Direction : DRV/RA
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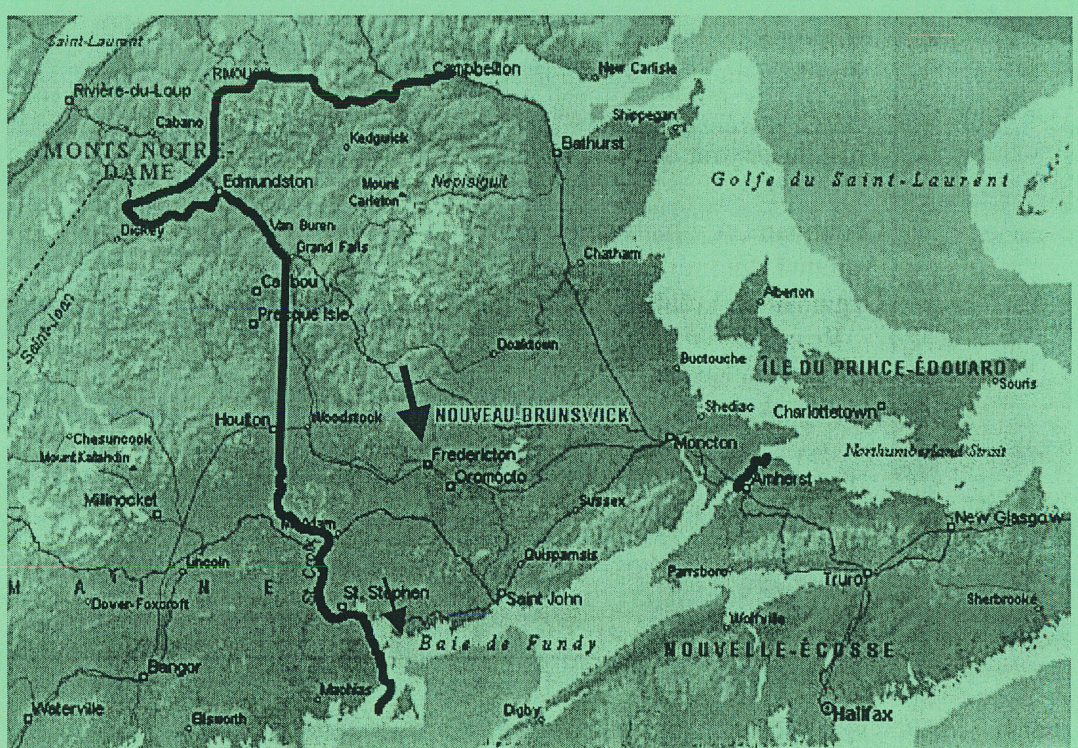
Auteur : J. Mazurié

Juin 2003 - R.INT.DRV/RA/LCB /2003-03

Ifremer

Rapport de mission
AQUANET Forum
Fredericton, New Brunswick, Canada, 16-18 juin 2003
&
Visite à la station biologique de St Andrews New Brunswick, Canada, 19 juin 2003



