the aquaculture industry as ingredients in feed. This presentation will summarize information that documents the current status of Fishery and Aquaculture Resource Utilization in Canada. It will also refer to some current examples of initiatives aimed at increasing resource utilization. The data presented will be used to point to the most significant opportunities that exist to increase the productive use of the fishery resource to while enhance the sustainability of the Canadian aquaculture sector.

Preliminary nutritional evaluation of a Canadian shrimp process residue meal and its potential to replace expensive sources of nutrients in aquafeeds

A. Dumas*¹

¹Coastal Zones Research Institute, 232B avenue de l'Église, Shippagan, NB E8S 1J2

Access to safe, available and affordable ingredients represent an increasing challenge for feed manufacturers, which ultimately affect the profitability of commercial carnivorous finfish producers in Canada. The objectives of this study are to (1) evaluate the nutritional value of an innovative shrimp process residue meal available in Eastern Canada, (2) assess its impact on feed cost, and (3) determine its effect on fish health and growth performance. The objectives 1 and 2 will be covered in this presentation, whereas the outcomes from objective 3 will be made available after the fish trial. The crude protein and lipid content of the shrimp process residue are 66.4 and 8.9 %, respectively. The essential amino acid profile mimicked that of herring meal. The results also indicated the residue contains higher levels of phospholipids (+312%) and cholesterol (+34%) than fishmeal. Moreover, the shrimp residue represents a source of E-astaxanthine (2 ppm). Several hundreds of metric tons can be produced consistently every year. Feed formulation scenarios will be presented along with considerations for cost. Overall, the shrimp process residue meal stands as a promising alternative to current expensive ingredients.

The use of whole cell algae as a sustainable omega-3 DHA source in aquaculture diets

F. Harding*¹

¹Martek Biosciences Corporation (Acquired by DSM in February, 2011) P.O. Box 5000 Kingstree, South Carolina, 29556, USA

As the world population continues to grow, the demands placed on our ocean's fisheries have increased to provide food for this growing population. Additionally, since aquaculture production relies heavily on the wild catch to provide a large portion of the nutritional requirements for farmed fish, the industry has been heading down an increasingly non-sustainable path. Development of alternative feeding strategies which rely much less on fish meal and fish oil are necessary to bring the wild fish input: farmed fish output ratio to less than one. Research has recently indicated that fish meal and fish oil can be significantly reduced or completely removed from aquaculture diets when formulated with non-fish protein sources, amino acids, and long chain polyunsaturated fatty acids (LCPUFA's) from algae. Additionally, this strategy of fishmeal and fish oil replacement enables producers to partially or completely remove fish products from their feeds with no negative impacts on survivability or growth characteristics while significantly increasing the levels of omega-3 fatty acids in tissue.

Health / Santé – 1

Wednesday, May 11, 2011 / Mercredi 11 mai, 2011: 08h00-12h20

Location: Borduas

Chair / Président: Nicolas Derome (Université Laval)

08h00-08h20 J.A. Bakker: Mixing within salmon aquaculture netpen tarps and skirts: Preliminary results from commercial therapeutant bath treatments conducted in South-west New Brunswick

08h20-08h40 F.H. Page: Mixing, flushing and effluent dispersal of sea lice therapeutants within and from aquaculture well boats: preliminary results

08h40-09h00 F.H. Page: Transport and dispersal of sea lice therapeutants from aquaculture net pen bath treatments: preliminary results

09h00-09h20 S. Leadbeater: Impact of oxygen level on feed consumption, body composition, growth and resistance to ISA_v in Atlantic Salmon (*Salmo salar*)

09h20-09h40 J. Webb: Can filter-feeding bivalves ingest planktonic sea lice larvae?

09h40-10h00 BREAK / PAUSE

10h00-11h00 CONFERENCE PLENARY / PLÉNIÈRE (Suzor-Coté/Krieghoff)

11h00-11h20 M. Beattie: Provincial approach to mitigating sea lice infestation in Atlantic salmon aquaculture: New Brunswick Department of Agriculture, Aquaculture and Fisheries R&D overview

11h20-11h40 S. Boutin: Antagonistic effect of indigenous skin bacteria of brook charr (*Salvelinus fontinalis*) against *Flavobacterium columnare* and *F. psychrophilum*

11h40-12h00 L.M. Braden: Real time gene expression analysis in salmonid skin: site-specific inflammatory responses elicited by the ectoparasite *Lepeophtheirus salmonis*

12h00-12h20 D. Lewis: Interactions between salmon macrophages and pathogenic bacteria in the presence of *Lepeophtheirus salmonis* secretions

12:20-14:00 LUNCH / DÉJEUNER

(This session continues after lunch / Cette session continue après le déjeuner)

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Mixing within salmon aquaculture netpen tarps and skirts: Preliminary results from commercial therapeutant bath treatments conducted in South-west New Brunswick

J.A. Bakker*^{1,2}, F. Page², M. Beattie¹, R. Losier², P. McCurdy², B. Thorpe¹, J. Fife² and K. Brewer-Dalton¹

¹New Brunswick Department of Agriculture, Aquaculture and Fisheries, St George Regional Office, P.O. Box 1037, St George, NB, E5C 3S9

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

In the New Brunswick salmon industry's fight against sea lice, they are employing chemical therapeutants as an element in an integrated pest management system. Bath treatments are one method used to apply the treatments. Cages of fish are tarped or skirted, the therapeutant is delivered, the fish are exposed for a prescribed amount of time, and subsequently the tarp or skirt is removed to allow the therapeutant to disperse from the cage into the receiving environment. Treatment efficacy depends on assumptions of instantaneous or rapid rates of mixing of therapeutants within the cages, but little information is available on mixing rates. Several studies on mixing within cages were completed during commercial treatments using dye tracers in the summer and fall of 2010. Test cages were located on different farm sites, using a variety of product delivery methods and under varying hydrographic conditions. Time series of fluorescence from fluorometers placed inside the cage, time lapse photography of the cage, and chemical samples from within the treatment cages indicated that the rate of mixing was not instantaneous and in some cases the cages may never have become fully mixed. Implications of these findings and further studies planned for this year are discussed.

Mixing, flushing and effluent dispersal of sea lice therapeutants within and from aquaculture well boats: preliminary results

F.H. Page*¹, M. Beattie², J. Bakker^{1,2}, R. Losier¹, P. McCurdy¹, B. Thorpe², J. Fife¹ and K. Brewer-Dalton²

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In 2010 well boat technology was introduced to the east coast of Canada to help control an outbreak of sea lice in the southwest New Brunswick salmon aquaculture industry. The well boats were used to conduct therapeutant bath treatments. At the request of Provincial and Federal Government entities and local aquaculture industry representatives, dye studies were conducted to help define mixing efficiencies within the boat wells and to characterize the spatial and temporal characteristics of dispersal in the receiving environment during well flushing. Preliminary analyses of the data indicates that although each well boat has its own unique characteristics, mixing throughout wells generally occurs within about ten minutes, the concentration of dye within wells during flushing decreases exponentially over time and concentrations within the discharge plumes decrease with distance from the discharge pipe(s).

Transport and dispersal of sea lice therapeutants from aquaculture net pen bath treatments: preliminary results

F.H. Page*¹, M. Beattie², J. Bakker^{1,2}, R. Losier¹, P. McCurdy¹, B. Thorpe², J. Fife¹ and K. Brewer-Dalton²

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In 2010 the southwest New Brunswick salmon aquaculture industry used bath treatments to help control an outbreak of sea lice in. In support of Federal therapeutant registration, environmental assessment and other regulatory needs, a series of dye studies were conducted to help define the transport and dispersal characteristics of therapeutants released from commercial net pen tarp and skirt bath treatments. Preliminary analyses of the data indicates that flushing from tarps into the receiving environment varies from minutes to hours depending upon net bio-fouling and water current conditions. The analyses also show that dye plumes are transported 100s to 1000s of meters and dye concentrations decrease by a factor of 100-1000 within hours.

Impact of oxygen level on feed consumption, body composition, growth and resistance to ISA v in Atlantic salmon (*Salmo salar*)

S. Leadbeater*¹, B.D. Glebe¹ and K.P. Ang²

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

²Cooke Aquaculture Inc. 874 Main Street, Blacks Harbour, NB Canada E5H 1E6

The availability of sufficient dissolved oxygen is an important environmental parameter required for sustainable and successful Atlantic salmon culture in seawater cages. Salmon in aquaculture can experience reduced dissolved oxygen in sea cages either as cyclical daily events (sub-lethal acute hypoxia), or as a chronic condition in areas that are naturally low in dissolved oxygen. Chronic exposure to reduced oxygen may result in metabolic stress, decreased feed conversion, and impairment of immune functions. Commercial operation under these conditions may result in reduced growth and depressed immune system capacity for salmon. As part of an ACRDP project to investigate the impacts of chronic hypoxia in salmon, post smolt salmon were split into three treatments; vaccinated, unvaccinated or direct injected carriers (shedders) and assigned to low (50%) or optimal (100%) oxygen saturation levels. Treatment tanks were allowed to acclimate for one month prior to challenge with ISA v. Fish exposed to saturation oxygen were seen to consume 40-60% more ration than low oxygen treatments, however differences in size at initiation of disease challenge could not be found. In this presentation results of the disease challenge, body composition as well as next steps in this project will be discussed.

Can filter-feeding bivalves ingest planktonic sea lice larvae?

J. Webb*^{1,2}, J. Vandenbor³, S. Cross¹, S. Jones², S. Robinson⁴, C. Backman⁵, S. DeDominicis⁵ and C.M. Pearce^{2,3}

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⁴Fisheries and Oceans Canada, St. Andrews Biological Station, St. Andrews, N.B., E5B 2L9, Canada

⁵Marine Harvest Canada, Campbell River, B.C., V9W 8C9

The effect of temperature (5, 10, 15°C) on ingestion of sea lice (*Lepeophtheirus salmonis*) larvae by filter-feeding bivalves (Pacific oysters, Pacific scallops, basket cockles, mussels) was examined in laboratory experiments at the Pacific Biological Station, Nanaimo, BC. Individual bivalves were placed in 2-L cylindrical containers holding 750 ml of aerated, filtered seawater and fed one of four food treatments: (1) 8×10^5 cells ml⁻¹ of phytoplankton (*Isochrysis* sp., TISO); (2) ~400 larvae; (3) phytoplankton with larvae; (4) phytoplankton with larvae, but no bivalve (control). Individual shellfish species were tested using six, randomised, replicate containers for each temperature/food treatment. The shellfish were allowed to feed for 1 hour. Then the bivalve soft tissues were preserved for later inspection of stomach contents for presence of sea lice larvae. A 10 ml water sample was preserved for later counts of TISO density as an indication of filter feeding. The remaining water in the container, holding all the sea lice larvae not ingested by the bivalve, was passed through a sieve with the contents being preserved for later counts of larvae. Preliminary results suggest that all four shellfish species will ingest sea lice larvae and that there may be a temperature effect.

Provincial approach to mitigating sea lice infestation in Atlantic salmon aquaculture: New Brunswick Department of Agriculture, Aquaculture and Fisheries R&D overview

M. Beattie*¹, K. Brewer-Dalton¹, J. A. Bakker^{1,2}, B. Thorpe¹

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The New Brunswick Department of Agriculture, Aquaculture and Fisheries (NBDAAF) has been proactive in responding to the sea lice infestation at Atlantic Salmon aquaculture sites. While supporting industry by applying for emergency registrations of products, NBDAAF is also active in assisting regulatory research for the assessment of products. In 2009 and 2010, NBDAAF collaborated in field studies on transport and dispersal and sentinel studies with DFO researchers at the St. Andrews Biological Station. Currently NBDAAF is a member of the group working on an alternative treatment technology, the Ecobath, spearheading research into de-activation of products prior to release into the environment, studying the effects of H₂O₂ on fish tissues and conducting lab and field experiments on the withdrawal times for double and triple doses of in-feed product emamectin benzoate (SLICE) in fish tissues. Projects proposed for the 2011 year include further field sentinel studies, further work on dispersal of products from wellboats, and examining withdrawal times and environmental fate of other priority products. Key components to accommodate the workload are a cohesive team with a project management approach and strong linkages and advisory support from federal, academic and industry colleagues.

Antagonistic effect of indigenous skin bacteria of brook charr (*Salvelinus fontinalis*) against *Flavobacterium columnare* and *F. psychrophilum*

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Aquaculture industry has grown for the last decade and massive production in fish farms exposes fish to stressful conditions, which induce infections by opportunistic pathogens. Probiotics appear to be the more promising way to prevent opportunistic infections in aquaculture. The current strategy to develop probiotic for a given host species is to test a probiotic agent already proven to be efficient for another host species. However, when transferred into a different interacting environment, the probiotic agent is likely to lose its probiotic properties, and possibly becoming harmful for its secondary host. Therefore, to ensure the harmless of a probiotic for our host species, we sampled it directly from the host endogenous bacterial community. We assumed first, that some mutualist bacteria living in the skin mucus of *Salvelinus fontinalis* were able to compete against pathogens under normal condition and second, that the stress itself induces changes in the bacterial community, and third, that this change allows opportunistic pathogen to infest the host. In order to identify which bacteria were able to compete against pathogens, we screened the bacterial community with a culture based method and tested *in vitro* the potential competitive effects against the pathogens. Our results from both agar diffusion assay and broth co-culture assay showed unambiguously that the mechanism involved is a competitive exclusion. We found eight bacterial strains, collected from unstressed fish, which exerted strong exclusive competition against both *F. psychrophilum* and *F. columnare*, suggesting they are all promising probiotic candidates.

