

PROGRAM



Securing Sustainable Economic Prosperity

**Shaw Conference Centre, Edmonton, AB
September 23 - 26, 2007**

24th Annual Meeting – Aquaculture Association of Canada

**The AC'07
Student Affairs
Committee is
proud to present:**

Aquaculture 100



- **WHERE:** Joe Brown Student BBQ
 - Rose and Crown Pub,
Sutton Place Hotel, 10235-101 St. NW, Edmonton
- **WHEN:** September 24th, 6:00 pm

Watch and get in on the fun as AC'07 conference delegates go head to head, performing their karaoke favourites while being judged by a panel of AAC's professional musicians!

***Plenty of prizes to be won and fun to be had at the Annual Joe Brown BBQ!
{ BBQ Tickets \$25 }***



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Aquaculture Canada 2007 Committees / Comités

Executive Committee

Chair: Chris Pearce (AAC President), Fisheries and Oceans Canada
Cyr Couturier, Memorial University
Chris Hendry, Newfoundland and Labrador Department of Fisheries and Aquaculture
Linda Hiemstra (Conference Organizer)

Program Committee

Chair: Chris Hendry, Newfoundland and Labrador Department of Fisheries and Aquaculture
Linda Hiemstra (Conference Organizer)
Eric Hutchings, Alberta Agriculture and Food
Mark McNaughton (President), Alberta Aquaculture Association
Rich Moccia, Aquaculture Centre, University of Guelph
Jason Nichols (AAC Webmaster), Marine Institute of Memorial University
Mia Parker, Grieg Seafood BC Ltd.
Chris Pearce (AAC President), Fisheries and Oceans Canada
Rod Penney, Canadian Food Inspection Agency
Alistair Struthers, Canadian Food Inspection Agency
Grant Vandenberg, Université Laval

Local Organizing and Sponsorship Committee

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Cyr Couturier, Memorial University
Chris Hendry, Newfoundland and Labrador Department of Fisheries and Aquaculture
Linda Hiemstra (Conference Organizer)
Eric Hutchings, Alberta Agriculture and Food
Terralynn Lander, Fisheries and Oceans Canada
Mark McNaughton (President), Alberta Aquaculture Association
Alistair Struthers, Canadian Food Inspection Agency
Grant Vandenberg, Université Laval



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- Aquaculture Association of Canada
- Alberta Agriculture and Food
- Alberta Aquaculture Association
- Interprovincial Partnership for Sustainable Freshwater Aquaculture Development

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- Agriculture and Food Council of Alberta, Agriculture and Agri-Food Canada's Advancing Canadian Agriculture and Agri-Food (ACAAF) Program
- Alberta Agriculture and Food, Agri-business Expansion Program
- Fisheries and Oceans Canada, Aquaculture Collaborative Research and Development Program
- Genome Atlantic

GOLD

- Aquaculture Centre, University of Guelph
- Atlantic Provinces Council on the Sciences
- Canadian Aquaculture Industry Alliance
- Grieg Seafood
- Interprovincial Partnership for Sustainable Freshwater Aquaculture Development
- Réseau Aquaculture Québec
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Welcome Messages to Delegates Mots de bienvenue aux délégués

On behalf of the Aquaculture Association of Canada and the Organizing and Program Committees of Aquaculture Canada^{OM} 2007, it is my pleasure to welcome you to the vibrant city of Edmonton and our 24th annual meeting. In so doing, I would like to officially thank our co-hosts – Alberta Agriculture and Food, the Alberta Aquaculture Association, and the Interprovincial Partnership for Sustainable Freshwater Aquaculture Development – for their generous assistance and support.



Our conference theme – *Securing Sustainable Economic Prosperity* – speaks to the need for our industry to maintain or increase financial profitability (economic sustainability) while ensuring environmental integrity (environmental sustainability) and safeguarding public support (social sustainability). They are three keys to assuring the future success of the Canadian aquaculture industry, so we have organized a number of special sessions and speakers to address these particular topics.

This year, Aquaculture Canada^{OM} is partnering with the Interprovincial Partnership for Sustainable Freshwater Aquaculture Development to host the Second National Freshwater Symposium (the first being held at Aquaculture Canada^{OM} 2004 in Quebec City), which will focus on issues that are especially relevant to our freshwater aquaculture industry. We are very excited to be showcasing this facet of Canadian aquaculture and to be highlighting some of the excellent work and research being conducted in freshwater aquaculture throughout Canada.

The organizers of Aquaculture Canada^{OM} 2007 have put together a program embracing a stimulating scientific agenda, a comprehensive trade show, exciting industry tours, and entertaining social activities. Organizing a conference and tradeshow as large as Aquaculture Canada^{OM} is no small task. It requires the dedicated effort of a number of individuals working tirelessly to make the event a success. I would like to thank all those who have devoted their time and energy to making Aquaculture Canada^{OM} 2007 happen. In particular I acknowledge Linda Hiemstra (Conference Organizer), Chris Hendry (Program Chair), Eric Hutchings (Local Organizing Committee), and Cyr Couturier (Sponsorship Chair) for all their hard work. Finally, appreciation is expressed to all our conference partners and sponsors.

I hope you enjoy the conference and benefit from the learning and networking opportunities it affords.

Chris Pearce
President, Aquaculture Association of Canada



Aquaculture Canada^{OM} 2007

Welcome to Aquaculture Canada^{OM} 2007 - the 24th annual meeting of the Aquaculture Association of Canada!

The goal of the Aquaculture Canada^{OM} events is to support aquaculture in Canada and we have held this conference in many cities across our country but this is our first time in Alberta. In honour of being on the prairies, we are featuring freshwater culture in the conference program and in the fabulous freshwater products at the President's Reception and the Welcome to Alberta Dinner and freshwater recirculation systems are highlighted in the post-conference tours. Alberta is a warm and hospitable province and as the host of the province's 1st Aquaculture Canada^{OM} conference, the city of Edmonton has provided an amazing line-up of talent – the Festival City Road Show – for the Welcome to Alberta Dinner.



Other events not to miss are the Genome Atlantic Reception providing networking opportunities for all and the long awaited "Aquaculture Idol Contest" at the Joe Brown BBQ. And be sure to visit the industry trade show adjacent to the registration area.

I am sure you will find the Alberta Aquaculture Canada^{OM} 2007 experience unique and rewarding. Enjoy the conference!

Linda Hiemstra
Conference Organizer

On behalf of the Canadian Aquaculture Industry Alliance, I am very pleased to welcome all delegates to Aquaculture Canada^{OM} 07.

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. The conference, which has become a 'must attend' annual event, has also served to strengthen cooperation between students, scientists, educators, industry members and government.



The selection of this year's conference theme, Securing Sustainable Economic Prosperity, is both timely and appropriate. We all know that the Canadian aquaculture industry has made great strides in terms of market development, research, technology and innovation. However, ensuring our industry's sustainable economic growth for the future is still only a goal. This year's 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, the AAC is playing a key role in helping to secure sustainable economic prosperity for the Canadian aquaculture industry.

CAIA congratulates the organizing committee of Aquaculture Canada for a job well done and wishes everyone in attendance a productive and successful conference.

Ruth Salmon
Executive Director, Canadian Aquaculture Industry Alliance



On behalf of the Alberta Aquaculture Association and its members, I would like to extend a warm welcome to all those who have taken the time to travel to our province to attend Aquaculture Canada^{OM} 2007. This is the first time that the AAC annual meeting has been held in Alberta, or for that matter on the prairies, and we are very excited to be a part of it. Through education and research, the Alberta Aquaculture Association has worked closely with Alberta Agriculture Food and Rural Development, the Lethbridge Community College, and producers to help develop and promote aquaculture in the Province.



At first glance Alberta seems like an unusual place to meet to discuss aquaculture. Upon further investigation, I think that you will find that Alberta has one of the most diverse mix of aquaculture producers and technology in Canada. Species from rainbow trout to tilapia, triploid grass carp, and eel, and systems that range from ponds to flow through, intensive recirculation and aquaponics – it's all happening in Alberta – right now! Aquaculture producers are spread throughout the province, providing unique products and services to satisfy market demand.

I hope that each of you have a chance to enjoy the attractions in the city of Edmonton, as well as venture out of the city and experience the vast spaces and hospitality that the prairies have to offer.

Mark McNaughton
President, Alberta Aquaculture Association

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

On behalf of the IPSFD Board of Directors and the organising committee of the 2nd National Freshwater Symposium, I would like to welcome all to this year's Aquaculture Canada meeting. Holding Aquaculture Canada in the interior of Canada allows us to focus on the plentiful natural resources with which we are blessed in this country, and as a consequence, the enormous potential of the freshwater aquaculture sector. With a new Industry Action Plan in place, the IPSFAD and its partners will highlight a number of themes during the Freshwater Symposium that have been identified as challenges to the development of this sector. We invite you to join in on our presentations and discussions and assist in promoting approaches for further sustainable development of the freshwater aquaculture industry in Canada.



Grant Vandenberg
Interim President, Interprovincial Partnership for Sustainable Freshwater Aquaculture Development (IPSFAD) Inc.



Message from Honourable Ed Stelmach Premier of Alberta



On behalf of the Government of Alberta, welcome to Aquaculture Canada 2007.

I am pleased that Alberta is the first prairie province to host the annual meeting of the Aquaculture Association of Canada. As a non-coastal province, it is gratifying to hear that in addition to marine activity, interest in freshwater aquaculture is a growing segment of your organization. Alberta is proud to be part of the reason for that growth.

The theme of this year's event, Securing Sustainable Economic Prosperity, is one that resonates strongly in Alberta. Our provincial government and agriculture industry are very committed to ensuring we balance economic growth with conserving and protecting our natural resources.

A healthy bottom line and environment is also the focus of a new Alberta government initiative. Under the leadership of our Minister of Agriculture, we are working to create agri-environmental partnerships involving industry, communities, and the agriculture, environment, and forestry sectors to help develop environmentally-friendly market solutions. Together, with organizations such as yours, we can meet the needs of consumers while respecting the needs of the environment and our communities.

In addition to the conference, I hope you also find time to experience our 'non-aqua' culture. Albertans are known for their warm hospitality and enjoy the opportunity to show visitors the many things that make our province unique. Enjoy the conference and your time in our province's capital.

Ed Stelmach

September 23 - 26, 2007



ALBERTA
MINISTER OF AGRICULTURE AND FOOD

Message from the Minister



As Minister of Alberta Agriculture and Food, it is my pleasure to welcome you to the 2007 Aquaculture Association of Canada Conference.

Aquaculture is a valuable part of the agriculture and food industry in this province, and we value the opportunity to network and learn from our colleagues across Canada.

The exchange of knowledge at this year's Aquaculture conference will help to generate new ideas, applications, and products to advance Canada's aquaculture sector. For those of us from the Prairies, the Freshwater Symposium will be of particular interest as we look to expand and improve our operations.

I know Alberta's aquaculture businesses are already taking advantage of some of the latest advancements. By investing in sophisticated recirculation technology, Alberta's aquaculture producers are demonstrating that environmental and economic success can go hand-in-hand. Their success stories are especially timely, as this year's conference theme, Securing Sustainable Economic Prosperity, underlines the importance of achieving that balance. As a growing area of our agriculture industry, I am proud of the environmental leadership our producers have shown, and confident this thoughtful approach will bring continued prosperity.

On behalf of the Ministry of Agriculture and Food, best wishes for a successful conference, and thank you to all of the organizers and volunteers who have helped bring this event to Alberta.

A handwritten signature in black ink, reading "George Groeneveld". The signature is written in a cursive, flowing style.

George Groeneveld
Minister



***Message from His Worship
Mayor Stephen Mandel***



I am pleased to welcome delegates to Edmonton for Aquaculture^{OM} 2007, the 24th annual meeting of the Aquaculture Association of Canada at the Shaw Conference Centre from September 23rd-26th, 2007.

This year's theme of "Securing Sustainable Economic Prosperity" is of particular interest to our province's \$10 million commercial aquaculture industry. The technical sessions, roundtable discussions, and the Second National Freshwater Symposium offer an excellent chance to learn about current practices and meet colleagues from across the country.

The City of Edmonton has a diverse population of over a million people, festivals throughout the year and a vibrant, urban spirit. While you're here, take some time to enjoy our fine Western hospitality and the attractions and events that have made us a Cultural Capital of Canada for 2007.

Yours truly,

A handwritten signature in black ink that reads "Stephen Mandel".

Stephen Mandel
Mayor



Office of the Minister
Fisheries and Oceans

Cabinet du ministre
des Pêches et des Océans

A MESSAGE FROM CANADA'S MINISTER OF FISHERIES AND OCEANS

As Canada's Minister of Fisheries and Oceans, I am pleased to welcome you to Edmonton for Aquaculture Canada^{OM} 2007: Securing Sustainable Economic Prosperity. Once again this year, the Aquaculture Association of Canada (AAC) has lined up an interesting program of top experts who will discuss the business, science, and technology of Canadian aquaculture.

As aquaculture takes its place alongside traditional fishing and farming as a viable economic pursuit for many Canadians, we have much to talk about: aquaculture health management, integration of science and policy, education and communication issues, to name just a few topics.

Opportunities like Aquaculture Canada^{OM} are a great way for academia and industry members to share their collective experience, collaborate on innovative solutions and put this knowledge into practice. This year, the AAC and the Inter-Provincial Partnership for Sustainable Freshwater Aquaculture Development will host the second National Freshwater Symposium, a shining example of how such leadership can benefit a growing industry brimming with potential.

Canada's New Government believes that developing a successful and responsible aquaculture sector is important. We support the scientific research and policy development that is fundamental to nurturing a healthy and diverse industry that can compete on the world stage.

Canada produces some of the very best farmed fish and seafood on the market today. I look forward to working with industry, science and other stakeholders to further this success. Together, we can continue building a vibrant and sustainable aquaculture sector of which all Canadians will be proud.

I wish you a successful conference and a pleasant stay in Edmonton.

*The Honourable Loyola Hearn, P.C., M.P.
Minister of Fisheries and Oceans*



MESSAGE DU MINISTRE DES PÊCHES ET DES OCÉANS DU CANADA

En ma qualité de ministre des Pêches et des Océans du Canada, j'ai le plaisir de vous souhaiter la bienvenue à Edmonton, à l'occasion d'Aquaculture Canada^{OM} 2007, dont le thème cette année est : « Assurer une prospérité économique durable ». Encore une fois, le programme élaboré par l'Association aquacole du Canada (AAC) promet d'être des plus intéressants. Il réunit des experts réputés qui traiteront des aspects commerciaux, scientifiques et technologiques de l'aquaculture au Canada.

Pour de nombreux Canadiens, l'aquaculture est en train de devenir une activité économique rentable, tout comme l'agriculture et la pêche traditionnelles, aussi les sujets de discussion ne manqueront pas : gestion de la santé des produits de l'aquaculture, intégration des sciences et des politiques et problèmes de communication, pour ne nommer que ceux-là.

Les activités comme Aquaculture Canada^{OM} offrent aux universitaires et aux membres de l'industrie une occasion en or de faire le point sur leur expérience collective, de collaborer à la mise au point de solutions innovatrices et de les mettre en pratique. Cette année, l'AAC et le Partenariat interprovincial pour le développement durable de l'aquaculture en eau douce accueilleront le deuxième Symposium national sur l'aquaculture en eau douce, exemple éclatant s'il en est de la manière dont une industrie en pleine croissance, dotée d'un formidable potentiel, peut s'imposer.

Le nouveau gouvernement du Canada croit que le développement d'un secteur aquacole prospère et responsable est important. Nous appuyons les recherches scientifiques et l'élaboration de politiques, deux activités fondamentales pour favoriser la prospérité et la diversité d'une industrie concurrentielle sur la scène mondiale.

Le Canada produit des poissons et fruits de mer d'élevage parmi les meilleurs sur le marché. C'est avec plaisir que je collaborerai avec l'industrie, les scientifiques et les autres parties intéressées pour consolider ces succès. Ensemble, nous pouvons édifier un secteur aquacole prospère, sûr et durable qui fera la fierté de tous les Canadiens.

Je vous souhaite une très bonne conférence et un agréable séjour à Edmonton.

*L'honorable Loyola Hearn, C. P., député
Ministre des Pêches et des Océans*



Aquaculture Association of Canada – Research Award of Excellence Association Aquacole du Canada – Prix d'Excellence en Recherche

Date: Tuesday, September 25, 2007

Time: 11:30 AM - 12:00 PM

Location: Salon 11/12

Richard D. Moccia

Associate Vice-President Research (Agrifood and Partnerships)

Professor and Director, Aquaculture Centre, University of Guelph



Biographical Note

Richard Moccia currently holds research and senior management cross-appointments at the University of Guelph, where he has been employed since 1987. He is the Associate Vice-President of Research (Agrifood and Partnerships), as well as Director of the university's Aquaculture Centre and the Alma Aquaculture Research Station – both centres of excellence dedicated to the development of aquaculture science and technology. Rich also holds a faculty appointment as a Professor of Aquatic Science in the Department of Animal and Poultry Sciences and is the Chair of the MSc Aquaculture Program.

Professor Moccia has been an enthusiastic member of the Canadian aquaculture sector for nearly 30 years. His career activities have always had a strong focus in research, as well as in education and extension service, in various capacities within the aquatics and fisheries sectors in Canada. Rich is a very student-centred educator, and has advised 32 students in either MSc or PhD programs, and has participated in the committees of over 100 other graduate students. His research career began in the mid-1970s, examining thyroid goiter and neoplasia in Great Lakes fish, using fish and birds as biological sentinels of ecosystem effects and environmental degradation. Rich's more recent research has been directed at industry related problems and he has dedicated himself primarily to applied studies related to the enhancement of the commercial success of the fish farming industry. These studies are highly varied and span such areas as: applied nutrition, aquatic and fish health, ecotoxicology, environmental impact assessment, reproductive and growth physiology and animal welfare studies related to captive aquatic livestock. Professor Moccia has published widely in journals such as Science, Cancer Research, Journal of Wildlife Disease, Aquaculture, Aquaculture Nutrition, Aquaculture Research, Fish and Fisheries, Environmental Biology of Fishes and many others.

Prior to his university career, Rich was President of the Ontario Aquaculture Association, as well as Research Director and Vice-president of an aquaculture technology and fish production company which he co-founded. He also established and ran a private consulting company, which was dedicated to helping farmers with fish health and water quality issues.

Rich Moccia was also a founding member of two private sector, national aquaculture lobbying groups, including the predecessor to CAIA, and was instrumental in helping to position the industry within the government's mandate during the early years of the industry's commercial development in Canada.

Professor Moccia is also the holder of a Distinguish Professorial Teaching Award (2002) and a Distinguished Extension Service Award (2004).

In his spare time he is an avid hockey player, scuba diver, hiker and coach of minor league sports.



Conference Keynote

Date: Monday, September 24, 2007

Time: 9:00 – 10:00 AM

Location: Salon 11/12

Title: The Challenge to Develop Aquatic Resources to Secure Economic Prosperity while Maintaining Social Approval

Hon. A. Brian Peckford P.C., L.L.D. (*honoris causa*)



Presentation Synopsis

I have been involved in numerous aspects of resource development all my life. I grew up in various fishing-, mining-, and forestry-based towns and was a real practitioner in both the fishing and forestry industries for a number of years. I was a social worker in various resource-based municipalities and an elected representative and legislator in 30 resource-dependent communities. More recently, I have been a consultant for resource-based businesses in both the oil and aquaculture industries. Successful resource development is a more complex process in today's society than in the past. Community, regional, provincial, and federal jurisdictional issues, as well as First Nations' issues and environmental and safety concerns all have to be taken into consideration when planning any sort of proposed resource usage. How does sound resource development occur? I will discuss my experience in successful offshore oil development in Newfoundland and Labrador, from a jurisdictional dispute to the Hibernia statement of principles – and the stellar environmental and safety records that have resulted simultaneously with large-scale hydrocarbon production. The role of early education, continuous and relentless public relations (involving early and ongoing community liaison and education), promotion, marketing, solid understandable scientific research, and development will be discussed. A streamlined and efficient regulatory environment is essential to successful development. I will describe how lessons learned from other resource-based industries can be applied to the development of the aquaculture industry in today's and tomorrow's world.

Biographical Note

Mr. Peckford was a member of the Newfoundland Legislature, Parliamentary Assistant to the Premier, Cabinet Minister, and the Premier at age 36 for 10 years. He is currently President of Peckford Consulting and President of Junior Mining Company.

He was awarded the Vanier Award in 1982 as an outstanding Young Canadian, was sworn to the Privy Council of Canada in 1984, awarded an honorary doctor of laws degree in 1988 by Memorial University, and was awarded an Outstanding Contribution Award in 2002 by the Newfoundland and Labrador Ocean Industries Association. Mr. Peckford published a book in 1982 entitled *Past in the Present* which gives a personal view on Newfoundland's economic history and future economic prospects.

Through the 1990's he has served on the Boards of public companies in Newfoundland, Ontario, Alberta and British Columbia and the Board of the Canadian Broadcasting Corporation. Mr. Peckford was elected to represent all the Provinces and Territories of Canada in a two year National Municipal Affairs and Housing Forum and was responsible for the first ever meeting of Provincial Ministers of Northern Development in 1978. Mr. Peckford conducted a one-person Inquiry for the British Columbia Government into the status of salmon stocks and management of the Pacific Salmon Industry with two reports issued in 90 days. He also served as the first Chair of the Pacific Offshore Energy Association until December 2003, a non-profit society supporting the responsible development of offshore oil and gas resources and seeking to ensure that British Columbia receives maximum benefit from such development.



Plenary Session I

Date: Tuesday, September 25, 2007

Time: 10:30 – 11:30 AM

Location: Salon 11/12

Title: Creating an Industry Model for Addressing Environmental Issues and Achieving Business Benefits

Rebecca J. Goldberg

Environmental Defence Fund

Presentation Synopsis

Rebecca Goldberg will provide an introduction to Environmental Defense, a leading US-based environmental advocacy organization that is solutions-oriented, science-based, and non-partisan. She will discuss, in particular, Environmental Defense's partnership projects with market-leading corporations, which aim to make significant, quantifiable progress on pressing environmental issues while also achieving business benefits and creating an industry model. She will also discuss his organization's work related to aquaculture and how it relates to aquaculture projects by other NGOs. Finally, she will offer some lessons learned, based on Environmental Defense's 15-year experience in undertaking win-win collaborations with market-leading corporations.

Biographical Note

Rebecca Goldberg is a senior scientist at Environmental Defense, a national nonprofit research and advocacy organization. Working from New York City, Goldberg's major focuses are increasing market demand for more sustainably produced seafood and addressing scientific and public policy issues concerning fish farming and antibiotic use in animal agriculture. Goldberg has worked in partnership with major corporations, including McDonald's, Compass Group USA, and Wegmans Supermarkets, to establish policies for environmentally preferable meat and seafood purchases. She is currently a member of the Monterey Bay Aquarium's Seafood Watch Advisory Board, USDA's working group to develop organic standards for aquaculture, and is a former member of USDA's National Organic Standards Board. Goldberg also served on the Marine Aquaculture Task Force, established by the Woods Hole Oceanographic Institution and Pew Charitable Trusts, which released recommendations concerning US aquaculture policy in January 2007.

An author of numerous articles, Goldberg coauthored the Pew Oceans Commission's report on marine aquaculture. Dr. Goldberg has an A.B. in Statistics from Princeton University as well as an M.S. in Statistics, a Ph.D. in Ecology, and an honorary Doctorate of Laws, all from the University of Minnesota.



Plenary Session II

Date: Wednesday, September 26, 2007

Time: 11:00 AM – 12:00 PM

Location: Salon 11/12

Title: Public Concerns and Policy Development for Aquaculture

Honourable David Anderson, PC, LL.B

Director, Guelph Institute of the Environment



Presentation Synopsis

For an industry as important economically and as long established in Canada as aquaculture, there is a surprising lack of common agreement as to its advantages and impacts, which is reflected by continuing political debate. The House of Commons Standing Committee on Fisheries and Oceans in the 90s, and in particular in its 2003 report, the Senate Standing Committee on Fisheries in 2001, and the BC Legislative Committee that reported earlier this year are all examples of this political concern, which in turn is a direct reflection of ambivalent public attitudes in this area.