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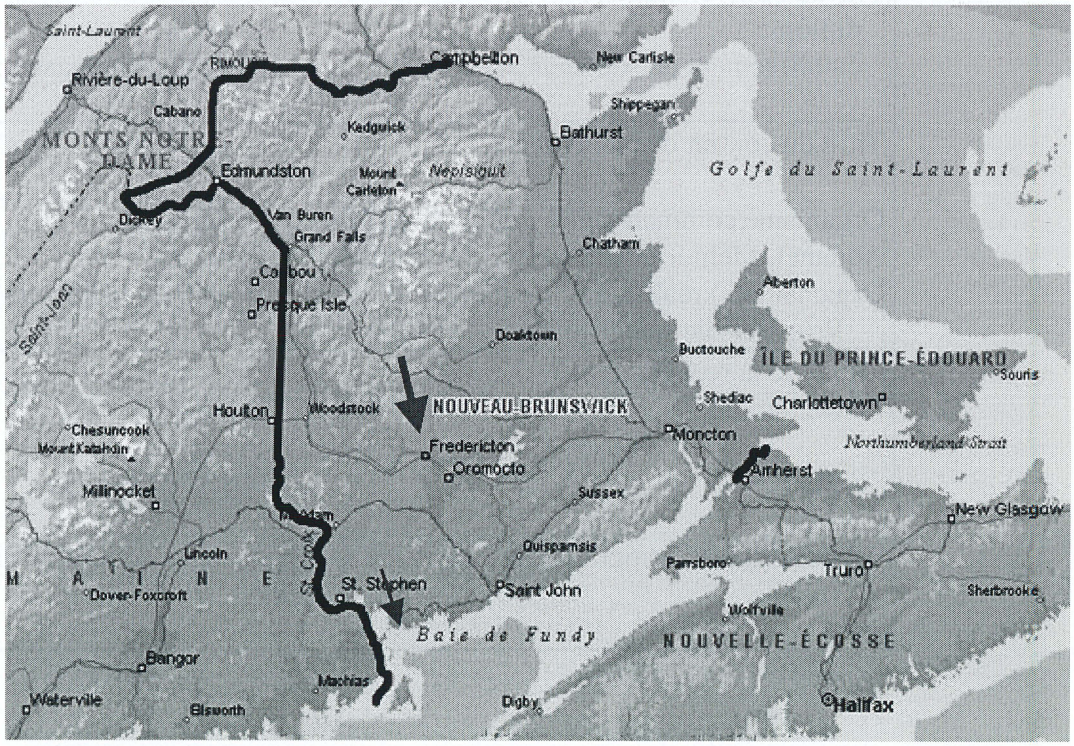

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Report of mission to Aquanet forum, Fredericton, New Brunswick, Canada, 16-18 june 2003

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Travaux universitaires :

diplôme : discipline :

établissement de soutenance : année de soutenance :

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Organisme commanditaire : nom développé, sigle, adresse
Aquanet, Memorial University, Newfoundland, Canada
Organisme(s) réalisateur(s) : nom(s) développé(s), sigle(s), adresse(s)
Responsable scientifique :

Cadre de la recherche :

Programme : Convention :

Projet : Autres (préciser) :

Campagne océanographique : (nom de campagne, année, nom du navire)

Résumé :
Parmi les centres d'excellence élaborés pour fédérer la recherche canadienne, Aquanet traite de l'aquaculture. Un forum interdisciplinaire regroupant une trentaine de chercheurs et professionnels essentiellement canadiens (un chercheur norvégien et un français invités), s'est réuni du 16 au 18 juin à Fredericton, New Brunswick, Canada, pour élaborer les orientations de recherche à partir d'une analyse des secteurs d'activités : pisciculture marine et d'eau douce ; conchyliculture.
Une visite de la station biologique (Pêches et Océan, Canada) et du centre des sciences marines Huntsman, à Saint-Andrews le 19 juin a conclu cette mission.

Abstract :
Among the Excellence Centers developed to federate the Canadian research, Aquanet deals with marine and freshwater aquaculture. An interdisciplinary science forum was held at Fredericton, New Brunswick, Canada, in order to analyse the state of the fish and shellfish aquaculture sector and propose orientations for the future researches. Around 30 Canadian scientists and professionnals (a Norvegian and a French scientist invited) attended the meeting.
A visit at the biological station and Huntsman marine center at Saint-Andrews, New Brunswick, concluded the mission.

