Aquaculture: Meeting the Challenges

L'aquaculture: Réalisons les Défis

Program Guide / Guide de programme

Aquaculture Canada[om] 2009

Nanaimo, British Columbia, 10-13 May 2009
Nanaimo, Colombie-Britannique, 10-13 mai 2009

Courtesy of the AC'09 Student Affairs Committee . . .

Joe Brown Student BBQ and Silent Auction

- ***WHERE:*** **Dinghy Dock Pub, Nanaimo (Protection Island)**
- ***WHEN:*** **May 11th, 2009 at 6:00 p.m.**
- ***Ticket Price:*** **$30, includes ferry to pub (Get them while they're still available!)**

Come and make a bid on items donated in aid to raise money for the Aquaculture Association of Canada Student Endowment Fund

SEE YOU THERE!

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Aquaculture Canada[OM]2009

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Vancouver Island University, Sturgeon Centre
Joy Wade

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

It is my pleasure to welcome everyone to the 26th Annual Meeting of the Aquaculture Association of Canada – *Aquaculture Canada*^{OM} *2009* – in the beautiful coastal community of Nanaimo, British Columbia. Our organizing and program committees have developed another great forum for industry and researchers to advance the business, science and technology of Canadian aquaculture. The theme of this year's meeting "*Aquaculture: Meeting the Challenges*" highlights our determination to address current issues facing our industry with topics in special sessions and plenary talks ranging from certification, fish welfare, genomics, and opportunities for First Nations to environmental and social stewardship. Be prepared for a stimulating scientific agenda, interesting tours to experience the BC industry at its finest and, as always, fun and entertaining social events. Our co-hosts this year are the Canadian Aquaculture Industry Alliance, Aboriginal Aquaculture Association, BC Salmon Farmers Association, and BC Shellfish Growers Association.

I would like to take this opportunity to thank, on behalf of all of us, the many people that have worked hard to pull off this conference, especially Joanne Burry (Conference Coordinator), Chris Pearce (Program Chair), and of course our sponsors, many of whom have reliably supported us over the years. Enjoy!

Debbie Martin-Robichaud
AAC President

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 09 here in beautiful British Columbia.

The selection of this year's conference theme, *Aquaculture: Meeting the Challenges* is reflective of what this industry is all about. Like other food producing industries, aquaculture is faced with ongoing challenges – but what is unique about aquaculture is how we meet those challenges. It is my experience that this industry doesn't give up but looks for innovative and creative ways of approaching a challenge. Here are just a few examples:

To meet the challenge of social acceptance, aquaculture needs community roots, in addition to corporate ones. On both coasts, the industry is now actively engaging at the community level and forming partnerships with a variety of stakeholders, including First Nations. To meet the challenge of demonstrating our sustainable practices in the marketplace, Canadian shellfish and finfish companies have either achieved certification – or they are exploring their options for certification. To meet the challenge of rising costs of production, the industry is investing in technologies that will continue to bring nutritious and affordable famed seafood to the table. Through innovation, diversification and improved communication – this industry is truly "meeting the challenges"

Since 1984, the annual conference of the Aquaculture Association of Canada has served as an effective forum for the exchange of the most up to date information on the business, science and technology of Canadian aquaculture. Once again, this year's AAC conference promises to encourage a cooperative exchange of knowledge between representatives of a wide range of important stakeholder groups. By facilitating this cooperative knowledge exchange, AAC continues to play a key role in bringing forward new information that will allow this industry to maintain a leadership role as a top quality food producing industry in Canada.

The CAIA Board of Directors congratulates AAC for another job well done and wishes everyone in attendance a productive and successful conference.

Ruth Salmon, Executive Director, Canadian Aquaculture Industry Alliance

British Columbia Salmon Farmers Association
Welcome to Delegates / Mot de bienvenue aux délégués

MESSAGE FROM THE EXECUTIVE DIRECTOR OF THE BC SALMON FARMERS ASSOCIATION, MARY ELLEN WALLING

BC Salmon Farmers would like to extend a warm welcome to presenters and attendees of Aquaculture Canada 2009!

The BC Salmon Farmers Association celebrates its 25th anniversary this year. From our pioneering roots, we have grown into a successful industry that in 2008 produced almost 80,000 metric tones of fresh farmed salmon, employed over 6000 men and women across the sector and are valued at over $900 million to BC's economy (PriceWaterhouseCoopers report 2008).

BC salmon farming's tradition of continuous change, growth and innovation is paralleled throughout the Canadian aquaculture industry. As such, the chance for farmers, academics, government and community to get together, share and explore current knowledge and future opportunities is essential. This year's program, "Aquaculture: Meeting the Challenges", is particularly focused on addressing not just where we are right now, but at looking at those ideas and technologies that will ensure we are poised for the future.

Looking at the session topics, there are undercurrents of those issues relevant to a sustainable industry: certification, social and environmental perspectives, research and new technologies. Aquaculture is a business, but our ability to go beyond basic economics and to meaningfully communicate the good work we do in social/community involvement and environmental responsibility will be the foundation for a strong, healthy and vibrant future.

Let's listen to and learn from each other at Aquaculture Canada 2009 and become global leaders in aquaculture!

Mary Ellen Walling, Executive Director
BC Salmon Farmers Association
May 2009

British Columbia Shellfish Growers Association
Welcome to Delegates / Mot de bienvenue aux délégués

BC Shellfish Growers Association
Unit F 2002 Comox Avenue, Comox BC, V9M 3M6 T: (250) 890-7561 F: (250) 890-7563 www.bcsga.ca info@bcsga.ca

MESSAGE FROM THE EXECUTIVE DIRECTOR OF THE BC SHELLFISH GROWERS ASSOCIATION, ROBERTA STEVENSON

Dear Attendees:

On behalf of the Board of Directors and staff of the BCSGA, I welcome you to the 2009 Aquaculture Canada conference.

It is my pleasure to acknowledge the accomplishments of the Canadian Aquaculture industry. The issues and accomplishments of the industry vary from Province to Province, but united we stand tall in our efforts to be a leading world force in research, innovation and commerce. Our potential is unlimited, and our hurdles are being removed block by block.

B.C.'s shellfish aquaculture industry is thriving and there is unprecedented demand for our products. The shellfish farmers want adequate returns on their labour and investment. The Aquaculture Canada Conference can facilitate opportunities to support this goal.

We welcome you all to British Columbia where we think we live and work in "the best place on earth"!

Sincerely,

Roberta Stevenson, Executive Director
British Columbia Shellfish Growers Association

BRITISH COLUMBIA
The Best Place on Earth

May 10 – 13, 2009

A Message from the Premier

On behalf of the Province of British Columbia, I am pleased to join in welcoming everyone attending the Aquaculture Canada 2009 Conference. I would like to add a special welcome to all those who travelled from within and from outside our province to be here.

The aquaculture industry is especially important to the economic viability of many of British Columbia's smaller coastal communities and Government is committed to the responsible management and development of aquaculture in our province.

A lot of work has gone into the planning of your event and I would like to thank all those who have worked so hard in organizing the program and coordinating the details. I would also like to thank the volunteers for their time and effort to make this event as successful as possible.

As Premier, I am delighted that you have chosen the beautiful City of Nanaimo for your conference. I encourage you to enjoy some of the stunning scenery and warm hospitality that this area has to offer during your stay with us. I want to assure you that our province is proud to be hosting you.

Please accept my very best wishes for a most successful and informative Conference.

Sincerely,

Gordon Campbell
Premier

Province of British Columbia
Office of the Premier
www.gov.bc.ca

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Victoria BC
V8W 9E1

A MESSAGE FROM CANADA'S MINISTER OF FISHERIES AND OCEANS

As Canada's Minister of Fisheries and Oceans, it is a great pleasure to welcome you to the Aquaculture Association of Canada's 26th annual meeting. Yours is an important organization that provides a forum to unite the voices of research and industry. I applaud you for your important role.

As Minister, I lead a department committed to helping Canada's aquaculture industry continue to be an economic driver in this country, particularly in rural and coastal communities.

In these times of global economic uncertainty, your industry continues to offer new opportunities for Canadians. Aquaculture production has more than doubled in our country since 1996 and its value has almost tripled to close to $1 billion a year. Providing vital job opportunities to coastal Canadians and contributing to the world food supply, the aquaculture sector is tremendously important to both the economic well-being of Canada and our world economy.

This year's theme, *Meeting the Challenges*, was aptly chosen. The aquaculture industry faces many challenges, ranging from certification and invasive species to social licence and sea lice. My department has always been a lead partner in helping to address many of these challenges. We will continue to play a lead role in helping to address key questions arising from these challenges. Working with industry, we will seek solutions to make the Canadian aquaculture industry more competitive in the global marketplace.

We will also continue to invest in aquaculture innovation and improve the predictability of regulations so that industry has more certainty about the rules. Our goal is to create conditions for the industry to become more successful and competitive.

Our government is proud of your industry and we are proud to support it. We will continue to work with industry, the provinces and territories, First Nations, the scientific community and other stakeholders to help further develop a sustainable aquaculture industry in Canada.

Collaboration is essential to our success. In partnership, we will rise to the challenges before us to help our country's aquaculture sector reach its fullest potential.

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

MESSAGE DU MINISTRE DES PÊCHES ET DES OCÉANS DU CANADA

À titre de ministre des Pêches et des Océans du Canada, j'ai l'immense plaisir de vous souhaiter la bienvenue à la 26e réunion annuelle de l'Association aquacole du Canada, une organisation importante qui offre une tribune pour unir les voix de la recherche et de l'industrie. Bravo pour le rôle important que vous jouez!

Le ministère que je dirige est déterminé à aider l'industrie aquacole du Canada à demeurer un moteur économique dans notre pays, notamment dans les collectivités rurales et côtières.

En ces temps incertains pour l'économie mondiale, votre industrie continue d'offrir de nouvelles possibilités pour les Canadiens. La production aquacole a plus que doublé dans notre pays depuis 1996 et son chiffre d'affaires annuel – près d'un milliard de dollars – a presque triplé. Le secteur de l'aquaculture, qui fournit des occasions d'emploi essentielles aux Canadiens vivant dans les collectivités côtières et qui contribue à l'approvisionnement mondial en nourriture, est extrêmement important pour le bien-être économique du Canada et pour l'économie mondiale.

Le thème de cette année – *Relever les défis* – est tout à fait indiqué. L'industrie aquacole est aux prises avec de nombreuses difficultés, allant de la certification aux espèces envahissantes, en passant par les permis sociaux et le pou du poisson. Mon ministère a toujours agi comme un partenaire de premier plan en aidant à surmonter bon nombre de ces défis. Nous continuerons de jouer un rôle décisif en contribuant à régler les principales questions relevant de ces défis. De concert avec l'industrie, nous chercherons des solutions pour améliorer la compétitivité de l'industrie aquacole canadienne sur le marché mondial.

Nous continuerons d'investir dans l'innovation en aquaculture et d'améliorer la prévisibilité des règlements pour que l'industrie acquière une plus grande certitude à ce chapitre. Notre but est de créer des conditions propices à la prospérité et à la compétitivité de l'industrie.

Notre gouvernement est fier de votre industrie et fier de la soutenir. En collaboration avec l'industrie, les provinces et les territoires, les Premières nations, la communauté scientifique et d'autres intervenants, nous continuerons de développer une industrie aquacole encore plus durable au Canada.

La collaboration est essentielle à notre réussite. Grâce au partenariat, nous réussirons à relever les défis qui se posent devant nous pour aider le secteur aquacole de notre pays à réaliser son plein potentiel.

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

May/2009

MESSAGE FROM THE MAYOR, CITY OF NANAIMO, BC

Welcome:

On behalf of the citizens of Nanaimo and City Council, I would like to thank you for selecting our City as the site for the 26th Annual Meeting of the Aquaculture Association of Canada to be held at the Coast Bastion Hotel on May 10-13, 2009.

It gives me great pleasure to extend a warm welcome to everyone attending this year's conference. A special note of thanks is extended to the many individuals who have worked hard in organizing this year's event. Your enthusiastic support and your efforts are greatly appreciated.

In Nanaimo, business mixes with pleasure. Just steps away from the Coast Bastion Hotel is the 5-kilometre Harbourside Walkway, the Nanaimo Boat Basin, quaint downtown shops and boutiques, hotels, cafes and art galleries. There is so much to see and do in Nanaimo.

Please accept my best wishes for a successful and enjoyable conference. While your stay with us will be brief, I trust it will be enjoyable. I invite you to visit us again in the foreseeable future when you can enjoy the full extent of our hospitality and the many points of interest that our beautiful city has to offer.

Yours truly

John Ruttan
M A Y O R

VANCOUVER ISLAND
UNIVERSITY
Office of the President

May 2009

On behalf of the faculty and staff of Vancouver Island University, I would like to welcome all of the Aquaculture Association of Canada (AAC) delegates to Nanaimo. The theme for this year's conference "*Aquaculture: Meeting the Challenges*" could not be more appropriate in the contexts of the economy, of aquaculture development in BC, and of the evolution of Vancouver Island University.

Even before the recent global economic crisis, BC's coastal communities were being challenged by a series of downturns and restructurings in all traditional resource industries. Now many communities are experiencing very hard times and are seeking new ways to rebuild themselves. Aquaculture, in all of its diversity, offers an opportunity to our coastal peoples to generate careers, support social services, and maintain their communities for all generations. The challenges are many, but there are also many solutions as we will hear during this important conference.

The designation of Vancouver Island University, in the spring of 2008, as a special purpose university to focus on coastal communities and their resources was in part a recognition of our long standing role in both aquaculture and fisheries. VIU seeks collaborative partnerships with coastal and First Nations communities to develop sustainable coastal economies on many fronts, and we have developed a number of research centres to facilitate this process including the Centre of Shellfish Research, the Deep Bay Research Station, and the International Centre for Sturgeon Studies, all with strong ties to aquaculture. We co-host the Centre for Coastal health, and we have created the interdisciplinary Institute for Coastal Research to focus on the social-ecological discussions necessary to build the foundations of social license for this relatively new but important industry. We attend this conference with appreciation for the role of the AAC in this important Canadian endeavour, one of great significance to our coast, and we are honoured that you have come to Nanaimo.

I invite all delegates to visit VIU and explore opportunities for collaboration to strengthen sustainable aquaculture development, not only in BC, but across Canada.

Sincerely,

Ralph Nilson, Ph.D.
President & Vice-Chancellor

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VIU

Aquaculture Association of Canada – Research Award of Excellence

Tuesday, May 12 (mardi, 12 mai), 2009 11:20 AM – 12:20 PM

Room/Salon: Ballroom, Coast Bastion Inn
Chair: Debbie Martin-Robichaud

The 2009 Research Award of Excellence goes to Drs. Thierry Chopin and Shawn Robinson, in recognition of their contributions to taking the concept of Integrated Multi-Trophic Aquaculture (IMTA) from the 'proof stage' to the realm of commercial production with the help of their inter-disciplinary team and industry partners. They realized that most of the challenges that would accompany large-scale IMTA development could not be thoroughly anticipated or studied in the laboratory or with pilot-scale projects and, consequently, emphasized the need for scientific research and commercial IMTA to develop together. This is what is now occurring, and to date no 'deal breakers' for the adoption of commercial IMTA have been identified. Their IMTA research has truly been an aquaculture good news story, with few aquaculture research projects having generated such international interest in mainstream and environmental non governmental organization (ENGO) media, including a National Geographic documentary.

Dr. Chopin was born and educated in France, where he obtained his Doctorate from the University of Western Brittany in 1985. He moved to Canada in 1989 and is now a Professor of Marine Biology at the University of New Brunswick in Saint John. He is Past President of the Phycological Society of America (2004) and of the Aquaculture Association of Canada (2004-05), and current President of the International Seaweed Association (2007-10). Dr. Robinson was born in British Columbia and educated on both the east and west coasts, obtaining his PhD in 1988 at the University of British Columbia. He began his career with Fisheries and Oceans Canada as a research scientist at the Biological Station in St. Andrews, New Brunswick, in 1988. He is also a Past President of the Aquaculture Association of Canada (2002-03).

Dr. Chopin was originally an ecophysiologist and biochemist working on the relationship between nutrients (phosphorus and nitrogen) and the production of phycocolloids in seaweeds of commercial value, both in controlled culture conditions and natural beds. Dr. Robinson was an invertebrate ecologist interested in applying ecological principles to the harvest and culture of

commercial species (scallops, clams and sea urchins) so that more efficient and sustainable commercial practices could be developed. They became interested in aquaculture in the late 1990's when they realized that the significant amount of inorganic nutrients and organic particles generated by fed finfish (salmon) aquaculture could be used to enhance the cultivation of extractive species, such as seaweeds (kelps and dulse) and invertebrates (suspension feeders such as mussels, and deposit feeders such as sea urchins, sea cucumbers and polychaetes), through the development of IMTA systems.

In 2000, Drs. Chopin and Robinson assembled an inter-disciplinary team to investigate the different, complex and inter-related aspects of IMTA. This team included natural and socio-economic scientists and graduate students from the University of New Brunswick and the St. Andrews Biological Station, industrial partners (Heritage Salmon Ltd. and now Cooke Aquaculture Inc., Acadian Seaplants Limited and Ocean Nutrition Canada) and federal and provincial agencies (Fisheries and Oceans Canada, Canadian Food Inspection Agency, New Brunswick Agriculture, Fisheries and Aquaculture, Atlantic Canada Opportunities Agency (ACOA) and New Brunswick Innovation Foundation). They were funded from 2001 to 2006 by AquaNet, Canada's Network of Centres of Excellence for Aquaculture, which allowed them to make excellent progress in R&D due to the dedication of the team members and their inter-disciplinary approach. Since 2006, the project has expanded from R&D to C (commercialization) with the support of ACOA's Atlantic Innovation Fund and industrial partners Cooke Aquaculture Inc. and Acadian Seaplants Limited. In 2008, Drs. Chopin and Robinson, now recognized as world leaders in the development of IMTA, were among the key players in the creation of the Canadian IMTA Network (CIMTAN), which became a reality in 2009. This pan-Canadian academic/government/industry partnership will provide the inter-disciplinary R&D and the training of highly qualified personnel needed for the commercialization of IMTA in Canada, with a focus on 1) ecological design, ecosystem interactions and biomitigation efficiencies, 2) system innovation and engineering, 3) economic viability and societal acceptance, and 4) regulatory science.

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Le Prix d'Excellence en Recherche pour 2009 est attribué aux Drs. Thierry Chopin et Shawn Robinson en reconnaissance de leurs contributions pour avoir mené le concept d'Aquaculture Intégrée Multi-Trophique (AIMT) du stade de la démonstration jusqu'à l'orée de la production commerciale avec l'aide de leur équipe inter-disciplinaire et de leurs partenaires industriels. Ils ont compris que la plupart des défis accompagnant le développement à grande échelle de l'AIMT ne pourraient pas être totalement anticipés ou étudiés ni au laboratoire ni à l'échelle pilote et, en conséquence, ils ont toujours insisté pour que la recherche scientifique et l'AIMT au niveau commercial soient développées ensemble. C'est ce qui est en train de se passer et jusqu'à maintenant aucun frein à l'adoption de l'AIMT commerciale n'a été identifié. Leur recherche sur l'AIMT est vraiment une nouvelle positive pour l'aquaculture et peu de projets de recherche en aquaculture ont généré autant d'intérêt dans les médias, généralisés et des organisations non gouvernementales environnementalistes (ONGE), notamment un documentaire avec National Geographic.

Le Dr. Chopin est né et a fait ses études en France, ou il a obtenu en 1985 son Doctorat à l'Université de Bretagne Occidentale. Il s'est installé au Canada en 1989 et est actuellement Professeur de Biologie Marine à l'Université du Nouveau Brunswick à Saint John. Il a été Président de la Société Phycologique d'Amérique (2004) et de l'Association Aquacole du Canada (2004-05) et est l'actuel Président de l'Association Internationale des Algues (2007-10). Le Dr. Shawn Robinson est né en Colombie Britannique et a fait ses études aussi bien sur les côtes est et

ouest, obtenant son Doctorat en 1988 à l'Université de Colombie Britannique. Il a commencé sa carrière avec Pêches et Océans Canada comme chercheur à la Station Biologique de St. Andrews, Nouveau Brunswick, en 1988. Il est aussi Ancien Président de l'Association Aquacole du Canada (2002-03).

Le Dr. Chopin était à l'origine un écophysiologiste et biochimiste travaillant sur la relation entre sels nutritifs (le phosphore et l'azote) et la production des phycocolloïdes chez les algues à valeur commerciale, aussi bien en conditions de culture contrôlées que dans les champs naturels en mer. Le Dr. Robinson était un écologiste des invertébrés intéressé par l'application des principes écologiques à la pêche et la culture d'espèces commerciales (les pétoncles, palourdes et oursins) afin que des méthodes commerciales plus efficaces et durables soient développées. Ils se sont intéressés à l'aquaculture à la fin des années 90 quand ils ont réalisé que la quantité importante de sels nutritifs inorganiques et de particules organiques générée par l'aquaculture de nourrissage des poissons (le saumon) pouvait être utilisée pour accroître la culture d'espèces d'extraction, comme les algues (les laminaires et dulse) et les invertébrés (se nourrissant des particules en suspension comme les moules ou des particules sur le fond comme les oursins, les concombres de mer et les polychètes), par le développement de systèmes d'AIMT.

En 2000, les Drs. Chopin et Robinson ont mis en place une équipe inter-disciplinaire pour étudier les différents aspects, complexes et reliés, de l'AIMT. Cette équipe était composée de chercheurs des sciences naturelles et socio-économiques et d'étudiants en thèse de l'Université du Nouveau Brunswick et de la Station Biologique de St. Andrews, de partenaires industriels (Heritage Salmon Ltd. et maintenant Cooke Aquaculture Inc., Acadian Seaplants Limited et Ocean Nutrition Canada) et d'agences fédérales et provinciales (Pêches et Océans Canada, l'Agence Canadienne d'Inspection des Aliments, le Ministère de l'Agriculture, des Pêches et de l'Aquaculture du Nouveau Brunswick, l'Agence de Promotion Economique du Canada Atlantique (APECA) et la Fondation de l'Innovation du Nouveau Brunswick). Ils ont été supportés de 2001 à 2006 par AquaNet, le Réseau de Centres d'Excellence en Aquaculture du Canada, ce qui leur a permis de faire d'excellents progrès en R&D attribuables au dévouement des membres de l'équipe et à leur approche inter-disciplinaire. Depuis 2006, le projet s'est étendu de la R&D à la C (commercialisation) avec le soutien du Fonds d'Innovation de l'Atlantique de l'APECA et des partenaires industriels Cooke Aquaculture Inc. et Acadian Seaplants Limited. En 2008, les Drs. Chopin et Robinson, maintenant reconnus comme leaders internationaux dans le développement de l'AIMT, étaient parmi les principaux acteurs pour la création du Réseau Canadien de l'AIMT (RCAIMT), qui est devenu une réalité en 2009. Ce partenariat pan-canadien entre des institutions universitaires et gouvernementales et des partenaires industriels va mettre en place la R&D inter-disciplinaire et la formation de personnes hautement qualifiées nécessaires pour la commercialisation de l'AIMT au Canada en se concentrant sur 1) le design écologique, les interactions écosystèmiques et les rendements en biomitigation, 2) les innovations des systèmes et de l'ingénierie, 3) la viabilité économique et l'acceptation sociétale, et 4) la science en support des réglementations.

Registration and Information / Inscription et informations

Registration / Inscription
Registration is located in the main lobby of The Coast Bastion Inn and operates daily as follows:
L'inscription est dans le lobby principal, Coast Bastion Inn et les heures d'opération sont:

- Sunday May 10th (dimanche 10 mai): 3:00 PM – 6:00 PM
- Monday May 11th (lundi 11 mai): 7:30 AM – 5:00 PM
- Tuesday May 12th (mardi 12 mai): 8:00 AM – 5:00 PM
- Wednesday May 13th (mercredi 13 mai): 8:00 AM – 12:00 PM

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

Entrance to Sessions / Accès aux sessions
Entry to a session will not be permitted without your Aquaculture Canada 09 name tag.
Vous devez porter votre carte d'inscription pour avoir accès aux salles de conférence.

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

Posters – Main Lobby, Coast Bastion Inn: Set-up time is Sunday May 10th from 4:00 PM to 6:00 PM. Presenters are asked to be available at their poster during the Poster Session on Tuesday May 12th from 2:00 PM to 4:00 PM as well as during morning and afternoon breaks. Posters should be taken down by 6:00 PM on Tuesday May 12th.

Affiches – Le Lobby Principal, Coast Bastion Inn: Montage dimanche le 10 mai entre 16:00 et 18:00. Les présentateurs sont priés de se présenter dans le salon pour la session des affiches mardi 12 mai entre 14:00 et 16:00, et aussi durant les pauses-café. Les affiches doivent être enlever au délais le plus tard à 18:00 mardi le 12 mai.

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 are asked to submit their presentations to the Registration Desk no later than 5:00 PM the day before they are to be given to allow for mounting on laptops. Speakers and poster presenters are encouraged to submit extended abstracts by June 1, 2009 to ac09papers@hotmail.com, for publication of the proceedings in the AAC bulletin.

Conférenciers **:** Ceux qui font des présentations orales doivent rencontrer le modérateur de la session et le personnel qui s'occupe du service audiovisuel au moins 15 minutes avant le début de la session. Si il y des changements dans le programme, ils seront annoncés au début de la session et montés près de la salle au début de la journée. Les

conférenciers sont priés de soumettre leurs présentations avant 17:00 le jour avant d'être présenter pour qu'on les installe sur les ordinateurs. Les présentateurs d'affiches et de présentations orales sont encouragés à soumettre des résumés prolongés avant le 1 juin, 2009 à ac09papers@hotmail.com, pour le compte rendu dans le Bulletin de l'AAC.

Media Room / Salle de media
Douglas Room is available for media related activities.
Le salon Douglas sera disponible pour les médias.

Job Board / Annonces d'emploi et résumés
Notice boards are available for posting résumés and job notices near the registration desk.
Il y aura des tableaux disponibles pour les annonces près de l'inscription.

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

Refreshment breaks are / Pauses-santé:
Monday May 11th (lundi 11 mai): 10:00 AM – 10:20 AM and 3:40 PM – 4:00 PM
Tuesday May 12th (mardi 12 mai): 10:00 AM – 10:20 AM and 2:50 PM – 3:10 PM
Wednesday May 13th (mercredi 13 mai): 10:00 AM – 10:20 AM and 3:40 PM – 4:00 PM

Student Affairs and Events / Affaires étudiant(e)s

Student Awards: The AAC is pleased to have sponsored travel for over 12 students to attend the conference. 27 students will compete for Best Oral and Best Poster presentations.

Prix étudiant(e)s : L'AAC est fière d'avoir commanditer plus de 12 étudiant(e)s avec des bourses de voyage pour participer à la conférence. 27 présentations par étudiant(e)s seront faites pendant la conférence.

Joe Brown Student Endowment BBQ: The proceeds from the activities at the Joe Brown Student BBQ on Monday May 11th 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.

Barbecue Joe Brown pour le fond de support étudiant : Les profits des activités au barbecue aquacole lundi le 11 mai sont placés dans un fond de support en forme de bourses pour les étudiant(e)s. On encourage les étudiant(e)s de participer au barbecue.

AAC AGM and Luncheon / AGA de l'AAC et lunch d'affaires

This will take place in the Benson Room, 12:20 PM- 1:30 PM, Tuesday May 12th. All AAC members are encouraged to attend. Luncheon tickets are available at the Registration desk. There will be several door prizes awarded during the luncheon.

L'AGA de l'AAC se tiendra dans la salle Benson de 12:20-13:30, mardi le 12 mai. Les membres de l'AAC sont bienvenus de participer. Les billets pour le lunch d'affaires sont disponibles au bureau d'inscription. Il y aura plusieurs prix de distribuer pendant le lunch d'affaires.

Social Functions / Évènements Sociaux

We will once again be having a number of exciting social events featuring exceptional Canadian aquaculture products.

Il nous fait plaisir de vous offrir des évenements sociaux mettant en oeuvre nos produits canadiens aquacoles de qualité exceptionnelle.

President's Reception / Réception dela présidente
Sunday May 10th, Ballroom, Coast Bastion Inn, 7:00 PM-9:00 PM. Cash bar.
Dimanche 10 mai, Salle de Bal, Coast Bastion Inn, 19:00-21:00. Bar payant.

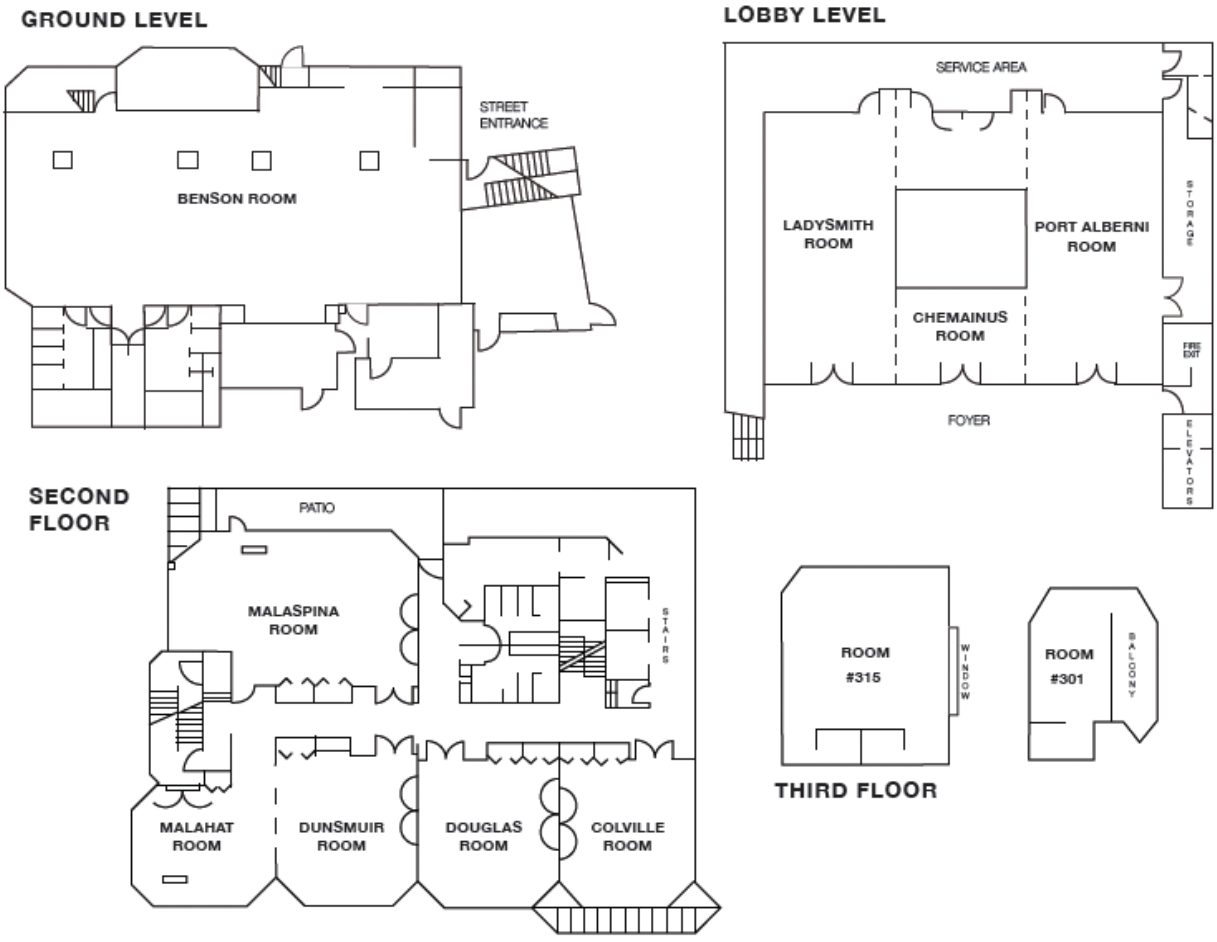
Joe Brown BBQ for Student Endowment / Barbecue aquacole Joe Brown pour fond des étudiant(e)s
Monday May 11th, Dinghy Dock Pub, 6:00 PM-11:00PM. Tickets required in advance (cover ferry cost to pub).
Lundi 11 mai, Dinghy Dock Pub, 18:00-23:00. Billets requis.

