Fisheries and Oceans Canada / Pêches et Océans Canada
Science / Sciences

_C S A S_ / **_S C C S_**

Canadian Science Advisory Secretariat / **Secrétariat canadien de consultation scientifique**

Proceedings Series 2007/059 / **Compte rendu 2007/059**

Practical Best Management Practices for Reduction of Effluent from Seafood Processing in Atlantic Canada:

Results of research to develop BMP methods designed to control effluents and to conserve water, raw material and energy in the seafood processing industry

Pratiques exemplaires de gestion afin de réduire les effluents provenant de l'industrie de la transformation de produits marins au Canada atlantique :

Résultats d'une recherche visant à élaborer des pratiques exemplaires de gestion afin de contrôler les effluents et de conserver l'eau, les matières premières et l'énergie dans l'industrie de la transformation des produits de la mer

February 15-16, 2006

Du 15 au 16 février 2006

Edited by :
C. J. Morry, A. Brideau, E. M. P. Chadwick, D. Giddens, G. Lindsay, P. Mallet and A. Woyewoda

Préparé par :
C.J. Morry, A. Brideau, E.M.P. Chadwick, D. Giddens, G. Lindsay, P. Mallet et A. Woyewoda

Fisheries and Oceans Canada / Pêches et Océans Canada
Oceans and Science Branch / Direction des Océans et des Sciences
343 Université Avenue / 343, avenue de l'Université
Moncton, New Brunswick / Moncton (Nouveau-Brunswick)
E1C 9B6

June 2008 / **Juin 2008**

Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings include research recommendations, uncertainties, and the rationale for decisions made by the meeting. Proceedings also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

This workshop was not carried out as a formal Department of Fisheries and Oceans (DFO) Science Advisory process; however, it is being documented in the Canadian Science Advisory Secretariat (CSAS) Proceedings series as it presents some topics of interest related to the advisory process.

Avant-propos

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d'analyses ou d'interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenus dans le présent rapport puissent être inexacts ou propres à induire en erreur, ils sont quand même reproduits aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considéré en tant que reflet des conclusions de la réunion, à moins d'indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l'information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

Le présent atelier n'a pas été tenu dans le cadre officiel du processus des avis scientifiques du ministère des Pêches et des Océans (MPO). Celui-ci est toutefois documenté dans la série des comptes rendus du Secrétariat canadien de consultation scientifique (SCCS), car il couvre certains sujets en lien avec le processus des avis.

Practical Best Management Practices for Reduction of Effluent from Seafood Processing in Atlantic Canada:

Results of research to develop BMP methods designed to control effluents and to conserve water, raw material and energy in the seafood processing industry

February 15-16, 2006

Edited by :
C. J. Morry, A. Brideau, E. M. P. Chadwick, D. Giddens, G. Lindsay, P. Mallet and A. Woyewoda

Pratiques exemplaires de gestion afin de réduire les effluents provenant de l'industrie de la transformation de produits marins au Canada atlantique :

Résultats d'une recherche visant à élaborer des pratiques exemplaires de gestion afin de contrôler les effluents et de conserver l'eau, les matières premières et l'énergie dans l'industrie de la transformation des produits de la mer

Du 15 au 16 février 2006

Préparé par :
C.J. Morry, A. Brideau, E.M.P. Chadwick, D. Giddens, G. Lindsay, P. Mallet et A. Woyewoda

Fisheries and Oceans Canada / Pêches et Océans Canada
Oceans and Science Branch / Direction des Océans et des Sciences
343 Université Avenue / 343, avenue de l'Université
Moncton, New Brunswick / Moncton (Nouveau-Brunswick)
E1C 9B6

June 2008

Juin 2008

ISSN 1701-1272 (Printed / Imprimé)

Published and available free from:
Une publication gratuite de :

Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Science Advisory Secretariat / Secrétariat canadien de consultation scientifique
200, rue Kent Street
Ottawa, Ontario
K1A 0E6

http://www.dfo-mpo.gc.ca/csas/

CSAS@DFO-MPO.GC.CA

Printed on recycled paper.
Imprimé sur papier recyclé.

Correct citation for this publication:
On doit citer cette publication comme suit :

DFO. 2008. Practical Best Management Practices for Reduction of Effluent from Seafood Processing in Atlantic Canada: Results of research to develop BMP methods designed to control effluents and to conserve water, raw material and energy in the seafood processing industry; February 15-16, 2006. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2007/059.

La version française est disponible à l'adresse ci-dessus :

MPO. 2008. Pratiques exemplaires de gestion afin de réduire les effluents provenant de l'industrie de la transformation de produits marins au Canada atlantique : Résultats d'une recherche visant à élaborer des pratiques exemplaires de gestion afin de contrôler les effluents et de conserver l'eau, les matières premières et l'énergie dans l'industrie de la transformation des produits de la mer ; du 15 au 16 février 2006. Secr. can. de consult. sci. du MPO, Compte rendu 2007/059.

TABLE OF CONTENTS

SUMMARY

This Workshop Report represents the culmination of an industry-led process to develop, test and perfect Best Management Practices (BMP) for the effective use of fish products, water and energy leading to a reduction in organic waste entering the environment. This process of study began in February 2003 when a first workshop on the same subject was held in Shippagan, NB. Over the course of the three years since then, a multi-stakeholder working group has continued to make advances. Together with several Provincial and Federal government agencies, the NB Seafood Processors Association and several seafood processors in NB have funded and undertaken a study examining Best Management Practices as applied to the six major product lines in NB: shrimp, sardines, herring roe, snow crab, and fresh cooked and frozen lobster. After 18 months of study the results of this research are now ready to be made public and the lessons learned will be disseminated to processors across NB and elsewhere. The results could constitute a major advancement in the way that seafood processing takes place in plants that embrace the innovative ideas that have emerged from the study.

The workshop also provided an updating on issues originally discussed at the workshop in Shippagan in 2003 on regulatory reform, routine monitoring of industry and environment, and new and interesting technologies that may be applicable in specific circumstances. An overview was provided on government and private agency programs designed to assist in promoting and supporting future work of this kind. Also representatives of the UK's Sea Fish Industry Authority provided an update on developments in the field in Europe. At the end of the workshop, participants took part in an open discussion on future directions to aid in directing action to achieve common goals.

SOMMAIRE

Ce colloque est le point culminant d'un processus dirigé par l'industrie afin d'élaborer, de tester et de parfaire des pratiques exemplaires de gestion (PEG) à des fins de mieux utiliser les produits de la mer, l'eau et l'énergie pour réduire les déchets organiques qui s'infiltrent dans l'environnement. Cette étude a commencé en février 2003, à Shippagan, N.-B. lors d'un premier colloque sur ce sujet. Ces trois dernières années, un groupe de travail multilatéral a réalisé des progrès : l'Association des transformateurs de produits de la mer du N.-B. ainsi que plusieurs transformateurs de produits de la mer du N.-B. avec l'appui d'agences gouvernementales provinciales et fédérales ont financé et entrepris une étude des pratiques exemplaires de gestion pour les six plus importantes chaînes de transformation du N.-B., celles des crevettes, des sardines, de la rogue de hareng, du crabe des neiges et du homard frais et congelé. On est en mesure à présent, après 18 mois d'étude, de diffuser au public les résultats de cette étude et de transmettre aux transformateurs du N.-B. et d'ailleurs, les leçons qu'on en a retirées. Les usines qui adopteront les idées novatrices de cette étude pourraient réaliser d'importants progrès dans leurs méthodes de transformation.

Ce colloque a aussi été une mise à jour sur des sujets déjà discutés à Shippagan en 2003 : la réforme réglementaire, l'inspection régulière de l'industrie et de l'environnement et les nouvelles technologies qui pourraient s'appliquer à certaines situations. On a aussi eu droit à un survol des programmes gouvernementaux et privés conçus pour la promotion et l'appui de ce genre de travail, à l'avenir. Des représentants de la Sea Fish Industry Authority du Royaume-Uni nous ont mis au courant sur les développements dans le domaine en Europe. À la fin du colloque, les participants ont pris part à une discussion ouverte sur la direction à prendre pour pouvoir réaliser des buts communs.

Chapter

1

Practical Best Management Practices for Reduction of Effluent from Seafood Processing in Atlantic Canada

A workshop on BMP methods designed to control effluents and to conserve water, raw material and energy in the seafood processing industry

INTRODUCTION

This workshop report could be viewed primarily as representing the direct results of a one year concerted study to perfect best management practices for a number of seafood processing lines in New Brunswick with the objective of reducing the volume and strength of liquid effluents entering the environment. That was certainly the prime motivator for starting down this road in early 2005 and, at least initially, it was the primary reason for holding the workshop. And that alone would represent a significant achievement and one that should be of interest to processors across Atlantic Canada and even further a-field, as well as to concerned members of the public and to government authorities.

However, the research study that formed a significant part of this workshop's discussions is also a part of a much larger ongoing process. One that may in time delve into many other aspects of fish processing with a view toward economising on the use of the raw resources and the water and the energy consumed in processing, but also to examine the opportunities that exist to turn unutilised raw material into valuable secondary products. For this reason we have decided to expand the workshop from one day to two to explore and update ourselves on some of these related issues.

All of these various inter-related activities have the combined objective of not only improving the environmental performance of the seafood processing sector in Atlantic Canada, but also of improving its economic performance so that it remains in the forefront of this highly competitive global industry.

In February of 2003, a workshop was held in Shippagan to examine the effects of seafood processing on the coastal environments of New Brunswick. Much public concern had been focused on this issue in recent years and there was reason to believe that a closer examination of the situation was now in order. What made that workshop unique was that, for the first time in Atlantic Canada, the industry, governments, academics and other technical specialists, environmental non-governmental organisations and the general public all took part in the debate on this sometimes sensitive subject with a spirit of common cause. Because of that, the outcome was a consensus to approach this issue systematically in order to find solutions together. A Working Group comprised of all of these separate interests was set up to keep up the momentum after the workshop and to concentrate on a logical progression of practical research and development investigations. When it became clear that it might well be possible to improve the status quo without major capital expense or involving the use of complex technologies, it was agreed that the first step should be to develop and test best management practices that would be customised to this industry and its unique place in the environment of the region.

The document that emerged after taking this first step (Best Management Practices: Marine Products Processing – Guide for best management practices for raw product, water and effluents for marine products processing plants in New Brunswick; Coastal Zones Research Institute, Inc.; December 2003) provided some very useful tools and guidance on how to conduct processing line audits to find ways to improve on the utilisation of water and raw material. The focus was on the primary parameters of concern, that being the organic loading that increases Biochemical Oxygen Demand (BOD), the particulate matter that increases Total Suspended Solids (TSS), and proteins that lead to excessive Ammonia and other Nitrogen-based elements in the receiving environment.

However guidelines such as these, no matter how well designed they may be, are only useful if they can be proven to be practical in application. Thus it was that the New Brunswick Seafood Processing Effluent Working Group passed the baton to the industry itself, as represented by the New Brunswick Seafood Processors Association, to put in place a study to test, prove and if necessary improve these techniques in real processing situations. There are many groups to thank for having assisted in launching this important initiative. A section of acknowledgements is presented in Annex II in which they are all recognised. But it would be remiss if I did not make special note of the contributions by our expert consultants, Boris Allard, of ADI Limited and James McClare of James McClare Consulting Services and their co-workers Charles Goguen of ADI Limited, and Arthur Austin of the Coastal Zones Research Institute. Without their expertise we would not have been able to accomplish so much in such a short period of time. This effort involved a significant investment on the part of the industry and government, both in terms of time and money. I would urge you to review the names of the organisations and individuals acknowledged later in this report.

Six processing lines were chosen for this study because they represent the lion's share of the seafood processed in the region. Now that the results of these analyses have been published it may make sense to go back and review whether other processing lines should also be studied in the same manner.

While there were mixed results in terms of the percentages of improvement observed in the quality and quantity of effluents, overall we can say that the results have proven the value of these low cost methods and we recommend them to the industry for their serious consideration.

The remainder of the workshop, after the presentation of the results of the research on the six processing lines, took the form of an updating on issues originally discussed at the workshop in Shippagan in 2003. The participants heard from government managers and scientists on issues related to regulatory reform and routine monitoring of industry and environment. They also heard some good news concerning old problems that have affected some of our inshore areas in which nutrient enrichment from multiple sources had heretofore led to significant problems for both the environment and human use. There is also contained in the workshop report an updating on the latest new and interesting technologies that may be applicable in specific circumstances. Brief presentations were given by half a dozen government and private agencies who are in a position to assist in promoting and supporting future work that may be required. We were also fortunate to have with us representatives of the UK's Sea Fish Industry Authority who brought us up to date on developments in the field in Europe.

At the end of this workshop, a round table discussion took place, as it had in Shippagan three years ago, to give thought to where we should go from here. Everyone attending the workshop was encouraged to share their voice in that discussion. Because, as the results of this first three years have amply demonstrated, the only way for us to succeed in achieving our common goals is to plan and to work together as a team.