Mots-clés :
Canada, Nouveau Brunswick, Pisciculture, Conchyliculture, Aquaculture, Programmation Recherche, Aquanet

Keywords :
Canada, New Brunswick, Fish, Shellfish, Aquaculture, Research, Aquanet

Commentaire :

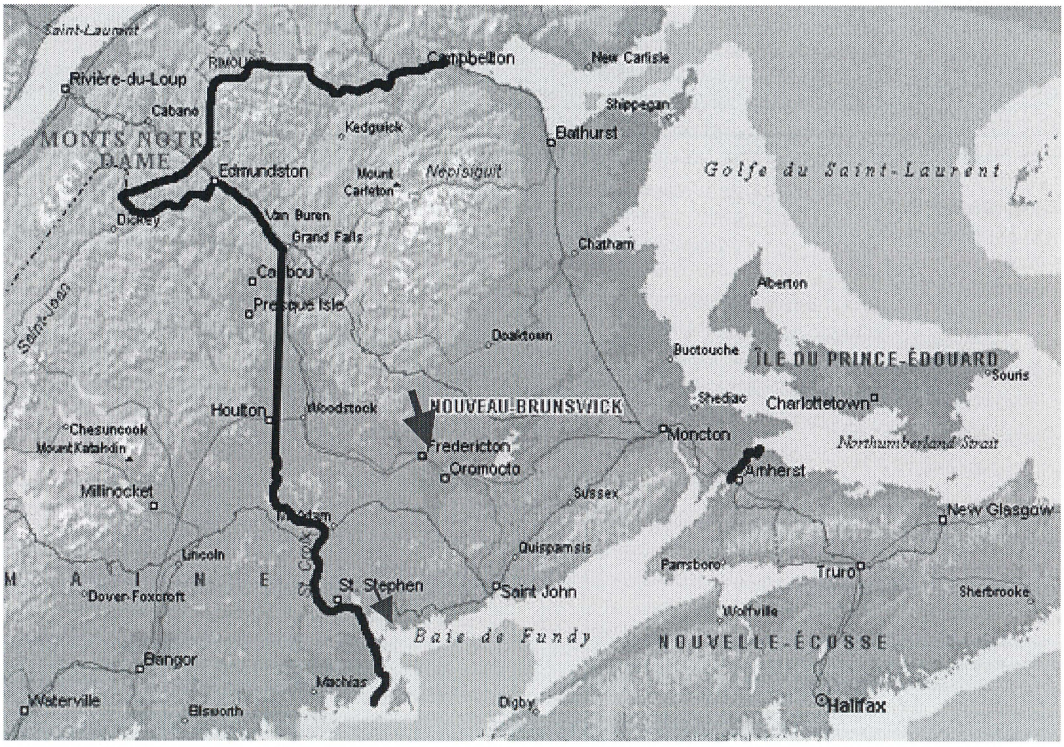
Compte-rendu de mission

J. Mazurié,
Ifremer DRV/RA-La Trinité-sur-mer

I- AQUANET forum
Fredericton, New Brunswick, Canada, 16-18 juin 2003

AquaNet

II- Visite à la station biologique de Saint-Andrews, New Brunswick, Canada : 19 juin 2003



Organisateur

Aquanet, réseau d'excellence canadien pour l'aquaculture
Drs Joe Brown & Jay Parsons (Memorial Un. Newfoundland) ; Moira Ferguson (University of Guelf),
Interdisciplinary Science Forum : "Enhancing sectoral efficiency and identifying future directions in Finfish and Shellfish Aquaculture".
3 domaines concernés :

- production animale
- intégrité de l'environnement
- enjeux socio-économiques

L'organisation s'est révélée efficace (encadrement par des représentants du réseau d'excellence Aquanet) et le groupe motivé.