Banquet – Ballroom ABC, Coast Bastion Inn / Ballroom ABC, Coast Bastion Inn
Tuesday May 12th. Tickets required in advance (from Registration desk). 7:00 PM dinner and exceptional entertainment.

Mardi 12 mai. Billets requis à l'avance (du bureau d'inscription). Diner 19:00 et un spectacle très spécial.

Session Rooms / Salles de conférences

FLOOR PLAN



Program Outline / Sommaire du programme

DAY 1 – SUNDAY, MAY 10 JOUR 1 – DIMANCHE, 10 MAI

13:00 – 18:00	**Registration Open / Inscription ouverte**
16:00 – 18:00	**Poster Set Up / montage des affiches**
19:00 – 21:00	**President's Reception / Réception de la présidente Coast Bastion Inn Ballroom**

DAY 2 – MONDAY, MAY 11 JOUR 2 – LUNDI, 11 MAI

07:30 – 17:00	**Registration Open / Inscription ouverte**
10:00 – 16:00	**Poster Session / Affiches**
08:00 – 17:00	**Opening Session, Keynote Speaker, Technical Sessions / Allocutions d'ouverture, session plénière, sessions techniques**
12:20 – 14:00	**Lunch (on own) / lunch (à sois même)**
18:00 – 23:00	**Joe Brown BBQ in Support of AAC Students / Barbecue Joe Brown – Dinghy Dock Pub**

DAY 3 – TUESDAY, MAY 12 JOUR 3 – MARDI, 12 MAI

08:00 – 17:00	**Registration Open / Inscription ouverte**
10:00 – 16:00	**Poster Session / Affiches Authors in attendance 14:00 - 16:00 / Auteurs présents 14:00-16:00**
08:00 – 17:00	**Plenary Speaker, Technical Sessions / Session plénière, sessions techniques**
11:20 – 12:20	**Research Award of Excellence / Prix d'excellence en recherche**
12:20 – 13:30	**AAC AGM Luncheon (members only) / AGA et diner d'affaires AAC (membres seulement)**
18:30 – 22:00 (cash bar 18:30, dinner 19:00)	**Gala Dinner with Comedian Todd Butler, Coast Bastion Inn Ballroom / Gala avec comédien Todd Butler**

DAY 4 – WEDNESDAY, MAY 14 JOUR 4 – MERCREDI, 14 MAI

08:00 – 12:00	**Registration Open / Inscription ouverte**
08:00 – 17:00	**Plenary Speaker, Technical Sessions / Session plénière, sessions techniques**
12:40 – 14:00	**Lunch (on own) / lunch (à sois même)**
14:00 – 14:20	**Student Awards / Prix étudiants - Ballroom**

IMTA Tour A: departs 6:00 AM Saturday May 9th, returns 6:00 PM Sunday May 10th

IMTA Tour B: departs 6:00 AM Thursday May 14th, returns 6:00 PM Friday May 15th

Speakers Outline & Abbreviated Titles / Résumés des présentations

MONDAY, MAY 11, Morning **LUNDI 11 MAI, matin**

7:30 AM	**Registration Open (to 5:00 PM)**		
8:00 AM	**Opening Session - Ballroom** Debbie Martin-Robichaud (President, Aquaculture Association of Canada) Viola Wyse (Chief, Snuneymuxw First Nation) Ruth Salmon (Executive Director, Canadian Aquaculture Industry Alliance) Richard Harry (Executive Director, Aboriginal Aquaculture Association) Mary Ellen Walling (Executive Director, BC Salmon Farmers Association) Roberta Stevenson (Executive Director, BC Shellfish Growers Association) John Ruttan (Mayor, City of Nanaimo) Ralph Nilson (President, Vancouver Island University) Representative, Fisheries and Oceans Canada New AAC website announcement		
9:00 AM	**Conference Keynote: Dr. Barry Costa-Pierce** Aquaculture as Culture: Trajectories of Change in the Social Ecology of Aquatic Foods		
10:00 AM	**HEALTH BREAK / Poster Session (10:00 AM – 4:00 PM)**		
	Ballroom	**Malaspina**	**Dunsmuir/ Malahat**
	Canadian Freshwater Aquaculture - Research, Development, and Commercialization	**Integrated Multi-Trophic Aquaculture**	**Environmental Interactions: New Perspectives on Sea Lice**
10:20 AM	**Faille, A.** - Identification of novel anti-Saprolegnia molecules and efficacy validation in trout	**Cross, S.F.** - SEA-system (IMTA) development in the pacific region – from research to commercialization	**Boyce, B.** - Marine Harvest Canada: sea lice trends and mitigation
10:40 AM	**Couturier, M.F.** - Accurate sizing of drum filters for aquaculture applications	**Chopin, T.** - The inorganic extractive component of Integrated Multi-Trophic Aquaculture (IMTA) – moving along the R&D&C continuum	**Saksida, S.** - Sea lice on BC salmon farms: so what are they hiding?
11:00 AM	**Wetton, M.** - Effects of aquaculture organic waste loading on benthic invertebrates	**Blasco, N.** - Maintaining an inorganic extractive component within an IMTA system: kelp management strategies	**Jones, S.** - Mortality risk to pink salmon *Oncorhynchus gorbuscha* due to the salmon louse *Lepeophtheirus salmonis* in the Broughton Archipelago, British Columbia
11:20 AM	**Moccia, R.** - Development of a selection and breeding program for rainbow trout aquaculture in Canada	**Robinson, S.M.C.** - Spatial considerations in the re-utilization of organic matter of open water, Integrated Multi-Trophic Aquaculture (IMTA) with a focus on filter feeding shellfish such as the blue mussel, *Mytilus edulis*	**Stucchi, D.** - A coupled biophysical sea lice model for the Broughton Archipelago
11:40 PM	**Boucher, E.** - Scale-up of a method for phase-feeding of dietary phosphorus (P) in rainbow trout to reduce P discharges	**Mullen, A.J.** - Effects of Atlantic salmon farm organic enrichment within an Integrated Multi-Trophic Aquaculture system (IMTA) in the Bay of Fundy	**Sutherland, B.** - Transcriptomic responses of juvenile pink salmon (*Oncorhynchus gorbuscha*) following exposure to the salmon louse (*Lepeoptheirus salmonis*)
12:00 PM	**Schmitt, C.** - Freshwater hatchery management practices which could be incorporated to rebuild wild stocks of Chinook salmon	**Cross, S.F.** - The potential use of green sea urchins (*Strongylocentrotus droebachiensis*) as a biocontrol for fouling on aquaculture net pens in British Columbia	**Ikonomou, M.G.** - Environmental fate and potential biological effects of SLICE®. A laboratory and a field based study
12:20 PM	**LUNCH (ON OWN)**		

MONDAY, MAY 11, Afternoon **LUNDI 11 MAI, après-midi**

	Ballroom	Malaspina	Dunsmuir/ Malahat
	First Nations' Opportunities and Challenges in Aquaculture Development	**Integrated Multi-Trophic Aquaculture**	**Environmental Interactions: New Perspectives on Predator Protection / Closed Containment / Sustainable Feeds**
2:00 PM	**Williams, T.** - Journey to economic independence: BC First Nations' perspectives	**Hannah, L.C.** - The use of the sea cucumber *Parastichopus californicus* in integrated multi-trophic aquaculture in British Columbia	**Rundle, T.** - New perspectives on predator protection
2:20 PM	**Harry, R.** - Opportunities for First Nations in aquaculture	**Reid, G.K.** - Efficiencies of open-water Integrated Multi-Trophic Aquaculture (IMTA): progress, challenges and considerations	**Albright, L.J**. - The use of a solid-wall containment system for rearing salmonids in fresh and sea waters
2:40 PM	**Silver, J.J.** - Getting from a wild shellfish harvest to shellfish aquaculture: talking about what your community venture needs to succeed	**Chopin, T.** - Focus group study on the social acceptability of Integrated Multi-Trophic Aquaculture (IMTA) and attitudinal survey of consumer preferences for differentiated IMTA products	**West, G.** - Aquaculture – where we are now
3:00 PM	**Hardy, R.** - Overcoming adversities in the shellfish aquaculture industry	**Chopin, T.** - Improving the efficiencies of the Integrated Multi-Trophic Aquaculture (IMTA) components – environmental system performance and species interactions	**Ikonomou, M.G.** - Alternate diets for salmon aquaculture: factors affecting fatty acid and contaminant residue levels
3:20 PM	**Sewid, H.** - Developing a successful service business to the aquaculture industry – an opportunity for First Nations	**Cross, S.F.** - IMTA adaptive strategies – ecological design and system engineering	**Saha, J.K.** - Evaluation of mixed feeding schedule varied with dietary protein level on the growth performance and reduction of production cost for pangas and silver carp
3:40 PM	**HEALTH BREAK**		
4:00 PM	**Nelson, T.** - Value of aquaculture to First Nations and how to develop agreements with aquaculture companies that benefit First Nations	**Knowler, D.** - Economic analysis and social implications of IMTA – what do we need to know and how will it affect the success of IMTA?	
4:20 PM	**Panel Discussion:** Finding creative solutions for constraints to successful aquaculture	**Costa-Pierce, B.A.** - Comprehensive planning for sustainable fisheries must include aquaculture	
4:40 PM		**Panel Discussion**	
6:00 PM	**Joe Brown BBQ in Support of AAC Students at Dinghy Dock Pub 6:00 PM – 11:00 PM**		

TUESDAY, MAY 12, Morning **MARDI 12 MAI, matin**

8:00 AM	**Registration Open (to 5:00 PM)**		
	Ballroom	**Malaspina**	**Dunsmuir/ Malahat**
	Environmental Interactions: New Perspectives on Aquaculture Management and Monitoring	**Application of Genome Science to Sustainable Aquaculture**	**Alternative Shellfish Culture**
8:00 AM		**Hardy, R.W.** - Research thrusts in nutritional genomics of rainbow trout	**McGaw, I.J.** - Effects of environmental perturbations on feeding and digestion in decapod crustaceans
8:20 AM	**Backman, C.** - Operational decisions in response to a performance based regulation reduce organic waste impacts near Atlantic salmon farms in British Columbia, Canada	**Rise, M.L.** - Cod genomics project	**Redjah, I.** - A natural zooplankton based diet to increase survival and cryptic behaviour of American lobster (*Homarus americanus*) larvae
8:40 AM	**Taekema, B.** - Development of an underwater video protocol for environmental monitoring of hard seabed substrates as a regulatory tool for coastal finfish aquaculture, British Columbia, Canada	**Gurney-Smith, H.** - Development of a health assessment tool for marine mussels (Myt-OME)	**Whyte, G.** - A review of abalone hatchery techniques throughout the world, with a focus on Canada
9:00 AM	**Chang, B.D.** - Characterization of dissolved oxygen concentrations in the vicinity of salmon farms in southwestern New Brunswick, Bay of Fundy	**Koop, B.F.** - Developing genomic tools for characterizing genetic diversity and selection in sablefish	**Marshall, R.** - Testing green sea urchins' potential to control mussel fouling in shellfish aquaculture
9:20 AM	**Filgueira, R.** - Coupling biological, physical and chemical submodels to assess the carrying capacity of aquaculture sites	**McGowan, C.** - The application of salmonid genomic research in a mid-sized commercial broodstock facility: the Icy Waters arctic charr experience	**Azad, A.K.** - Larval development and survivorship of laboratory-reared purple sea urchins (*Strongylocentrotus purpuratus*): influence of stocking density
9:40 AM	**Hughes, S.** - Remote sensing techniques for aquaculture management and monitoring		**Pearce, C.M.** - Effect of temperature on gonad yield and gonad sensory attributes in the green sea urchin, *Strongylocentrotus droebachiensis*
10:00 AM	**HEALTH BREAK / Poster Session (10:00 AM – 4:00 PM, authors in attendance 2:00 PM – 4:00 PM)**		
	Ballroom	**Malaspina**	**Dunsmuir / Malahat**
10:20 AM	**Conference Plenary I: Mr. Tim Davies** Navigating Sustainable Development		
11:20 AM	**Research Award of Excellence: Dr. Thierry Chopin and Dr. Shawn Robinson**		
12:20 PM	**AAC AGM Luncheon (Members Only) - Benson Room**		

TUESDAY, MAY 12 Afternoon **MARDI 12 MAI, après-midi**

1:30 PM	**Ballroom**		
	Trevor Swerdfager The Canadian Aquaculture Sector: Overview and Market Context		
	Ballroom	**Malaspina**	**Dunsmuir/ Malahat**
	Aquaculture Innovation and Market Access Program (AIMAP) Update	**Fish Welfare and Fish Health**	**Alternative Shellfish Culture**
1:50 PM	**Struthers, A.** - The Aquaculture Innovation and Market Access Program: program update	**Saksida, S.** - Fish welfare: understanding the issues in farming fish	**Gurney-Smith, H.J.** - Cockles, the new frontier: past, present, and future research and applications
2:10 PM	**Johnson, G.** - Halibut PEI: the use of lobster pounds in the off-season for the land-based culture of halibut	**Braithwaite, V.A.** - Do fish have feelings – are they sentient and can they suffer?	**Marshall, R.** - The effects of temperature on broodstock conditioning of geoduck clams (*Panopea abrupta*)
2:30 PM	**Bridger, C.** - Innovative & sustainable technologies for Canadian finfish aquaculture operations: AEG solutions for an eco-friendly aquaculture future	**Griffin, G.** - Fish welfare and the Canadian Council on Animal Care	**Doiron, S.** - Evaluation of growth of oysters reared using glued and floating bag methods
2:50 PM	**Stechey, D.** - Manitoba - Canadian model aqua-farm initiative	**Kreiberg, H.** - Toward consistent good welfare in harvested farmed salmon: field trial of a Sotra Singelstunner™ electric stunner	**Stirling, D.** - Mechanized clam harvesting for coastal British Columbia – environmental implications
3:10 PM	**HEALTH BREAK**		
3:30 PM	**Nikleva, D.** - Red rock crab predator management techniques for intertidal shellfish culture	**Sacobie, C.F.D.** - Dietary energy requirements of triploid brook trout, *Salvelinus fontinalis*	**Cassis, D.** - Can manipulation of culture depth reduce summer mortalities in Pacific oyster seed?
3:50 PM	**Cross, S.F.** - The SEA-system infrastructure innovation project – modifying steel fish-cage systems to accommodate Integrated Multi-Trophic Aquaculture	**Verhille, C.E.** - Early screening of triploid salmonids for swimming endurance can improve overall stock performance	**Couturier, C.** - Does the presence of predators affect cultured shellfish performance?
4:10 PM	**Nicoll, R.S.** - Simulation-based design of shellfish cultivation rafts	**Moret, C.** - Phase II of the Fin-Immune™ trials: testing its efficacy against furunculosis in cultured rainbow trout, *Oncorhynchus mykiss*	**Werstink, G.** - Economic efficiency of soft shell clam aquaculture (*Mya arenaria*) in the Magdalen Islands
4:30 PM	**Powell, F.** - Newfoundland Atlantic cod farm demonstration project	**Araya, M.T.** - Morphological and molecular effects of *Vibrio splendidus* on hemocytes of soft-shell clam, *Mya arenaria*	**Askary Sary, A.** - Diet protein effect search and water with different salinity on hemolymph osmolality and hemolymph protein in Pacific white shrimp (*Litopenaeus vannamei*)
4:50 PM			**Das, S.R.** - Nursing of hatchery produced *Paneous monodon* PL in floating cages in coastal areas of Bangladesh
6:30 PM	**Pre-Dinner Cash Bar**		
7:00 PM	**Gala Dinner - Ballroom, Coast Bastion Inn**		

WEDNESDAY, MAY 13, Morning **MERCREDI 13 MAI, matin**

8:00 AM	**Registration Open (to 12:00 PM)**		
	Ballroom	**Malaspina**	**Dunsmuir/ Malahat**
	Ecosystem Approaches: Strategies and Tools	**Aquatic Invasive Species**	**Aquaculture Certification and Traceability: Global and Local Solutions**
8:00 AM	**Jones, H.** - A Scottish case study: the Tri-Partite Working Group	**Landry, T.** - Tunicate infestation on mussel farms in Prince Edward Island Canada: investigating management tools and approaches	**Rose, M.** - A review of critical components of aquaculture standards and certification in today's marketplace
8:20 AM	**Chamberlain, J.** - Defining an ecosystem-based approach to marine aquaculture	**Perry, G.** - The control and management of invasive colonial tunicates in Newfoundland in 2008 and 2009	**Rose, M.** - Feed food chain vulnerability to contamination through loss in traceability
8:40 AM	**McGreer, E.R.** - Important considerations in the selection of tools for implementing an ecosystem-based approach (EBA) to aquaculture	**Locke, A.** - Ecosystem consequences of vase tunicate (*Ciona intestinalis*) infestation in mussel-producing estuaries of Prince Edward Island	**Salmon, R.** - The Canadian Aquaculture Standards Forum & Canadian initiatives underway
9:00 AM	**O'Riordan, J. -** An ecosystem based approach to evaluating the effects of sea lice on wild salmon in the Broughton Archipelago, British Columbia	**Epelbaum, A.** - Environmental tolerances and predation susceptibility of non-native tunicates in British Columbia: implications for eradication and control	**Smith, J.** - Certification and DFO's Sustainable Aquaculture Program
9:20 AM	**Dudas, S.E.** - Shellfish aquaculture in an ecosystem context: bottom-up and top-down approaches and tools	**Gartner, H.** - Invasive tunicates in subtidal fouling communities of British Columbia	**Cross, S.F. -** The Aboriginal Certification of Environmental Sustainability (ACES) program - respecting First Nation traditional values in aquaculture
9:40 AM	**Cranford, P.J**. - Mussel aquaculture interactions with phytoplankton and potential indicators and thresholds for an ecosystem-based management approach	**Therriault, T.W.** - Biology and ecological impacts of the European green crab, *Carcinus maenas*, on the Pacific coast of Canada	**Panel Discussion**
10:00 AM	**HEALTH BREAK**		
	Ballroom		
10:20 AM	**Conference Plenary II: Dr. Richard Beamish** The Importance of Aquaculture and Hatcheries to Fisheries in British Columbia as our Climate Changes		
	Ballroom	**Malaspina**	**Dunsmuir/ Malahat**
	Ecosystem Approaches: Human Dimensions	**Shellfish Culture**	**Alternative Finfish Culture**
11:20 AM	**Bocking, S.** - Salmon aquaculture: understanding the science and politics of an environmental controversy	**Grant, J.** - Manipulation of productivity for mussel culture carrying capacity in a Norwegian fjord	**Maher, J.** - Histopathology among juvenile white sturgeon, *Acipenser transmontanus*, associated with exposure to varying concentrations of therapeutic formalin baths
11:40 AM	**Silver, J.J.** - Beyond the bottom line: striving for meaningful First Nations engagement with aquaculture	**Heath, W.A.** - Pre-culture benthic environmental conditions at the demonstration farm shellfish tenure of the Centre for Shellfish Research in Deep Bay, Baynes Sound, B.C.	**Henry, J.** - Development of white sturgeon (*Acipenser transmontanus*) culture in Canada

12:00 PM	**Thomson, I.** - Mining, aquaculture and the social license to operate	**Rayssac, N.** - Extrinsic biotic regulating factors of blue mussel *(Mytilus* sp.) recruitment on artificial collectors in two bays of the Gaspé Peninsula (eastern Canada)	**Feindel, N.** - Spawning capacity of triploid Atlantic cod males and the early life history performance of their offspring
12:20 PM	**Anderson, J.** - Hybrid aquaculture research: the case of Dedza, Malawi	**Switzer, S.** - The effects of seasonal variation and tray composition on invertebrate fouling communities	**Fraboulet, E.** - Effects of photoperiod and temperature on growth and body lipid composition of young juvenile winter flounder
12:40PM	**Flaherty, M.** - International perspectives on human dimensions	**Lunch (on own)**	
1:00PM	**Lunch (on own)**		

WEDNESDAY, MAY 13, Afternoon **MERCREDI 13 MAI, après-midi**

	Ballroom		
2:00 PM	**Student Awards**		
	Ballroom	**Malaspina**	**Dunsmuir/ Malahat**
	Ecosystem Approaches: Strategies, Tools and Techniques to Meet the Challenge of Sustainability	**Responding to the Challenges of Aquaculture Training Needs**	**Alternative Finfish Culture and Microalgal Culture**
2:20 PM	**Brannen, C.** - Aquaculture dialogues	**Beal, B.F.** - Public aquaculture in eastern Maine: creating new economic and educational opportunities through applied research & development	**Leadbeater, S.** - Initial nutritional study of shortnose sturgeon (Acipenser brevirostrum LeSueur): egg composition and protein to energy ratio requirement
2:40 PM	**DeJager, T.** - Trust and transparency: using the web to create community connection and collaboration	**Rideout, K.** - Meeting the training needs of a maturing industry; an East coast perspective	**Lush, L.** - Feeding F1 Atlantic cod broodstock…insights into the mystery
3:00 PM	**Cubitt, K.F.** - Current processes of community engagement in British Columbia: examples and merits	**Alward, N.** - Facing the challenges of aquaculture education	**Campbell, B.** - The aquaculture of sablefish, *Anoplopoma fimbria*
3:20 PM	**Sherrell, R.** - Life in a potential eco-system based decision making process …. a participants perspective	**McCarthy, A.** - The world is your oyster at VIU	**Ahmed, J.** - Survey of fisheries resources in some selected thanas under Feni district of Bangladesh
3:40 PM	**HEALTH BREAK**		
4:00 PM	**Panel Discussion**	**Richards, S.** - First Nations Youth Leadership Shellfish Program, FLOW - future leaders on the water	**Bujold, S.** - Microalgae for aquaculture: centralised supply vs on-site production
4:20 PM		**Macnaughton, A. -** Integrated clam fisheries and aquaculture for coastal community development in Northeastern Brazil – the value of local social and environmental capital	**Mehrannezhad, R.** - Purification of *Dunaliella salina* of Urmia Lake
4:40 PM			
5:00 PM			

Opening and Welcome / Allocution d'ouverture et de bienvenue
Monday May 11, 2009 – lundi 11 mai, 2009
8:00 AM – 9:00 AM
Room/Salon: Ballroom

Chair: Debbie Martin-Robichaud (President, Aquaculture Association of Canada)

Debbie Martin-Robichaud (President, Aquaculture Association of Canada)
Viola Wyse (Chief, Snuneymuxw First Nation)
Ruth Salmon (Executive Director, Canadian Aquaculture Industry Alliance)
Richard Harry (Executive Director, Aboriginal Aquaculture Association)
Mary Ellen Walling (Executive Director, BC Salmon Farmers Association)
Roberta Stevenson (Executive Director, BC Shellfish Growers Association)
John Ruttan (Mayor, City of Nanaimo)
Ralph Nilson (President, Vancouver Island University)
Representative, Fisheries and Oceans Canada
New AAC website announcement

Monday May 11, 2009 – lundi 11 mai, 2009
9:00 AM – 10:00 AM
Room/Salon: Ballroom

Chair: Debbie Martin-Robichaud (President, Aquaculture Association of Canada)

Keynote Speaker: Dr. Barry Costa-Pierce, Professor of Fisheries and Aquaculture and Director, Rhode Island Sea Grant College Program, University of Rhode Island

Presentation: Aquaculture as Culture: Trajectories of Change in the Social Ecology of Aquatic Foods

Biography: Barry Costa-Pierce is the Director of the Rhode Island Sea Grant College Program and Joint Professor of Fisheries and Oceanography at the University of Rhode Island (URI). He has a Ph.D. in Oceanography from the University of Hawaii and a M.Sc. in Zoology from the University of Vermont, USA. Costa-Pierce is currently a Senior Fellow at The World Fish Center in Penang, Malaysia and a member of the Board of Directors of the World Aquaculture Society. For the last 10 years he has served as one of the four international editors of the journal Aquaculture, making decisions on ~500 scientific manuscripts a year. He has >140 publications, including some 15 scientific books and monographs [including Ecological Aquaculture: The Evolution of the Blue Revolution (2002), Urban Aquaculture (2005), and the just released Science for Ecosystem-Based Management: Narragansett Bay in the 21st Century (2008)]. His research interests are in the social ecology of food systems, with an emphasis on agroecology, farming systems, and "ecological aquaculture", which he defines as "the social ecology, design, and development of integrated, land/water interactive aquaculture farming ecosystems". His URI research group, which he calls EAT — the Ecological Aquaculture Team — is currently funded by the National Science Foundation Integrative Graduate Education Research and Training program, FAO, the World Wildlife Fund, and the Packard Foundation, and has developed methods to conduct "sustainability strategic and implementation planning"; "baselining" to document the ecological and social impacts of aquaculture; and "sustainability trajectories" all of which have led to the collaborative design and implementation of "aquaculture ecosystems" at homes, family farms, schools, and industries. Before URI, Costa-Pierce was a Director and Research Scientist for the International Center for Living Aquatic Resources Management (ICLARM, now The World Fish Center), based at first at the Institute of Ecology in Indonesia, then he was the Director of ICLARM's Africa office in Malawi. After ICLARM, he taught in the graduate program at the Scripps Institution of Oceanography at the University of California San Diego, then was selected as a "Student Recommended Faculty in Global Sustainability" at UC Irvine where he was recognized for making an "exceptional impact on undergraduate education".

Abstract: Aquaculture businesses are dynamic, evolutionary, knowledge-based entities that do much more than serve the public with aquatic products. Indeed, they are part of a larger picture of major social ecological and cultural shifts and innovations in ocean resource use, education, marketing, and consumer behavior (Costa-Pierce, 2008*a*). I argue that in such dynamic scenarios of rapid changes in technologies, environments, and markets that businesses need new frameworks to capture and communicate the rapidly-changing social ecology of aquaculture to decision-makers and the public such as the use of "sustainability strategic and implementation

planning" that uses "orders of outcomes" to capture, measure, and communicate change in aquaculture and fisheries (Costa-Pierce, 2008*b*). Once change is well understood, better choices can be made on the appropriate use of either precautionary or risk analysis methods for decision-making. There is no sustainable seafood nirvana in sight. I contend that use of social ecological frameworks and tools can end the confusing debates over the use of seafood "watch cards" as decision-making tools for both consumers and industry. However, the next generation of aquaculture businesses would be well served if aquaculture was marketed more as a culture having the following characteristics (and characters!): (1) as an integral part of peoples' health, as a doctor-recognized food having the highest personal, ethical values; (2) as a vital part of the identity of a bioregion, its unique communities and characters, and its educational establishments; (3) as an important contributor to "green" jobs with workers requiring to have a multidisciplinary education; (4) as part of a broader movement towards an ecological society of sustainable local communities, having local community and regional leaders working to provide incentives for the use of local inputs, to recycle wastes, and (5) businesses providing a diversity of unprocessed and value-added products for not only export but also for local market access (Costa-Pierce, 2002; Costa-Pierce & Desbonnet, 2008).

References

Costa-Pierce, B.A. 2008*a*. Epilogue, p. 315-325. In: Culver, K. and D. Castle (eds.) *Aquaculture, Innovation and Social Transformation*. Springer Science, New York, N.Y.

Costa-Pierce, B.A. 2008*b*. An ecosystem approach to marine aquaculture: A global review, p. 81-116. In: Soto, D. et al. (eds). Building An Ecosystem Approach to Aquaculture. FAO Fisheries and Aquaculture Proceedings 14. Rome, Italy. 221p.

Costa-Pierce, B.A. and A. Desbonnet. 2008. An "ecofunctional" approach to ecosystem-based management for Narragansett Bay, p. 537-554. In: A. Desbonnet & B.A. Costa-Pierce, Editors. 2008. *Science for Ecosystem-Based Management: Narragansett Bay in the 21st Century*. Springer Science, New York, N.Y.

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Plenary Session I / Session plénière

Tuesday, May 12, 2009 - mardi 12 mai 2009
10:20 AM – 11:20 AM
Room/Salon: Ballroom

Chair: Debbie Martin-Robichaud

Plenary Speaker: Tim Davies, Redcorp Ventures Ltd.

Presentation: Navigating Sustainable Development

Biography: Tim Davies is a regulatory and community affairs specialist presently working in the BC mining industry. Formerly, Tim worked in BC's salmon aquaculture industry with Grieg Seafoods and Heritage Aquaculture prior to its sale to Mainstream. Tim assisted Grieg with increasing its annual licensed production capacity from 3,700 MT to over 37,000 MT during his five years with that company and oversaw First Nations and Community Affairs. Tim is presently working on a $300 million mine development project in northwest British Columbia with trans-boundary issues that involve Alaska and US federal regulators. Sustainable development stands on social, economic, and environmental legs; all three must be stable for balanced progression. Initiating, building, and keeping that balance is a challenging endeavour in British Columbia, no matter what resource sector you are working in.

Plenary Session II / Session plénière

Wednesday, May 13, 2009 - mercredi 13 mai 2009
10:20 AM – 11:20 AM
Room/Salon: Ballroom

Chair: Chris Pearce

Plenary Speaker: Dr. Richard J. Beamish, Fisheries and Oceans Canada, Pacific Biological Station

Presentation: The Importance of Aquaculture and Hatcheries to Fisheries in British Columbia as our Climate Changes

Biography: Dick Beamish was born in 1942 in Toronto, Canada and started his career as a fisheries biologist in the 1960s. He finished his Ph.D. at the University of Toronto in 1970 and went directly to the Woods Hole Oceanographic Institution for a Post-doctoral Fellowship with Dick Backus. He worked at the Freshwater Institute in Winnipeg for a few years, ending up at the Pacific Biological Station in Nanaimo, British Columbia in the mid-1970s. He was the Head of the Groundfish Section from 1977-1979 and Director from 1980-1992. Currently he is the Senior Scientist in the Salmon and Freshwater Ecosystems division. He has published around 350 articles; about one half are in peer-reviewed journals. He is an Editor for Transactions of the American Fisheries Society, a member of the Science Panel for the North Pacific Research Board, Chairman of the Scientific Steering Committee for the North Pacific Anadromous Fish Commission, an active member of PICES, a member of the Committee for Scientific Cooperation for the Pacific Salmon Commission, the Department's representative on the Pacific Fisheries Resource Conservation Council, one of two scientists on the Deputy Ministers' Science Management Board, a former Canadian Commissioner for the International Pacific Halibut Commission, a Professor at Vancouver Island University, and currently President of the American Institute of Fisheries Research Biologists. Dr. Beamish has been honoured with a number of awards including the Order of Canada and the Order of British Columbia. He was made a Fellow of the Royal Society of Canada and recently became the first foreign scientist to be made an honorary member of the fisheries laboratory TINRO in Vladivostok, Russia. Recently Dick was awarded the Professor Kazimierz Demel Medal by the Sea Fisheries Institute in Gdynia, Poland. His research interests have included the discovery of acid rain, age determination and the discovery of the longevity of some of our Pacific fish species, the identification of new lamprey species and the evolutionary relationship between these species, and the effects of climate on fish populations. He was one of the first scientists to write about climate regimes and regime shifts.