David Giddens, President, New Brunswick Seafood Processors Association

The Workshop Program

The Workshop was essentially divided into two parts:

- A detailed presentation of the results of research on BMP undertaken over the past year on six processing lines in NB
- An updating on related regulatory, technological and environmental issues and developments

Within these parts, the subject matter was further divided into Themes as follows:

- **Theme 1: What can be done to reduce environmental impacts? Implementing BMP through in-plant modifications & material recovery**
- **Theme 2: A brief update on regulatory and industrial design strategies for management of seafood processing effluent in Canada and abroad**
- **Theme 3: What more can be done to reduce environmental impacts? Conventional and interesting new technological advancements**
- **Theme 4: What are the environmental effects of seafood plant effluents and other land-based nutrient sources?**
- **Theme 5: Funding change – opportunities for financial support to research and implement process improvements in the NB seafood industry.**
- **Final Panel Discussion: Directions and mechanisms to move forward**

The full program can be found in Annex I. The workshop followed the outline of the previously distributed program closely but actual times of presentations differed slightly as the give and take of the presentations and the questions and answers sessions that followed dictated. One additional presentation not shown on the program as previously distributed was an address on the morning of February 16th by Byron James, Deputy Minister of the Department of Agriculture, Fisheries and Aquaculture for the province of New Brunswick.

The order of presentations at the workshop was intermixed to some extent to provide a break in the discussion on the lengthier topic of the results of the primary research on the six processing lines. For the purpose of this workshop report, however, the discussions are presented in a more structured order as presented above.

Chapter

2

Theme 1: What can be done to reduce environmental impacts?

Implementing BMP through in-plant modifications & material recovery

Co-Chair: Andy Woyewoda (NRC-IRAP)

Biographical Sketch

Andy Woyewoda holds a BSc in Chemistry from the University of Alberta and an MSc in Food Science from the University of British Columbia. After working as chemist on fats & oils, rancidity prevention, developing lab methods for measuring fish and seafood quality in DFO's Halifax labs for three years he spent 8 years working with the Canadian Institute for Fisheries Technology (CIFT), Dalhousie University leading research projects under contract to seafood companies for exploring quality improvement in fish and seafood, packaging, shelf-life extension and dealing with the quality of almost every commercial species. For the following five years he was been employed as a Technology Transfer officer for the Canadian Institute of Fisheries Technology covering Atlantic Canada. He has been with the National Research Council IRAP (Industrial Research Assistance Program) since 1992 serving the food, seafood, aquaculture and biotech sectors. Mr. Woyewoda has a number of publications on seafood quality and holds one patent.

The Chairman explained that the following presentations formed the results of one comprehensive study on best management practices for the management of seafood processing effluent that took place over the previous 12 months. Within that study there were six sub-components, each addressing a different processing line. The first presentation addresses the overall design of the experimental procedures followed. After that presentations will focus on each of the following processing lines in turn:

- Shrimp
- Sardine cutting
- Herring roe
- Cooked lobster
- Raw lobster
- Snow Crab

After each presentation there will be time for specific questions related to the results of studies on that processing line. At the end there will be a longer question and answer period to address questions of a more general nature on best management practices, potential further developments on these and related subjects of interest to participants.

1.0 Application of BMP to pollution prevention in the seafood processing industry in six processing lines in NB – Introduction

James McClare (James McClare Consulting) and Boris Allard (ADI Limited)

Biographical Sketch
James McClare holds a B.Eng. and M. Eng. from the Technical University of Nova Scotia. After twenty years of experience with several major food processing companies across Canada, Mr. McClare struck out on his own to establish James McClare and Associates in 1984. He has also spent seven years as a senior food process engineer with the Research and Productivity Council in Fredericton. While he continues to work across the entire food processing sector, since his return to the Maritimes an increased focus on seafood processing has characterised much of the work that he has undertaken.

Biographical Sketch
Boris Allard holds a B.Sc. in Civil Engineering from the Université de Moncton. Since graduating in 1989 he has employed with ADI Limited in Fredericton where he was first employed as a Project Engineer and has, since 2000, held the position of Project Manager in Water and Wastewater Services Division. The project work undertaken during this period has encompassed a wide array of activities at the industrial, municipal and federal government scale and has included projects related to waste water treatment and the processing of a variety of seafood species including shrimp, crab, lobster and herring.

In 2003, Fisheries and Oceans Canada organized a workshop in Shippagan, NB on the challenge that seafood plant effluent streams poses, their impact and how to strategize future management of this issue. One session addressed in the application of "Best Management Practices" (BMP), or the application of in-house measures that are "low-tech" in nature, and do not require much expense A task force was subsequently formed to develop a plan to address this matter, and conceived a demonstration project to gather baseline data, to test application of BMP principles, and to identify more extensive ways to achieve control of seafood plant effluents.

Six plants, each representing the processing of a species important to New Brunswick's seafood industry, volunteered to host these studies. To ensure the protection of proprietary information but at the same time allow for the optimum sharing of information gathered during these studies, careful attention was given to the development of confidentiality agreements signed with each processor. A great deal of attention was also dedicated to the initial establishment of communications with all those involved in the plant, on the steering committee and on the research team to ensure the least disruption to plant schedules and the most efficient conduct of the audits and studies. The processing of cooked lobster, raw lobster, herring roe, machine cut herring, snow crab and shrimp were studied. Each species was treated as a separate sub-project, and each comprised three phases. The first included process mapping and collection of baseline data; the second studied the effect of selected BMP measures and gathered data to identify potential improvements for Phase III (future), which will comprise the evaluation of measures requiring significant change and expense. In every case, flexibility was the key, as information gathered in Phase I invariably led to changes in the anticipated next steps in Phase II. The Phase I and II work is summarized for each of these processing lines in the presentations which follow. Phase III is essentially the subject of the remainder of this workshop. Although the conclusions and recommendations for each process line are presented at the end of Phase II, it is up to the individual volunteering plants, the funding agencies and the Working Group to collectively decide how to advance from here in the interests, not only of the individual plants that participated, but of the industry at large. For this reason, the input of participants at this workshop is vital in setting the stage for future developments.

A number of general observations or lessons learned pertain to all the six operations carried out and will also be germane to any future studies of this kind in new Brunswick or elsewhere. Firstly, because of the limitations of scheduling and funding availability, work generally had to be done within the timeframe of a single processing season; observations made during the course of this work sometimes lead to changes that cannot be implemented within this timeframe. While any Phase III work eventually carried out may capture these changes, additional scheduling flexibility is recommended to address this limitation in future studies. Secondly, it is impossible to over-emphasis the importance of the initial meetings to build buy-in by both management and staff in the plant. Implementing best management practices is a multi-disciplinary process and requires the full cooperation of many individuals with different skills and knowledge. Teamwork is critical.

Each of the six presentations that follow will be ordered along the same lines:

- Objectives
- Description of Plant Flows and Loading
- Summary of Findings
- Experiments
- Conclusions and Recommendations

A detailed report on these six studies, including overall observations, conclusions and recommendations of a more general nature is available upon request.

Lessons learned from in-plant audits and the application of BMP in individual seafood processing operations in NB

1.1 Observations on improvements in shrimp processing lines James McClare (James McClare Consulting), Boris Allard (ADI Limited) and Marcel Duguay

The demonstration plant process in which this study took place includes de-icing, washing, cooking, peeling, inspection and IQF freezing of northern shrimp. Analysis of process-water stream samples were carried out, and are presented in tables in the report body. The major user of water is the peeling process, where water is used to wash away the waste (shell material) and to flume the product downstream. A portion of this water is re-used to flume raw material to the cooker feed hoppers.

Cooker feed hopper water (reused peeler water) was found to contribute over 50% of BOD and TSS loadings. Water from the dumping hoppers and ice from incoming shrimp were also found to be important contributors. But, this having been said, it is vital to a complete understanding of the situation to realise that in one way or another most of the loading has originated at the peeler. "Peeler water after the screens" and a portion (about ¼ to ⅓) of the dumping hopper overflow are loadings that actually originate with the peeling operation (the latter is also reused peeler water). This is important because the pH experiments and by-product recovery described below are aimed at the peeler stream and the reader should understand that this is overwhelmingly the largest source of organics in the effluent stream.

Experiments were carried out to test whether adjustment of pH in cooking and flume water could prevent solubilisation during cooking or fluming, thereby increasing yield and reducing effluent loadings. Bench top trials were conducted, and slight reductions of loadings were obtained when pH was reduced by adding citric acid to cook water. Cooked product was added to clean water to simulate fluming in another trial, and lower loadings were found when water was slightly acid. However, significant changes in processing would be required to take advantage of this principle, and the economics would have to be assessed.

Raw product dump hopper water showed high loadings including high ammonia content along with high BOD and TSS, suggesting that on-board storage practices, harvest to delivery time span and preservation methods have an effect and should be reviewed.

Again, water was noted running to drain through solids accumulating on the floor. Mechanical changes to equipment and tightening of joints etc. to prevent this are mentioned and recommended. An experiment to test the leaching effect of water draining through a bed of typical floor waste was conducted, and showed that an increase in BOD and TSS loadings did indeed take place.

The recovery potential of protein in peeler water was estimated. If this could be desalted even partially and concentrated, there may be the potential to recover a high-value by-product that could be marketed as a soup base or shrimp flavouring product. A substantial capital expense would be involved but the product will likely have enough value to carry this, and a feasibility assessment is recommended.

Much of the nutrient loading in the shrimp line originates before the product arrives in the plant. There needs to be increased dialogue between plant owners and the fishing industry to promote better handling of the shellfish from the very moment of capture right up to the point of delivery at the plant.

Questions and Answers

This study focused on processing of a species that can result in a very heavy organic loading in the effluent. One issue raised from the floor pertained to a recommendation by James McClare to consider the use of citric acid to buffer the pH of flume water. Because the near neutral pH of flume water tends to dissolve the flesh of the shellfish being processed, James McClare had noted that lowering the pH somewhat to the isoelectric point with citric acid would have a major potential to reduce BOD, Chemical Oxygen Demand (COD) and TSS also to some extent Total Dissolved Solids (TDS) and Total Nitrogen (also known as Total Kjeldall Nitrogen - TKN). This was particularly true in the transport water more than the cook water. However acid would have to be added constantly since the alkalinity of shrimp shells would buffer the acidity and reduce its effectiveness.

One participant expressed the concern, however, that this might have an impact on product quality. James observed that anytime a chemical is added to a process (even one that is in common use as a food additive/preservative, like citric acid) one must exercise caution and learn through experimentation the most effective and safest manner to do this. Market dictates are also an important consideration. If treatment of this kind would cause certain markets (e.g. Japan) to reject the product despite the absence of an impact on quality, then obviously this would not be an appropriate strategy to pursue. Certainly recirculation of acidified water would also need the approval by CFIA.

Marcel Duguay, who had participated in this experiment as a representative of the plant which volunteered to host the study, had some additional comments to make. Although their plant had been undergoing constant change in its operations since the inauguration of their internal working committee on plant process modernisation in 2000, they found it very useful to have a new set of eyes in the plant to see things that might have skipped all of their attention. Many changes had taken place since 2002 in particular leading up to this experiment. The Coastal Zones Research Institute (CZRI) had been working with them also, looking at ways to recover product for beneficial secondary uses. This in turn has a tremendous potential to reduce nutrient loading in the effluents. In regard to pH adjustment, one question that remained in his mind is whether it is better to adjust pH before or after dewatering.

Andy Woyewoda, who chaired this session of the workshop and who has had years of experience in the chemistry and food sciences, responded that there is no simple answer to that question. It is very much site dependent and is one of those things that needs to be looked at in the context of an individual in-plant audit. The application of acid does reduce protein coming off the product at the isoelectric point and the key is to know when to use it (before or after the cooker for example).

Andy asked Marcel a question pertaining to the change in culture within the plant that is required. Marcel noted that the employees are more vigilant to avoid letting waste stay on the floor and are more aware of the benefits of using dry cleaning techniques. There is a lot of training required and moreover it must be constantly repeated to keep these ideas current among the workers. Control of cleaning liquids is another issue on which they have focused.

Jim McClare added that there has been a change as the old generation retires and young people demonstrate much more interest in doing things well and in increasing the quality of product. But in the end it is good leadership that motivates people. He felt that Marcel deserves a lot of credit for the success at this plant - he runs a tight operation there.

Another participant picked up on a point made by Marcel – when your pH curve is close to neutral, this will solubilise protein. Can you then deal with the result by pH adjustment at the end of the line in the pit? Or is it too late for the proteins to be precipitated out at that point? Andy Woyewoda responded that theoretically protein will come out even at that point but salt reduces this effect. Moreover dilution in pit makes it harder to do than in earlier concentrated streams.

In concluding this question and answer session, Boris Allard added that the BMP report prepared by the CZRI was the actual starting point for the NB Seafood Processing Effluent Working Group but they recognised that it was necessary to put theory to the test and this is exactly what has been done now, following closely the original methodology but making modifications as experience is gained.