Mr. Anderson – who had responsibility for the aquaculture file as federal Fisheries Minister from 1997 to 1999 and who appointed the first Commissioner for Aquaculture Development, Mr. Yves Bastien, in December of 1998 – will speak on this background of political uncertainty, how it has affected the development of policy for the industry, and offer some comments on the possibility of improved policy certainty in the future.

Biographical Note

David Anderson, PC, LL.B is currently the Director of the University of Guelph, Institute for the Environment. Mr. Anderson previously represented the ridings of Esquimalt and Victoria from 1968-1972 and 1993-2005 as a Liberal MP and is a former member of Cabinet. Mr. Anderson was an Olympic silver medalist in rowing and a member of the Royal Canadian Air Force. He entered politics on the federal level, before going on to serve as leader of the British Columbia Liberal Party. He was a member of the Legislative Assembly of British Columbia for single terms in 1972 and 1975. Mr. Anderson resigned as party leader three months prior to the 1975 provincial election.

Mr. Anderson has been a legal counsel, environmental consultant, foreign-service officer, professor and a public servant. He has served as Minister of National Revenue, Minister of Transport, Minister of Fisheries and Oceans and the Minister of the Environment from 1998 to 2004. He retired from the House of Commons when Parliament dissolved for the 2006 federal election.



Registration and Information / Inscription et informations

Registration / Inscription

Registration is located in the lobby of the Meeting Level of the Shaw Conference Centre (see map) and operates daily as follows:

Sunday September 23, 1:00 PM – 7:00 PM

Monday September 24, 7:30 AM – 5:00 PM

Tuesday September 25, 8:00 AM – 5:00 PM

Wednesday September 26, 8:00 AM – 12:00 PM

Entrance to Sessions / Accès aux sessions

Entry to a session or to the trade show will not be permitted without the appropriate Aquaculture Canada^{OM} 2007 conference delegate nametag.

Notes for Speakers and Posters / Notes pour conférenciers et affiches

Poster Presenters – Salon 8-9-10 (with tradeshow)

Set-up time is Sunday September 23 5:00 PM to 7:00 PM and Monday September 24 from 8:30 AM to 10:00 AM. **NOTE:** Posters must be removed by September 25, 6:00PM

AUTHORS IN SESSION Tuesday, September 25 from 12:00 – 3:00 PM

Posters will be open to the delegates for viewing at the following times:

Monday September 24, 10:00 AM – 5:00 PM

Tuesday September 25, 10:00 AM – 4:00 PM

Speakers / Oral presenters

Speakers / oral presenters are asked to provide a copy of their presentation (CD or floppy) to the registration desk by **5PM the evening prior to their scheduled session AT THE LATEST**. All presenters are requested to meet their session chair and AV personnel no less than **30 minutes prior to session commencement**.

Program changes will be announced at the beginning of each session and posted in the foyer next to each session room (Salon 11/12, Salon 2, and Salon 3).

Media Room / Salle de média

Salon 7 is available for speakers to finalize their presentations

Job Board / Annonces d'emploi et résumés

Notice boards are available for posting résumés and job notices in the lobby of the Meeting Level of the Shaw Conference Centre, near the registration desk.

Tradeshow

Salon 8-9-10 – see insert for complete trade show details

Monday September 24, 10:00 AM – 5:00 PM

Tuesday September 25, 10:00 AM – 4:00 PM



Student Affairs and Events / Affaires étudiantes

Student Awards – The AAC is pleased to have sponsored travel for the following six students to attend the conference and AGM:

1. **Guillaume Dagenais** – Université Laval
2. **Erin Friesen** – University of British Columbia
3. **Matthew Liutkus** – University of New Brunswick, Saint John
4. **Melanie M. Mamoser** – University of Victoria
5. **Joanne Power** – University of New Brunswick, Fredericton
6. **Michelle Wetton** – University of Manitoba

Student Travel Awards have been sponsored by the Atlantic Provinces Council for the Sciences Aquaculture Committee and the Canadian Aquaculture Industry Alliance.

Best Oral Presentation and Best Poster Presentation Awards are sponsored by the Aquaculture Centre, University of Guelph and Aqua Health.

Joe Brown BBQ in Support of AAC Students / le BBQ aquacole – The Joe Brown BBQ will be held at the historic Rose and Crown Pub a couple of blocks from the Shaw Conference Centre. Opened in 1978, the Rose and Crown was Edmonton's home to the famous, infamous, and downright local. Waylon Jennings, Johnny Cash, Rick Moranis, and Tom Jones have all joined the rousing sing-a-longs and quaffed quantities from the great selection of beer and scotch. This year the BBQ will feature the first-ever Aquaculture Idol contest! So come out and sing along to your favorite tune. The BBQ will be combined again this year with an auction in support of the AAC Student Endowment Fund (SEF).

AAC AGM, Luncheon and Student Presentation Awards – Awards for Best Student Oral and Best Student Poster presentations will be given out during the AGM on Wednesday September 26. Lunch is available for the nominal cost of \$15 (tickets must be purchased by Monday, September 24) and students are encouraged to attend for the Award presentations.

Social Functions / Fonctions

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

Sunday September 23, Salon 11/12

7-10 PM President's Reception / Réception du président

Monday, September 24th

6pm start Joe Brown BBQ in support of AAC Students / le BBQ aquacole

8-9pm Aquaculture Idol Contest

6-9pm Silent Auction

Rose and Crown Pub, Sutton Place Hotel, 10235-101 St. NW, Edmonton. Tickets are required and must be purchased at the Registration desk by noon September 24.

Tuesday, September 25th Hall D

5:30-7 PM GENOME ATLANTIC RECEPTION – Open to All

7-8 PM WELCOME TO ALBERTA DINNER Ticket required

8-10:30 PM FESTIVAL CITY ROAD SHOW included with ticket



FESTIVAL CITY ROAD SHOW

1. Annie Duggan

Firefly Theatre's signature blend of aerial arts and theatre is unique in Canada. Audiences of all ages have been awed and astonished by Firefly's performances at the Edmonton International Street performers Festival and the International Children's Festival.

2. Kita No Taiko

Kita No Taiko means "Drums of the North". Rhythmic and synchronous team drumming incorporated discipline, physical strength and grace with extensive musical talent. Trained in North America and Japan, the Kita No Taiko drummers will thrill you with their musical creativity and energy and their collective spirit.

3. Kent Sangster – Obsession

One of Canada's most sought after musicians is Edmonton jazzman Kent Sangster and there are no signs ahead of it slowing down. Deeply passionate melodies are the hallmark of the quartet's stellar interplay. Sangster's latest project 'OBSESSION' has been nominated for a 2007 Juno Award for Contemporary Jazz Album of the Year!

4. Souljah Fyah

A high-energy female fronted Reggae band out of Edmonton with a wicked stage show, Janaya "Sista J" Ellis is the lead vocalist and bassist, and is backed by a solid ensemble of multi talented reggae musicians. Janaya was awarded Global TV's Woman of Vision award in March 2007 for her work in building Edmonton's music scene. Music combines African percussion, sweet harmonies and heavy bass lines to produce their soulful sound.

Social function tickets can be purchased at the registration desk.

Monday September 24 Salon 8-9-10

12 -1:30 PM AAC Delegate Luncheon -Everyone Welcome

Tuesday September 25, Salon 8-9-10

12 -1:30 PM Atlantic Genome Luncheon –Everyone Welcome

www.genomeatlantic.ca



GenomeAtlantic

Wednesday, September 25 Hall C

12 - 2 PM AAC Annual General Meeting and Luncheon / Assemblée des membres et lunch d'affaires

Ticket required and must be purchased at Registration desk by noon September 26.



Industry Tours

Tour 1: “See the Real Alberta”

Travel in a comfortable air-conditioned coach with a local guide to state-of-the-art recirculation facilities. Smoky Trout Farm of Red Deer cultures cold-water trout species and MDM Aqua Farms Ltd. in Rumsey is a warm-water facility combining tilapia culture with herb and vegetable aquaponics. The trip will also include an inside tour of the newly constructed supersized Agricore United grain elevator at Three Hills.

An **Alberta-style BBQ** with buffalo and beef burgers will be included at MDM Aqua Farms Ltd. with locally grown produce and a sampling of tilapia and trout to whet your appetite.

Cost: \$100/person. Tickets available at the Registration Desk

Tour price includes:

- Bus transportation to all facilities from the Westin Edmonton Hotel and return
- Tour of two recirculating aquaculture facilities
- Tour of Agricore United grain elevator
- BBQ lunch on site at MDM Aqua Farms Ltd.

Date: September 27, 2007

Leave: Westin Edmonton Hotel lobby at 8:15 AM

Return: Westin Edmonton Hotel lobby at approximately 5:30 PM

Smoky Trout Farm

Smoky Trout Farm, near the city of Red Deer, is a cold-water trout producer using recirculation systems. They also provide advice and information about pond management, aeration, algae control, and other culture techniques. This family fish farming venture was started in 1998 by father and son, Dan and Max Menard. The Menards specialize in pond stocking of rainbow trout throughout Alberta with fish raised in an intensive indoor recirculation facility that uses biological and mechanical filters. Through filtering and reuse, the net water usage is very low. Chemicals and antibiotics are not used and maintenance of good water quality is of paramount importance. Water leaving the culture facility is filtered through a constructed wetland for natural absorption of the nutrients. There are cattails over 6 feet tall in the wetlands!

MDM Aqua Farms Ltd.

MDM Aqua Farms Ltd. produces high quality tilapia in a warm-water recirculation system that was designed to utilize part of existing hog barns. The culture system, partially designed by PR Aqua Technologies of Nanaimo, BC, is a low water usage re-circulation system. Pure oxygen, ozone, and sand filters are used to maintain water quality and allow for high stocking densities. This results in a highly productive, compact, self-contained system. A family fish culture operation since 1999, the opportunity arose in 2001 to switch from rainbow trout to tilapia of 1.5 lb market size. More recently, herbs and other vegetables have been added to utilize the fish culture effluent.

Agricore United

Agricore United is the largest grain handler and crop input retailer in western Canada with more than 290 crop protection products and more than 100 crop nutrition products available. The company employs over 2,800 employees and is able to conduct business in English, French, Spanish, Japanese, and Mandarin. In 2005, 9.9 million tonnes of grain were shipped to over 50 countries. Tour the newly built supersized grain elevator outside of the community of Three Hills and experience this massive operation first hand.



Tour 2: “West Edmonton Mall” Behind the Scenes

West Edmonton Mall is the largest entertainment & shopping centre in the world!

Featured in the Guinness Book of Records as the "World's Largest Mall". The total construction cost was \$1.2 billion. The mall covers 493,000 m² which is equivalent to 104 Canadian football fields (115 American).

The mall has nine major attractions, three theme streets, over 800 stores and services including six major department stores, 21 movie theatres, 110 eating establishments, bingo hall, world class casino, chapel, works-of-art, bungee jumping, and of course a state-of-the-art aquarium. And Alberta has NO PROVINCIAL SALES TAX!!!

WORLD WATERPARK with the WORLD'S LARGEST INDOOR WAVE POOL is a five-acre indoor facility with water temperatures of 26-30°C and with more than 20 different aquatic activities including the wave pool, miles of waterslides, bungee jumping, hot tubs, and fun-filled interactive play areas. World Waterpark is home to more than 200 species of fish (including sharks and sting rays), reptiles, and penguins. Interactive exhibits and daily live presentations provide guests with education and enjoyment of the marine and freshwater environments and the amazing creatures that inhabit them.

Have a behind-the-scenes tour of the enormous water system that supports World Waterpark and still have time to have a leisurely lunch and do a bit of shopping, take in the latest movie, skate circles around your friends, or see if you can keep your trunks on in the wave pool.

Cost: \$45/person. Tickets available at the Registration Desk

Tour price includes:

- Bus transportation from the Westin Edmonton Hotel and return
- One hour behind-the-scenes tour of the water system for World Waterpark
- Four hours of free time at the mall

NOTE: THIS TOUR RUNS ON BOTH SEP 27TH AND 28TH. PLEASE INDICATE WHICH TOUR DAY YOU WISH TO PURCHASE ON THE REGISTRATION FORM.

Date: September 27, 2007

Leave: Westin Edmonton Hotel lobby at 10:00 AM

Return: Westin Edmonton Hotel lobby at approximately 4:00 PM

Date: September 28, 2007

Leave: Westin Edmonton Hotel lobby at 10:00 AM

Return: Westin Edmonton Hotel lobby at approximately 4:00 PM



AC07 Program Outline / Sommaire du Programme

Day 1 – Sunday, September 23, 2007

1300-1900	Registration	Lobby
1900-2100	President's Reception	Salon 11/12

Day 2 – Monday, September 24, 2007

0730-1700	Registration	Lobby
0830-1700	Aquaculture Canada ^{OM} 07 Keynote and Technical Sessions 2nd National Freshwater Symposium	Salons 2, 3, 11/12
1000-1700	Trade Show and Poster Session	Salon 8/10
1200-1330	Delegate Luncheon (provided)	Salon 8/10
1800-2300	Joe Brown BBQ in Support of AAC Students and Aquaculture Idol Contest	Rose and Crown Pub

Day 3 – Tuesday, September 25, 2007

0800-1700	Registration	Lobby
0830-1700	Aquaculture Canada ^{OM} 07 Keynote and Technical Sessions 2nd National Freshwater Symposium	Salons 2, 3, 11/12
1000-1600	Trade Show and Poster Session	Salon 8/10
1200-1330	Delegate Luncheon (provided)	Salon 8/10
1730-1900	Genome Atlantic Delegate Reception	Hall D
1900-2200	Welcome to Alberta Dinner and The Festival City Road Show	Hall D

Day 4 – Wednesday, September 26, 2007

0800-1200	Registration	Lobby
0830-1200	Aquaculture Canada ^{OM} 07 Keynote and Technical Sessions 2nd National Freshwater Symposium	Salons 2, 3, 11/12
1200-1330	Aquaculture Association of Canada AGM Luncheon & Student Best Paper and Best Poster Awards	Hall C

Day 5 – Thursday, September 27, 2007

0815-1730	See the Real Alberta Tour	
1000-1600	West Edmonton Mall Tour	

Day 6 – Friday, September 28, 2007

1000-1600	West Edmonton Mall Tour	
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Tradeshow Exhibitors

AGES – Division of Brock White

Your first choice supplier of construction materials, environmental products & services, equipment & supplies www.brockwhite.com

Booth 26

AIRSEP Corporation

The most complete line of PSA and VSA oxygen generators www.airsepcpd.com

Booth 35

AKVA Group Canada

World's leader in fish farm technology

www.akvagroup.ca

Booth 27

Aquaculture Association of Alberta

Supports the pursuit of aquaculture promotion and education for freshwater aquaculture industry in Alberta www.affa.ab.ca

Booth 22

Aquaculture Association of Canada

Not for profit association dedicated to supporting Canadian aquaculture.

www.aquacultureassociation.ca

Booth 18

Aquafarms 2000 Inc.

Manufacturer of fiberglass tanks for the fisheries industry www.aquafarms2000.ca

Booth 24

AquaPort.ca

Web portal delivering vital information to the Canadian aquaculture community over the internet

www.aquaport.ca

Booths 28-29

Aquatics Informatics

Software solutions firm specializing in the water and climate information industry

www.aquaticinformatics.com

Booth 33

Corey Feed Mills

World's premiere manufacturer of fish feed for the aquaculture industry www.corey.ca

Booth 9

Hoskin Scientific

Providing geotechnical & materials testing, environmental monitoring and test & measurement instrumentation www.hoskin.ca

Booth 10

Lethbridge Community College

Aquaculture training programs and Aquaculture Centre of Excellence with many leading and innovative research projects

www.lethbridgecollege.ab.ca

Booth 22

Malaspina University College Fisheries and Aquaculture Program

Aquaculture training programs including work and field experience www.mala.ca/fisheries

Booth 25

Northern Aquaculture/ Capamara Communications

Bi-monthly publication supporting economically viable & environmentally conscious cold water aquaculture industry www.northernaquaculture.com

Booth 19

Octaform Systems Inc.

Provides the ultimate in concrete forms agricultural and industrial applications www.octaform.com

Booth 23

Pointfour Systems

Leading supplier of products for the measurement, control and diffusion of oxygen and other gases in water www.pointfour.com

Booth 21

Skretting Canada

Provides a comprehensive range of starter, fry, freshwater and marine diets for Atlantic salmon, Pacific salmon, Arctic charr and trout

www.skretting.ca

Booth 1

Unipac Packaging Ltd.

Providing customers with comprehensive advice and food processing expertise to address your food packaging challenges www.unipac.cc

Booth 32

ZCL Composites Inc.

Canada's leading designer, manufacturer and supplier of cost-effective fiberglass tank systems

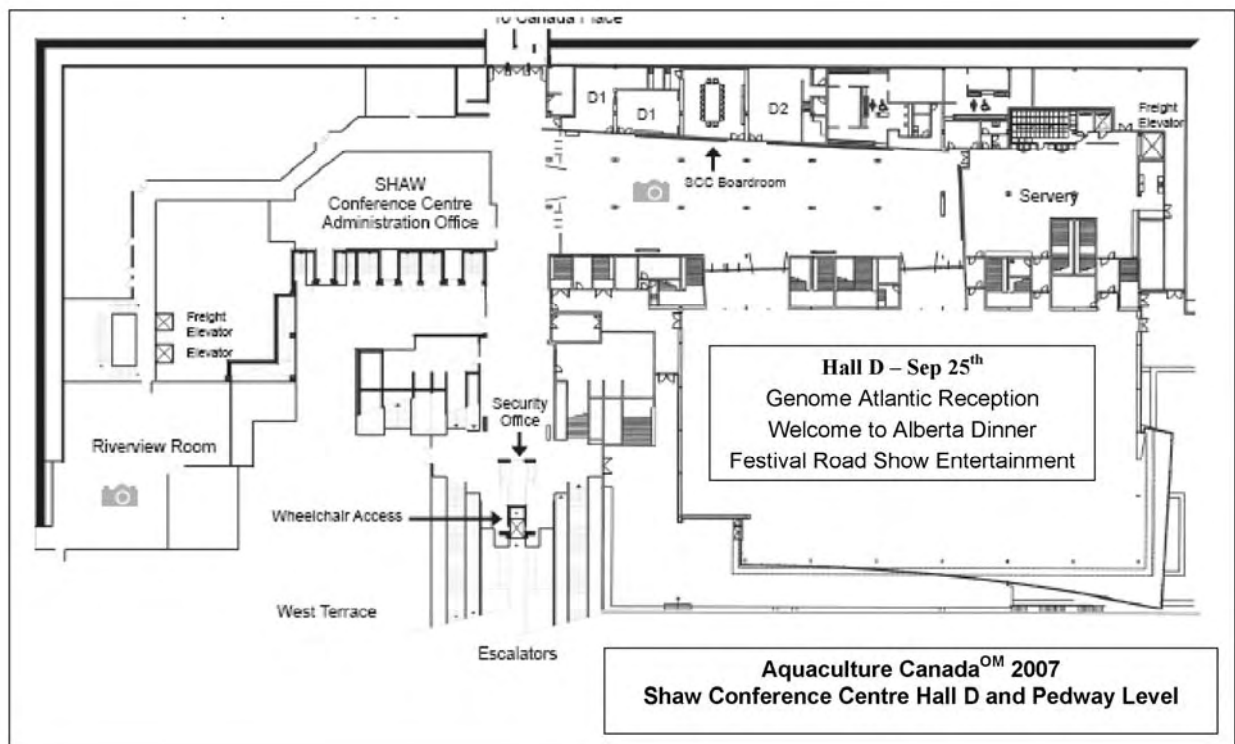
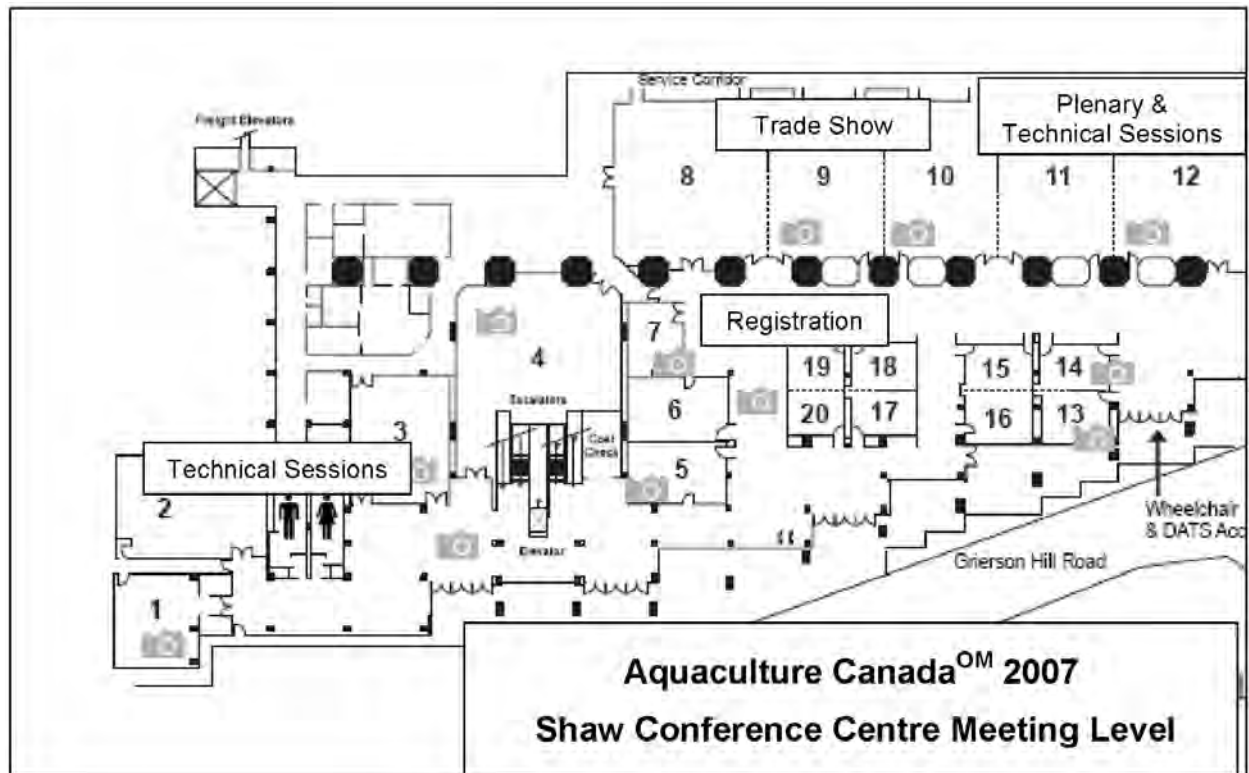
www.ZCL.com

Booth 30

***SEE INSIDE BACK COVER FOR TRADESHOW FLOOR PLAN**



Conference Floor Plan





Speakers Outline and Abbreviated Titles – Aquaculture Canada^{OM} 2007

Liste des conférenciers et titres des présentations

Monday September 24, 2007 – Morning

7:30 AM	Registration Open (to 5:00)		
8:30 AM	Opening Session - Salon 11/12 C. Pearce, Aquaculture Association of Canada M. McNaughton, Alberta Aquaculture Association G. Vandenberg, Interprovincial Partnership for Sustainable Freshwater Aquaculture Development R. Salmon, Canadian Aquaculture Industry Alliance Minister G. Groeneveld, Alberta Ministry of Agriculture and Food		
9:00 AM	Conference Keynote Honourable Brian Peckford The Challenge to Develop Aquatic Resources to Secure Economic Prosperity while Maintaining Social Approval		
10:00 AM	HEALTH BREAK AND TRADESHOW (Salon 8-9-10)		
	Salon 11/12	Salon 2	Salon 3
	SNFWS I - Inter-Provincial Partnership for Sustainable Freshwater Aquaculture Development in Canada and Freshwater Aquaculture Potential in Canada	Moving Aquaculture outside the Box	Educating Workers and the Community
10:30 AM	Grant Vandenberg - IPSFAD Past, Present and Future & RDC Action Plan 2007-09	Parker - Increasing Stakeholder Involvement and Improving Company Profile Through Integration in the Community	Rose - Commercial Performance of Arctic Charr
10:50 AM	Dan Stechey & Eric Hutchings - Experimental Freshwater Fish Farm Design and On-Going Feasibility Study- in Alberta	DeJager - Giving Up Control: How The New Web Can Shift The Knowledge Balance For Aquaculture In Canada - Aquaport.Ca	Harry - Making Aquaculture Work for First Nations Communities
11:10 AM	Regional Perspective on Acheiving Freshwater Aquaculture Potential -	Vaillancourt - Ropin' the Web - Connecting Information to Industry	Foss - TBA
11:30 AM	Albright (BC) / McNaughton (AB) / Foss (SK) / Bottomley (MB) / Meeker - Tracey (ON) /	Bastien (Facilitator) - Discussion: Building Trust and a Successful Engagement Process	Jaworski - Attracting and Retaining Different Generations to the Workforce
11:50 AM	Lareau - Maheu (QC) / TBC (Maritime Provinces)		Halfyard - Education and Training for the Canadian Aquaculture Industry Bonvegna - TBA (12:10)
12:10 PM	LUNCH (Provided, Salon 8-9-10 with tradeshow)		