Real time gene expression analysis in salmonid skin: site-specific inflammatory responses elicited by the ectoparasite *Lepeophtheirus salmonis*

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The site-specific response of infection with the ectoparasite *Lepeophtheirus salmonis* is known to differ among host salmonid species: Atlantic salmon (*S. salar*) are unlikely to mount an inflammatory response whereas the more resistant pink salmon (*Oncorhynchus gorbuscha*) exhibit a strong inflammatory reaction. Given the ecological and economic importance of *L. salmonis*, understanding this interaction at the molecular level is critical and is the focus of this research. Atlantic, pink and chum salmon (*O. keta*) were infected with adult *L. salmonis* and the expression of select immune-related genes at the louse-skin interface was measured by real-time quantitative PCR (qPCR). Preliminary analysis suggest species-specific differences particularly among expression of interleukin 8 (IL-8), IL-1 β and tumor necrosis factor- α (TNF- α) ($p = 0.004$, $p < 0.0001$, $p < 0.0001$, respectively). To investigate this relationship further, a more comprehensive array of inflammatory mediators and components of wound healing were examined by qPCR analysis. Expression profiles of treatment groups were compared to non-infected

sites from the same individual, so that the local response could be qualified. Additionally, the systemic stress response of each salmon species due to *L. salmonis* infestation was assessed using plasma cortisol levels.

Interactions between salmon macrophages and pathogenic bacteria in the presence of *Lepeophtheirus salmonis* secretions

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²Department of Fisheries and Aquaculture. Vancouver Island University. Nanaimo, BC V9R 5S5

While feeding, sea lice (*Lepeophtheirus salmonis*) secrete trypsin-like proteases and the prostaglandin, PGE₂, which have significant immunomodulatory effects on the host's cells. Furthermore, it has been observed that salmon (*Oncorhynchus kisutch*, *O. tshawytscha*, *O. gorbuscha* and *Salmo salar*) show varied inflammatory responses and threshold tolerances to *L. salmonis* infections. Recently, it has been shown that sea lice can harbour the pathogenic bacteria *Tenacibaculum maritimum*, *Pseudomonas fluorescens*, *Aeromonas salmonicida* and *Vibrio* spp. As part of a larger NSERC funded project studying the potential role of sea lice in disease propagation, my objective is to determine if the presence of *L. salmonis* secretions impairs the cellular immune response in salmonid hosts. First, the ability of macrophages to phagocytise the intracellular and cytotoxic, *A. salmonicida*, in the presence/absence of *L. salmonis* secretions will be examined using commercially available salmon head kidney (SHK-1) cell lines. Second, the difference in susceptibility among salmon species will be explored using macrophages from *O. gorbuscha*, *O. keta* and *S. salar*. As in objective one, these macrophages will be isolated and challenged with pathogenic bacteria while in the presence/absence of *L. salmonis* secretions to determine if there is any effect on the cellular immune response.

Aquaculture Engineering / Technologie d'aquaculture

Wednesday, May 11, 2011 / Mercredi 11 mai, 2011: 08h00-12h00

Location: Place Montcalm

Chair / Président: Tim Jackson (NRC-IRAP / CNRC-PARI)

08h00-08h20 T. Sclodnick: Demonstration of shark proof aquaculture containment nets

08h20-08h40 K. Robertson: Development of shark resistant aquaculture containment nets

08h40-09h00 M. Couturier: Hydraulic model for large diameter tanks

09h00-09h20 B. Chase: Stationary bed filter for the removal of fine solids in RAS

09h20-09h40 D. Huyben: The evaluation of membrane filtration as an alternative disinfection system in recirculating aquaculture systems and its comparison to UV irradiation

09h40-10h00 BREAK / PAUSE

10h00-11h00 CONFERENCE PLENARY / PLÉNIÈRE (Suzor-Coté/Krieghoff)

11h00-11h20 D.M. Steinke: Assessment of the structural integrity of finfish aquaculture sites in hurricanes through finite-element analysis and measurement

11h20-11h40 P. Bergeron: A new tool for estimating loads induced by currents and waves on submerged shellfish aquaculture longlines

11h40-12h00 J. Saunders: Validation of co-oximetry for the measurement of methemoglobin in rainbow trout, *Oncorhynchus mykiss*

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Demonstration of shark proof aquaculture containment nets

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²DSM Dyneema, 1101 Highway 27 S., Stanley, North Carolina, 28164, USA

Damage to aquaculture cages from predators can lead to huge economic losses as well as allowing captive fish to escape into the surrounding environment. Finding solutions to predation problems is essential to the future of offshore aquaculture especially in warm waters where sharks are more prevalent. The current solution to predators is to use a secondary or anti-predator net. Using a single net that resists predator attacks is simpler and more economical. Two sample nets were sewn onto 1.8m cylindrical cages, baited with fish carcasses and deployed at two different locations in South Eleuthera, The Bahamas. Video cameras were also deployed to confirm any attacks were done by sharks and to observe their species and size. Both sample nets were attacked by blacktip (*Carcharhinus limbatus*) and bull (*C. leucas*) sharks that measured up 2.2 meters total length. Neither net suffered any complete holes and only showed minor abrasion on a few strands. This demonstrates that a single net can be used to prevent sharks from biting holes in an aquaculture net without the use a second, anti-predator net.

Development of shark resistant aquaculture containment nets

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²DSM Dyneema, 1101 Highway 27 S., Stanley, North Carolina, 28164, USA

All warm water aquaculture sites and some cold water aquaculture sites, are susceptible to attacks from sharks. The losses due to sharks, and other predators, can result in significant mortality, escapes, and requires expensive and laborious repair efforts. The cutting efficiency of a shark's tooth, combined with their powerful jaws and thrashing movement, makes the shark unique and highly efficient at tearing nets. Novel lab tests to simulate a shark bite on netting and to predict net performance in the ocean were required. Utilizing the new lab tests and collecting data from sea trials in shark infested waters drove development efforts to create a hybrid netting using Dyneema® fiber in an Ultra Cross Knotless® Braided construction. This new netting product provides options for the fish farmer to deploy a lightweight solution for fish farmers facing predation by sharks and seals while avoiding secondary anti-predator nets.

Hydraulic model for large diameter tanks

M. Couturier*¹ and M. Smith¹

¹Recirculating Aquaculture Research Group, Department of Chemical Engineering, University of New Brunswick, PO Box 4400, Fredericton, NB E3B 5A3

An increasingly popular approach for achieving substantial savings in recirculating aquaculture systems is to shift production in fewer but larger tanks. This provides economies of scale and tanks with diameters greater than 10 m are becoming increasingly common. Little information is available however on the impact of increasing tank size on tank hydraulics. The adjustment of the tangential water velocity in circular tanks is critical to maintain fish health. The tangential velocity must not exceed the recommended swimming speed for the fish and yet must be strong enough to create a secondary radial flow along the floor of the tank that can carry settled solids to a central drain. The objective of the project is to develop and validate design guidelines for large fish rearing tanks using a computational fluid dynamics (CFD) model. Two-dimensional CFD models of 1.5 and 5 m tanks were used to quantify the effect of swirling velocity on the radial flow along the floor and skin friction. This information was used to develop a simple model for predicting the maximum tangential velocity in multi-drain rearing tanks as a function of tank size, flow rate and tank geometry. The predictions of the model are in good agreement with tangential velocities measured in 1.5, 5 and 9.2 m tanks.

Stationary bed filter for the removal of fine solids in RAS

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²Cooke Aquaculture Inc, 874 Main Street, Blacks Harbour, N.B. Canada, E5H 1E6

Accumulation of solids in recirculating aquaculture systems (RAS) affects fish health both directly through gill irritation, and indirectly by acting as a carbon source for heterotrophic bacteria. Excess solids too fine to be captured by the solids removal equipment build up in the system until the rate of their production equals the rate of their removal in the system overflow. The focus of this study was to characterize the potential of a stationary bed of sinking curler biocarrier media for the removal of fine solids in a salmon-smolt RAS. Theoretical modeling suggests that sedimentation is the main method of capture in the bed. Lab tests on a 1.09 m bed were employed to determine the effect of fluid velocity on pressure drop and capture efficiency of particles smaller than 90 μm . The pressure drop across the bed was accurately modeled by the Ergun equation, and the overall capture efficiency increased from 5% to 79% as the superficial fluid velocity decreased from 0.024 m/s to 0.0015 m/s. These results were corroborated by performing tests on an industrial scale prototype installed at a salmon-smolt hatchery. The prototype which employed a 0.56 m bed and operated at a superficial velocity of 0.006 m/s had an average capture efficiency of 36%.

The evaluation of membrane filtration as an alternative disinfection system in recirculating aquaculture systems and its comparison to UV irradiation

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Recirculation aquaculture systems (RAS) utilize combinations of wastewater disinfection treatments, e.g. UV and ozone, to reduce pathogens. However, UV is commonly used as the only disinfection treatment due to ozone production requirements and safety concerns. UV disinfection efficiency is also limited by decreasing bulb intensity, high levels of wastewater turbidity, and UV resistant pathogens. In the past, RAS have routinely adapted emerging municipal wastewater treatment technologies (e.g. UV). Currently, membrane filtration (MF) is being recognized as a reliable and affordable wastewater treatment process in numerous municipal and industrial industries. This study will evaluate MF as an alternative disinfection treatment in RAS. A common fish pathogen, *Flavobacterium psychrophilum*, will be used as an indicator of disinfection efficiency due to its ability to be cultured and tolerate UV radiation. Comparisons of pathogen removal between MF and UV technologies under various wastewater conditions will determine if MF can improve pathogen disinfection in RAS.

Assessment of the structural integrity of finfish aquaculture sites in hurricanes through finite-element analysis and measurement

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Canada's eastern provinces contain many aquaculture sites that frequently encounter hurricanes and severe storms that have the potential to jeopardize the structural integrity of finfish farms. Up until now, very little data has been gathered on the kind of strain that these storms place on the mooring lines, anchors, and nets at sites. In addition, engineering software tools specific to aquaculture have not been available to allow site operators to assess the integrity of their sites. Because of this need, Dynamics Systems Analysis Ltd (DSA) has developed a finite-element net model (FENM) that can be used within its mooring analysis software called ProteusDS. Towards the goal assessing the integrity of finfish sites and validating the FENM, DSA partnered with the Nova Scotia Department of Fisheries and Aquaculture and Cold Water Fisheries to deploy instrumentation at a finfish site near Liverpool, NS. At the site, DSA measured the motion of the floating collars, the tensions in the mooring lines and rigging, and the waves and currents present. DSA then analyzed and simulated the dynamics of the site in ProteusDS. In September 2010 the site was directly hit by Hurricane Earl. DSA was fortunate to measure data on the site during the storm. DSA has simulated the conditions of the storm in its software, and the results have shown that ProteusDS is a suitable tool for the analysis of finfish aquaculture sites.

A new tool for estimating loads induced by currents and waves on submerged shellfish aquaculture longlines

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²Institute for Ocean Technology, Nat. Research Council, St. John's, NL, Canada, A1B 3T5

³Engineering and Applied Sciences, Memorial University of Newfoundland, St. John's, NL, Canada, A1B 5S7

The Aquaculture Longline Simulation (ALS) software was developed by the IOT and Biorex based on an existing mooring line model. ALS contains three programs: a simulation engine and a plotting engine developed using Matlab[®] and a graphical user interface developed using Microsoft .NET framework[®]. ALS can simulate any design of a submerged longline under the effects of steady currents and waves. Rope, buoys, and growing units are the main components of the system and are modeled as cylinders and spheres to which the following parameters can be assigned: length, diameter, weight, buoyancy, elasticity and drag coefficients. The software calculates line tension and the loads acting on the anchoring points. The shape of the longline with the position of the lower end of growing units (seabed contact) under various loading scenarios is provided. The force required to lift a portion of the main line above the water surface can also be calculated. Results of the simulations of a typical longline used for mussel culture along the Gaspé coast are presented. ALS will help improve longline design and minimize the risk of failure during severe storm events.

Validation of co-oximetry for the measurement of methemoglobin in rainbow trout, *Oncorhynchus mykiss*

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Methemoglobin (metHb) is oxidized hemoglobin that cannot reversibly bind oxygen. MetHb concentration in healthy mammals is 0-3%, compared to reports of 0.6-24.8% in fish. The reported variability may be because metHb measurement in fish has been problematic. Fish metHb has never been measured by co-oximetry, the standard method for humans. The objectives of this study were to validate co-oximetry for metHb measurement in fish, compare co-oximetry to an older method that uses KCN, and to use co-oximetry to establish a reference interval for metHb in *Oncorhynchus mykiss* and *Salmo salar*. Method: metHb was measured using an IL-682 co-oximeter or the KCN method of Evelyn and Malloy. Results: whole blood was stable at 4°C up to 7 days for metHb measurement. Intra-day precisions using co-oximetry and KCN had a CV of 14.7% and 76.6%, respectively. Measurements were linear up to 58.2% (r=0.98) and 27.5% (r=0.94) for co-oximetry and the KCN method respectively. The lowest detectable level was 0.8% using co-oximetry. The reference intervals for *O. mykiss* and *S. salar* were 0.6-1.8% and 1.1-1.9% using co-oximetry (n=40). Conclusion: co-oximetry can be used to measure metHb in fish. The reference intervals in the species examined were similar to that of mammals.