Financement

Invitation à un chercheur Français (initialement P.G.Fleury), transmise à J. Mazurié
Prise en charge par le Canada (Aquanet)

Participants **(Liste jointe en Annexe)**

Quelques représentants "shellfish" :
Chercheurs canadiens: Jay Parsons, Monica Bricelj, Jon Grant, Robin Anderson (environnementaliste), Bruce Mc Donald, Jean-Paul Vanderlinden (socio-économiste)
Chercheur des USA : John Kraeuter (NJ)
Professionnels Côte Ouest : Keith Reid, et Tim DeJager
Professionnels Côte Est : Terry Mills, Jason Mullen
Professionnels Québec : Jean Côté

Planning

16 juin : session plénière (6 communications dont J. Mazurié, sur conchyliculture européenne)
17 et 18 juin : 3 groupes de travail constitués de scientifiques et de professionnels : poissons espèces commerciales et précommerciales ; mollusques.

19 juin : visite de la station de biologie marine de St Andrews (interlocuteur : Dr Shawn Robinson, chargé des programmes shellfish et Mark Costello, directeur du centre des sciences de la mer Huntsman)

Documents joints

Le relevé de conclusion des 3 groupes, avec les recommandations pour la recherche
La liste des participants

Sujets abordés

Le workshop a passé en revue la situation du secteur aquacole (poissons et mollusques, eau marine et eau douce) au Canada, les difficultés rencontrées et les axes de recherche à développer.

La diversité des compétences des participants et la présence de consultants ou de producteurs ont amené des points de vue divers et une approche pragmatique.

J'ai tâché de mettre en relief les spécificités de l'aquaculture française et européenne, d'intérêt potentiel pour le Canada. Réciproquement, j'ai découvert avec intérêt le potentiel et les particularités de l'aquaculture (de la conchyliculture en particulier) canadienne.

Les actions de coopération en cours entre la France (l'Ifremer) et le Canada n'ont pas fait l'objet de discussions.

Aquaculture et conchyliculture au Canada

Production aquacole du Canada en 2001 (tonnes)

	1991	**2001**	**2001-1991**	**export 2001**	Province dominante
Poisson					
Saumon	34109	105306	209%	53925 t (USA surtout)	Colombie britannique et Nouveau Brunswick
Truite	2839	6516	130%		Ontario
Truite anadrome	485	4705			
Autres (1)	34	1558			
Total, Poisson (3)	39004	118161	203%		
Mollusques					
Palourdes	642	1400			Colombie britannique
Huîtres	5900	10713	82%		Colombie britannique
Moules	3956	21666	448%	8516 t (USA surtout)	Ile du Prince Edouard
Pétoncles	2	128			
Autres	0	455			
Total, Fruits de mer	10590	34362	224%		
Total	49594	152523	208%		

Statistique Canada - Cat. no. 23-603-Ul Division de l'agriculture

Les revenus totaux d'exploitation se sont montés à 704 millions de dollars canadien en 2001 (dont 65 millions de Can $ pour les mollusques).

Du point de vue des espèces, on peut noter une dominance de la **salmoniculture,** et une majorité d'huîtres et de **moules** (comme en France) dans la production conchylicole.

En conchyliculture, ce sont essentiellement l'huître et la palourde qui sont cultivées sur la côte ouest (Colombie britannique), tandis que la moule est l'espèce majoritairement cultivée sur la côte est.

On note **un triplement (+ 200%) de la production** tant piscicole que conchylicole **depuis 10 ans**, et une orientation privilégiée vers l'exportation (USA principalement).

Une forte prise en compte de préoccupations environnementales (limitation de transfert de souches différentes entre provinces par exemple) et sociales (par exemple éviter la concurrence avec la ressource naturelle exploitée par des communautés de pêcheurs) peut tendre à freiner le développement de l'aquaculture.

Production conchylicole

Par rapport au linéaire de côtes et aux ressources naturelles du pays, la production conchylicole n'est pas considérable .