1.2 Observations on improvements in sardine cutting lines James McClare (James McClare Consulting), Boris Allard (ADI Limited) and David Giddens

This project focused on fish cutting machines such as Baaders. In the subject plant, the machines made several lateral cuts and separated product into offal (heads and tails), steaks (thick slices through the centre of the fish), and the back section. These were taken away by fluming.

In this case the main issue was stream separation, to use analysis to identify high strength streams to send directly to treatment. Lower strength streams could be discharged directly if permissible, or identified for low-grade re-use, say for fluming offal. Flumewater samples were taken and analyzed for this purpose. The results were unexpected, identifying the steak flume rather than the offal flume, as the highest strength stream, as had been thought. Sampling and analysis in this case enabled the correct decision and avoided potential judgement errors. It is recommended that further study be carried out, extending this analysis to the rest of the plant.

The volunteer plant had a complex fish fluming system, but water was noted to be running through parts of the system unnecessarily when empty. It is further recommended to explore the use of variable frequency drives on pumps to reduce water consumption and save on energy costs.

Accumulations of solid waste on floors and leaks in various parts of the system were noted. It is recommended that dry cleaning be explored as a means of reducing loadings. Leakage points were identified, and these can be dealt with internally by plant maintenance staff.

One of the most important take away lessons from this experiment was to avoid allowing pre-conceptions to interfere with an objective assessment of the in-plant sources of loading. Intuitively it would not have been expected that the steak sections would have contributed 90% of the loading on this line even though this stream constitutes only 30% of the flow, but this proved to be so. Therefore it is most important to start off without any limitations on what sampling should take place in order to avoid missing an important finding of this kind.

Questions and Answers

The presentation on sardine cutting lines represented a radical departure from that on shrimp, with many of the concerns and issues and ways of resolving them being different.

One participant was particularly interested in knowing if there was a rule of thumb in regard to water usage. Is there one species above all others that requires the use of more water? Boris responded that this very much depends on quantity of the product being processed more than the species being processed. This was not an objective of the current research and ADI has not done such detailed studies to be able to lay out a table of water consumption on a species by species or processing line by processing line basis, but theoretically this kind of information could be assembled from the literature and by assembling the results observed in a wide range of in-plant audits.

Andy Woyewoda noted that it is the steaks (the middle cut) that contain the gut and that this is very soluble. Presumably this would lead to the observation that the steak line produces the highest BOD loading of all. Boris agreed that this was the main source of the BOD problem in the sardine cutting line.

Another question was raised in regard to the source of the processing water. Is the incoming water fresh or saltwater in this instance? In this case there is both fresh and salt water. Where potable water is not needed the plant uses saltwater. A corollary question was then asked as to whether they compared the BOD loading in the two (fresh versus saltwater lines). Boris responded that they had not examined this specific subject but that the plants may wish to do this later to determine if there is a correlation between the salinity of the processing water and dissolution of protein. As already observed in the discussion of the shrimp processing line, there is a corresponding issue pertaining to salinity and pH and therefore this does seem to call for further investigation.

1.3 Observations on improvements in herring roe processing lines James McClare (James McClare Consulting), Boris Allard (ADI Limited) and Rémi Roussel

The subject plant conveys fish by fluming, to cutting tables where roe and milt are extracted. The roe is packed dry, milt is flumed to receiving baskets, and the remainder of the carcass (split) is flumed to the loading area, to be sent to smokers or to fishmeal. This project focused mainly on water flow reduction and attendant energy costs for pumping.

Flows were measured and results are presented in the report tables. The round fish flume delivering product to cutting positions along the table had the highest flow, requiring over half the estimated output from the wells. Samples were taken from the various flumes and sent for analysis; results are presented in table form.

The drainage from the unloading hopper, representing ice and bloodwater from dumping of incoming boxes flowing into the drain separately from flume water, was found to be the highest contributor of BOD loadings. This, and the presence of torn fish and carcass fragments draws attention to harvesting and unloading practices. Reports of previous investigations into relevant issues at this stage were reviewed, and it is recommended that the need for re-education in the harvesting and dockside handling sectors be evaluated. It was also noted that herring landed and processed in New Brunswick can be caught in virtually any part of the southern Gulf of St. Lawrence and the distance of travel between the harvesting site and the processing site may play an important role in determining the quality at the time of landing at the wharf and thus impact on the loading in effluents.

Water overuse occurs in the round fish flumes bringing fish to the cutting positions. Backup of product as the table flumes fill up causes massive overflows as the manual control gates are operated. Brief experiments carried out comprising attempts to model water flow reduction and improved control proved a failure. With the system as it exists, a brisk forward flow of flume water is necessary; else cutting table positions are starved of product. Flumes are configured for re-use of round fish flume water for fluming waste; however, the backup of uncut round fish aided by the packing of milt and fish fragments caused restriction of flow, preventing flow to be diverted for re-use. For Phase III, design modifications to improve re-use flow could be developed. The preferred methods of round fish transport are dry methods, e.g., conveyer belt or tote, however this would involve justifying a major change for existing operations in an often marginal business.

Waste on the floor includes scales, damaged roe clumps and eggs, fish fragments and blood clots. Dry cleaning is seen to be useful in this case but closure of the short roe season precluded testing. Again, work tables should be designed to eliminate elevated worker stands if possible, to ease and to speed up the dry cleaning process.

Questions and Answers

The presentation on herring roe processing promoted perhaps the greatest number of questions and feedback from the audience of all the studies presented.

Andy Woyewoda started the discussions by raising an issue concerning the quality of fish as it comes into the plant. Information on this over the years constantly tells us that rigour mortis plays a big role in quality. When it goes into rigour, fish will not spoil, but after that enzymes break down and bacteria set in. This argues for the need to keep fish cold so that they stay in rigour longer. It has been observed repeatedly that quality of the raw product and the solubility of the proteins and particulates are closely linked and the consequence for control of effluent quality should be obvious. The need to control raw product quality from the very moment of capture, not just from the time that the fish enters the plant is vital.

James McClare noted that roe herring is almost 100% gill netted in this region. This is a form of fishing that causes much damage to the fish and that can therefore release a great deal of protein. It was noted in a study back in the 1990s that when the gillnet is pulled in it goes over a roller, thereby damaging the fish. By simply changing to a spindle type roller less damage was done. It isn't clear if this study was ever completed or if fishing and management practices have changed as a consequence of the early results. From what is known it would appear that the study was not pursued and that practices were not altered accordingly, therefore it would be useful to pursue the issue of pursue the spindle roller design further.

Another participant (a processor) corrected James by noting that in fact 23% of herring are caught by seiners and some of this catch (5-6%) goes to roe production. He noted as a processor that there is a big difference in quality and pollution depending on whether the fish they process comes from seiners (higher quality, better condition and less pollution) or gillnets (lower quality, poorer condition and more pollution). But this is not something they as processors can pick and choose because the gill-netters' quota is set so high and therefore the vast percentage of raw product available comes from this source. In his experience, many gill-netters also don't use any ice and as the nets are pulled they go through a roller, as James observed, which crushes the fish. Worse still, the fish are walked on in the boat and damaged even more. He noted that he has videos of both types of fishing and in the seiners they will test to see if roe is ripe and if so they will put the fish in refrigerated tanks and the fish arrives at the plant alive. Quality does not compare at all between the two fishing methods. The difference should be tested in future in the plant to see the impact. Boris Allard agreed this should be done.

Andy Chapman noted this problem goes back long before the 90s and the quality issue is still with us today. Both processors and government have a role to play in getting the quality issue addressed by the fishing industry.

Another participant raised the issue of water from the pump-out of whole herring which must be high in BOD. The fish are then held in tubs where BOD gets concentrated even more so that when this comes into the plant the processor is already faced with a problem that needs to be addressed. Boris noted that the water from the tubs is screened for debris but that the high BOD is still there. Wharf-side handling clearly needs extra attention.

Andy Woyewoda made an observation that pertained to all of the experiments, not just the herring roe line. In some cases estimates of water flow were required since no flow meter was available. Boris answered that there is often only one meter at the well-head. To quantify relative flows of the various lines one needs to estimate using dimensions of the flume and water depth, friction variables etc. Sometimes they used a simple bucket and timer. This may be crude but it works in small volumes.

Andy Woyewoda also noted that the older product gives off more BOD. But recalling the situation in regard to the shrimp processing line, this species needs to be aged in order for the shrimp shell to be removed. This would explain some of the high readings that show up there. Boris agreed.

Andy Chapman (CCFI) noted that enzymatic activity can be decreased when the raw product is kept properly chilled until processed.

Another participant (Mauricio Gonzalez, a chemist with experience in the best management practices field) felt it was important to know how samples were collected and stored in transit prior to analysis. It was explained that waste water is collected in clean bottles and taken immediately to the testing laboratory. Time in transit would vary and attempts were made to keep the product cold in deference to this fact. In answer to a follow-up question in regard to whether they had observed any significant improvements in the treated versus the pre-treated effluent streams, Boris noted that in this instance there was no treatment other than screening and therefore they don't have any samples showing TSS an BOD removal by various possible secondary treatment processes. The effluent is screened by use of rotary 25 mesh screens. Solids are dumped in a bin for shipment to fish meal plants and the remaining liquid effluent goes directly to the waste line.

1.4 Observations on improvements in cooked lobster processing lines James McClare (James McClare Consulting), Boris Allard (ADI Limited) and Marcel Richard

The process in the participating plant included meat extraction and cleaning from cooked lobster bodies, legs and claws. The major areas of water usage were leg wringers (fluming) and overflow cooling of cooked lobster. The mincing operation, wringers and drip or spillage from work tables were identified as solid waste sources.

These steps are manual, and there is substantial accumulation of solids on the floor that has to be cleaned up occasionally. Effluent and other water samples were taken and analyzed, and the results are presented in the report. Major loading contributors were wringer tables, batch coolers and cookers. Tests were carried out on waste receivers at the wringers, showing pickup of loadings as water flowed through waste receiving baskets. Generally, this could be avoided by designing equipment to dewater before falling into receivers, or using open mesh conveyers rather than flumes.

In addition, a trial was again carried out with dry cleaning procedures showing significant decreases in effluent BOD (25%) and TSS (60%), but increasing again as waste accumulated. It is recommended to adopt this procedure; again management buy-in and good worker training and supervision would be vital to success. Batch cooler flow was studied. Time-temperature profiles were measured and showed that adequate cooling could be attained with lower flow rates.

Batch coolers are commonly used in the industry. The basket of product is dipped for a period of time. The inflow pipe is always open “full throttle” and continuously feeds the cooler. The question arises, could this be done with slower or periodic flows? To attempt to answer this question, data loggers were used to measure the temperature of water over time. Then the flow was reduced by a half. This was done under strict plant supervision. After only 60 seconds the temperature reached the same point, begging the question, why use more water than is necessary to achieve the level of cooling desired? There is also a concern that the manifold for cold water might be getting short-circuited when the basket is lowered which could be reducing the flow and affecting the efficiency of cooling operations.

Batch coolers can be modified to optimize cooling. Recirculating cooling equipment will eliminate this flow altogether but would use refrigerating capacity (higher energy costs) and significant capital expense.

Questions and Answers

One of the key observations that arose during the presentation of results on the cooked lobster processing line was the impact that employee schedules can have on effluent characteristics. This is not something that would intuitively come to mind but that shows up when measurements are taken over the period of a full processing day.

One observation by Boris was that when the processing line workers take their break and an attempt is made to clean up the worksite using dry cleaning methods there is an initial drop in BOD after the break, but that this benefit soon disappears.

A participant queried if production might increase following rest breaks and if that could explain, at least in part, why the BOD rose again so sharply at these times? Boris agreed that this is possible, but unfortunately they did not have production figures in enough detail over that narrow a time scale to demonstrate this.

Another processor enquired if they weighed the lobster before and after they tested effluent characteristics. In his estimation this would affect the BOD curves. Boris agreed that this is likely, but once again the experiment was not designed to examine this level of detail and it cannot be demonstrated from the data collected.

Andy Chapman continued with the same line of enquiry by asking if they looked at total yield versus total BOD loading for example. Boris indicated that this is in the report.

Andy also wondered if they had examined the relative cost of dry versus wet cleaning. This was not examined but James noted that the costs of cleaning are already inherently included in the overall cost of operating because the cleaning must go on anyway but may not be taking place most efficiently. The cost of dry-cleaning would be the same and possibly even less. Furthermore cleaning can be done more efficiently; for example, table designs could be improved to facilitate dry cleaning.