Abstract: Pacific salmon catches in the past 15 years in the North Pacific have been at the highest levels in history. These high catches are a result of a favourable climate and hatcheries. Perhaps 40% of the over one million tons of Pacific salmon catch by all countries in 2007 came from hatcheries. The favourable climate changes are related to the increased levels of greenhouse gases, but there are also natural trends that are commonly accepted in Russia, but seldom recognized in North America. These shifts tend to occur after about 10 years and we are due for one, perhaps in this year.

Unfortunately, the changes that have been good for Pacific salmon in most countries have not been good for some species of Pacific salmon in British Columbia. In fact, our share of the total Pacific catch has declined from 24% in the 1970s to 1% in 2008. It will be hard to change the impacts of climate on some populations if trends continue. However, if we can solve the problem of how climate reduces the survival of salmon populations, we may be able to use our culture skills to maintain some key populations in support of recreational and commercial fisheries. To do this, I propose that we revisit our idea of an aquaculture centre that was announced by all levels of government 20 years ago but never built.

Tuesday, May 12, 2009 - mardi 12 mai 2009
1:30 PM – 1:50 PM
Room/Salon: Ballroom

Chair: Debbie Martin-Robichaud

Speaker: Trevor Swerdfager, Aquaculture Management Directorate, Fisheries and Oceans Canada

Presentation: The Canadian Aquaculture Sector: Overview and Market Context

Abstract: Fisheries and Oceans Canada (DFO) plays the lead role in managing and safeguarding Canada's aquatic resources. Within DFO, Aquaculture Management creates the conditions necessary to enable sustainable and environmentally responsible aquaculture development in Canada, with the objective of establishing enduring benefits for Canadians through the harvesting of aquatic organisms and upholding ecological and socio-economic values. This is done in collaboration with other federal departments; provincial and territorial governments; industry; the private sector; and, non-government organizations. This presentation will give an overview of the Canadian aquaculture sector and examine the sustainable seafood movement and its market implications, third party certification and the way in which DFO is working with stakeholders to move forward.

Sessions and Abstracts – Aquaculture Canada^{OM} 2009

Canadian Freshwater Aquaculture – Research, Development, and Commercialization

Monday, May 11, 2009 – lundi 11 mai, 2009
10:20 AM – 12:20 PM
Location: Ballroom

Chair: Eric Boucher

10:20 **Faille, A.**
Identification of novel anti-Saprolegnia molecules and efficacy validation in trout

10:40 **Couturier, M.F.**
Accurate sizing of drum filters for aquaculture applications

11:00 **Wetton, M.**
Effects of aquaculture organic waste loading on benthic invertebrates

11:20 **Moccia, R.**
Development of a selection and breeding program for rainbow trout aquaculture in Canada

11:40 **Boucher, E.**
Scale-up of a method for phase-feeding of dietary phosphorus (P) in rainbow trout to reduce P discharges

12:00 **Schmitt, C.**
Freshwater hatchery management practices which could be incorporated to rebuild wild stocks of Chinook salmon

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

Identification of novel anti-Saprolegnia molecules and efficacy validation in trout

A. Faille*[1], E. Proulx[2], E. Boucher[2], D. Proulx[2], J. Legault[3], A. Pichette[3], P. Belhumeur[1], and G. Vandenberg[2]

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[2]Département des sciences animales, Université Laval, Québec, Qc G1V 0A6
[3]Département des sciences fondamentales, UQAC, Chicoutimi, Qc G7H 2B1

Fungal diseases are the second largest cause of mortality in aquaculture, particularly in the cultivation of shellfish and fish species. One of most destructive pathogens having the greatest economic impact in freshwater aquaculture sectors is the fungus *Saprolegnia parasitica*. Evidence suggests widespread infection in most freshwater fish species; left untreated, saprolegniosis can quickly escalate, resulting in up to 50%. New restrictions on the use of malachite green used to prevent and treat fungal infections have lead to the need for alternative products to control saprolegniosis. We have evaluated the potential of cinnamaldehyde to serve as a new antifungal agent. In vitro susceptibility assays as well as in vivo challenge assay have been developed. Cinnamaldehyde possesses potent in vitro antifungal activity however in vivo, it demonstrates significant anaesthetic properties leading to toxicity of fish in bath treatments, preliminary experiments using feed containing cinnamaldehyde gave promising results to treat enteric infection at first feeding. Finally, potential of new molecules with anti-Saprolegnia activity from boreal forest extracts are currently being assessed. These experiments should allow the development of expertise in these fish diseases models as well as the identification of new compounds and procedures to treat and/or prevent *Saprolegnia parasitica* infections in trout.

Accurate sizing of drum filters for aquaculture applications

M.F. Couturier* and N. Greencorn

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

Rotary drum filters are widely used for removing suspended solids in aquaculture systems but their design has hereto been performed using rules of thumb. It is important for technical and economic reasons that the drum be properly sized. If the drum is too large, it will meet technical requirements but its price will be excessive. If the drum is too small, it will not meet specific application requirements and will have to be replaced at a significant cost. The objective of this study was to develop a mathematical model for predicting the pressure drop across drum filters as a function of time since the last cleaning cycle. An apparatus was devised to measure the two key input parameters of the model: the inlet concentration of solids with a diameter greater than the screen opening and the screen coverage per unit mass of captured solids. Contrary to popular belief, the single-pass solids removal efficiency of drum filters is determined not by the total inlet solids concentration but by the fraction of the inlet solids which are larger than the screen opening. The model was validated by comparing its predictions with transient pressure-drop data from a large drum filter operating at a salmon-smolt farm.

Effects of aquaculture organic waste loading on benthic invertebrates

M. Wetton*[1] and C.L. Podemski[2]

[1]Department of Entomology, University of Manitoba, Winnipeg, MB R3T 2N2
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The Manitoulin Island/Georgian Bay area of Lake Huron produces the majority of open net-cage production of rainbow trout (*Oncorhynchus mykiss*) in Ontario, with annual production estimated at 4000 metric tonnes. Cage culture results in enrichment of this nutrient poor system with approximately 5.11 kg P, 30.64 kg N, and 164.3 kg of solid waste per tonne of fish produced. The main goal of this research was to establish the relationship between organic waste loading from freshwater aquaculture operations and the growth, survival and community composition of benthic invertebrates. We utilized an integrated approach, combining field survey data of sedimentation rates, sediment chemistry, and benthic data with laboratory bioassays. In the field, replicate sediment cores were taken along a distance transect from two commercial (L. Huron) and one experimental fish farm (L375, Experimental Lakes Area) for nutrient and invertebrate community analysis. Sedimentation traps were positioned in the water column along transects at these farms to determine the spatial dispersion and rates of sedimentation of organic matter. A comparison of sedimentation rates and invertebrate density along these transects will be presented. This data was used to determine realistic loading rates for a laboratory multispecies bioassay, where a community comprised of *Tubifex* (Oligochaeta, Tubificidae), *Hyalella* (Amphipoda, Talitridae), *Chironomus* (Diptera, Chironomidae) and *Sphaerium* (Pelecypoda, Sphaeriidae) were subjected to daily additions of various concentrations of faecal matter from a commercial fish farm. Invertebrate survival and growth was determined by enumeration and measurements of dry weight. Establishing this relationship between organic waste loading and invertebrate growth, survival and community composition through simulations and field experiments will assist in the development of modelling tools for freshwater open cage farm management.

Development of a selection and breeding program for rainbow trout aquaculture in Canada

R. Moccia*[1], G. Vandenberg[2], E. Boucher[3], K. Tracey[4], S. Naylor[5], D. Bevan[1], and M. Burke[1]

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[4]Northern Ontario Aquaculture Association, Box 124, 13 Worthington St., Little Current, ON, P0P 1K0
[5]Ontario Ministry of Agriculture and Food, 1 Stone Road West 3rd. Floor NE, Guelph, ON, N1G 4Y2

A priority for the Canadian freshwater aquaculture industry is the establishment of a National Broodstock program to develop enhanced performance in rainbow trout, specifically targeting

improved fillet yield, accelerated growth rates and greater tolerance to warm-water conditions. As a first step in this process, on February 12th & 13th 2009, the Interprovincial Program for Sustainable Freshwater Aquaculture Development (IPSFAD) held a workshop on developing a, 'Selection and Breeding Program for Rainbow Trout Aquaculture in Canada'. This event drew together various Canadian stakeholders in the rainbow trout aquaculture industry, as well as Canadian and international specialists in the field of animal breeding to help establish selection priorities. It also brought old and new players together to enable effective partnerships for the purpose of developing a future, national broodstock program. The workshop report will present the ideas and strategies regarding the scope and nature of the proposed, "Canadian Rainbow Trout Broodstock Program" that were suggested by the participants. We will also review the current status of available technologies and practices regarding all aspects of a selection and breeding program. Finally, the report will identify the research, development and commercialization components necessary to establish a successful 'Public Sector-Private Sector' program, and will examine possible models for this partnership. This presentation will provide an overview of findings from this important two-day workshop.

Scale-up of a method for phase-feeding of dietary phosphorus (P) in rainbow trout to reduce P discharges

E. Boucher[2*], J. Fournier[1], R. Lambert[1], J. de la Noüe[1], D. Proulx[1], E. Proulx[1], and G. Vandenberg[2]

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In aquaculture condition, the phosphorus, which is an essential element for growth and bone development, comes essentially from the dietary intake. Thus, the phosphorus discharged originates largely from feed that is not ingested and from the ingested phosphorus exceeding physiological needs of the fish. Consequently, intensive aquaculture generates a phosphorus load for the environment and may contribute to the eutrophication of sensible receiving water bodies.

It is possible to reduce phosphorus waste from aquaculture facilities by acting directly on the bioavailability of the element and on the formulation of the feed used. The objectives of the project are to optimize the formulation of a Phosphorus-deficient diet, to identify the alternating sequence of diets (Phosphorus-deficient and Phosphorus-sufficient) to maximize rainbow trout growth and minimize phosphorus discharge, to test the chosen alternating sequence under commercial conditions at a fish farm, and to conduct a technical and economic study to assess the impact of the new Phosphorus-deficient dietary regime and of the periodic feeding of fish for commercial production.

Freshwater hatchery management practices which could be incorporated to rebuild wild stocks of Chinook salmon

C. Schmitt*

Omega Pacific Hatchery Inc., P.O. Box 9, Port Alberni, B.C. V9Y 7M6

The West Coast of Vancouver Island has many streams with extremely low escapement numbers of wild stocks of Chinook Salmon. Intervention will be required to rebuild these numbers. Conventional enhancement currently releases all progeny at the same time as an s0 smolt (ie eggs spawned in fall, juveniles released the following spring). Wild stocks naturally have offspring going to the ocean as s0, s1, s2 or s3 (ie first spring up to 3 years in fresh water before they go to the ocean). Genetics, freshwater temperatures and feed availability are factors which determine when a smolt is ready to migrate to the ocean. Limited resources and difficulties in capturing the few returning Chinook make it essential if brood stock is captured, that they and their offspring be managed to minimize the risk of loss and ensure maximum gains from the releases. Best management requires one operate by adopting "an every fish is valuable principal" and incorporate a preventative management approach." ie why did a fish die, what else do we know that can affect the fish negatively, what can be done to prevent loss, ensure survival in the future," Some key management tools incorporates proper adult handling, transportation and spawning of eggs, adult disease screening, surface disinfection of eggs, smolt health checks, ensuring osmoregulation competency of early entries to net pens in estuaries, hatchery competency in view of water quality, incubator and rearing containers, multi age release strategy (integrate the s1 superiority) , captive freshwater brood stock program (insures available eggs from year 4 to 7), cryopreservation of milt (saving a genetic pool) and feminization . It is important to use all management tools available and incorporate a multi strategy plan to minimize risk and maximize results when tackling the rebuilding of these stocks.

Integrated Multi-Trophic Aquaculture

Monday, May 11, 2009 – lundi 11 mai, 2009
10:20 AM – 12:20 PM
Location: Malaspina

Chair: Steve Cross and Chris Pearce

10:20 Cross, S.F.
SEA-system (IMTA) development in the pacific region – from research to commercialization

10:40 Chopin, T.
The inorganic extractive component of Integrated Multi-Trophic Aquaculture (IMTA) – moving along the R&D&C continuum

11:00 Blasco, N.
Maintaining an inorganic extractive component within an IMTA system: kelp management strategies

11:20 Robinson, S.M.C.
Spatial considerations in the re-utilization of organic matter of open water, Integrated Multi-Trophic Aquaculture (IMTA) with a focus on filter feeding shellfish such as the blue mussel, *Mytilus edulis*

11:40 Mullen, A.J.
Effects of Atlantic salmon farm organic enrichment within an Integrated Multi-Trophic Aquaculture system (IMTA) in the Bay of Fundy

12:00 Cross, S.F.
The potential use of green sea urchins (*Strongylocentrotus droebachiensis*) as a biocontrol for fouling on aquaculture net pens in British Columbia

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

SEA-System (IMTA) development in the pacific region – from research to commercialization

S.F. Cross[*1], D.R. Smith[1], D.I. McKirgan[1], N.Blasco[1], and H.F. Smith[1]

[1]Kyuquot SEAfoods Ltd., 2541 Conrad Rd., Courtenay, British Columbia, Canada V9N 9N8

Canada is taking an active role in assessing the socio-economic and environmental benefits of Integrated Multi-Trophic Aquaculture systems. In coastal British Columbia the Sustainable Ecological Aquaculture (SEA) System design has evolved from an 8-year history of baseline research and initial performance trials on a pilot-scale. Kyuquot SEAfoods Ltd. became the first licensed IMTA producer in the province in 2007 and is currently investing in the commercial development of a vertically integrated SEAfarm operation on the northwest side of Vancouver Island. The first KSL farm site is dedicated to ongoing commercial-scale R&D, and represents a west coast component of a national research initiative on IMTA research. This presentation provides some of the background research leading to this avenue of system development for open netcage aquaculture, the business and environmental arguments supporting such development, and the SEA-vision we are pioneering for our future coastal aquaculture industry.

The inorganic extractive component of Integrated Multi-Trophic Aquaculture (IMTA) – moving along the R&D&C continuum

T. Chopin[1]*, M. Sawhney[1], R. Shea[1], E. Campbell[1], E. Belyea[1], S. Bastarache[1], W. Armstrong[1], G.K. Reid[1,2], S.M.C. Robinson[2], K. Haya[2], L. Burridge[2], F. Page[2], N. Ridler[1], S. Boyne-Travis[3], J. Sewuster[4], M. Szemerda[5], F. Powell[5], and R. Marvin[5]

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[4]Acadian Seaplants Limited, 30 Brown Avenue, Dartmouth, NS B3B 1X8, Canada
[5]Cooke Aquaculture Inc., 874 Main Street, Blacks Harbour, NB E5H 1E6, Canada

The inorganic extractive component of several IMTA sites in the Bay of Fundy is presently made up of the kelps *Laminaria saccharina* and *Alaria esculenta*. Kelp culture techniques have improved both in the laboratory and at the aquaculture sites. Increased growth rates of kelps (46%) cultured in proximity to fish farms reflect the increase in food availability and energy. None of the therapeutants used in salmon aquaculture have been detected in kelps collected from the IMTA sites over 8 years; levels of heavy metals, arsenic, PCBs and pesticides have always been below regulatory limits. The raft design has evolved to increase structural resilience and facilitate seaweed deployment, growth and harvesting. We continue to scale-up experimental systems towards commercial levels. Drying and processing techniques are being investigated which promote efficiency, quality, cost reduction, niche markets and demand for a variety of applications. New candidate species are under investigation to increase the inorganic biomitigation capacity of the system throughout the year. Rethinking site design, dimensions, scale and logistics are crucial to optimizing open-water IMTA, not just within the conventional site boundaries but also at the bay management level. The value of the environmental services

rendered by seaweeds (nutrient credits, carbon trapping and oxygen provision) needs to be accounted for to establish the true value of the inorganic extractive component of IMTA.

Maintaining an inorganic extractive component within an IMTA system: kelp management strategies

N. Blasco[*1] and S. Cross[1]

University of Victoria, Department of Geography, P.O. Box 1200 Station CSC, Victoria, BC, V8W 2Y2

In integrated multi-trophic aquaculture (IMTA) seaweeds, such as kelps, serve to extract inorganic nutrients from fed components (finfish) and in doing so create a more environmentally sustainable aquaculture system. This environmental benefit is realized when both cultures are growing in concert and when the seaweed culture is of significant biomass. Given the highly seasonal nature of kelp aquacultures, the environmental benefit of kelps in an IMTA system may be limited. Seasonality of the kelp culture was tested at the Pacific SEA-Lab IMTA research site in Kyuquot Sound by entering *Saccharina latissima* seeded lines four times, one each season, from December 2007 to September 2008. Growth of each kelp entry and environmental variables were, and still are, being monitored periodically. Findings to date suggest that having a large biomass of kelp on site at all times may be difficult, but methods of maintaining significant kelp biomass on site for longer periods of time than traditional kelp culture methods have been realized. Further discussion on methods to maintaining a year round seaweed component will be made with particular attention paid to alternative kelp species and red seaweed species.

Spatial considerations in the re-utilization of organic matter of open water, Integrated Multi-Trophic Aquaculture (IMTA) with a focus on filter feeding shellfish such as the blue mussel, *Mytilus edulis*

S.M.C. Robinson[1*], M. Liutkus[2], T.R. Lander[2], G.K. Reid[2], T. Chopin[2], L. Burridge[1], F. Page[1], N. Ridler[2], B. MacDonald[2], J. Sewuster, M. Szemerda[4], R. Marvin[4], F. Powell[4] and S. Boyne-Travis[3]

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The basic tenet underlying Integrated Multi-trophic Aquaculture (IMTA) is the concept of recycling. Using the principle of energy cascades, where energy flows from higher trophic levels to lower ones while organic matter is being produced, a semi-natural ecosystem is created using biofilters of economic value to reduce the near-field organic loading to the benthos. In addition, it also increases the economic viability of the aquaculture operation.

In the Bay of Fundy, commercial trials are currently underway to test the concept of IMTA in conjunction with commercial salmon farming operations. The blue mussel, *Mytilus edulis*, is being grown in commercial volumes on rafts meters away from the salmon farming operation

where it is able to intercept a proportion of the fine particulate organic matter being released during salmon farming activities. Currently, environmental regulation of the farming operation is conducted through the use of benthic monitoring of the sulphides contained in the bottom sediment. There is a concern that the incorporation of additional species within the aquaculture lease will increase the benthic loading, thus impacting benthic performance.

There are a number of different facets that should be considered with this issue. The particulate nutrient stream that is released from salmon farm is not all composed of the same size particles. The size spectrum is very important since it is the size of the particle that ultimately determines the settling velocity and thus the dispersion rate of organic loading to the benthos. If bivalve filter feeders ingest some of the small, slowly sinking particles and repackage them into heavier fecal pellets, the near-field loading will increase. However, since they are also removing rich organic matter from their food and releasing lower energy output, this benthic loading may not be significant depending on the overall loading rate and the assimilation capacity of the benthic environment. Since these organic biofilters are ultimately removed from the system via commercial harvest, a significant amount of the original organic input in the form of salmon feed can ultimately be remediated. Spatially locating these biofilters within the nutrient plume of the site will be critical to the success of the IMTA operation. Examples of these concepts will be highlighted with data from the IMTA project in the Bay of Fundy.

Effects of Atlantic salmon farm organic enrichment within an Integrated Multi-Trophic Aquaculture system (IMTA) in the Bay of Fundy

A.J. Mullen[*1,2], S.M.C. Robinson[2], B.A. MacDonald[1], G.K. Reid[1,2], T.Chopin[1], T.Lander[1,2], M.Sawhney[1], K.Haya[2], L.Burridge[2], F.Page[2], N.Ridler[1], S. Boyne-Travis[3], J.Sewuster[4], M.Szemerda[5], F.Powell[5], and R. Marvin[5]

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In the Bay of Fundy, Canada, blue mussels (*Mytilus edulis*) and kelps (*Saccharina latissima* and *Alaria esculenta*) have been co-cultured with Atlantic salmon (*Salmo salar*) at IMTA sites to maximize the use of farm nutrients in attempt to reduce environmental impact as well as produce additional farm crops. However, the effects of salmon farm nutrients on the growth and reproduction of IMTA species and naturally occurring species are not clearly understood. To address this, *M. edulis* and *Strongylocentrotus droebachiensis* have been grown at IMTA and reference sites, supplemented by laboratory experiments, to determine the assimilation of salmon farm nutrients and effects on growth and reproduction. Early data have shown that salmon farm nutrients are positively correlated with increased growth and reproductive output (57% and 1358% respectively) for *S. droebachiensis*. However no significant growth difference in *M. edulis* has been seen at their current growth stage. These species, representing different functional groups within the IMTA farm ecosystem, provide insight into the effects of organic enrichment on secondary production, trophic energy transfer efficiencies as well as nutrient recovery

potential of these species. Ultimately this research aims to improve our understanding of energy flow and effects within IMTA sites and coastal ecosystems.

The potential use of green sea urchins (*Strongylocentrotus droebachiensis*) as a biocontrol for fouling on aquaculture net pens in British Columbia

C. Edwards[a], S.F. Cross[b,*]

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Biofouling in the aquaculture industry is an expensive problem, requiring toxic chemical treatments and manual cleaning of net pens. It is a problem that negatively impacts cultured stocks by occluding net openings, thereby reducing water flow and stressing stocks, and by physically damaging nets and infrastructure. Many invertebrates feed on and thus remove fouling organisms. Biocontrol aims to integrate these natural grazers into aquaculture systems to remove fouling. Ideally, the biocontrol species is an exploitable resource so that it becomes part of an integrated multi-trophic system. This study describes the potential use of green sea urchins (*Strongylocentrotus droebachiensis*) as a biocontrol for fouling on net pens at the Pacific SEA-lab research site in Kyuquot Sound. The study extended over a 10 month period, which included the peak fouling season. The experiment involved immersing 1m² sample nets at three depths with three urchin densities. The efficacy of urchins as biocontrols was measured using percentage net occlusion. Tensile strength was also measured to determine if urchins abrade netting material while grazing. The results will be used to determine potential stocking densities for the use of green sea urchins as a biocontrol at a commercial scale.

Environmental Interactions: New Perspectives on Sea Lice

Monday, May 11, 2009 – lundi 11 mai, 2009
10:20 AM – 12:20 PM
Location: Dunsmuir / Malahat

Chair: Duane Barker

10:20 Boyce, B.
Marine Harvest Canada: sea lice trends and mitigation

10:40 Saksida, S.
Sea lice on BC salmon farms: so what are they hiding?

11:00 Jones, S.
Mortality risk to pink salmon *Oncorhynchus gorbuscha* due to the salmon louse *Lepeophtheirus salmonis* in the Broughton Archipelago, British Columbia

11:20 Stucchi, D.
A coupled biophysical sea lice model for the Broughton Archipelago

11:40 <u>Sutherland, B.</u>
Transcriptomic responses of juvenile pink salmon (*Oncorhynchus gorbuscha*) following exposure to the salmon louse (*Lepeoptheirus salmonis*)

12:00 Ikonomou, M.G.
Environmental fate and potential biological effects of SLICE®. A laboratory and a field based study

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

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Marine Harvest Canada: sea lice trends and mitigation

B. Boyce*[1], D. Morrison[1], M. Mills[1], C. LaTrace[1], G. Burry[1], T. MacWilliam[1], and S. Saksida[2]

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The interaction between sea lice and farmed salmon in British Columbia has been, and remains, a continuous learning procedure. Marine Harvest Canada has maintained a comprehensive sea lice monitoring program for all of our farms stock since 2003. The data garnered from our program will be used to demonstrate regional and seasonal trends in sea lice infestations, effect of environmental conditions on sea lice infestations, optimization of treatment timing, and treatment efficacy. Our data analyses has given us a better understanding of sea lice dynamics on farmed Atlantic salmon and allowed us to develop successful mitigation strategies.

Sea lice on BC salmon farms: so what are they hiding?

S. Saksida*

BC Centre for Aquatic Health Sciences, Box 277, Campbell River BC V9W 5B1

The issue of sea lice and salmon farms is a very emotionally charged topic in British Columbia. There continues to be a common misconception that salmon farms are heavily infested with sea lice, farms have to repeatedly treat to control the problem and that salmon farms are unwilling to release information to the public. The presentation will address these issues as well as others using published data and data readily available to the public on the web.

Mortality risk to pink salmon *Oncorhynchus gorbuscha* due to the salmon louse *Lepeophtheirus salmonis* in the Broughton Archipelago, British Columbia

S. Jones*[1]

[1]Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo, B.C., V9T 6N7

Pink salmon enter the ocean when they are less than 0.3 g and have poorly developed skin that lacks scales. At this size the fish are at risk of dying following exposure to sea lice. Juvenile pink salmon grow rapidly and acquire a natural resistance to the parasite before they are 1 g. Laboratory trials have shown that mortality among the smallest pink salmon is a function of fish weight and parasite number. Among pink salmon weighing less than 0.7 g an infection density of 7.5 lice per gram was estimated to be the lethal infection threshold. Marine surveillance showed the percent of pink salmon in the same size class with lethal *L. salmonis* infections declined from 4.5% in 2005 to zero in 2008. This was coincident with a decline in parasite prevalence and intensity suggesting that the risk of mortality associated with the parasite had decreased during this period. Possible explanations for the decline and implications for the coexistence of salmon aquaculture and juvenile pink salmon will be discussed.

A coupled biophysical sea lice model for the Broughton Archipelago

D. Stucchi*, M. Foreman, M. Guo, and P. Czajko

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Recent research on the interactions between sea lice and wild and farmed salmon in the Broughton Archipelago of British Columbia has underlined the need to better understand the role that physical oceanography plays in the development, behaviour and movement of these lice. In this talk we will describe biological models that estimate the production of sea lice eggs at salmon farms and simulate the development, mortality and behaviour of the planktonic larval (nauplius and copepodid) life stages. These biological models are coupled to a finite volume circulation model that in turn provides the three-dimensional salinity, temperature and velocity fields that control the transport and development/mortality of the sea lice larvae. A three week simulation for March 2008 will be evaluated against available observations. The utility of these coupled models in an aquaculture management strategy will be briefly discussed.

Transcriptomic responses of juvenile pink salmon (*Oncorhynchus gorbuscha*) following exposure to the salmon louse (*Lepeoptheirus salmonis*)

B. Sutherland*[1], G.A. Cooper[1], S.R.M. Jones[2], and B.F. Koop[1]

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

L. salmonis is an ectoparasite of wild and farmed salmon. In this study, a 32,000-gene salmonid microarray platform was used to investigate changes in gene expression following a single parasite exposure of wild pink salmon (*O. gorbuscha*) weighing 0.3, 0.7 and 2.4 g. Laboratory-reared salmon were each exposed to 100 copepodids and tissues were sampled six days after exposure. Size-matched control salmon were not exposed. Transcriptome profiles indicate a size-dependent response to the infection. These results, combined with salmon mortality data, provide the first insight into the characteristics of the protective defense response of juvenile pink salmon to *L. salmonis*. Furthermore, this work shows the power of using microarrays to observe both large and small variations in global gene expression patterns. This tool enables identification of innate and adaptive immune responses, in addition to changes in metabolic and physiological processes.

Environmental fate and potential biological effects of SLICE®. A laboratory and a field based study.

M.G. Ikonomou[1*], J. Chamberlain[2], E.R. McGreer[2], D. Stucchi[1], G. van Aggelen[3], C. Dubetz[1], and C. Helbing[4]

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[3]PESC, Environment Canada, Vancouver, BC
[4]Biochemistry, University of Victoria

Sea-lice infestation at marine cage finfish farms in British Columbia and elsewhere are most often treated by the application of the anti-sea-lice chemo-therapeutant SLICE®. Concerns regarding the potential ecosystem effects and biological uptake of the active compound, emamectin benzoate (EB) and its metabolites, by non-target organisms have been raised by some stakeholders groups. This project was designed to evaluate the environmental fate and the potential ecosystem impacts of EB and its metabolites post-treatment with SLICE® near aquaculture sites in BC. This was examined by measuring EB concentrations in sediment, water & biota in target locations. The concentrations measured in the biota are linked to toxicological end-points that were developed from laboratory exposures experiments conducted in parallel to the field study. Genomics based methodologies were used to assess biological effects in prawn species from both the laboratory exposure experiments, and the species collected near aquaculture sites treated with SLICE®. The EB concentrations measured in water and sediment were used to test, calibrate and implement the DEPOMOD model in predicting environmental concentrations of EB in potentially impacted areas.

First Nations' Opportunities and Challenges in Aquaculture Development

Monday, May 11, 2009 – lundi 11 mai, 2009
2:00 PM – 5:00 PM
Location: Ballroom

Chair: Richard Harry

2:00 **Williams, T.**
Journey to economic independence: BC First Nations' perspectives

2:20 **Harry, R.**
Opportunities for First Nations in aquaculture

2:40 **Silver, J.J.**
Getting from a wild shellfish harvest to shellfish aquaculture: talking about what your community venture needs to succeed

3:00 **Hardy, R.**
Overcoming adversities in the shellfish aquaculture industry

3:20 **Sewid, H.**
Developing a successful service business to the aquaculture industry – an opportunity for First Nations

3:40 **HEALTH BREAK**

4:00 **Nelson, T.**
Value of aquaculture to First Nations and how to develop agreements with aquaculture companies that benefit First Nations

4:20 **Panel Discussion**
Finding creative solutions for constraints to successful aquaculture

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

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Journey to economic independence: BC First Nations perspectives

T. Williams*

Project Manager, British Columbia Ministry of Technology, Trade and Economic Development

In October 2006, the Ministry of Economic Development with the support of the First Nations Leadership Council initiated the First Nations Economic Development Project. The purpose of the project is to understand how BC First Nations can create economies for their communities while participating more fully in regional and provincial economies. Information on the history of economic development was collected from eleven participating BC First Nations, seven of whom are the largest First Nations in the province. A summary of the information was compiled into a report entitled "Journey to Economic Independence – First Nations Perspective". This presentation will cover First Nations entrepreneurial activities past to present and the evolution of these activities, as well as key information from the report including barriers to economic success, best practices, and the seven themes important to First Nations in their journeys to achieving significant own-source revenues and a sustainable economy.

Opportunities for First Nations in aquaculture

R. Harry*

Executive Director, Aboriginal Aquaculture Association and Elected Chief, Homalco First Nation, Campbell River, BC

The Aboriginal Aquaculture Association was established in July, 2003 by six Founding Members, representing a cross-section of aboriginal leaders in British Columbia. These leaders had come to realize that there were very few opportunities for their band members to look forward to within the resource sectors of their local communities. After careful studies, they concluded that various forms of aquaculture may provide successful careers for their communities, especially among young aboriginal people. The Mission of the Aboriginal Aquaculture Association is to promote and assist the development of First Nations' Aquaculture in British Columbia that respects and supports First nation Communities, Culture and Values. Since inception, the Association has served as a resource body providing guidance and advice with respect to sustainable aquaculture development, regulation and management of aquaculture to enable aquaculture development that has the potential to play a major role in the diversification and strengthening of the local and regional economies of First Nations. Aquaculture is an opportunity for many First Nations communities hard hit by the downturn in the resource industries and the economic slow-down. This presentation will provide an overview of the many opportunities for First Nations in finfish, shellfish, and plant aquaculture.