3rd National Symposium on Freshwater Aquaculture – 7: Freshwater Aquaculture: Diversification and Conservation Initiatives

Troisième symposium national en aquaculture d'eau douce – 7: Aquaculture d'eau douce: initiatives de diversification et de conservation

Wednesday, May 11, 2011 / Mercredi 11 mai, 2011: 08h00-09h40

Location: Suzor-Coté/Krieghoff

Chair / Présidente: Nathalie Le François (Biodôme de Montréal)

08h00-08h20 B.-A. Dupont-Cyr: Integration of simple zootechnical improvements for pairing and early-stage operations in the management practices of a commercial Arctic charr facility

08h20-08h40 J. Henry: Advances in sturgeon culture in Canada

08h40-09h00 C.M. Gaudreau: From Atlantic salmon to striped bass cultivation: conservation and resources enhancement perspectives and opportunities

09h00-09h20 L. Therrien: Maintien et reproduction de géniteurs de doré jaune en élevage: échelle pilote commercial

09h20-09h40 R.C. Summerfelt: Walleye cultural technology from fingerling to food fish

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Integration of simple zootechnical improvements for pairing and early-stage operations in the management practices of a commercial Arctic charr facility

B.-A. Dupont-Cyr^{*1}, N.R. Le François², P.U. Blier¹, F. Dupuis³ & F. Dufresne¹

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³Aquaculture Gaspésie inc., 1811, Montée de Pointe-Navarre, Gaspé (Québec), G4X 1A8

The objectives of the present study supported by the ACRDP is to: 1) to estimate genetic variability of an uncommon *Nauiyuk* strain cultured population in Québec 2) to establish a breeding program based on the evaluation of the degree of relatedness between the parents 3) to evaluate the growth performances of the constituted families and 4) to evaluate the positive effects of increased velocities early after hatching on growth performances. The rationale originated from previous research (Grünbaum et al. 2008, 2009, Ditlecadet et al. 2006, 2009) and this project can be considered as a technological transfer project at the benefit of the Arctic charr industry. Each broodstock fish was genotyped and two groups of families (n=20) were produced according to their levels of inbreeding: closely ($R \geq 0.7$) and distant

related ($R \leq -0.7$). At hatching, families of the same groups (closely related and distantly related) were mixed and distributed in 8 raceways in which 4 units representing each group were exposed to two experimental velocities (0.4 and 3.2 cm/s) in replicates. All experiments were conducted at the facilities of Aquaculture Gaspésie inc. (Gaspé, QC, Canada). Preliminary growth results will be presented and discussed.

Advances in sturgeon culture in Canada

J. Henry^{*1}

¹Target Marine Hatcheries Ltd. 7333 Sechelt Inlet Road, Sechelt, BC V0N 3A5

Twelve years of Target Marine's research, development, and early commercialization of white sturgeon culture has successfully grown sturgeon from egg to over 120 kg and has resulted in essential expertise required to diversify the freshwater aquaculture industry in Canada. With the assistance of the Aquaculture Innovation and Market Access Program, recirculation systems have been designed to provide specific environmental parameters for production and maturation. These green technologies conserve energy and water and enable the optimization of the animals rearing environment. Later this year the first spawn of a domestic white sturgeon in Canada will take place at the hatchery site: a significant step towards the long term sustainable supply of juveniles. Trials carried out have revealed influences of different feeds and environmental conditions on the maturation of the fish and quality of the caviar. Canadian farmed white sturgeon and caviar has now made its way to the national and international marketplace. This diversification of the freshwater aquaculture industry will help position Canada as one of the world leaders in sustainable caviar supply, while helping to take pressure off endangered wild stocks.

From Atlantic salmon to striped bass cultivation: conservation and resources enhancement perspectives and opportunities

C.M. Gaudreau^{*1}

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Québec (Canada) cumulates more than 135 years of restocking and expertise aimed at wild indigenous salmonid species such as the anadromous Atlantic salmon (*Salmo salar*). Recently, large-scale re-introduction efforts through artificial breeding plans were initiated for walleye (*Stizostedion vitreum*), striped bass (*Morone Saxatilis*) and the endemic catostomid, the copper redhorse (*Moxostoma hubbsi*), due to severe declines in their abundance and the reduction of their distribution range. Three major fish hatcheries owned and operated by the MRNF are devoted to fish production to support freshwater recreational fishing and the conservation and restoration of wild freshwater fish populations. Significant contributions to the rebuilding of these populations are already perceivable in the wild despite the early stages of most of the recovery action plans put forward by the governmental network. During the next decade, the MRNF wishes to significantly increase its production capacities and support diversification initiatives. These objectives could be achieved through the integration of research and development partnerships with other organizations to its actual production facilities and expertise. Research themes of interest include genetics, nutrition, sexual maturation control, eggs quality and early stage performances.

Maintien et reproduction de géniteurs de doré jaune en élevage: échelle pilote commercial

L. Therrien*¹, M. Blanchet² et A. Paquette³

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³Ferme piscicole André Paquette, 14 Montée Sirard, Ferme-Neuve, QC J0W 1C0

Le développement de la production du doré jaune à l'échelle commerciale nécessite un approvisionnement en œufs de qualité obtenus à partir de géniteurs produits, maintenus et reproduits en pisciculture. La maîtrise des techniques d'élevage et de reproduction des géniteurs de doré jaune doivent être développées à l'échelle commerciale. Le projet vise à reproduire à l'échelle pilote commerciale des combinaisons de conditions d'élevage (environnement X alimentation) qui ont donné des résultats prometteurs lors d'essais expérimentaux. Aux cours des 2 premières années, les succès sont variables pour l'obtention d'œufs et de larves viables. Les meilleurs résultats de survie des œufs et des larves sont généralement associés aux géniteurs exposés aux conditions naturelles de température et de photopériode en phase hivernale. La proportion de pontes mises en incubation tend à être supérieure parmi les génitrices alimentées de poisson-fourrage plutôt qu'uniquement de moulée commerciale à salmonidés. Ce projet se réalise sur 3 ans. Les premiers résultats suggèrent qu'une alimentation composée de poisson-fourrage favorise le succès de reproduction des génitrices et leur survie en général. Cependant, les coûts d'alimentation sont élevés. En conséquence, le développement et la fabrication d'une moulée adaptée aux besoins et au goût des géniteurs devraient contribuer au développement de cette production.

Walleye cultural technology from fingerling to food fish

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Walleye, doré jaune (*Sander vitreus*), is a popular sport and an esteemed freshwater food fish in Canada and the United States. Both governmental and private sources produce fry and fingerlings for enhancement stocking, but lacking farm-reared product, wild-caught fish are the source for food fish markets. The U.S. imports about 7,000 metric tons of Canadian wild-caught walleye from commercial fishers on the northern shore of Lake Erie and by First Nations fishers from lakes of western Ontario, Manitoba, Saskatchewan and NW Territories. The food market has also attracted imports of pikeperch (*Sander lucioperca*) that are sold as walleye. Thus, walleye is an established species in the marketplace, with obvious potential to be a trademark species for Canada and a major contributor to Canadian freshwater aquaculture. The objective of the presentation is to demonstrate that heretofore production constraints have been overcome and the opportunity is now available to move ahead with commercial culture. A brief summary is given of the state of the art of tandem pond-to-tank culture, with habituation of pond-reared fish to manufactured feed, and on growing to market size.

3rd National Symposium on Freshwater Aquaculture – 8: Innovation in the Freshwater Sector

Troisième symposium national en aquaculture d'eau douce – 8: Innovation dans le secteur d'eau douce

Wednesday, May 11, 2011 / Mercredi 11 mai, 2011: 11h00-12h20

Location: Suzor-Coté/Krieghoff

**Co-Chairs / Co-Présidents: Alistair Struthers & Keith Were (Fisheries and Oceans Canada /
Pêches et Océans Canada)**

11h00-11h20 D. Foss: Integration of submersible iCages into an existing freshwater trout production site

11h20-11h40 B. McNamara: Réalisation de réservoirs d'élevage en coffrage de PVC

11h40-12h00 D. Marcotte: Un nouveau concept d'étang d'élevage en béton

12h00-12h20 Domingue Gauthier: Identification of anti-*Saprolegnia parasitica* compounds from Pseudomonads

Integration of submersible iCages into an existing freshwater trout production site

D. Foss^{*1}

¹Wild West Steelhead, Box 190, Lucky Lake, Saskatchewan, S0L 1Z0

Culture of trout in freshwater lakes in Canada has significant growth potential. However, expansion of the industry has not reached its potential due to, among other things, climate related production hurdles. Two unique features offered by the iCages are submergibility and rotation on a central, horizontal axis. The first of these characteristics offers protection against the significant risk posed by moving ice, while the second provides the potential for net cleaning, inspection and mortality removal by cage rotation. Three iCages were installed at a licensed aquaculture site on Lake Diefenbaker in Saskatchewan in 2010, alongside traditional square surface cages. In addition to the above features the cages were assessed for ease of operation with respect to the daily on- farm activities of feeding, diving, maintenance, etc. While the mooring set-up and the individual “pod” arrangement of the iCages pose some operational challenges which require further adaptation, the significant benefits of submergence and net-cleaning by rotation were immediately obvious.

Réalisation de réservoirs d'élevage en coffrage de PVC

B. McNamara*¹

¹DC International, 75 De Vaudreuil, Boucherville, QC J4B 1K7

La pisciculture McKenzie est en opération depuis 1993 et fournit de l'Omble de Fontaine pour l'ensemencement à plusieurs pourvoiries du Québec. La pisciculture possède 5 bassins accueillant entre 40,000 et 75,000 poissons chacun. La pisciculture cherchait une technologie économique et facile à installer pour augmenter sa capacité. Le système développé par DC International utilisé depuis plus de 10 ans a été conçu initialement pour la réalisation des immeubles en béton. Les réservoirs fabriqués par DC International peuvent mesurer jusqu'à 25 mètres de diamètre et 5 mètres de hauteur. Ils peuvent varier selon différentes formes et les parois peuvent être isolés afin d'économiser de l'énergie et de permettre un meilleur contrôle la température de l'eau. Les essais effectués par le Centre de recherche industrielle du Québec (CRIQ) et financés en partie par le gouvernement fédéral, ont démontrés que le coffrage de PVC fabriqué par DC International respectait la norme NSF-61 se rapportant à l'eau potable et ne favorisait pas la prolifération des bactéries. Cette technologie sera utile à l'ensemble de l'industrie piscicole ici au Canada mais aussi à l'étranger. Cette technologie permet la réalisation rapide de grands réservoirs de béton, avec une main d'œuvre non spécialisée et à un coût compétitif.

Un nouveau concept d'étang d'élevage en béton

D. Marcotte*¹

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L'objectif principal de ce projet de recherche a été de concevoir et de tester un nouveau concept d'étang d'élevage extérieur avec réutilisation de l'eau et enlèvement régulier des fumiers. Ce concept d'étang combine à la fois des caractéristiques des bassins artificiels (enlèvement régulier des rejets, construction en béton, recirculation de l'eau) et des étangs extérieurs (densités requises pour une production de poissons dédiés au marché de l'ensemencement). L'élément principal de ce concept est un aérateur de surface. Cet aérateur permet de réaliser simultanément l'oxygénation, le dégazage et le « pompage » pour la recirculation de l'eau tout en participant à l'enlèvement des fumiers en les entraînant dans des cônes de sédimentation situés sous ce dernier. Une purge régulière des cônes de sédimentation permet alors de récupérer les fumiers et le phosphore qu'elles contiennent. Les données recueillies lors de ce projet de recherche permettent d'offrir un nouveau concept d'étang extérieur pour les pisciculteurs dont le marché est l'ensemencement. Au Québec, dans le cadre particulier des exigences de la STRADDAQ, ce type d'étang offre une méthode simple de récupération du phosphore et adéquate pour une production de poissons en étangs. En réalisant le retrait régulier du phosphore, le temps de séjour du phosphore dans la station est diminué et donc la possibilité qu'il se retrouve à l'effluent. Finalement, dans le but d'atteindre l'efficacité optimale de récupération des fumiers tout en réduisant les coûts de construction et d'opération, des travaux de modélisation sont en cours (projet 2010-2012). Ces travaux ont, comme objectif, de déterminer les critères de conception optimaux pour la deuxième génération de ce nouveau concept d'étang d'élevage.

Identification of anti-*Saprolegnia parasitica* compounds from *Pseudomonads*

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Disease is the single largest cause of economic losses in aquaculture, and fungal infections are second only to bacterial diseases in economic importance. Fifty percent per year losses due to fungal infections have been reported in a number of species including salmonids (*Oncorhynchus* sp., *Salmo* sp.) which are particularly susceptible to *Saprolegnia* sp. The ability to effectively treat fungal infections has become increasingly difficult with restrictions on the use of the most effective fungicide available, malachite green due to concerns regarding its carcinogenicity. From a *Saprolegnia parasitica*-infected fish farm, we have isolated three *Pseudomonas fluorescens* bacterial strains able to inhibit the growth of this oomycete in vitro. While the identities of these secreted activities are being characterized, we have also identified an antifungal activity in the supernatant of *Pseudomonas aeruginosa* culture. This activity is linked to 4-hydroxy-2-heptylquinoline (HHQ), a quorum sensing molecule. It is noteworthy to mention that HHQ is not produced by *P. fluorescens*. We show that towards *S. parasitica*, HHQ has a fungistatic effect with a minimal inhibitory concentration (50%) of 6 ppm in vitro. Additional work is ongoing, but these initial results suggest that small bacterial metabolites could lead to the new therapeutic strategies for the industry.

Health / Santé - 2

Wednesday, May 11, 2011 / Mercredi 11 mai, 2011: 14h00-15h20

Location: Borduas

Chair / Président: Nicolas Derome (Université Laval)

14h00-14h20 C.W. Novak: *Lepeophtheirus salmonis* (Caligidae) as a potential vector of *Aeromonas salmonicida*

14h20-14h40 G. Filion: Qu'en est-il de la perte du plasmide pAsa5, impliqué dans la virulence d'*Aeromonas salmonicida*, sous l'effet de la chaleur?