1.5 Observations on improvements in raw lobster processing lines James McClare (James McClare Consulting), Boris Allard (ADI Limited) and Maurice Babin

This process included the "butchering" of raw lobsters into various parts: tails, claws and knuckles, bodies, and heads, or "caps" (which go to solid waste). Claws and knuckles, and bodies, go to cooking, and tails are graded, cleaned and frozen raw. Tomalley is a by-product and is conveyed to receiving tubs by fluming. Butchering was identified as the processing step generating the majority of loadings. Bits of meat, shell, entrails and fragile tomalley accumulate on the floor around the butchering table, and are washed down by water flowing across the floor. Tomalley accounts for most of this accumulation; this falls out of the lobster on breaking and may miss the flume. Also, small particles of tomalley are thrown off by water sprays that lubricate the belts. Other than sprays, water use in this department is minimal. Samples were taken and analyzed as baseline data; results are presented in tabular form.

Dry cleaning procedures (gathering up solids on the floor prior to hosing down the floors) were carried out experimentally on two occasions, and produced measurable reductions in BOD. TSS reductions were less consistent, but likely affected by the "first-flush" phenomenon (initial increase in loading after cleaning the area, due to remaining residues being flushed off, followed by a rapid decrease in loading as the water run-off effectively completes the cleaning operation). For this reason it is important not to jump to the conclusion that dry cleaning techniques are not effective. There real benefit may only show up over the period of a full processing cycle. To successfully incorporate a dry cleaning protocol into the plant's routine operating procedures requires "buy-in" by management, from first-line supervision to the top executive level. Training of workers in the correct procedure and constant attention by floor supervisors is also critical to its success. Butchering technique has an effect on solid waste and workers should be trained to do this correctly.

Equipment should be designed with ease of floor cleanup in mind. For example, lowering line equipment to normal working height makes dry cleaning at breaks easier and faster, impacting less on line productivity.

Samples of water dropping into receiving containers, running through product then flowing onto the floor to the drain were tested before and after running through the product. Pickup of loadings by leaching and dispersion of solids was confirmed to occur. Therefore it is recommended that (1) systems be designed so that water does not fall through beds of solid product or waste, and (2) water flow from equipment should be piped directly to drain if possible. For example, conveyer sprays could be caught in specially designed trays and a run drain through a pipe or sluice.

Screening technology needs to be developed to take tomalley out of the waste stream and possibly even collected as a secondary product. In this study, the tomalley flume contributed fully 87% of the TSS and 39% of the BOD. Rotary screens may be most effective. Or possibly wedge-wire screens in the floor drains if it is not intended to attempt to reuse the material. Also it was noted that tomalley settles out quite well and the use of a settling vessel may be recommended to reduce the concentration of tomalley in effluent. Manufacturers are prepared to rent equipment like screens and settling vessels on trial so that up front costs of such experimentation can be quite low.

One additional clean up method, using wet vacuums, should be considered in areas where the volume of waste is low enough to make this technique effective.

Questions and Answers

Following the presentation by James McClare, Maurice Babin, the representative of the processing plant in which this study took place offered an interesting anecdote that demonstrates the old adage that necessity is the mother of invention. In 2000 they were told by the government that they couldn't use water from their salt water well due to an oil spill that took place three days before the processing season began. Because of this they were forced to truck in water for the whole season. This led to extreme water conservation measures being adopted in the plant. They had a pre-existing tomalley recovery operation, located at one end of the butchering room, which was very messy and required substantial water for wash-up. Also flume water was a source of contamination, falling into a perforated basket. The product plugged the basket and product actually overflowed onto the floor. The tomalley processing/packing was relocated elsewhere, the workplace was redesigned to reduce the spillage, and a small dewatering conveyer was introduced so that water didn't flow into the basket. By altering procedures to reduce wastage of product and introducing a dewatering conveyer, operations were able to proceed and a high quality tomalley product was recovered despite water restrictions. They would not have learned this lesson if they hadn't been forced by circumstances to find solutions to their water use problem.

A topical question arose in regard to the potential for spread of invasive species accompanying lobster moved from one area to another for processing. Is there any thought on doing something to prevent invasive species like the tunicates that are present in PEI from being spread around in New Brunswick? Is it possible that one wastewater system can treat both problems (effluent quality and invasives)? James replied that they did not look at this as a part of the experiment and cannot comment. But it is certainly an area that future research should be put into.

Lea Murphy (DFO, Charlottetown) noted that PEI is suffering severely as a result of the problem of invasives. These species may come into the plant on the raw product. A 25 mesh screen collects big pieces only and cannot prevent the spread of the finer particles of tunicates, for example, that are still viable and can lead to spreading of the problem.

Andy Woyewoda observed that James was particularly concerned with water running into baskets placed to capture solid wastes. Is there a flume design that could avoid this, perhaps by a system of perforations just before the flume reaches the basket? James agreed that he was not in favour of using these wet baskets and yes there are ways of dewatering streams before they enter the basket. Another important aspect of this is the positioning to lube sprays to avoid their unnecessarily covering these areas with spray.

1.6 The experience in snow crab processing lines James McClare (James McClare Consulting), Boris Allard (ADI Limited) and Paul Boudreau

The butchering, cooking and washing steps for both round crab and crab sections were studied. Water is used mainly for washing, cooking and cooling product, and some fluming. It is noted that water reuse is already practised in the volunteer plant. Due to season limitations, only the audit phase was carried out this year. Results of sampling and analysis are presented in tabular form in the report.

The major source of solid waste is the butchering area, where gills, bits of shell and meat, viscera and "miso" (liver) fall to the floor amid water flowing to the drain. Again, this water leaches soluble material and picks up fine solids from the waste, creating effluent loadings. Miso is a particular problem, as it breaks up easily into fine particles and exposes soluble material for leaching. Miso is a potential by-product provided markets can be found, and could be recovered. Mechanical changes to the butchering table are suggested, to reduce the quantity of solids falling to the floor.

There are various areas around the processing rooms where waste accumulates on the floor. Frequent dry cleaning is recommended, and, where possible, water should be piped directly to the drains without running across the floor.

The screening system for butchering waste was investigated. The rotary screen in use was found to toss the solids, causing breakage of the fragile miso, allowing it to pass the screen and increasing loadings. Investigation of alternate screening equipment, either vibrating or "Hycor" types, is recommended. These are available for rental which would reduce the cost of experimentation prior to a decision to buy.

Further investigation of cooling is recommended to reduce water usage.

Questions and Answers

The processing operation in which this study took place contains two parallel lines, one producing sections and one producing high quality whole crab for the Japanese market. The research will be completed in the 2006 processing season.

In follow-up questions, Andy Chapman enquired if the plant that volunteered for this study carried out any meat extraction processes. The answer was that they do not.

Andy Woyewoda observed that BOD represents the cumulative result of everything going on in the processing including the handling of solids, so one could measure how much BOD is removed in a dry cleanup procedure because it removes solids and these could be weighed and compared to the resulting reduction in BOD. It was noted by James that this form of analysis had actually been carried out in one of the plants studied.

A processor commented that they suffer under conflicting pressures – a refrigerated recirculated cooling system is the best option for reducing effluent loading, but CFIA insists that they use fresh water, not recirculated water, for cooling the cooked product. So there needs to be further study on contamination risks to make sure this is a non-issue and if it is perhaps CFIA will change its requirements. James agreed and noted that one of the volunteer plants is actually doing some recycling at this time but CFIA still requires a very high percentage of make-up water. The processor added that some government funding needs to go into this form of research as water supplies are being challenged in many locations by the large volumes needed to operate without recirculation. James agreed once again that this is a good use of government money with an industry that is so obviously interested in making improvements in conservation and effluent reduction.

Andy Woyewoda observed that cooling is a factor of the differential between the water temperature and the cooked product temperature. Is there any economically viable way to keep the water cold? James noted that he has looked at this in non-seafood processing areas and the numbers are astronomical. Chilled water units are not cheap to operate.

Another participant called into question an apparent anomaly in the results. TSS in waste water before screening is actually lower than after screening. James responded that this is indeed the case. The rotary screen masticates the liver and breaks it up and increases both BOD and TSS. Another area in which improvements in mechanical design are possible that could lead to better effluent characteristics.

1.7 Final feedback session - audience response to the results of the BMP Study

David Giddens (President of the NB Seafood Processors Association) opened the floor to questions and comments of a more general nature on the overall study, its objectives, its findings and its shortfalls, if any, as well as ideas on what next steps should be taken.

The first comment raised was to the effect that the results we have seen and indeed the concepts associated with best management practices for seafood processing effluent management are all quite new and, in order for them to be of general benefit across the industry, there will need to be a lot of work done on dissemination of the information and training.

James McClare responded that, in one form or another, best management practices for seafood processing have been known for quite a few years and some plants are more advanced in their application than others. This workshop is the first public release of the results of the research. The benefits in the environment will take at least a year to demonstrate themselves. In the meantime there needs to be a concerted program of promotion and education to advance the acceptance of these methods more broadly across the industry. As Maurice Babin's story shows, all too often we don't act until there is a crisis. Obviously, it would be better for everyone to avoid the crises arising in the first place and benefit from the results that have been learned in this study.

David Giddens added that there is already a plan by the CZRI to increase the level of training for plant employees and managers in regard to these BMP methods by carrying out a series of seminars throughout the province. He wondered if this was still on track for the Spring of 2006. Representatives of the CZRI present indicated that the plan is still in place and will proceed soon, though the Institute has not set the schedule yet.

Marcel Duguay noted that BMP is not the solution, it is only the beginning of the solution. You still need to have a plan to deal with the concentrated streams of effluent that result from the application of BMP. In their case, even after making significant reductions in plant effluent flows, they were still subject to Environment Canada legal action because the resulting streams were more concentrated and were deemed to be toxic to the environment. In the end it consumes less energy and is less expensive to treat smaller quantities of effluent, but nevertheless they must be treated in some manner because they still have a potential to do harm to the environment.

Another fish meal plant owner noted that it is important to them also that the waste solids not be over-watered. It takes an enormous amount of energy to dry solid wastes that are too wet to begin with. Moreover the product loses quality by being diluted in this manner. There is high demand at present for high protein items that can be manufactured from seafood processing solid waste if it is handled properly and especially if the exposure to excessive quantities of water is eliminated. If you over-wash the waste you leach out all the goodness. Reduction of water use has many benefits outside of improving the management of liquid effluents.

James responded to Andy Woyewoda's previous question on cooling water and noted that Mauricio Gonzalez had pointed out the way in which water is made to flow through a vessel can make as much difference as the volume of water used. In other words the physics and design of equipment can also help to reduce the quantity of water needed to carry out many of the functions for which water is used and sometimes overused along the processing line. Taking advantage of counter-current flow to increase efficiency can reduce significantly the amount of water used. The opportunities thus presented should be taken into consideration in future research of this kind.

Mike Chadwick introduced the idea of industry-set standards of performance or a code of practice whereby criteria could be set up that are acceptable to the industry as a whole and that will allow them to essentially self-regulate their industry. He invited the visitors from the UK Seafish Industry Authority to comment on this idea.

Richard Watson said this subject will be dealt with extensively in their presentations. But he noted on another matter that had arisen that for rapid cooling of cooked product binary ice (or slurry ice), which is a suspension of very fine ice particles in brine, is an ideal cooling medium. It has a very high cooling capacity and is used extensively in Europe. He also noted that this technique actually was developed originally in Canada.

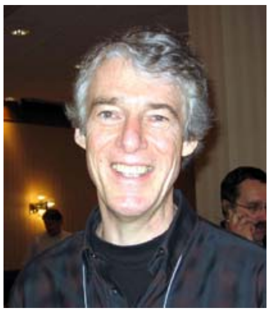
Lea Murphy reflected on the nutrient enrichment issue on Prince Edward Island and the workshop that took place on that subject last year. In that case, the used of fertiliser on row crops is the greatest source of the problem, but even so there are lessons to be taken from that experience. Heike Lotze, one of the scientists from Dalhousie University who presented at that workshop, was originally from Germany and made the point, based on their experience in the Wadden Sea, that we should not let a generation go by without attending to these kinds of problems; the next generation may never know what clean water looks like. In the Wadden Sea eutrophication has become so extreme that have completely lost many of the species of fish that thrived there only a generation ago. In PEI anoxic events leading to fish kills have been common over the years, but last year, at least in part as a result of increased awareness of the problem and a commitment to deal with it, there were fewer events of this kind than before. We should not lose sight of the fact that significant change is possible once awareness of a problem becomes common.

Chapter

3

Luncheon Presentation: Dealing with Seafood Plant Effluents
The cooperative approach adopted in Atlantic Canada

A Brief review of the Problem and 3 Years of Progress in Atlantic Canada
Mike Chadwick



Biographical Sketch

Michael Chadwick is interested in solving problems related to the management of aquatic systems, with an emphasis on making science more accessible to the public. He studied at University of Guelph and at Memorial University of Newfoundland (Ph.D.). He has conducted research on groundfish, anadromous and pelagic fish, and marine invertebrates of Atlantic Canada and has worked with the Canadian Federal Department of Fisheries and Oceans since 1976. He has lived in the Moncton area since 1982 and for the past seven years has been Science Director, Gulf Region. He is also associate Professor at Université de Moncton; Canadian delegate of the International Council for the Exploration of the Sea (ICES) Living Resources Committee; member of steering committee for K.C. Irving Chair of Sustainable Development at Université de Moncton; and past member of the Interdisciplinary Committee of the Natural Sciences and Engineering Research Council of Canada (NSERC); previous assistant editor of ICES Journal of Marine Science and Canadian Journal of Fisheries and Aquatic Sciences. He has over 100 scientific publications.