Getting from a wild shellfish harvest to shellfish aquaculture: talking about what your community venture needs to succeed

J.J. Silver*[1]

[1]School of Resource and Environmental Management, Simon Fraser University, 8888 University Drive, Burnaby, BC V5A 1S6

Everyone in the seafood industry is talking about aquaculture, but does that make it right for your community? Moving from wild harvest fisheries like shellfish and salmon, to aquaculture is a big leap to take, so how do you decide to go for it (or not)? I have been researching Aboriginal involvement in aquaculture for about four years and believe the industry has both pros and cons for Aboriginal communities. With my presentation I will provide some background on my research, talk about the structure of the seafood industry, and some of the advantages and disadvantages of aquaculture for Aboriginal communities. Following this, we will discuss some of the things that communities might want to consider before getting involved in aquaculture and how pros and cons can be presented to those who will be involved; community members or share holders, Band Council, employees, elders and youth, for example. Your participation and questions will direct the presentation and discussion!

Developing a successful service business to the aquaculture industry – An opportunity for First Nations

H. Sewid*

Hereditary Clan Chief, Mamalilukulla-Qwe'Qua'Sot'Em Band

Harold Sewid is a fourth generation commercial fishing captain who retained his fishing licenses and boats during the decline of the commercial industry by working these boats in the off season in the fish farming industry. Initially he was looking for work for himself and his three sons and now employs a crew of ten to twenty four people with the potential for more through his company Qwe'Qua'Sot'Em Faith Aquaculture Services. He believes the aquaculture industry is a natural place for coastal First Nations with their knowledge of and experience with the ocean environment. He will outline the events that drove him to work with an industry that he initially mistrusted and his ongoing education about the industry. He will also speak on the value of setting up rules in the working environment so both parties benefit.

Integrated Multi-Trophic Aquaculture

Monday, May 11, 2009 – lundi 11 mai, 2009
2:00 PM – 5:00 PM
Location: Malaspina

Chair: Steve Cross and Chris Pearce

2:00 **Hannah, L.C.**
The use of the sea cucumber *Parastichopus californicus* in integrated multi-trophic aquaculture in British Columbia

2:20 **Reid, G.K.**
Efficiencies of open-water Integrated Multi-Trophic Aquaculture (IMTA): progress, challenges and considerations

2:40 **Chopin, T.**
Focus group study on the social acceptability of Integrated Multi-Trophic Aquaculture (IMTA) and attitudinal survey of consumer preferences for differentiated IMTA products

3:00 **Chopin, T.**
Improving the efficiencies of the Integrated Multi-Trophic Aquaculture (IMTA) components – environmental system performance and species interactions

3:20 **Cross, S.F.**
IMTA adaptive strategies – ecological design and system engineering

3:40 **HEALTH BREAK**

4:00 **Knowler, D.**
Economic analysis and social implications of IMTA – what do we need to know and how will it affect the success of IMTA?

4:20 **Costa-Pierce, B.A.**
Comprehensive planning for sustainable fisheries must include aquaculture

4:40 **Panel Discussion**

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

The use of the sea cucumber *Parastichopus californicus* in integrated multi-trophic aquaculture in British Columbia

L.C. Hannah*[1], S.F. Cross[2], and C.M. Pearce[1]

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Integrated multi-trophic aquaculture (IMTA) can provide an environmentally responsible, yet still profitable, approach to aquaculture production. In the system studied here in BC, several invertebrate species are utilised to consume different organic fractions of fish farm wastes (*i.e.* uneaten feed, faecal material) to reduce the impact on the environment and provide additional harvestable crops. This paper describes preliminary data on the growth of deposit-feeding sea cucumbers (*Parastichopus californicus*) maintained since November 2008 in the waste flow of a sablefish farm located on the west coast of Vancouver Island. Experimental cages placed underneath the sablefish pens contain either juvenile or adult sea cucumbers at three stocking densities; a set of control cages, also containing juvenile or adult sea cucumbers, are placed outside the influence of the farm site. The objective of the experiment is to determine whether the sea cucumbers remain healthy and receive enough nutrients from consuming sablefish culture waste to support somatic growth. If the sea cucumbers are found to exhibit suitable survival and growth, the next objective of the experiment is to determine the size and stocking density resulting in optimal sea-cucumber survivorship/growth.

Efficiencies of open-water Integrated Multi-Trophic Aquaculture (IMTA): progress, challenges and considerations

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

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Matter and energy fluxes within Integrated Multi-Trophic Aquaculture (IMTA) systems, and how they interact with the environment, need to be qualified and quantified in order to develop system designs and measures of sustainability. Many existing measures of IMTA efficiency are based on differences in nutrient concentrations of inflow and outflow waters in land-based systems. Empirical measures of concentrations in open-water systems, as a means to assigning causality to a particular process or niche, have obvious challenges in such a highly variable, 'leaky' environment. Some level of modelling will therefore be unavoidable to determine these efficiencies. Efficiency measures of system design and sustainability have yet to be established for open-water IMTA. While modelling efficiencies is mathematically simple, meeting the basic data requirements in a multi-niche, open-water IMTA system is difficult. This is largely due to uncertainties in load partitioning as it relates to the number of trophic transfers and multiple pathways of effects. Nevertheless, quantifying these types of efficiencies for open-water IMTA is necessary to provide crucial information on where 'losses' are occurring in the system and, consequently, as a basis for optimizing system design. Determining what efficiency levels are possible, as well as practical, will assist in developing realistic metrics for sustainability. Progress, challenges and considerations of determining efficiencies of open-water IMTA are discussed.

Focus group study on the social acceptability of Integrated Multi-Trophic Aquaculture (IMTA) and attitudinal survey of consumer preferences for differentiated IMTA products

T. Chopin[1]*, S.M.C. Robinson[2], K. Barrington[1], B. Robinson[1], H. Shuve[3], E. Caines[1], N. Ridler[1], G.K. Reid[1,2], M. Sawhney[1], J. Lamontagne[4], M. Szemerda[4], F. Powell[4], R. Marvin[4], and S. Boyne-Travis[5]

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[5]Canadian Food Inspection Agency, 99 Mount Pleasant Road, St. George, NB E5C 3S9, Canada

Social acceptability is a critical component of aquaculture sustainability. Focus group sessions with several segments of the New Brunswick population (restaurateurs, residents of communities near aquaculture facilities and general population) were held and the participants' knowledge of, and opinions on, IMTA were recorded. Most participants felt that IMTA had the potential to reduce the environmental impacts of salmon farming, benefit community economies, and improve industry competitiveness and sustainability. All felt that seafood produced in IMTA systems would be safe to eat and 50% were willing to pay 10% more for these products.
An attitudinal survey of New York City area seafood consumers found a preference for IMTA over fish monoculture. IMTA seafood was considered better for the environment and animal welfare, and safer and healthier. Regarding quality, freshness and taste, IMTA seafood outperformed conventional seafood; however, many consumers did not recognize differences. A penetration analysis showed that 61% of the consumers were willing to buy ecolabelled IMTA mussels if available at the same price as other mussels, 38% would pay a 10% premium and 18% a 20% premium.
Solid marketing plans that include a sound pricing strategy and strong channel distribution, coupled with an effective educational component on the IMTA environmental and product benefits, will be critical to developing a sustainable consumer retail market for IMTA products.

Improving the efficiencies of the Integrated Multi-Trophic Aquaculture (IMTA) components – environmental system performance and species interactions

T. Chopin[1]* and S.M.C. Robinson[2]

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R&D on IMTA has been conducted on both the east and west coasts of Canada since 2001. Significant progress has been made, but the need for a concerted and strategic, inter-disciplinary, multi-institutional and multi-sectoral approach is now needed so that IMTA can move from an interesting academic and experimental concept into a valued economic and social reality at

commercial scale. Progress in the following domains are needed: 1) ecological design, ecosystem interactions and biomitigation efficiencies, 2) system innovation and engineering, 3) economic viability and societal acceptance, and 4) regulatory science, to transform environmental and socio-economic issues into benefits and facilitate the commercialization of IMTA.
The objectives of Domain 1 are concerned with how an IMTA system operates and its relative efficiency and effects. It is essential to understand the potential roles that each component part may play in the recycling and mitigating operation. These must be understood on a spatial and temporal basis. This Domain can be envisioned as a series of two components, an internal component which deals with how the system works and its efficiency within the aquaculture operation, and an external component that deals with how the system works within the surrounding natural environment with respect to dispersion of nutrients, pathways of effects and interactions among associated species.

IMTA adaptive strategies – ecological design and system engineering

S.F. Cross[*1] and C. M. Pearce[2]

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The Canadian finfish aquaculture industry currently uses two types of netcage systems: the circular grid system (prevalent on the East coast) and the consolidated steel cage system (prevalent on the West coast). Ongoing IMTA research will need to explore how these respective systems can be adapted – in terms of ecological design, engineering, configuration and orientation within the environment – to facilitate the introduction of IMTA components without interfering with the operational (husbandry) needs of the individual components, and yet ensure that optimal recapturing efficiencies are achieved for the new multi-species systems. New system components will need to be designed and tested for the various organic extractive species (*e.g.* suspension feeders in the water column adjacent to the fish and deposit feeders near the bottom of the sites below the fish) and the inorganic extractive species (*e.g.* seaweeds in the dissolved nutrient zone). The configuration and orientation of the new system components – with respect to the finfish (source of nutrients and energy), tidal currents and site physiography (bathymetry, local topography) – will also need to be explored to identify the factors affecting IMTA extractive/operational efficiencies. This presentation will discuss the collaborative research proposed in Canada for addressing these issues over the next 5 years.

Economic analysis and social implications of IMTA – what do we need to know and how will it affect the success of IMTA?

D. Knowler*[1], A. Noce[2], M. Flaherty[3], and G. Murray[4]

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Integrated multi-trophic aquaculture (IMTA) raises new challenges and research needs in the natural and social sciences. We examine the latter domain, including an assessment of where we stand at present and what further research is needed. For example, the financial profitability of IMTA in open ocean settings, and its net economic benefits generally, still need to be demonstrated. Such analyses hinge critically on the 'premium' consumers may be willing to pay for IMTA products and whether this is sufficient to generate widespread adoption of IMTA by the aquaculture industry. We also might ask what further financial incentives are needed and justified to promote IMTA? Additionally, there are wider social, political, historical and cultural realities, that will mediate the potential for IMTA to contribute to sustainable livelihoods in remote coastal communities. These must be identified and characterized. A second challenge lies in elaborating effective governance and management structures. Any new or adapted management/governance structures should be attendant to the needs and interests of coastal communities and should promote the health of Canada's linked coastal social-ecological systems. IMTA also must be consistent with First Nations' values and traditions. We describe an emerging research agenda that addresses some of these issues.

Comprehensive planning for sustainable fisheries must include aquaculture

B.A. Costa-Pierce*

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Planning for aquaculture developments is not incorporated into the overall planning framework for sustainable seafood supplies, fisheries and coastal zone management while there are vital connections between capture fisheries and aquaculture in the ecological, fisheries management, seafood market and social dimensions. Substantial price and volume competition occur between fisheries and aquaculture products in the modern marketplace. The concepts of pristine, wild fisheries and untouched habitats are at odds with the modern science and management reality, and the important contributions of the use of aquaculture hatcheries to sustain "wild" fisheries. Modern lobster fisheries in the Atlantic and Pacific salmon fisheries are more akin to extensive aquaculture operations than capture fisheries but are managed using traditional stock assessments that do not completely explain production dynamics. Although aquaculture expands the production of commercially valuable species, it depends upon intact natural ecosystems and ecosystem services. There have been questions whether aquaculture contributes to the depletion of world fisheries. This "aquaculture paradox" recognizes the dependence of both wild and

farmed fish stocks on many of the same marine and agricultural resources—from food to habitats. Although capture fisheries and aquaculture operations are researched, planned and managed as if they were independent entities, they both share common concerns about water quality, genetic diversity in hatchery-raised organisms, feeds and the sustainability of fish meal/oil fisheries and industries. Fisheries science needs to incorporate aquaculture into the longer-term outlook for managing the fisheries of the future. Analyses of the trends in species having aquaculture and capture fisheries components are required along with in-depth examinations of functional interdependencies. A more comprehensive planning framework with guidelines for incorporating aquaculture into the planning for sustainable fisheries and coastal zone management is required in order to recognize the vital contribution of culture fisheries (aquaculture) and enhanced fisheries (ranching) to fisheries production and to enhance aquaculture's efficiencies in order to protect ecosystems and ecosystem services and to evolve more sustainable capture fisheries.

Environmental Interactions: New Perspectives on Predator Protection / Closed Containment / Sustainable Feeds

Monday, May 11, 2009 – lundi 11 mai, 2009
2:00 PM – 5:00 PM
Location: Dunsmuir / Malahat

Chair: Duane Barker

2:00 **Rundle, T.**
New perspectives on predator protection

2:20 **Albright, L.J.**
The use of a solid-wall containment system for rearing salmonids in fresh and sea waters

2:40 **West, G.**
Aquaculture – where we are now

3:00 **Ikonomou, M.G.**
Alternate diets for salmon aquaculture: factors affecting fatty acid and contaminant residue levels

3:20 **Saha, J.K.**
Evaluation of mixed feeding schedule varied with dietary protein level on the growth performance and reduction of production cost for pangas and silver carp

3:40 **HEALTH BREAK**

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

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New perspectives on predator protection

T. Rundle[*1]

[1]Creative Salmon Co. Ltd.

Tim Rundle earned a B.Sc. in Marine Biology from the University of Guelph in 1992 before moving out to the west coast. He has been salmon farming with Creative Salmon Company based in Tofino, BC for more than 15 years with roles starting at farm tech to his current position of General Manager . He is also one of the directors of the BC Salmon Farmers Association, and the Pacific Organic Seafood Association.

Abstract: This presentation will discuss Creative Salmon's current approach to predator protection. The goals of any predator protection should be non-lethal deterrents for the predator, avoiding escape of fish stock and of course protection of the fish from harm. There will be an overview of predators related to aquaculture here on the west coast but the focus of this presentation will be on recent events relating to Creative Salmon's predator interactions with sea lions and how the company has adapted its equipment and approach. Discussion will occur on the nature of the sea lion interactions as well as information on predator nets, grower nets, shark guard netting, net strengths and deployment options based on our experience, talks with other companies and many aquaculture suppliers.

The use of a solid-wall containment system for rearing salmonids in fresh and sea waters

R. Buchanan and L.J. Albright*

AgriMarine Industries, Campbell River, BC

The cost of mass-rearing salmonids in either fresh or sea water flow through systems in tanks on land is too expensive with regard to energy costs and commercial size production. AgriMarine Industries is therefore initiating the design, construction and operation of several farms which use commercial size (24 and 30 m diameter and up to 12 m deep) tanks for flow-through culture of salmonids. Each tank is constructed of fibre glass laminate with closed-cell foam in the wall that gives it structural strength so that the tank will float and withstand marine loads.

The tanks are designed, as modified swirl separators, that will culture upwards of 100,000 salmonids each and with energy costs that do not exceed 10 % of the cost of production. In addition the tank systems are designed to: (1) Eliminate escapes of the cultured salmonids (2) Eliminate predator attacks (3) Lessen the possibility of toxic phytoplankton blooms coming in contact with the cultured fish and provide year-round appropriate culture water temperatures by pumping deep water to the tanks as appropriate (4) Oxygenate the culture water as appropriate (5) Allow for ease of mortality retrievals (6) Lessen the costs of transport and labour by using culture locations close to where the produced finfish are consumed and (6) Collect and concentrate the majority of the feces and uneaten feed for subsequent disposal on land as fertilizer.

Aquaculture – where we are now

G. West [*1]

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Fish are being raised on land either to complete grow out or for portions of its juvenile life. The technology has advanced to a point where very little water needs to be used and energy consumption is kept to a minimum, two fundamental goals in our world today.

There are several different technologies being utilized in order to raise, healthy fish in as little time as possible. For intensive fish rearing, growing fish where limited water resources are available or rearing species that are not native more control may be needed and a reduction of new water coming into the rearing facility would be required. There are progressive options for ammonia removal, oxygenation and removing solids which have changed over the last few decades and are continuing to improve. This aids in the economical and necessary task of raising fish on land, both for environmental and world food consumption purposes.

The technology and process involved with on-land fish rearing is solids removal, ammonia removal, CO2 removal, oxygen addition and in some cases, disinfection. Most fish, no matter what the species require most of these steps in water quality adjustment to meet their production goals when raising fish on land. An informed aquaculturist is able to make educated decisions with regards to water quality, equipment requirements and fish rearing technologies being adopted.

Alternate diets for salmon aquaculture: factors affecting fatty acid and contaminant residue levels

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[2]DFO / University of British Columbia, Centre for Aquaculture and Environmental Research, West Vancouver, BC
[3]Skretting Canada Inc., Vancouver, BC
[4]Cooke Aquaculture Inc., Saint John, NB

[1] Fisheries and Oceans Canada (DFO), Institute of Ocean Sciences, Sidney, BC, [2] DFO / University of British Columbia, Centre for Aquaculture and Environmental Research, West Vancouver, BC; [3] Skretting Canada Inc., Vancouver, BC; [4] Cooke Aquaculture Inc., St. John, NB.
Several studies have documented the occurrence of persistent organic pollutants (POPs) and heavy metals in commercial aquafeeds and in the flesh of farmed salmon. In recent years, based on a relatively limited and somewhat biased set of contaminants data, some groups have aimed to generate a negative perception on the flesh quality of farmed salmon in particular. In this study, we report findings of a comprehensive investigation that involved measurements of fatty acids and POPs in commercial aquafeeds, as well as the flesh of three species of farmed salmon and five species of wild salmon from British Columbia. The results from a parallel study demonstrate the effects of using terrestrial based oils as major sources of dietary lipid in commercial aquafeeds for salmon with respect to dietary and flesh concentrations of POPs and *n*-3 HUFAs. The relative benefits and risks of consuming farmed versus wild salmon will be discussed

considering the national and international guidelines for intake of lipids and fatty acids and the Canadian and international toxicological regulatory standards pertaining to human health. A mathematical model has also been developed for the purpose of predicting levels of POPs and n-3 HUFAs in farmed salmon from known levels in aquafeed.

Evaluation of mixed feeding schedule varied with dietary protein level on the growth performance and reduction of production cost for pangas and silver carp

J.K. Saha*[1], J. Ahmed[1], S.R. Das[1], M.M. Ali[2], and M.B. Uddin[3]

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An on station pond trail was conducted for 6 months to investigate the suitability of mixed feeding schedules with varying protein levels on the growth of pangas, *Pangasius hypothalamus* and silver carp, *Hypophthalmicthys molitrix*. Ten experimental ponds were divided into 5 different protein level treatment groups each with two replicates. Fishes were stocked at the ratio of 80:20 (pangas:silver carp) at the total rate of 25000/ha. Feeding rate was calculated on the basis of pangas body weight and fed at the rate of 15, 10, 8 or 5% for the 1st, 2nd, 3rd, and subsequent months, respectively. The results of the study showed that significantly ($P<0.05$) higher weight gain of fishes was achieved in feeding schedules of H (30% protein) and 1L/IH (one day low protein diet followed by one day high protein diet) showing significantly the lowest i.e. the best FCR. The survival of pangas and silver car were 80.1 to 82.5% and 92-95%, respectively. Total production of pangas ranged between 3606-7082 kg/ha while silver carp raged between 1781-2225 kg/ha. For profitable pangas farming in Bangladesh, farmers can adopt a mixed feeding schedule of alternative low and high protein diet instead of continuous feeding a high protein diet.

Environmental Interactions: New Perspectives on Aquaculture Management and Monitoring

Tuesday, May 12, 2009 – mardi 12 mai, 2009
8:00 AM – 10:00 AM
Location: Ballroom

Chair: Duane Barker

8:20 Backman, C.
Operational decisions in response to a performance based regulation reduce organic waste impacts near Atlantic salmon farms in British Columbia, Canada

8:40 Taekema, B.
Development of an underwater video protocol for environmental monitoring of hard seabed substrates as a regulatory tool for coastal finfish aquaculture, British Columbia, Canada

9:00 Chang, B.D.
Characterization of dissolved oxygen concentrations in the vicinity of salmon farms in southwestern New Brunswick, Bay of Fundy

9:20 Filgueira, R.
Coupling biological, physical and chemical submodels to assess the carrying capacity of aquaculture sites

9:40 Hughes, S.
Remote sensing techniques for aquaculture management and monitoring

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

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Operational decisions in response to a performance based regulation reduce organic waste impacts near Atlantic salmon farms in British Columbia, Canada

C. Backman*[1]

Marine Harvest Canada, #124-1334 Island Highway, Campbell River, British Columbia, Canada. V9W 8C9

Nutrient enrichment of the sea floor (benthos) has been a primary subject of investigation since the beginning of commercial salmon farming. While early studies of salmon farming in British Columbia Canada (500 - 1200 metric ton production farms) showed that these effects varied greatly but were often minimal, more recent studies of farms producing in excess of 2000 tons of fish have documented measurable organic benthic impacts. The implementation of a performance based waste regulation in British Columbia in 2002 has caused operational changes to achieve and maintain compliance. This paper describes field monitoring data for three representative farm operations including the waste impact levels prior to the implementation of regulatory standards and the effect of adaptive management actions taken to reduce organic loading in order to achieve continuing compliance. Monitoring over several full production cycles at selected farms indicated that sediment impacts at maximum production levels have decreased while maintaining, and in some cases increasing overall production of salmon.

Development of an underwater video protocol for environmental monitoring of hard seabed substrates as a regulatory tool for coastal finfish aquaculture, British Columbia, Canada

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Recent amendments proposed for BC's Finfish Aquaculture Waste Control Regulation (FAWCR) include new compliance standards for net-pen operations situated over hard ocean bottom substrates. The background research and testing to support the new standards including the development of video generation and assessment protocols and practical environmental parameters will be presented. A technical committee undertook a series of research projects and field trials to: i) establish suitable video generation specifications and deployment protocols; ii) develop an interpretive video classification system; iii) develop specific compliance parameters; and iv) determine an appropriate monitoring program. Video generation specifications and deployment protocol characteristics included speed over ground, lighting, resolution and geo-positioning. The classification framework included the use of video "quadrats" based on a unique time/unit basis. A key component is the development of a "zone of compliance" concept. The benefits of adopting a compliance zone are: 1) overcoming the difficulty of precisely locating the position of a ROV at any point in time with affordable technology; and 2) recognizing that hard

ocean bottom sites are typically heterogeneous in nature, resulting in a non-uniform build-up of organic waste material. The two primary parameters, *Beggiatoa* (bacterial mat) and opportunistic polychaete complex (marine worms) will also be discussed.

Characterization of dissolved oxygen concentrations in the vicinity of salmon farms in southwestern New Brunswick, Bay of Fundy

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

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

Dissolved oxygen (DO) concentrations were measured inside and outside salmon cages at two fish farms in southwestern New Brunswick, Bay of Fundy. Water current velocities were relatively low at both farms during the study period, averaging about 5 cm s^{-1}. DO concentrations at both sites showed cyclical fluctuations, with a period equal to that of the tidal cycle (12.4 h), and a range of 1-2 mg L^{-1}. At both sites, DO concentrations were lower inside the cage, compared to outside, with an average difference of 0.35 mg L^{-1} at site A and 1.06 mg L^{-1} at site B. The greater difference in DO concentrations at site B may have been due to the higher biomass of fish in the cage (130 000 kg) compared to that of the cage at site A (50 900 kg). The Page oxygen depletion model was applied to the data from both sites.

Coupling biological, physical and chemical submodels to assess the carrying capacity of aquaculture sites

R. Filgueira* and J. Grant

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Carrying capacity of mussel aquaculture sites can be studied by means of box models, however spatial detail provided by a fully-coupled model is often desirable. High spatial resolution allows simulation of the effects of farm location on the ecosystem and the interaction between farms. Therefore, management policies pertaining to the spatial arrangement of farms can be established as well as a prediction of bivalve growth rate as a function of culture biomass in each location. In addition, the results can be can be mapped, which enhances the potential of the model to represent real-life conditions. A fully-coupled biological-physical-chemical model requires the coupling of a physical submodel to describe the water exchange within the study area and an ecophysiological-chemical submodel to describe the physiology of the different organisms and the interactions between them and the environment. This paper presents a modelling technique that can be used to build fully-coupled models for aquaculture studies and its application to mussel farming in eastern Canada.

Remote sensing techniques for aquaculture management and monitoring

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Management of aquaculture production requires unbiased and timely information on infrastructure and environmental conditions. While many traditional observation techniques exist, remote sensing can provide a cost-effective mechanism to support monitoring and development of aquaculture systems. However, its use to date has been limited and mostly restricted to aerial photography surveys, often resulting in costly and quickly outdated information. The Canadian satellite RADARSAT-2 is a new Synthetic Aperture Radar (SAR) satellite that carries high resolution and polarimetric capabilities. Applied research funded by the Canadian Space Agency (CSA) demonstrated that SAR imagery, acquired independent on cloud cover, can be used to detect and measure finfish and shellfish aquaculture infrastructure and can effectively support property management for commercial fishing operations and regulatory bodies. The analysis employed polarimetric decompositions and target-to-clutter ratios to separate aquaculture structures from the ocean surface. Measurements of chlorophyll-a and sea surface temperature for detection of Harmful Algal Blooms (HABs) are possible with MODIS and MERIS satellite imagery. This information, integrated with wind direction and speed data extracted from SAR imagery, can be used as input data for HABs dispersion models. Examples of practical applications using both SAR and optical data in Canada and Chile are explored in this work.

Application of Genome Science to Sustainable Aquaculture

Tuesday, May 12, 2009 – mardi 12 mai, 2009
8:00 AM – 10:00 AM
Location: Malaspina

Chairs: William Davidson and Linda Hiemstra

William Davidson
Session introduction and global perspectives

8:00 **Hardy, R.W.**
Research thrusts in nutritional genomics of rainbow trout

8:20 **Rise, M.L.**
Cod genomics project

8:40 **Gurney-Smith, H.**
Development of a health assessment tool for marine mussels (Myt-OME)

9:00 **Koop, B.F.**
Developing genomic tools for characterizing genetic diversity and selection in sablefish

9:20 **McGowan, C.**
The application of salmonid genomic research in a mid-sized commercial broodstock facility: the Icy Waters arctic charr experience

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

Research thrusts in nutritional genomics of rainbow trout

R.W. Hardy*

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Sustainable aquaculture depends in part on the use of sustainable inputs and on minimizing outputs that affect the aquatic environment. Challenges facing the aquaculture industry include the fact that fish meal and fish oil are finite resources that are bound to increase in cost as demand by the aquafeed industry taxes world supplies. Using alternative ingredients derived from grains and oilseeds in aquafeeds is widespread, but replacing more than approximately half of the fish meal or fish oil in feeds for salmonids and other marine piscivorous species is difficult. Genomic tools are being applied to this problem in a number of ways ranging from metabolic responses to alternative proteins to investigations to determine if differences in omega-3 fatty acid retention exist among strains or family lines of fish. Dietary inputs that affect muscle cell formation, long-term responses to dietary carbohydrate levels, and factors affecting mineralization of bone are all being revealed through the application of genomics in aquaculture research. Basic research to understand protein retention as well as protein turnover will lead to a reduction in waste outputs from fish farms and to more precise diet formulations containing alternative protein and oil sources.

Cod genomics project

M.L. Rise*[1], S.Hubert[2], B. Higgins[2], T. Borza[2], J. Kimball[3], C. Stone[2], G. Simpson[2], M. Rise[1], C.Y. Feng[1], T.S. Hori[1], J.R. Hall[1], M. Booman[1], A. K. Gamperl[1], E. Trippel[4], S.C. Johnson[5], and S. Bowman[2,6]

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The goals of the Atlantic Cod Genomics and Broodstock Development Project (CGP) include the creation of an extensive set of genomics tools that will be used in the selection of improved broodstock for the Atlantic cod aquaculture industry in Canada. These genomic resources include a large set of expressed sequence tags (ESTs), microsatellite and single nucleotide polymorphism (SNP) markers, and a 20K oligonucleotide microarray. Approximately 158,000 ESTs from normalized and suppression subtractive hybridisation (SSH) libraries representing various tissues, developmental stages, and stress and immune challenges have been submitted to GenBank. Marker identification has yielded over 4,500 predicted informative SNPs and over 140 microsatellite markers, and a high-resolution linkage map and SNP genotyping assay system are being generated. These genetic resources will allow identification of quantitative trait loci (QTL)

present within cod families enrolled in two CGP selective breeding programs. CGP tools are being used to investigate traits of importance to the aquaculture industry (e.g. disease resistance, tolerance to temperature stress, and harvest traits such as growth and product quality). Detailed studies are also being conducted on genes involved in the immune response, thermal stress, and reproduction. The CGP has dramatically improved the availability of resources for genomic research on Atlantic cod.

Development of a health assessment tool for marine mussels (*Myt*-OME)

H. Gurney-Smith*[1] and S. Johnson[2]

[1]Vancouver Island University, 900 Fifth St. Nanaimo BC V9R 5S5
[2]Fisheries and Oceans Canada, Pacific Biological Station, 3190 Hammond Bay Road, Nanaimo, BC V9T 6N7

Increasing environmental pressures on the BC coastline have affected both coastal habitats and the productivity of the aquaculture industry. For cultured and wild shellfish a variety of environmental, biological and human factors that could have significant effects on their populations have been identified. To date, detailed studies on the effects of these factors are limited, due in part to a lack of appropriate tools. Within this program we are developing genomic information and tools for studying marine mussels (*Mytilus* spp.). In addition to being important in Canadian shellfish aquaculture, mussels were chosen as they are also widely used bioindicator species of ecosystem health. Libraries will be generated from mussels exposed to a variety of stressing agents, producing sequence information in the form of expressed sequence tags (ESTs) and identifying genes involved in environmental stress responses. From these libraries a microarray will also be developed for use in expression analysis. Over the long term, these resources will be invaluable to researchers interested in developing and improving mussel culture, as well as those who use mussels to access environmental health. This presentation will provide an overview of the project and report on progress to date.

Developing genomic tools for characterizing genetic diversity and selection in sablefish

B.F. Koop*

Departments of Biology & Medical Sciences, University of Victoria, Victoria, British Columbia CANADA V8W 3N5

Sablefish (*Anoplopoma fimbria*) genomic research initiates the development of genetic resources for a new aquaculture species as well as a valuable, existing natural fishery. As nothing is known about the genetics of sablefish, basic resources such as polymorphic genetic markers for individual and stock identification are the single most important contribution that can be made for both aquaculture and wild fishery applications. These markers enable identification, conservation and management of wildstocks as well as enable broodstock selection in aquaculture. In aquaculture, selected matings can be based on egg quality, juvenile survival and even F1 adult production traits. Known genotypes further enable tracing fish of farm sources in the event of an escape.

Genomic studies in sablefish has three specific objectives:

To identify genes and characterise genetic variation in sablefish. Single Nucleotide Polymorphisms (SNP) and microsatellite markers will be developed from these genes.
To apply polymorphic genetic markers in
Determining population structure, migration patterns and genetic variation in wild sablefish.
Monitoring and conservation of wildstocks.
Characterizing individual broodstock parental genotypes in aquaculture.
Initiating selective breeding strategies in aquaculture programs.
Development of genomic tools for general gene expression analyses with an emphasis on genes associated with growth, reproductive success, and larval metamorphosis.