Monday September 24, 2007 – Afternoon

	Salon 11/12	Salon 2	Salon 3
	SNFWS II - Fish Nutrition, Feeds and Feeding	Sustainability - Beyond the Triple Bottom Line?	Contributed Papers in Marine Aquaculture
1:20 PM	Overturf - Improving Utilization of Sustainable Products in Aquaculture	Parker - Session Introduction	Benfey - Preliminary Evaluations Of Triploidy for Suppressing Sexual Maturation in Farmed Cod
1:40 PM	Maenz - The Use of Canola Protein Concentrate as a Replacement for Fishmeal in Fresh Water Fish Feeds	Ish - Creating Win-Win Solutions for Business and the Environment	Lu - The Marketing of Atlantic Halibut and Demand Estimates
2:00 PM	Olson - Lupin and Low Tannin Faba Bean as Potential Feed Ingredients for Aquaculture	Severne - Sustainability - A Maori Perspective from New Zealand	Davidson – Is Scallop Aquaculture and Enhancement Economically Viable in the Gulf Region?
2:20 PM	Drew - Opportunities for Western Canadian Pulse Crops in Aquafeeds	Greba - TBA	Martin-Robichaud - The Correlation between Ovarian Fluid Characteristics and Egg Fertilization Success in Atlantic Halibut
2:40 PM	Feed Company Panel - New Perspectives in Freshwater Feed Diet/Formula and Markets	Parker (Facilitator) - Discussion	Mamoser - An Ecosystem-Based Approach to the Management of the Shellfish Aquaculture Industry in B.C.: An Industry Needs Assessment
3:00 PM	HEALTH BREAK AND TRADESHOW (Salon 8-9-10)		
	SNFWS III - Environmental Aspects of Freshwater Cage Farming	Aquaculture Health Management	Contributed Papers in Marine Aquaculture (Continued)
3:30 PM	Paterson - The Effect of an Experimental Rainbow Trout Cage Farm Operation on Nutrients and the Plankton Community of a Freshwater Lake	Brewer - Factors in Controlling ISA and the Transferability to the “Next Disease”	Manning - Expression Of Ghrelin During Larval Development In Atlantic Halibut
3:50 PM	Podemski - Development of Benthic Changes at an Experimental Freshwater Aquaculture Facility	McCallum - Progress Towards the BC Shellfish Aquatic Animal Health Program	Power - Cage Culture Characteristics of Juvenile Atlantic Halibut
4:10 PM	Mills - Impacts of Rainbow Trout Cage Culture in a Small Lake: Lake Trout Enhancement?	Osborn - National Aquatic Animal Health Program: Update on Activities and Direction	Rodhaj - The Development of Fish Farming along the Albanian Coast
4:30 PM	Blanchfield - Survival and Distribution of Farmed Rainbow Trout Released from an Experimental Aquaculture Operation	Boyce - The Marine Harvest Canada Strategy for Successful Sea Lice Management	Hekmatpour - Preliminary Results from the Establishment of Experimental Artificial Reefs in Qeshm Island (Persian Gulf) with an Emphasis on Decapod Fauna
4:50 PM		Sams - How Independent Research Facilities and Organizations Can Support Innovation and Excellence in Aquatic Health Management	



Tuesday September 25, 2007 – Morning

Tuesday, September 23, 2008 - Morning			
8:00 AM	Registration Open (to 5:00)		
	Salon 11/12	Salon 2	Salon 3
	SNFWS III - Environmental Aspects of Freshwater Cage Farming (Continued)	Contributed Papers in Alternate Species	Talking About Aquaculture
8:20 AM	Podemski - Assessment of the Benthic Effects of Freshwater Commercial Net-Pen Aquaculture	Rakocy - Global Tilapia Production and Markets – 2007	Fraser (workshop) - Make a difference – learn the skills to provide helpful responses to those questions we all get asked about aquaculture, in a constructive and non defensive way to your friends, associates, and family.
8:40 AM	Wetton - Effects of Aquaculture Organic Waste Loading on Benthic Invertebrates	George - The Grass Carp and Tilapias as Biological Control Agents and Their Role in Aquaculture for Food Security	
9:00 AM	Wilson - Genetic Interactions of Cage Culture Escapees and Naturalized Rainbow Trout Populations in Lake Huron	Derkson - The Balance of Risk and Benefit in Culturing an Exotic – Review of Triploid Grass Carp Culture in Alberta	
9:20 AM	Geiling - A GIS-Based Assessment of the Potential for Cage Culture Expansion in Lake Huron	Chavan - Evaluation of the Nutritional Value of Natural and Artificial Feed Feeding to Nile Tilapia	
9:40 AM		Hasanalipour - Cortisol Changes in Response to Rearing Density in Siberian Sturgeon	
10:00 AM	HEALTH BREAK AND TRADESHOW (Salon 8-9-10)		
	Salon 11/12		
10:30 AM	Plenary I: Rebecca Goldberg Creating an Industry Model for Addressing Environmental Issues and Achieving Business Benefits		
11:30 AM	Research Award of Excellence - Rich Moccia		
12:00 PM	Genome Atlantic Delegate Luncheon (Provided, Salon 8-9-10 with tradeshow)		


Tuesday September 25, 2007 – Afternoon

	Salon 11/12	Salon 2	Salon 3
	SNFWS IV - Diversification of Freshwater Production	R&D Coordination	Contributed Papers in Aquaculture
1:20 PM	Chaudhary - Role of Aquaculture in Agriculture Diversification006E	McCallum - Session Introduction and Background on Canadian Aquaculture R&D	Conroy - Denitrification using Volatile Fatty Acids Produced by Hydrolysis of Waste Solids
1:40 PM	Frantsi - The Development of Alternate Finfish Species for Aquaculture; An East Coast History & Perspective	Rose - Icywaters Arctic Charr R&D Initiatives	McDonald - Solar Water Heating for Aquaculture
2:00 PM	Stechey - SWOT- Based Technique for New Species Development – An Evaluation and Planning Model	Jackson - IRAP R&D Funding	George - Wild and Farmed Fish, their Nutritional Value and Role of Aquaculture for World Food Production
2:20 PM	Taylor - Constructed Wetlands / Lagoons for Effluent Treatment: Technical and Economic Feasibility for the Canadian Experimental Aqua-Farm	Cross - Pacific SEA-Lab: Building a Practical Industry-Academia Interface for R,D&T	Plesowicz - Fish as a Research Animal
2:40 PM	Panel Discussion	Green - Aquaculture Industry R&D Network	
3:00 PM	HEALTH BREAK AND TRADESHOW (Salon 8-9-10)		
	SNFWS V - Fish Health Management in Freshwater Aquaculture	Integrated Multitrophic Aquaculture	
3:30 PM	Lumsden - Viral Hemorrhagic Septicemia Virus (VHSV) type IV'b' Experimental Infection In Rainbow Trout and Fathead Minnows	Chopin - Up-Scaling of The Seaweed Inorganic Extractive Component in an Integrated Multi-Trophic Aquaculture System in the Bay Of Fundy, Canada	
3:50 PM	Penney - Viral Haemorrhagic Septicaemia (VHS) in the Great Lakes	Cross - Sustainable Ecological Aquaculture (SEA) Systems in Coastal British Columbia – Assessing the Benefits	
4:10 PM	Lumsden - <i>Flavobacterium psychrophilum</i> Strain Heterogeneity and Antimicrobial Resistance; Implications for Management	Lander - The Effects of Cuprous Oxide on Blue Mussel Larval Settlement and its Implications for Recycling Treated Salmon Net Cages for Mussel Spat Collection in IMTA	
4:30 PM	Belhumeur - Options for the Control Of <i>Saprolegnia</i> sp in Freshwater Fish Species	Blasco - Breaking the Seasonality of Kelp Farming and the Implications in IMTA	
4:50 PM	Larson - Fish Health Issues in Alberta	Liutkus - Effects of Fines from Salmon Feed on Biodeposit Dynamics of Various Size Classes of Mussels	
5:10 PM		Reid - Recent Developments and Challenges for Open-Water, IMTA in the Bay of Fundy, Canada	



Wednesday September 26, 2007 – Morning

8:00 AM	Registration Open (to 12:00)		
	Salon 11/12	Salon 2	Salon 3
	SNFWS VI - Aquaponics (Combining Aquaculture and Hydroponics) - Profits from Natural Effluent Treatment	Science and Policy	Contributed Papers in Aquatic Animal Health and Nutrition
8:50 AM	Rakocy - Fish and Vegetable Production in a Commercial Aquaponic System: 25 Years of Research at the University of the Virgin Islands	Burgham - Science and Policy in Aquaculture: The Federal Perspective	Moccia - Formulation of Salmonid Fish Feeds with High Dietary Levels of Plant Ingredients: Effects on Waste Outputs and Potential Environmental Impacts of Fish Culture Operations
9:10 AM	Harston - Naturally Grown Fish and Organically Grown Fine Herbs from Tilapia Effluent	Page - Centre for Integrated Aquaculture Science (CIAS)	McGowan - The Search for Genetic Markers Associated with Disease Resistance in Two Strains of Arctic Charr
9:30 AM	Savidov - Latest Canadian Aquaponics Research: Is Aquaponics a Viable Option for Fish Farmers?	Moccia - Ontario's Approach to the Development of Science-Based Regulatory Reform	Dagenais - Utilisation of White Corn Gluten and Lysine Supplementation in Fish Feed; Impacts on the Colouration of Rainbow Trout Flesh
9:50 AM	Millar - Aquaponic Production from Trout Effluent	Heath - The Science and Policy of Geoduck Farming in British Columbia	Friesen - Lowering Flesh Organic Contaminants in Farmed Atlantic Salmon while Concurrently Maintaining Levels of EPA and DHA Through Dietary Modifications
10:10 AM		Sweeney - Science and Policy in Aquaculture: An Industry Perspective from Atlantic Canada	Yazdanpanah - Cold-Inducible Proteins of <i>Flavobacterium psychrophilum</i> , the Cause of Coldwater Disease
10:30 AM	HEALTH BREAK (Foyer of Salon 11-12)		
	Salon 11/12		
11:00 AM	Plenary II: Honourable David Anderson Public Concerns and Policy Development for Aquaculture		
12:00 PM	AAC AGM Luncheon and Student Awards - Hall C		



Sessions and Abstracts – Aquaculture Canada^{OM} 2007

Opening and Welcome

Date: Monday, September 24, 2007

Time: 8:30 – 9:00 AM

Location: Salon 11/12

Chair: C. Pearce (President, Aquaculture Association of Canada)

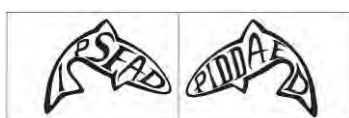
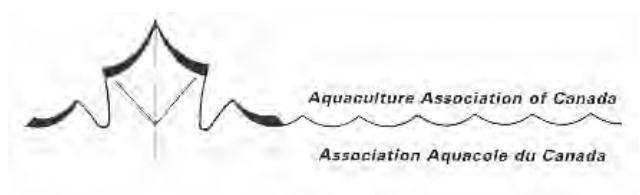
Chris Pearce, President, Aquaculture Association of Canada

Mark McNaughton, President, Alberta Aquaculture Association

Grant Vandenberg, Interim President, Interprovincial Partnership for Sustainable Freshwater Aquaculture Development

Ruth Salmon, Executive Director, Canadian Aquaculture Industry Alliance

Honourable George Groeneveld, Alberta Minister of Agriculture and Food



Conference Keynote

Date: Monday, September 24, 2007

Time: 9:00 AM – 10:00 AM

Location: Salon 11/12

9:00 A.B. Peckford

The Challenge to Develop Aquatic Resources to Secure Economic Prosperity while Maintaining Social Approval



SNFWS I - Interprovincial Partnership for Sustainable Freshwater Aquaculture Development in Canada and Freshwater Aquaculture Potential in Canada

Date: Monday, September 24, 2007

Time: 10:30 AM - 12:10 PM

Location: Salon 11/12

Chairs: Eric Gilbert and Grant Vandenberg

10:30 G. Vandenberg

IPSFAD Past, Present and Future & RDC Action Plan 2007-09.

10:50 D. Stechey and E. Hutchings

Experimental Freshwater Fish Farm Design and On-Going Feasibility Study in Alberta

11:10 Regional Perspective on Achieving Freshwater Aquaculture Potential

L.J. Albright (BC)

M. McNaughton (AB)

D. Foss (SK)

J. Bottomley (MB)

M. Meeker - K. Tracey (ON)

S. Lareau - M. Maheu (QC)

TBA (Maritime Provinces)

Freshwater Aquaculture in British Columbia: Current Status, Potential and Developmental Challenges

Lawrence J. Albright

Chair, Freshwater Aquaculture Association of British Columbia, 3104 Cardinal Drive, Burnaby, BC, V5A 2T6

The commercial freshwater aquaculture industry in British Columbia is relatively small with 2005 production being approximately 112 tonnes – most of this was rainbow trout with smaller quantities of coho and sockeye salmon, tilapia, sturgeon and crayfish. Most of the freshwater aquaculture production is consumed within the Province with the remainder being exported to the other western provinces of Canada. A trained work force and adequate freshwater supplies exist in BC for the expansion of the freshwater aquaculture industry. However, government actions at the Federal level have limited the expansion of the freshwater industry. This, together with intense price competition from rainbow trout product from the United States has tended to limit BC production of rainbow trout. The Freshwater Aquaculture Association of BC is exploring ways of more efficiently culturing rainbow trout as well as the cultivation of new species in freshwater.



Moving Aquaculture Outside the Box

Date: Monday, September 24, 2007

Time: 10:30 AM - 12:10 PM

Location: Salon 2

Chair: Tim DeJager

10:30 T. DeJager

Session Introduction

10:30 M. Parker

Increasing Stakeholder Involvement and Improving Company Profile through Integration in the Community

10:50 T. DeJager

Giving Up Control: How the New Web Can Shift the Knowledge Balance for Aquaculture in Canada - Aquaport.ca

11:10 G. Vaillancourt

Vaillancourt - Ropin' the Web - Connecting Information to Industry

11:30 Y. Bastien (Facilitator)

Discussion: Building Trust and a Successful Engagement Process

Increasing Stakeholder Involvement and Improving Company Profile through Integration into the Community

Mia Parker

Manager, Regulatory Affairs, Grieg Seafood BC Ltd.

Public stakeholders usually become engaged on an issue because of fear of loss. The risk of loss to a community or individual is perceived as much greater than any benefit realized by the proposed activity. Public education and open dialogue can often mitigate the perceived loss, but information sharing isn't as simple as it should be. Successful knowledge and information transfer is not possible without the meaningful involvement of all parties.

Communication is essential to stakeholder involvement and lays the foundation for knowledge transfer. You can't have one without the other, but good communication is not enough. In addition to saying the right things and sharing the right information, you must demonstrate your right to operate and engender some measure of mutual trust.

Eventually, every business encounters the challenge of social license. If you think of social license as social credit, you can apply the four C's of financing to improve stakeholder involvement.

Giving Up Control: How the New Web Can Shift the Knowledge Balance for Aquaculture in Canada - Aquaport.ca

T. DeJager^{*1}, B. Thomas², L. Hiemstra³

¹CO3 Consulting, 115 Gibraltar Rock, Nanaimo, BC, Canada V9T 4M3

²Faculty of Management, Malaspina University-College, 900 Fifth Street, Nanaimo, BC, Canada, V9R 5S5.

³Mel Mor Science, 6036 Breonna Drive, Nanaimo, BC, Canada V9V 1G1

A social and economic revolution is occurring, driven by a new form of the web. Traditional models of knowledge transfer, communication, and public awareness are proving to be increasingly cumbersome and ineffective. The aquaculture industry in Canada can benefit from this transformation. Knowledge demands are high in this industry and effective engagement and collaboration are key to its future. AquaPort.ca is developing a portal that will integrate the new web tools for information discovery, retrieval, and sharing and will enable far greater user participation, contribution, and collaboration than has previously been possible. Examples of how these tools are transforming business, research, and learning include customer-led innovation, harnessing the power of an



organization or community through open knowledge contribution systems such as “wikis”, and innovative forms of information “mashups”. Tools such as these have the potential to help create the conditions for a more open, transparent, credible, and innovative knowledge foundation for Canadian aquaculture.

Ropin’ the Web – Connecting Information to Industry

G. Vaillancourt

Organizational Effectiveness and Rural Services, Alberta Agriculture and Food, Room 203, 7000 – 113 Street,
Edmonton, Alberta T6H 5T6 Canada

Ropin’ The Web (RTW) is an interactive web site that provides primary agriculture producers information and tools for decision making. It is also an important information resource for processors, agribusiness and employees of Alberta Agriculture and Food. The site uses a faceted taxonomy that provides information by subject, audience and date based on metadata associated with objects, data and information stored in the RTW content management system. With nearly 3.5 million visits annually, the site is the primary method the ministry uses to share information with clients. In addition to a larger information repository, it includes interactive tools to that producers use to make management decisions, community bulletin boards for producers to list crops and livestock that are for sale. More recently, RTW has taken steps to improve the usability of information on the site with dynamic mapping and charting tools.



Educating Workers and the Community

Date: Monday, September 24, 2007

Time: 10:30 AM - 12:30 PM

Location: Salon 3

Chair: Laura Halfyard

10:30 J. Rose

Commercial performance of Arctic Charr

10:50 R. Harry

Making Aquaculture Work for First Nations Communities

11:10 D. Foss

TBA

11:30 B. Jaworski

Attracting and Retaining Different Generations to the Workforce

11:50 L. Halfyard

Education and Training for the Canadian Aquaculture Industry

12:10 A. Bonvegna

TBA

Making Aquaculture Work for First Nations Communities

Richard Harry

Executive Director, Aboriginal Aquaculture Association. Email: richard@aboriginalaquaculture.com

There are few opportunities for coastal First Nations to look forward to within the resource sectors. Aquaculture can provide successful careers for communities, especially for young aboriginal people. It is the mission of the Aboriginal Aquaculture Association is to promote and assist the development of First Nations' aquaculture that respects and supports First Nation communities, culture and values. However, many First Nations are currently reluctant to engage in aquaculture. This presentation will outline a key piece that is missing for First Nations - a stronger component of environmental sustainability - and explore the aboriginal and non-aboriginal definition of environmental sustainability. Also discussed will be the Aboriginal Aquaculture Association, Aboriginal Certification of Environmental Sustainability (ACES) program which has been developed in direct response to the First Nation's requirements for environmental sustainability and takes into consideration the differences between First Nation communities and territories. The ACES program will provide the avenue by which First Nations can evaluate aquaculture opportunities, the framework for aquaculture projects to proceed, and the basis for integration of aquaculture projects into the communities through training programs and community involvement.

Attracting and Retaining Different Generations to the Workforce

Barbara Jaworski

Workplace Institute, 2239 Bloor St. W. Suite 4, Toronto, ON M6S 1N7

Our workforce now contains four distinct generations – each with its own values, aspirations, work style, needs, and communication style. There are the veterans, those born before 1946; the Baby Boomers, that huge post-WWII demographic that makes up one third of our present workforce; Generation Y, a small but significant generation born between 1967 and 1979, and now, just beginning to enter the marketplace, a huge new generation – Generation X, the children of the Boomers. This last group will not be as large or as influential as their parents, but will still have an enormous impact on the economy, the culture, and employers. For managers and organizations, this multi-generational workforce creates huge challenges as each group demands different benefits, training and development, managerial style, organizational culture, and tools. With the escalating talent war, retention must be first and



foremost with organizations and managers. Juggling the needs of four distinct generations will be a major battle in this war for talent – a battle that must be waged and won if organizations are to prosper.

Education and Training for the Canadian Aquaculture Industry

L. Halfyard* and C. Couturier

School of Fisheries, Marine Institute, Memorial University of Newfoundland, St. John's, NL A1C 5R3

As Canada's aquaculture industry continues to develop, issues of worker recruitment and training have become concerns. As one of Canada's lead educational institutes offering aquaculture education and training, the Marine Institute has developed various programs and strategies to attract and train people for the industry, while striving to meet the advances in technology and pressures of changes in rural/urban populations. This presentation will discuss how MI is seeking to increase aquaculture awareness and recruitment through various audiences and methods such as: high school on-line science technology courses; community awareness activities; flexible short modular training which is geared to both existing and new farm workers; various methods of training/instruction to accommodate different student/worker education levels (e.g. literacy levels, workshops, on-farm practical, on-line course content); collaboration with industry to validate training needs and on-farm practical skills.



SNFWS II - Fish Nutrition, Feeds and Feeding

Date: Monday, September 24, 2007

Time: 1:20 PM – 3:00 PM

Location: Salon 11/12

Chair: Grant Vandenberg

1:20 K. Overturf

Improving Utilization of Sustainable Products in Aquaculture

1:40 D. Maenz

The Use of Canola Protein Concentrate as a Replacement for Fishmeal in Fresh Water Fish Feeds

2:00 M. Olson

Lupin and Low Tannin Faba Bean as Potential Feed Ingredients for Aquaculture

2:20 M. Drew

Opportunities for Western Canadian Pulse Crops in Aquafeeds

2:40 Feed Company Panel

New Perspectives in Freshwater Feed Diet/Formula and Markets

Improving Utilization of Sustainable Products in Aquaculture

Kenneth Overturf

Research Geneticist, 3059 F National Fish Hatchery Rd., Hagerman, Id, 83332. kennetho@uidaho.edu, Phone: (208) 837-9096 ext. 1104, Fax: (208) 837-6047

Evaluation of genotype by diet interactions in aquaculture species for specific dietary components has only recently begun on a limited basis. Initial studies have examined such species as sea bream, rainbow trout and Atlantic salmon. Because of the high-protein diet these species consume in the wild, commercial diets have relied heavily on fish meal and fish oil as protein and energy sources. Other omnivorous fish species such as tilapia and catfish have demonstrated a greater proclivity for utilizing plant feedstuffs and carbohydrate for energy, but little research has been performed on these species in regards to precise physiological changes in accord with nutrient modification or selection to alter performance on specific feed types. Research performed in other agriculture animal systems, such as cattle, swine, and poultry, have found alterations in specific physiological traits for different strains. These changes have also been found to significantly correlate with individual genes in research done with murine and laboratory fish models. This research is now being applied to commercial fish species. Initial findings have varied between stocks and with different diets, but as the technology and experimental designs improve, it appears that this type of research will prove important for optimizing diets and carnivorous fish species for enhanced utilization of sustainable products.

The Use of Canola Protein Concentrate as a Replacement for Fishmeal in Fresh Water Fish Feeds

David D. Maenz

MCN BioProducts Inc., 860-410 22nd St. E., Saskatoon, SK, S7K 5T6, Canada

A novel canola protein concentrate (CPC) was supplied by MCN BioProducts Inc. (Saskatoon, SK, Canada). The product contained 72.5% crude protein, with no detectable phytic acid. Two performance trials with rainbow trout were conducted with CPC replacing graded levels of fish meal in commercial-type diets. In trial #1, all of the diets contained 17% corn gluten meal, 10% soybean meal and were balanced for crude protein, energy and lysine. The control diet contained 39% fish meal (S.A. prime) and the test diets contained CPC at inclusion levels of 6, 12 and 18% of the diet as a direct for fishmeal protein. In comparing the control and test diets, no statistically significant differences were obtained in feed intake, weight gain or feed:gain ratio over the 9 week trial period. In trial #2, the test diets contained CPC at 15 and 30% of the diet with replacement of 38% and 76% of the fishmeal protein in the diet. No trends or differences in feed intake were obtained at any time during the trial. After 12 weeks of feeding,



weights gain of fish were 94% of controls for the lower CPC diet and 89% of controls on the higher CPC diet, however, these trends were not statistically significant. After 12 weeks of feeding, feed conversion rates were statically lower ($p < 0.05$) for the control group (0.96) when compared to the low CPC group (1.05) and the high CPC group (1.07). The data demonstrates that dephytinized canola protein concentrate can replace substantial levels of fish meal in a commercial type of diet for rainbow trout with marginal effects on performance. Cost-effective commercial production of CPC has the potential to reduce the reliance on fishmeal and thereby support the continued growth and sustainability of the fresh water farmed fish industry.