Three years ago I put the challenge to my staff to try and get some momentum going on what I perceived to be the growing problem of seafood plant effluents and how they impact on coastal water quality and ecosystems. Many of you will recall that it was about that time the problem at Lamèque, N.B. first began making headlines. It wasn't so much the environmental impacts that attracted the public's attention at that time, it was the human consequences of those impacts, in the form of deteriorating air quality; people were actually getting sick as a result of the H_2S given off by the rotting algae in the area But as I scientist I knew there was an underlying and even more serious problem that needed to be addressed.

At the same time that the Lamèque problem first began catching media attention, scientists around the world were already recognising the fact that our coastal waters were becoming more and more eutrophic. Yet this wasn't a new phenomenon and it didn't happen overnight. The problem had increased gradually so that levels of eutrophication had doubled since the Second World War without attracting much public attention until dead zones began appearing in the world's oceans.

Again, this is not a situation that develops overnight, nor is it one that has a single cause. Nutrient enrichment in coastal waters (mostly in the form of nitrogen and phosphorous compounds) comes from a variety of sources. One of the most prevalent, and at the same time the most difficult to control, is long-range transport of air pollution. Regionally, there isn't much we can do about that. We are downstream of the largest sources of air pollution in North America and until Canada and the US get a grip on this continental problem we will continue to be the victims of it. Both countries are committed nationally, bilaterally and internationally to tackle this problem at the source and are endeavouring to do so. Of course we must control our own use of automobiles and the emissions from our own industries but, by comparison, these are minor inputs overall.

Regionally we do have one other major source of nutrient enrichment from land-based sources and that is agriculture. Where agricultural development is concentrated, such as in PEI, and some parts of NB and NS, runoff and atmospheric emissions carry with them large quantities of nutrients in various forms that all wind up eventually in coastal waters. Here too, provincial and federal governments are making every effort to bring this source under control.

The remaining sources of nutrient enrichment are local point sources, such as municipal outfalls, pulp and paper mills and food processing plants (including seafood processing) on land and salmon aquaculture facilities, both in the water and on land. Of these sources, seafood processing plants are the only source that has been largely unregulated over the years.

This seeming anomaly isn't really that hard to understand. It dates back to the early 1970s when the federal government was considering the measures needed to rationalise environmental pollution from various sectors. While industries like metal mining, pulp and paper, municipal waste treatment and even many forms of food processing were considered to be serious potential sources of pollution, largely because of the inorganic and persistent organic chemicals associated with them, it seems that seafood processing was viewed in a different light. It was seen by many as returning to nature what had been taken from nature in the first place.

Thus, rather than regulations, the seafood processing industry was asked to conform voluntarily with the *Fish Processing Operations Liquid Effluent Guidelines*, which obligated them to pass their waste through a 25 mesh screen into a submerged outfall and little more than that.

These guidelines persist unchanged to this day. Moreover, they form the basis of licensing requirements passed out by most provincial regulators, including those here in Atlantic Canada. In the meantime, the industry has grown by leaps and bounds. Where there were only 322 fish plants in Atlantic Canada in 1969, there are by recent count now over 800. Moreover, despite the collapse of the cod and other groundfish stocks, through new fisheries the quantity of landings has almost recovered from the initial declines in the 1990s and is now over 850 thousand metric tonnes (2002), while diversification of the industry has seen large quantities of fresh fish and seafood being brought into the region for processing here. All of these statistics describe a strong and viable industry, but one that is much different than it was in the mid-1970s and one that is obviously in need of some increased attention in regard to its potential impacts on surrounding environments.

The liquid effluents from seafood processing operations are characterised by high levels of Biological and Chemical Oxygen Demand (BOD and COD), Total Suspended Solids (TSS) and ammonia and other nitrogen compounds (TKN). It is difficult to generalise in regard to the sources of these substances in such a diversified processing sector. One truth seems to stand out as universal – the longer that the raw seafood remains in contact with water, the more concentrated the nutrient loading in the effluent will be. These nutrients take up oxygen from surrounding waters as they are broken down and they also promote increased growth of algae, which further deplete oxygen when they die and rot. The end result in extreme cases can be the kinds of dead zones we hear about in Gulf of Mexico for example. The southern Gulf of St. Lawrence is a shallow, warm and slow moving body of water and compounds like these have a real potential to cause similar problems here.

Three years ago at the first workshop to address these concerns in this region we had all the interest groups present for first time thinking of ways to deal with this issue. The action plan that resulted had three primary objectives – to set up a Working Group to keep up the momentum and see that progress would continue to be made; the design of Best Management Practices that were specifically geared to the industry in this region of Canada; and the initiation of pilot projects on technologies that hold promise to assist further in dealing with the tougher problem areas. Of these the last one has been slow to start but other two are working fine. The Working Group has been meeting regularly since then every 6-8 weeks. The BMP methodology was first developed by Sylvain Poirier and his associates Nadeja Tchoukanova and Mauricio Gonzalez at the Coastal Zones Research Institute and published with the assistance of Chris Morry at DFO.

This past year, pilot projects on the application of these BMP methods to the six processing lines that represent the large portion of production in NB have taken place. They show that modest changes bring big rewards – reducing nutrients and saving money at the same time. At this workshop we are learning about those techniques and finding that they can be applied with minimal trouble and expense to cut back on the levels of nutrients escaping from seafood processing operations. These findings give great hope for improvement down the road. Later we will hear some discussion of alternate technologies we may wish to research in the next while.

But there is other work taking place that we should pay heed to as well.

At the Atlantic region scale, the National Program of Action (NPA) for the Protection of the Marine Environment from Land-based Activities struck its own Working Group to grapple with the problem. Although the membership of this Working Group is defined by the mandate of the NPA as federal/provincial, nothing prevents them from forming partnerships with industry and community groups and on a subject such as this one that is the direction the Working Group will likely be heading. The report they commissioned AMEC to carry out has given us a clearer idea of what we know and what more we have yet to learn about the seafood processing industry in Atlantic Canada so that we have a clearer idea of the challenges we face. MT Grant will report on this work later in this workshop.

Subsequently, other studies were initiated by Environment Canada (Christine Garron will report on this) and also by the government-funded but independent Dalhousie Research Chair of Water Resource Management. Graham Gagnon and his colleagues will present a report on this work at the workshop as well.

The Coastal Zones Research Institute in Shippagan continues to be a major player in this field. They provided the analytical capability for the six studies on best management practices and will also be offering training seminars across the province to inform plant managers, supervisors and plant workers, but also fishermen about ways of handling seafood to maintain its quality and reduce the level of organic loading in waste streams.

Work also continued in the receiving environment. At this workshop we will hear from several researchers including Simon Courtenay, Joël Chassé, Fred Page, François Plante and Marie-Hélène Thériault. And other researchers including John Hughes-Clarke at UNB continue to provide expertise in disciplines that offer promise of proving tools to apply remotely sensing to assess the health of the coastal marine environment in the region.

All of this is showing good progress but we need to pause now and then to define our next steps and that is the main purpose of the second day of this workshop. We look to hear what everyone at the workshop recommends. We need to make the team bigger, keep this useful collaboration going and develop useful guidelines to assist industry. We need to include more people from around he Atlantic region. The turn out at this workshop proves that the will is there to cooperate and succeed in this important endeavour.

Theme 2: A brief update on regulatory and industrial design strategies for management of seafood processing effluent in Canada and abroad

Chair: Perry Haines (NBDELG)

Biographical Sketch

Perry Haines has a Bachelor of Science in Engineering and a Master of Science in Engineering from the University of New Brunswick in Fredericton and has worked in the New Brunswick Department of Environment and Local Government for almost 20 years. His time in the Department has been spent in various areas including solid waste management, municipal water and wastewater, environmental impact assessment and industrial approvals. He is currently the Director of the Approvals Branch within the Department. Prior to working with the Department Perry worked for Imperial Oil in Toronto.

Perry Haines is the Director, Approvals Branch, New Brunswick Department of Environment and Local Government. As such he has a close association with the regulatory processes governing many industries in New Brunswick, including the seafood processing sector. He kindly agreed to step in to chair this session at the last minute when the original chair, Joseph Labelle, was prevented from attending on this day due to urgent business.

2.1 Assessing the environmental risks of fish processing effluents
Christine Garron, Environment Canada

Biographical Sketch

Christine Garron is the Toxic Chemicals Advisor with the Toxics and Inventories Section of Environment Canada, in Dartmouth, Nova Scotia. She has worked with Environment Canada for 15 years and has been involved with scientific studies related to a number of substances including chlorinated municipal wastewater effluents, textile mill effluents, heavy metals and pesticides. Among other projects she is currently involved with the study of seafood processing plant effluents in the Atlantic Region.

The Toxics Inventory Section of Environment Canada has been working on this topic (the quality of seafood processing effluents in the region) for the past three years with much of the work being undertaken by Benoit Lalonde.

Number of seafood processing plants in Canada has increased from 460 in 1990 to over 1100 in 2004. Ontario and B.C. account for over 200 plants each. Québec has over 80 plants. But by far the largest number of plants is located in Atlantic Canada - 831 processing plants in operation. The size of the plants varies from just a few employees to over 1000.

There is a significant gap in information on where plants discharge (to municipal systems or to the environment). From what is known, most plants in Ontario discharge into treatment plants while about 50% do so in BC and Québec. However, very few fish plants discharge to municipal systems in this region.

The key characteristics by which effluents from various sources can be compared are BOD, TSS and Ammonia. Ammonia in seafood processing effluents comes primarily from blood and cleaning agents and the resulting toxicity varies directly with the pH of the effluent.

Although the quality of seafood processing effluents varies tremendously from plant to plant, from process to process and over the period of a processing day or season, it can generally be stated that, because few of these plants are equipped with any form of treatment system, the outflow quality is orders of magnitude higher in BOD, TSS and Ammonia than other point sources such as potato processing, meat rendering and treated or even raw municipal wastewater.

In the current study which has been under way since 2003, sixteen processing plants have been sampled with a total of 19 composite samples taken in all. The types of processing involved include: crab, shrimp, lobster, mussel, clam, scallop, pollock, herring, sea cucumber, algae, redfish, smoked salmon, flounder, and fish meal.

Because the aim of the research is to try and explore the root causes of toxicity associated with seafood processing, a large number of parameters have been tested of which the main ones are:

- Physicochemical parameters: BOD, TSS, Oils and Grease (O&G), ammonia, Total Nitrogen (TN), Total Organic Carbon (TOC), Nitrate (NO3), sulphate (SO4), chlorine, pH, Polychlorinated Biphenyls (PCBs), mercury, Organochlorines (OCs) and Polybrominated Diphenyl Ethers (PBDEs)
- Toxicity: Microtox®, Sea Urchin, Stickleback, Inland Silverside, Rainbow Trout

The collection methodology involved the use of automated samplers capable of taking a composite sample representative of the entire processing cycle (usually seven to nine hours). Final waste water was collected as close to exit from the plant as possible and 100 liters were taken to ensure an adequate sample size for the many tests to be performed.

As indicated previously, there it would be impossible and meaningless to provide average figures for the quality of effluents in terms of the parameters measured because of the wide range of results over all the plants sampled. For example, BOD, COD and TSS vary widely, ranging from almost undetectable to extremely high.

Nevertheless, some statements can be made concerning significant observations made.

Ammonia levels are generally not that high, but with high pH near 10, this can become a problem from the point of view of elevated toxicity.

Only two of the plants tested (processing clam and mussel) showed almost no toxicity to all of the test organisms. Of the 62 toxicity analyses run on various effluents, 32% of the samples showed no toxicity (concentration of effluent resulting in toxicity would have to exceed 100%), 26% of the samples showed mild toxicity (toxicity present at wastewater concentrations ranging from 50-100% dilution), 17% of the samples showed moderate toxicity (concentrations ranging from 25-50%), and 26% of the samples showed high toxicity (concentrations ranging from 0-25%)

Persistent organic chemicals like Dieldrin, DDE and PCBs showed up in some of the wastewater samples. For this reason, samples of the fish being processed in those plants have been taken to determine if the source is within the plant, the water supply or the fish.

These results will all require replication in order to establish statistical significance. In addition, it is intended to use statistical processes to try to determine what parameter or parameters are causing lethality where it occurs.

One observation of particular note is that wash water usually exhibits greater toxicity than process water; a lesson that may be beneficial in terms of facilitating improvements in plant.

In summary, there are many data gaps that need to be filled before answers can be provided to industry:

- More complete characterization of liquid effluents (repeat sampling, different species).