The advantage of this approach is that it provides a foundation for building more extensive suites of markers for marker-assisted selection, genetic mapping of traits and disease resistance and building gene expression microarray resources. At the same time this work provides basic, fundamental genetic tools that benefit both aquaculture and wild fisheries.

The application of salmonid genomic research in a mid-sized commercial broodstock facility: the Icy Waters arctic charr experience

C. McGowan*[1], E. Davidson[2], J. Lucas[1], J. Rose[1], N. Quinn[2], and W.S. Davidson[2]

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Icy Waters Ltd. is a privately owned Canadian company and a world leader in Arctic charr (*Salvelinus alpinus*) aquaculture. Located in Whitehorse, Yukon Territory, Icy Waters Ltd. is a fully integrated operation that includes a DFO certified broodstock facility, hatchery, tank farm and CIFA approved processing plant. Icy Waters also sells its *ova* to aquaculture operations throughout the world.

In 2001, Icy Waters embarked on a six-year collaboration with Simon Fraser University to incorporate new technologies from the fields of molecular genetics and genomics into their breeding strategy. Genetic markers have been used to determine the genetic relationship of two purebred strains (Nauyuk Lake and Tree River), avoid inbreeding and to resolve pedigrees for the estimation of genetic parameters such as heritability. Markers that identify sex are being used to generate all-female lines of broodstock and production fish. A genome-mapping project has identified QTLs for early growth rate that have been used in a marker-assisted selection program. More recently, the company's interests have turned towards the discovery of genetic markers that are associated with disease and stress resistance. We continue to collaborate with SFU and are involved in projects investigating gene expression at high water temperatures and the evolution of the Salmonid sex chromosome.

Alternative Shellfish Culture

Tuesday, May 12, 2009 – mardi 12 mai, 2009
8:00 AM – 10:00 AM
Location: Dunsmuir / Malahat

Chair: Chris Pearce

8:00 **McGaw, I.J.**
Effects of environmental perturbations on feeding and digestion in decapod crustaceans

8:20 **Redjah, I.**
A natural zooplankton based diet to increase survival and cryptic behaviour of American lobster (*Homarus americanus*) larvae

8:40 **Whyte, G.**
A review of abalone hatchery techniques throughout the world, with a focus on Canada

9:00 **Marshall, R.**
Testing green sea urchins' potential to control mussel fouling in shellfish aquaculture

9:20 **Azad, A.K.**
Larval development and survivorship of laboratory-reared purple sea urchins (*Strongylocentrotus purpuratus*): influence of stocking density

9:40 **Pearce, C.M.**
Effect of temperature on gonad yield and gonad sensory attributes in the green sea urchin, *Strongylocentrotus droebachiensis*

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

Effects of environmental perturbations on feeding and digestion in decapod crustaceans

I.J. McGaw*[1,2] and D.L. Curtis[1,2]

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[2]Bamfield Marine Sciences Centre, Bamfield, BC V0R 1B0

Worldwide, crustaceans comprise about one fourth of aquaculture species; a number of studies have examined the effects of environmental challenges on the growth of shrimps. However, much less is known about brachyuran crabs. Knowledge of their feeding and digestive processes is useful for determining optimal culture conditions. The effects of hypoxia and salinity on feeding and digestion were investigated in the Dungeness crab, *Cancer magister*. Crabs reduced their feeding rate in oxygen tensions below 3.2kPa and where able, moved food into higher oxygen regimes to feed. Low oxygen concentrations (<5kPa) slowed gastric contraction rates and thus food passage through the system, resulting in a reduced digestive efficiency. During low salinity exposure crabs prioritized respiratory events associated with osmoregulation over those of digestion. This manifested itself as a reduction in gut contraction and slowing of enzyme release, but had no marked effect on digestive efficiency. Low salinity also reduced the likelihood and frequency of feeding. In the wild, postprandial crabs used behavioural mechanisms to avoid challenging environmental conditions, thereby maximizing digestive efficiency. However, if they are unable to seek out optimal conditions, the observed changes in gastric processes and feeding behaviour may have drastic effects on growth and reproduction.

A natural zooplankton based diet to increase survival and cryptic behaviour of American lobster (*Homarus americanus*) larvae

I. Redjah[1*], R.Tremblay[1], S. Motnikar[2], M.-L. Beaudin[1], S. Belvin[1,2], and F. Pernet[3]

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The main objective of this study was to examine the effects of natural zooplankton diet on fatty acids composition and the cryptic behaviour of the american lobster (*Homarus americanus*) larvae. We compared, in hatchery production, the natural zooplankton to the traditionally used enriched artemia diets on triacylglycerols (TAG) and polyunsaturated fatty acids (PUFA), especially the docosahexaenoic acids (22:6n-3), content of the larvae. The preliminary results, obtained in 2007, showed that larvae fed with natural zooplankton had doubled their 22:6n-3 ratio values in cell membranes (polar lipids) compared to those fed with enriched artemia (23.9± 0.7% and 10.9±1.3% respectively) associated with higher TAG content (7.8±7.25 mg/g_{tissu} and 3.1 mg/g_{tissu} respectively) and survival rates (12.9±10.3% and 4.2±1.3% respectively) at stage IV. In 2008, we compared the same diets on larvae rearing to correlate PUFA composition with cryptic behaviour. The results showed clearly that diet based on natural zooplankton increase significantly DHA content of larvae at stage IV. These DHA enriched larvae, had an increased cryptic behaviour compared to artemia fed larvae.

A review of abalone hatchery techniques throughout the world, with a focus on Canada

G. Whyte*[1]

[1]Pacific Trident Fishing Co. Ltd., Duncan, BC, Canada

This presentation will focus on hatchery procedures for abalone production throughout the world (Asia, China, Japan, Africa, Australia, New Zealand, and the Americas), with a focus on work done in Canada on the pinto abalone, *Haliotis kamtschatkana*. In Canada, prior to harvesting, Fisheries and Oceans Canada requires a survey of the harvesting area in order to determine the number of adult abalone available for capture. This is because the local abalone species, ***H. kamtschatkana***, is listed as "threatened" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The hatchery must have adequate facilities to house and mature the broodstock for spawning, which can be induced by using variable temperature and light regimes. Spawn induction can also be achieved using ultra-violet light or through the addition of certain chemicals. The presentation will discuss methods for egg fertilization, egg hatching, larval rearing through settlement, preparation of settlement substrates and early juvenile feeds, removal of juveniles from settlement substrates, and juvenile food conversion. The presentation will also examine facility and equipment requirements for a small, grow-out facility.

Testing green sea urchins' potential to control mussel fouling in shellfish aquaculture

R. Marshall*[1], A. Epelbaum[2], S. Cross[3], T. Therriault[1], and C.M. Pearce[1]

[1]Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo, BC, Canada V9T 6N7
[2]Vancouver Island University, Nanaimo, BC, Canada V9R 5S5
[3]Pacific SEA-Lab, University of Victoria, Victoria, BC, Canada V8P 5C2

In shellfish aquaculture, biofouling is typically managed by frequent cleaning of grow-out gear with high-pressure water hoses, regular net/cage changes, and treating gear with antifouling chemicals. Adding natural grazers to cultivation nets or cages could be a low-cost, environmentally friendly, labour-saving technique that avoids the use of chemicals or new equipment and reduces dislodged biofouling accumulation on the seafloor. Ideally, the biological control organism is also exploited, so that the method becomes a form of integrated multi-trophic aquaculture. The goal of our project was to evaluate the practicability of using sea urchins *Strongylocentrotus droebachiensis* as biological control for mussel fouling in shellfish aquaculture. When placed inside suspended oyster farming trays at a density of 10 ind per tray for the growth season (April to November), green sea urchins were found to be efficient in controlling mussel fouling both on the inside and outside of the trays, as well as on the oysters themselves. In order to explore the mechanism of how urchins control mussel fouling, we conducted a subsequent lab experiment where urchins were placed inside trays pre-fouled with juvenile (10-20 mm shell length) mussels. Results indicated that urchins inside of trays had no effect on mussels on the exterior surface of trays, suggesting that the use of urchins inside of trays as a control for biofouling is only effective if used before mussel settlement.

Larval development and survivorship of laboratory-reared purple sea urchins (*Strongylocentrotus purpuratus*): influence of stocking density

A. Kalam Azad*[1,2], R.S. McKinley[1], and C.M. Pearce[2]

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To determine the optimal larval rearing density for the purple urchin, *Strongylocentrotus purpuratus*, we examined the influence of four stocking densities (0.5, 1.0, 2.0, 4.0 inds ml^{-1}) on larval development and survivorship. Larval total length, body length, body width, post-oral arm length, time to reach metamorphic competency, and survival rates were assessed during the developmental period. Results showed that, at each sampling time, larvae reared at the highest density had the smallest mean total length, whereas larvae reared at the lowest density had the largest mean total length. Larvae held at 0.5 ind ml^{-1} displayed a more typical morphology and 50% of larvae became competent to metamorphose at day 24, whereas only 5% of larvae at 2.0 inds ml^{-1} were competent to metamorphose at day 28 of the culture period. Larvae held at 4.0 inds ml^{-1} failed to develop to metamorphosis. Survivorship at the end of the experiment was significantly higher when larvae were reared at 0.5 or 1.0 ind ml^{-1} (48.3% and 48.9%, respectively) than when held at 4 inds ml^{-1} (27.3%). The results suggest that a stocking density of 0.5 ind ml^{-1} is best for hatchery culture of *S. purpuratus.*

Effect of temperature on gonad yield and gonad sensory attributes in the green sea urchin, *Strongylocentrotus droebachiensis*

C.M. Pearce*, D. Bickerton, S. Leonard, J. Blackburn, and L. Keddy

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

Green urchins in two size ranges (42.0–52.0, 56.5–66.5 mm) were held at four temperatures (4, 8, 12, 16ºC) and fed kelp for six months. Various gonad characteristics (percent yield, colour/texture/firmness ratings, and CIE lightness/redness/yellowness) were measured in all urchins at the end of the experiment. A sub-sample of individuals was sent to a seafood processor for evaluation of gonad colour and flavour. Percent yield was significantly affected by size, temperature, and the interaction between the two factors. There was no significant difference between the two size groups at 4, 8, or 12ºC, but smaller urchins had significantly higher percent yields than larger individuals at 16ºC. For larger urchins, there was no significant difference among the four temperatures in terms of percent yield. For smaller urchins, percent yield was highest at 12ºC; significantly higher than at 4 or 8ºC. Colour rating was significantly affected by size – smaller individuals having better colours than larger ones – but not by temperature or the interaction. Texture rating, firmness rating, and L*, a*, b* values were not significantly affected by size, temperature, or the interaction. The processor judged the smaller urchins to have better gonad colour than the larger urchins and those reared at the two higher temperatures to have better gonad colour and flavour than those at the two lower temperatures. Urchin size did not seem to affect the processor's assessment of flavour. The results of this study suggest that the best temperature for optimizing yield and quality of green sea-urchin gonads would be 12ºC.

Aquaculture Innovation and Market Access Program (AIMAP) Update

Tuesday, May 12, 2009 – mardi 12 mai, 2009
1:50 PM – 4:50 PM
Location: Ballroom

Chair: Alistair Struthers

1:50 **Struthers, A.**
The Aquaculture Innovation and Market Access Program: program update

2:10 **Johnson, G.**
Halibut PEI: the use of lobster pounds in the off-season for the land-based culture of halibut

2:30 **Bridger, C.**
Innovative & sustainable technologies for Canadian finfish aquaculture operations: AEG solutions for an eco-friendly aquaculture future

2:50 **Stechey, D.**
Manitoba - Canadian model aqua-farm initiative

3:10 **HEALTH BREAK**

3:30 **Nikleva, D.**
Red rock crab predator management techniques for intertidal shellfish culture

3:50 **Cross, S.F.**
The SEA-system infrastructure innovation project – modifying steel fish-cage systems to accommodate Integrated Multi-Trophic Aquaculture

4:10 **Nicoll, R.S.**
Simulation-based design of shellfish cultivation rafts

4:30 **Powell, F.**
Newfoundland Atlantic cod farm demonstration project

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

The Aquaculture Innovation and Market Access Program: program update

A. Struthers*[1]

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

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

Halibut PEI: the use of lobster pounds in the off-season for the land-based culture of halibut

G. Johnson*[1,2]

[1]J. Dunphy Inc., Charlottetown, Prince Edward Island, Canada, C1A 9E3
[2]Atlantic Veterinary College, University of Price Edward Island, Charlottetown, PE, C1A 4P3

Halibut PEI will determine the feasibility of raising halibut fingerlings to market size using the salt water wells and lobster holding facilities at MorningStar Fisheries in Victoria, PEI during the 9 months of the year when the facility is not required for lobster operations. It is expected that the salinity levels and temperature ranges of the water in this facility could produce marketable halibut in one growing season if the proper stocking size is determined. The proponents believe that a land based grow out of halibut industry can be created in PEI that utilizes existing infrastructure in other PEI lobster holding facilities with their temperatures stable water temperatures and with minimal capital investment for renovation, creating a new aquaculture industry in PEI and year round employment in plants that have been seasonal to date.

Innovative & sustainable technologies for Canadian finfish aquaculture operations: AEG solutions for an eco-friendly aquaculture future

C. Bridger*[1]

[1]Aquaculture Engineering Group Inc., St. Andrews, New Brunswick, Canada, E5B 1Y9

Aquaculture Engineering Group Inc. was incorporated in November 2002 to develop equipment and management solutions that meet existing technology shortcomings. The AEG DFO AIMAP funded project has established a small finfish aquaculture operation in St. Mary's Bay, NS to raise Atlantic salmon through the early smolt stage of a grow-out cycle (60-300 g). Specifically,

the project aims to demonstrate the *AEG Feeder* pulse feeding capability compared with the now standard meal feeding approach. The project also integrates the fish sizing AquaSonar technology with the AEG site management software application – *Neptune* – to allow daily fish size updates for superior feed management and market planning. Additional logistics mitigation has been developed through onfarm use of *AEG Solutions* including an integrated nursery net strategy and submersible HDPE collar to avoid seasonal surface perils.

Manitoba - Canadian model aqua-farm initiative

D. Stechey*[1], G. Vandenberg[2], and J.Eastman[3]

[1]Canadian Aquaculture Systems Inc., Cobourg, Ontario, Canada, K9A 5N4
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The Canadian Model Aqua-Farm Initiative comprises the development and construction of a state-of-the-art commercial land-based freshwater aquaculture production system intended to be the basis for a standardized approach to freshwater aquaculture production. In addition, this first model farm will be heavily monitored to document the economic and environmental performance of the design. The anticipated outcome is a 'turn-key' freshwater aquaculture operation that will catalyze the development of a sustainable freshwater aquaculture industry in Canada.

Red rock crab predator management techniques for intertidal shellfish culture

D. Nikleva*[1]

[1]Below Sea Level Oyster Co, Cortes Island, British Columbia, Canada, V0P 1K0

Intertidal shellfish culture is under intense predation from the Red Rock Crab. This project will fabricate four styles of a U shaped trench that will be installed as a subsurface barrier to crabs. The subject area will be contained within the trench, seeded with oysters, and compared against an adjacent non-treated area also seeded with oysters to determine predation trials. The trench section parallel to the LWM will have "T" intersections that will empty towards deepwater, where it is expected that the crabs will exit back to the ocean. The other subject of the trials will determine if the crabs can leave the trench easily and therefore become a non-lethal solution to predator management. This may be a sustainable solution that minimizes impact on the predator, and may greatly increase the productivity for intertidal shellfish culture.

The SEA-System infrastructure innovation project – modifying steel fish-cage systems to accommodate Integrated Multi-Trophic Aquaculture

S.F. Cross*[1]

[1]Kyuquot SEAfoods Ltd., Courtenay, British Columbia, Canada, V9N 9N8

The SEA-System Infrastructure Innovation Project will design, engineer and test prototype infrastructure components for existing fish farm net-cages that will allow these systems to be modified to accommodate additional production species in support of a balanced, Sustainable Ecological Aquaculture (SEA) system design. In addition to the single fed component (fish), contained within net cages, a proposed SEA-Tram System will service a shellfish (oysters / scallops) component adjacent and downstream of the fish (extracting fine organic wastes from the water), with a SEA-Tray System envisioned to support the culture of species such as sea cucumbers beneath the fish cages, thereby intercepting and using the heavier organic waste particles before they hit the sea floor. While the ecological design of such integrated aquaculture systems will ensure significant environmental as well as socio-economic benefits, this project will provide additional 'green' benefits by incorporating Sustainable Energy Alternative (SEA-Power) systems to operate these infrastructure components. The overall production model is envisioned to intensify aquatic agri-food production, yet do so in an efficient (economic) and environmentally sustainable manner.

Simulation-based design of shellfish cultivation rafts

R.S. Nicoll*[1] and B.J. Buckham[2]

[1]Dynamic Systems Analysis, Ltd., Victoria, BC, Canada, V8W 3W2

[2]University of Victoria, Department of Mechanical Engineering, Victoria, BC, Canada, V8W 3P6

The combination of storm conditions and deteriorating structural components has repeatedly led to catastrophic failure of existing shellfish cultivation raft designs. In addition to the obvious economic impact, these failures can have significant environmental and social repercussions. During storm conditions, significant wave forces, hydrodynamic drag, added mass and inertial forces are applied on the raft beams through the primary floats and mooring and cultivation tray lines. Accurate models of these forces in conjunction with a dynamic structural model of the raft can be used to guide design by identifying the failure modes and the components that need to be reinforced. Furthermore, numerical modeling is risk-free and has shown to be a valuable tool in the design of cabled underwater vehicle systems and other offshore moored ocean infrastructure. This work outlines how an in-house dynamic analysis software package, ProteusDS, has been used to gauge survivability of several raft designs in simulation. Various beam sizes, shapes, materials, and raft structural layouts have all been tested in the search for a more reliable raft design. One key result is that raft pitch and roll facilitates lateral beam loading. Simulations indicate rafts with circular pipes instead of rectangular beams are more reliable.

Newfoundland Atlantic cod farm demonstration project

F. Powell*[1]

[1]Cold Ocean Salmon Inc., Black's Harbour, New Brunswick, Canada, E5H 1E6

The main objective is to develop a commercial scale cod farm in Newfoundland that utilizes "best approach" techniques and equipment to successfully grow cod from fry through to market demonstrating both technical and financial feasibility. It is thought this "demonstration" will in turn stimulate further financial investment from us and possibly other private sector companies. To enhance achievement of our objectives we propose to stock 250,000 cod annually for 3 years and for purposes of the project harvest the first year class of fish in year 4. It is anticipated that the project will be successful and further year classes of cod will be stocked in subsequent years as the business continues to grow. In addition to successfully taking commercial quantities of cod to market, we feel the project will also provide grounds for training of students/workers in the area of cod farming, as well as providing an enhanced location to allow further R and D activities to take place.

Fish Welfare and Fish Health

Tuesday, May 12, 2009 – mardi 12 mai, 2009
1:50 PM – 4:50 PM
Location: Malaspina

Chair: Tillmann Benfey

1:50 **Saksida, S.**
Fish welfare: understanding the issues in farming fish

2:10 **Braithwaite, V.A.**
Do fish have feelings – are they sentient and can they suffer?

2:30 **Griffin, G.**
Fish welfare and the Canadian Council on Animal Care

2:50 **Kreiberg, H.**
Toward consistent good welfare in harvested farmed salmon: field trial of a Sotra Singelstunner™ electric stunner

3:10 **HEALTH BREAK**

3:30 **Sacobie, C.F.D.**
Dietary energy requirements of triploid brook trout, *Salvelinus fontinalis*

3:50 **Verhille, C.E.**
Early screening of triploid salmonids for swimming endurance can improve overall stock performance

4:10 **Moret, C.**
Phase II of the Fin-Immune™ trials: testing its efficacy against furunculosis in cultured rainbow trout, *Oncorhynchus mykiss*

4:30 **Araya, M.T.**
Morphological and molecular effects of *Vibrio splendidus* on hemocytes of soft-shell clam, *Mya arenaria*

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

Fish welfare: understanding the issues in farming fish

S. Saksida*, L.O.B. Afonso, E. Downey

BC Centre for Aquatic Health Sciences, Box 277, Campbell River BC V9W 5B1

As fish health professionals we have developed practices and protocols to monitor the health of populations of farmed fish. Preventing and controlling disease through preventative and treatment practices, good husbandry techniques and biosecurity measures are the main tenets currently applied in fish farm health management. It is commonly accepted that if the animals are healthy, their well being and quality of life are adequate. However, there is more to good welfare than good health. Stress, for example, is a term freely used by fish health managers, and it is frequently associated to developing health problems. Still, stress is rarely adequately assessed (qualitatively or quantitatively) in fish production settings. This presentation will outline a number of current practices such as vaccination, feeding, housing (stocking density) and slaughter and their potential implications on the welfare. Also, there will be discussion on methods used to assess stress in fish in controlled settings such as a laboratory and their suitability for use in the field to monitor stress on farmed fish.

Do fish have feelings – are they sentient and can they suffer?

V.A. Braithwaite*[1,2]

[1]School of Forest Resources and Department of Biology, Penn State University, PA16801, USA
[2]Department of Biology, University of Bergen PO Box 7800, N-5020 Norway

There is a growing interest in fish welfare, particularly for the fish we farm. Research has shown that teleost fish possess the same kinds of pain receptors, nociceptors, as terrestrial vertebrates. These enable the fish to respond to tissue damaging, or noxious, stimuli, but does the presence of the nociceptors mean that the fish feel pain? Much of the concern we have for animal welfare makes the assumption that certain animals can experience negative sensations and emotions, and that they have a basic awareness of these experiences. In this presentation I will review the evidence we have for fish and their capacity to experience pain and fear, and I will ask whether it is meaningful to consider that they suffer. While we are becoming increasingly aware of the types of on-farm processes that cause increased levels of physiological stress in fish, our understanding of psychological stressors and the ways in which these affect fish remain little studied. In terrestrial vertebrates we recognize that physiological stress is often directly affected by psychological state. Finding ways to quantify and modify the psychological state of fish could therefore be a useful tool to manage on-farm stress.

Fish welfare and the Canadian Council on Animal Care

G. Griffin[*1]

[1]Canadian Council on Animal Care, 1510-130 Albert St., Ottawa ON, K1P 5G4

The CCAC is the national organization responsible for setting and maintaining standards for the care and use of animals in science in Canada. Around 750,000 fish are used annually for research, teaching or testing, approximately 37% of all animals used in science. Aside from the impact of improving the welfare of large number of animals, as many of those animals are used for aquaculture research, there is the potential to improve the welfare of farmed fish in general. In 2005, the CCAC published *guidelines on: the care and use of fish in research, teaching and testing*. These guidelines include recommendations concerning facility design, water quality, tank design as well as general husbandry of the animals. Arguably of most importance, the guidelines also consider the issue of pain and distress for fish, and make specific recommendations relating to welfare assessment of fish in a research setting. The careful monitoring that is possible in this environment helps to identify critical signs which can be used to implement appropriate endpoints in research studies. Establishing endpoints prior to the start of a study enable the research data to be collected, while minimizing the potential for pain and distress for the fish.

Toward consistent good welfare in harvested farmed salmon: field trial of a Sotra Singelstunner™ electric stunner

S. Saksida[1], H. Kreiberg[*2], O. Grydeland[3], V. Funk[1], and E. Downey[1]

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[2]Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo, BC V9T 6N7
[3]Diversified Aquaculture Inc., 2573 Coho Road, Campbell River BC V9W 7J5

Welfare and quality concerns require a stress-free slaughter process for farmed salmon. Carbon-dioxide stunning has been shown to achieve no cessation of brain activity in various fish species, and is now banned in Norway for Atlantic salmon harvest. Captive bolt (percussion) stunning is welfare-effective, but is hampered by consistency issues, and reliable achievement of an insensible state prior to slaughter of farmed salmon remains problematical. We tested a new design of electro-stunning device having two charged belts inside a chute (Sotra Singelstunner™), under commercial harvest conditions on Vancouver Island, BC. Effective stunning was achieved in 82.5% of the Atlantic salmon put through the Singelstunner™ (via eye-roll and other non-invasive measures of brain function). Commercial grading of the electro-stunned (ES) fish was not significantly different from the percussion-stunned (PS) fish, with 31.6% of the ES fish showing bloodspot or muscle/bone damage versus PS fish at 38.1%. Spine damage was observed only in the ES fish (10.5%), but did not affect grading. No pigmentation difference was found. We conclude that the Singelstunner showed solid potential for humane stunning of farmed fish, and recent methods of assessing brain-function loss in fish work well in the field. Achieving successful welfare and top quality of harvested fish requires meticulous attention to every step of the harvest process.

Dietary energy requirements of triploid brook trout, *Salvelinus fontinalis*

C.F.D. Sacobie*[1], T. J. Benfey[1], and S.P. Lall[2]

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Triploid salmonids are used in aquaculture because they are sterile, which eliminates pre-harvest loss in flesh quality associated with sexual maturation. Despite this advantage, studies have shown that triploids do not perform as well as their diploid counterparts. Triploids are fed commercial diets formulated for diploids, in spite of being quite different in their physiology. Would a difference in energy requirement be the cause for reduced performance? Diets were formulated with three different energy levels (15, 16.5 and 18 MJ/kg) and fed to triplicate groups of diploid (control) and triploid brook trout. Thirty fish per tank were fed to satiation twice daily for a 10-week period and the amount of food consumed was recorded daily. The fish were measured initially and every 4 weeks until the end of the experiment, when 5 fish per tank were randomly collected for determination of whole body proximate composition. Following the growth trial, 10 fish from each tank were used for digestibility trials using the same diets (but incorporating chromic oxide), and feces were collected daily to determine apparent digestibilities. Triploids had lower growth rates, condition factor and feed efficiency on all three diets compared to diploids. They also had lower lipid content, but equal protein content, which resulted in lower energy content in both the initial and final sampling compared to diploids. Triploidy did not affect feed digestibility, suggesting that the reduced performance of triploids must be due to a difference in metabolic energy utilization. This project was funded by NSERC and NBIF, in partnership with Heritage Salmon, Corey Feed Mills, Cooke Aquaculture and the Atlantic Salmon Federation.

Early screening of triploid salmonids for swimming endurance can improve overall stock performance

C.E. Verhille* and A.P. Farrell

Department of Zoology, University of British Columbia, Vancouver, B.C.

The benefits of triploid salmonid sterility are not realized for the aquaculture industry due to impaired survival and growth of triploid relative to diploid salmonids. Physiological studies show reduced triploid aerobic scope (the difference between resting and maximum metabolic rate). Aerobic scope, has been hypothesized as an important factor limiting survival of fish in the wild. Thus, early screening of hatchery stocks for aerobic scope and removal of low performance fish can elevate overall performance of triploid populations.
It is impossible to efficiently screen large numbers of fish for aerobic scope. Endurance swimming rank, which correlates with aerobic scope and is repeatable over a period of 9 months within rainbow trout populations, can be rapidly quantified for large groups of fish.
Endurance swimming tests were performed on groups of 500 maternally matched rainbow trout in order to divide the groups into quartiles based on swimming endurance. The tested fish were

then released into small monoculture lakes in order to relate endurance rank with summer lake survival.
Survival of the entire triploid population was 60% of diploid survival, while survival of the triploid high endurance quartile was 86% of the entire diploid population survival. Similar benefits are likely with screened triploids in aquaculture sea cages.

Phase II of the Fin-Immune™ trials: testing its efficacy against furunculosis in cultured rainbow trout, *Oncorhynchus mykiss*

C. Moret*[a], D. Barker[a], G.Cruise[a], D. Fox[a], L. Harris[a], R.Saraga[a], G. Spray[a], and J. Wade[b].

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[b]Fundy Aqua Services, Nanaimo, BC, V9S 1J3

Oral immunomodulators are easy to administer to cultured fish and boost the general, non-specific immune response, thus should offer protection against several pathogens. Recently, mushroom-derived oral immunomodulators have been the focus of research for commercial use in agriculture and aquaculture settings. In Phase I of research (May-August 2008) at Vancouver Island University's trout hatchery, we examined the immune response of rainbow trout (*Oncorhynchus mykiss*) fed various concentrations of the *Cordyceps* mushroom-based immunomodulator Fin-Immune™ (Aloha Medicinals Inc. ™). The resultant optimum concentration (20 mg g^{-1}) was used in Phase II (March-May 2009), to evaluate the efficacy of Fin-Immune™ against *Aeromonas salmonicida,* causative agent of furunculosis. We used a cohabitation disease challenge model, whereby 'donor' fish were injected with 0.1 ml of 10^5 CFU ml^{-1} *A. salmonicida* and were added to the experimental treatment tanks (n = 60 per treatment). Group one were fed Fin-Immune™ for 6 weeks, then exposed *A. salmonicida* and received regular feed for 4 weeks. Group two were fed Fin-Immune™ and exposed to *A. salmonicida* in the same manner, but continued to receive Fin-Immune™ throughout the duration of the trial. Group three (positive control) were exposed to *A. salmonicida* after 6 weeks but never received Fin-Immune™; while group four (negative control) were never fed Fin-Immune™ and were not exposed to *A. salmonicida*. The results will be discussed in terms of commercial applicability of Fin-Immune™ at a hatchery.

Morphological and molecular effects of *Vibrio splendidus* on hemocytes of soft-shell clam, *Mya arenaria*

M.T. Araya*[1], A. Siah[1], D. Mateo[1], F. Markham[1], P. McKenna[1], G. Johnson[1], and F. C.J. Berthe[2]

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[2]Animal Health and Welfare Unit, European Food Safety Authority (EFSA), Largo N. Palli 5/A, I-43100 Parma, Italy

Although mollusc are getting more attention due to their economic and nutritional values, bacterial diseases remain one of the major limiting factors in mollusc aquaculture production. Nevertheless bacterial diseases are not common in soft-shell clams and understanding the immune mechanisms of this organism could help us to prevent bacterial disease in other mollusc species. Hemocytes constitute the cellular part of mollusc immune system and they are involved

in phagocytosis, production of toxic oxygen radicals, antimicrobial peptides, opsonising molecules, lysozymes, digestion, excretion and nutrient transport. In this study the effect of various concentrations of *Vibrio Splendidus* on hemocytes was tested. Moreover the effect of *V. splendidus* (1:1 hemocyte to Vibrio) on morphology, expression of genes associated with cytoskeleton and immune functional assays (phagocytosis and respiratory burst activity) of hemocytes of *Mya arenaria* was investigated. Both flow cytometry assay and confocal microscope observations showed that soft-shell clam hemocytes have the ability to phagocytise. Post-challenge, a significant number of hemocytes lost their pseudopodia compared to hemocytes in control. *V. splendidus* also inhibited respiratory burst activity and impaired phagocytosis in hemocytes of soft-shell clam. Moreover genes (actin and EF-2) associated with cytoskeleton filament stability were up regulated in challenged hemocytes. Hence, we can conclude that *V. splendidus* is a potential pathogen for soft-shell clams and this *in vitro* interaction model could unravel the pathogenesis mechanisms of bacteria in mollusc.

Alternative Shellfish Culture

Tuesday, May 12, 2009 – mardi 12 mai 2009
1:50 PM – 5:10 PM
Location: Dunsmuir / Malahat

Chair: David McCallum

1:50 **Gurney-Smith, H.J.**
Cockles, the new frontier: past, present, and future research and applications

2:10 **Marshall, R.**
The effects of temperature on broodstock conditioning of geoduck clams (*Panopea abrupta*)

2:30 **Doiron, S.**
Evaluation of growth of oysters reared using glued and floating bag methods

2:50 **Stirling, D.**
Mechanized clam harvesting for coastal British Columbia – environmental implications

3:10 **HEALTH BREAK**

3:30 **Cassis, D.**
Can manipulation of culture depth reduce summer mortalities in Pacific oyster seed?