On observe un fort contraste entre la côte Pacifique (qui cultive uniquement des espèces de mollusques d'origine non indigène, ceci à partir de naissain d'écloserie) et la côte atlantique (productrice d'espèces locales, de moules notamment).

une double perspective a été identifiée :

- production à petite échelle, notamment d'espèces locales, à valoriser en frais localement (restauration, tourisme…)
- production compétitive au plan mondial, de moules en particulier, pour le marché nord américain, avec éventualité de transformation : les grands concurrents sur le marché mondial de la moule sont la Nouvelle-Zélande et le Chili. Le marché européen est a priori peu accessible (protections sanitaires ou zoosanitaire, coût de transport).

Les technologies sont inspirées de l'état de l'art international (technologie néo-zélandaise pour la moule par exemple). Dans le cas de la moule *Mytilus edulis* de Terre-Neuve, la croissance apparaît bonne (taille marchande en 12-18 mois) et les coûts de production inférieurs aux coûts de production de la moule de bouchôt française (communication personnelle de Terry Mills, Black Gold Inc., Botwood, Nfl, qui produit 1000 tonnes de moules environ sur 400 ha)

Parmi les problèmes d'ordre biologique, on peut noter la forte gêne occasionnée par les Ascidies (Tuniciers), espèce introduite accidentellement, qui envahit les élevages de moules de la côte est.

Les questions jugées les plus prioritaires sont relatives à l'accès aux sites, aux espèces invasives, aux mortalités et à la disponibilité en naissain (cf fin de texte).

CONCLUSIONS DES 3 GROUPES DE TRAVAIL Aquanet
QUESTIONS FOR RESEARCH

1- COMMERCIAL FISH (mainly salmon)

Husbandry

Freshwater phase

What is the extent of genetic variation in broodstock?

How does genetic variation express in terms of growth, physiological performance and disease resistance?

What is the value of triploids in terms of performance, new imports, etc.?

What are the important early husbandry issues related to disease, mortality, physiological variation, application of therapeutants?

How can recirculation and other rearing technologies be improved?

Smolt entry

How can we manipulate timing, size, phenotype re smolt entry to optimize grow-out?

Grow-out

How can we manage saltwater entry and grow-out in terms of growth, sexual maturation, disease resistance, feeding (and food), and market supply?

How can we optimize harvesting, processing, and animal welfare to improve product quality, quantity, and food safety?

Traceability

How can this be managed through the whole growth/processing stream?

Environment

What new tools can be developed to standardize environmental assessment and monitoring of farm sites?

What criteria should be included in the above, and what is their value in assessing near- and far-field impacts (hypoxia, etc.)?

What sort of indices can be applied to summarize these impacts?

How can new sites be assessed for culture suitability and potential impact?

Policy/Regulation/Communication

What are the public perceptions and issues regarding salmonid culture?

How can we communicate science results to improve public perception?

How can aspects of the science results be used as feedback to government policy in terms of environmental regulation and rearing/grow-out/processing technology?

How can the Canadian industry maximize marketing positions and marketing power?

Environment

Tools (models & monitoring) Priority 1 (1-2 year)

Needs: Indices, criteria, far field & near field
Project: synthesis of existing data → model
→ impacts & suitable indices
→ criteria for regulation

Focus: process (waste, contaminants, therapeutics)
biotic interaction (disease, reefs, escapees,
gene flow, recovery)

Linkage: Public perception & Government regulations

Environment

New Sites **Priority 2** (long term)

Policy

Public Perception **Priority 1** (2 years)

Need: What is the public view of Aquaculture
Project: National survey:
- Why would you eat salmon?
- What are the food safety concerns?
- What are the environmental effects?

Public Education **Priority 1** (1 year)

Need: Pre-emptive, aggressive and balanced
Project: Education arm of AquaNet

Policy

Government Policy Input **Priority 2** (2 years)

Need: Dependent on outputs from above

Improving Marketing Positions & Power **Priority 3**

Company/association responsibility

Husbandry

Sterile, new source stocks **Priority 1** (3 years)

Need: Characterize performance of triploids
Project: Focus on disease & stress tolerance

Environmental & genetic triggers of grilsing
Priority 1 (3 years)

Need: Delay or prevent grilse
Project: ??