Lupin and Low Tannin Faba Bean as Potential Feed Ingredients for Aquaculture

Mark Olson^{*1}, Ken Lopetinsky², Sheri Strydhorst³ and Alan Dooley⁴

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³Department of Agricultural, Food, and Nutritional Science, 4-10 Agriculture Forestry Ctr, University of Alberta, Edmonton, Alberta T6G 2P5

⁴Business Expansion and Commercialization Division, Alberta Agriculture and Food, 3rd fl JG O' Donoghue Building, 7000 - 113 Street, Edmonton, Alberta, T6H 5T6

From 2004-2006, lupin (*Lupinus angustifolius*) and low tannin faba bean (*Vicia faba minor*) was investigated for agronomic adaptability and nutritional attributes for food and feed. Lupin had never been grown commercially in Western Canada. Faba bean had been grown before, however, these cultivars contained higher levels of tannin and were late maturing. The range in yield of lupin and low tannin faba bean in small plot trials across years and locations was 2092 to 3486 kg/ha⁻¹ and 4601 to 6981 kg/ha⁻¹, respectively. Both crops were shown to be higher in protein compared to field pea with whole seed values of 29 to 40 % for lupin and 26 to 31 % for low tannin faba bean. Limited testing as a feed ingredient indicated that both grains could be incorporated into farmed salmon diets. One report on faba bean concentrate concluded that low tannin faba bean values for salmonid feed formulation was roughly equivalent to corn gluten meal, however, maximum inclusion levels for salmon diets will have to be determined if this feed comes onto the market on a commercial scale. De-hulling of lupin and air classification (fractionation) of both lupin and low tannin faba bean were studied to improve utilization.

Opportunities for Western Canadian Pulse Crops in Aquafeeds

S.A. Collins and M.D. Drew*

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Historically fishmeal has been the most important protein source in commercial aquatic feeds. However, annual growth of greater than 10% per year has put increasing pressure on fishmeal supplies. Since the supply of feed grade fish is limited, expansion of aquaculture production in the future will be dependent on lowering the inclusion rate of marine products in aquafeeds and replacing them with plant based protein sources. Recent research at the University of Saskatchewan has investigated the use of Western Canadian pulse crops, including peas and faba beans as aquafeed ingredients. Peas and faba beans in their native forms are too low in protein (22 and 28% respectively) and too high in starch (approximately 45% for both crops) for use in most aquafeeds. However, both crops may be converted to protein concentrates economically using air classification. Pea protein concentrate contains 50-55% crude protein and has apparent digestibility coefficients of 0.95, 0.84 and 0.87 for crude protein, dry matter and energy digestibility respectively in rainbow trout. Faba bean protein concentrate contains between 60 and 65% crude protein and has apparent digestibility coefficients of 0.88, 0.81 and 0.86 for crude protein, dry matter and energy digestibility respectively in rainbow trout. These ingredients may be further improved through crop breeding programs to improve the chemical composition of the crops and reduce levels of antinutritional factors such as tannins. The combination of improved varieties and crop processing may lead to a desirable new protein sources for the aquafeed industry.



Sustainability - Beyond the Triple Bottom Line?

Date: Monday, September 24, 2007

Time: 1:20 PM – 3:00 PM

Location: Salon 2

Chair: Mia Parker

- 1:20 M. Parker**
Session Introduction
- 1:40 T. Ish**
Creating Win-Win Solutions for Business and the Environment
- 2:00 C. Severne**
Sustainability - A Maori Perspective from New Zealand
- 2:20 L. Greba**
TBA
- 2:40 M. Parker (Facilitator)**
Discussion
-

Sustainability-A Māori Perspective from New Zealand

Charlotte Severne

One of New Zealand's most fundamental obligations to Māori under the Treaty of Waitangi (Fisheries Claim) Settlement Act 1992 —is to make better provision for Māori non-commercial customary fishing rights and interests; and Māori participation in the management and conservation of New Zealand's fisheries. Ease of access and variety of "desirable" taonga species has resulted in the supporting ecosystems sustaining intensive commercial, recreational and customary harvests, illegal fishing and other anthropogenic effects over many years. Management of this pressure has been compounded by the lack of fisheries specific and ecosystem information, little or no customary fisheries monitoring, and confusion of roles, responsibilities. The outcome of the combined Māori Commercial Fisheries Settlement and recent Aquaculture Law Reform is that Māori control of more than 50% of New Zealand seafood sector. Māori now have significant opportunity to influence how we view sustainability of future aquaculture and wild fisheries management.



Contributed Papers in Marine Aquaculture

Date: Monday, September 24, 2007

Time: 1:20 PM – 3:00 PM

Location: Salon 3

Chair: TBA

- 1:20 T. Benfey**
Preliminary Evaluations of Triploidy for Suppressing Sexual Maturation in Farmed Cod
- 1:40 Y. Lu**
The Marketing of Atlantic Halibut (*Hippoglossus hippoglossus*) and Demand Estimates
- 2:00 L.-A. Davidson**
Is Scallop Aquaculture and Enhancement Economically Viable in the Gulf Region?
- 2:20 D. Martin-Robichaud**
The Correlation between Ovarian Fluid Characteristics and Egg Fertilization Success in Atlantic Halibut (*Hippoglossus hippoglossus*)
- 2:40 M. Mamoser**
An Ecosystem-Based Approach to the Management of the Shellfish Aquaculture Industry in B.C.: An Industry Needs Assessment

Preliminary Evaluations of Triploidy for Suppressing Sexual Maturation in Farmed Cod

Tillmann J. Benfey^{*1}, Edward A. Trippel² and Steven R.E. Neil²

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

Atlantic cod are currently being evaluated for aquaculture in New Brunswick to complement the existing salmon aquaculture industry. From experiences to date, early (pre-harvest) sexual maturation is likely to be one of the greatest constraints to economically viable cod culture in New Brunswick and elsewhere. Induced triploidy has been demonstrated to be an effective tool for suppressing sexual maturation in numerous teleost species and we have initiated a project to evaluate the production characteristics of triploid cod for this purpose. A triploid population of cod was successfully produced by hydrostatic pressure treatment of eggs for 5 minutes at 8500 psi, beginning 30 minutes after fertilization at an incubation temperature of 6°C. At 2 years of age, no sexually mature triploid females were observed and only 12.5% of triploid males were mature. In comparison, 90% of sibling diploid females and 55% of sibling diploid males were mature. However, female triploids grew at a slower rate than female diploids in a small-scale tank experiment, with no difference in growth between triploid and diploid males. A family-by-ploidy interaction for growth was nearly significant ($P=0.052$), underlining the importance of incorporating selective breeding into any triploid production program.

The Marketing of Atlantic Halibut (*Hippoglossus hippoglossus*) and Demand Estimates

Yi Lu^{*1}, B. Jia¹, T. Benfey¹, C. Frantsi, D. Martin-Robichaud², L. Hammell³, N. Ridler¹, P. Sykes³ and Skip Wolf⁴

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³Veterinary College, University of Prince Edward Island, Canada

⁴Canadian Halibut Ltd, St George, NB., Canada

Atlantic halibut (*Hippoglossus hippoglossus*) is a high value species whose output from global and Canadian capture fisheries has been declining. This scarcity offers the potential for farming, which would reduce economic risks in New Brunswick through diversification. A project is underway in New Brunswick to grow halibut commercially,



and to further this goal a study of the potential market of farmed halibut was undertaken. The demand for Atlantic halibut is estimated using US data for prices and incomes, as well as possible substitutes. Demand for seafood- particularly whitefish- in the US is expected to increase because of population and income growth, and also demographic factors. Elasticity coefficients confirm the “luxury” nature of halibut and suggest that farmed output can increase without a detrimental impact on farmers’ incomes. They also indicate that cod and haddock are not significant substitutes for halibut. The paper looks at potential market destinations for the farmed halibut.

Is Scallop Aquaculture and Enhancement Economically Viable in the Gulf Region?

L.-A. Davidson^{*1}, B. Frenette² and M. Niles¹

¹ Department of Fisheries and Oceans, Gulf Fisheries Center, 343 Université Ave, Moncton, NB, E1C 9B6

² Pecten UPM/MFU Inc, Maritime Fishermen’s Union, 408 Main St, Shediac, NB E4P 2G1

In the Gulf Region, various aspects of scallop aquaculture and enhancement have been studied since the early '90. Projects were launched with industry partners such as the Botsford Professional Fishermen Association and the Maritime Fishermen’s Union. The provinces of New Brunswick, Nova Scotia and Prince Edward Island were also implicated in the various projects along with many funding agencies. Only recently, has sufficient data been accumulated to predict the economical viability of the activities in questions, however these predictions have not been tested. Major hurdles were overcome before attaining the knowledge we have today. For examples, locating the ideal scallop spat collection sites required many years of investigation. Culture gear and techniques were borrowed from the Japanese however needed to be adapted to our waters. Great losses of gear and time were encountered during this adaptation process. The biggest hurdle, which is not completely surmounted yet, is the social management of the activities. All the studies were done on a small scale. Results indicate that economical viability can be achieved, if activities are conducted at a much larger scale. Management strategies required to test the activities on a larger scale need to be put in place.

The Correlation between Ovarian Fluid Characteristics and Egg Fertilization Success in Atlantic Halibut (*Hippoglossus hippoglossus*)

D. Martin-Robichaud^{*}

St. Andrews Biological Station, DFO, St. Andrews, NB E5B 2L9 E-mail: martin-robichaud@mar.dfo-mpo.gc.ca

Predicting the time of ovulation, and correspondingly the right time to strip oocytes, of serial egg batches of Atlantic halibut is critical for good fertilization success. Spawning Atlantic halibut females release egg batches about every 3-4 d but cycles vary within and between individual females, and are influenced by other environmental conditions, making predictions difficult. During 5 annual spawning periods, ovarian fluid and eggs were collected daily from spawning broodstock during ovulation cycles to attempt to correlate various physico-chemical characteristics of the ovarian fluid to fertilization success. The pH, osmolality and refractive index of ovarian fluid were measured and subsamples of eggs were fertilized with milt from 2 males. None of the 3 variables measured showed a significant pattern related to the 4 day ovulatory cycle. However, fertilization rates were directly and inversely correlated to pH and refractive index, respectively. The daily sampling and handling regime probably interfered with normal ovulation processes somewhat but were necessary to detect any chemical changes in the ovarian fluid during hydration and oocyte maturation processes. Further correlations between pH and refractive index with fertilization rate should be made on full ovulated batches stripped after ovulation is predicted, as normally done during routine spawning protocols.

An Ecosystem-Based Approach to the Management of the Shellfish Aquaculture Industry in B.C.: An Industry Needs Assessment

M. Mamoser^{*1}, R. Canessa¹, J. Grant², P. Cranford³ and M. Archambault²

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³ Ocean and Environment Branch, DFO, Bedford Institute of Oceanography, Dartmouth, NS B2Y 4A2

The shellfish aquaculture industry presents a viable means of economic diversification in coastal communities hardest hit by the closure of traditional resource-based industries. The industry is already established on both the East and West coasts of Canada with the potential for further expansion, but the availability of suitable grow-out



sites has become one of the biggest challenges facing both industry proponents and regulators. Site selection is paramount in ensuring the sustainable development of the industry from both a social, economic and environmental perspective. Fisheries and Oceans Canada (DFO) has a policy of ecosystem-based management of the shellfish aquaculture industry. The use of remote sensing, geographic information system (GIS) and the associated spatial analysis is one way of meeting this policy objective by departing from the current case-by-case model used for site selection and management of the industry to an approach in which synoptic information from a broader regional such as a bay, inlet, sound or other marine region is assessed. An important component of ecosystem-based management is its emphasis on collaboration across all user groups. The effectiveness of spatial technology to achieve an ecosystem-based approach must take into account the needs of the regulators and the industry proponents. A questionnaire assessing industry proponent needs for site selection and achieving ecosystem-based management was sent out to all shellfish farmers in British Columbia and Nova Scotia. This presentation will focus on the results stemming from the B.C. questionnaires.



SNFWS III - Environmental Aspects of Freshwater Cage Farming

Date: Monday, September 24, 2007

Time: 3:30 PM – 4:50 PM

Location: Salon 11/12

Chair: Doug Geiling

3:30 M. Paterson

The Effect of an Experimental Rainbow Trout Cage Farm Operation on Nutrients and the Plankton Community of a Freshwater Lake

3:50 C. Podemski

Development of Benthic Changes at an Experimental Freshwater Aquaculture Facility

4:10 K. Mills

Impacts of Rainbow Trout Cage Culture in a Small Lake: Lake Trout Enhancement?

4:30 P. Blanchfield

Survival And Distribution Of Farmed Rainbow Trout Released From An Experimental Aquaculture Operation.

The Effect of an Experimental Rainbow Trout Cage Farm Operation on Nutrients and the Plankton Community of a Freshwater Lake

M.J. Paterson^{*1}, D. Findlay¹, C.L. Podemski¹, L. Wesson¹, C. Bristow² and A. Azevedo¹

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²University of Ottawa, Department of Biology, 30 Marie Curie, P.O. BOX 450, Station A, Ottawa, Ontario, Canada, K1N 6N5

In recent decades, there has been increased interest in the development of a freshwater aquaculture industry for rainbow trout in Canada, but the potential ecosystem impacts of cage farms on lakes are poorly understood. At the Experimental Lakes Area in northwestern Ontario, we established a rainbow trout cage farm in a small lake after two years of pre-impact study. Operation of the farm increased loading of phosphorus to the lake by 6.5 times, but phosphorus and phytoplankton biomass in the epilimnion increased by only 2X. The greatest changes occurred in spring, when phosphorus accumulating in the hypolimnion was mixed into the epilimnion, resulting in dense blooms of dinoflagellates. At other times of the year, phosphorus concentrations were elevated in the hypolimnion, but comparatively inaccessible to phytoplankton. Large changes in bacteria were not observed. Despite increases in phytoplankton biomass, no dramatic changes in *Mysis* densities and distribution, zooplankton biomass, species composition, or turnover have been observed to date.

Development of Benthic Changes at an Experimental Freshwater Aquaculture Facility

C. L. Podemski^{1*}, R. Rooney², M. Wetton² and Azevedo, P.A. ¹

¹Freshwater Institute, Fisheries & Oceans Canada, 501 University Crescent, Winnipeg, MB, R3T 2N6

² University of Manitoba, Department of Entomology, Winnipeg, MB, R3T 2N2

In May 2003, an experimental rainbow trout farm with an annual production of approximately 10T was established in Lake 375 at the Experimental Lakes Area (northwestern Ontario). The benthic environment of the lake was sampled prior to operation of the farm and then periodically during operation. We have monitored the development of changes in sediment and porewater chemistry, and in the benthic invertebrate community in response to aquaculture. The magnitude and spatial extent of these impacts and how they have changed over four years of operation will be discussed. Porewater ammonia was a sensitive measure, showing detectable changes shortly after operations began. After one production season, there was a significant accumulation of wastes on the surface of the sediment directly under the cage and a change in sediment N and P content. These effects were and continue to be spatially limited. Changes to the invertebrate community have been significant, but have taken longer to develop



than changes in sediment chemistry. They also extend further away from the cage than do detectable changes in sediment chemistry but have also been complicated by the failure of the lake to completely mix several years in a row with resulting hypoxia in the hypolimnion.

Impacts of Rainbow Trout Cage Culture in a Small Lake: Lake Trout Enhancement?

K.H. Mills^{*1}, S.M. Chalanchuk¹, D.J. Allan², P.J. Blanchfield¹, and C.L. Podemski¹

¹Fisheries & Oceans Canada, Freshwater Institute, 501 University Crescent, Winnipeg, MB R3T 2N6

²Limno Tech Enterprises, 135 Bayridge Avenue, Winnipeg, MB R3T 5B4

Researchers at the Experimental Lakes Area (ELA), northwestern Ontario, are conducting a whole-lake experiment to assess the impacts of cage aquaculture of rainbow trout in a small oligotrophic lake. Ten thousand rainbow trout have been cultured during each of the past four years, 2003-2006. Changes in lake sediments, water quality, primary productivity, phytoplankton, zooplankton, benthic invertebrates, and native fish populations have been studied during each year of the experiment. Few changes occurred during the first year of cage culture, but changes have occurred during subsequent years. Nutrient concentrations in the lake have progressively increased, and the biomass of fishes has increased starting the second year of cage culture. Abundances of minnow, slimy sculpin, and white sucker have increased. Growth and fatness of lake trout have increased and age of first maturity has decreased. After four years of cage culture, there have been no negative impacts on the fish populations in this lake. Although some eutrophication has occurred in this small lake, it is less than we expected based on other ELA nutrient addition experiments. The increase in biomass of the fishes in this lake is more than we expected based on the increase in biomass of phytoplankton.

Survival and Distribution of Farmed Rainbow Trout Released From an Experimental Aquaculture Operation

P.J. Blanchfield^{*1}, L.S. Tate¹ and C.L. Podemski¹

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The raising of rainbow trout (*Oncorhynchus mykiss*) dominates the open-pen aquaculture industry in Canadian freshwaters; however, the potential ecological impacts of escaped fish are difficult to quantify in the large water bodies where most of this industry occurs. We released rainbow trout from an experimental farm (ELA project) and monitored their survival, behaviour and habitat use within the study lake using automated telemetry systems. Survival of farmed rainbow trout varied considerably among years ($p < 0.05$). Median lifespan of trout was 1 mo (31 d) in 2003, in contrast to ~11 mo in both 2004 (339 d) and 2005 (330 d). Less than one-quarter (22%) of tagged fish survived for a period of one year. Rainbow trout spent most of their time in close proximity to the cage site while the farm was in operation; otherwise they were widely distributed around the lake. Rainbow trout consistently maintained a shallow (~2 m) depth distribution. Early results from this ongoing study suggest that only a small proportion of fish survive after an “escape event”, but these fish are able to maintain high growth rates by exploiting a variety of habitats, including dependence upon the cage site for waste food pellets.



Aquaculture Health Management

Date: Monday, September 24, 2007

Time: 3:30 PM – 5:10 PM

Location: Salon 2

Chair: Rod Penney

3:30 K. Brewer

Factors in Controlling ISA and the Transferability to the “Next Disease”

3:50 D. McCallum

Progress towards the BC Shellfish Aquatic Animal Health Program

4:10 A. Osborn

National Aquatic Animal Health Program: Update on Activities and Direction

4:30 B. Boyce

The Marine Harvest Canada Strategy for Successful Sea Lice Management

4:50 L. Sams

How Independent Research Facilities and Organizations Can Support Innovation and Excellence in Aquatic Health Management

Factors in Controlling ISA and the Transferability to the “Next Disease”

Kathy Brewer* and Dr. Michael Beattie

New Brunswick Department of Agriculture and Aquaculture, P.O.Box 6000, Fredericton, NB, E3B 5H1

Infectious Salmon Anemia first occurred in New Brunswick in the summer of 1996. Due to the unknowns of this disease and lack of information several initiatives were championed in order to control the virus. As part of an effort to manage ISA the provincial government partnered with industry, researchers and fish health professional to develop a comprehensive fish health management program that addressed areas of hydrographics, data keeping and sharing, biosecurity, diagnostics, enforcement and continued research and development. The elements of this program can be used as a template to address the “next disease” to ensure quick responses from government agencies in order to put programs in place to control and manage new emerging diseases in the Aquaculture industry.

Progress towards the BC Shellfish Aquatic Animal Health Program

David McCallum

R&D Coordinator, BC Shellfish Growers Association

With food security issues and global demand for BC’s shellfish products in mind, the BCSGA is leading a charge towards import and export confidence by initiating the BC shellfish Aquatic Animal Health Program (AAHP). In 2006, the BCSGA commissioned a report to outline the industry components of the BC shellfish AAHP. Karreman (2006) advised that the high priority components included: (1) development of a Shellfish Health Code of Practice, template Standard Operating Procedures, and template Shellfish Health Management Plans (drafts complete Spring 2007); (2) shellfish health training for producers (basic) and technicians (commencing Fall 2007); and (3) a federal surveillance pilot project, led by the Canadian Food Inspection Agency (CFIA) (commencing Fall of 2006 and ongoing for two years). The objective of the surveillance pilot project is to provide evidence of disease freedom for the Manila clam (*Venerupis philippinarum*) and Pacific oyster (*Crassostrea gigas*) industries in BC for a list of 12 OIE listed pathogens. Results of the pilot project will be presented, along with a discussion of the experiences and challenges of the BC shellfish AAHP program.



National Aquatic Animal Health Program: Update on Activities and Direction

Andrea Osborn, DVM

Canadian Food Inspection Agency, Aquatic Animal Health Division, British Columbia, Canada

The Canadian Food Inspection Agency (CFIA) and the Department of Fisheries and Oceans (DFO) are working in partnership to develop the National Aquatic Animal Health Program. The program objective is to protect the health and welfare of Canada's aquatic resources while fostering access to international markets. Currently, the focus for CFIA is to undertake regulatory consultations across the country so that the Health of Animals Act can be enabled and the program implemented. In the past year the CFIA has been working on many aspects of program development including surveillance, risk assessment, disease control and import/export requirements. DFO has undertaken the development of the National Aquatic Animal Health Laboratory System (NAAHLS) that will provide quality assured diagnostics and targeted research in support the national program, while concurrently processing surveillance samples and proceeding with new test development and validation. A few of the ongoing elements of the NAAHP include: collaborative surveillance projects in the Great Lakes and British Columbia; the development of hazard specific plans for priority diseases in Canada (IHN, VHS, ISA and MSX); the development of outlines for the permitting of imports and domestic movements; the aquatic animal risk analysis framework and the refinement of export program delivery.

The Marine Harvest Canada Strategy for Successful Sea Lice Management

B. Boyce*, D. Morrison, M. Mills, C. LaTrace and G. Burry

Department of Fish Health, Marine Harvest Canada, 124-1334 Island Highway, Campbell River, BC V9W 8C9

Managing sea lice in British Columbia requires balancing fish health, government regulations, politics and economics. Environmental and biological aspects such as; sources of lice, species of lice, water temperature, salinity and currents, all add to the complexity. As an integral part of the Marine Harvest Canada fish health program, we have developed a sea lice management strategy to maintain healthy stocks, comply with government regulations, minimize potential environmental impacts and remain involved in sea lice research. Our strategy includes; analyzing sea lice records from our extensive database, optimizing treatments for efficacy and cost, monitoring environmental conditions, standardizing sampling procedures, staff training and auditing, and identifying research priorities. Utilizing this comprehensive strategy has enabled Marine Harvest Canada to successfully manage sea lice.

How Independent Research Facilities and Organizations Can Support Innovation and Excellence in Aquatic Health Management

Ms. Linda Sams

CEO, BC Centre for Aquatic Health Sciences

Industrial clusters and associated research networks are known to enhance an industry's competitiveness through accelerating innovation, increasing talent, and attracting investment. In addition, collaborative research networks can be instrumental in linking community engagement into the innovation process leading to locally grounded, sustainable industry development. The independent, not for profit research facility can be an important component of these networks. In a multi-stakeholder environment, collaborative research can be the path to shared solutions and conflict resolution. However, the collaborations need to be inclusive and transparent and perhaps most importantly, facilitated. Playing a supporting and facilitating role, these research centers can work to bring together diverse groups to achieve common objectives. These facilities can also support and enhance government, NGO, academic and industry programs and research initiatives and be a key component in emergency response plans.



Contributed Papers in Marine Aquaculture (Continued)

Date: Monday, September 24, 2007

Time: 3:30 PM – 4:50 PM

Location: Salon 3

Chair: TBA

3:30 A. Manning

Expression of Ghrelin during Larval Development in Atlantic Halibut, *Hippoglossus hippoglossus* L.