- More complete information on types of chemicals used at plants.
- More data on water from wash-down of the seafood processing plant representing a variety of chemicals used. (Only one sample of this has been analysed so far by Environment Canada in 2004).
- Volume of discharge, batch/continuous
- Volume / flow rate of receiving environment
- Toxicity and chemical characterization water and sediments)
- The effect on populations and communities of aquatic organisms by seafood processing wastewater using different species of seafood and processes must be measured.
- The effects of different wastewater treatment on toxicity
- The effects of different best management practices on chemical characterisation and toxicity of the seafood processing wastewater.

Considering the importance and the nature of the topic of the research, the cooperation that has been received from the industry is most encouraging and it is hoped that a larger number of processors will participate in this research in the future.

Questions and Answers

The first question that came from the audience had to do with to what extent the results of this kind of research depend upon the nature of the receiving environment – one wonders why there aren't dead fish everywhere when first looking at these results. Is it because there is an active environment that is ameliorating these potential impacts? Christine agreed the nature of the environment is a factor that must be considered in any risk assessment carried out.

Another concern was that with only 16 plants tested and on average about 4 distinct samples in each plant there may not have been sufficient samples collected to make comparisons between plants processing the same species. It was confirmed that for the most part there were not multiple plants processing each species in the test group (usually only one). Because of this limited sample size it is not possible at this stage to say which species leads to more toxicity.

Andy Woyewoda wondered if there was a possibility that sampling design might be affecting the results. For example, what is the effect of the long collection time for each sample on toxicity assuming that the sample must have deteriorated to some extent at the collection point. Christine noted that it was their practice to endeavour to keep the carboys cold for samples collected in warmer weather and to do some sampling in winter in order to minimise this effect. However, these are standard sampling procedures for such tests and the results would therefore be comparable to other results of similar surveys found in the literature

Another participant likened the sampling protocol to be similar to collecting septic tank samples, since the worst possible results can be expected. Christine agreed that this is true but on the other hand it gives the opportunity to pinpoint where future work should be concentrated.

2.2 Environment Canada's national working group on seafood processing effluents.
MT Grant (Environment Canada)

Biographical Sketch

M.T. is a member of the Association of Professional Engineers of Nova Scotia and a graduate of St. Francis Xavier University and the Technical University of Nova Scotia, with a degree in Civil Engineering (1985). Her career began with as an Approvals Engineer with the Municipality of the County of Halifax and continued in the municipal services area (primarily wastewater management) with a period of employment with the Nova

Scotia Department of the Environment. In 2000, M.T. joined Environment Canada – Atlantic Region, where she has worked in the pulp and paper sector, the municipal wastewater sector and since 2002, the seafood processing sector. She currently chairs the National Program of Action, Atlantic Region Team, Seafood Processing Effluent Working Group. She is also a member of the Environment Canada National Seafood Processing Effluent Working Group.

Environment Canada's (EC) interest in the seafood processing effluent issue stems from its delegated responsibility for managing Section 36 of the *Canada Fisheries Act*, generally known as the pollution prevention provisions of the act. It is this section of the Act more than any other article of federal legislation that applies to this industry because there is an absence of specific regulations to apply in this case.

EC is seeking to develop a national strategy to ensure that effluent discharges from land-based fish processing facilities are managed in a manner that protects fish, fish habitat and human use of fish, and at the same time to provide more clarity under Section 36(3) of the *Fisheries Act.*

The nature of the problem of seafood processing effluent is now well known – it is high in nutrients, BOD, Ammonia, TSS and in some cases has also been shown to be toxic by standard measures of toxicity. More often than not however, it is the visible consequence of eutrophication in coastal areas that leads to enforcement action being taken.

The diversity and seasonality of seafood processing together with the wide range of chemicals used in cleaning and other non-processing activities within seafood plants, and the sporadic nature of toxicity levels makes it hard to deal with the industry systematically.

The existing Guidelines, the *Fish Processing Operations Liquid Effluent Guidelines* (1975) are now over 30 years old and are no longer adequate, if they ever were. They provide inadequate and out-dated guidance on managing the liquid effluent from land-based fish processing operations. Other than these guidelines, the only legislative alternative is to apply the general provisions of the *Fisheries Act* which is not a reasonable solution to deal with specific issues associated with a unique industry like seafood processing.

Information from the BMP project which has recently been completed and Christine Garron's work on seafood processing effluent characterisation still doesn't provide enough information on which to manage the sector.

In Atlantic Canada, at the same time that the NB Seafood Processing Effluent Working Group was coming into being, the regional team of the National Program of Action for the Protection of the Marine Environment from Land-based Activities (NPA) identified nutrients as a high priority for action in this region. Because seafood processing is a major source of nutrients in this region it was decided to set up its own working group to address the issue region-wide.

The first project undertaken by the NPA Seafood Plant Effluent Working Group was to contract a study to set the baseline of what is known about the sector in Atlantic Canada. This study (by AMEC Ltd.) not only showed how big the sector had become, beyond all expectation by the members of the working group, but also demonstrated very clearly how little information we possess on the industry. The data base that formed the basis of that study is full of gaps, but with the assistance of the provinces, these gaps are now being filled. Information sharing is the greatest benefit of team at moment.

The NPA regional team is a government only group at this time but there is interest in broadening the membership to bring in expertise as advisors from industry as has already been done from universities.

In addition, efforts have been made to provide cross linkages to the Pacific and Québec regions share information on what each region is working on.

At the national level, last September a national Working Group on Seafood Processing Effluent was set up but it is temporarily dormant due to departmental reorganisation. Also at the national level, in January 2006, EC set up a *Fisheries Act* Working Group which has identified several non-regulated sectors including seafood processing, agriculture, municipal wastes, finfish farms, etc as areas for action subject to senior management approval.

Actions that are seen by Environment Canada as proposed next steps are the following:

- Revitalizing EC National Seafood Processing Effluent Working Group
- Work to further characterize the issue in collaboration with regional working groups, Dalhousie Research chair, etc.
- Begin “Risk Assessment” process under CEPA (1999) for whole effluents
- Outcome of risk assessment to guide development of management strategy
- Develop national approach to deal with complaints

2.3 Compliance auditing: Benefits of increased inspections of New Brunswick fish processing facilities.

Danny Stymiest (NBDELG)

Biographical Sketch

Danny Stymiest is an employee of the New Brunswick Department of Environment and Local Government, where he is currently working with the Project Assessment Branch on a two-year secondment. Danny graduated from the University of New Brunswick in 1999 with a Bachelor of Science Degree in Civil Engineering. For the past 4 years he had been employed with the Approvals Branch of Environment and Local Government where he was actively involved with the regulatory aspects of the fish-processing sector within New Brunswick. He has participated in meetings with both the New Brunswick Seafood Plant Effluent Working Group and the NPA Seafood Processing Effluent Working Group.

New Brunswick is the only province in Atlantic Canada which has instituted a systematic audit process for all seafood processing operations. The process was inaugurated in 2000. Although there had been a small number of enforcement actions required over the years (e.g. one in 1999, none in 2000 or 2001), the motivation behind carrying out the regular audits was not with a view toward increased legal proceedings but rather to assist the industry in knowing what it ought to be doing to comply with its operating permits. Prior to this time, spot checks had indicated that there was little compliance with the minimal requirements being asked of industry (screening and submerged outfalls)

In 2001-2002 the audit process was continued in much the same vein as it was started in 2000 and there continued to be non-compliance incidents. It was necessary to charge two companies in 2002 with non-compliance.

In 2003 the Department decided to make some changes to the process in an effort to improve compliance and to become more proactive rather than simply responding to complaints. By now most plant managers had gotten used to the periodic visits by departmental inspectors and the level of cooperation increased notably. For their part the departmental inspectors were also becoming more knowledgeable of the technologies in use and the limitations facing the processors.

In this year also a regular sampling program was put in place which was more or less rigorous depending on the class of facility (class being based upon the volume of production). This testing and monitoring was intended to help gain an understanding of contaminants in effluent being released depending on the species processed and to show trends. High levels at a particular facility may indicate improper screening and trigger an audit.

Not coincidentally it was also in 2003 that the first New Brunswick Seafood Processing Effluent Workshop was held in Shippagan. This not only helped to raise awareness of the issues but it also gave new hope for relatively simple solutions in the form of the Best Management Practices that were described in the manual produced by the CZRI later that year. Also in this year the department was able to double the number of audits and the results paid off not only in terms of awareness and compliance, but also in increased follow-up on the plants in non-compliance as well to ensure that the problems were being looked after.

By 2004, the Approvals Branch started auditing all industrial sources and instituted separate partial and full audit procedures at that time. This too was looked upon as a good way to increase awareness. However, an unintended result was that more companies wound up being charged (8 companies have been charged between 2002 and 2005). This is still considered a last resort and every effort is made to assist the industry in complying rather than resorting to legal remedies. It is always considered better to work with the company than fine them. There is no net benefit in legal action as the money wasted on both sides could be better employed in making essential improvements in the plant.

In conclusion, there has been a major increase in awareness in industry as a result of these audit procedures. Significant effort has been made by many processors and this was not achieved without considerable expense in some instances. Many new screening systems have now been installed. And there are four new DAF systems operating in the province.

One mark of the effectiveness of this strategy and the cooperation received from the industry is that there are now far fewer complaints being received from the public.

In terms of future directions, the first goal has been to bring all plants into compliance with 1975 guidelines. That has yet to be fully achieved. When it has been the next steps will be defined in consultation with the industry.

Questions and Answers

Doug Wright (Atlantech) enquired what were the conditions that led to the DAF systems being installed. In two cases plants were required by the local municipality because they were adding to much loading to the system. Lamèque and St-Simon were specific situations that required additional treatment because of either the capacity of the receiving environment or the type of species being processed in the latter case. All situations are unique and need to be examined on their own.

A processor wondered is anybody using the information that they gather annually in the monitoring programs and audits? Danny indicated that all the information is compiled to give a better understanding of the industry. Now they are looking at a larger number and variety of plants and species processed and the picture is getting clearer. The annual statistics are also used to classify plants according to the criteria set out in the provincial regulations which govern the schedule for monitoring.

Another plant manager noted that they are charged license fees based on the highest day of discharge of the year and the fee is the same regardless of whether the plant operates for one month or twelve. Danny agreed that the fees are dictated under the water quality regulations and that these regulations are not presently sensitive to seasonality.

Keynote Presentation: Seafood Waste Management in the EU
Michaela Archer (UK Sea Fish Industry Authority)

Biographical Sketch

Michaela Archer qualified in environmental studies at the University of Humberside (as was) in 1995. This background covered many different aspects of environmental management including management systems, auditing, economics and resource management. With 10 years in the seafood industry, Michaela's experience includes seafood technology and quality issues; however, her main role at Seafish is to deal with the environmental issues that affect the shore-based seafood industry. This includes water and effluent, packaging use and disposal, Integrated Pollution Prevention and Control (IPPC) and energy issues. During the past 5 years Michaela has concentrated on seafood by-products and waste, with the intention of finding alternative utilisation or disposal options.

This presentation is intended to open a dialogue between Canada and the UK that may lead to future collaboration on a subject of mutual interest and concern. While the presentation will necessarily deal with the situation in the EU as a whole, in as much as the UK is a part of the EU and is affected by EU decisions on standards and legislation, the focus will be on the situation in the UK specifically.

The Sea Fish Industry Authority of the United Kingdom is a non-departmental public body whose purpose is to improve the efficiency of the UK sea food industry, raise standards and aim to secure a sustainable future whilst accounting for the needs of the consumer. Its main activities include research & development, business support & industry training. Seafish is primarily funded by a levy on seafood landed or imported into the UK and must work in industry's interest but also serves as liaison with government.

A little background on the EU is necessary to understand how a nation like the UK operates within the EU framework. At the present time there are 25 sovereign countries making up the EU with very diverse cultures (several other nations, including Turkey and a number of eastern European emerging economies) are waiting in the wings to join and their presence will increase the diversity considerably). In total these countries have a population of 450 million people. The EU aims to develop co-operation and collaboration between and among its members. The EU has established many rules on food safety, hygiene, environmental protection, fisheries regulation etc. and its primary role in this regard is to ensure harmonisation across the EU on these issues – a challenge that many would say is not quite there!

The UK fishing industry is actually fairly small by EU standards but large by Canadian standards. There are 7,000 licensed fishing vessels that employ 11,600 people. In addition there are 550 processing units employing 18,200 employees in processing and more than about 10,000 jobs in retail and catering outlets.

The seafood trade is comprised of 79% finfish and 21% shellfish with a total supply to the UK market (including imports, which make up a large share of the total) of 656,000 tonnes per annum, valued at £ 4.6 Billion (roughly $9 Billion CAD). Seafood is seen as a luxury item in the UK, costing more pound for pound than meats of various kinds.

As far as the processing sector is concerned it can be said that direct costs of processing are high at 78-88% of sales and that profits are low (2-7%). This is important to keep in mind when it comes to valuing the cost of waste. Though the true cost of waste is unknown, a good estimate would place it at 4%, which begs the question “is the industry wasting more than its profits?”