Husbandry

Optimizing harvesting, processing and animal welfare **Priority 1** (3 years)

Need: Maximizing flesh quality
Minimize "attention" on fish handling
Project: Review current methodologies
Recommend new methodologies

Smolt health window **Priority 1** (2 year)

Need: optimal timing of prophylactics before cages

Husbandry

Taceability **Priority 3**

Industry issue

Food & Feeding **Priority 3**

Industry issue & On-going AquaNet project

Recirculating & other rearing technologies **Priority 3**

Ran out of steam!!!!!

2- PRE-COMMERCIAL SPECIES

Research in support of regionally and culturally important aquaculture species. With respect to non-salmonids species include: haddock, Atlantic halibut, Atlantic cod, black cod, wolf fish and sturgeon.

Broodstock
The group recognizes the importance of broodstock for the successful development of non-salmonid aquaculture.

Overall Rating Short Term: 14.5 Long Term: 28.75

Do available broodstock diets meet the nutritional requirements of the species with respect to reproductive output and larval quality/survival?

Long term:
Are there particular strains/populations that are more suitable for use in aquaculture?

Long term: But should studies should be initiated soon.

Are there adequate programs for the screening of broodstock for potential pathogens?

Larval Rearing:
Overall Rating Short Term: 29 Long Term: 28

Do current husbandry practices meet the needs of the different species and their developmental stages?

Short and Long term:
What are the effects of different husbandry practices and rearing conditions on the physiology/stress response of larval and juvenile stages and how does this effect long-term growth performance?

Short Term:
Do growth conditions experienced as larvae or juveniles affect later performance (e.g. juvenile quality, early maturation)?

What measurements can be used as indicators of larval quality?

Short Term:
What are the causes and solutions to the problem or early maturation? Are the causes and solutions similar for all species?

Short and Long Term:

What are the effects of the environment of the cage site on growth performance, survival and disease resistance? How can husbandry practices be used to overcome environmental problems?

Fish Health

Overall Rating Short Term: 24 Long Term: 29.9

Are fish health management practices used for salmonids suitable for use in non-salmonid aquaculture? If not how do these practices need to be modified?

Short term:
There is the need to development and standardize diagnositic techniques and health management practices for non-salmonid fish.

What does the presence of pathogens mean with respect to the risk of disease outbreaks and risks of transfer of pathogens to new regions or wild fish? For example what does the presence of nodavirus positive broodstock mean with respect to health of their offspring? These questions are important with respect to transport permits?

Long term:
Is it possible to use commercially available vaccines and vaccination strategies suitable in non-salmonid culture?

Nutrition:
What is the energy utilization of different species at different stages in their development? Do different species differ in their energy utilization?

Short term and Long term:
What are the optimal feeding strategies for the different species under different environmental conditions (e.g. effects of low temperature on feeding regimes)?

Long term:
What alternative sources of protein are suitable for use in diets for these species?

Long term:
What are the levels of nitrogenous and phosphorus waste generated from commercial feeds as it relates to environmental considerations?

Short and Long Term:

What are the real and perceived real risks of disease transfer to wild, or transfer between salmonid and non-salmonid fish?

Long Term:

Are the environmental effects seen at sites culturing non-salmonids similar to those seen at sites culturing salmonids?

Short and Long Term:
Does the present regulatory frame-work require adjustment before application to non-salmonid fish?

Short Term:
How can AquaNet through education and public awareness programs improve the perception and acceptance of aquaculture?

Short Term:
What federal and provincial government programs can be created or improved to facilitate the financing, access to facilities and research in aquaculture?

Short and Long Term:
Are there any lessons that can be learnt from the agricultural sector?
How can access to current programs be improved for people engaged in aquaculture (e.g. use of scientific tax credits)?

Summary of our Thoughts

Broodstock
The group recognizes the importance of broodstock for the successful development of aquaculture however this is a very long-term activity with associated high costs.