3:50 J. Power

Cage Culture Characteristics of Juvenile Atlantic Halibut (*Hippoglossus hippoglossus*)

4:10 E. Rodhaj

The Development of Fish Farming Along the Albanian Coast

4:30 F. Hekmatpour

Preliminary Results from the Establishment of Experimental Artificial Reefs in Qeshm Island (Persian Gulf) With an Emphasis on Decapod Fauna

Expression of Ghrelin during Larval Development in Atlantic Halibut, *Hippoglossus hippoglossus* L.

A. Manning*, H. Murray, J. Gallant, M. Matsuoka, E. Radford and S. Douglas
National Research Council, Institute for Marine Biosciences, Halifax, NS B3H 3Z1

Ghrelin is a highly conserved hormone which functions in growth hormone release and appetite regulation and is found in teleosts and mammals alike. It is mainly expressed in the stomach and can stimulate appetite in response to fasting. The objective of the study was to determine at which point ghrelin is expressed during the prolonged larval development of Atlantic halibut. The full-length complementary DNA sequence for ghrelin preprohormone was isolated from RNA extracted from halibut stomach tissue. The sequence encodes a 105 amino acid preprohormone that contains the halibut ghrelin peptide, the deduced sequence (GSSFLSPSHKPPKGKPPRA) demonstrates high conservation with other fish ghrelin peptides. Quantitative real-time PCR analyses on samples of larval halibut showed that ghrelin is expressed at low levels prior to exogenous feeding during halibut larval development (hatching and mouth-opening stages), and increases dramatically through metamorphosis. This rise was pronounced during climax metamorphosis and coincided with stomach differentiation. *In situ* hybridization studies on metamorphic halibut showed that ghrelin expression was localized to two different cell types in the developing stomach. Observed patterns of preproghrelin expression suggest that ghrelin has important roles both during and after larval development in halibut.

Cage Culture Characteristics of Juvenile Atlantic Halibut (*Hippoglossus hippoglossus*)

J. Power^{*1,2}, T. Benfey¹, D. Martin-Robichaud², E. Stuart²

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Atlantic halibut (*Hippoglossus hippoglossus*) is an alternative aquaculture species being evaluated to complement salmon aquaculture in Atlantic Canada. Although significant progress has been made on improving hatchery production of juveniles, a number of biological issues remain to be addressed concerning optimal conditions for their sea-cage grow-out, particularly those exposed to the unique environmental conditions experienced in the Bay of Fundy. These issues include determining the optimal size for transfer to cages, the impact of malpigmentation on growth and its potential to change over time, and the effect of sex and sexual maturation on growth rate. Growth and mortality rates of three different size grades of fish (ranging from <250g to >500g at transfer), held in 5 cages, have been monitored over the past year at a commercial site in the Bay of Fundy, and will continue to be monitored in the



coming fall. Growth rates, thus far, are up to and exceeding expectations. Malpigmentation patterns on individually tagged fish have been photographed and preliminary analysis shows an apparent decrease in malpigmentation over time. Fish were sexed with ultrasound and measurements indicate that females are growing faster than males. Additional research has looked into the effects of externally tagging individuals to monitor individual growth and survival rates. These results will expand the knowledge base pertaining to halibut culture and provide documentation demonstrating the economic potential of halibut culture in Atlantic Canada.

The Development of Fish Farming Along the Albanian Coast

Emiljano Rodhaj

Polytechnic University of Tirana, National Biodiversity Institute, Rr. "Duresit", 222, Tirana, Albania

The paper attempts to present recent trends in fish landings in the Adriatic Sea basin especially along the Albanian coast, in terms that allow comparison of estimates of production in the different periods and zones. Although marine catches have increased over the last decades, this tendency has changed and landings have been stabilised. Moreover, about 70% of the world's conventional species are fully exploited, overexploited, depleted or in the rebuilding process following depletion: As in many parts of the Mediterranean, aquaculture production in Albania has been expanding rapidly over recent years. The Albanian coast displays a wide range of geographical characteristics and supports many functions, such as tourism, residential development, and conservation, which may compete with aquaculture for resources. Many coastal areas are also physically exposed, unsuitable for traditional inshore-based farming. Within this context, intensive marine fish farming is increasingly moving towards exposed offshore environments, requiring technology development. In Albania, there are about 42 species of freshwater and diadromous fishes in the inland waters as well as some euryhaline species. Among the native species of economic importance are: the European eel, brown trout, barbel, chub, roach, tench, and the euryhaline species. Albania has a considerable number of introduced fishes in its inland waters. Among the most important of these are: rainbow trout, pollan, common carp, goldfish. The shads frequent the Albanian coasts and enter the rivers and a subspecies, the lacustris, is landlocked in some of the coastal lakes where it furnishes both food and sport. A number of other euryhaline fishes also enter lagoons (Karavasta, Narta and Butrinti) to feed during the spring and summer. This paper reviews the process of development of fish farming in Albania, providing information on statistics (volume, species, number of farms) and an overview of production techniques, main farm characteristics, and finally some thoughts about industry constraints and development options.

Preliminary Results from the Establishment of Experimental Artificial Reefs in Qeshm Island (Persian Gulf) with an Emphasis on Decapod Fauna

Fatimeh Hekmatpour^{*}, Preeta Kochanian, and Vahid Yavari

Department of Fisheries, Faculty of Marine Resources, Khoramshar Marine Science and Technology University, Iran. fhecmat@gmail.com ,

Artificial reefs produce significant biomass and if long lasting, appropriately deployed and scientifically managed, are useful tools for restoring the reefs systems and enhancing local fishery resources. Qeshm Island located in the southern of Persian Gulf. Salakh port on the southern coast of the Qeshm Island supports about ~20% of the total landings of the island. During the last 5 years a decline of 46% in catches of major fish species has been reported from Qeshm and was attributed to reduction in stock. The significant decline led the Salakh village council to obtain assistance of UNDP- GEF/SGP to deploy ARs in the coastal waters of Salakh in September, 2004. The pilot area included two sites, A&B, each with 80 concrete pyramids (1m³) deployed at 10m depth covering a rectangular area of 200m² parallel to the coast. These sites were monitored and compared with two similar areas in natural ecosystem (NE) (coral reef/sand- muddy bed). At each site 3 transects and at each transect 3 quadrates were selected for sampling of benthic epifauna, which commenced 1 year after deployment of the ARs. Quantitative samples were collected seasonally using quadrat and scuba diving methods. The results of quantitative analysis of samples provided valuable information on species composition, abundance and distribution of decapods. Invertebrate community was found to settle and inhabit the reef units. Decapod fauna revealed a tendency to dominate the benthic community when macroalgae were abundant. The major genera identified were Xantho, Petrolisthes, Thalamita, Charybdis, Alpheus, Hyastenus, Brachycarpus and Latreutes. Numerical analysis and comparison with NE revealed an increased rate of settlement of decapod species in the ARs sites. Overall 5 species were collected from NE, whereas the results of 12 months after deployment of ARs revealed 11 new species. The



seasonal variations in occurrence and abundance of the Decapoda are explained in detail in this paper. Comparison between the ARs and the NE sites clearly indicated that ARs could be productive habitats for benthic epifauna, which in turn attract predator species such as fish. This indicates that in the long run, these ARs would lead to replenishment of fishery resources of the area, thus contributing to the fishery production of Salakh coast.



SNFWS III - Environmental Aspects of Freshwater Cage Farming (Continued)

Date: Tuesday, September 25, 2007

Time: 8:20 AM – 9:40 AM

Location: Salon 11/12

Chair: Doug Geiling

8:20 C. Podemski

Assessment of the Benthic Effects of Freshwater Commercial Net-Pen Aquaculture

8:40 M. Wetton

Effects of Aquaculture Organic Waste Loading on Benthic Invertebrates

9:00 C. Wilson

Genetic Interactions of Cage Culture Escapees and Naturalized Rainbow Trout Populations in Lake Huron

9:20 D. Geiling

A GIS-Based Assessment of the Potential for Cage Culture Expansion in Lake Huron

Assessment of the Benthic Effects of Freshwater Commercial Net-Pen Aquaculture

C.L. Podemski* and R. Rooney

Freshwater Institute, Fisheries & Oceans Canada, 501 University Crescent, Winnipeg, MB, R3T 2N6

The discharge of waste materials from net-pen aquaculture directly into the open lake ecosystem has raised questions regarding the potential impacts of this settleable material on benthic environments and benthic communities. In 2006, we conducted surveys of the benthic environment underneath and surrounding seven commercial freshwater aquaculture sites in Canada. The objectives of the survey were to determine if accumulation of waste materials occurred and how far from the farm accumulations were visible, and the degree and spatial extent to which settled material affected sediment chemistry and the composition of the benthic invertebrate communities. At each farm site, sediment core samples were taken directly under an operational cage and along a distance transect away from the cage. The depth of the visible layer of fish waste was measured at each sampling station. A subset of cores were analyzed for benthic invertebrates and another set were analyzed to determine the elemental composition of sediment in the top 0-2cm strata. The depth of the visible layer of fish waste was highly variable. Although some farm sites had accumulations of wastes, several farms that have been in operation for substantial periods of time had little or no accumulation of waste material. Benthic invertebrate communities existed under all farms, although altered to favour species more capable of withstanding sedimentation of organic material. In all cases the observed changes were relatively localized.

Effects of Aquaculture Organic Waste Loading on Benthic Invertebrates

M. Wetton*¹ and C.L. Podemski²

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²Freshwater Institute, Fisheries and Oceans Canada, Winnipeg, MB R3T 2N6

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 3000 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 using an integrated approach combining sediment chemistry, field biological data and laboratory bioassays. In the field, replicate sediment cores were taken along a distance transect from a commercial (L. Huron) and experimental fish farm (L375, Experimental Lakes Area) for nutrient and invertebrate community analysis. Sediment traps were positioned in the water column along this same transect at both farms to determine the



amount of sedimentation that occurred at various distances from the cages. 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 *Tubifex* (Oligochaeta, Tubificidae), *Hyalella* (Amphipoda, Talitridae), *Chironomus* (Diptera, Chironomidae) and *Sphaerium* (Pelecypoda, Sphaeriidae) were subjected to 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.

Genetic Interactions of Cage Culture Escapees and Naturalized Rainbow Trout Populations in Lake Huron

Chris Wilson^{1*}, Tom Johnston², and Doug Geiling³

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²Ontario Ministry of Natural Resources, Cooperative Freshwater Ecology Unit, Laurentian University, Sudbury, ON

³Department of Fisheries and Oceans, Great Lakes Laboratory for Fisheries and Aquatic Sciences, 1 Canal Drive, Sault Ste. Marie, ON P6A 6W4

Potential genetic and ecological effects of cage culture escapes on wild fish populations are a contentious issue for aquaculture. Although the debate has mostly involved marine operations and native fish populations, similar concerns and frictions exist for aquaculture in the Great Lakes and potential impacts on naturalized and native species. To examine the potential genetic and ecological effects of cage culture escapes in northern Lake Huron on naturalized populations of rainbow trout, spawning runs on and near Manitoulin Island were sampled to determine the prevalence and reproductive contributions of escaped domestic trout. Adult fish were nonlethally captured, qualitatively scored for wild versus domestic phenotype, measured for length, weight, and sexual maturity, and sampled for ageing and genetic tissues. Genetic results from samples collected in 2005 and 2006 showed evidence of previous escape events. Multilocus genotyping with microsatellite DNA markers identified two distinct groups of rainbow trout which largely corresponded with field identifications of wild/domestic phenotypes. Non-naturalized fish were further subdivided into two groups, indicating that fish from more than one escape event were interacting with wild populations. The genetic data detected very few mixed-ancestry fish, suggesting that recruitment from interbreeding between naturalized and domestic fish is limited.

A GIS-Based Assessment of the Potential for Cage Culture Expansion in Lake Huron

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The nine existing rainbow trout cage culture sites in Lake Huron account for greater than 60% of the total freshwater aquaculture production from Quebec through Alberta. Growth in the Ontario rainbow trout aquaculture industry has stalled, however, with no increase in production from 1996 through 2005, and no new cage culture site licenses issued in the past decade. Contributing to the absence of growth is a regulatory structure involving numerous provincial and federal agencies. To address the complexity of the regulatory structure, the Ontario Ministry of Natural Resources brought together representatives from the agencies involved, along with members of the academic community, to develop Coordinated Guidelines for cage aquaculture site assessment and monitoring. While ongoing, one early result from the process was the identification of conditions that would prevent approval of a new site application, termed “no-go” criteria. To assess whether potential remains for the expansion of the Lake Huron cage aquaculture industry, we used GIS software to spatially represent a subset of the “no-go” criteria. Based upon the existing “no-go” criteria, the majority of the nearshore area of Lake Huron is not suitable for new cage sites. The areas that may have potential are located adjacent to Manitoulin Island.



Contributed Papers in Alternate Species

Date: Tuesday, September 25, 2007

Time: 8:20 AM - 10:00 AM

Location: Salon 2

Chair: TBA

8:20 J. Rakocy

Global Tilapia Production and Markets – 2007

8:40 T. George

The Grass Carp and Tilapias as Biological Control Agents and Their Role in Aquaculture for Food Security

9:00 J. Derkson

The Balance of Risk and Benefit in Culturing an Exotic – Review of Triploid Grass Carp Culture in Alberta

9:20 B. Chavan

Evaluation of the Nutritional Value of Natural and Artificial Feed Feeding to Nile Tilapia (*Oreochromis niloticus*)

9:40 A. Hasanlipour

Cortisol Changes in Response to Rearing Density in Siberian Sturgeon (*Acipenser baerii*)

Global Tilapia Production and Markets – 2007

Kevin Fitzsimmons¹ and James Rakocy^{2*}

¹University of Arizona, Environmental Research Lab, 2601 E. Airport Road, Tucson, AZ 85706 USA

²University of the Virgin Islands, Agricultural Experiment Station, RR1, Box 10,000, Kingshill, VI 00850 USA

Tilapia is the second most important farmed fish after the carps and is the most widely grown of any farmed fish. World tilapia production was 2,348,656 mt in 2006. Tilapia production in China (>1.3 million mt) exceeds the total combined production of all other countries. Consumption of tilapia in the U.S. has steadily increased from 0.3 lb/capita in 2000 to 1.0 lb/capita in 2007 and currently ranks in fifth position after shrimp, tuna, salmon and pollock. Consumption of tilapia in the U.S. was equivalent to 368,295 mt live weight in 2006. The majority of tilapia consumed in the U.S. is imported in the form of fresh fillets (23,101 mt), frozen fillets (74,381 mt) and whole frozen fish (60,772 mt) based on 2006 data. U.S. tilapia production supplies approximately 9,000 mt for the live fish market. The value of tilapia imported to the U.S. was US\$482,743,000 in 2006. Demand is increasing for stricter food safety standards, higher quality and value-added tilapia products, improved packaging and environmental safeguards. Growth in market demand is projected for all tilapia product forms, especially frozen meals. Worldwide tilapia production and sales are expected to maintain their upward trend.

The Grass Carp and Tilapias as Biological Control Agents and Their Role in Aquaculture for Food Security

Thomas T. George

President, Global Aquaculture Consultants, Toronto, Canada, M1V 3G3. E-mail: profitg@yahoo.ca.

Many problems related to decrease of water flow, sedimentation and harboring the vectors of water-borne diseases, are associated with heavy infestations of aquatic weeds especially, in irrigation canals of agricultural schemes. The grass carp and several species of tilapias are used as biological control agents for aquatic weeds and associated disease vectors. This paper highlights the problems of weed infestations in irrigation canals and lakes, accounts for the biology of the grass carp and tilapias and their roles in both, biological control of aquatic weeds and aquaculture for food security.



The Balance of Risk and Benefit in Culturing an Exotic – Review of Triploid Grass Carp Culture in Alberta

John Derksen*¹ and Dan Watson²

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²Alberta Agriculture and Food, Agriculture Centre, Lethbridge, AB T1J 4V6

With the continual expansion of aquaculture in many parts of the world, made possible through technological advancements and the development of new species for market, the incidence of risk assessments for potential aquaculture candidates has like wise grown. Although the threat of an unintended introduction of a specific aquaculture species becoming established is greater in some regions or watersheds then in others, the scrutiny of assessed risk must not be. In Alberta the risks imposed by the development of Grass Carp culture were off set by the species benefits to society. The threats and the mitigation measures taken are reviewed in response to the tentative popularity of this species for culture in Canada and North America.

Evaluation of the Nutritional Value of Natural and Artificial Feed Feeding to Nile Tilapia (*Oreochromis niloticus*)

B.R. Chavan*¹, Amararatne Yakupitiyage¹ and S.R. Kovale²

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² College of Fisheries (DBSKKV), Ratnagiri, Maharashtra, India-415629.

Abstract: The quantitative information on the nutritional contribution of the natural and artificial feeding system is scarce. This study was carried out to investigate the nutritional contribution of natural and artificial feeds of Nile tilapia (*Oreochromis niloticus*) culture in cages and open pond. The study was conducted by using a Completely Randomized Block Design (CRBD), for 8 weeks. Male Nile tilapia fry were stocked at 400 individuals in each happa in a 56-day trial based in three 5.4-m² happa fixed in four 200-m² earthen ponds and four cement tanks. By giving 0%, 50%, and 100%, of pelleted feed in pond which were compared with 100% pelleted feed in cement tank. Feeds contained 30% crude protein, 3,000 kcal digestible energy, and were supplied twice a day. Ponds were fertilized once in week. Temperature, dissolved oxygen, pH, total phosphorus, total nitrogen, chlorophyll a and suspended solids were monitored weekly. Growth of tilapia fingerlings during prolonged nursing (56days) in pond cages, were compared with fish nursed with 100% feed in cement tank for duration of 56 days. The tilapia fed with 0% feed showed no much growth (stunted growth). Mean daily weight gain of stunted tilapia were 0.0125± 0.003 per fish day⁻¹, 0.0603± 0.01 g per fish day⁻¹ for 50% feed fed and 0.1045± 0.03 g per fish day⁻¹ for 100% feed fed were compared with 0.1951± 0.03g per fish day⁻¹ for 100% feed fed in cement tank. The SGR of tilapia fed with 50% artificial feed showed better growth (2.583 ± 0.30%/day), Net yield was 890.1 ± 24g and Survival rate was also better 74.13 ± 16 than 100% artificial feeding trial. The results indicate that, the Nile tilapia can satisfy the nutritional requirement by ingesting natural feeds. However, when the stock of fish in the culture systems exceeds critical standing crop, artificial feed is required to satisfy the nutritional demand.

Cortisol Changes in Response to Rearing Density in Siberian Sturgeon (*Acipenser baerii*)

A. Hasanalipour^{1*}, M. Bahmani², V. Yavari¹, and R. Kazemi²

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² International Sturgeon Research Institute, P.O.Box 41635-3464, Rasht, Iran

Rearing density induced cortisol levels have been determined in cultured Siberian sturgeon (*Acipenser baerii*), introduced to Iranian aquaculture systems for the first time, in order to monitor crowding stress. Ninety, 2 years old juvenile fish with 342 ± 30 gr mean weight and 45.3 ± 1cm total length (T.L.) were held in three ,low (6 fish) moderate (12 fish) and high (18 fish) densities in 3 equal repeatments for 5 months culture period in two phases, from july to november. In equal total experimental conditions (water volum of tanks, primitive biomass, feeding rate and etc), our results showed no significant interaction effects between density – time parameters & cortisol levels (p > 0.05). Separate analysis, showed significant correlation of time and cortisol levels (p < 0.05) in October (23.22 ± 4.44ng/ml) when maximum cortisol levels observed. Significant corelatioin between density – time parameters &



growth indices (length and weight) was observed ($p < 0.05$). Biomass in tir, mordad, mehr and aban estimated 5, 8.5, 13.5 and 17.2 kg/m³ for low density, 12, 16.2, 24 and 28 kg/m³ for moderate density and 19, 25.2, 36 and 42 kg/m³ for high density, achieved (primitive biomass was 1.5 kg/m³ in all of treatments). We conclude that Siberian sturgeon is not sensitive species against rearing density in Iranian aquaculture systems.

Talking About Aquaculture

Date: Tuesday, September 25, 2007

Time: 8:20 AM - 10:00 AM

Location: Salon 3

Facilitator: Jocelyn Fraser

Make a difference – learn the skills to provide helpful responses to those questions we all get asked about aquaculture, in a constructive and non defensive way to your friends, associates, and family. Skilled media consultant Jocelyn Fraser will lead an interactive workshop on how to present the aquaculture industry and get positive reactions in this complicated world. Topics covered will include frequently asked questions, understanding your audience and framing your response, as well as resource materials available to you.

NOTE: This session is limited to the first sixty attendees.

Conference Plenary I

Date: Tuesday, September 25, 2007

Time: 10:30 AM – 11:30 AM

Location: Salon 11/12

10:30 R. Goldberg

Creating an Industry Model for Addressing Environmental Issues and Achieving Business Benefits



SNFWS IV - Diversification of Freshwater Production

Date: Tuesday, September 25, 2007

Time: 1:20 PM – 3:00 PM

Location: Salon 11/12

Chair: Dan Stechey

- 1:20 G. Chaudhary**
Role of Aquaculture in Agriculture Diversification
- 1:40 C. Frantsi**
The Development of Alternate Finfish Species for Aquaculture; an East Coast History and Perspective
- 2:00 D. Stechey**
SWOT-Based Technique for New Species Development – An Evaluation and Planning Model
- 2:20 S. Taylor**
Constructed Wetlands / Lagoons for Effluent Treatment: Technical and Economic Feasibility for the Canadian Experimental Aqua-Farm
- 2:40 Panel Discussion**

Role of Aquaculture in Agriculture Diversification

G. Nabi Chaudhary

Alberta Agriculture and Food, #303, 7000 – 113 Street, Edmonton, Alberta, Canada T6H 5T6

It is widely known that aquaculture is not a new industry. The care and farming of fish is rooted in ancient history perhaps as far back as 2500 B. C. Aquaculture is gaining momentum with the increase in demand for more nutritional food and fresh produce. The future of aquaculture appears to be bright as it is demand driven. In Canada current trends show that consolidation of farms has accelerated during the last few decades and is expected to continue with the aging of farm population. This development has created some definite challenges for the sustainability of family farms. Family farm operators must diversify their operations to enhance productivity if they are to survive in the era of “Wal-Martization of Agriculture”. Aquaponics is one of the many options that should be considered to increase profitability. This presentation will discuss how aquaponics can help family farms to be sustainable and enhance farm income.

The Development of Alternate Finfish Species for Aquaculture; an East Coast History and Perspective

Chris Frantsi*

Chris Frantsi & Associates, 54 Demonts Ave, St. Andrews, NB, E5B 2K4, Canada

Work on the development of a number of species alternative to Atlantic salmon has been ongoing in Atlantic Canada since the early 1980's. Although the technology for the early rearing of most species of interest can be considered commercial ready this has not resulted in significant sustained commercial culture of any of the species. The reasons are many but primarily related to a lack of both public and private investment and programming required to move the available technology through to full commercial status. This presentation provides a history and logical progression for the development of new species and attempts to outline what is required to improve our success.



SWOT- Based Technique for New Species Development – An Evaluation and Planning Model

Daniel Stechey*, W.D. (Bill) Robertson, and Brian Kingzett

¹ Canadian Aquaculture Systems, Inc

² Rethink Inc.

³ Blue Revolution Consulting Group Inc.

A 4-phase process for evaluation, development and commercialization of new candidate species for aquaculture has been developed based on the application of SWOT Analysis (Strengths, Weaknesses, Opportunities, Threats) within key functional areas. SWOT Analysis has been selected as the fundamental approach to the model because it is a robust, strategic tool that requires reflection on a broad range of considerations which can influence the success of a project. When conducted thoroughly, a SWOT Analysis will reveal key strengths to build upon and opportunities to exploit while simultaneously focusing attention on those areas where improvement is necessary and where external factors may impose additional constraints to be addressed. The SWOT approach guides the compilation of necessary information in a way that enables development of structured response plans to resolve underlying critical issues that must be addressed to generate the intended results. The 4-phases of the model include: Preliminary Evaluation of Species (Market & Basic Biology); Species Selection & Commitment (Applied Research); Testing and Validation (Pilot Project); and Verification & Technology Transfer (Commercialization). By reviewing the SWOT analysis on a regular basis, stakeholders will be able to track progress on the development of the species, enabling the Research, Development & Commercialization Plan to remain current.