In the EU, management of wastes is an imperative, but some countries embrace the benefits of the public and the environment, whereas in the UK and some other countries, however, it is done because they have to. But there are many opportunities and benefits to waste management not the least of which is the reduction of costs and resulting increase in profits. In the UK it could cost up to £100K just to obtain a permit to dump seafood wastes at sea. It is also felt that properly managing wastes will strengthen the UK industry’s position and competition in the global seafood market. There is also a compelling argument for maximising the benefits from increasingly scarce resources. Finally, not to be underestimated is the importance of simply being a good neighbour. Seafood plants are universally found in centres of population and must be good stewards of the shared environment.

There are a variety of opportunities for improved waste management starting with water and effluents.

Sine the late 1990s there has been legislation across the EU to control the quality of effluent discharged to sea. This has led to the construction of more sewage treatment works, particularly in coastal regions. In the UK, charges became dependant on the both the strength and volume of the effluent. Unlike in many parts of Canada, the cost of water is also charged to the plant by the water authority on a usage basis. Water and effluent charges have increased significantly in a very short timescale. This initially caught seafood processors, who were used to cheap effluent charges, off-guard. Seafood processing uses a large volume of water, and produces a large volume of high strength effluent. Thus these increasing charges have imposed a huge rise in the operational costs of the seafood sector.

Outrage across the industry and even a sympathetic media did not change much and the charges stayed. Therefore something had to be done to address the problem at source. The first step was to audit many factories to assess the efficiency of their operations. Most businesses were wasting water to a very large extent (sometimes twice to three times what is needed). Not unexpectedly, the two being directly related, excessively high strength effluent was also being produced. These early findings helped to raise awareness of the problems in the industry.

The next step was to identify simple solutions based on what was seen in the audits, including changes in routine practices, modification of processing equipment and an evaluation of appropriate end of pipe treatment equipment.

By far the most important lesson learned was the problem is best controlled by reducing waste at source. For water, this means measuring and monitoring and turn off the flow when not in use. Simple changes can be highly effective – management, flow regulators, trigger sprays, timer taps, etc. For effluent the approach entails first and foremost keeping the product out of water wherever possible, making sure it is kept off the floor and preventing the solid waste from going down the drain.

Looking specifically at filleting benches as one major source of waste in terms of water and effluent problems included excessive flow rates, water being left on all day and ineffective management of flows. The solutions that presented themselves included use of flow regulators, timers to switch off water at breaks, improved water delivery systems and ‘drier’ filleting systems. As far as effluents were concerned, problems were again related to water wastage, with waste soaking in the tub and ending up on the floor and in the drain. Redesigning the filleting benches by installing flow regulators, incorporating trimming catch trays, modifying water overflows and redesigning catch baskets under the bench led to substantial improvements – as much as 30% savings, at a cost which could be recouped in 100 days of operations.

Automated processing machines presented many of the same problems but afforded opportunities for different and innovative solutions. The problems there were also found to be excessive flow rates, water being left on when not in use, water washing through waste in baskets and waste washing down the drain. One solution that lent itself to this application was to install wedge wire grills in the waste chutes to dewater the solid waste before disposal. Wedge wire works better than conventional screening because particles tend to cling less to it.

In mechanised filleting machines (e.g. Baader) a great deal of waste winds up on the floor due to the design waste chutes and waste removal systems (usually flumes). Redesign of ineffective waste removal systems by introducing effective conveyors led to a significant decrease in this source of waste.

Another area where waste was common was in the defrosting of product prior to processing. In many case water was left running constantly over the frozen fish overnight unnecessarily, since the produce was defrosted long before the processing began the following day. More attention to limiting the flow of water to the minimum required and the shortest time needed to finish defrosting the product results in major reductions in waste of water and a reduction in effluent volumes. Since management was not aware of this area of waste and the opportunity it presented for savings, a little education leads to rapid uptake of such ideas and virtually immediate improvements.

Cleaning operations are also another area where waste of water was prevalent. Many inefficient practices had simply become accepted as normal. For example hoses were used to ‘herd’ waste and power washers were used when not required and indeed when their use was making cleanup more difficult, time consuming and wasteful. Educating the line-workers pays off in a big way here. It was found that the use of a squeegee and spray triggers on hoses reduced this source of waste considerably as did attention to the timing of the cleaning schedule. Improper cleaning techniques also add to the effluent problem because waste ends up going down the drain, The solution is no more complicated than using a shovel to pick up solid waste and keep it out of the drain. The key is to educate staff and to institute effective cleaning schedules.

The traditional slotted design of drain covers allows solids to easily enter the drain. Moreover plant workers assigned to cleaning operations have tended to defeat the purpose of having perforated drains by removing the drain covers altogether during cleaning to prevent their clogging, rather than removing the solids from the floor first. Improved drain cover design using smaller aperture covers prevents much solid waste from entering the drains to counter-act human nature it is also necessary to prevent easy removal of the drain covers.

Another problem related to drains is that in many cases they are either not equipped with drain baskets to collect solids or else these are not maintained properly and the solids are simply allowed to fill the baskets and stay there and rot. Effluent increases in strength after washing through waste of this kind. The solution seems obvious - empty & clean the baskets regularly; but here again a great deal of education is necessary.

Improvements in catch basket design can also help. One idea that works very well is to install a wedge-wire separator chute at a shallow angle to the flow below the drain cover and above the catch basket. These chutes are self-cleaning and dewater the solids before they enter the catch basket.

A few real life examples of the application of these simple methods and the resulting savings help to prove how beneficial this can be. One large whitefish processor in Hull modified equipment, installed regulators, ‘brainwashed’ staff with Seafish’s training video, introduced key performance indicators on water, effluent and waste and instituted continuous monitoring which effectively led to competition between staff. In consequence, they were able to demonstrate savings of nearly 50% of water use in 3 years for very little cost. Another large whitefish processor in Scotland was able to demonstrate a similar 50% reduction in water use just by improving staff management at no cost. A medium-sized pelagic processor in Scotland modified processing equipment nozzle, installed flow regulators on all equipment and instituted a water monitoring program and thereby reduced water use by 75%. Finally, a large pelagic processor in Scotland was shocked to discover that they were wasting 400m3 of water in poor cleaning techniques over a 2 week period. This wastage resulted in costs of £2,300 plus personnel, energy etc. They immediately revised their cleaning schedule to improve practices and reduce their costs.

The UK has been a latecomer in addressing these problems compared to some other parts of the EU. In Scandinavia they have found that through systematic implementation of simple waste minimisation measures they have reduced water use of 70 - 75% and reduced effluent strength by 60 - 75%. In Ireland, parts of the pelagic industry have largely converted to use of conveyors instead of waste flumes in pelagic factories.

End of pipe treatment is expensive in both up front capital cost and in the cost of operation. They are not always the best solution. They should only be considered where waste minimisation at source has proven inadequate to meet the requirements of the local area. The systems available include Dissolved Air Flotation (DAF), screening and membrane filters. All of these lend themselves to application only where there are high strength streams.

Rotary wedge wire screens have been used to effect in some plants. For pelagic fish such screening systems with a 0.2mm aperture have been shown to lead to a 30 - 40% reduction in BOD & TSS. For whitefish, a 1mm aperture screen has been estimated to lead to a 10%-20% reduction in BOD & TSS of skinning effluent.

DAF systems have been installed in a number of plants as well. For herring effluent, BOD reduction of 80%, TSS reduction of 99% and a cost reduction of 80% in waste charges was demonstrated in one case. In an application involving screened whitefish skinning machine effluent, BOD reduction of 80%, TSS reduction of 90% and a cost reduction of 63% was demonstrated. These reductions were achievable through the use of chemical flocculants which has implications for sludge disposal.

Although it is not the subject of this workshop, some findings on Seafish's work on management of solid wastes may prove enlightening for future discussions.

The utilisation and disposal of all by-products of animal origin is highly regulated in the EU. Regulation is becoming more stringent because of increasing concerns over animal feed, the food chain and the environment. These regulations include seafood by-products as well. This is now driving a greater need for resource efficiency and increased utilisation.

It is estimated that a total of 312,875 tonnes of seafood waste is generated in the UK each year, comprised of 249,950 tonnes (80%) finfish and 62,925 tonnes (20%) shellfish wastes. Comparing this to the figure given above for seafood entering the processing stream (656,000 tonnes) gives some indication of the magnitude of the problem and indeed the sad waste of raw material that could otherwise be beneficially utilised. To compound matters, since processing is not evenly distributed in the UK, the large proportion of this waste is generated in several pockets mostly in the north to northeast regions respectively of England and Scotland, creating problems for those areas in particular.

Currently in the UK the majority of the waste generated from finfish is used for fishmeal earning a small revenue. For shellfish waste, processors are desperately trying to find short term outlets (disposal). Waste has to be transported many miles and where outlets are available, costs are increasing (>50%). In the longer term the industry needs to evaluate by-product utilisation, particularly for crustaceans.

Numerous potential by-products and waste management options are being explored. For heads, tongues, cheeks, fins, roe and milt, mince, soup, stocks and sauces are all potential by-products. Some seafood wastes can be used directly as animal feeds or can be converted to fertilisers and soil conditioners following initial treatment. Many pharmaceutical and cosmetics are derived from marine sources. For finfish only some additional options include collagen and gelatine, fish protein concentrates or hydrolysates, enzymes and fish skin leather. Crustacean and mollusc shells have a number of applications. And if none of these uses are considered suitable there the options of incineration to recover energy and also in some instances the creation of biofuels. As a last resort, disposal routes are necessary but increasingly regulated and restricted.

A recent example of the sort of technical work being carried out at Seafish is composting seafood. Different types of seafood waste have been composted for six weeks using a carbon source to produce a final compost which was then tested in growing trials to evaluate the potential use / marketability of the composts. The results were very encouraging. A commercial scale demonstration project is planned which will hopefully lead to commercial uptake.

Elsewhere in Europe the same set of problems has also resulted in experimentation on the options that are available. In Norway, 610,000 tonnes of by-products are produced each year. 30% of the raw product is discarded as waste and it is their aim to turn that into a resource through research, development and industry support to add value to the seafood industry and to transfer technology across the EU.

Seafood is a major part of the Icelandic economy. Work on fish head utilisation started over 10 years ago. It has since developed into million dollar export business (Africa being the main market) and the supply of raw product to meet market demand is now expanding into the UK and other countries.

A final note on solid waste handling relates to the issue of packaging. A Packaging Waste Directive has been implemented across the EU. Member states are required to recover & recycle waste packaging and demonstrate that packaging use is minimised. Packaging is a large part of the waste stream. Used fish-boxes are a significant part of the problem. Polystyrene/waxed board is difficult to recycle. They also take up a great deal of space in waste storage areas and more frequent emptying means more cost. Solutions are available.

Collective EPS fish box recycling schemes have sprung up across the EU. Individual schemes have been instituted for larger businesses. Boxes are compacted and sent for recycling as garden furniture, video cases, picture mouldings etc. There is an ongoing evaluation of readily recyclable materials: other plastics, cardboard, standardised EPS. The problem is made somewhat easier with an improved chill distribution chain.

In regard to other environmental issues facing the industry, energy conservation is a growing area of interest especially since the imposition of a Climate Change Levy. An energy tax was introduced in April 2001. Its aim is to promote energy efficiency and reduce environmental impact of energy and it applies to electricity, gas, coal & LPG. This tax adds approximately 15% to typical energy bills which is a strong incentive for energy efficiency. Savings can be made particularly on seafood plant equipment. These levies now apply across all aspects of energy. They are increasingly seeing the knock-on effects in other sectors, such as the harvesting sector.

The EU is moving toward an integrated pollution prevention and control approach. Its aim is to prevent, reduce and eliminate pollution at source, improve the efficient use of natural resources and assist industries in achieving sustainability. It covers emissions to air, land & water, noise & vibration, energy efficiency, waste minimisation, environmental accidents and site protection. It will apply to all new and substantially changed installations. During 2004/5, existing food and drink producers were brought under the IPPC if their finished product production capacity was over 75 tonnes/day. This will require businesses to obtain permits to operate and generate emissions to air, land & water. A part of the strategy entails the introduction of 'Best Available Techniques'.

The future holds more regulation, responsibilities and administration, leading to increased operating costs, but also to improved resource management on a holistic level.

In summary, some EU countries are more advanced than others on environmental management. Voluntary developments had variable success in the past. The EU favours regulation as a tool for improvement. The 'polluter pays' principle is in evidence everywhere now. As a result, businesses have higher operating costs and numerous operational difficulties. Waste minimisation is vital to improving business performance. Industry has become mindful of savings but needs help and support. Significant effort is needed to find and implement real solutions – no one solution exists for all situations. Waste minimisation is vital to business survival and ensures the maximised use of valuable resources. There is no escaping these realities and the only way to succeed is to start the process early and benefit from the opportunities that are presented.

In a follow up question it was clarified that the Authority receives a levy for each tonne of seafood landed or imported into the UK. The levy rate varies depending on the species and type of product. This levy is not applied to salmon and trout.