14h40-15h00 S. Dallaire-Dufresne: Un facteur de virulence d'*A. salmonicida* méconnu: à la recherche de l'identité d'Ati2

15h00-15h20 N. Gagné: The National Aquatic Animal Health Program: a laboratory perspective

Lepeophtheirus salmonis (Caligidae) as a potential vector of *Aeromonas salmonicida*

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The motile stages of the salmon louse *Lepeophtheirus salmonis* have been hypothesized to be vectors of pathogens among salmonids. Previous studies have isolated pathogens (*Tenacibaculum maritimum* and *Aeromonas salmonicida*) from *L. salmonis* attached to clinically diseased fish. My Master's research examines the potential role of *L. salmonis* acting as a vector of the pathogenic bacteria *Aeromonas salmonicida* to naïve Atlantic salmon (*Salmo salar*). Three objectives were examined for this study: (i) *L. salmonis* can transfer *A. salmonicida* from ip-injected salmon to naïve salmon; (ii) there is a gender-specific differentiation in pathogen transmission among *L. salmonis*; and (iii) *L. salmonis* and *A. salmonicida* act synergistically to significantly decrease fish condition factor. In the disease challenge, bacteria-carrying sea lice were obtained from *A. salmonicida*-injected salmon (n=78, ~80-100g) then allocated among 40L tanks containing naïve salmon. To check for the presence of *A. salmonicida*, swabs were taken from the spleen, kidney and mucus of salmon along with external and internal swabs of attached sea lice. Isolated pure cultures were tested via OIE protocols, combined with API-20NE to confirm identity. We have evidence of vector to host bacterial transfer and preliminary data suggest a greater prevalence of female sea lice carry bacteria.

Qu'en est-il de la perte du plasmide pAsa5, impliqué dans la virulence d'*Aeromonas salmonicida*, sous l'effet de la chaleur?

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La furunculose, une maladie infectant les truites et les saumons, est causée par *Aeromonas salmonicida*. Cette bactérie est porteuse de facteurs de virulence, dont le système de sécrétion type trois (TTSS), qui est situé sur le plasmide pAsa5. Ce plasmide peut être perdu lorsque la bactérie est cultivée à plus de 22°C, ce qui entraîne la perte de sa virulence. Cependant, cette conclusion était tirée par l'analyse d'un seul gène du plasmide pAsa5. L'objectif de la présente étude est de mieux caractériser l'effet de la culture à 25°C sur la stabilité de pAsa5 et sur la virulence de la bactérie. Différentes souches ont été cultivées à 25°C pendant deux semaines. Quatorze gènes situés sur le pAsa5 ont été analysés afin de vérifier s'ils étaient toujours présents. La virulence de ces souches a été évaluée à l'aide d'une cellule hôte, l'amibe *Dictyostelium discoideum*. Cette étude a démontré qu'il s'agit plutôt d'un réarrangement du pAsa5 dans lequel seulement certains gènes sont perdus dont ceux du TTSS. Ce réarrangement conduit également à la perte de la virulence des bactéries testées. Ces résultats amènent une nouvelle perspective quant à la stabilité de pAsa5. Le mécanisme provoquant le réarrangement reste à être déterminé.

Un facteur de virulence d'*A. salmonicida* méconnu: à la recherche de l'identité d'Ati2

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Aeromonas salmonicida provoque la furunculose chez les salmonidés. Cette bactérie utilise le système de sécrétion de type trois (SSTT) pour infecter l'hôte. Plusieurs effecteurs sont injectés dans les cellules de l'hôte par le SSTT. L'étude du génome de cette bactérie a révélé l'existence d'Ati2, un effecteur potentiel. La présente étude vise à confirmer le rôle d'Ati2 comme effecteur du SSTT. Une analyse des protéines sécrétées par le SSTT a permis de confirmer qu'Ati2 est aussi sécrété par ce dernier. Pour confirmer l'effet potentiellement toxique d'Ati2, celui-ci a été exprimé dans des cellules de *Dictyostelium discoideum*, une amibe connue pour être un hôte de remplacement adéquat pour étudier la virulence d'*A. salmonicida*. L'expression d'Ati2 dans les amibes réduit grandement leur croissance.

Pour finaliser la confirmation du rôle d'Ati2 et de son importance relative dans la virulence de cette bactérie, la création de bactéries mutantes pour le gène Ati2 est en cours. Celles-ci permettront de tester l'importance d'Ati2 lors de la confrontation hôte-pathogène en utilisant l'amibe comme hôte dans un test de virulence quantitatif. En conclusion, Ati2 est un effecteur majeur du SSTT qui semble essentiel à la virulence d'*A. salmonicida*. Les analyses futures permettront d'établir le mécanisme d'action d'Ati2.

The National Aquatic Animal Health Program: a laboratory perspective

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This presentation will give an overview of the National Aquatic Animal Health System (NAAHLS) laboratory network. Fisheries and Oceans Canada (DFO) works with the Canadian Food Inspection Agency (CFIA) to deliver the National Aquatic Animal Health Program (NAAHP). The NAAHP improves protection of Canadian aquaculture and wild fisheries from diseases to maintain the country's competitive access to seafood trade markets. The NAAHP will complement measures already in place - on the farm and through provincial aquatic animal health management programs. The NAAHLS delivers the diagnostic and research needs of the program. The laboratories offer diagnostics e.g. histology, virology, and molecular biology, and are responsible for the development and validation of diagnostic assays. The diagnostic repertoire offered represents a list of foreign and domestic disease agents.

Feeding and Nutrition in Aquaculture

Alimentation et nutrition en aquaculture

Wednesday, May 11, 2011 / Mercredi 11 mai, 2011: 15h40-17h00

Location: Borduas

Chair / Président: André Dumas (Coastal Zones Research Institute)

15h40-16h00 S. Granier: Leptin and ghrelin concentrations in Arctic charr (*Salvelinus alpinus*) raised either in fresh water or brackish water

16h00-16h20 R. Yossa: Interactions between biotin and avidin in zebrafish *Danio rerio*: Effects on growth, survival, feed conversion, biotin status and gene expression

16h20-16h40 E. Fraboulet: What kind of challenges young microalgae producers have to deal with?

16h40-17h00 S. Plante: Combining nutrition and physiology studies to evaluate the performance of alternate protein and lipid sources in aquaculture

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Leptin and ghrelin concentrations in Arctic charr (*Salvelinus alpinus*) raised either in fresh water or brackish water

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In fish, appetite and growth are regulated by complex neuro-endocrine mechanisms. Several substances are involved in the control of appetite and the present study focuses on two antagonistic hormones: ghrelin and leptin. Ghrelin is an orexigenic hormone that stimulates appetite and food intake, while leptin is an anorexigenic hormone that inhibits those same activities. The objective of the present study was to test whether the rearing salinity modifies circulating levels of these hormones. 17 months-old Arctic charr originating from 30 families were reared for one year at a commercial fish farm in Advocate, Nova Scotia. Fish were reared in fresh or brackish (20 ppt) water under natural temperature conditions (from 2°C to 17°C according to the season). Results showed different patterns of hormone concentrations relative to rearing conditions. Fish reared in fresh water showed higher plasma ghrelin concentrations in autumn and had a better growth than those kept for one year in brackish water. On the other hand, plasma leptin concentrations were not significantly different for fish reared under fresh or brackish water.

Interactions between biotin and avidin in zebrafish *Danio rerio*: Effects on growth, survival, feed conversion, biotin status and gene expression

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A study was conducted to investigate the effects of dietary avidin on growth, survival, food conversion, biotin status and gene expression of zebrafish juveniles (average wet weight 0.178 g) fed 7 purified diets for 12 weeks. Experimental diets were formulated to provide 0x, 1x, 15x, 30x, 60x and 120x excess avidin versus biotin kg⁻¹ diet, on a molar basis; the control diet contained neither supplemental biotin nor avidin. Fish fed the control diet exhibited the lowest percentage weight gain, while the highest value was obtained with the 0x diet ($P < 0.05$). The highest mortality was recorded with the control diet, while the lowest mortality was observed with the 0x diet ($P < 0.05$). A linear relationship was observed between FCR and dietary avidin ($r = 0.876$; $P < 0.0001$). Fish fed diets with 120x more avidin than biotin had the highest whole-body biotin content, while the lowest value was obtained with the control and avidin-free diets ($P < 0.05$). Elevated levels of *acca*, *mcc* and *pcca* transcripts were recorded in fish fed the control diet, in comparison to the other diets. A broken-line analysis indicated that feeding zebrafish a diet with 60 times more avidin than the dietary biotin requirement level will cause biotin deficiency signs.

What kind of challenges young microalgae producers have to deal with?

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In production at a pilot scale level since 2005, NutrOcean moved to industrial extent in 2010 in a new facility with larger production units. Such scale-up is often correlated with numerous changes in biological efficiency and quality. Collaborative R&D projects produced important information on microalgae growth performances which allowed to control and optimise their production at a larger scale. For example, results from university research projects about the culture lighting were transferred to the new facility and allowed to increase the culture productivity and, in addition, to minimise the energy consumption. Using quality indices as fatty acids content or bacterial contamination, cultures conditions were assessed and optimised throughout the scale-up process. Results from production techniques and performances data are already considered for the next facility's expansion whereas market studies allow targeting microalgae's sectors to focus. Finally, these integrative projects increased our definition of microalgae quality that can be used as basis for next scale-up and at the end, will be a benefit to our customers.

Combining nutrition and physiology studies to evaluate the performance of alternate protein and lipid sources in aquaculture

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The cultured of aquaculture carnivorous species such as salmon, greatly depend on the worldwide supply of fishmeal and fish oil. It is now well established that these key ingredients originated from overfished wild fisheries. Thus, to secure the growing demand of aquaculture products, it is now urgent to seek alternate protein and lipid sources for these aquaculture species. One of the main objectives of our research program is to use classical nutrition studies with stress physiology analyses, to evaluate the performance of fish fed alternative ingredients. Some of those ingredients are plant-based, while other derived from fishery by-products, rich in marine bioactive molecules. When evaluating fish performance, growth is too often used as the major criteria. Indeed, fast growth is not always a guarantee of fish health. Fish could perform well in optimal conditions, but growth rate and even survival may become critical in challenging rearing conditions. By combining these two fields of research in aquaculture studies, we are able to more completely assess fish true performance. We will present an overview of our research program including examples and results from our current projects on Atlantic salmon and American lobster larviculture.

Fish Production / Production piscicole

Wednesday, May 11, 2011 / Mercredi 11 mai, 2011: 14h00-17h00

Location: Krieghoff

Chair / Président: Tillmann Benfey (University of New Brunswick, Fredericton)

14h00-14h20 S. Neil: Cryopreservation of Atlantic cod (*Gadus morhua*) sperm in large-volume straws: applications for commercial production and gene banking

14h20-14h40 J.A. Whitehead: Using gynogenesis to elucidate the sex determining mechanism of Atlantic cod (*Gadus morhua*)

14h40-15h00 S. Lin: Sex control of Atlantic cod (*Gadus morhua*)

15h00-15h20 S. Peruzzi: Production of sterile Atlantic cod: A way to satisfy industrial and environmental criteria?

15h20-15h40 BREAK / PAUSE

15h40-16h00 R. Morin: Production d'omble de fontaine et d'omble chevalier monosexes femelles stériles et évaluation de leurs performances en conditions d'élevage commercial

16h00-16h20 C. Pelletier: Overview on the Arctic charr (*Salvelinus alpinus*), Fraser strain, performance from eggs to market size

16h20-16h40 D. Hamoutene: Fish distribution of two strains of Arctic charr in sea cages in Bay d'Espoir, Newfoundland

16h40-17h00 R. Haché: Does high density production system for rotifers really work? Trial on cod (*Gadus morhua*) larvae

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Cryopreservation of Atlantic cod (*Gadus morhua*) sperm in large-volume straws: applications for commercial production and gene banking

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In our study, we used a full factorial analysis of variance design to examine the effects of diluent [Mounib's sucrose-based diluent + hen's egg yolk (EY) and Hanks' balanced salt solution (HBSS) + EY], freezing rate (-2.5, -5.0 and -7.5 °C·min⁻¹) and thawing rate (2.5, 5.0 and 7.5 °C·min⁻¹) on motility and velocity of Atlantic cod sperm cryopreserved in 2.5mL cryogenic straws. We found that post-thaw sperm performance was strongly influenced by the presence of higher-order interactions of the factors we tested. For all models broken down by diluent, the 2.5 °C·min⁻¹ thawing rate had the lowest sperm motility recovery index. Mounib's sucrose-based diluent + EY had the highest motility recovery index at all thawing rates. Mean per cent motility for fresh sperm (87.7 ± 2.9%) was not significantly different than of sperm cryopreserved using Mounib's sucrose-based diluent + EY, frozen at -2.5 °C·min⁻¹ and thawed at 5.0 °C·min⁻¹ (77.1 ± 2.9%). For Mounib's sucrose-based diluent + EY, velocity was significantly higher with sperm thawed at 7.5 °C·min⁻¹, than sperm thawed at 2.5 °C·min⁻¹, while thawing rate had no effect for HBSS + EY. Our findings have implications for cod mariculture and aiding in conservation efforts for a dominant marine fish species.

Using gynogenesis to elucidate the sex determining mechanism of Atlantic cod (*Gadus morhua*)

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Cultured Atlantic cod (*Gadus morhua*) typically reach sexual maturity prior to harvest, causing reduced flesh quality. Recent research has shown that female triploid Atlantic cod exhibit suppressed gonadal development, potentially resolving pre-harvest sexual maturation. Industry is looking to produce female mono-sex stocks, but cannot do so until the sex determining mechanism is uncovered. The objective of this research is to determine the genetic basis of sex for Atlantic cod, by means of gynogenesis. This process results in uniparental maternal inheritance following exposure of spermatozoa to UV radiation. The UV treatment that gave the best yield of gynogenetic offspring was pre-dilution of milt to a 15% spermatocrit followed by a further 1:10 dilution and exposure to 113.4mJ/cm² UV light. A hydrostatic pressure shock was applied to zygotes following activation with UV-treated milt, inhibiting the extrusion of the haploid second polar body, resulting in diploid gynogenetic embryos. The sex ratio of gynogenetic and control populations was examined at approximately 9 months of age by macroscopic observation of gonads and is currently being confirmed through histology. Final sex ratio results will be presented. If only females result from gynogenesis, then male heterogamety (XY) can be supported. A 1:1 or female-biased sex ratio may support female heterogamety (ZW).