Juvenile Production
The group recognized the importance of improved levels of juvenile production for the industry. We feel that experiments should be conducted at a semi-commercial level and designed to allow for comparisons to be made between species.
Short-term priorities include: studies on early larval survival and studies of physiology and stress. Longer-term priorities include: studies on the impact of rearing conditions on long-term performance (growth and survival) and early maturation.

Ongrowing
The group recognized the central importance of successful ongrowing of juveniles to support the early stages of the sector.
Priorities include: studies on husbandry and environmental effects of growth performance, early maturation and fish health. These studies need to be conducted on both the short and long-term.

Health
The group recognizes the importance of fish health for the success of the industry and as a necessity for obtaining permits for the movement of fish.
Priorities include: studies designed to modify and improve fish health management strategies/biosecurity, to improve diagnostic tools and to test

vaccines for efficacy. These studies will be conducted on both the short and long-term with many of the projects falling in the later category.

Nutrition

The group recognized you are what you eat. Short-term priorities include studies designed to: investigate dietary energy utilization of different developmental stages with the aim of improving energy utilization, develop improved feeding strategies and develop estimates of phosphorous and nitrogen loadings. In the long-term we should evaluate the potential of alternative dietary protein sources.

Environmental Integrity

The group recognizes the importance of having clean water for growing fish. Two areas of long-term research should include studies on: the risk of disease transfer from wild to farmed and *visa versa*, the risk of transfer from non-salmonids to salmonids, and cage site interactions with the environment.

Socio-Economics

Areas of short term research to include but not be limited to: surveying the present regulatory framework with the view of making it more amenable to the development of new commercial species, examination of provincial and federal programs and how these programs can be used for the support of aquaculture, and methods of education for government, non-government organizations and other stakeholders.

3- SHELLFISH

Shellfish Industry

We recognize the need to emphasize the distinctive features and concerns of the shellfish industry:

- Predominantly comprised of small independent growers, with diverse interests
- It is difficult for growers to organize and have a public voice (except via provincial associations)
- Industry goals include social and economic development, local community employment
- Requires identification of local, niche markets and global competitive markets

Shellfish Industry

- Is likely to see some consolidation in the future
- Is focused on species low in the trophic chain that require no added food
- Have potential for eutrophication control
- Are highly influenced by environmental conditions and natural food supply

Shellfish Overview

- Research questions were not organized into the three AquaNet themes. All industry constraints were discussed and research question written with the knowledge that there are integrated social-economic, production, environmental integrity aspects to the problem.
- Each problem/constraint represents a risk or uncertainty to the industry – and will provide a means of identifying or quantifying and reducing risk to the industry.
- Each problem represents a key constraint to the industry. The prioritized list represents from the most urgent to urgent priorities.

Shellfish Priorities Level 1

- How do we improve the regulatory framework for site allocation and site management in an acceptable way that will allow sustainable development and expansion of aquaculture?
  - Short term: (regulatory issues)
  - Long-term: Evaluate and communicate impacts (positive or negative) of shellfish aquaculture on the environment
- What scientific, technological and regulatory policy can we use to identify invasive species, prevent future introductions, and mitigate present problems?
  - Principally east coast problem.

  Short and long-term. One AquaNet project in current funding cycle

Shellfish Priorities Level 1

- What are the causes and indicators of unexplained mortalities and poor performance of stocks (e.g. winter kill of oysters and quahogs, summer kill of scallop, west coast mussels and oysters, mass mortalities)
  - What strategies should be developed to manage these and known diseases? (e.g. husbandry practices, development of genetic/physiological strains, stress indicators).

  Emphasis on species suited to the harsh Canadian environment and on development of increased tolerance for species at their northern distribution limit

  Short and long-term.