R&D Coordination

Date: Tuesday, September 25, 2007

Time: 1:20 PM – 3:00 PM

Location: Salon 2

Chair: David McCallum

1:20 D. McCallum

Session Introduction and Background on Canadian Aquaculture R&D

1:40 J. Rose

Icywaters Arctic Charr R&D Initiatives

2:00 T. Jackson

IRAP R&D Funding

2:20 S. Cross

Pacific SEA-Lab: Building A Practical Industry-Academia Interface For R,D&T

2:40 D. Green

Aquaculture Industry R&D Network

Icywaters Arctic Charr R&D Initiatives

John Rose

President, Icy Waters Arctic Charr Limited, Whitehorse, Yukon

Icy Waters Ltd. is a privately owned Canadian company and a world leader in Arctic char (*Salvelinus alpinus*) aquaculture. It is committed to the belief that Arctic char are one of the finest freshwater finfish available in the marketplace today. Located in Whitehorse, Yukon Territory, Icy Waters Ltd. is a fully integrated operation that includes a certified broodstock facility, hatchery, tank farm and processing plant. Since its establishment in 1986, the company has worked to develop a peerless strain of Arctic Charr well suited for commercial aquaculture. In this presentation, Icy Waters will examine from an overview perspective its various research projects including everything from husbandry efforts such as alternate day feeding, light regimes, and harvesting protocols as well as selective breeding projects to enhance genetic diversity, find specific genetic markers for qualitative traits and implement marker assisted selection in the breeding program. The theme of the presentation will be the underlying business impact of the research, what has worked, what hasn't and some ideas on where to go forward in the effort to constantly improve the commercial performance of Arctic Charr.

Pacific SEA-Lab: Building a Practical Industry-Academia Interface for R,D&T

Stephen F. Cross, Ph.D.*

Coastal Aquaculture Research & Training (CART) Network, Department of Geography, University of Victoria, Victoria, British Columbia, Canada V8P 1A1

Academic institutions provide a valuable avenue for the development of high-level researchers within the Canadian educational landscape. However, while most of these programs are designed to provide our developing research community with a thorough understanding of scientific principles and how these should be used in an objective pursuit of knowledge, many do not offer a strong and practical link with the industrial community, such as aquaculture, to which they purport to apply these skills. The Pacific SEA-Lab Research Society was incorporated as a not-for-profit entity in 2006 and was developed to bridge this inherent gap and to provide "solution-oriented research for sustainable ecological aquaculture". With an inaugural board of directors that comprise university, college, shellfish and finfish producer associations, first nations, and DFO, the operational goal of the society is to provide and maintain industry-based infrastructure for applied multidisciplinary R,D&T programs in support of coastal community and First Nation capacity building. This paper will discuss the structure of the Pacific SEA-Lab, its current (and developing) infrastructure, and how this approach is fitting into a coordinated, collaborative British Columbia innovation initiative.



Aquaculture Industry R&D Network

Darrell Green

Research and Development Coordinator (RDC), Newfoundland Aquaculture Industry Association (NAIA).

The Atlantic Canada Aquaculture Industry Research & Development Network (ACAIRDN) was established to facilitate and communicate R&D initiatives in the Canadian aquaculture industry. The Network has existed since 2002 and in 2006, the Network grew from four to six RDCs, and now has representation on both the East and West coasts of Canada, and in both the finfish and shellfish sectors. This session will touch on recent aquaculture industry R&D developments in Atlantic Canada, as well as provide a discussion on the purpose and role of ACAIRDN.



Contributed Papers in Aquaculture

Date: Tuesday, September 25, 2007

Time: 1:20 PM – 3:00 PM

Location: Salon 3

Chair: TBA

1:20 J. Conroy

Denitrification Using Volatile Fatty Acids Produced By Hydrolysis of Waste Solids

1:40 M. McDonald

Solar Water Heating for Aquaculture

2:00 T. George

Wild and Farmed Fish, Their Nutritional Value and Role of Aquaculture for World Food Production

2:20 T. Plesowicz

Fish as a Research Animal

Denitrification using Volatile Fatty Acids Produced by Hydrolysis of Waste Solids

Jessica Conroy* and Michel Couturier

Recirculating Aquaculture Research Group, Department of Chemical Engineering, University of New Brunswick,
PO Box 4400, Fredericton, NB, E3B 5A3, Canada, Tel.: (506)455-4690, Fax: (506)453-3591, cout@unb.ca

The objective of this study was to investigate the feasibility of using volatile fatty acids (VFA), which are produced by the hydrolysis of waste solids from a recirculating aquaculture system, as a carbon source for nitrate removal via denitrification. The VFA production was studied during a series of semi-continuous experiments at room temperature with different hydraulic retention times. It was found that the maximum SCOD yield was 1.4 gSCOD/gTSS with approximately 30% solids destruction. A major concern with the hydrolysis of waste solids is the amount of phosphorus that goes into solution. However, during the course of this study it was found that only about 10% of the total solid phosphorus goes into solution. The denitrifying reactor consisted of three attached growth, continuous stirred reactors in series. One of the objectives of this portion of the study was to determine the minimum hydraulic retention time (HRT) required for nitrate removal. It was found that an HRT as low as ten minutes was able to achieve approximately 81% nitrate removal. An important parameter for denitrification is the amount of SCOD required for nitrate removal because too little COD can lead to nitrite production. Using the SCOD produced during the hydrolysis experiments, it was found that approximately 4.5 gSCOD are required per gNO₃-N removed. Therefore, it is possible to perform denitrification using VFA produced during the hydrolysis of waste solids, thereby converting nitrate in the effluent to nitrogen, as well as destroying some of the solids.

Solar Water Heating for Aquaculture

M. McDonald*

Taylor Munro Energy Systems, 11-7157 Honeyman Street, Delta, BC. V4G 1E2

Aquaculture is often criticized for its environmental impacts. Land-based operations tend to have high operating costs for treating and heating water. Solar water heating and heat reclamation technologies can be successfully employed to help offset some of the costs and environmental impacts at these facilities. The intensity of solar radiation varies from moment to moment, as well as daily and seasonally, so it is important that the control strategy be well designed to optimize the renewable energy contribution without disturbing the prescribed temperature range for the tanks. This paper will review two case studies where this has been achieved: one at a salmon hatchery and one at a tilapia farm, both in British Columbia. This will include a review of the solar thermal technology used, the reduction in fossil fuel consumption and greenhouse gas emissions, the impacts on operating costs and maintenance procedures, and a discussion of opportunities and barriers to the uptake of solar technology in other applications.



Wild and Farmed Fish, Their Nutritional Value and Role of Aquaculture for World Food Production

Thomas T. George

President, Global Aquaculture Consultants, Toronto, Canada, M1V 3G3. E-mail: profitg@yahoo.ca.

This paper reports on the scientific facts about the nutritional value of wild and farmed fish as compared to beef, pork and chicken; their stand with respect to cholesterol, omega-3s and the allegations made against farmed fish species, in particular, salmon. Furthermore, the roles of aquaculture in world food production and that of the Government of Canada with respect to NAAHP and HACCP, are highlighted.

Fish as a Research Animal

Tadeusz Plesowicz

Aquatic Technician, Aquatic Facility, Biosciences Animal Service, Biol.Sci.Bldg CW-401; University of Alberta, Edmonton T6G 2E9 Ph./780/492-5482; fax./780/492-7257

Fish are excellent animal models for many types of research because they are extremely diverse, very adaptable to a wide range of environments and they are the oldest and largest group of vertebrates. According to the Canadian Council on Animal Care use records around 650,000 fish were used for research purposes in 2005, which is the second largest group of animals used, representing approximately 25% of all animal research use in Canada. The smaller species of fish such as zebrafish and cichlids make excellent models for many studies in genetics, neurobiology, behaviour and physiology. In our facility at the University of Alberta we used around 13,000 fish in research in 2006, in which smaller size such as zebrafish and cichlids made more than 50% of all species of fish. Currently these fish are used at the University of Alberta for genetic manipulation, vertebrate developmental neurobiology, embryology and interactions among hormones, pheromones and reproductive behaviour in fish. The larger species such as goldfish, rainbow trout, carp, and channel catfish make excellent models for immunology, endocrinology and ionic balance studies. Examples of some of the users for these larger species at the University of Alberta include evaluation of control of growth and hormonal regulations, immune response to parasites and biology of fish macrophages.



SNFWS V - Fish Health Management in Freshwater Aquaculture

Date: Tuesday, September 25, 2007

Time: 3:30 PM – 5:10 PM

Location: Salon 11/12

Chair: Rich Moccia

3:30 J. Lumsden

Viral Hemorrhagic Septicemia Virus (VHSV) type IV'b' Experimental Infection in Rainbow Trout and Fathead Minnows

3:50 R. Penney

Viral Haemorrhagic Septicaemia (VHS) in the Great Lakes

4:10 J. Lumsden

Flavobacterium psychrophilum Strain Heterogeneity and Antimicrobial Resistance; Implications for Management

4:30 P. Belhumeur

Options for the Control of *Saprolegnia* sp. in Freshwater Fish Species

4:50 B. Larson

Fish Health Issues in Alberta

Viral Hemorrhagic Septicemia Virus (VHSV) type IV'b' Experimental Infection in Rainbow Trout and Fathead Minnows

L. Al-Hussiney¹, E. Nagy², R.M.W. Stevenson³, S. Russell¹, K.M. Young¹, P. Huber¹, V.M. LePage¹ and J.S. Lumsden^{1*}

¹Fish Pathology Laboratory, ²Department of Pathobiology, University of Guelph, Guelph, ON, Canada, N1G 2W1;

³Fish Health Laboratory, Dept. of Molecular and Cellular Biology, University of Guelph.

The purpose of this study was to determine the effect of VHSV IV 'b' (freshwater drum isolate) on a commercial strain of Ontario rainbow trout (*Oncorhynchus mykiss*). Fish were determined to be healthy (VHSV-free) by virus isolation, tissue RT-PCR, bacteriology and histopathology. Treatment groups used (triplicate tanks of 40, ~10-12g fish) were intraperitoneal (i.p.) injection and three graded waterborne dosages that received TCID₅₀ titres of $10^{7.5}/0.1\text{ml}$, $10^{6.5}/\text{ml}$, and $10^{4.5}/\text{ml}$, respectively; with three tanks of control fish (media). Fish were housed in 60L tanks with flow through water at 12°C and three fish per tank were sampled weekly. Morbidity, mortality, histopathology for VHSV, RT-PCR on tissues, and virus isolation on EPC cells were performed. Virus was isolated from all groups of infected fish for up to 38d post-infection. Mortality was minimal and morbidity peaked 15-20d post-infection. Gross lesions included exophthalmia, splenomegaly, mild petechiation and serosanguinous coelomic fluid. Smaller groups (10-15) of fathead minnows (*Pimephales promelas*), a common baitfish in Ontario, were also infected (i.p., waterborne and control) and significant morbidity and mortality were noted.

Viral Haemorrhagic Septicaemia (VHS) in the Great Lakes

Rod Penney*

Aquatic Animal Health Division, Canadian Food Inspection Agency, Ottawa, ON

The Canadian Food Inspection Agency (CFIA) in partnership with Fisheries and Oceans Canada (DFO) is collaborating with the Ontario Ministry of Natural Resources (OMNR) and Quebec's Ministère des Ressources naturelles et de la Faune (MRNF) to monitor Viral Hemorrhagic Septicemia (VHS) in Canadian portions of the Great Lakes Basin. Recent detections of VHS in the Great Lakes have prompted Canada to undertake surveillance to gain a better understanding of the geographic occurrence of the virus and to identify affected species. Surveillance will also provide the scientific basis for the development of joint VHS management strategies involving federal and



provincial governments and the United States. Elements of these strategies include movement controls, public and stakeholder education, and industry biosecurity. In May 2007, CFIA hosted a VHS workshop with assistance from DFO, OMNR, University of Guelph, and Ontario Ministry of Agriculture Food and Rural Affairs (OMAFRA) to initiate stakeholder education. Workshop objectives included updating stakeholders on the current science of the VHS virus (VHSV) and scoping present and possible future biosecurity measures to slow the spread of VHSV. The CFIA and DFO are continuing to work together to assess the implications of VHS for Canada. A plan is being developed, in consultation with the provinces, to address domestic and international VHS issues, including research, surveillance, and diagnostic testing. The CFIA is also working closely with the United States to address these issues.

***Flavobacterium psychrophilum* Strain Heterogeneity and Antimicrobial Resistance: Implications for Management**

S. Hesami¹, L.L. Brown², J.S. Lumsden^{1*} and J.I. MacInnes³

¹Fish Pathology laboratory, ²Department of Pathobiology, University of Guelph, Guelph, Ontario Canada N1G 2W1;

³NRC Institute for Marine Biosciences, 1411 Oxford St., Halifax, NS B3H 3Z1.

Strain heterogeneity and antimicrobial resistance was determined for 75 isolates of *F. psychrophilum* from cases of coldwater disease in Ontario, Canada. The isolates were morphologically and serologically homogeneous but two distinct biovars were identified by API-ZYM. A 194 bp PCR product was generated from all Ontario isolates that was digested individually with MaeIII or with MnlI. PCR-RFLP analysis demonstrated four restriction patterns and correlations between biovar I and digestion with MaeIII (lineage II); and between biovar II and digestion with MnlI (lineage I). Sequence analysis of the 194 bp ribosomal RNA fragment revealed that there are at least six different PCR-RFLP clusters of Ontario *F. psychrophilum* and in some cases two heterogeneous strains were isolated from the same outbreak. To determine antimicrobial resistance patterns of these *F. psychrophilum* strains, the minimum inhibitory concentrations (MICs) were assessed using TREK SENSITRE susceptibility plates for aquaculture. The MIC for the majority of the strains to three approved antibiotics (trimethoprim/sulfa-methoxazole, sulphadimethoxine/ormetoprim and oxytetracycline) were high. In contrast, the MIC for the majority of strains to florfenicol was low. The implications of these findings for the management of coldwater disease, as well as the strategies that have been used in Ontario, are discussed.

Options for the Control of *Saprolegnia* sp. in Freshwater Fish Species

A. Faille¹, E. Boucher², D. Proulx², G. Vandenberg², P. Belhumeur^{*1}

¹Département de microbiologie et immunologie, Université de Montréal, Montréal Qc Canada H3C 3J7;

²Département des sciences animales, Université Laval, Québec Qc Canada G1K 7P4

The water mold *Saprolegnia* is responsible for devastating infections on fish in aquaculture and fish farms, and infects fish at a variety of life stages, from embryos to brood fish. Saprolegniosis is a disease characterized by visible white or grey patches of filamentous mycelium on the body or fins of freshwater fish. The oomycete *S. parasitica* is economically one of the most important fish pathogens, especially on salmon and trout species causing infections believed to be second only to bacterial diseases. It causes tens of million dollar losses to aquaculture business worldwide notably in Scotland, Scandinavia, Chile, Japan, Canada and USA.. While these infections were well kept under control with malachite green, an organic dye with a great fungicide efficacy, this simple and inexpensive compound has been banned around the world in 2002 as it has been shown to have carcinogenic and toxicological effects. This has resulted in dramatic recrudescence of *Saprolegnia* infections for which novel methods of management are indeed required. This presentation will therefore be an overview of the features of this fungus and the disease, along with the current trends, strategies and novel molecules being tested.

Fish Health Issues in Alberta

Bev Larson^{*1}

Fish Disease Lab, Fisheries Allocation and Use Branch, Fish and Wildlife Division, Alberta Sustainable Resource Development, Edmonton, AB T6H 4P2

Our focus is monitoring for fish diseases in our provincial hatcheries, including health screening of wild brood during egg collection. Some agents of concern for Alberta, which have required eradication and deterrence schemes



have been BKD & IPN, along with the usual bacterial gill disease, coldwater disease & other management challenges. Wild fish kill/morbidity investigations have implicated 'columnaris' gill infections in whitefish & tulibee in presumed 'summer-kill' conditions, *Vibrio cholerae*, and *Mycobacterium chelonae* in trout and perch lesions (respectively). In private aquaculture facilities we have seen 'Ich' to IPN, columnaris to cold-water disease. The importation of more exotic species to Alberta has raised concerns for Asian tape-worm (*Bothriocephalus aechilognathi*) from grass and silver carp, and other exotic micro-organisms. I will discuss the recent isolation of a new *Francisella* species, from moribund tilapia in an aquaponics facility. This may be a new emerging disease; similar bacteria have recently been reported from cod, in Norway and striped bass in California. I'll also provide summary data on surveillance for *Myxobolus cerebralis* in Alberta's wild trout populations, including sentinel exposures in trout streams with identified *T. tubifex* populations.



Integrated Multitrophic Aquaculture

Date: Tuesday, September 25, 2007

Time: 3:30 PM – 5:10 PM

Location: Salon 2

Chair: Shawn Robinson

3:30 T. Chopin

Up-scaling of the Seaweed Inorganic Extractive Component in an Integrated Multi-Trophic Aquaculture (IMTA) System in the Bay of Fundy, Canada

3:50 S. Cross

Sustainable Ecological Aquaculture (SEA) Systems in Coastal British Columbia – Assessing the Benefits

4:10 T. Lander

The Effects of Cuprous Oxide on Blue Mussel (*Mytilus edulis*) Larval Settlement and Its Implications for Recycling Treated Salmon Net Cages for Mussel Spat Collection in Integrated Multitrophic Aquaculture (IMTA)

4:30 N. Blasco

Breaking the Seasonality of Kelp Farming and the Implications in Integrated Aquaculture

4:50 M. Liutkus

Effects of Fines from Salmon Feed on Biodeposit Dynamics of Various Size Classes of Mussels (*Mytilus* spp.)

5:10 G. Reid

Recent Developments and Challenges for Open-Water, Integrated Multi-Trophic Aquaculture (IMTA) in the Bay of Fundy, Canada

Up-scaling of the Seaweed Inorganic Extractive Component in an Integrated Multi-Trophic Aquaculture (IMTA) System in the Bay of Fundy, Canada

T. Chopin^{*1}, R. Shea¹, M. Sawhney¹, E. Campbell¹, E. Belyea¹, S. Bastarache¹, W. Armstrong¹, J. Sewuster², R. Ugarte², P. Watson², T. Wilcox², M. Szemerda³, R. Marvin³, F. Powell³, G.K. Reid^{1,4}, S.M.C. Robinson⁴, N. Ridler¹, F. Page⁴, K. Haya⁴, L. Burrige⁴, and S. Boyne-Travis⁵

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

Integrated multi-trophic aquaculture (IMTA) is an age-old, common sense, recycling and farming practice in which the by-products from one species become inputs for another: fed aquaculture (fish) is combined with inorganic extractive (seaweed) and organic extractive (shellfish) aquaculture to create balanced systems for environmental sustainability, economic diversification and social acceptability. After several years of developing such a system at the experimental scale, we are moving to the commercial scale, presently co-cultivating salmon (*Salmo salar*), kelps (*Saccharina latissima* and *Alaria esculenta*) and blue mussels (*Mytilus edulis*) at several aquaculture sites in the Bay of Fundy, Canada. Kelp culture techniques have been modified both in the laboratory and at the aquaculture sites. The design of rafts has evolved to increase their structural resilience and facilitate seaweed deployment, growth and harvesting; no point source and edge effect from the nutrient perspective have been documented. Drying and processing techniques are being investigated based on efficiency, quality, costs, niche markets and demands for different applications. New seaweed candidate species are being contemplated to increase the inorganic



biomitigation capacity of the system. Rethinking of site design, dimensions and logistics will be key as we plan to optimize IMTA systems.

Sustainable Ecological Aquaculture (SEA) Systems in Coastal British Columbia – Assessing the Benefits

Stephen F. Cross Ph.D.*

Coastal Aquaculture Research & Training (CART) Network, Department of Geography, University of Victoria, Victoria, British Columbia, Canada V8P 1A1

Design, engineering and performance evaluations of BC's first coastal SEA-System are currently being conducted at a commercial-scale Integrated Multi-Trophic Aquaculture (IMTA) facility on the northwest coast of Vancouver Island. This paper provides a progress report of the R&D initiative in British Columbia and our vision for these systems in our future aquaculture industry. Results of our Canadian research suggest a wide range of social, technical and economic benefits associated with commercial-scale SEA-System development. The introduction of IMTA, or SEA-Systems, in coastal British Columbia could have both immediate and long-term benefits to aquaculture industry development, despite the continued pressure of environmental groups to completely eliminate open netcage practices. Viewed, in many respects as an 'organic' approach, SEA-Systems have the potential to satisfy many of the social dilemmas argued through media outlets.

The Effects of Cuprous Oxide on Blue Mussel (*Mytilus edulis*) Larval Settlement and its Implications for Recycling Treated Salmon Net Cages for Mussel Spat Collection in Integrated Multitrophic Aquaculture (IMTA)

R.K. Shaw¹, T.R. Lander^{*1}, S.M.C. Robinson¹, and J.D. Martin¹

¹Biological Station, Department of Fisheries and Oceans, 531 Brandy Cove Road, St. Andrews, N.B., E5B 2L9, Canada

The recycling of waste in aquaculture systems is the foundation for Integrated Multitrophic Aquaculture (IMTA). Many integrated systems utilize shellfish, such as blue mussels, as the extractive species, but there is an ongoing need for juveniles or "seed" to put into the IMTA system. The potential for reusing old salmon nets, treated with cuprous oxide, for blue mussel collection is of particular interest for the mussel component of IMTA. The settlement density and shell length of blue mussels was measured on newly treated (NT), previously treated (PT) and untreated (UT) collector panels, made from commercial salmon nets, to assess how mussel spat collection efficiency was affected by commercial cuprous oxide treatment. Collector units were deployed at 4 locations for approximately 5 months commencing on August 10, 2006. Significant differences were found between treatments for mean spat density (MSD) in 3 of 4 locations in decreasing order of UT>PT>NT. Reduced settlement on NT and PT panels was attributed to the inhibitory effects of cuprous oxide on mussel settlement. Although PT panels collected fewer spat than UT panels, the numbers were still adequate for commercial spat collection. Mean shell length (MSL) was not significantly different between treatments but a trend of decreased shell length in the order of NT>PT>UT was observed. Self-thinning is a possible explanation for the inverse relationship observed between MSL and MSDs. Based on these results, we feel there is a potential for recycling used salmon nets for mussel collection as PT panels continued to collect large numbers of mussel spat while inhibiting unwanted foulers with lingering antifoulant properties. In order to substantiate these results, it would be beneficial to conduct a similar trial whereby mussel spat are grown to full socking size to account for the potential drop in mussel settlement density.

Breaking the Seasonality of Kelp Farming and the Implications in Integrated Aquaculture

Nathan Blasco* and Stephen Cross

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

Integrating the culture of kelp with fish farming has been shown as a method which reduces environmental impacts. To take maximum advantage of the environmental benefits, the kelp culture would need to be in place whenever fish were within the integrated system. This would include the fall and winter when typical kelp farms are in harvesting and/or out-planting new kelp seed. The purpose of our study is to determine if kelp seed can be entered into the integrated system and effectively grow during any season of the year. To do this multiple lines seeded with *Saccharina latissima* and *Saccharina groenlandica* will be vertically suspended in the water column to a depth of



15m. The seeded lines will be entered into the farm at four month intervals throughout the year (each season) and growth will be monitored throughout each line for a full year. Growth limiting parameters such as light, nitrates, and salinity will be monitored.

Effects of Fines From Salmon Feed on Biodeposit Dynamics of Various Size Classes of Mussels (*Mytilus spp.*)

M. Liutkus^{*1,2}, S.M.C. Robinson¹, B. MacDonald² and J.D. Martin¹

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Integrated Multi-Trophic Aquaculture (IMTA) promotes sustainability by co-culturing extractive species with upper-trophic fed species (fin-fish); thereby providing additional harvestable commodities that also act as biofilters. An IMTA site in the Bay of Fundy, Canada, is making the transition from a pilot project to a commercial scale. Increasing the culture scale of extractive organic species such as blue mussels (*Mytilus edulis*) may alter local benthic dynamics. Bivalves filter out particles and either; conglomerate and egest as pseudofaeces or intestinal faeces or; digest and biodeposit them. Different diets generate different mussel biodeposits potentially affecting deposition dynamics. Preliminary findings have shown that mussels produce biodeposits with distinct morphological and compositional characteristics as a function of diet fed. Differences are minimal within small mussel sizes (average mussel lengths 25mm), but become more significant as mussel lengths increase (50mm to 75mm). Regardless of their diet, small mussels will produce biodeposits that can disperse over a greater area than produced by larger mussels. In contrast, larger mussels produce biodeposits that may settle near field. Implications of the biodeposit dynamics and the scale of loading on the net nutrient recovery of blue mussels at IMTA sites are discussed.