Sex control of Atlantic cod (*Gadus morhua*)

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Production of sterile triploid fish would alleviate the problem of early maturation which commonly occurs in both sexes of Atlantic cod (*Gadus morhua*). The objective of this project is to develop techniques to produce monosex stocks as the first step to producing monosex triploids. 17 β -estradiol (E₂) and 17 α -methyl-dihydrotestosterone (MDHT) were applied to fish diets during the labile period of sex differentiation (LP). In the first year, triplicate treatments of 5, 10 and 20ppm E₂ and 0.67, 2 and 6ppm MDHT were given to fish between 17 \pm 2 and 43 \pm 1mm SL. In the second year, duplicate treatments of 20, 40, 80 and 120ppm E₂ and 3, 6, 12 and 18ppm MDHT were utilized between 7.8 \pm 1 and 43 \pm 1mm SL. The shift in sex ratio in both hormone treated groups was proportional to hormone dosage in the second year, while this was not observed in the first year. MDHT treatments \geq 6ppm in the second year resulted in > 90% male. Significantly reduced male ratio was observed in E₂ groups with dosage \geq 80ppm. The LP of cod occurs around 8mm SL. It is possible to manipulate the phenotypic sex of cod through dietary hormonal manipulation.

Production of sterile Atlantic cod: A way to satisfy industrial and environmental criteria?

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Unresolved issues that are having an influence on the development of cod farming include precocious sexual maturation and farmed fish escapes. Pre-harvest sexual maturation is of concern because it results in reduced growth and poorer flesh quality. The escape of cod from farms not only represents an economic loss for producers but might also have ecological and genetic impacts on wild fish. The farming of sterile cod may be an option both for reducing the incidence of early maturation and for reproductive containment, and the production of triploid fish could be a method for inducing sterility. Triploid cod can be reared to market size and there is evidence of gametic sterility in males. Triploidy may also result in improved post-harvest production traits, such as reduced fillet gaping. Work is in progress to examine differences in gut morphology between diploid and triploid cod and to evaluate the merit of carrying out comparative studies on digestion, absorption and nutrient utilization. Triploidy may be a management option to address issues related to genetic containment of farmed cod. Although there appear to be advantages associated with adopting farming technologies that involve the induction of triploidy, informing the layman about, and changing negative public attitudes to, triploid technology may prove a difficult task.

Production d'omble de fontaine et d'omble chevalier monosexes femelles stériles et évaluation de leurs performances en conditions d'élevage commercial

R. Morin*¹

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La production des ombles au Québec est affectée par la maturation sexuelle des individus apparaissant avant leur mise en marché. Par ailleurs, l'ensemencement massif de l'omble de fontaine fertile dans le milieu naturel est l'objet d'une controverse en regard de la contamination génétique des populations sauvages. La stérilisation des ombles par triploïdisation (3N) au moyen d'un choc de pression administré aux œufs est la solution mise de l'avant pour régler ces problèmes, mais elle n'est efficace que chez les individus femelles. L'objectif du projet est de mettre au point la technique de production d'ombles monosexes femelles stériles et de l'implanter à l'échelle commerciale dans les entreprises piscicoles privées. Différents traitements hormonaux expérimentés ont permis de réaliser l'inversion de sexe, il reste à les affiner pour en augmenter le taux de succès. Les poissons stériles ont été testés en conditions d'élevage de manière à en évaluer la croissance, la survie et la sensibilité aux maladies. Le taux de capture de l'omble de fontaine stérile a été testé en milieu naturel à la suite d'ensemencements. La production des ombles monosexes femelles stériles est en bonne voie d'implantation dans les entreprises piscicoles privées au Québec. Ces poissons présentent de bonnes performances d'élevage et aucun risque de contamination génétique à la suite de leur ensemencement.

Overview on the Arctic charr (*Salvelinus alpinus*), Fraser strain, performance from eggs to market size

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The growers and scientists of the Atlantic region have identified the major challenges faced by the Arctic charr aquaculture industry: early maturation, inconsistency of fillet pigmentation and poor egg quality and supply. To solve these issues, the CZRI implemented a breeding program which objectives are (1) to develop a competitive Arctic charr that is viable commercially in Eastern Canada, and (2) to develop and provide certified high quality eggs to the industry. The CZRI, in collaboration with the scientists and the producers, selected rigorously individuals from each family and improved each generation to minimize inbreeding and reduce the occurrence of early maturation. A fifth generation was obtained in the fall 2009 and no sign of maturation has been observed to date (current body weight: 450g). Thus far, weight gain increased by 75% compared to the first generation. Survival of eggs improved by more than 140% on a semi-commercial scale. Details about our selection method, fish growth, survival, feed conversion, and effect of rearing sites on family performance will be given during the presentation. Overall, the team at CZRI overcomes certain challenges and is progressing toward the production of a competitive Arctic charr for aquaculture.

Fish distribution of two strains of Arctic charr in sea cages in Bay d'Espoir, Newfoundland

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Conflicting results have been obtained regarding seawater rearing of Arctic charr with data suggesting that fish general performance is highly strain dependent. An ACRDP project was initiated in April 2010 (Nordic Salmon Co. Inc., DFO Newfoundland) to study fish movement of two strains of Arctic charr in sea cages (Labrador, hybrids between Tree Rivers and Nauyak). Recent trials by the industry partner suggest that Arctic charr have been successfully reared in seawater in the summer with satisfactory growth and survived the harsh local winter with mortalities lower than 0.5% per month. However, issues have been observed in feeding behaviour (surface and bottom feeders) as well as appropriate depth for feed distribution. These observations raise a number of questions on preferred depths for feeding as well as fish swimming patterns in cages. In August 2010, Sondes and hydroacoustic material were deployed in two cages containing two strains of Arctic charr in order to measure environmental conditions and how these parameters may influence fish swimming patterns. Our environmental data (August to November) reveals variation of temperatures between ~ 5°C to ~ 20°C and salinity shifts from as low as 1.4 ppt to 30.5 ppt especially at the first 5 meters of water. Bay d'Espoir is subject to considerable physical and chemical water-column variability due to stratification of fresh water at the surface and underlying marine waters. The hydroacoustic data is being processed in order to attempt to determine preferred thresholds of environmental conditions for both strains.

Does high density production system for rotifers really work? Trial on cod (*Gadus morhua*) larvae

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Immature digestive system of several marine finfish species suggests live food will remain a significant source of nutrients in hatcheries. Live food production is labor intensive and costly. To circumvent these constraints, rotifers were cultured using a High Density Production System (HDS) and a traditional production unit (control). The HDS was enriched with (1) Algamac 3000[®] + Protein Selco Plus[®], or (2) Pablova-DHA[®]. Only Enrichment 1 was added to the control. Production time, yield and bacterial load were compared between production units. The rotifers were fed to cod larvae afterwards. The HDS reduced rotifer production time by over 70%, increased and stabilized rotifer yield (37.0±5.6% versus 7.7±10.6%), and reduced bacterial load by 10X. There were no significant differences in terms of survival and growth between cod fed with rotifers from HDS and the control when using Enrichment 1. Differences in survival were observed between cod fed rotifers from the HDS with enrichment 2 and the control. The EPA levels were significantly higher for rotifers produced in HDS than in the control, which also impacted the DHA:EPA and EPA:AA ratios. These results indicated that HDS, with a proper enrichment, can reduce production costs of commercial hatcheries, and facilitate rotifer production.

3rd National Symposium on Freshwater Aquaculture – 9: Environmental Management

Troisième symposium national en aquaculture d'eau douce – 9: Gestion environnementale

Wednesday, May 11, 2011 / Mercredi 11 mai, 2011: 14h00-17h00

Location: Suzor-Côté

Chair / Président: Doug Geiling (Fisheries and Oceans Canada / Pêches et Océans Canada)

14h00-14h20 C.L. Podemski: Validation of DEPOMOD for freshwater cage aquaculture

14h20-14h40 C.L. Podemski: Impacts and recovery from freshwater aquaculture: water chemistry and lower trophic levels in Lake 375 before, during, and after cage aquaculture

14h40-15h00 K.H. Mills: Enhancement of native fish populations as a by-product of cage aquaculture

15h00-15h20 J.E. Milne: Monitoring and modeling phosphorus contributions in a freshwater lake with cage-aquaculture

15h20-15h40 BREAK / PAUSE

15h40-16h00 G. Ouellet: La stratégie de développement durable de l'aquaculture en eau douce au Québec : le point après six ans d'application

16h00-16h20 Y. Comeau: Extensive technologies for phosphorus removal from fish farms

16h20-16h40 A. Snow: The use of a constructed wetland for the treatment of concentrated effluent from a salmonid raceway fish hatchery

16h40-17h00 M. Auffret: Detection of geosmin and MIB synthesis genes in closed-circuit aquaculture system, using quantitative PCR

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Validation of DEPOMOD for freshwater cage aquaculture

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The suitability of DEPOMOD, a particle tracking model developed by Cromeey et al (2002) for marine systems, is being investigated for application to the freshwater cage culture industry in Canada. Suitability testing included parameterization of the model and validation at commercial rainbow trout sites in Lake Diefenbaker and Lake Huron, and parameter sensitivity analysis. Validation of the model was conducted by comparing model predictions with observations from sediment traps and with sediment coring. In general, DEPOMOD produces overestimations of carbon loading directly beneath and in close proximity to cages, and underestimates deposition further away. We have multiple collections of sediment traps for model validation in Lake Diefenbaker in both 2008 and 2009, and a single collection in 2009 at each of two farms in Lake Huron. Multiple validations are allowing us to see that there can be considerable temporal and spatial variation in prediction success. Mean Absolute Relative Error (MARE) ranged from 52 to 147% in Lake Huron and 29 to 72% in Lake Diefenbaker. Sensitivity analysis was conducted to confirm model response to changes in input parameters. This allows us to determine where best to focus resources for measurement of input parameters for improving modelling accuracy. The variables tested included feed type (digestibility) and carbon content, feed wastage, settling speeds of waste and waste feed, and horizontal and vertical coefficients of dispersion. Our initial results suggest that within the hydrodynamic environment at freshwater sites, the model is most sensitive to changes in feed digestibility and coefficients of horizontal dispersion. Cage movement in a system with limited dispersion and sharp deposition gradients is an ongoing challenge for model validation.

Impacts and recovery from freshwater aquaculture: water chemistry and lower trophic levels in Lake 375 before, during, and after cage aquaculture

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Lake 375, a small, oligotrophic located on the boreal shield in north western Ontario, has been the focus of a long-term whole ecosystem experiment to understand the mechanisms through which cage aquaculture can affect the ecology of lakes. From 2003-2007, a 10T rainbow trout farm was operated in the lake. Given the volume and residence time of the lake, this represented a worse case scenario as compared with commercial operations in Lake Huron and Lake Diefenbaker. The fish farm represented a significant source of both phosphorus and nitrogen to Lake 375, increasing loading approximately 15- and 4-fold, respectively. Before, during, and after aquaculture operations, the Lake 375 ecosystem was monitored to detect pathways through which aquaculture exerted an influence. Epilimnetic phosphorus concentrations and algal biomass were significantly increased by aquaculture. The changes were less than expected and were greatest during periods of lake mixing. Two years after the cessation of fish farming, the algal community has returned to pre-farm conditions. Total crustacean and rotifer biomass did not change detectably in response to aquaculture. Solid wastes accumulated under the farm and showed limited dispersion. The waste quickly affected sediment chemistry and benthic invertebrate abundance and community composition. Stable isotopic analysis demonstrated that aquaculture waste was utilized by the native food web but two years after farming, $\delta^{13}\text{C}$ values have returned to baseline.

Significant reductions in the waste pile have been observed and will continue to be monitored until complete recovery has occurred.

Enhancement of native fish populations as a by-product of cage aquaculture

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We studied the impacts of five years of experimental cage aquaculture on the native fish populations of Lake 375, a small lake in the Experimental Lakes Area, northwestern Ontario. Approximately 10,000 rainbow trout were cultured each year from 2003 to 2007 in one pen in Lake 375. The native fish populations in Lake 375 were monitored during each year of cage culture as well as during the 12 years prior to the experiment and during three years after the experiment. There was little change in the Lake 375 fish populations during the first year of cage culture, but abundance of many native fish populations (lake trout, white sucker, fathead minnow, pearl dace, and slimy sculpin) increased during the years of cage culture. Lake trout abundance more than doubled and abundance of minnow species increased an order of magnitude. Lake trout were fatter, grew faster, and matured earlier than prior to the experiment. Enhancement of the native fish populations continued through the first year post cage culture, but did not continue in the following years. Fish populations in other nearby non-experimental lakes were monitored during the same time period and did not have corresponding abundance changes.

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

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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 inlet 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 4 sources of outputs from the lake. We then applied a sensitivity analysis to establish parameters that require empirical measurement and field validation. Results of the sensitivity analysis show tributaries to be the most sensitive parameter in terms of phosphorus loading, followed by the exchange via the inlet, lake sedimentation, groundwater, dwellings, and then the contributions by the farm itself. Information from this project will provide water quality managers with scientific information to aid in the decision-making processes related to determining policy and regulatory approaches for water quality risk assessment and management of cage-aquaculture in Ontario.

La stratégie de développement durable de l'aquaculture en eau douce au Québec: le point après six ans d'application

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À l'été 2004, l'Association des Aquaculteurs du Québec, le ministère du Développement durable, de l'Environnement et des Parcs et le ministère de l'Agriculture, des Pêcheries et de l'Alimentation ont signé une entente sur la Stratégie de développement durable de l'aquaculture en eau douce au Québec (STRADDAQ). L'objectif de la STRADDAQ est l'atteinte, d'ici 2015 pour les piscicultures de salmonidés existantes qui y auront adhéré volontairement, d'un rejet maximal à l'effluent de 4,2 kg de phosphore (P) par tonne (t) de production annuelle. Depuis 2004, plusieurs échantillonnages ont été réalisés dans 56 piscicultures. Ceux-ci ont révélé que près de 70 % des entreprises avaient déjà des rejets inférieurs à 4,2 kg P/t. D'autres échantillonnages ont démontré que les boues sédimentées au fond des étangs de production renaient des quantités significatives de phosphore. De même, il a été montré que les activités ponctuelles de seinage de poissons et de nettoyage des étangs de production n'avaient pas d'effets notables sur les rejets moyens annuels de phosphore. Actuellement, des entreprises représentant plus de 50 % de la production piscicole québécoise ont adhéré à la STRADDAQ et ont entrepris ou entreprendront prochainement des travaux d'amélioration de leurs équipements de traitement.