Shellfish Priorities Level 2

- What are some of the strategies allowing reliable, cost-effective and high quality production and availability of seed (wild and hatchery source)?
  - (a) biological/production approaches: identification and performance evaluation of genetic stocks, and nutrition requirements of various life history stages. Short and long-term.
  - (b) biological, social and regulatory issues: seed transfers (risk management, protocols). Short-term.
- What are the cumulative impacts of other resource users on shellfish production?
  - E.g. Upland development, especially PEI, NL. Long-term.
- What strategies can be used to enhance safety (e.g. biotoxins, bacterial and viral pathogens) and marketability (added-value, meat quality, nutritional value, reduced stress resulting from harvesting practices, shelf-life)? Short and long-term.

Shellfish Priorities Level 2?

- Alternate or pre-commercial species: How can we solve the bottlenecks/impediments (biological and regulatory) in culturing alternate species? Short and long-term.
  - There was consensus that this problem should be given higher priority and be combined with all alternate finfish species

Shellfish Priorities Level 3

- What are the economic and technological requirements for scaling up the shellfish aquaculture sector, e.g. process and handling innovations, industry structure (diversity and flexibility, market development). Short and long-term.

Recommendations

- AquaNet should be doing what the industry can't do itself and should not be duplicating efforts of other funding agencies or programs
- Need for consistency and continuity in AquaNet's long term objectives
- AquaNet should be a voice of science in terms of environmental sustainability
- Need to match the strengths of the Canadian research community to industry needs
- Appeal process following proposal review
- Increase efforts to communicate research results to industry (e.g., promote participation of industry in AquaNet meetings)
- Ensure effective representation of the shellfish sector on RMC and Board
- Institute procedures/mechanism to ensure industry relevance of research projects

	AquaNet Workshop, June 16-18, 2003 Fredericton, N.B.						
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Minkoff, Gidon	Sablefin Hatcheries Ltd.	gminkoff@telus.net	807 Alder Place	Parksville, BC	V9P 1S2	250-298-9911	
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Reynolds, Carl	PEI Mussel Growers	reynolds@isn.net	Box 1476	Charlottetown, PE	C1A 7N1	902-569-1790	902-892-1130
Rogers, Brian	Rogers Consulting	brian.rogers@sympatico.ca	40 Walton Dr.	Halifax, NS	B3N 1X7	902-477-7447	902-477-8889
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2ème partie : visite à la **station biologique de St Andrews** (côte sud du Nouveau Brunswick, au débouché de la baie de Fundy)

Cette station, magnifiquement implantée dans un cadre de verdure, à proximité immédiate de la petite ville de St Andrews (petite cité historique, à vocation aujourd'hui balnéaire).

Elle comprend 2 structures indépendantes :

Une station biologique du Département Pêche et Océan (ex DFO) : environ 75 personnes http://ww.mar.dfo-mop-gc.ca/sabs avec 2 départements :

- Aquaculture research (marine fish culture, atlantic salmon culture, shellfish culture, broodstock management, marine fish physiology, environmental biology, biotechnology and nutritional research)
- Marine Environmental Sciences : benthic ecology, salmon ecology, harmful algal blooms, environmental chemistry and toxicology

J'ai bénéficié des explications de Shawn Robinson, responsable du secteur shellfish, qui mène en particulier des recherches sur :

- l'aquaculture des oursins (aliment composé en fin de mise au point, qui permet une amélioration très significative de croissance)
- l'élevage de moules en complément de l'élevage de saumons : perspectives très encourageantes, les moules recyclant une partie des nutriments en excès et affichant elle-mêmes des croissances accélérées.

Le "Huntsman marine science center", www.huntsmanmarine.ca , 50 agents, dirigé par Mark J. Costello, institution non gouvernementale qui exerce des missions d'éducation (accueil scolaires, visite aquarium), de recherche (Atlantic salmon broodstock development program…) et de transfert technologique au secteur privé (location d'installations aquacoles pour élevages d'esturgeon par exemple).