Recent Developments and Challenges for Open-Water, Integrated Multi-Trophic Aquaculture (IMTA) in the Bay of Fundy, Canada

G.K. Reid^{*1,2}, S.M.C. Robinson², T. Chopin¹, Mullen J.^{1,2}, T. Lander^{1,2}, M. Sawhney¹, B. MacDonald¹, K. Haya², L. Burrige², F. Page², N. Ridler¹, S. Boyne-Travis³, J. Sewuster⁴, M. Szemerda⁵, F. Powell⁵ and R. Marvin⁵

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⁵Cooke Aquaculture Inc., 14 Magaguadavic Drive, St. George, NB, E5C 3H8, Canada

An open-water IMTA project in the Bay of Fundy is successfully making the transition from an experimental to a commercial scale. However, several challenges need to be overcome for open-water IMTA to optimize sustainability. It is the ratio of nutrient releasing fed biomass (*i.e.* fish) to the nutrient converting biomass of co-cultured extractive species in their respective biomitigating niches that largely influence nutrient recovery efficiency; not necessarily the physical/spatial scale of any one component. Consequently, rearing extractive species at scales complementary to the upper-trophic fed species presents novel challenges. ‘Trial and error’ learning approaches are largely unavoidable, due mainly to new husbandry and site design. Appropriate culture scale of extractive species necessary to optimize nutrient recovery, and spatial deployment to facilitate husbandry and harvest access, become major design considerations. Temporal issues, such as grow-out cycles, variable nutrient loadings, seasonal growth rates, site rotation, and harvest times for multiple species, add considerable complexity. Continuous site evolution and unpredictable dynamics are typical of commercial operations and present unique challenges for model validation. Nevertheless, some modelling approaches, like Monte Carlo simulation, can generate a likelihood of outcomes based on ‘partial data’ thereby providing practical estimates until validation can occur at ‘fully evolved’ commercial sites. Such challenges cannot be thoroughly anticipated or studied in laboratory or pilot-scale projects and, consequently, emphasizes the need for scientific research and commercial development to progress in a concerted manner.



SNFWS VI - Aquaponics (Combining Aquaculture and Hydroponics) - Profits from Natural Effluent Treatment

Date: Wednesday, September 26, 2007

Time: 8:50 AM - 10:10 AM

Location: Salon 11/12

Chair: Eric Hutchings

8:50 J. Rakocy

Fish and Vegetable Production in a Commercial Aquaponic System: 25 Years of Research at the University of the Virgin Islands

9:10 M. Harston

Naturally Grown Fish and Organically Grown Fine Herbs from Tilapia Effluent

9:30 N. Savidov

Latest Canadian Aquaponics Research: Is Aquaponics a Viable Option for Fish Farmers?

9:50 D. Millar

Aquaponic Production from Trout Effluent

Fish and Vegetable Production in a Commercial Aquaponic System: 25 Years of Research at the University of the Virgin Islands

James E. Rakocy*, Donald S. Bailey, R. Charlie Shultz and Jason J. Danaher

University of the Virgin Islands, Agricultural Experiment Station, RR 1, Box 10,000, Kingshill, VI 00850 USA

A commercial-scale aquaponic system for the production of fish and vegetables was developed over 25 years at the University of the Virgin Islands (UVI). The UVI system, which has produced tilapia and a variety of vegetable crops, serves as a successful design model for the nascent aquaponics industry. The system consists of four fish rearing tanks (7.8 m³ each), two cylindro-conical clarifiers (3.8 m³ each), four filter tanks (0.7 m³ each), one degassing tank (0.7 m³), six raft hydroponic tanks (11.3 m³ each), one sump (0.6 m³), and one base addition tank (0.2 m³). The total water volume and hydroponic tank growing area are 110 m³ and 214 m². The land area occupied by the system is 0.05 ha. Treatment processes consist of aeration, solids removal, denitrification, decomposition, degassing, nitrification and direct uptake of ammonia and other nutrients by plants. The production capacity of the system is 5 mt of tilapia annually under optimum temperatures and feeding management. Production averages 580 kg of tilapia every 6 weeks and 160 kg/m³/year of rearing tank space. Examples of crop production capacity include annual yields of 1,400 cases of lettuce (24-30 heads/case) or 5 mt of basil. Enterprise budgets are given.

Naturally Grown Fish and Organically Grown Fine Herbs from Tilapia Effluent

Myles Harston

Aquaranch Industries, PO Box 658, Flanagan, Illinois 61740 USA, Email: myles@aquaranch.com

Aquaponics is the combination of aquaculture and hydroponics. With aquaponics there is a symbiotic relationship between the fish and the plants. We feed the fish and the fish nutrients feed the plants and the plants aid in cleaning the water for the fish. Aquaponics utilizes the waste from the fish as a resource rather than putting it into the environment. Aquaponics has the ability to produce high quality fish, herbs and vegetables in a relatively small area. Aquaponics can contribute to local food supplies, thus reducing the long distances that much of our food supply travels to reach the end user. AquaRanch has manufacture aquaculture products and grown fish since the mid 1980's and began working with aquaponics in 1992. We have attended Dr Rakocy's program at the University of Virgin Islands. AquaRanch has chosen to grow tilapia naturally and organic certified culinary herbs and lettuce and other garden produce. Our fish have no exposure to hormones, GMO, heavy metals, herbicides or other unnatural substances. Presently, our tilapia are sold into the Chicago market and to individuals, looking for an all



natural product, we come to the farm. We market our produce wholesale to grocery stores and we sell retail at Farmers markets.

Latest Canadian Aquaponics Research: Is Aquaponics a Viable Option for Fish Farmers?

N. Savidov^{1*}, J. Rakocy², E. Hutchings³, and M. Nichols⁴

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Aquaponics operation combines production of fish and plants in one closed system. Aquaponics became a reality in commercial agriculture in North America and around the world. A multifaceted project undertaken at Crop Diversification Centre South in 2002 is aiming to study production levels for fish and plants, food safety, marketing, and economic feasibility of commercial operations in Alberta, Canada. The project started from building aquaponics facility based on model developed by Dr. James Rakocy at University of Virgin Islands. Total volume of fish tanks is 22 cubic meters and water flow is 100 liters per minute per tank. Nile and hybrid tilapia were used for aquaculture. The fish had less than 1% mortality using only plants as a biofilter. Total fish production in 2006 was 2,815 kg with average weight of 0.718 kg per fish and 1.3 FCR. Since the beginning of the project, more than 60 crops were tested using Deep Flow Technology (DFT). The crops included long English cucumbers and tomatoes, which show with high demand to nutrient levels in hydroponic solution, and green vegetables. All tested crops responded well to aquaponics, which relies on fish waste as a major source of nutrients. Lime, potassium bicarbonate, and iron were added to the system for pH regulation and iron as a nutrient supplement on weekly basis during the first two years of operation. The additions were significantly cut down to the average one per month without affecting the yield due to improved self-regulation of the system. Tomato plants produced over 60 kg per square meters and cucumber crop produced 140 cucumbers per square meter. A separate experiment was conducted with greenhouse strawberry, cv. Albion, which was grown on aquaponic water (EC, 1.2 mS cm⁻¹, pH 6.5) using three different techniques including DFT, Nutrient Film Technique (NFT) and substrate (coconut coir). DFT and NFT grown plants performed best during the first month of production. However, the growth rates changed on the second month and the coir-grown plants performed as well as the plants grown in the other two cultures. It was suggested that nutrient limitation during the first month contributed to the lower growth rate of coir-grown plants. A robust food safety study revealed no contamination with salmonella and E. coli of aquaponically-grown produce. The aquaponic facility utilized a closed recirculating system, in which water has never been changed since the beginning of the operation in 2002. The average water losses due to evapotranspiration were 0.7% per day. It makes aquaponics the most water-use-efficient system in agricultural production.



Science and Policy

Date: Wednesday, September 26, 2007

Time: 8:50 AM - 10:30 AM

Location: Salon 2

Chair: Gregor Reid

8:50 M. Burgham

Science and Policy in Aquaculture: The Federal Perspective

9:10 F. Page

Centre for Integrated Aquaculture Science (CIAS)

9:30 R. Moccia

Ontario's Approach to the Development of Science-Based Regulatory Reform

9:50 B. Heath

The Science and Policy of Geoduck Farming in British Columbia

10:10 B. Sweeney

Science and Policy in Aquaculture: An Industry Perspective from Atlantic Canada

Science and Policy in Aquaculture: The Federal Perspective

M.C.J. Burgham

Fisheries and Oceans Canada. Aquaculture Management Directorate. 200 Kent Street. Ottawa, Ontario Canada, K1A 0E6

As the lead federal agency for aquaculture, Fisheries and Oceans Canada looks to the Aquaculture Management Directorate (AMD) to provide the horizontal management and co-ordination of the aquaculture file at the national level. AMD's mandate is to bring departmental focus and strategic direction to aquaculture development in Canada. In partial fulfilment of this mandate AMD establishes and maintains strong linkages with the department's Science Sector to ensure a sound scientific basis for regulatory and policy development and decision-making. The processes involved in scientific-based policy development can be complex however, and the inner workings of regulatory decision making may seem confusing to aquaculture stakeholders. This presentation aims to 'de-mystify' the regulatory decision making process, particularly in instances where scientific uncertainty remains. Implications on the application of science in the context of aquaculture renewal being undertaken by the federal and provincial governments are discussed.

Centre for Integrated Aquaculture Science (CIAS)

Fred Page* and Edward Kennedy

Centre for Integrated Aquaculture Science, Fisheries and Oceans Canada, 531 Brandy Cove Rd., St. Andrews, NB CANADA E5B 2L9

The Science sector within Fisheries and Oceans Canada has created Centres of Expertise (COEs) in key areas to promote innovation, effectiveness, and efficiency in the delivery of its science. The Centre for Integrated Aquaculture Science (CIAS) was created in February 2007 and it is a virtual Centre of Expertise that will incorporate staff from DFO facilities across Canada. The CIAS Secretariat, consisting of a Director, Fred Page, and Manager, Edward Kennedy, is located at the St. Andrews Biological Station. The CIAS will coordinate DFO's national aquaculture research program, identify, implement, and facilitate new research activities that address existing and emerging issues, and generate scientific knowledge in support of policies and management decisions. Research of the CIAS focuses on an integrated, ecosystem-based management framework; meaning all facets of departmental knowledge, including oceans, habitat and ecosystem science, and aquaculture production science, will be incorporated to deliver quality and unbiased scientific knowledge pertaining to aquaculture. The CIAS also will facilitate collaboration among aquaculture scientists across Canada, within an integrated research framework, to



leverage expertise, improve efficiency, and minimize duplication of activities. Communication of research results to clients, partners, and aquaculture stakeholders is an important element of the CIAS research program, and the CIAS is continuing its efforts to develop effective tools (e.g., CIAS website) that will communicate the activities of the CIAS. The structure of the CIAS as well as its recent activities and future directions will be discussed.

Ontario's Approach to the Development of Science-Based Regulatory Reform

Richard Moccia^{1*}, Steve Naylor², Gregor K. Reid³ and Quentin Day⁴

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The licensing of new cage-aquaculture facilities in Ontario has been a challenging undertaking. Several government agencies and private stakeholder groups are involved in this process, often with differing approaches and value-based decision systems for the estimation of environmental effects. In the absence of complete scientific data, government regulators are still required to make licensing decisions. Several recent initiatives have attempted to update aquaculture policy and licensing procedures, incorporating more science-based principles into the decision analysis. Most recently, a set of Harmonized Guidelines (HG) for the licensing of cage aquaculture were developed to enhance the application process. The HG have been developed around key sections such as water quality, sediment, fish ecosystems, security, physical environment, user conflicts and others. Writing teams were assigned to each section to review the state of the science and recommend decision thresholds for licensing. These criteria were then incorporated into a decision support tool (DST), to bring a more objective, quantitative and transparent approach to the licensing process. The DST guides reviewers through the appropriate decision analysis pathways, ensuring consistency in the evaluation of siting criteria, and provides an approach with which to address subjectivity. The HG and DST are now in a stage of public review and consultation. This presentation will review the experiences of this approach to policy reform in Ontario.

The Science and Policy of Geoduck Farming in British Columbia

B. Heath^{1*} and A. Castledine²

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²Ministry of Agriculture and Lands, Aquaculture Development Branch, 1st Floor, 808 Douglas St. Victoria, BC. V8W9B4

Interest in geoduck farming began in British Columbia in the early 1990's. Through cooperation between the Province and, Fisheries and Oceans Canada, the first sub-tidal, pilot-scale farm was approved in 1996; the results of the pilot to determine economic feasibility and inform policy development prior to further commercial initiatives. The pilot showed that sub-tidal geoduck farming could be commercially successful. Policies for access to sub-tidal growing areas were developed between the two governments culminating in the offer of ten sites in 2006. Only one of the sites has been tenured and licensed, and it is still not in operation. The B.C. presentation will describe this history and identify some of the reasons for lack of progress.



Science and Policy in Aquaculture: An Industry Perspective from Atlantic Canada

R. Sweeney

SIM Corp. 103 Milltown Blvd. PO Box 52 St. Stephen, N.B. CANADA E3L 2W9

The aquaculture industry in Atlantic Canada is undergoing a transition. Recent consolidation of the industry and major expansions into Newfoundland waters has provided an impetus to re-examine the fit between science and aquaculture policy. Site licensing, performance based standards (PBS), and ecosystem based management all rely on scientific information for decision making. The type of data required, the amount needed and, what should or should not be legislated; is evolving. Complexities result largely from discrepancies between what data collection is possible and what is practical. Differing Provincial interpretations on what is acceptable and consequent data requirements, introduce further complexity. A brief overview of the most pressing issues and suggestions for future developments on the liaison between science and policy are discussed.



Contributed Papers in Aquatic Animal Health and Nutrition

Date: Wednesday, September 26, 2007

Time: 8:50 AM - 10:30 AM

Location: Salon 3

Chair: TBA

8:50 R. Moccia

Formulation of Salmonid Fish Feeds with High Dietary Levels of Plant Ingredients: Effects on Waste Outputs and Potential Environmental Impacts of Fish Culture Operations

9:10 C. McGowan

The Search for Genetic Markers Associated with Disease Resistance in Two Strains of Arctic Charr

9:30 C. Dagenais

Utilisation of White Corn Gluten and Lysine Supplementation in Fish Feed: Impacts on the Colouration of Rainbow Trout Flesh (*Onchorynchus mykiss*)

9:50 E. Friesen

Lowering Flesh Organic Contaminants in Farmed Atlantic Salmon While Concurrently Maintaining Levels of EPA and DHA through Dietary Modifications

10:10 A. Yazdanpanah

Cold-Inducible Proteins of *Flavobacterium psychrophilum*, the Cause of Coldwater Disease

Formulation of Salmonid Fish Feeds with High Dietary Levels of Plant Ingredients: Effects on Waste Outputs and Potential Environmental Impacts of Fish Culture Operations

D.P. Bureau¹ and R.D. Moccia^{2*}

¹ Fish Nutrition Research Laboratory, Department of Animal and Poultry Science, University of Guelph, Ontario, Canada N1G 2W1

² Aquaculture Centre, Department of Animal and Poultry Science, University of Guelph, Ontario, Canada N1G 2W1

Due to scrutiny over their potential environmental impacts, fish culture operations are increasingly receptive to various approaches to managing waste outputs. Accumulation of solid (undigested) organic matter in the hypolimnion, which may lead to high biological oxygen demand (BOD) with concomitant reduction of dissolved oxygen (DO) levels, is arguably the primary concern for aquafarms in temperate, freshwater lakes. Another concern is the excretion of phosphorus (P) in chemical forms that can potentiate algal proliferation in some circumstances. Increase use of certain plant ingredients in feeds has the potential to significantly alter the amount, composition, and characteristics of fecal and feed waste released by aquaculture operations. Contrary to popular belief, some plant ingredients, such as corn gluten meal and soybean meal, are actually highly digestible and allow the manufacture of feeds producing very low amounts of waste output. The main issues remain with using other feed ingredients which are rich in indigestible, non-starch polysaccharides (NSP) and phytate-P. Various processing methods have been evaluated and many have been shown to be cost-effective for improving ingredient digestibility and minimizing waste outputs. Dietary manipulations have also been shown to affect the physical "stability", density (sinking speed), particle size and BOD of solid fecal wastes produced by fish. A better understanding of these processes will enable improved farm operations and more effective monitoring protocols to assess environmental responses.



The Search for Genetic Markers Associated with Disease Resistance in Two Strains of Arctic Charr

Colin McGowan^{*1}, Evelyn Davidson², Jonathan Lucas¹, Michael Edwards¹, William Davidson² and John Rose¹

¹Icy Waters Arctic Charr Limited, Whitehorse, Yukon

²Department of Molecular Biology and Biochemistry, Simon Fraser University, Burnaby, B.C.

In this study, several backcross lines, each consisting of ten full sibling families, were subjected to a furunculosis challenge. Each line was generated by crossing hybrids of the Nauyuk Lake and Tree River Arctic charr strains with one of the respective purebred lines. Tissue samples were collected from sensitive and resistant individuals to search for genetic markers associated with furunculosis resistance. DNA fingerprinting and pedigree analysis were used to separate a selected population into full sibling families. Two of the families were selected for linkage analysis and genome wide scans using amplified fragment length polymorphisms (AFLPs) and microsatellite markers. Several linkage groups with associations for furunculosis resistance were identified. Although markers were predominantly AFLPs, comparative analysis with other genetic maps for Arctic charr provided several new microsatellite markers with the potential to identify furunculosis resistance in the Icy Waters populations. Last fall, genetic markers believed to be associated with growth rate and disease resistance were used in marker-assisted selection trials. The products of this selection are currently being tested to see if a genetic improvement in furunculosis resistance was achieved.

Utilisation of White Corn Gluten and Lysine Supplementation in Fish Feed: Impacts on the Colouration of Rainbow Trout Flesh (*Onchorynchus mykiss*)

G. Dagenais^{*1}, GW. Vandenberg¹, É. Proulx¹, DP. Bureau², and M. deFrancesco²

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²Guelph University, Centre for Nutrition Modelling, Department of Animal & Poultry Science Guelph Ontario N1G 2W1

The main goal of this study was to test the use of white corn gluten in experimental diets to counter the problems associated with the undesirable colouring of trout flesh. We monitored the differences in colouring of the fish flesh having received diets containing various xanthophyll concentrations by colorimetric techniques (CIE L*a*b*) and HPLC. We also supplemented feed with lysine to see if we can improve carotenoid binding in fish flesh via protein deposition. Three different types of xanthophylls (astaxanthin, lutein and zeaxanthin) were detected with the HPLC analyses in feed, flesh and feces. The fish showed a better retention of astaxanthin ($p < 0.05$) when they were fed with lysine-supplemented diet. There are also significant differences in flesh colour according to the type of corn gluten (yellow or white) present in fish feed ($p < 0.05$). A significant effect of the fish weight on the yellow flesh colour (b*) with colorimetric analyses ($p < 0.001$) was shown. The results of this study will enable researchers and aquaculturists to gain a better theoretical understanding of the pigmentation of trout flesh as a result of the effect of lysine, while promoting the use of white corn gluten as a low-polluting, non-colouring, high protein feed ingredient.

Lowering Flesh Organic Contaminants in Farmed Atlantic Salmon while Concurrently Maintaining Levels of EPA and DHA through Dietary Modifications

E. Friesen^{*1}, D. Higgs², M. Ikonomou³, S. Balfry², B. Skura¹, T. Farrell^{1,2}, J. Oakes², G. Deacon⁴, J. Mann⁵, A. Gannam⁶, and A. Oterhals⁷

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³ Department of Fisheries and Oceans, Institute of Ocean Sciences, 9860 West Saanich Rd. Sidney, British Columbia, V8L 4B2.

⁴ Skretting Canada Ltd. 1350 East Kent Ave. Vancouver, British Columbia, V5X 2Y2

⁵ Ewos Canada Ltd. 7721-132nd Street, Surrey, British Columbia, V2W 4M8

⁶ US Fish and Wildlife Service, Abernathy Fish Technology Center, 1440 Abernathy Creek Road, Longview WA. 98632, USA

⁷ Norwegian Institute of Fisheries and Aquaculture Research, Kjerreidviken 16, N-5141 Fylingsdalen, Norway



Since Marine fish oil (MFO) and to a lesser extent, fishmeal (FM), are considered to be the main sources of POPs in cultured fish, we conducted a feeding trial that examined the use of alternative lipid sources (flaxseed oil, poultry fat, crude super de-gummed canola oil, activated carbon treatment anchovy oil) and protein sources (canola concentrate meal, soy concentrate meal and poultry by-product meal) in Atlantic salmon feed with the objective of dramatically reducing flesh POP concentrations while concurrently maintaining flesh levels of fatty acids of importance to human health viz., eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Triplicate groups of Atlantic salmon (mean initial wt 84g) were fed one of 7 dietary treatments for 24 weeks, followed by a 12-week washout period with fish oil based diets. At the end of phase 1, fillet fatty acid compositions were found to reflect those of the dietary treatments, and the levels of EPA and DHA were almost restored completely by the end of phase 2 when the fish were returned to the fish oil- based diets. Flesh levels of POPs were lowered significantly by feeding the salmon the alternative lipid based-diets. The significance of the preceding findings to the consumer and the salmon aquaculture industry will be discussed.

Cold-Inducible Proteins of *Flavobacterium psychrophilum*, the Cause of Coldwater Disease

Arman Yazdanpanah^{*1}, Paul Huber¹, Janet I. MacInnes² and John S. Lumsden¹

¹Fish Pathology Laboratory, ²Department of Pathobiology, University of Guelph, Guelph, ON, Canada, N1G 2W1

Coldwater disease is a worldwide problem in temperate freshwater aquaculture and is caused by the Gram-negative bacterium *Flavobacterium psychrophilum*. There are numerous manifestations of this organism including tail rot/peduncle disease, necrotic myositis, osteochondritis/scleritis and rainbow trout fry syndrome. As the name 'coldwater disease' suggests, low water temperatures are characteristic of all of the presentations. Our hypothesis is that there will be differential expression of proteins from a given strain of *F. psychrophilum* grown at 8°C vs. 18°C and that these proteins may be associated with virulence. 2DPAGE is used to examine spot-pattern differences of two strains (ATCC and Ontario) of *F. psychrophilum*. The spots of greatest interest are those that are only present at 8°C or those that are more prominent at 8°C vs. 18°C. So far the conditions for 2D-PAGE of *F. psychrophilum* have been established and the identification of spot differences is being evaluated using SYPRO- and Coomassie-stained gels and densitometric quantification. Spots will be manually excised from gels for analysis by mass spectroscopy (MALDI-tof) and MS/MS (tandem mass spec.) for internal amino acid sequence.

Conference Plenary II

Date: Wednesday, September 26, 2007

Time: 11:00 AM – 12:00 PM

Location: Salon 11/12

10:30 D. Anderson

Public Concerns and Policy Development for Aquaculture



Poster Abstracts – Aquaculture Canada^{OM} 2007

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

Changes in TMA as Quality Indices in Orange-Spotted Grouper, *Epinephelus coioides* during Ice Storage and Relation between Microbial Count

Seraj Bitar¹, Hossein Najafzadehvarzi², Parita Kochanian¹, Ali Fazlara² and Hossein Pashazanoosi¹

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Most marine fish contain a substance called trimethylamine oxide (TMAO). Certain bacteria that occur naturally on the skin and in the guts of fish and in sea water can break down TMAO to trimethylamine. The amount of TMA produced is a measure of the activity of spoilage bacteria in the flesh and so is an indicator of the degree of spoilage. In this study Changes in TMA as Quality Indices in Orange-spotted grouper, *Epinephelus coioides* and Relations between Bacterial count during ice storage at 18 days were studied. trimethylamine (TMA) values of fishes increased very slowly at first days, whereas during last days of storage higher values were obtained reaching a final value of 12/46 mg/100g (day 18). Level of TMA at first days and last days, showed significant difference ($p < 0/05$). Bacterial count specially psychrophilic bacteria were increased during storage, whereas mesophilic bacteria count decreased at day 15 of storage. According to the linear regression, TMA showed good relation between psychrophilic bacteria and storage days ($R = 0/98$). At end of the storage days psychrophilic bacteria count reached above 7/72 log cfu/g. these value showed that fishes unconsumption for human at day 18th when total bacterial count reached above the limit determined by ICMSF.