Extensive technologies for phosphorus removal from fish farms

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Trout farms in the Province of Québec produce about 1500 tons of fish per year, below the historical maximum of 2200 tons in the year 2000 and well below the market potential and actual consumption. The STRADDAQ ("stratégie de développement durable de l'aquaculture en eau douce au Québec") was implemented in 2004 with the goal of reducing by 40% the discharge of phosphorus from fish farms with a capacity greater than 5 tons per year, by 2014. To reach this goal, fish farmers should use not only improved feeds and stricter fish farm management, but also collect and treat their biosolids to prevent phosphorus discharge in the environment. Biosolids can be thickened and often spread on land, but the supernatant must be treated to capture organic matter and nutrients. To this end, extensive technologies such as macrophyte beds and reactive filtering media – containing slag - can be used. Various approaches were developed to prevent calcite clogging in these reactive filters. Alternatively, biosolids can be treated by macrophyte drying beds followed by reactive filters.

The use of a constructed wetland for the treatment of concentrated effluent from a salmonid raceway fish hatchery

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The most common treatment technologies for wastewaters from raceway-based fish hatcheries include gravitational sedimentation and mechanical screening. These physical treatment processes remove settleable solids and particulate bound nutrients, but do not treat the dissolved fractions of the wastewater such as ammonia, urea, phosphate and carbon compounds that can harm the receiving environment. Over the past ten years, the use of constructed wetlands, which incorporate physical, chemical and biological mechanisms, for the treatment of flow-through aquaculture wastewaters has been gaining attention. A hybrid subsurface flow constructed wetland was used to treat concentrated effluent from a 300 m³/day flow-through, raceway-based salmonid hatchery located in Haliburton County, ON. In the 2009 – 2010 sampling season, average reductions in the wetland outlet of total suspended solids (TSS), biochemical oxygen demand (BOD), chemical oxygen demand, ammonia, total phosphorus (TP) and phosphate were 54.2, 54.6, 59.1, -71.1, 45.0 and 20.4 %, respectively. This study demonstrated the successful use of constructed wetlands for the treatment of TSS, oxygen demand and TP from concentrated raceway-based salmonid hatchery effluent in a northern, temperate climate, but exhibited increasing ammonia concentrations and minimal phosphate removal. In the 2010 – 2011 sampling season, modifications were made to the constructed wetland to improve TSS, BOD and ammonia removal efficiencies. Water quality results from the 2010-2011 sampling season will be presented.

Detection of geosmin and MIB synthesis genes in closed-circuit aquaculture system, using quantitative PCR

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The off-flavours compounds as geosmin and 2-methylisoborneol (MIB), produced by some bacteria such as *Streptomyces* are one of the major problems in industrial water systems. These compounds are characterised by an exceptionally low detection threshold by human taste and odour (on the order of 2-10 ng.L⁻¹), reducing the drinking water quality or affecting negatively many aquaculture facilities. A SYBR Green quantitative PCR (QPCR) assay was developed to detect and quantitate the geosmin bacterial producers in recirculating aquaculture system (RAS). Non-degenerated primers were designed to target *geoA*-like genes coding for terpene synthases. The method was tested on a water sample from a RAS at the Laboratoire régional des sciences aquatiques (LARSA; U. Laval) that was spiked with dilution series of *Streptomyces* cultures. Our results showed an accurate number of *geoA* in the water sample. Finally, QPCR assays on samples from two RAS where geosmin was detected showed 1.0×10^7 and 2.0×10^6 *geoA* copies ml⁻¹, respectively. We are currently working on QPCR assays for the *tpc* gene involved in the synthesis of MIB. The QPCR method will be useful for evaluating the presence of geosmin- and MIB-producing bacteria in water treatment system or RAS.

Posters / Affiches

Authors in attendance / Auteurs présents

Tuesday, May 10, 2011 / Mardi 10 mai, 2011: 17h00-18h30

Location: Foyer (3rd Floor) / Hall d'exposition (troisième étage)

Anderson: Evaluation of Maxi-Gen[®] as a feed attractant for first feeding rainbow trout (*Oncorhynchus mykiss*) fry

Barkhouse: Mussel seed quality based on survivorship and growth at 6 sites in New Brunswick and Prince Edward Island: A reciprocal transfer experiment

Ben Khemis: Comparative study of pikeperch (*Sander lucioperca*) eggs and larvae from wild or captive females

Boily: Analytical tools and experimental limits for assessing mussel immunocompetency during *in vivo* bacterial challenge

Boudreau: A novel treatment against the infectious salmon anemia virus using RNA interference

Camarillo-Sepulveda: Measurement of some sperm parameters of wild and farmed Atlantic salmon (*Salmo Salar*) in Newfoundland

Chen: Evaluation of hull-less oats processed in different ways in practical diets for rainbow trout (*Oncorhynchus mykiss*)

Chiasson: The production of all-female populations of Fraser strain Arctic charr

Deschamps: Bone tissue responsiveness to prolonged dietary phosphorus deficiency in rainbow trout, *Oncorhynchus mykiss*

Doucet: Novel approach for recombinant DNA vaccine against Infectious Salmon Anemia Virus (ISAV)

Fournier: Mise à l'échelle d'un procédé d'alimentation en phase de la truite arc-en-ciel par contrôle du phosphore (P) alimentaire pour réduire les rejets en P

Fredriksson: Investigation of the tension distribution in aquaculture nets with a finite element model and laboratory tests

Granados: The contrasting differences in zooplankton community composition and abundance between aquaculture (farm) and control sites in the Havre-aux-Maisons lagoon, QC

Gutierrez: Genetic mapping of quantitative trait loci (QTL) for body weight in Atlantic salmon (*Salmo salar*)

Hamoutene: Effect of diet on some sperm biochemical parameters in hatchery reared cod (*Gadus morhua*) broodstock

Hennebicq: Measurement of mechanical properties, metals and amino acid composition of *Mytilus edulis* byssal threads in relation to reproduction

Jauvin: Seasonal variations of *Mytilus edulis*'s immunity in harvest areas/ étude des variations saisonnières de l'immunité de la moule bleue *Mytilus edulis* en région conchylicole

Khodadadi: Effect of salinity on survival and cortisol levels in fingerling grass carp (*Ctenopharyngodon idella*)

Lafille: Expression de gènes reliés à la croissance et au métabolisme lipidique en période de métamorphose chez la plie rouge

Laplante: Taux de recapture optimal pour assurer une viabilité de la production de larves de homard américain (*Homarus americanus*) en éclosure aux fins d'ensemencement pour soutenir une pêche durable dans la Baie des Chaleurs

Le François: Evaluation of the stress response of the wolffishes (*Anarhichas minor*, *A. lupus* and reciprocal hybrids): acoustic and handling stress

Martel: Utilisation d'extraits de plantes, un avenue envisageable dans la prévention et le traitement de la saprolegniose chez les alevins de truite arc-en-ciel

Pilote: Strategies to prevent off-flavours in fish raised in closed-circuit aquaculture systems

Plante: Determination of optimal protein and lipid levels in American lobster (*Homarus americanus*) larvae nutrition

Sarker: Effects of dietary biotin restriction on growth, deficiency syndrome and biotin dependent hepatic gene expression of juvenile tilapia *Oreochromis niloticus*

Savoie: Pilot-scale cultivation of spotted wolffish (*Anarhichas minor*): a progress update on growth performances including family and strain comparisons

Séguin Heine: Metal content and isotopic enrichment of the byssus of the blue mussel, *Mytilus edulis*

Webb: Effects of broodstock diet on egg lipid content in farmed Atlantic cod (*Gadus morhua*) broodstock

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Evaluation of Maxi-Gen[®] as a feed attractant for first feeding rainbow trout (*Oncorhynchus mykiss*) fry

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Maxi-Gen[®], a yeast derived product was added to first feeding diets as a feed attractant. Four thousand eyed Rainbow trout eggs were equally distributed to 40 (16L) tanks in two (20 tank) flow through systems (0.5l/min/tank). Fish in each system were fed either semi-purified (P) or natural ingredient (N) diets with or without Maxi-Gen[®] (0.5%) to evaluate Maxi-Gen[®]. Initially, hatchlings in each system 10°C or 16°C were fed every 2 hours during daylight. At tank average weight (1-2g/fish), fish numbers were reduced to 25/tank. In this 4x2 factorial design (diet x temp) feed consumption (FC), weight gain (WG), feed conversion ratio (FCR), and protein efficiency ratio (PER) measured at 21-day intervals, were subjected to repeated measures in the mixed model program of SAS. Orthogonal contrasts were used to compare diets ($P \leq 0.05$). No differences in FC, WG, FCR, PER occurred when Maxi-Gen[®] was added in P or N diets at 10°C. The WG and PER at 16°C fed N-, N⁺, P- and P⁺ were 9.4 ± 0.32 , 9.2 ± 0.32 , 6.6 ± 0.32 , 7.8 ± 0.32 , and 1.2 ± 0.04 , 1.1 ± 0.04 , 1.1 ± 0.04 , 0.8 ± 0.04 , 0.9 ± 0.04 respectively. With purified diets fish fed Maxi-Gen[®] had better WG and PER ($P \leq 0.05$).

Mussel seed quality based on survivorship and growth at 6 sites in New Brunswick and Prince Edward Island: A reciprocal transfer experiment

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A reciprocal mussel seed transfer experiment was conducted as part of a larger study to evaluate mussel seed quality criteria based on their physiological and pathological health. This project was initiated to investigate unexplained cultured mussel seed mortalities, which were being reported by Maritime mussel growers at an increasing rate in recent years. In 2004, Mussel seed from 3 sites in New Brunswick (NB) and 3 sites Prince Edward Island (PEI) were collected and cross-planted back to each of the sites. Survivorship was measured after 8 months and growth rate and length were measured after 10 months of deployment. There were significant differences ($p \leq 0.05$) in survivorship, growth rate and mean length between seed stocks but not between sites. Mussel seed from Shippagan (NB), Tracadie Bay (PEI) and St. Peter's (PEI) demonstrated significantly higher survivorship after 8 months than mussel seed from Caraquet (NB), Miramichi (NB) and New London (PEI) regardless of the site location. After 10 months, the largest mussels were produced by the Tracadie Bay seed stock followed in descending order by Shippagan, St. Peter's > New London, Miramichi > Caraquet. In this study, genotypic variation (seed stock) rather than environmental factors (site differences) was the best determinant of survivorship and length after 10 months.

Comparative study of pikeperch (*Sander lucioperca*) eggs and larvae from wild or captive females

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Possessing captive fish brood-stocks is essential to guarantee regular supply of eggs in hatcheries. However, breeding conditions, nutrition, stress and captivity are known to influence the quality of

obtained eggs and larvae. Present comparative study of quality of eggs and larvae from wild or captive females was performed in the frame of a research program aiming to improve production of pikeperch (*Sander lucioperca*) juveniles, used for reservoir stocking in Tunisia. Morphometric characteristics, proximal analysis, and fatty acids profiles were analysed. Main difference concerned polyunsaturated fatty acids which consisted mainly in n-6 series in eggs and larvae from wild females while n-3 series and in particular the docosahexaenoic acid (DHA = C22: 6n-3) were the most important in eggs and larvae from captive females. These differences reflected the diet of respective females and significantly affected the ratios (n-3/n-6) and (DHA / EPA). Results were also discussed in regard to larvae initial growth performances.

Analytical tools and experimental limits for assessing mussel immunocompetency during *in vivo* bacterial challenge

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An experimental approach to studying the immune response of bivalve to bacterial infections can be useful for understanding the resistance of bivalves challenged by contamination with bacteria in their environment. However, most of the parameters measured during studies on immunocompetence (e.g. reactive oxygen species and nitrogen oxides production) are not exclusively related to responses to infectious agents but can also be associated with inflammatory responses and stress reactions. Indeed, transport and manipulation of the organisms prior to bacterial challenge represent additional stressors that could interfere with the true immune response to infectious agents. Furthermore, bacterial challenges are often accomplished by direct injection into the adductor muscle; this can also add a supplementary stress. This presentation is based on an experimental study of the immune response of *Mytilus edulis* toward bacterial infections and reveals the limits of the classic experimental design.

A novel treatment against the infectious salmon anemia virus using RNA interference

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Aquaculture of Atlantic Salmon (*Salmo salar*) produces millions of dollars each year and is an important economic resource for many countries around the world. Infectious salmon anemia virus (ISAV), an orthomyxoviridae, infects Atlantic Salmon, causing serious illness and often leading to large scale deaths. Current vaccination efforts against ISAV are not 100% efficient and more solutions are needed. RNA interference (RNAi) is a method that can be used for the targeting and the cleavage of single stranded RNA, including the genomic RNA of ISAV. As such, it offers not only a potential vaccine strategy, but also a potential treatment strategy post infection. Studies have shown that viral replication can be stopped using RNAi against the Influenza A virus, another virus of the orthomyxoviridae family. This study uses small hairpin RNA (shRNA), a part of the RNAi system, in effort to stop the viral replication of ISAV in different salmon cell lines while trying to target all the strains of ISAV.

Measurement of some sperm parameters of wild and farmed Atlantic salmon (*Salmo Salar*) in Newfoundland

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³Gray Aqua Group Ltd., PO Box 275, Conne River, NL, A0H 1J0.