3:50 **Couturier, C.**
Does the presence of predators affect cultured shellfish performance?

4:10 **Werstink, G.**
Economic efficiency of soft shell clam aquaculture (*Mya arenaria*) in the Magdalen Islands

4:30 **Askary Sary, A.**
Diet protein effect search and water with different salinity on hemolymph osmolality and hemolymph protein in Pacific white shrimp (*Litopenaeus vannamei*)

4:50 **Das, S.R.**
Nursing of hatchery produced *Paneous monodon* PL in floating cages in coastal areas of Bangladesh

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

Cockles, the new frontier: past, present, and future research and applications

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The native basket cockle, *Clinocardium nuttallii*, occurs on the Pacific coast of North America from San Diego to the Bering Sea, with a disjunctive population reported in Hokkaido, Japan. Although this species can be found around the coast of British Columbia on sandy to muddy shores, it is not generally present in great abundance. In BC, there is significant commercial interest in basket cockles as an aquaculture species as a result of their relatively fast growth rate, ability to utilize different substrata, adaptation to the cold waters of BC, and importance as a preferred First Nations' food group. Previously, research in BC has been conducted on broodstock conditioning, embryogenesis, and larval and post-larval development (including diet preference, rations, and stocking densities). Currently, research is being undertaken on the on-growing considerations for this species, combining both laboratory and field experiments to investigate post-settlement movement in different substrata, seed production optimization, on-growing culture operation (intertidal versus suspension), and the effects of seed transplantation size and stocking density on growth and survivorship. This research will be presented, along with a discussion of potential markets and requirements for successful basket cockle production.

The effects of temperature on broodstock conditioning of geoduck clams (*Panopea abrupta*)

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This study looked at the effects of various temperatures on the gonad development of broodstock geoduck clams. Adult clams were held at temperatures ranging from 7 to 19˚C and fed *Chaetoceros muelleri* and *Phaeodactylum tricornutum* over a period of six months. To quantify the effects of temperature on gonad development several indicators were examined including histological classification, oocyte diameters, gamete occupation indices (GOI), gonadosomatic indices (GSI), oocyte per follicle counts and organic content of gonad tissue. The highest temperature of 19˚C was found to be inappropriate for broodstock conditioning as gametes were resorbed, resulting in low GSIs, GOIs and oocyte counts. On the other extreme, 7˚C had favourable indicators with ripe gonads, high GSI, GOI and oocyte counts (9-20 oocytes/follicle) but had few spawn events, indicating a minimum temperature requirement for reproduction. The temperature of 11˚C had the most spawn events (6 over 23 weeks), followed by 15˚C (5 over 23 weeks). Both 11 and 15˚C temperature treatments maintained the gonads at a partially spawned state, but 15˚C had more spawned out individuals after five months.

Evaluation of growth of oysters reared using glued and floating bag methods / Évaluation de la croissance des huîtres collées et en poches flottantes

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The primary goal of this study was to document the rearing potential of the glued oyster method. The glued oyster technique is used mainly in Thau Lagoon in France where oysters glued to lines are suspended vertically on oyster aquaculture leases. In New Brunswick, the method was introduced in the early 2000s and had to be modified considerably to suit the physical characteristics of the province's bays. The bag longline rearing method is commonly used on the east coast of N.B., and it proved to be a good candidate for making comparisons between the two growing techniques. The linear growth of glued oysters was therefore compared to that of oysters reared in bags. The results obtained with glued oysters are very significant. The glued method results in better linear growth and weight gain and improves quality. In addition, with glued oysters, there is less variation in growth between individuals in the same lot. As for biological and commercial productivity, the glued oyster rearing method produces results that are clearly superior to those associated with the floating bag rearing method.

L'élevage de l'huître américaine (*Crassostrea virginica*) en poches flottantes est pratiqué depuis près d'une dizaine d'années sur la côte est du Nouveau-Brunswick. La technique a connu beaucoup de succès et les retombées économiques sont mesurables. Malgré ce constat, cette méthode d'élevage est continuellement remise en question en raison des taux de croissance enregistrés dans les poches flottantes, et de nombreux aquaculteurs trouvent qu'une proportion de leur cheptel n'atteint pas la taille commerciale. La faisabilité des huîtres collées à la verticale a été démontrée, mais cette technique ne convient pas pour tous les sites. Par ailleurs, de nouvelles structures de flottaison pour les huîtres collées ont été développées au Nouveau-Brunswick et le présent rapport contient les conclusions d'une évaluation plus approfondie du potentiel de cette méthode. En particulier, l'étude visait à mesurer le taux de croissance moyen de deux lots d'essai dans quatre sites de production ostréicole, à évaluer la qualité de la forme des huîtres, à comparer le rendement des huîtres collées à celui des huîtres en poches flottantes, à mesurer l'impact des évaluations mensuelles sur la longueur moyenne finale, à évaluer le rendement d'un nouvel appareil d'élevage et à déterminer le pourcentage d'huîtres atteignant la taille marchandes selon la technique utilisée.

Mechanized clam harvesting for coastal British Columbia – environmental implications

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For certain shellfish species, a mechanical harvester has the potential to greatly reduce harvesting costs, leading to increased profitability. Traditional shellfish harvesting in BC is by using hand rakes. In order to determine the feasibility of using a mechanical harvester, an environmental assessment on mechanical harvesting and traditional harvesting needs to be completed to

determine impact and compare the two methods. In July 2008, a preliminary oceanographic assessment was conducted at the study sites in Baynes Sound using a 1200khz ADCP. Residual flow directions were ascertained and allowed the proper design of the pre- and post-harvesting sampling program. Each of the three study sites contained a mechanical and manual harvest plot and reference stations. Sampling stations were at fixed positions in each plot and also positioned at 1m, 25m, 50m and 75m stations along transects following the dominant current direction from each plot. Surveys were conducted 24 hours pre-harvest, immediately post-harvest, and 24 hours post-harvest. Parameters included *in situ* sediment sulphides, eH (REDOX), sediment grain size (SGS), visual condition (digital imagery), sedimentation (silt flux) and sediment macro-fauna. Initial results show only localized environmental effects associated with each harvest approach, with no significant difference documented between the manual and mechanical harvesting methods on the study beaches. Further testing, on a larger scale, of the mechanical harvester is needed to provide more data on the environmental impacts and will be competed in 2009-10.

Can manipulation of culture depth reduce summer mortalities in Pacific oyster seed?

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British Columbia oyster growers lose approximately 10% of their stock in raft-based operations during the summer. Transient periods of very high temperature and harmful algal blooms can decimate oyster stocks by as much as 50 to 100%. The management option we propose to mitigate the impact of these environmental factors involves lowering oyster culture trays to a depth where the temperature is lower and harmful algae are less concentrated, as soon as the temperature reaches certain critical values. The caveat of this method is that phytoplankton concentrates close to the surface and lowering the oysters for extended periods would take them out of reach of their food source, thus reducing their growth. In order to find the optimum balance between oyster mortality and growth, it is necessary to find the depth at which to lower the oysters, as well as the correct temperature trigger for the change of depth. This project has been geared to study this problem, with scientific methods applied to farm conditions throughout the Strait of Georgia, BC. The results of this research should allow oyster growers to develop a system to reduce the mortalities in their stock based on simple environmental monitoring and tray movement.

Does the presence of predators affect cultured shellfish performance?

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Shellfish farming operations provide habitat for predators such as seastars or crustaceans. The presence of such predators near benthic shellfish populations can result in thicker shells and reduced tissue growth. Predator abundance on or near shellfish farms increase significantly, and so the mere presence of the predators may influence shellfish behavior and performance. We investigated the effects of native seastars, *Asterias vulgaris*, and a recently introduced invasive

green crab, *Carcinus maenas*, on the performance of farmed mussels, *Mytilus sp.* and wild scallops, *Placopecten magellanicus*. Shellfish were exposed to aquaeous predator extracts of varying concentrations (0g, 0.5g, 5g, 50g) for a week, held at temperatures of 2-4C, and fed a daily diet (1-2% body weight) of phytoplankton. Shellfish behavior (valve gaping, byssal attachment, feeding rates) as well as physiological condition (neutral red assay) were measured before, during and after exposure. Mussels exposed to crab and starfish extracts showed diminished food intake, greater valve closure, and reduced byssal attachment with increasing concentration of predator extracts. Lysosomal destabilization increased in predator-exposed mussels indicating greater stress levels in the presence of extracts. Similar results were observed for sea scallops exposed to predator extracts. The implications of these findings for shellfish farm management will be discussed.

Economic efficiency of soft shell clam aquaculture (*Mya arenaria*) in the Magdalen Islands

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The soft shell clam, *Mya arenaria*, is a good candidate for shellfish aquaculture diversification in eastern Canada. In the Magdalen Islands (Quebec), research and development efforts and the sustained interest on the part of a developer may soon lead to commercial levels of production. Since 2000, the clam culture research program in the Magdalen Islands generated a considerable amount of information useful for the development of all production cycle levels. All these technological innovation are constantly revisited from an economic point of view. Indeed, the ultimate goal of clam culture research is to create a profitable activity. From the most recent research data and the promoter's business experience, it has been possible to estimate the degree of profitability of two different production scenarios. Cost production analysis also gives an overview of the most influential factors in clam culture economic potential. In the present context, clam production cycles based on benthic spat collection does not appear to be profitable. Actual collection efficiency is not high enough. However, the transfer of under commercial size clams from natural beds to seeding sites with growth-favorable conditions appears to be a profitable exploitation scenario. Considering these observations, the strategy to advocate would be to base production on clam transfer to ensure financial viability while attempting to develop an efficient and reliable spat collection technique.

Diet protein effect search and water with different salinity on hemolymph osmolality and hemolymph protein in Pacific white shrimp *(Litopenaeus vannamei)*

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Key words: *Litopenaeus vannamei*, Protein, Salinity , hemolymph osmolality , hemolymph protein .

This research did in Pajoheshkadeh-e- migo in Boshehr city in 2006 winter In this research reard white western shrimp (*Litopenaeus vannamei , Boone* . 1931)for Diet protein effect search and water with different salinity on hemolymph osmolality and hemolymph protein .the shrimp with 2 grams weight securing from Helleh culture center in boshehr.used five diet with five different protein level contain 20% , 25% , 30% , 35% and 40% protein with 3300 Kcal/g Energy and three salinity level contain 15-17^{ppt},27-30^{ppt},and 40-45 ^{ppt} salinity.shrimp cultured 60 deys. Hemolymph Osmolality average in 15-17^{ppt}salinity was 573.88 mOsm/kg had meaning different with hemolymph osmolality in 27-30^{ppt} salinity that was 650. 380 mOsm/kg and in 40-45^{ppt} salinity that was 630.38 mOsm/kg ($p < 0.05$). Hemolymph Osmolality between 27-30^{ppt} salinity and 40-45^{ppt} salinity hadn´t meaning different($p > 0.05$). The protein change in diet hadn´t effect in Hemolymph Osmolality and the water salinity hadn´t effect in Hemolymph protein. Hemolymph protein in 15-17^{ppt} salinity was 124.72 mg/ml hadn´t meaning different with hemlymph protein in 27-30^{ppt} salinity that was 136.52mg/ml and with hemolymph protein in 40-45^{ppt} salinity that was 128.84 mg/ml ($p > 0.05$) .the diet protein had effect in Hemolymph protein and with increase protein in diet increase Hemolymph protein but hadn´t meaning different.

Nursing of hatchery produced *Paneous monodon* PL in floating cages in coastal areas of Bangladesh

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It is estimated that for one *P. monodon* PL collected 99 fry of other fish and shrimp are destroyed during collection of PL from the wild. To over come this problem government of Bangladesh has recently banned PL collection, affecting the livelihoods of PL collectors. Stocking nursed PL in the culture pond enables farmers to more accurately predict survival, standing crop, feeding rate and production level in grow out ponds. Nursing for *P. monodon* PL in floating cages of 2 x 3 x 1.5 m, installed in sheltered areas of the coast tried. Cage frame was made from locally available wood or bamboo. Two nets one as outer and other as inner net was fixed to the cage frame. Four empty plastic drums of 1501 capacity were used as floats, Post larvae PL_{10} to PL_{15} purchased from the hatchery were stocked in the cages at a density of 2-4 PL/l. Raw ground fish or dry fish meal were provided as feed 3-4 times a day. Average survival rate after 6-7 days nursing was 80% with promising growth. Two to seven fold growths were recorded in 6-7 days nursing period. The system was found as profitable alternate livelihood.

Ecosystem Approaches: Strategies and Tools

Wednesday, May 13, 2009 – mercredi 13 mai, 2009
8:00 AM – 10:00 AM
Location: Ballroom

Chair: Fiona Cubitt

8:00 **Jones, H.**
A Scottish case study: the Tri-Partite Working Group

8:20 **Chamberlain, J.**
Defining an ecosystem-based approach to marine aquaculture

8:40 **McGreer, E.R.**
Important considerations in the selection of tools for implementing an ecosystem-based approach (EBA) to aquaculture

9:00 **O'Riordan, J.**
An ecosystem based approach to evaluating the effects of sea lice on wild salmon in the Broughton Archipelago, British Columbia

9:20 **Dudas, S.E.**
Shellfish aquaculture in an ecosystem context: bottom-up and top-down approaches and tools

9:40 **Cranford, P.J.**
Mussel aquaculture interactions with phytoplankton and potential indicators and thresholds for an ecosystem-based management approach

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

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A Scottish case study: the Tri-Partite Working Group

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Official statistics for wild salmon and sea trout catches since 1951 show a downward trend in some stocks, particularly on the west coast of Scotland. A major outbreak of Infectious Salmon Anaemia in 1998-99 highlighted the need for a cooperative approach to the sustainable management of aquaculture and wild fisheries. Government brought those interests together and all agreed to work cooperatively towards solutions, using an ecosystem-based approach. As a result, a tripartite approach to local area management was adopted, under the management of a Tripartite Working Group (TWG). TWG field staff support action at local level, through 18 Area Management Agreements, to protect the health of wild and farmed salmonids. Practical problems tackled through the TWG process include sea lice management, siting of fish farms, escapes of farmed fish and action to restore wild fish populations to former levels. The TWG process, structures, funding and operations will be explained. Details will be presented of one large-scale catchment where the movement of a few farms and an agreement to synchronise treatments for sea lice seem to show improvements in sea lice levels and wild salmonid populations, although monitoring of the effects is still at an early stage.

Defining an ecosystem-based approach to marine aquaculture

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Over recent years, the management approach applied to many natural resource activities around the world has shifted from one focussing upon individual sectors and user groups to a more comprehensive area-based approach that recognizes the inter-relatedness of biological communities and systems. Such a transformation in the management approach to marine aquaculture activities has been recommended in many reviews of the environmental effects and performance of the industry. This has required a paradigm shift in the approach to aquaculture management, regulation and development, and identified the critical need for integrated decision making frameworks. Progress towards the implementation of such an approach has been difficult to measure, mainly because a clear understanding and definition of the form and scope that such an approach would take is currently both highly variable and somewhat elusive.

This presentation examines the bases upon which an area-based approach to aquaculture management can be founded, the differences and difficulties between 'ecosystem-based management' and 'management of aquaculture activities within an ecosystem', and proposes some definitions and understanding for consideration and discussion.

Important considerations in the selection of tools for implementing an ecosystem-based approach (EBA) to aquaculture

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Jurisdictions around the world have committed to support sustainability to ensure the health of aquatic ecosystems, stable economic development and prosperous communities. One widely accepted, science-based methodology to integrate these various components and support broader management frameworks is the Ecosystem-based Approach (EBA). As the EBA structure is defined for each of the physical-biological, economic and social ecosystems, outputs, tools and performance measures can be generated and applied within the context of an Ecosystem-based Management (EBM) framework.

EBM tools are software or other documented methodologies which can assist in EBA implementation by:

- Providing models of ecosystems and key ecosystem processes.
- Generating scenarios illustrating the consequences of different management decisions.
- Facilitating stakeholder involvement and understanding in the planning processes.

EBM tools can include tools for: data collection and management; conceptual modeling; modeling for watersheds, marine ecosystems, waste dispersion, habitat impacts, socioeconomic changes; scenario visualization; decision-support for coastal zone management, conservation, site selection, and resilience planning; project management; stakeholder communication and engagement; and tools for monitoring and assessment.

This presentation will provide a brief overview of the types of EBM tools available together with some helpful hints to avoid common mistakes, and to use tools more effectively.

An ecosystem based approach to evaluating the effects of sea lice on wild salmon in the Broughton Archipelago, British Columbia

Jon O'Riordan*

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The BC Pacific Salmon Forum supported the development of two eco-system based modeling approaches to evaluate the effects of sea lice on wild pink and chum salmon in the Broughton Archipelago. The Forum addressed three questions—do fish farms increase sea lice populations and risk of infection to wild salmon; what are the thresholds as which lice have sub-lethal or lethal effects on individual wild salmon; is there an effect at the population level of sea lice infection from fish farms. The Forum concluded that there is strong indirect evidence that fish farms increase sea lice populations in the vicinity of pens but that in the Broughton recent changes in farm operations that have significantly reduced lice populations on the farms and also on wild salmon. Several scientists established possible thresholds at which sub-lethal and lethal effects from sea lice infection occur to individual wild fish but these scientists were unable to distinguish these effects at the population level due to many other environmental factors affecting mortality.

Shellfish aquaculture in an ecosystem context: bottom-up and top-down approaches and tools

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Shellfish populations, wild and cultured, interact with many ecosystem components and link benthic and pelagic environments. The complexity of shellfish-ecosystem interactions poses a challenge for ecosystem based management. To address some of these issues I propose a research approach to examine interactions from 1) the bottom-up, 2) the top-down and 3) to synthesize them in an ecosystem based model. Water column properties and primary production influence shellfish populations from the bottom-up. To investigate how aquaculture activities influence these factors, a variety of in-situ oceanographic instruments can be used to monitor oceanographic conditions, and to conduct targeted experiments to asses the influence of specific aquaculture activities. They can also be used to investigate top-down influences, such as the depletion of phytoplankton blooms by filter-feeding shellfish at high densities. Predator exclusion or removal aquaculture activities have the potential to directly affect the ecosystem from the top-down. These influences can be investigated using traditional field survey methods and experiments. To synthesize our knowledge of shellfish-ecosystem interactions an ecosystem model could be utilized that includes both top-down and bottom-up influences. The long-term goal of this approach is to develop a monitoring program that will facilitate the detection of changes in the ecosystem.

Mussel aquaculture interactions with phytoplankton and potential indicators and thresholds for an ecosystem-based management approach

P. J. Cranford[1*], W. Li[1], Ø. Strand[2], and T. Stroheimer[2]

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Filter-feeding by mussels naturally results in some local reduction in their food supply. If the spatial scale of phytoplankton depletion includes a significant fraction of the coastal inlet, then this effect on the base of the food web raises concerns about ecological costs to other ecosystem components. These costs can be used to define ecological carrying capacity. Phytoplankton depletion was documented at mussel aquaculture farms in Canada and Norway using a computer controlled, towed undulating vehicle that collects geo-referenced CTD and chlorophyll *a* data. Rapid synoptic surveys with intensive horizontal and vertical sampling permitted mapping of phytoplankton variations over farm to coastal ecosystem scales. This rapid 3-D mapping approach has proven to be reliable for quantifying food depletion at farm- to bay-scales. Intensive mussel culture not only affects phytoplankton concentration, but can also alter phytoplankton size. A survey of Prince Edward Island embayments in August, 2008 found that those bays that are at the highest risk of bay-wide particle depletion were dominated by picophytoplankton (0.2 – 2.0 μm cell diameter). This represents a significant destabilization at the base of the marine food-web that can be expected to alter competition and predator-prey interactions between resident species.

Aquatic Invasive Species

Wednesday, May 13, 2009 – mercredi 13 mai, 2009
8:00 AM – 10:00 AM
Location: Malaspina

Chair: Tom Therriault

8:00 **Landry, T.**
Tunicate infestation on mussel farms in Prince Edward Island Canada: investigating management tools and approaches

8:20 **Perry, G.**
The control and management of invasive colonial tunicates in Newfoundland in 2008 and 2009

8:40 **Locke, A.**
Ecosystem consequences of vase tunicate (*Ciona intestinalis*) infestation in mussel-producing estuaries of Prince Edward Island

9:00 **Epelbaum, A.**
Environmental tolerances and predation susceptibility of non-native tunicates in British Columbia: implications for eradication and control

9:20 **Gartner, H.**
Invasive tunicates in subtidal fouling communities of British Columbia

9:40 **Therriault, T.W.**
Biology and ecological impacts of the European green crab, *Carcinus maenas*, on the Pacific coast of Canada

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

Tunicate infestation on mussel farms in Prince Edward Island Canada: investigating management tools and approaches

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The mussel aquaculture industry on Prince Edward Island (PEI) has recently been affected by several exotic tunicates with various degrees of impacts. Over the past decade, four exotic tunicates (*Styela clava*, *Ciona intestinalis*, *Botrylloides violaceus* and *Botryllus schlosseri*) have been reported in some mussel growing areas of PEI. These invasive tunicates compete with mussels and associated fauna for space and food, potentially decreasing the growth rates and meat yields of cultured mussels. However, the main impact is the additional cost of working with the added biomass, particularly in the case of *Styela clava* and *Ciona intestinalis* infestations. This is clearly becoming a pest control management situation. To date, most of the management strategy developed to mitigate the impact of these exotic tunicates on mussel farm operations have been driven from an invasive biology context. Here, the emphasis is placed on early detection, risk analysis and rapid response with an underlying goal of eradication. In PEI, the HACCP (Hazard Analysis and Critical Control Points) approach has been investigated to develop mitigation strategies in aquaculture. Similar work has been initiated on the west coast. The use pest management model is also currently being investigated with the goal of decreasing tunicate biomass and reducing the rate of population expansion. In this context, the scientific support will need to be adapted to provide the proper advice. In PEI, monitoring and research activities for aquaculture pest management are being developed within the principle of farm health management.

The control and management of invasive colonial tunicates in Newfoundland in 2008 and 2009

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Violet tunicate, *Botrylloides violaceus,* was first detected in Newfoundland in October 2007 in a fishing harbour at Belleoram, Fortune Bay. A rapid response framework was applied and suppression and eradication trials were attempted. This paper describes the control project, subsequent surveillance, evaluation of the effectiveness of this effort, and recommendations on future rapid response to detection of aquatic invasive species. We also update research initiatives on invasive tunicates in Newfoundland.

Ecosystem consequences of vase tunicate (*Ciona intestinalis*) infestation in mussel-producing estuaries of Prince Edward Island

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The vase tunicate, *Ciona intestinalis*, has developed heavy infestations in Prince Edward Island estuaries and especially on mussel aquaculture operations since its invasion in 2004, leading to questions about its overall impact on the productivity of areas in which mussels are grown. We hypothesized that the addition of *Ciona* could have profound effects on the productivity of estuarine ecosystems; it could increase overall filtration rates, suppress standing stocks of phytoplankton and zooplankton, and increase competition for the planktonic food supply, which in turn could reduce growth rates of other filter-feeders. We compared nutrients, chlorophyll, phytoplankton community composition, zooplankton biomass and composition, tunicate settlement, blue mussel (*Mytilus edulis*) growth rates, and estimated total filtering capacity of mussels, vase tunicates and other epifauna, in three mussel-producing estuaries with *Ciona* and three without the tunicate. Samples were collected in early summer, when the *Ciona* population was at its lowest point in the annual cycle, and twice in the autumn, after the peak recruitment of the tunicate.

Environmental tolerances and predation susceptibility of non-native tunicates in British Columbia: implications for eradication and control

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Over the past 50 years, numerous tunicate species have spread across the globe, posing a threat to natural ecosystems and becoming a growing concern in areas of expanding aquaculture. In British Columbia, four non-native tunicate species (*Styela clava*, *Botryllus schlosseri*, *Botrylloides violaceus*, and *Didemnum vexillum*) have been identified at many shellfish culture sites, but they have not proliferated to the extent that they have in Atlantic Canada, where recent tunicate invasions have resulted in significant challenges for the blue mussel farming industry. We conducted a series of laboratory experiments to assess environmental tolerances and potential predation effects on survival and growth of these tunicate species. Broad environmental tolerances of botryllid tunicates (5-25ºC, 14-38‰) suggest that physical methods of control, such as sinking or raising aquaculture gear, are unlikely to be efficient. A number of benthic invertebrate species native to BC were found to prey on non-native tunicates of concern, the most efficient grazers being green sea urchins. Using sea urchins as biological control organisms on shellfish aquaculture gear may help to significantly reduce tunicate fouling. Chemical control methods, such as the use of biocidal agents, need to be evaluated carefully in terms of their environmental impacts and effects on cultured species.

Invasive tunicates in subtidal fouling communities of British Columbia

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Worldwide there are growing ecological and economic concerns over non-native species invading natural ecosystems. Invasive tunicates pose a serious threat to aquaculture operations as they are biofouling organisms that tend to colonize hard substrates and overgrow other organisms. In BC there are at least four species of invasive tunicates (*Botrylloides violaceus, Botryllus schlosseri, Styela clava,* and *Didemnum* sp.) that have been identified as posing a potential threat to the aquaculture industry. Little is known about their current distributions and abundances. In the spring of 2007 an initiative began to examine geographic patterns in the distributions of invasive tunicates along the BC coast. Through a large collaboration with marinas, aquaculture industry, and the Coast Guard, 100 settlement arrays were deployed and collected five months later. Sample processing involved identifying all species present, their relative abundance, and any ecological interactions observed between invasive tunicates and native species. Distribution and patterns of non-native species include new reports of invasive tunicate presence in the Queen Charlotte Islands. Invasive tunicates were more predominant at shellfish aquaculture sites to finfish aquaculture sites. The data from this from project is an important step in gaining pertinent information on key invasive species that can be used for monitoring and management.

Biology and ecological impacts of the European green crab, *Carcinus maenas,* on the Pacific Coast of Canada

G.E. Gillespie[1] and T.W. Therriault[*1]

[1]Fisheries and Oceans Canada, Pacific Biological Station, 3190 Hammond Bay Road, Nanaimo, BC, Canada, Graham.Gillespie@dfo-mpo.gc.ca

The European green crab, *Carcinus maenas*, is well-documented as a global invader in Australia, Tasmania, Japan, Patagonia and both coasts of North America. Green crab invaded British Columbia in the winter of 1998/99 as larvae transported from populations on the Pacific coast of the United States. *Carcinus* has since established local populations throughout the west coast of Vancouver Island; extensive monitoring in other areas of the coast did not produce records of green crab. Tagging programs were undertaken at one site in 2007 and 2008 to estimate abundance and collect growth information. Oceanographic models predict that larvae from Vancouver Island could seed new populations in the North Coast area of British Columbia and in southeastern Alaska. Comparisons of catches of native species in areas with and without green crabs are proposed to examine potential impacts of *Carcinus* on native populations, especially in the lower salinity habitats exploited by this species.

Aquaculture Certification and Traceability: Global and Local Solutions

Wednesday, May 13, 2009 – mercredi 13 mai, 2009
8:00 AM – 10:00 AM
Location: Dunsmuir / Malahat

Chair: Rod Penney

8:00 **Rose, M.**
A review of critical components of aquaculture standards and certification in today's marketplace

8:20 **Rose, M.**
Feed food chain vulnerability to contamination through loss in traceability

8:40 **Salmon, R.**
The Canadian Aquaculture Standards Forum & Canadian initiatives underway

9:00 **Smith, J.**
Certification and DFO's Sustainable Aquaculture Program

9:20 **Cross, S.F.**
The Aboriginal Certification of Environmental Sustainability (ACES) program - respecting First Nation traditional values in aquaculture

9:40 **Panel Discussion**

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

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A review of critical components of aquaculture standards and certification in today's marketplace

M. Rose*

IFQC Global Inc.

Certification of organizations to a definable standard has become a universal and growing phenomenon across all businesses, noticeably within the food sector and including aquaculture. But the objectives, value and options available to the global aquaculture industry have not been evaluated on a consistent basis. Effective Certification programming can represent a valuable confidence tool for meeting market expectations, delivering safe, consistent and nutritious products, demonstrating compliance to agreed principles of responsible practice and providing assurance to stakeholder of the ability of aquaculture to contribute to sustainable economic growth. This presentation examines the critical components that should be displayed by aquaculture certification programs, with respect to governance and administration; the key components that are essential for standards to operate effectively (systematic, definable, measurable, traceable); and the principles and criteria which are deemed important to meet key market and stakeholder concerns and needs in order to have credible market acceptance.

Feed food chain vulnerability to contamination through loss in traceability

M. Rose*

IFQC Global Inc.

The Canadian citizen requires protection from food contamination incidences that may arise as a consequence of the vulnerability of modern day food chains. Chain vulnerability varies depending on food chain characteristics; batch mixing versus continuous process; multiplicity of ingredients, long versus short geographic chains.
This presentation provides a review of the results of a European project (Sigma Chain) examining modern day feed-food chains with respect to their vulnerability to contamination arising out of loss in traceability. A framework was constructed for the assessment of chain vulnerability and the prioritization of chain contamination risk. The outputs have been synthesized into a Stakeholders' Guide to food and feed chain vulnerability to contamination. Modern food chains can more aptly be described as food webs with respect to the complexity of their design, supply linkages, geographic spread, multiple supplier options and the onward distribution of fresh and prepared consumer foods to a globalised market. The presentation discusses the results of the project and the potential next steps with respect to commercial validation of the outputs through industry case studies.

The Canadian Aquaculture Standards Forum & Canadian initiatives underway

R. Salmon*

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

The Canadian aquaculture industry is committed to continuous improvement as it provides safe, high quality seafood in a sustainable manner. An unmistakable trend is the ever-growing awareness and market pressure to 'objectively demonstrate' adherence to sustainable practices. Independent third party certification programs are becoming increasingly important as the vehicle to confirm that industry operates to established and agreed upon standards. In response to the importance of standards and certification, CAIA is promoting the establishment of an ongoing industry/government forum for education and information exchange: the Canadian Aquaculture Standards Forum. The Canadian aquaculture industry is at different stages of certification preparedness and action. Some Canadian aquaculture companies have already implemented a comprehensive certification program, and others are proactively exploring their options.
In this session, the CASF will be introduced and discussed, together with the range of certification initiatives currently under review by the Canadian aquaculture industry.

Certification and DFO's Sustainable Aquaculture Program

J. Smith*

Director, Certification and Sustainability Reporting, Aquaculture Management Directorate, Fisheries and Oceans Canada, Ottawa, ON

Fisheries and Oceans Canada's Sustainable Aquaculture Program (SAP) was established in 2008 with a clear vision to set the conditions for a successful, vibrant and innovative Canadian aquaculture sector that is environmentally and economically competitive for the benefit of all Canadians. The SAP was designed to achieve this vision through program priorities that include governance and regulatory reform, innovation, certification and market access, and regulatory science.

This presentation will describe specific activities of the certification and market access element of the SAP. These activities have been established with the goal of having a Canadian aquaculture sector that is well positioned to meet market demands for high value features such as certification for social, economic, and environmental performance within 4-5 years. Activities are organized into components related to: development and/or adaptation and early adoption of certification programs that asses and verify aspects of sustainability and support access to markets; collection and management of data, information, and knowledge regarding the sector that define and describe aspects of sustainability; and, targeted communications with stakeholders concerning the conduct and outcomes of activities.