Lipid and Glycogen Content as Indices of IMTA Mussel Condition

T. Blair^{*}, S. Robinson, T. Lander, J. Castell, L. Burridge and M. Lyons

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

Integrated multi-tropic aquaculture (IMTA) is an advanced food production technology where blue mussels are grown in conjunction with salmon farming operations to act as an additional crop and an organic biofilter within the culture system. Studies have shown that IMTA mussels grow faster than mussels at nearby reference sites. Since this suggests that IMTA mussels may have higher condition factors, the objective of this study was to examine the relative condition (via lipids and glycogen) of IMTA mussels and wild or traditionally cultured (i.e. reference) mussels. We also examined differences in fatty acid content between IMTA mussels and reference mussels. Lipid levels in IMTA mussels were not significantly different from reference sites when sampled in November, but were significantly higher than two of three reference sites when sampled in February ($p < 0.05$). Significant differences in glycogen content were found, with one IMTA site having the highest content overall (957 $\mu\text{mol/g}$ dry tissue). These results suggest that IMTA mussels retain energy stores during winter, likely due to nutrients associated with the salmon farm. Significant differences in levels of certain fatty acids were found at both sample dates, suggesting that fatty acids may be useful biomarkers to differentiate mussels grown in different environments.

Stress in Eastern Oyster (*Crassostrea virginica*)

Daria Gallardi¹ and Cyr Couturier^{*1}

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The Eastern oyster (*Crassostrea virginica*) is an important commercial species in the Maritimes and is a candidate for aquaculture in Newfoundland. The present study evaluated the stress responses of farmed oysters held under different storage conditions: 1) fed, 2°C water, 2) unfed, 2°C water, 3) fed, 10°C water, 4) unfed, 10°C water, and 5) air storage (2-4°C)(control). Stress levels were measured using the Neutral Red Retention Assay (NRA), and by measuring condition index and glycogen content of the oysters in each treatment as independent indices of stress. Glycogen content was not related to Neutral Red Retention times, suggesting different stress response mechanisms from these indices. Condition index did not appear to be related to stress levels based on NRA or glycogen. Oysters lost weight in all treatments however the levels of stress based on NRA were lower in all treatments compared to



control animals. Wet storage appears to reduce the stress response in oysters, with the least stress experienced in oysters held in conditions most closely approximating ambient seasonal temperatures (2-4°C). The NRA appears to be a useful indicator of stress for post-harvest holding conditions in Eastern oysters, however further studies on the seasonality of the response are needed to confirm these findings.

Are Blood Eosinophil Levels as a Parasite Performance in Beluga Juveniles (*Huso huso*)

N. Haghi ^{*1}; M. Bahmani ²; A. Savari ¹; M. Mohseni ²; H. Pasha Zanoosi ¹; M. Pourdehghan ²; M. Peike Mosavi ¹; A. Nateghi ¹; R. Zare ¹ and M. Yooneszade ¹

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The non-specific and specific responses of immune system have a key role for the survival in vertebrates. Eosinophil, also as a part of this system, reacts against parasites. It is reported that increase in percentage of eosinophil (higher than approximately 2-3%) can be a sign for parasitic diseases. In present study, 195 juveniles of beluga, *Huso huso* (initial weight 31.58±2.42g) were treated with five levels of methionine (0, 0.5, 1.0, 1.5 and 2.0 percent of diet weight) in triplicate for four months. Blood samples were collected from three fish for each treatment at the end of 2nd, 3rd and 4th month, three smears were prepared for each blood sample (Giemsa method) and percentage of eosinophils was calculated by leukocyte differential count method. The range of eosinophils was 6.20±1.99 to 26.87±10.74 percent of total leukocytes. Although there is no significant difference between treatments ($P>0.05$), but amount of eosinophils were considerably high. Diagnostic tests for parasites include macroscopic and microscopic investigations of skin, gills, gut and gut contents (wet mount method) as well as blood smears didn't show any parasite. The results of these study show that high level of eosinophils isn't an immune response to parasites. So, it may be a normal characteristic of this species or may caused by some other conditions include environmental factors (non-parasitic), genetic characteristic or age related factors.

Feed Attractants for Juvenile Chinook Salmon (*Oncorhynchus Tshawytscha*) Prepared from Hydrolysates of Pacific Hake (*Merluccius productus*)

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Soybean meal has been used extensively in aquaculture diets to help lower feed ingredient costs, but it also produces organoleptically unfavorable conditions for several species. The use of feed attractants could help mask the undesirable properties found in soybean meal and enhance the palatability of the diet. The objective of this study was to assess the feasibility of utilizing Pacific hake hydrolysates, made using Alcalase and Flavorzyme enzymes, to be used as flavor attractants. A 5-week palatability feeding trial was conducted with hake attractants and commercial feed attractants (krill and screen I & II) on Chinook salmon, all in soy-based diets, compared with a non soy-based control diet. The Alcalase hydrolysate, krill, and screen I attractants provided significant increases to weight gain, feed efficiency ratio, and specific growth rate when compared with the negative soy-based control. The percent of feed wasted of feed dispensed was significantly lowered with the use of these three dietary attractants. The results demonstrate the potential for Pacific hake, an inexpensive product, to be converted to a high quality feed attractant to help minimize the problems associated with soybean meal use in aquaculture.

Immunohistochemical Localization of Two Putative Defense Lectins, Rainbow Trout Ladderlectin and Intelectin in Healthy and Diseased Rainbow Trout

S. Russell, K. M. Young, M.A. Hayes, J.S. Lumsden^{*}

Fish Pathology Laboratory, Department of Pathobiology, University of Guelph, Guelph, ON, Canada, N1G 2W1, University of Guelph.

Previously, we identified two rainbow trout plasma lectins (ladderlectin and intelectin) capable of binding various Gram-negative bacteria and chitin. In the present study, we further describe the pattern of immunohistochemical



tissue localization of ladderlectin (RTLL) and intelectin (RTInt) in healthy rainbow trout, and describe alterations in this pattern in rainbow trout infected with a variety of infectious agents. RTLL and RTInt proteins were localized to individual cytoplasmic granules within epithelial cells of the gill and intestine in healthy rainbow trout. Both proteins were clearly demonstrated within cytoplasmic granules of polymorphonuclear granulocytes, and macrophages/monocytes found in blood vessels, hepatic sinusoids, renal interstitium, mucosal epithelium and sub-mucosa of normal tissue. In tissue from diseased rainbow trout, there was an overall relative increase in both lectins when compared to healthy controls. RTLL and RTInt proteins were detected in extra-cellular spaces surrounding bacteria, fungi and protozoa and increased distribution of both proteins was demonstrated along mucosal surfaces and within inflammatory leukocytes in infected tissues. The findings demonstrate a role for both RTLL and RTInt as innate defense molecules in the immune system of rainbow trout.

An Individual Mating Pair Comparison of Egg Quality Based on Gamete Collection Method in Atlantic Cod (*Gadus morhua*)

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The importance of a reliable and readily available high quality gamete supply is imperative for a family based genetic selection program. The ability to successfully collect eggs using paired mating and strip spawning for Atlantic Cod was demonstrated by the Aquaculture Collaborative Research and Development Program's cod broodstock project in 2006. Comparisons were based on groups of broodstock and were compared to gametes collected from communally spawning cod and no significant difference was observed in egg quality between the methods. Based on these data, it was apparent that the necessity to investigate gamete collection method using focused comparisons of single cod pairs in both settings is highly important to have a complete understanding of the effect of method on gamete quality and potential maternal/paternal effects. This past spawning season, 10 cod pairs were both paired mated and strip spawned and egg quality was assessed based on fertilization rate, egg diameter, and blastomere normality. Results indicate that in 80% of the pairs, egg fertilization rates were higher in paired mated individuals over the stripped pairs. Egg diameters were not significantly different between collection methods. Further details on egg quality parameters will be presented based on collection methods for individual cod pairs.

Primary and Secondary Antibody Responses to Immunisation with Single Antigens and *Aeromonas salmonicida* Bacterin in Atlantic Salmon, *Salmo salar* L.

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An important property of an effective vaccine is its ability to establish immunological memory. In this 25 week study, we compared primary and secondary antibody responses of individually tagged juvenile salmon immunised with three non-adjuvanted preparations: i) recombinant TapA protein, an *A. salmonicida* pilus protein that is a putative thymus-dependent antigen with memory-inducing potential; ii) lipopolysaccharide (LPS) purified from *A. salmonicida* (A449), a thymus-independent antigen of poor memory-inducing potential; and, iii) bacterin, the basis of most commercial vaccines, a suspension of formalin-killed *A. salmonicida* (A449) cells cultured under iron-restricted conditions. ELISA results showed that primary antibody responses to rTapA or LPS were synchronized while bacterin responses were individually variable. Immunological memory followed secondary immunisation with rTapA, but not LPS, which suggests that thymus-dependent and thymus-independent designations apply to these antigens. The immune response of bacterin-immunised fish to *A. salmonicida* lacked evidence of memory and was dominated by antibodies produced against LPS. This suggests that bacterin-based vaccines, while capable of producing short-term immunity to *A. salmonicida*, may not be able to stimulate immunological memory for adequate long-term antigen recognition. The study highlights the need to ensure that bacterin preparations are supplemented with thymus-dependent antigens capable of stimulating immunological memory.



The Pathways and Effects of Atlantic Salmon Farm Nutrient Enrichment within an Integrated Multi-Trophic Aquaculture System (IMTA) in the Bay of Fundy, Canada.

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Nutrition of the marine environment has gained considerable attention in recent decades with expanded anthropogenic activities and development in coastal zones. Aquaculture is one potential source of nutrient enrichment. In the Bay of Fundy, Canada, blue mussels (*Mytilus edulis*) and kelps (*Saccharina latissima* and *Alaria esculenta*) have successfully utilized nutrients (both organic and inorganic) from co-cultured Atlantic salmon (*Salmo salar*) resulting in increased growth rates and nutrient recovery. However, pathways and physiological effects (reproduction and growth) of salmon farm nutrients on targeted and non-targeted species within the localized ecosystem are not clearly understood. To investigate these issues, two additional trophic levels are proposed for this project: 1) detritivores, represented by the clam worm, *Nereis virens*, and 2) predators/scavengers, represented by the green sea urchin, *Strongylocentrotus droebachiensis*, and the invasive Japanese skeleton shrimp, *Caprella mutica*. Such research is essential for model development of nutrient recovery and efficiency of commercial IMTA sites. These research results will ultimately improve our understanding of nutrification pathways and effects within IMTA sites and coastal ecosystems.

The Effect of Lysine Requirement on Growth of Beluga (*Huso huso*) Juvenile at One Level of Carnitine Supplementation

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In this study, effect of Carnitine and Lysine supplemental, were carry out in *Huso huso* juvenile feeding, experimental in 8 week experimental duration in International Sturgeon Fish Research Institute. 165 juvenile Beluga (mean weight 20±0.5 g) obtained from local supplier and fed with live food for 2 weeks in 15 fiberglass tanks (500 l), during the experiment period, fish fed with 5 treatments of 5 different Lysine levels (0, 0.75, 1.5, 2.25, 3%) at a constant dietary Carnitine level (600 mg/kg) in 3 replicate (4% of body weight & three times a day). Initial and final sampling applied and samples (3 fish from each treatment) sent to laboratory for further analysis.

Results showed no significant variation of growth indices ($P>0.05$) among fishes fed with different lysine diets. Maximum increase in weight and condition factor in 2.25% lysine treatment found ($W = 121.2 \pm 3.7$ g, $CF = 0.37 \pm 0.015$). Feed conversion rate, specific growth rate, feed efficiency, protein efficiency ratio and body weight increase, were found in optimum levels in 3% lysine treatment ($FCR = 1.15 \pm 0.03$, $SGR = 3.23 \pm 0.08$, $FE = 87.06 \pm 2.85$, $PER = 0.347 \pm 0.012$ and $BWi = 454.15 \pm 23.36$). Maximum hepatosomatic indices was observed in 1.5% lysine treatment ($HIS = 5.08$). Maximum lipid content and minimum moisture were found in 1.5% lysine treatment (17.40 ± 0.79 and 64.23 ± 1.47) respectively. Maximum protein content in control treatment (59.08 ± 0.75) and Maximum ash in 0.75% lysine treatment was found. Survival rate was in total treatments estimated of 98.78%. We concluded that considering carnitine and lysine, as important essential dietary requirements for Beluga, no significant difference of growth and feeding indices observed as a result of lysine-carnitine interaction.



The Role of Temperature and Organic Degradation on the Persistence of Stable Isotopes in Cage Aquaculture Waste: Implications for Monitoring and Waste Identification Methodologies.

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The growth of cage aquaculture in the Great Lakes region of Ontario is constrained by a lack of policy and legislative framework regarding the management and mediation of the environmental effects associated with aquaculture waste. Identifying and differentiating aquaculture waste in the environment from other anthropogenic and natural sources is a first step in assessing the true benthic footprint of a cage site. In this study, we look at the potential use of the stable isotopes of carbon and nitrogen as natural tracers (i.e. isotopic signatures) which are known to persist in feed, feces and carcass musculature. Isotopic signatures of sediment samples from six different cage sites around Georgian Bay, Ontario, will be compared with the feed used at the sites. The effect of temperature on the fractionation of the isotopic signature in fecal samples will be assessed in the lab under different temperature regimens that reflect thermal variations observed in the field. Temperature-depth-time profiles are currently being recorded at each of several cage sites using vertical temperature logging strings. The data collected in this study is intended to help improve both farm management and the supporting policy and legislative reform aimed at enabling a sustainable aquaculture industry in Ontario.

Consideration of Different Levels of Methionine Amino Acid on Growth Indices and Whole Body Composition of Juveniles Cultured Beluga (*Huso huso*)

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Feeds for carnivorous fish contain large proportions of Fish meal. Increasing of feeding stimulants, such as essential amino acids(EAA) in fish diet, may be increased food intake and decreasing cost of food. we conducted this experiment due to determine effects of different levels of methionine on growth indices and body composition of juvenile sturgeon fishes (*Huso huso*) in institute of Sturgeon fishes Shahid Dadman. The basal diet contained Fish meal as protein source. five diets were formulated with 5 graded levels of methionine, (0.0, 0.50, 1.0, 1.50, 2.00g/100g diet) and amount of cystein was 0.65% in diet. Each diet was randomly assigned to triplicate groups of 195 juvenile *Huso huso* (initial weight 31.93±12.86) in fifteen 500-L circular fibreglass tanks. Fish were fed 4% of their body weight 3 times daily (07:00, 15:00, 23:00) for 10 weeks. After this time, the analyzes of growth indices and body composition showed that: weight gain(WG), Specific growth rate (SGR), feed conversion efficiency (FCE) and protein efficiency ratio(PER), condition factor(CF), hepatosomatic index (HIS) had no significant differences among the dietary treatments (P>0.05). But whole body composition analyzes showed that body composition, significantly affected by dietary methionine (P<0.05) and among this treatments, treat 4(Met=1.5%) had the highest values (Pr =%55.9±.32, Fat = %13.3±.3, Ash =% 8.4±0.2, moisture =% 66.9±0.7). this result determined the role of essential amino acids on qualitative factors of growth in juveniles cultured *Huso huso*

The Role of Detritivores in the Integrated Multi-Trophic Aquaculture (IMTA) System in the Bay of Fundy, Canada

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Integrated Multi-Trophic Aquaculture (IMTA) is an evolving aquaculture technique that is attempting to use ecological engineering principles to create more efficient, profitable and environmentally-friendly aquaculture systems. By using carefully selected trophic levels as biofilters, biological wastes from one species are recycled



through other species so that an ecosystem is created. Preliminary work in our project has demonstrated that effective biofilters can be successfully cultivated; stimulating substantial interest from both industry and resource managers. However, the IMTA system still needs to evolve to a more mature state where a higher proportion of the outputs emanating from the fed components are recycled through the unfed components.

One of the missing components to date has been detritivores that are capable of utilising some of the larger organic particulates. One of the candidates we are currently exploring is the sea urchin, *Strongylocentrotus droebachiensis*. It is a species that fits many of the IMTA selection criteria namely: fast growth, ability to be grown in high densities, important trophic niche, high commercial value, and commercially available juvenile supply. This study is designed to investigate the potential of this species for incorporation as a biofilter into the ongoing IMTA system in the Bay of Fundy.

Histogenesis of Lymphatic Structures in Juveniles in Comparison with Adults of *Acipenser stellatus* M.T. Sheibani

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Regarding to the importance of defensive organs and tissues against many pathogens, which these species are encountered with, this study was carried out on the spleen and gut associated lymphatic tissues of five adults and twenty juvenile sturgeons. The specimens were fixed in Buin's fluid, paraffin blocks were sectioned for six microns and stained with hematoxylin and eosin. The results showed that in juveniles from the first week onwards the spleen as a pyramidal organ developed rapidly, though with no traces of distinguishable white pulps. At day 32 some evidences of gathering lymphocytes forming white pulps and at day 40 a thin capsule and some delicate trabeculae were observed. Although, the gut associated lymphatic tissues were not yet well developed until this day. In adult fish, the spleen possessed a well-developed capsule with distinguishable white and red pulps. In red pulp many sinusoids containing large macrophages were present. The gut associated lymphatic tissues were mainly localized in intestines, as the form of large lymphatic follicles and diffuse lymphatic tissues. This arrangement and also production of too many lymphocytes by these organs and tissues would provide a strong defensive barrier against parasites and many other pathogenic organisms in different fish diseases.

Managing Mussel, *Mytilus* spp. Seed Health: The Effect of Brine, Lime and Acetic Acid Antifouling Treatments and Transport on Mussel Seed Performance

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Transferring mussel seed from collection sites to grow-out sites can subject seed to unique and multiplicative stressors (e.g. long transport times and treatments for mitigating the spread of marine invasives) that could compromise the health and subsequent performance of the seed. Batches of mussel seed (20*3 replicates) were subjected to the following antifouling treatments, either before (30-s seawater rinse or no rinse), or after a 15-h simulated storage/transport period: 4% lime (fresh water solvent), 4% lime (salt water solvent), 4% acetic acid, or 300 ppt brine (30-s. dip). Seed was then placed in re-circulating raceways and the number of mussels attached via byssal threads was determined following 24, 48 and 72 hrs. Seed treated with lime (fresh or salt), or acetic acid, that was not rinsed prior to transport/storage, had the poorest performance (lowest survival and attachment). Acetic acid was the most potent treatment with rinsing still resulting in significantly reduced attachment. Brine treatments did not differ significantly from the control. Brining offers the most flexibility, without compromising early performance, however, its efficacy, with respect to mitigating the spread of potential marine invasives, needs further study. Future research will address the long-term performance of seed exposed to such treatments.



The Effects of Rearing Density on Growth Performance and Food Conversion Ratio of Siberian Sturgeon (*Acipenser baeri* Brandt)

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This study was carried out to evaluate the effects of stocking density on total and differential leukocyte number in Siberian sturgeons (*Acipenser baerii*). Three years old experimental fish were with an average weight of 460±90g were reared at five densities [6, 9, 12, 15 and 18 fish per 500-L fiber-glass tanks (3-9 kg/m²)] for an 8-week period. To examine the leucocytes level changes, blood sample of 1/3 tanks population were analyzed in first and end of study period with prepare 3 blood smear of each sample. The results show that lymphocyte and neutrophyle levels in the high stocking density treatment were significantly (P<0.05) lower and higher than other treatments, respectively. No significant difference was found in monocyte and eosinophyle percentage among the experimental treatment. These results demonstrated that stocking density caused significant increase in lymphocyte and significant decrease in neutrophyle level in Siberian sturgeon. Significant flocculation in lymphocyte and neutrophyle levels could be related to chronic stress caused due high stocking density treatment.

The Effects of Rearing Density on Differential Leukocyte Count of Siberian Sturgeon (*Acipenser baeri*)

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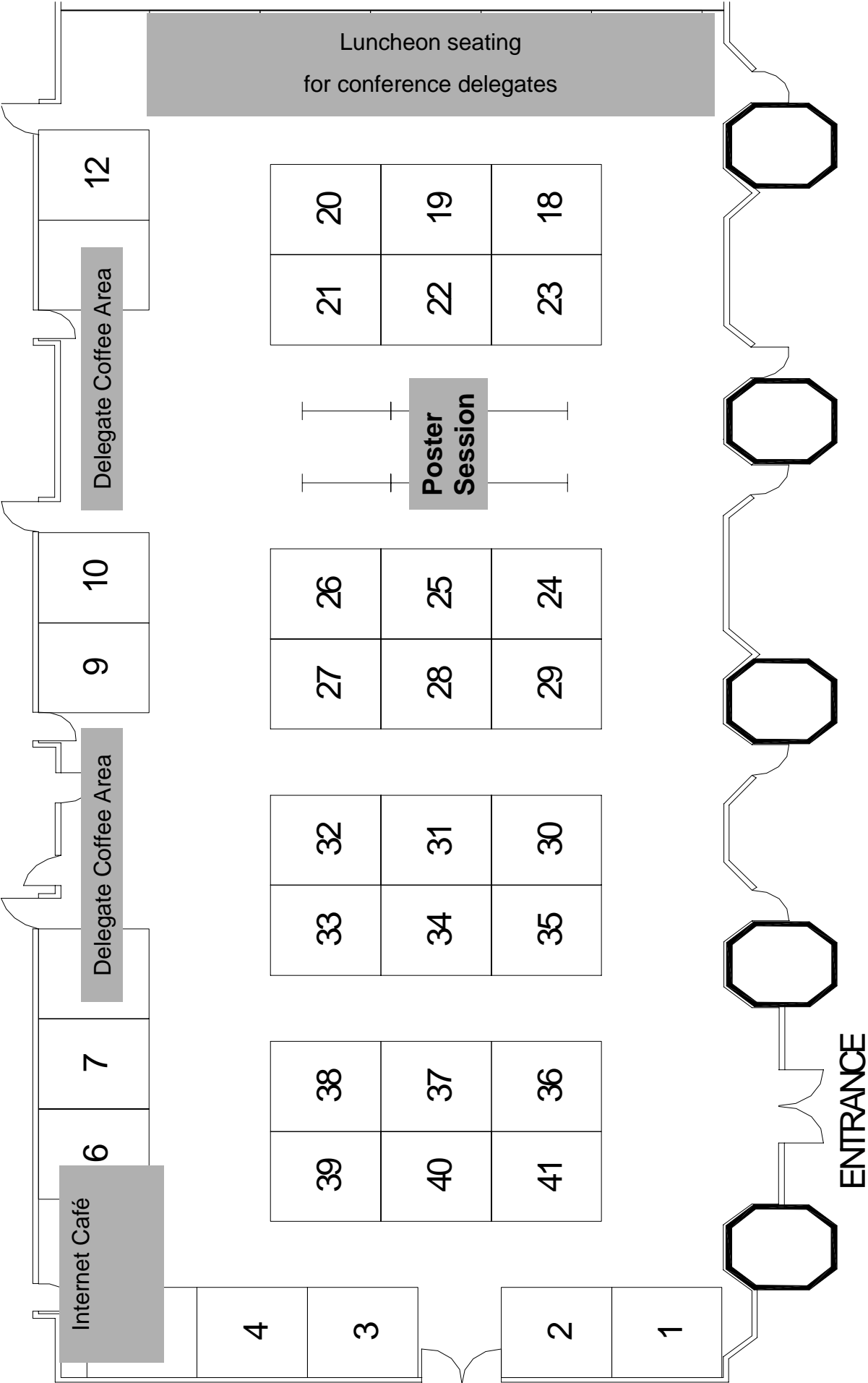
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