In order to ensure the conservation of wild salmon populations throughout the Atlantic region, a better understanding of the potential impact of aquaculture escapees on wild stocks is necessary. As part of a study aimed at determining the mating success between farmed and wild spawners by analyzing their reproductive output, we assessed some quality parameters of wild and farmed salmon sperm. We measured cell counts, energy levels (ATP), as well as the activities of enzymes of the aerobic (citrate synthase, CS), glycolytic metabolism (lactate dehydrogenase, LDH), lipid catabolism (lipase, LIP) as well as oxidative phosphorylation (creatine kinase, CK) in sperm samples from farmed salmon (St John river strain) and wild salmon (mature and precocious parr) collected at the North East Placentia River in Newfoundland. No differences between wild precocious parr and wild mature fish were found in ATP and/or enzyme activities. Results indicate that despite higher cell counts in farmed salmon, sperm cells of wild males show statistically higher levels of energy and CK than farmed fish. Similarly, a trend (non-significant differences) can also be seen in CS, LIP, and LDH with higher activities in wild salmon than in farmed salmon. Our results indicate that, despite the fact that farmed salmon have higher number of cells, sperm biochemical parameters indicate an overall higher sperm quality in wild salmon thus increasing their chances of reproductive success.

Evaluation of hull-less oats processed in different ways in practical diets for rainbow trout (*Oncorhynchus mykiss*)

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Wheat byproducts added to trout diets provide improved pellet binding characteristics. Hull-less oats can potentially replace the wheat. Six hundred Rainbow Trout (initial weight 25.9 ± 1.4 g) in 18 tanks (40L) supplied with 16 °C fresh water in a flow-through system (2L/min/tank) were fed one of six diets (control (C) with wheat, high fat hull-less oats (HFO) or normal hull-less oats (NO) with no pre-pelleting processing (R), NO processed by extrusion (NOE), popping (NOPO) or pelleting (NOPO)). Three tanks of fish were fed each pelleted diet that were isocaloric and iso-nitrogenous. Fish were weighed initially and at 21 day intervals with feed consumption (FC) weight gain (WG) and feed conversion ratio (FCR) measured and subjected to repeated measures analysis using the mixed model procedure of SAS. Total WG (range 76.2-83.5g) and daily FC (range 1.42-1.52g) were similar among diets. The FCR for NO (1.04) was better than NOR (1.20) $P \leq 0.05$. The other diets were similar and intermediate to these diets, C (1.08), HFOR (1.07), NOPO (1.07) and NOPE (1.18). Hull-less oat diets had good quality pellets and effectively replaced wheat in the diets.

The production of all-female populations of Fraser strain Arctic charr

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When used to produce all-female populations, hormonal manipulation reduces the incidence of early maturation and yields larger fish without the economic loss of reduced flesh quality. The aim of this research is to evaluate the suitability of using microsatellite markers to identify genetic females after being treated with the synthetic androgen 17 α -dihydromethyl testosterone (MDHT) to produce masculinised genetic females (neo-males). Effective identification of neo-males is an essential step in producing all-female stocks by indirect feminization. Feed samples containing MDHT at 0.0 (control) and 0.5 mg/kg were fed to 8 families of charr for 600°C-days beginning at first feeding. Sub-samples from these families (24/family) were euthanized at a mean weight of 300 g to determine phenotypic sex and collect tissue for genetic analysis. The MDHT treatment group had 99.5% male fish compared to 50% in the control. Genotyping for microsatellite markers which have been hypothesized to be linked to the sex-determining locus on AC-4 will allow the separation genetic males and females in experimental families. The identified neo-males will be selected for broodstock and at maturity they will be crossed with normal females to produce all-female offspring. Funded by ACRDP in partnership with the CZRI and CanAqua Seafoods Ltd.

Bone tissue responsiveness to prolonged dietary phosphorus deficiency in rainbow trout, *Oncorhynchus mykiss*

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A prolonged dietary phosphorus (P) deficiency induces a generalized demineralization of bone tissues however the differential responsiveness of different bone tissue to P-deficiency is unknown. Two practical diets consisting of P-deficient (0.3 % digestible P) and P-sufficient (0.5 % digestible P) were formulated. Experiments were conducted on female juvenile rainbow trout (initial mass ~ 60 g) until fish fed continuously with P-sufficient diet reached ~ 850 g. Two carcass samplings were carried out at 134 and 241 days to assess bone tissue characteristics. The proximate composition (% of dry matter, ash, phosphorus, calcium and magnesium, and Ca: P ratio) of bone tissues (scales, opercula, ribs and vertebrae) was analyzed separately. The relative difference (%) between P-deficient and P-sufficient fish was also calculated for each parameter. The ranking of tissues most affected by P deficiency was as follows: vertebrae > scales > opercula > ribs. These results suggest that dietary P-deficiency affects bone tissues differentially, and may be based on the physiological and biomechanical roles of the tissues. As the scales can be easily taken from living organisms, a better understanding of the metabolism of P in the scales could facilitate the P status estimation of fish.

Novel approach for recombinant DNA vaccine against Infectious Salmon Anemia Virus (ISAV)

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The Infectious Salmon Anemia Virus (ISAV) is a recurrent problem for salmon cultivation in Canada and other countries such as Chile. A commercial vaccine is available in Canada, although a heat-inactivated virus vaccine does not offer total protection to ISAV. In light of these circumstances, it would seem appropriate to embrace an alternative method of vaccination. Given success associated with DNA vaccines against other viruses such as Infectious haematopoietic necrosis virus (IHNV) and the viral hemorrhagic septicemia virus (VHSV), we believe this approach provides a promising avenue for protection against ISAV. We propose the cloning of the ISAV hemagglutinin esterase protein (HE) into a high expression vector, with the addition of a javelin sequence for degradation by heat shock proteins (HSP), and a signal sequence for localization to the ER. To favor cross-presentation to B-cells, we suggest a second plasmid expressing a lysosome membrane associated protein (LAMP) to further aid with major histocompatibility complex (MHC) presentation. We present, here, results obtained to date.

Mise à l'échelle d'un procédé d'alimentation en phase de la truite arc-en-ciel par contrôle du phosphore (P) alimentaire pour réduire les rejets en P

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En condition d'élevage, le phosphore, qui est un élément essentiel au développement du squelette et à la croissance, est essentiellement de source alimentaire. Les rejets en phosphore des piscicultures dans l'environnement proviennent donc en grande partie de la moulée qui n'est pas ingérée par les poissons ou du phosphore ingéré qui dépasse les besoins physiologiques. L'aquaculture intensive génère donc une charge en phosphore dans l'environnement qui peut contribuer à l'eutrophisation des plans d'eau récepteurs sensibles. Il est possible de réduire les rejets en phosphore des piscicultures, en agissant directement sur la biodisponibilité de cet élément et sur la composition des moulées distribuées aux poissons. Les objectifs de ce projet sont d'optimiser la formulation d'un régime déficient en phosphore, d'identifier le patron d'alternance de régimes suffisant et déficient en phosphore qui maximise la croissance des truites arc-en-ciel et minimise les rejets en phosphore, de tester le patron d'alternance choisi dans des conditions commerciales de pisciculture et finalement, de mener une étude technico-économique; le tout dans un but d'analyser l'impact d'un nouveau régime d'alternance de moulées déficientes et suffisantes en phosphore et de l'effet sur la production commerciale de salmonidés.

Investigation of the tension distribution in aquaculture nets with a finite element model and laboratory tests

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Net failures in a marine fish farm can be catastrophic from both the environmental and economic perspectives. Most net pens deployed in an oceanic environment are compliant structures subjected to dynamic loads due to waves and currents. These loads increase as operations move from calm to open ocean sites. Understanding the tension distribution and being able to monitor net “hot spots” will help to prevent and mitigate net failures. In this study, the tension distribution in netting components is analyzed with a numerical model and as part of a series of laboratory tests. The numerical model uses the finite element approach with simple nodes at each cross-strand location. Simulations were conducted with both fish cage and net panel models to examine the distribution and magnitude of tensions with different load scenarios. The laboratory tests, however, utilize actual knotless net samples from the Norwegian salmon farming industry. The samples were cut into individual panels and placed in a rig where tensions on individual strands could be adjusted. Different loading schemes were then examined to ascertain the tension distribution characteristics in the net samples and to determine if the model could reproduce the laboratory results.

The contrasting differences in zooplankton community composition and abundance between aquaculture (farm) and control sites in the Havre-aux-Maisons lagoon, QC

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Relegated to the benthos, the blue mussel, *Mytilus edulis*, is confined to consuming resources available in the water above substrates. However, aquaculture manipulates the distribution of mussels and renders the resources of the water column available to mussels. With the identification of mussels as significant consumers of zooplankton, the presence of mussels in the water column suggests aquaculture could have an impact on the abundance and composition of zooplankton. The Havre-aux-Maisons lagoon in the Magdalen Islands, Québec has supported mussel aquaculture for over a quarter century. Water samples were obtained from farm and control sites in the lagoon in August 2010 to describe the differences in zooplankton composition and abundance. Data indicates substantial differences between farm and control sites. Multivariate analyses revealed significant differences in community composition between farm and control sites (ANOSIM, $p < 0.05$), whereas estimates of abundances indicated a significant reduction in zooplankton biomass in farm sites. Analysis of the community data also indicated a lower abundance of pre-adult life stages at farm sites relative to control sites. While the mechanism for the observed differences remains unknown, the results suggest the presence of mussels in the water column can alter the structure of zooplankton communities.

Genetic mapping of quantitative trait loci (QTL) for body weight in Atlantic salmon (*Salmo salar*)

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We examined five families from the Mainstream Canada Atlantic Salmon broodstock program, to identify QTL associated with Body Weight at four time points during the production cycle. The parents and 49-65 progeny from each family were genotyped using a relatively dense 6.5K SNP chip Array developed by the Centre for Integrative Genetics (CIGENE). Male and female linkage maps were constructed using LINKMFEX software. QTL analysis was carried out using GridQTL software utilizing the Sib-Pair model to take advantage of the full-sib nature of the families. Significance thresholds to assess QTL effect were obtained from a 10000 permutation tests. We identified several chromosomes which contain suggestive QTL associated with body weight with a p value <0.05, but also others including Ssa04, Ssa26 and Ssa29 which are significant at p<0.01 and have previously been identified as being associated with Body Weight QTL in Atlantic salmon. Our findings provide useful evidence of QTL associated with body weight traits. These QTL could be valuable candidates for use in marker-assisted selection breeding programs. However, it is an important step towards the identification of genes and the understanding of the genetic components underlying the growth and body weight in Atlantic salmon.

Chromosomes containing QTL

Time during production cycle	FAMILY				
	7	23	76	88	107
1	15, 20, 19*	4*, 25	10, 14, 11, 4, 26*	12, 2, 7	
2	17, 4, 19			1, 11	
3	29*,	9	1,	19, 21, 15	27, 3
4	1, 16*, 27*, 25*	26	19, 2, 8	16	24

* Significant QTL (p<0.01)

Effect of diet on some sperm biochemical parameters in hatchery reared cod (*Gadus morhua*) broodstock

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Despite the fact that a number of studies have demonstrated that reproductive performance is influenced by nutrients, broodstock nutrition remains poorly understood. A study aimed at determining the influence of diet on spawning and growth of first generation (F1) cod broodstock was initiated in 2008 by testing three diets on farmed broodstock hatched in 2006. One group was fed a commercial on-growing pellet, the second group a commercial pellet formulated for marine finfish broodstock (not currently available in Canada), and the third a diet of baitfish supplemented with vitamins. Results show that fish fed baitfish have better growth and condition factor than fish fed pelleted diets. A quick ranking of sperm motility (at two spawning seasons) revealed higher ranks in both broodstock pellet and baitfish fed males. To further explore differences in sperm quality, energy levels (ATP), respiration, cell counts, as well as enzymatic activities (lactate dehydrogenase, lipase, citrate synthase, catalase) were measured in sperm samples from males fed the three diets. Results reveal statistically higher values of proteins and lipase activity in baitfish fed males when compared to males fed on-growing pellets. Despite the fact that some of the differences are not statistically significant a trend can also be seen with higher citrate synthase, catalase, respiration, as well as cell numbers in the sperm of the males fed the baitfish. Our results confirm the influence of diets on the reproductive performance of broodstock and that the baitfish diet appears to result in superior outcomes.

Measurement of mechanical properties, metals and amino acid composition of *Mytilus edulis* byssal threads in relation to reproduction

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The Canadian mussel industry, using suspended long line culture, suffers from mussels falloff related to weakness of byssus strength, especially in spawning season (summer). In this study, we are interested in evaluating the effect of spawning in controlled laboratory conditions on the strength of byssal attachment in relation to metals and amino acid composition of byssus. Forty mussels were sampled from a mussels culture site from Magdalen Islands and conditioned for spawning in laboratory conditions at the Pointe-aux-Pères aquaculture station. Spawning was induced on half batch by thermal shock. Byssal threads production of each mussel was counted and distal parts were collected every other day for six days to study the mechanical properties, metals and amino acid composition of filaments (distal section) before and after spawning. The diameter of each filament was measured before investigation of the elastic behaviour using a dynamic mechanical thermal analyser to examine the elastic modulus, the stress and strain at break. Metals composition was determined by ICP *mass spectrometry* after acid dissolution of byssal threads. Finally, amino acid composition will be determined by mass spectrometry.

Seasonal variations of *Mytilus edulis*'s immunity in harvest areas/ étude des variations saisonnières de l'immunité de la moule bleue *Mytilus edulis* en région conchylicole

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Mussel cultivation is an important industry in eastern Canada. High concentration of bivalves in growing areas implies greater risk of pathogen contamination. As filter feeders, mussels may also concentrate microbes originating from numerous sources of the coastal environment including surface run-off, human/animal waste and wastewater outfalls. Fluctuations in the Canadian climate as well as energy spending all along the reproductive cycle of mussels might influence their immune capacity. This study aims greater comprehension of blue mussel's immune system (cellular and humoral immunity) throughout the year to detect and understand health problems that could arise from an alteration of mussel immunocompetency. This research is currently still in progress. The results obtained in October indicate that stimulation of cellular immunity is effective: 62,8% of the hemocytes have a good phagocytic capacity and their production of reactive oxygen species (to kill engulfed bacteria) was significantly stimulated by Zymosan, LPS and beta-glucans. Cellular immunity of the mussels is therefore capable to respond to various stimuli in autumn. Humoral immunity of mussels sampled in October and all results obtained with mussel sampled in February 2011 are still being examined. February findings will be compared to those from October on our poster.