The Aboriginal Certification of Environmental Sustainability (ACES) Program - respecting First Nation traditional values in aquaculture

S.F. Cross[*1], M. Flaherty[1], and R. Harry[2]

[1]Coastal Aquaculture Research & Training (CART) Network, Department of Geography, University of Victoria, Victoria, British Columbia, Canada V8W 3P5
[2]Aboriginal Aquaculture Association, 105-2005 Eagle Drive, Campbell River, British Columbia, Canada, V9H 1V8

The *Aboriginal Certification of Environmental Sustainability* (ACES) Program represents an aquaculture management and certification development process that is supported by not only First Nations, but by the majority of the aquaculture industry sectors across Canada. In contributing to a new, nationally recognized and aboriginal-inclusive certification process, this approach has been designed to address aquaculture sustainability in a manner that integrates science-based research with Traditional Ecological Knowledge maintained within aboriginal communities. The ACES Program, in supporting those who employ the science/TEK approach to Area-Based management, is envisioned to provide increased operational certainty for participating aquaculture companies, and assurances for the regional First Nation communities that their respective values and concerns are adequately addressed within the framework of an auditable environmental certification program.- with both contributing to the development and maintenance of a sustainable Canadian aquaculture industry. This presentation provides an overview of the operational framework of the ACES Program and our initial development plans for this initiative in Canada.

Ecosystem Approaches: Human Dimensions

Wednesday, May 13, 2009 – mercredi, 13 mai 2009
11:20 AM – 1:00 PM
Location: Ballroom

Chair: Grant Murray

11:20 **Bocking, S.**
Salmon aquaculture: understanding the science and politics of an environmental controversy

11:40 **Silver, J.J.**
Beyond the bottom line: striving for meaningful First Nations engagement with aquaculture

12:00 **Thomson, I.**
Mining, aquaculture and the social license to operate

12:20 **Anderson, J.**
Hybrid aquaculture research: the case of Dedza, Malawi

12:40 **Flaherty, M.**
International perspectives on human dimensions

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

Salmon aquaculture: understanding the science and politics of an environmental controversy

S. Bocking*

Environmental and Resource Studies Program, Trent University, Peterborough, Ontario, Canada, K9J 7B8

This presentation reports on a continuing study of the controversy over the environmental consequences of salmon aquaculture in British Columbia. Building on work by environmental historians and by historians and sociologists of science, the study has three chief objectives: to outline the environmental history of the aquaculture industry; to analyze the dynamics of debates over aquaculture, with special reference to the use of science; and to explore the potential contribution of this case study to defining how science can play more effective roles in solving environmental challenges. Beyond reporting on progress towards each of these objectives, the presentation will illustrate the value of a social science perspective on the controversy. This project is being conducted in collaboration with Dr. Grant Murray and Dr. Tim DeJager of Vancouver Island University.

Beyond the bottom line: striving for meaningful First Nations engagement with aquaculture

J.J. Silver*[1]

[1]School of Resource and Environmental Management, Simon Fraser University, 8888 University Drive, Burnaby, BC V5A 1S6

First Nations participation in aquaculture is often publicized as win-win: an opportunity for industry expansion and for increased First Nations employment. Indeed, there are several examples of economically successful First Nations aquaculture ventures in Canada. There are also at least as many examples of unprofitable initiatives. But perhaps First Nations participation in aquaculture should, at least in some cases, be evaluated beyond the bottom line. Might we find a profitable initiative to be problematic for many segments of the community? Or, might tangible benefits have arisen as a result of an initiative that has failed economically? By what decision-making process should a First Nations Band or business come to the decision to pursue aquaculture in the first place?

These are some questions with important human/social dimensions that I have been exploring with my dissertation research. Through a case study of one First Nations Band's experiences with shellfish aquaculture on Vancouver Island, I have identified various community-level impacts. Findings indicate that overly optimistic initial projections for financial success may actually destabilize community confidence and morale, marginalize longstanding subsistence-driven harvesting activities, and thus limit the potential for sustainable industry participation over the long run.

Mining, aquaculture and the social license to operate

I. Thomson*

On Common Ground Consultants Inc, 902-1112 West Pender Street, Vancouver, BC, V6E 2S1

It may come as a surprise, but there are close similarities between the mines and shellfish farms in terms of their social interaction with local populations. Both are commercial activities that are geographically confined in that they take place where fundamental features of the natural environment converge to make economic exploitation possible. In that sense, and unlike almost every other industry, miners and shellfish farmers cannot chose where to set up operations to optimize social and economic parameters. Rather, they work where they can and have to find a way to live with the neighbors. It is proposed that the concept of a 'social license to operate, which is well developed in the mining sector, is relevant to shellfish farming. An examination of the normative characteristics of the social license – social legitimacy, credibility and trust – will be presented together will case histories that illustrate the operational aspect s of the social license. The presentation will demonstrate the ways in which the two industries share common characteristics and then draw on the experience of the mining industry to offer suggestions to shellfish farmers on how they might strengthen their relationship with local communities along the BC coast.

Hybrid aquaculture research: the case of Dedza, Malawi

J. Anderson*[1]

[1]Geography Department, University of Victoria, Victoria, BC V8W 3R4

Recent research acknowledges the natural and social dimensions of aquaculture systems. However, studies often create an artificial divide by attempting to address each aspect in isolation. Social science research has tended to overlook the biophysical aspects of aquaculture, while scientific research has uncritically accepted orthodox explanations of environmental outcomes without recognizing the social construction of such systems. This research analyses the case of small-scale tilapia aquaculture in Malawi and presents evidence to support the central argument that aquaculture systems must be addressed through hybrid research. The social dimension of this research reveals that fish farmers in Malawi are rejecting practices which do not work in the local context (fertilization with pond mud) and adopting strategies that do work (irrigation with pond water). The physical component of this research compliments the social by elucidating that irrigation with pond water resulted in higher soil nutrient and moisture content. It is argued that understanding aquaculture impacts on ecosystems may only be achieved through locally-based hybrid research methods that recognize the complex, connected nature of these systems.

International perspectives on human dimensions

M. Flaherty[1*]

Coastal Aquaculture Research and Training Network, Department of Geography, University of Victoria, SSM Bldg. 3800 Finnerty Road, Victoria, B.C., V8P 5C2

With little scope for further expansion of capture fisheries, the development and wider adoption of aquaculture is seen by many national governments and international development agencies as an important base for improving household food security and reducing poverty in coastal communities. This has lead to the formation of aquaculture policies and development initiatives that are "pro-poor" in that their stated aim is to enhance the ability of indigent women and men to participate in, and benefit from, aquaculture. Although coastal people in Thailand, Viet Nam and India have been practising aquaculture for hundreds of years, new technologies and rising global demand for seafood are dramatically altering the basic character of aquaculture. Traditional, low intensity forms of production that help meet the subsistence needs of local households are being replaced by intensive, technologically complex culture systems that cater to international markets. This paper examines how growing international demand and trade for seafood is creating new challenges for the management of coastal ecosystems in Thailand, India and Viet Nam. It also examines local community and government responses to these challenges.

Shellfish Culture

Wednesday, May 13, 2009 – mercredi 13 mai, 2009
11:20 AM – 12:40 PM
Location: Malaspina

Chair: Chris Pearce

11:20 Grant, J.
Manipulation of productivity for mussel culture carrying capacity in a Norwegian fjord

11:40 Heath, W.A.
Pre-culture benthic environmental conditions at the demonstration farm shellfish tenure of the Centre for Shellfish Research in Deep Bay, Baynes Sound, B.C

12:00 Rayssac, N.
Extrinsic biotic regulating factors of blue mussel *(Mytilus* sp.) recruitment on artificial collectors in two bays of the Gaspé Peninsula (eastern Canada)

12:20 Switzer, S.
The effects of seasonal variation and tray composition on invertebrate fouling communities

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

Manipulation of productivity for mussel culture carrying capacity in a Norwegian fjord

J. Grant*[1], R. Filgueira[1], and Ø. Strand[2]

[1]Dept. of Oceanography, Dalhousie Univ., Halifax, NS CANADA B3H4J1, jon.grant@dal.ca
[2]Institute of Marine Research, Bergen, Norway

Norway has a continuing interest in the development of sustainable mussel aquaculture in its many pristine coastal fjords. These environments are characterized by deep water, and in summer highly stratified nutrient conditions, such that phytoplankton production is nutrient-limited. By pumping freshwater to depth, the diffusion of nutrients to the euphotic zone was increased, removing this limitation. Within the context of the CANO research program (Carrying capacity in Norwegian aquaculture, http://www.imr.no/cano/), scientists from Canada, Norway, France and the Netherlands have collaborated to undertake field studies and modelling of nutrient distribution, phytoplankton production, and mussel feeding. The present talk will provide details of resulting ecosystem models at various spatial scales, and the ways that numerical experiments have been used to predict culture carrying capacity in terms of location and biomass.

Pre-culture benthic environmental conditions at the demonstration farm shellfish tenure of the Centre for Shellfish Research in Deep Bay, Baynes Sound, B.C.

W.A. Heath,*[1] C. Collins,[1] S. Pilcher[1], and M. Peemoeller[1]

[1]B.C. Ministry of Agriculture and Lands, Courtenay, B.C., Canada V9N 5M6

To establish baseline conditions prior to development of the demonstration shellfish farm of Vancouver Island University's Centre for Shellfish Research, benthic sampling was conducted in 2005-6 in the intertidal and subtidal areas in and around the site in Deep Bay, B.C. Grab samples from subtidal stations fronting the tenure and other sites in Deep Bay were analysed for geochemical parameters (eH, % organics, particle size distribution). Habitat assessment was conducted in late March and June 2006 on the tenure according to the Marine Foreshore Environmental Assessment Procedure of Fisheries and Oceans Canada. Habitat profiles from HHW to subtidal depths were constructed along nine transects (marked by lead line with5m increments) spaced at 50m intervals. Subtidal transect segments were surveyed by diver with video camera. Intertidal blooms of *Ulva* spp. were observed in both periods, with large subtidal areas of loose blades of this green macroalga present in June. Extensive areas covered by a layer of bark and wood fragments were also observed in subtidal video and grab samples. Comparisons with video and geochemical results from other parts of Deep Bay reveal that the CSR tenure, especially in the subtidal portion, is still affected by wood handling practices of the previous century (higher % organics; woody layer). Implications of these pre-existing conditions to the operation and ongoing monitoring of the CSR demonstration shellfish farm will be discussed.

Extrinsic biotic regulating factors of blue mussel (*Mytilus* sp.) recruitment on artificial collectors in two bays of the Gaspé Peninsula (Eastern Canada)

N. Rayssac*[1], R. Tremblay[1], B. Thomas[2], and J.-M. Sévigny[3]

[1]Institut des Sciences de la Mer, Université du Québec à Rimouski, Rimouski, QC G5L 3A1
[2]Centre aquacole marin de Grande-Rivière, Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec, Direction de l'Innovation et des Technologies, Grande-Rivière, QC G0C 1V0
[3]Institut Maurice-Lamontagne, Pêches et Océans Canada, Mont-Joli, QC G5H 3Z4

Recruitment determines the dynamics of benthic communities and influences production success of blue mussel (*Mytilus* sp.) culture in Eastern Canada. Although the presence of pediveliger larvae may indicate the beginning of settlement, several researchers have observed an important variability and delay in mussel recruitment intensity. In the perspective of sustainable development of the marine aquaculture industry which requires that the entire ecosystem be taken into consideration, we have studied recruitment determinism on artificial collectors in regards to epifaunal presence. Our primary goal was to describe the dynamics of biocenosis on mussel collectors from Gaspé harbour and Cascapédia bay. The secondary one was to analyse predator and competitor impacts on mussel recruitment. Recruitment patterns of mussels, their predators and competitors were established described by weekly collectors immersion in the two sites from 2004 to 2006. Preliminary results, underlined an interannual variability of mussel recruitment intensity in the two sites. Biocenoses of Gaspé and Cascapédia bays have different structures that seem to influence mussel recruits' size. Epifauna influences mussel density while predators have no effect between settlement and harvesting periods. These results tend to confirm impacts of biotic extrinsic factors on blue mussel recruitment for post-settlement stages.

The effects of seasonal variation and tray composition on invertebrate fouling communities

S. Switzer*[1], P. Barnes[2], and R.S. McKinley[3]

[1,3]Centre for Aquaculture and Environmental Research, University of British Columbia, Vancouver, BC, V6T 1Z4
[2]Barnes Marine Research Inc., 942 Sunset Drive, Saltspring Island, BC, V8K 1E6

Suspended oyster aquaculture supports diverse invertebrate communities through colonization of the farming equipment and the cultivated species. Invertebrate colonization is species specific, dependant primarily on local recruitment, hydrodynamics and habitat conditions. Fouling invertebrates can potentially adversely effect the growth and health of the oysters, through competition and predation, as well as the market value by influencing the appearance of the oyster. To minimize the negative impact of fouling some farmers have altered farming practices, including changes in the tray composition and regular cleaning of the trays and oysters in particular seasons. A comparative study was conducted over the course of a year at a deep-water Pacific oyster farm located in Sansum Narrows, British Columbia, to determine the effects of seasonal variation and tray composition on the invertebrate fouling community composition of the trays and oysters respectively. Examination of seasonal fouling in January, April, July and October, on standard plastic and special poly-vinyl coated trays, determined invertebrate tray and oyster fouling communities changed seasonally with respect to total abundance, total number of species and total biomass, with evidence of species-specific seasonal changes. The seasonal

variation seen for the above parameters was not as clear for tray variation; however significant differences were seen for specific species.

Alternative Finfish Culture

Wednesday, May 13, 2009 – mercredi 13 mai, 2009
11:20 AM – 12:40 PM
Location: Dunsmuir / Malahat

Chair: Duane Barker

11:20 **Maher, J.**
Histopathology among juvenile white sturgeon, *Acipenser transmontanus*, associated with exposure to varying concentrations of therapeutic formalin baths

11:40 **Henry, J.**
Development of white sturgeon (*Acipenser transmontanus*) culture in Canada

12:00 **Feindel, N.**
Spawning capacity of triploid Atlantic cod males and the early life history performance of their offspring

12:20 **Fraboulet, E.**
Effects of photoperiod and temperature on growth and body lipid composition of young juvenile winter flounder

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

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Histopathology among juvenile white sturgeon, *Acipenser transmontanus,* associated with exposure to varying concentrations of therapeutic formalin baths

J. Maher*[1], D.E. Barker[1], G. Edmondson[1], and W.H. Bennett[2]

[1] Department of Fisheries and Aquaculture, Vancouver Island University, Nanaimo, BC, CAN
[2] Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo, BC, CAN.

Chemotherapeutic protocols for fish hatcheries are based on salmonids. With the recent increase in alternative finfish aquaculture, it is imperative to evaluate if such protocols can be universally applied. The objective of this study was to document the hematological and histopathological effects of Parasite-S™ (therapeutic formalin) exposure among hatchery-reared, juvenile white sturgeon, *Acipenser transmontanus.* Six groups of ten, 50-100g fish were exposed to a 60 minute static bath of 0 mg L^{-1}, 250 mg L^{-1}, 500 mg L^{-1}, 1000 mg L^{-1}, 1500 mg L^{-1} and 2000 mg $L^{-1}$of Parasite-S™. No sturgeon died during the exposure period, but mortalities (40-50%) occurred in the high concentration test groups during a subsequent nine day recovery period. Blood hematocrit, RBC count, and histopathology of the gills, dermis, stomach and intestine were used to determine the effects of treatment following euthanasia by overdose of TMS. Blood hematocrit values were not significantly different between the highest dosage group and the control. However, gross histopathology (epithelia hyperplasia, lamellae hemorrhaging, mucous cell degeneration, epidermal sloughing) was most evident among the intestine and gill samples. The applicability and safety implications of such formalin treatments at a commercial sturgeon hatchery will be discussed. It is expected that the baseline data collected in this study will assist white sturgeon hatcheries.

Development of white sturgeon (*Acipenser transmontanus*) culture in Canada

J. Henry*[1]

[1]Target Marine Hatcheries Ltd., 7333 Sechelt Inlet Road, Sechelt, BC, Canada, V0N 3A4

Over the past decade species diversification in Canada's aquaculture industry has been applauded by Federal and Provincial governments. Despite this, few new finfish species have been developed into a Canadian industry. Target Marine Hatcheries identified white sturgeon as a potential candidate for Canadian aquaculture in 1998, partially as a result of the dramatic decline in wild sturgeon populations. Over the past ten years Target Marine has carried out research and development on early rearing, feeding, environmental preferences, and sex identification techniques. The numerous technical, biological, and political challenges and obstacles encountered have given some insight into why few new species become commercialized. Target Marine has successfully cultured white sturgeon in land based recirculation systems to nine years of age and 90 kg in size. Research carried out in conjunction with the Freshwater Fisheries Society of BC has resulted in an increased understanding of the early rearing and first feeding requirements for this species. In the spring of 2009 Target Marine carried out the first spawn of a domestic Fraser River white sturgeon. Each hurdle overcome pushes white sturgeon one step closer to commercialization in Canada.

Spawning capacity of triploid Atlantic cod males and the early life history performance of their offspring

N. Feindel*[1], T. Benfey[2], and E. Trippel[3]

[1,3]St. Andrews Biological Station, Fisheries and Oceans Canada, St. Andrews, NB E5B 2L9
[1,2]Department of Biology, University of New Brunswick, Fredericton, NB E3B 5A3

Cod culture is in its infancy, giving the industry and scientific community the opportunity to develop cod culture in an environmentally sound and profitable manner. Preliminary research has shown that triploid females are sterile, but male triploids undergo spermatogenesis. The purpose of this study was to examine if male, triploid Atlantic cod are capable of outcompeting male diploids, for spawning access to female partners and to evaluate the viability of their offspring. Fertilization rates, daily embryonic survival, hatch rates and daily larval survival were compared by manually fertilizing eggs with sperm of each ploidy. Data were collected from ten replicate trios, with each trio comprised of a male of each ploidy and a diploid female. No significant difference was found between fertilization rates using milt stripped from triploids and diploids. A significant difference was found for hatch rates and larval survival, with diploids being superior to triploids. Egg batches were collected from trios of fish, which were placed in eight tanks and permitted to undergo spawning. Embryos were genotyped to determine the proportion of embryos sired by each male and whether a triploid male was able to gain access to a female in a competition setting. These data are currently being analysed.

Effects of photoperiod and temperature on growth and body lipid composition of young juvenile winter flounder

E. Fraboulet*[1], Y. Lambert[2], R. Tremblay[1], and C. Audet[1]

[1]Institut des sciences de la mer de Rimouski. Université du Québec à Rimouski. 310 Allée des Ursulines, Rimouski (QC), G5L 3A1, CANADA
[2]Institut Maurice-Lamontagne, Department of Fisheries and Oceans Canada. 850 Route de la Mer, Mont-Joli (QC), G5H 3Z4, CANADA

Exposure to long photoperiod conditions during summer and fall did not improve growth in early-settled juvenile winter flounder. In spring, juveniles that had been raised under normal temperature conditions until the end of October and then exposed to long photoperiod conditions and a minimal temperature of 4°C during winter were 25% longer and twice as heavy than control fish exposed to natural temperature and photoperiod. They also had twice as much lipids and five times more triacylglycerols and free fatty acids than control fish. However, those that had not experienced short photoperiod conditions during the fall had growth similar to those raised under normal photoperiod and temperature conditions. Similarly, temperatures above 0°C did not improve growth under normal winter photoperiod conditions.

Ecosystem Approaches: Human Dimensions

Wednesday, May 13, 2009 – mercredi 13 mai, 2009
2:20 PM – 5:00 PM
Location: Ballroom

Chair: Grant Murray

2:20 **Brannen, C.**
Aquaculture dialogues

2:40 **DeJager, T.**
Trust and transparency: using the web to create community connection and collaboration

3:00 **Cubitt, K.F.**
Current processes of community engagement in British Columbia: examples and merits

3:20 **Sherrell, R.**
Life in a potential eco-system based decision making process …. a participants perspective

3:40 **HEALTH BREAK**

4:00 **Panel Discussion**

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

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Aquaculture dialogues

C. Brannen*

World Wildlife Fund, 1250 24th Street NW, Washington, DC 20037

Through a series of roundtables, called Aquaculture Dialogues, WWF works with farmers, retailers, NGOs, scientists and other aquaculture industry stakeholders worldwide to develop standards for certifying aquaculture products. The standards will minimize the key environmental and social impacts associated with aquaculture. Currently Dialogues are underway for twelve species including tilapia, salmon, shrimp, molluscs, trout, and pangasius.

More than two dozen standards or certification programs for aquaculture exist. However, none of the programs are effective at making the aquaculture industry more sustainable. The standards created by the Aquaculture Dialogues will be credible because they will be:

- Created by a broad and diverse set of stakeholders
- Based on consensus
- Developed through a transparent process
- Science-based
- Measurable and performance-based

The Aquaculture Dialogues build off of previous work done by WWF. Since the early 1990s, WWF has spearheaded the creation of certification programs for forestry (the Forestry Stewardship Council), fisheries (the Marine Stewardship Council), agriculture (Protected Harvest) and climate (the Climate Savers Program).

Trust and transparency: using the web to create community connection and collaboration

T. DeJager*[1]

[1]co3 consulting, 115 Gibralter Rock, Nanaimo, BC, V9T 4M3, dejagert@co3.ca

Ecosystem-based approaches to resource management and economic and social development are inherently participatory and reach across not only disciplinary boundaries but social ones as well. Developing and applying the tools to carry out such ambitious collaborative efforts present a significant challenge. The social web, which has emerged over the past 5 years, overcomes many of the traditional obstacles to effective connection and collaboration. The social web is about people in relationships rather than information in isolation. Adapting these platforms and tools, as *aquaport.ca* has envisioned, could provide a strong pillar for fostering transparency and trust among participants collaborating in ecosystem based approaches.

Current processes of community engagement in British Columbia: examples and merits

K.F. Cubitt*

BC Ministry of Agriculture and Lands, PO Box 9120 Stn Prov Govt, Victoria, BC, V8W 9B4

Corporate sustainability is often referred to as having three pillars; social, environmental and economic. The social pillar encompasses communities whose interests overlap, positively or negatively, with the interests of companies within their locale. Integration and discussion of those interests can be accomplished through engaging the community. Community engagement differs from more traditional forms of consultation by encouraging reflection and learning, promoting a focus on common ground, assuming that community input will add value, and taking the necessary time. With respect to governance, community engagement can result in the involvement of communities in problem-solving or decision making, with a view to making more informed decisions.

This presentation will draw on examples of successful community engagement and provide recommendations as to how this approach can provide benefits to finfish and shellfish aquaculture industries in British Columbia, and the communities in which they operate.

Life in a potential eco-system based decision making process …. a participants perspective

R. Sherrell*

502 Sherrell Road-Box1258, Port McNeill, British Columbia V0N 2R0

The presentation will provide an insight into local government officials and members of the public attempting to sort out key issues related to two environmentally sensitive industries on British Columbia's west coast. The first to be described is the development of a committee to deal with the multiple issues related to finfish aquaculture with a particular focus on the Broughton Archipelago. The second deals with the work of a group of community leaders from Campbell River on Vancouver Island to Prince Rupert on the mainland, including the Queen Charlotte Islands, tasked with providing advice to the provincial government with respect to what actions, if any, should be taken in respect to what is considered to be a moratorium on offshore oil development. Neither of these activities started out using an Eco-System Based design however at the end of the day both resulted in suggested structures and process that reflect similar general principles as advocated by the process.

Responding to the Challenges of Aquaculture Training Needs

Wednesday, May 13, 2009 – mercredi 13 mai, 2009
2:20 PM – 4:20 PM
Location: Malaspina

Chair: Brian Kingzett

2:20 **Beal, B.F.**
Public aquaculture in eastern Maine: creating new economic and educational opportunities through applied research & development

2:40 **Rideout, K.**
Meeting the training needs of a maturing industry; an East coast perspective

3:00 **Alward, N.**
Facing the challenges of aquaculture education

3:20 **McCarthy, A.**
The world is your oyster at VIU

3:40 **HEALTH BREAK**

4:00 **Richards, S.**
First Nations Youth Leadership Shellfish Program, FLOW - future leaders on the water

4:20 **Macnaughton, A**
Integrated clam fisheries and aquaculture for coastal community development in Northeastern Brazil – the value of local social and environmental capital

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

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Public aquaculture in eastern Maine: creating new economic and educational opportunities through applied research & development

B.F. Beal*[1,2]

[1]University of Maine at Machias, Machias, Maine 04654
[2]Downeast Institute for Applied Marine Research & Education, P.O. Box 83, Beals, Maine 04611

In 1987, a public shellfish hatchery effort began in eastern Maine to enhance commercial stocks of soft-shell clams (*Mya arenaria*) with cultured seed. Because clam landings were declining, and downeast Maine is the center of the shellfishing industry in the state, the plan to create the "Beals Island Regional Shellfish Hatchery (BIRSH)" was accepted enthusiastically by industry and local coastal communities. After a decade of annual clam production and field work, we found that although enhancing local stocks was economically important, our public education activities – working hand-in-hand with clammers and local stewardship committees, creating new learning opportunities for teachers and school children, collaborating with state marine resource managers, and serving as a public conduit for information about clam biology, ecology, and management – were, perhaps, more important. Through time, we found that a shellfish hatchery located near a working waterfront provided enormous opportunities for the community to learn about its resource, for a wide variety of scientific investigations focused on manipulative field experiments, and for opportunities to produce shellfish besides soft-shell clams. Today, BIRSH has evolved into the Downeast Institute for Applied Marine Research and Education, and will become the easternmost marine research laboratory and education center in the United States.

Meeting the training needs of a maturing industry; an East coast perspective

K. Rideout* and L. Halfyard

School of Fisheries, Fisheries and Marine Institute of Memorial University. P.O. Box 4920, St. John's, NL, A1C 5R3

The face of aquaculture training in Canada is changing. In recent years, many long-term training programs have been discontinued and many that remain are struggling with enrolment. This downward trend in enrolment is counter to the production increases that most aquaculture sectors have experienced. Declining enrolments in aquaculture programs are partially a reflection of how our industry is losing the public relations fight with anti-aquaculture groups. In addition, however, we have been slow to respond to the changing training requirements of the maturing Canadian aquaculture industry. In this maturation, there is a need for different types of employees and different types of training. It can be argued that we have been very good in producing individuals with very strong academic backgrounds, many of whom end up in academia, government agencies and management levels within industry. Many of these positions, however, are now filled with young, energetic graduates of post-graduate degree and diploma programs from across the country. Given that academic and government positions are becoming increasingly difficult to find, a change in the types of aquaculture training programs, that are available, is needed. At the Fisheries and Marine Institute of Memorial University we are currently looking at more industrially driven, technical training, as well as continuing education approaches to meet the needs of those professionals already in the industry.

Facing the challenges of aquaculture education

N. Alward*

NBCC, 99 Augustus St., St. Andrews, NB, E5B 2E9

Canadian educational institutions offering aquaculture programs are at a crossroads of change; industry revolution and all that it brings, aging population demographics, and demands for new approaches to teaching all make for very nervous program planners. How can current faculty and administrators expect to keep pace with the ever increasing rate of change and do it with ever dwindling resources? With a little hope, a lot of heart, and some visionary planning, that's how. In the turmoil of today there is tremendous opportunity to bring new life into the education system and into our programs. This presentation will take a SWOT-like approach to casting an optimistic eye to the future.

The world is your oyster at VIU

A. McCarthy*

Fisheries and Aquaculture Program, Victoria Island University

The Fisheries and Aquaculture Program is in its 29th year of operation. What began as a two year technology diploma for government hatchery workers has expanded into an assemblage of interrelated programs covering a much broader range of subjects including aquaculture of fish and invertebrates, fisheries management, habitat assessment, and water quality. A hallmark of the Department's teaching is the combining of theory and practice, the latter taking place in the culture facilities on campus and on the sites of many government and private sector operations on Vancouver Island. The facilities on campus include the new Centre for Shellfish Research, trout, sturgeon, and warm water fish systems, aquaponics, and teaching laboratories. Soon to be built are a new marine research station in Deep Bay and an International Centre for Sturgeon Studies. A masters degree is in the planning stages.

First Nations Youth Leadership Shellfish Program, FLOW - future leaders on the water

S. Richards*[1]

[1]Centre for Shellfish Research, Vancouver Island University, 900th St, Nanaimo, BC, V9R 5S5

FLOW - *Future Leaders On the Water* is a First Nations youth leadership shellfish program is designed for First Nation youth from 13 – 18 years of age. The goals of this program are to bring together youth from different communities, to teach leadership skills and to provide a basic knowledge of key areas that are fundamental to successful shellfish aquaculture. This program was envisioned following consultation with First Nation communities regarding their current efforts to become involved in shellfish aquaculture. The Centre for Shellfish Research, at Vancouver Island University, has been providing shellfish aquaculture training and mentoring to twenty coastal First Nation communities. The common concern for all was that youth in the

communities have lost touch with the ocean. This will potentially impact their future success in aquaculture. The Centre for Shellfish Research responded by developing and sponsoring the First Nations Youth Leadership Shellfish Program for teens from these communities that focuses on science and leadership. The outcomes of the 2008 pilot and future goals of this innovative program will be presented.

Integrated clam fisheries and aquaculture for coastal community development in Northeastern Brazil – the value of local social and environmental capital

A. Macnaughton*[1], F. Suplicy,[2] V. Pasquotto[2], and J.Carolsfeld[1]

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[2]Secretaria Especial de Aquicultura e Pesca, Esplanada dos Ministérios, Bloco D. Brasília, DF 70043-900 (SEAP)

Artisanal fisheries for the pointed venus clam, *Anomalocardia brasiliana*, and the mud clam *Lucina pectinata*, sustain thousands of low-income families in coastal communities of northeastern Brazil. A CIDA-funded project led by World Fisheries Trust and the Brazilian Special Secretariat of Aquaculture and Fisheries (SEAP), in partnership with the University of Victoria, Vancouver Island University and a variety of local Brazilian institutions[1] proposed the introduction of clam and oyster culture as alternative livelihood strategies to improve opportunities for these communities.
The initial project needed to be adapted with extensive local input to become widely accepted and now has a more holistic integrated approach to improved livelihoods, including capacity-building, new strategies to improve sustainability of existing local fisheries, enhancement of natural shellfish banks, value-added processing and small-scale aquaculture. Cross-institutional and cross-societal linkages are a novel, but very popular cornerstone, and are visibly strengthening social capital and improving trust amongst participants, effectively transforming opponents of aquaculture into resources and co-contributors in the development process. We are finding that this could be a path to appropriate and responsible development of integrated fisheries and aquaculture solutions for community development in this part of Brazil, as well as possibly being appropriate elsewhere in the world.

[1] UFERSA, UFBA, Associação de Marisqueiras de Grossos, Terra Viva, IDEMA, BahiaPesca, IBAMA, ICMBio, UFRPE and others.

Alternative Finfish Culture and Microalgal Culture

Wednesday, May 13, 2009 – mercredi 13 mai, 2009
2:20 PM – 4:40 PM
Location: Dunsmuir / Malahat

Chair: Duane Barker

2:20 **Leadbeater, S.**
Initial nutritional study of shortnose sturgeon (*Acipenser brevirostrum* LeSueur): egg composition and protein to energy ratio requirement

2:40 **Lush, L.**
Feeding F1 Atlantic cod broodstock…insights into the mystery

3:00 **Campbell, B.**
The aquaculture of sablefish, *Anoplopoma fimbria*

3:20 **Ahmed, J.**
Survey of fisheries resources in some selected thanas under Feni district of Bangladesh

3:40 **HEALTH BREAK**

4:00 **Bujold, S.**
Microalgae for aquaculture: centralised supply vs on-site production

4:20 **Mehrannezhad, R.**
Purification of *Dunaliella salina* of Urmia Lake

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

Initial nutritional study of shortnose sturgeon (*Acipenser brevirostrum* LeSueur): egg composition and protein to energy ratio requirement

S. Leadbeater*[3], S.P. Lall[2], J.D. Kieffer[1], and M.K. Litvak

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Shortnose sturgeon (*Acipenser brevirostrum* LeSueur) is a potential candidate for commercial aquaculture in New Brunswick because of its high value meat and caviar. Large eggs and juvenile hardiness make this species attractive for culture since they can be reared using many existing salmonid technologies. The nutritional requirements of this species need to be defined in order to ensure high quality animals are available for industry examination. Currently wild and captive broodstock are used to provide gametes for juveniles. Nutrient composition of the eggs produced by wild females with those of captive females fed commercially available feeds was examined. Differences in the amino acid profile were small. Differences in fatty acid and mineral composition will be discussed. In a second study, a twelve week growth trial on juvenile shortnose sturgeon, we found that lipid levels in the diet to have a significant influence on the lipid and energy retention, digestibility, nutrient retention efficiency and ammonia output rates. No increase in any growth parameters with respect to protein content of the diet was seen. Results from the growth study indicate that 40% dietary protein should be sufficient. Further results from our study will be discussed.

Feeding F1 Atlantic cod broodstock…insights into the mystery

L. Lush*[1], D. Hamoutene[1], S. Samuelson-Abbott[1], K. Burt[1], D. Drover[1], J.C. Perez-Casanova[1], and S. Kenny[1]

[1]Aquaculture, Biotechnology and Aquatic Animal Health Section, Department of Fisheries and Oceans, St John's, NL, A1C 5X1

Difficulties in determining proper feeding for hatchery raised F1 Atlantic cod broodstock have been prominent in the culture of this species. Previously, broodstock raised on grow out diets have not performed well on first spawning. The question has been asked whether this is a function of diet or naïve spawning. Our project aims to determine how diet influences the spawning and growth performance of F1 broodstock by testing three diets on three duplicate groups of photomanipulated F1 cod broodstock hatched in 2006. One group was fed a manufactured on-growing pellet, a second group fed a manufactured pellet specifically formulated for marine finfish broodstock and the third group was fed the current standard diet of baitfish supplemented with vitamins. Feeding trials commenced in late August. Results show that so far, specific growth rates and condition factors are significantly higher in the groups fed baitfish, and that grow-out and broodstock diets lead to similar growth rates. Spawning unexpectedly started in January and assessment of egg and sperm quality is being completed. This assessment will bring preliminary information (fish fed for 4 months only) on the potential

impact of these diets on reproductive output keeping in mind more time is needed to conclude with certainty on this matter.

The Aquaculture of Sablefish, *Anoplopoma fimbria*

B. Campbell*

Sablefish Canada Inc. 335 Walkers Hook, Saltspring Island, BC V8K 1N7

Since the 1980's it has been known that the sablefish has a great potential for development into a viable aquaculture species. Since that time several individuals have driven the scientific and industrial development of this species forward and, with the combination of government and private backing, two commercial sablefish hatcheries are now established on Vancouver Island. The commercial market for sablefish continues to expanded with multiple product outlets, from live fish to sashimi, commanding the highest price per pound of all current aquaculture fish species. Despite this initial success there are many aspects of sablefish biology and rearing that remain to be understood in order to remove production bottle necks, reduce costs and provide the market with a consistent, reliable high class product. Work is required to optimize larval, juvenile and grow-out rearing. Most importantly, the industry requires a concerted effort to establish stable, genetically sound broodstocks. This will provide year round supplies of high quality seed essential for the long-term improvement and sustainability of this new industry in British Columbia.

Survey of fisheries resources in some selected thanas under Feni district of Bangladesh

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[2]Department of Aquaculture, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh

A comprehensive fisheries resource survey was conducted in three unions under Dagon Bhuyan, Sonagazi and Feni Sadar thana of Feni district based on stratified random sampling procedures. Number of ponds were 1906 in the surveyed unions. Of the total numbers of ponds, 9% were found to be derelict, 27% cultivable and 64% under fish culture. Majority of the ponds were smaller in size. Among the total fish farmers 31.3% were literate and 68.7% were illiterate. Of the literate fish farmer 20.7% received education up to S.S.C. or higher level. A significant proportion (22.5%) of the total ponds, were found to be flood affected. Almost all the ponds were shaded and covered with surface vegetation. Fish production was found to be 3.1 to 4.9 kg/decimal/yr (766 to 1210kg/ha/yr). Private hatchery and nursery were the main source of fingerling supply to the fish farmers. Majority of the pond owners showed their performance for culturing Indian major carps and Chinese silver carps. Lack of knowledge on scientific fish culture, shortage f funds, risk of flooding and poaching, incidence of disease, non-coperation of the share holders, shortage of fingerlings were identified as being the constraints to fish culture in the surveyed area.

Microalgae for aquaculture: centralised supply vs on-site production

D. Diouf[1], S. Bujold*[2], and R. Fournier[2]

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Polyunsaturated fatty acids which are known to be essential for larvae stem from microalgae in the marine environment. As hatchery foodstuffs, microalgae are mainly presented in paste or live forms. Several studies have demonstrated the poor nutritional quality of algal paste for many species. In this extent, Knuckey (1998) found that more nutritious aquaculture species were damaged by centrifugation and deteriorated with storage. According to him the high shear forces during centrifugation are the probable cause of cell damage and damaged cell deteriorated with storage time and leached organic content on resuspension. As a result, their poor nutritional quality is a constraint for their regular use as full diet in hatcheries. Consequently, live algae represent until now the only reliable feed for hatchery nutritional operations. Nevertheless, the high costs associated with algal production, the great volume used, the risks for bacterial contamination and the temporal variations of quality still constitute major bottlenecks for any sustainable marine hatchery business. The solution would likely be the implementation of centralised mass algal production facilities which are well equipped and capable of maintaining continuous and high quality production so as to support the growing hatchery demand.

Purification of *Dunaliella salina* of Urmia Lake

R. Mehrannezhad*

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There are different products such as B-carotene, Agar and est. extract from Phytoplanktons.*Dunaliella salina* is one of the families of green algaes considered as and unicellular and flagellate algaes .Dunaliella is considered as effective nutrients in all research systems of productive and other systems. D.salina is a natural inhabitant of Urmia lake, and it is the main food of *Artemia urmiana*.In this survey first the samples are taken from lake then after filtration by special alchoholes are cultured under standard condition in Vallneh media at 24^{o}C.After growth of algae and increasing of its density, samples are investigated under microscope and then algaes are purified by micropipettes under invert microscope. Afterward the pure samples are moved to solid media so the isolated samples can growth and then moved to liquid media.

Key words: Algae, Dunaliella salina, Urmia Lake, Culture

Poster Session / Session affiches

Tuesday, May 12, 2009 – mardi 12 mai, 2009
2:00 PM – 4:00 PM
Location: Main Lobby

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

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Early life stage biology of a new population of green crab *Carcinus maenas* in Placentia Bay & implications for mussel culture in Newfoundland
K. Best*[1], C. McKenzie[2], and C. Couturier[1]

Fisheries and Oceans Canada's new Program for Aquaculture Regulatory Research (PARR)
I. Burgetz*[1] and G.J. Parsons[1]

Monitoring of environmental conditions on salmon sites in Fortune Bay (Newfoundland and Labrador): emphasis on the occurrence of hypoxia
K. Burt*[1], D. Hamoutene[1], T. Puestow[2], D. Drover[1], S. Samuelson-Abbott[1], A.K. Gamperl[3], and L. Lush[1]

***In vitro* effect of acute hypoxia on blood cell metabolism and the respiratory burst response in three aquaculture finfish species, Atlantic cod (*Gadus morhua*), Atlantic salmon (*Salmo salar*), and steelhead trout (*Oncorhynchus mykiss*)**
D. Hamoutene[1], K. Burt*[1], S. Samuelson-Abbott[1], G. Mabrouk[1], A. Mansour[1], and K. Williams[2]

Aquaculture Collaborative Research and Development Program (ACRDP)
C. Busby*[1], T. Gheorghe[1], I. Burgetz[1], and G.J. Parsons[1]

Oceanographic study of the South Coast of Newfoundland
D. Drover*[1], G. Mabrouk[1], F. Page[2], and R. Losier[2]

Pathologic macrophage aggressions and ovarian haemosiderosis in silver catfish *Chrysichthys nigrodigitatus* from locations on the Lagos Lagoon, Nigeria
H.A. Fashina-Bombata[1]*

Using an aquaponics unit as a tool to teach sustainable food production to elementary school students
L. Forsthovel*

Effects of dietary protein and digestible energy levels on the performance of Gattan, *Barbus xanthopterus* (Heckel, 1983)
M., Khosravi zadeh[1*], J., Ghafleh Marrammazi[2], P., Kochanian[1], E., Rajabzadeh[1],V., Yavari[1] and M., Nikpey[2]

Is the green sea urchin pathogen *Paramoeba invadens* present around Vancouver Island?
B. McNish*, D.E. Barker, and A. McCarthy

American oyster (*C. virginica*) productivity and physiological condition at low and high salinity sites
D. Méthé*[1], T. Landry[1], J. Davidson[2], and L. A. Comeau[1]

Definition methods for processing of cysts of *Artemia urmiana*
R. Mehrannezhad*

Quality investigation of decapsulated cysts of *Artemia urmiana*
R. Mehrannezhad* and N. Peykaran

Determination of the approaches for improvement of high salinity impacts on the biological cysts of Artemia urmiana
R. Mehrannezhad*

Evaluation of hatching percentage and hatching efficiency of *Artemia urmiana* cysts
N. Peykaran and R. Mehrannezhad*

Survey on characterization of shrimp farms in relation to the use of antimicrobials and chemicals
M. N. D.Munasinghe*[1], C. Stephen[2], P. Abaynayake[1], and I.S. Abaygunawardena[3]

Development of novel recombinant vaccine models against Infectious Salmon Anemia Virus (ISAV)
M. Roy*[1,2], M. Laflamme[1,2], K. Salonius[3], N.C. Simard[3], M. Robichaud-Haché[1], G.A. Robichaud[2], and N. Gagné[1,2]

Mercury concentration comparison and measurement in mudskipper (*Periophthalmus waltoni*) and flat fish (*Cynoglossus arel*) in Bandar-e-Emam and Bandar Abbas
A. Askary Sary[1], M. Velayatzadeh[2*], and M. Mohammadi[3]

Early life stage biology of a new population of green crab *Carcinus maenas* in Placentia Bay & implications for mussel culture in Newfoundland

K. Best*[1], C. McKenzie[2], and C. Couturier[1]

[1]School of Fisheries, Marine Institute of Memorial University, St. John's, NL, A1C 5R3
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Following the discovery of the introduced, invasive green crab *Carcinus maenas* in Placentia Bay Newfoundland in August 2007 there have been concerns for mussel aquaculture, seed movement and for clam culture populations. Post-larval green crab has been noted in Europe to hide in mussel habitats, and this might include mussel collectors or socks. If this is true for other green crab populations mussel seed transfers from Placentia Bay could provide a vector for green crab transfers to other regions, where it is currently not found. We are examining the reproductive biology (age at maturity, spawning and larval release) of the introduced green crab populations to obtain a better understanding of recruitment dynamics of this introduced invader so that mitigation and preventative measures can be taken to avoid spreading the organism to other areas. Larval settlement behavior experiments and mussel seed mitigation experiments will be undertaken in 2009 to evaluate the effectiveness of activities in preventing the spread of the organism to other culture regions. Early findings suggest this Newfoundland crab matures at a smaller size in Newfoundland than warmer populations, and that the species is very active at temperatures where they are normally seen to undergo "hibernation" in other regions.

Fisheries and Oceans Canada's new Program for Aquaculture Regulatory Research (PARR)

I. Burgetz*[1] and G.J. Parsons[1]

[1]Fisheries and Oceans Canada, 200 Kent Street, Ottawa, Ontario

As part of the federal government's Budget 2008 investment in aquaculture, a new Fisheries and Oceans Canada (DFO) internal research program was created to support priority aquaculture regulatory research. In 2008/2009, 16 research projects across Canada were supported under the Program for Aquaculture Regulatory Research (PARR), addressing priorities related to ecosystem carrying capacity and near and far-field ecosystem effects of aquaculture. The research supported in 2008/2009 has been directed both to projects that build on existing DFO research and position the Department to provide scientific advice and undertake new research activities in support of anticipated requests for scientific advice and information linked to the siting and environmental management of potential aquaculture development. Over the longer term, research priorities will be primarily driven by the information gaps and research recommendations identified through a planned Canadian Science Advisory Secretariat (CSAS) science advisory process that will review the scientific literature and evidence available relative to key aquaculture activity-related stressors and their potential effects, as described in three aquaculture pathways of effects diagrams. A key to the success of this program is communicating the research results with federal and provincial experts responsible for the environmental regulation of aquaculture, as well as ensuring that research is aligned with aquaculture regulatory research needs and information gaps.

Monitoring of environmental conditions on salmon sites in Fortune Bay (Newfoundland and Labrador): emphasis on the occurrence of hypoxia

K. Burt*[1], D. Hamoutene[1], T. Puestow[2], D. Drover[1], S. Samuelson-Abbott[1], A.K. Gamperl[3], and L. Lush[1]

[1]Aquaculture, Biotechnology and Aquatic Animal Health Section, Department of Fisheries and Oceans, St. John's, NL, A1C 5X1
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[3]Oceans Sciences Centre, MUN, St. John's, NL, A1C 5S7

As part of a study examining the influence of environmental conditions on salmon aquaculture, and in close collaboration with fish farmers, we monitored oxygen, temperature, and salinity at two selected salmon cage-sites from July 23rd to December 12th 2008. One of the sites (A) had revealed low dissolved oxygen in the past; the other one (B) had not been monitored by DFO but was not expected to become hypoxic (i.e. dissolved oxygen < 6 mg/L). Both sites had salmon cages; site A with a density of ~8.5kg/m^3 (avg. mass: 1.7 kg) and site B with a density of ~7.6kg/m^3 (avg. mass 0.18 kg). Almost no hypoxic events were recorded at site A, showing that measures taken by farmers had solved the dissolved oxygen issue observed in previous years. Site B had intermittent hypoxic events (O_2 levels generally ranging from 4 to 6 mg/l), mostly at 4 and 6m, with a mean duration of approx. 70 min. at 4m and 80 min. at 6m Most hypoxic events were observed during the day (from 7:00 to 20:00), when fish could potentially be present at these depths. On average the fish were exposed to 4 hypoxic events per day from August 24th to October 6th. Further data analysis is being performed to determine the most informative parameter(s) (using decision tree analysis) influencing DO. Questions remain about the effect of this intermittent hypoxia on fish health and growth, and will be the focus of future research.

***In vitro* effect of acute hypoxia on blood cell metabolism and the respiratory burst response in three aquaculture finfish species, Atlantic cod (*Gadus morhua*), Atlantic salmon (*Salmo salar*), and steelhead trout (*Oncorhynchus mykiss*)**

D. Hamoutene[1], K. Burt*[1], S. Samuelson-Abbott[1], G. Mabrouk[1], A. Mansour[1], and K. Williams[2]

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Investigation was conducted on *in vitro* effect of hypoxia on blood cells of three aquaculture finfish species widespread in Atlantic Canada: cod, steelhead trout (anadromous rainbow trout), and salmon. Exposure to 3 hours of acute hypoxia had no significant effect on red blood cell antioxidant enzyme, citrate synthase, or lactate dehydrogenase activity in any of the three species. This result was surprising considering known differences in tolerance to hypoxia between these species. However, the lack of an effect on red blood cell metabolic activities could be explained by the short-term nature of the exposure. The respiratory burst (RB) activity of steelhead trout and salmon blood was also unaffected by hypoxic conditions. In contrast, cod blood cell RB was decreased by hypoxic conditions. This latter result suggests a higher sensitivity of cod immune

cells to low oxygen levels, and is interesting given previous studies on cod immunity. These studies have revealed an inferior mechanism (capacity) for antibody generation in cod as compared to other fish species, and thus one would expect that the direct (innate) response of immune cells to stress/pathogens would be of primary importance in this species defence against pathogens.

Aquaculture Collaborative Research and Development Program (ACRDP)

C. Busby*[1], T. Gheorghe[1], I. Burgetz[1], and G.J. Parsons[1]

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

The Aquaculture Collaborative Research and Development Program (ACRDP) is an industry driven research and development activity aimed at increasing the level of collaborative research between the aquaculture industry and Fisheries and Oceans Canada (DFO). This program has been in operation since 2001 and is jointly funded by DFO and industry partners. The ACRDP funding envelope is $4.275 million annually (subdivided regionally), and must include a minimum industry contribution of 30% of the ACRDP amount requested (7.5% in-cash, 22.5% in-kind). There are three main research and development objectives to the program: (1) best performance in fish production, (2) optimal fish health, and (3) industry environmental performance. To date, over 250 projects have been approved and funded totaling $59.2 million in aquaculture research. This includes minimum contributions of $27.3 million in ACRDP funds, $13.1 million from industry contributions, $13.5 million in other DFO funding and $5.3 million from other partners. The ACRDP also supports a number of key national projects such as communications initiatives, including the development of project Fact Sheets, Key Issue Papers to address aquaculture-related topics of high interest, and the bi-annual R&D Review summarizing current aquaculture research being undertaken in Canada. The program continues to strive for improvement through stakeholder engagement by seeking feedback on key priorities that address solutions for the sustainable development of the sector.

Oceanographic study of the South Coast of Newfoundland

D. Drover*[1], G. Mabrouk[1], F. Page[2], and R. Losier[2]

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The province of Newfoundland is experiencing a significant influx of investment in salmonid farming. The increasing biomass, the increase in the number of companies operating, the diversity of production strategies, and the increasing concentration of farm sites, particularly in outer Bay d'Espoir, challenges biosecurity and the sustainability of this growth. Currently there is a lack of data and understanding of the oceanography of the outer Bay d'Espoir area that precludes establishment of scientifically validated production and management areas to guide site licensing, production planning, and sustainable management of the industry. The problem is particularly acute in this area because company production plans will result in overlapping year-

classes in the area in 2009. This study will establish the infrastructure and the foundation for Newfoundland to be able to carry out an oceanography program to collect and model the physical environmental data - currents, dissolved oxygen, temperature, and salinity - and map the environmental parameters and potential zones of influence that will be used to establish production management areas.

Pathologic macrophage aggressions and ovarian haemosiderosis in silver catfish *Chrysichthys nigrodigitatus* from locations on the Lagos Lagoon, Nigeria

H.A. Fashina-Bombata[1]*

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As part of the results of a continuing series of studies to investigate the effects of aquatic pollutants on morphometry and gonadal condition in fish from estuaries in Lagos state, Nigeria, pigmented macrophage aggregates of heavy deposition of Haemosiderin in the ovaries of the silver catfish *C. nigrodigitatus* from the Lagos Lagoon complex are reported. Contrary to expectation, fish from the Lagos Lagoon (location 1; polluted), the site which receives the largest volumes of multivariate wastes showed no pathologic pigmentation in the specimens, while those from the mildly polluted (Ologe) and pristine (Badagry) locations exhibited haemosiderosis. No disease agent was implicated as the cause of haemosiderosis in the lagoon complex, toxic and pollution related causes are thus probable.
Keywords: Chrysichthys nigrodigitatus, Lagos Lagoon, pollution, Haemoside

Using an aquaponics unit as a tool to teach sustainable food production to elementary school students

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As a pilot project, I set up an aquaponics unit for future use at a local elementary school to teach students about sustainable food production. I used a 30 gallon aquarium and stocked it with three Tilapia, *Oreochromis niloticus.* Four Strawberry plants, *Fragaria ananassa*, in plastic cups were inserted in holes cut into one and one half inch PVC piping. Light was supplied with a thirty-six inch long full spectrum fluorescent tube (6400 K). The goal of this project is to teach elementary students how to successfully raise fish and grow fruit in the same system. This project is designed to be a hands-on learning experience for students to gain knowledge in aquaculture and horticulture basics, fish husbandry, water quality, and ammonia and nutrient cycles. The importance of accurate documentation is to be emphasized. The weight of the fish is to be recorded both at the beginning and end of the project. Fruit is to be picked and weighed at the end of the project.

Effects of dietary protein and digestible energy levels on the performance of Gattan, *Barbus xanthopterus* (Heckel, 1983)

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8-week feeding trial with 9 semi-purified diets to contains 3 levels of crude protein (25%, 30% and 35%) and 3 levels of digestible energy (DE 2.5, 3 and 3.5 kcal/g), in a flow-through system (1L/min) at 26.2 ± 0.46°C was carried out to investigate optimum protein and lipid levels in Gattan, *Barbus xanthopterus* fingerlings. Triplicate groups of 15 fish (12.12±0.22 g) were each stocked in 300-L circular polyethylene tanks and were fed 1-5% of their body weight thrice a day based on fortnightly weight measurements. Result of this study showed that growth performance, feed efficiency and nutrients utilisation were significantly affected by protein and digestible energy levels. Diet 8 (35% CP and 3 kcal/g DE) was the preferential diet and exhibited the best growth performance, feed and protein efficiency, nutrient utilisation and condition factor (CF) among the examined diets. Protein efficiency ratio (PER) and apparent net protein utilization (ANPU) between varying levels of CP was difference insignificant ($P>0.05$). However, PER and ANPU were significantly affected by varying DE levels ($P<0.05$). Highest lipid deposition and lowest moisture content ($P<0.05$). was observed in diets containing high energy levels (3.5 kcal/g DE). On the other hand, it was found that varying levels of CP and DE in the diets did not significantly ($P<0.05$) affect the protein and ash content of the fish in the dietary treatment. Hepatosomatic Index and Viscerosomatic Index increased significantly ($P<0.05$) with the increase in DE level. However, interaction of protein and energy did not significantly affect these parameters ($P>0.05$). The best of protein-sparing effect of DE was observed in energy level of 3 kcal/g. Comparison between varying levels of dietary protein and energy and their interaction on the growth, feed utilization and whole body of Gattan indicated that 35% CP and 3 kcal g^{-1} DE could be the preferential dietary levels in fingerling stage of this species.
Key words: Gattan (*Barbus xanthopterus*); Protein; digestible energy; Growth performance; Protein utilization; Whole body

Is the green sea urchin pathogen *Paramoeba invadens* present around Vancouver Island?

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Paramoeba invadens is a pathogen that has impacted the green sea urchin (*Strongylocentrotus droebachiensis*) stocks on the east coast of Canada. During the 1980s and 1990s, abnormally high water temperatures were hypothesized to have induced these epizootics near Nova Scotia. Thus far, *P. invadens* has not been recorded as a pathogen of urchins on the west coast of Canada, yet knowledge of its presence would be critical for development of urchin culture. In a pilot study (2007) at Vancouver Island University, green sea urchins were held at three different

temperatures (4°, 6°-10° and 20 °C) and monitored for 21 days. At the end of the study, coelomic fluid was removed (using a needle + syringe at the peristomal membrane), placed on slides, dried and stained with Diff-Quik™ to examine for the presence of *Paramoeba*. Urchin mortalities displayed the clinical symptoms of *Paramoeba* infections and all three treatments had at least one sample of what resembled *Paramoeba* p, with 100% prevalence among samples from 20° C. However, the species identification from stained samples was equivocal; consequently a Phase-II study in 2009 at Vancouver Island University was undertaken using phase-contrast on live samples for better diagnostic identification. Three 5 gallon glass aquaria, each containing 6 green sea urchins, were at 20 °C, three other aquaria were held at 6°-10° C and six green sea urchins were held in a tank open to the environment. The results of the Phase-II study will be discussed to address the query of whether *Paramoeba invadens* is present around Vancouver Island, Canada.

American oyster (*C. virginica*) productivity and physiological condition at low and high salinity sites

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Given that high salinity environments often harbor pests, pathogens and diseases, Elsipogtog First Nations are considering the possibility of extending their oyster operation upriver (12 ppt) in the Richibucto estuary (New Brunswick). Our project has been designed to assess the productivity and physiological condition of oysters in both low and high salinity environments. Growth, condition, mortality and lysosomal membrane stability are being measured to determine the productivity and stress response of oyster seeds and juveniles. This information will be used to evaluate the potential benefits of moving seed from a low salinity collection site to a high salinity site, and vice versa. In addition, the data will be used to evaluate the benefits of growing seed oysters to a juvenile stage at a low salinity site before transferring them to a high salinity site for final grow out.

Definition methods for processing of cysts of *Artemia urmiana*

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In this survey in orther to define necessary methods of cysts processing F.B.D and layer drying methods, are used were taken from a group of hemogen cysts and treated in two groups including five temperature treated(28,30,32,34,36) and six time treated(1,2,3,4,5,6hours) for layer drying method and five temperature treated(28,30,32,34,36) and four time treated (0.5,1,1.5,2 hours) for F.B.D drying system. After that in each treat we measured hatching percentage and hatching efficiency until next 15 months. All of the data analyzed by Spss software using dual side variation method. The best treat was with F.B.D in 28 °C for 0.5 hour, and the best treat for layer drying system was in 34 °C for 4 hours. The best humidity left in system after processing is 15 percent.

Key words: cysts, Artemia urmiana, Urmia Lake, F.B.D, hatching efficiency, hatching percentage

Quality investigation of decapsulated cysts of *Artemia urmiana*

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In this study produced cysts of Artemia urmiana from Urmia Lake, with low hatching percentage were decapsulated by hypochlorite solution and packed and vacuumed in cans. Thereafter to know quality decreasing of the products during storage, some samples were taken and investigated because of there protein, fat, carbohydrate, humidity and microbial infectious. Then according to the durability of the product decision were made to pack the products.

Key words: decapsulated cyst, Artemia urmiana, quality investigation

Determination of the approaches for improvement of high salinity impacts on the biological cysts of Artemia urmiana

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According to the researches results performed in Iranian Artemia Research Center, salinity of Urmia lake is about 294 gr/L at Persent.The Lake has 27 billions m^3 water and 8 billions tons salt. Statistical analysis suggests that we may produce up to 2 millions tons salts from this lake annually, in orther to reduce the stress imposed on Artemia urmiana due to high salinities.It should be rememberd that similar conditions govern on Great Salt Lake in United States and about 3 millions tons salts are produced from this lake annually(Gwynn,2001).salt production from Urmia lake in this scale not only will improve biological situation and reproduction state of Artemia as a unique organism in aquaculture, but will also provide more employments and export. According to the past two decades assessment, the most suitable salinity for thriving the Artemia is 80-150 gr/L.Therefore, we may provide this condition in the lake in order to increase phytoplankton community diversity and density in the lake which Artemia feed on them

Key words: Artemia urmiana, salt, biological cycle

Evaluation of hatching percentage and hatching efficiency of *Artemia urmiana* cysts

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Today, various life stages of Artemia such as newly hatched naplius is the only food for postlarvae stage in shrimps.Naplius maybe applied for feeding the larval stage of sturgeon ,ornamental and marine fishies.The main life stage of shrimp in which Artemia cysts are mostly used is postlarval stage(from mysis to pL_{15}).Hatching efficiency and percentage are two important factors for assessment of the cysts consumption rate in shrimp farms and also in cysts price determination.Salinity,temperature,PH,oxygen and light are the most effective factors in hatching efficiency and percentage. Hatching percentage is defined as the number of nauplii

which are produced from 100 cysts under the standard incubation. Hatching efficiency is the number of the nauplii which are produced from one gram dried cysts under the standard incubation.

Key words: Artemia urmiana, cyst, hatching percentage, hatching efficiency

Survey on characterization of shrimp farms in relation to the use of antimicrobials and chemicals

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Shrimp farms are largely concentrated along the North Western coastal belt of Sri Lanka (Puttalam district) due to presence of suitable habitats and proximity to the international airport which facilitates trade. The major cultivated shrimp species in Sri Lanka is *Panaeus monodon*, the black tiger shrimp. Farmed shrimp are the major aquatic export commodity of Sri Lanka with exports to the EU, China, Japan, Singapore, and USA. Specific objectives of this project are to characterize shrimp farms with respect to size, resources, production, health management practices and major constraints affecting the production. These findings will be correlated with reported antimicrobial and chemical use. Spatial relationships between farm characteristics and management practices in North Western Region of Sri Lanka will be examined. A survey is being carried out in all the functioning farms within the Puttalam district. Data collection will be achieved by personal interviews using questionnaires, global positioning system (GPS) and Remote Sensing (RS) and by site visits. Although there were 1150 shrimp farms in the area, only 500 farms are functioning. The reasons for temporary and permanent abandon include disease outbreaks, fluctuating and low market prices, monopoly dominated export market and high costs of production. More than 33% of the investors are small scale farmers having less than 1 hectare. The majority of farmers (82.7 %) follow an open water management system. The major water sources are lagoons, canals, river basins and tube wells. The survey results to date (260/500 farms) indicate 23% of farms use antimicrobials, 53% probiotics and 63% use vitamins. Chemicals are also used for water quality controllers, fertilizers and molting agents. Analysis of associations between farm features, management and drug or chemical use will be conducted once 100% of the operational farms are assessed.

Development of novel recombinant vaccine models against Infectious Salmon Anemia Virus (ISAV)

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Infectious salmon anemia virus (ISAV) is an important viral pathogen which has caused mass mortalities of salmonid fish in aquaculture. It remains a recurrent problem in Eastern Canada and Maine since the initial epizootics of 1996. A commercial heat-inactivated virus vaccine is currently available against the virus. However, with the current management of ISAV requiring depopulation at first signs of the disease, this vaccine may not get wide acceptance as it does not provide total protection from the disease. Vaccine technologies, based on recombinant viral proteins produce immune reactions similar to that of the inactivated virus, and have other advantages e.g. the possibility to form heterologous protein complexes, or to increase immunogenicity, etc. We propose a novel approach, where recombinant ISAV proteins will be produced *in vitro*, and combined to salmon heat shock proteins (HSP) *in vivo*. We believe this approach shows great promise as it has been demonstrated that HSPs naturally bind many peptides and proteins, and that recombinant peptides bound to HSPs produce much stronger antigens than the recombinant peptides alone. Results obtained to date are presented.

Mercury concentration comparison and measurement in mudskipper (*Periophthalmus waltoni*) and flat fish (*Cynoglossus arel*) in Bandar-e-Emam and Bandar Abbas

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Key word: Mercury, Mudskipper, Flat fish, Bandar-e-Emam and Bandar Abbas

This study was done at Mudskipper (*Periophthalmus waltoni*) and Flat fish (*Cynoglossus arel*) which had caught from the Bandar-e-Emam and Bandar Abbas in order to measurement and comparison about the concentration of the mercury (Summer,2008). Fishes were used as a Bioindicator for search the effect of mercury of the Bandar-e-Emam Petrochemistry impure at the species comparison with the Bandar Abbas. The average of the mercury concentration in flat fish from Bandar-e-Emam was 0.68 mg/Kg and for the Bandar Abbas was 0.14 mg/Kg that had a meaning different between them ($P<0.05$). The average of the mercury concentration in Mudskipper from Bandar-e-Emam was 0.81mg/Kg and for the Bandar Abbas was 0.07 mg/Kg that had a meaning different between them ($P<0.05$). The concentration of the Bandar-e-Emam and Bandar Abbas had a meaning different ($P<0.05$).

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