Effect of salinity on survival and cortisol levels in fingerling grass carp (*Ctenopharyngodon idella*)

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Survival and physiological changes in cortisol levels were studied in fingerling grass carp (*Ctenopharyngodon idella*). Grass carp provided by Shahid Maleki Warm Water Fish Culture Organization in Ahvaz (Iran) were maintained in circular tank (2 m³). They were fed twice daily with a 3% body weight (bw) ration (Wang *et al.*, 1989) of powder feed (Beta). Animals were acclimated to these conditions for at least 30 days prior to the experimental use (Luz *et al.*, 2008). For this reason treatment with salinity (3, 6, 9, 12ppt) and fresh water for control were made. Then grass carp with initial weight and length (13.55±0.726 g, 11.04±0.093 cm) were placed in 250 l-circular tank (15 fish/tank) at 24.16±1.35 °C for 21 days by randomized design. At the end of experiment we founds that salinities up to and including 3‰ did not affect survival and physiological changes in cortisol levels (P>0.05). Higher salinities (6 and 9ppt) produced significant increases in circulating cortisol and adverse effects on survival. In 12‰ all fishes died prior to 14 days. Trial results indicate that grass carp is a freshwater stenohaline fish exhibits no signs of stress in saline waters up to 3‰ salinity.

Expression de gènes reliés à la croissance et au métabolisme lipidique en période de métamorphose chez la plie rouge

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La métamorphose est une étape critique en production des poissons marins et c'est la période où les mortalités sont les plus importantes. La teneur en acides gras polyinsaturés (HUFA) s'avère avoir des effets majeurs sur le développement de la pigmentation des poissons plats. L'objectif de cette étude était de mieux comprendre les processus géniques activés en période de métamorphose et leur lien avec la teneur en HUFA du régime. Des larves de plies rouges ont été nourries à l'aide de rotifères enrichis avec trois régimes de microalgues choisis de façon à modifier leur apport alimentaire en HUFA: 1) un régime à base de *Nannochloropsis oculata*, riche en acide eicosapentanoïque (EPA) et acide arachidonique (AA); 2) un régime à base de *Isochrysis galbana*, riche en acide docosahexanoïque (DHA); 3) un mélange de *Isochrysis galbana*, *Nannochloropsis oculata* et *Pavlova lutheri*, riche en EPA. Des échantillonnages ont eu lieu à la déposition, 15 jours et 30 jours après le début de leur vie benthique. Pour cette présentation, l'accent sera mis sur les résultats obtenus avec les gènes reliés à la régulation de la croissance (hormone de croissance) et du métabolisme lipidique (lipase triacylglycerol, lipase carboxyle ester).

Taux de recapture optimal pour assurer une viabilité de la production de larves de homard américain (*Homarus americanus*) en éclosérie aux fins d'ensemencement pour soutenir une pêche durable dans la Baie des Chaleurs

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En 2009, les débarquements gaspésiens de homards ont subi une baisse comparativement aux années précédentes. Un projet pilote sur l'élevage de larves de homard américain (*homarus americanus*) a été mis sur pied au Centre Aquacole Marin de Grande-Rivière pour une durée de trois ans. L'objectif principal vise à augmenter le volume de production de 20 000 larves en 2010 jusqu'à 100 000 larves en 2012. La méthode d'élevage employée privilégie la culture en eau verte, basée sur un mélange d'artémies et de deux souches phytoplanctoniques (*Chaetoceros gracilis* et *Isochrysis galbana*). Le taux de survie moyen obtenu en 2010 est de 40%, pour un élevage qui prend fin au stade IV. Les investissements initiaux, les coûts variables et fixes de production ont été intégrés à une analyse technico-financière pour évaluer la rentabilité économique du projet sur 20 ans. En 2010, un coût unitaire larvaire de 2,69 \$ a été calculé et est évalué à la baisse pour les années subséquentes suite aux économies d'échelle (0,77 \$ en 2012). Les conditions d'élevage actuelles exigent un taux de recapture de 15,5% pour permettre la viabilité du projet. Lors des prochaines années, une production en continu sera préconisée et permettra de diminuer les coûts de production.

Evaluation of the stress response of the wolffishes (*Anarhichas minor*, *A. lupus* and reciprocal hybrids): acoustic and handling stress

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Spotted and Atlantic wolffish are both known to be promising species for coldwater aquaculture in the East of Canada. This study proposes to compare the stress response of the parental species (*A. minor* and *A. lupus*) and their reciprocal hybrids in presence of an acute and a chronic stress. Based on observation in aquaculture settings, *A. minor* seems to be less agitated and less aggressive than *A. lupus* (e.g disturbances near the tanks, grading and handling procedures) which makes *A. minor* a priori a more suitable species to farming. In addition, from conservation point of view *A. minor* is considered a “Threatened Species” and *A. lupus* a “Species of Concern” in Canada. In order to prevent these species from more threats, and knowing that stress response may lead to population decrease, the collected information in the present study could help design strategies to reduce anthropogenic stressor affecting wolffish such as chronic noise levels due to maritime traffic or gas exploration. Cortisol, glucose and other blood parameters of interest will be measured. The potential differences in the stress response between the two species and the hybrids will be discussed.

Utilisation d’extraits de plantes, un avenue envisageable dans la prévention et le traitement de la saprolegniose chez les alevins de truite arc-en-ciel

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Saprolegnia parasitica est un oomycète, aussi appelé moisissure aquatique (water mold). C’est un parasite opportuniste qui attaque les salmonidés en aquaculture. Cet agent pathogène était jusqu’à récemment contrôlé avec le vert de malachite, mais ce produit a été banni d’utilisation en aquaculture parce qu’il est potentiellement cancérigène. L’industrie est donc à la recherche d’un anti-oomycète de remplacement. Notre hypothèse est qu’il existe un composé extrait d’une plante de la forêt boréale peut efficacement traiter ou prévenir la saprolegniose. Nous avons ciblé des extraits qui inhibent la croissance de *Saprolegnia parasitica* in-vitro. Par contre, jusqu’à présent tous les extraits actifs contre saprolegnia sont aussi toxiques pour les alevins de truites arc-en-ciel. Toutefois, l’ajout de ces extraits à la moulée d’alevin ne semble pas toxique et pourrait être un outil de prévention de la saprolegniose.

Strategies to prevent off-flavours in fish raised in closed-circuit aquaculture systems

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One major problem in the development of RAS is the presence of “earthy” and “muddy” off-flavours in the fish flesh. The off-flavours come from the absorption by a fish of substances including geosmin and 2-methylisoborneol (MIB) which are produced by cyanobacteria and actinomycetes. The presence of undesirable odours or tastes in fish may cause a major reduction in the consumption of the products, or make them unsuitable for sale. The presence of off-flavours therefore represents a major hurdle for the wide-scale adoption of RAS technologies as a production technique. This research proposal aims to develop strategies to prevent or limit the development of microorganisms involved in the production of off-flavour substances in RAS. The present experiment is to evaluate the influence of the solids in suspension on the appearance of off-flavours. Two types of diets were used: one that is known to produce friable feces (Martin High Energy) and the other that is known to produce compact feces (Skretting), thereby a lower level of solids in suspension. The present results show lower levels of solids in suspension and a lower concentration of geosmin in fish filets in the unit that used Skretting diet.

Determination of optimal protein and lipid levels in American lobster (*Homarus americanus*) larvae nutrition

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Until recently, the rearing of American lobster larvae relied greatly on live *Artemia*. The maintenance of this live food is expensive, time-consuming, and depends on well-trained personnel, all factors limiting the commercial production of lobster larvae. Several replacement diets have been tested in different laboratories around the world, all with mixed successes. The objective of this project was to produce a diet for American lobster larvae specifically designed to meet their nutritional requirements. The first stage of this project was to establish the optimal protein and lipid levels in the diet. A full factorial design experiment has been tested: three levels of proteins (35, 45 et 55%) and two levels of lipids (7 and 13%). A seventh diet, based on frozen *Artemia*, was also included in the design, serving as a control. All diets were tested in triplicate. At the beginning of the experiment, three pools of approximately 50 larvae were sampled for biochemical analyses. Thereafter, 600 stage I larvae were added in 40-L tanks for each experimental diets and hand-fed three times per day until all larvae reached stage IV. We will present the results of survival, growth and proximate analyses on larvae fed the experimental diets.

Effects of dietary biotin restriction on growth, deficiency syndrome and biotin dependent hepatic gene expression of juvenile tilapia *Oreochromis niloticus*

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Dietary biotin deficiency results in metabolic malfunctions leading to reduce growth rate, and increased mortality in fish. Information on the biotin deficiency for tilapia (*Oreochromis niloticus*) is lacking. This study was undertaken to determine whether biotin is required for growth and characterized biotin deficiency syndromes in tilapia. Growth was significantly higher in fish that received the biotin supplemented diet, compared to diets lacking biotin or supplemented with avidin, suggesting that tilapia require dietary biotin. Tilapia fed higher degree of biotin deficient diets had more significant growth depression and produced severe biotin-specific deficiency syndromes such as lethargy, convulsions and ultimately led to death. Hepatic gene expression of carboxylases and biotinidase had a tendency to increase with incremental avidin supplementation, suggesting a possible increase in biotin recycling in response to severe biotin-deficiency. Intestinal synthesis may also be a significant source of biotin in tilapia, particularly when fed deficient diets.

Pilot-scale cultivation of spotted wolffish (*Anarhichas minor*): a progress update on growth performances including family and strain comparisons

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A pilot-scale growth trial featuring the spotted wolffish (*Anarhichas minor*) is currently being run by the UQAR at the facilities of the Maurice-Lamontagne Institute (Fisheries and Oceans) in collaboration with ACRDP, SODIM, MAPAQ, and MDEIE. Spotted wolffish is a cold-adapted marine fish species identified as a promising candidate for aquaculture diversification in extreme environments. Research efforts have been conducted in Québec since 1999 and the next crucial step is to demonstrate that it is an economically interesting species and worthy of further development. The objective of this project is to apply ‘state of the art’ rearing practices in order to reach best possible growth rate of spotted wolffish. Two groups of mixed families (n=26) of spotted wolffish were produced from captive broodstock of wild and domesticated origins and transferred at IML. Each fish was individually tagged and genetic analyses performed using seven microsatellite loci in order to identify best performing families. After approximately 1.5 year, fish of the first and second group reached 612.87 g and 571.06 g at 749 and 663 days post-hatching, respectively. The outcomes of this project will provide crucial production data including growth rate of wolffish originating from Canadian population and thus enable the production of a clearer bio-economic evaluation of wolffish cultivation.

Metal content and isotopic enrichment of the byssus of the blue mussel, *Mytilus edulis*

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To prevent dislodgment by tide and waves, mussels anchor to solid substrates using high-performance fibres known as byssal threads. These fibres show remarkable resistance and extensibility. They are made of collagen-based domains which connection is mainly ensured by cross-linking of flanking histidine-rich blocks with metal ions, mainly Fe⁺³. To better understand the structure of the byssus, we have first determined the metal content of byssal threads from the blue mussel *Mytilus edulis* by ICP-MS. Our results show that iron, aluminum and boron are abundant in the byssus while their concentration is below 1 ppm in the molluscs' mantle or gills. This indicates that these trivalent metal ions could be used as cross-linking ions in the fibres. The byssus molecular structure can be studied by ¹³C solid-state nuclear magnetic resonance (SS-NMR) spectroscopy. To do so, the byssus must be enriched to allow two-dimensional experiments. Thus, a protocol for ¹³C assimilation by the blue mussel using ¹³C-enriched *Chlorella* algae was established. The concentration of food and time of exposure has been optimised through monitoring of the extent of labelling by LC-MS measurements. The obtained labelling allowed two-dimensional experiments to be carried out, enabling the structural analysis of the mussel byssus.

Effects of broodstock diet on egg lipid content in farmed Atlantic cod (*Gadus morhua*) broodstock

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A study aimed at determining the influence of diet on spawning and growth of first generation (F1) cod broodstock was initiated in 2008 by testing three diets on farmed broodstock hatched in 2006. One group was fed a commercial on-growing pellet, the second group a commercial pellet formulated for marine finfish broodstock (not currently available in Canada), and the third a diet of baitfish supplemented with vitamins. Egg samples were taken from the female broodstock during the third spawning season and the lipids were extracted into a 2:1 chloroform-methanol solution. The lipid extracts were separated into 9 lipid classes: Hydrocarbons (HC), Steryl Esters (SE), Ketones (KET), Triacylglycerols (TAG), Alcohols (ALC), Free Fatty Acids (FFA), Sterols (ST), Acetone Mobile Polar Lipids (AMPL), as well as Phospholipids (PL) and analyses are being completed using an Iatroscan Mark V TLC/FID analyzer. Our results appear to yield smaller amounts of lipids than what has been described by previous authors on wild experienced cod spawners. This might be due to the fact that the broodstock used in this study are young spawners of farmed origin. Preliminary results suggest that the eggs obtained from the females fed the commercial on-growing diet have higher amounts of phospholipids but analyses are being completed to confirm this fact. Further analyses of the pellets and the baitfish are also being completed.

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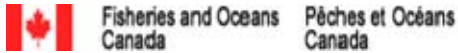
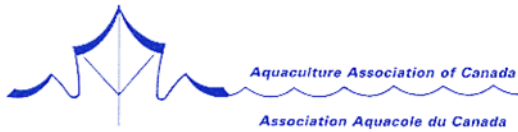
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