After Dinner Presentation: A New Industry Forum in Europe

Richard Watson (UK Sea Fish Industry Authority)

Biographical Sketch

Richard Watson graduated from Bristol University in the UK with an Applied Biology Honours Degree. He has worked at Tbilisi University in the former USSR on enzyme production from waste and later worked with the Leatherhead Food Research Association (UK) in their R&D group before joining the Seafish Industry Authority (UK). He has worked with Seafish for the past 15 years specialising in innovate developments in quality and safety of fishery products. Topics of research during this period have included: ice powered refrigeration systems; seawater disinfection; shelf life extension; water and effluent minimisation and end of pipe treatment systems; waste utilisation; and equipment/process design to reduce water and effluent costs. He has managed the Technology Development section for 5 years and is now a member of the Technology Implementation Department Richard is the UK representative to the Western European Fish Technologists Association.

In the mid-1990s, the Sea Fish Industry Authority conducted on-site audits of water consumption and waste generation at processing plants in many parts of the UK. Their experience has shown that low cost and even no cost solutions can provide substantial savings in both water consumption and waste disposal charges. In the end, minimising wastes in the plant reduces end of pipe costs. This is a universal lesson as applicable in Canada as it is in the UK.

The important thing to note is that collaboration between industry and government and also to some extent between countries has proven to be mutually beneficial. In the EU, for example, the UK has learned from Denmark which had in turn picked up ideas from Sweden which faced the same issues twenty or so years ago and by attending this workshop these lessons are being shared with Canadians. But this form of information sharing is not the norm. In the EU each country focuses on its own industry and there is generally minimal collaboration between countries and even sometimes little collaborative effort between organisations within one country. For researchers who are operating in this field it is sometimes difficult to find out what others have already attempted and with what results. This results in an inefficient use of personnel, time and resources . This can also really affect business negatively. For example not learning from others and not even knowing in some cases about legislative changes until they are upon you can be economically devastating.

In an effort to improve on this situation, recently the Sea Fish Industry Authority in the UK has begun to develop a new initiative to promote increased and more efficient exchange of ideas across Europe. This new industry forum or virtual network would serve as a professional resource “central hub” for collaboration and information exchange between industry and research.

It will be cognizant of the needs of industry as well as researchers. These are not one always and the same. Through the forum it will be possible to find applied technical information not easily uncovered and, where necessary, translated into different languages. The latest scientific developments will be showcased. It will provide a bulletin board to answer technical questions and incorporate a powerful database to permit users to find institutes that provide a particular product or service. Details of upcoming events and recruitment and research opportunities will also be exchanged. Most importantly it will give industry a mechanism to participate in and steer new research to address real needs. It will also collate and forecast the threats and issues facing each sector of the industry and provide targeted dissemination.

Potential benefits are huge, but now Seafish are looking for ways to make it all come into being. The Western European Fish Technologists Association, representing 20 countries, with membership composed of one organisation like Seafish for each country, has considered this concept and given it unanimous approval. The UK network will be built first as a model by Seafish, this model will then be applied to other countries, built by its own industry.

Each country network will then feed into one common hub. Other countries like Canada, US and the Far East have much to contribute and to gain and will be encouraged to consider joining the network. Canada could show the way to others by becoming the first country outside of Europe to join the network.

The next WEFTA meeting will be held as a joint meeting with the Atlantic Fisheries Technology Conference to be held in Québec City on the 16^{th} to 18^{th} of October 2006 and this would make an excellent opportunity to discuss further the idea of Canadian participation in the network.

A follow question had to do with the ban on use of fish meal for ruminant feed in the UK. It is true that this is not allowed but within the legislation there are technical uses for wastes that are allowed. For example the extraction of chitin from crab and Nephrops shells (so-called Norwegian lobster). There may not be a large enough quantity of this kind of waste in one area to allow this to be practical in the UK but it could be viable in Canada. Also it is permissible to extract pigments. There are also potential uses for fish bone that is known to absorb heavy metals from soil and can be used in mining remediation as mentioned by Michaela earlier. Other pharmaceutical and medical products are also produced from seafood wastes. Seafish has produced a report on this subject which includes twenty or thirty different technical uses for seafood wastes. So even though the legislation may seem restrictive, it does force the industry to find imaginative and profitable uses for the fish waste, which also serves to conserve the resource by optimising the use of raw material. Each country has to address its own circumstances (e.g. location, quantity and type of wastes available) in order to determine the best options for utilisation of this valuable material.

Chapter

4

Theme 3: What more can be done to reduce environmental impacts?

Conventional and interesting new technological advancements

Co-Chair: Andy Chapman (CCFI)

Biographical Sketch

Andy Chapman is originally from Newfoundland and currently resides in Bedford Nova Scotia working as an Industrial Liaison Officer for the Canadian Centre for Fisheries Innovation covering the Maritime Region. Andy has a Bachelor of Business Administration with a double major in Management and Marketing. Andy's career began in the early 80's as a fisherman on both inshore and offshore vessels. After completing university he built and managed a processing facility and eventually returned to sea with DFO enforcement as well as science. In the mid 90's Andy became Newfoundland operations manager for 300 fish quality inspectors covering 60,000 vessel landings per year. He has developed and facilitated in excess of 100 seafood quality training programs reaching in excess of 5,000 fish harvesters and processors for government, industry associations and community colleges. He has conducted scientific assessments of various marine species as well as assessing efficiencies in both the harvesting and processing sectors. A jack-of-all-trades, Andy continues to learn about and share his knowledge of all aspects of the industry.

The purpose of the third Theme session in this workshop was to gain some insights as to progress made in the technological area that might offer some opportunities for those industries facing situations in which the application of best management practices alone was found to be insufficient to regulate their wastes. At the Shippagan workshop in 2003 a variety of options were presented under this Theme, many of which were impractical at the time due to their cost or the difficulty of their application in this industry in particular. The following presentations were intended to provide an update in order to ascertain if options now existed that had not been available or as easily applied previously.

3.1 Treatment technologies for seafood processing effluents - advantages, disadvantages and impediments to their broad-scale implementation.
Adrian Desbarats, Atlantech Companies

Biographical Sketch

Adrian Desbarats graduated from Dalhousie University with a degree in Marine Biology. He is currently employed as the Senior Biologist for Atlantech Companies in Charlottetown, PEI. He has over 6 years of experience in the area of design and construction of water recirculation systems and effluent treatment systems

The topic given for this presentation is very broad and in order to narrow in somewhat the discussion will focus on effluent characteristics, discharge reduction strategies, capital costs and operating costs. The presentation will deal with the state of the art in primary, secondary (e.g. DAF) and some tertiary treatment options. Atlantech's experience has been largely related to salmon processing operations. Some of the experience gained in that area will be provided as it applies to the seafood processing industry more generally.

The major sources of liquid effluent in a salmon processing operation are bloodwater processing line wastewater, clean-up wastewater and surface runoff from the external facilities. The latter two streams are relatively low in strength, particularly in terms of BOD. Overall in the order of 80% of the waste stream by volume comes from processing. Blood water, though it only constitutes 10% of the flow, represents the highest strength stream.

For example, BOB ranges from a low of about 400 mg/l to a high of 6000 mg/l. TSS can range from 500-2000 mg/l. Oils and greases (O&G) range from 100-1500 mg/l. Bloodwater represents the upper end of all these limits. Other typical parameters like salinity and temperature are dependent on local conditions.

Dealing with effluents of these characteristics may entail a step-wise progression from primary through tertiary, starting with optimised best management practices to avoid unnecessary expense.

Best management practices begin with reduction of water use and continue with the reduction of the escape of large particulates in the effluent. Capture of solids at the source is the optimal approach. Otherwise the turbulence in the line will take solids and reduce them in size and also leach out the nutrients. Identification of the characteristics of each contributor to the final waste stream is essential to focus effort on those high strength streams that can be concentrated and isolated to be dealt with separately.

When dealing with primary treatment, settling is not a preferred option because again the solids stay in contact with water longer and the BOD increases the longer the contact.
The choice of technology is critical because by removing the contact of solids with water impressive reductions in BOD and TSS (on the order of 50%) are feasible. Atlantech recommends use of drum filtration, belt filtration and sieve screens as several good options for this separation process in different applications. For example a belt filtration system would be preferable for dealing with delicate and easily dissolved materials like tomalley.

Secondary treatment systems such as Dissolved Air Flotation (DAF), when used in conjunction with chemical flocculating agents, are capable of removing up to 85-90% of BOD and TSS and 65-85% of oils and grease. The main problems with these systems are that that produce 25 gallons of sludge for every 1000 gallons of waste water treated and they are also expensive to build and operate.

Tertiary treatments involve some form of biological reaction to reduce remaining organics. These are only recommended where a very strict limit on final BOD and TSS (20 mg/l) is dictated because in addition to being expensive they are also highly temperature and load dependent and require expert technical management. A typical tertiary treatment system that would be appropriate for processing seafood processing effluents would be sequencing batch reactor (SBR).

Capital costs for primary, secondary and tertiary treatment are load dependent to a greater or lesser extent. Primary treatment (e.g. belt filter) is the least load dependent rising only slightly in cost for systems producing 400 gpm versus 100 gpm (e.g. $50K versus $40K). Secondary treatment costs increase more or less in direct proportion to load (e.g. $400K+ from $200K) for the same range of wastes. Biological treatment is most expensive of all (perhaps $660K for a system capable of handling 100gpm) and is not recommended for systems with larger volumes of effluent.

Operating costs for the three levels of treatment vary as well: primary from 3-6 cents per 1000 gallons; secondary from 50 cents to $1.80, though this can be highly variable ; and tertiary from 45-60 cents.

In conclusion, improvements in best management practices and use of mechanical treatment could potentially reduce BOD and TSS discharges by more then 50%. If additional treatment is required, separation of high BOD / TSS water for secondary treatment may be an option (e.g. bloodwater).

In the following questions it was remarked that settling systems shouldn't be rejected out of hand; swirl separators could potentially be very effective for handling tomalley for example. Settling tests conducted during the experiments on the six processing lines mentioned earlier in the workshop suggest this may be a worthwhile area for further research. Adrian noted that in salmon operations it has been found not to be effective due to leaching and resuspension, but it may have applications in specific instances in other processing lines.

The question of dealing with sludge from DAF systems was also raised. How "user friendly" is this material and are there any applications for its use? In reply Adrian note that this all depends on what the local circumstances are. In some cases it can be sent to a rendering facility. But it is only 6% solids normally and the renderer won't take it unless concentrated to reduce cost of boiling off the water. Moreover, flocculating agents have to be approved for animal use by CFIA, which adds expense.

On the same subject it was observed that the DAF sludge from shrimp processing produces sludge that would appear to have many potential uses but the problem is with the chemical flocculating agents. There needs to be more research to give value to this as a product. Adrian agreed that it is a shame to simply compost such a valuable source of protein and potential secondary products.

3.2 New and improved industrial approaches to wastewater treatment

Graham Gagnon and Margaret Walsh (Faculty of Engineering, Dalhousie University)

Biographical Sketch

Dr. Graham Gagnon is the Canada Research Chair (CRC) in Water Quality & Technology at Dalhousie University in Halifax. The Chair program is co-supported by NSERC and Environment Canada and has research priority in wastewater treatment for seafood processing and municipal effluents. In addition, Graham is also the Associate Director for the Centre for Water Resources Studies, which is the focal point for applied water research in Atlantic Canada. At Dalhousie, Graham has received research funding from industrial and governmental sources, which has been used to support graduate student training of over 25 graduate student researchers.

The Dalhousie Centre's laboratories have worked with many technologies over the past several years to assess their potential for application in the seafood processing sector with mixed success. This talk will therefore focus on laboratory studies on more conventional technologies. Much of the results reported are from research being carried out by Lee Jamieson, a graduate student in this program.

It is hard to generalise when talking about treatment of seafood processing effluent because they vary so widely in their nature from one plant to another. For example readings for standard parameters may vary as follows: BOD – 100-10,000 mg/l; COD – 400-50,000 mg/l; Nitrogen (as Ammonia) – 10-100 mg/l; and TSS – 100-25,000 mg/l.

The standard federal guidelines (1970) only require use of a 25 mesh screen and a submerged outfall; this does little to reduce the effect of effluents of this strength. Eutrophication, acute and sub-lethal toxicity and bioaccumulation of unwanted chemicals are all a potential result. Treatment by sedimentation (e.g. by use of alum) and by DAF have both been recommended in the literature as being capable of reducing BOD, COD and TSS by two thirds to three quarters. But much research is still needed on effluent characterization, treatment options, aquatic toxicity and receiving water body impacts/loadings. Biological treatment options do have some definite advantages but the technology is still being reviewed for application in this industry.

In work currently being undertaken by Lee Jamieson, samples are being collected from a variety of processing operations across Atlantic Canada for characterisation using the standard measures mentioned above plus Absorbable Organic Halides (AOX) and for assessment of potential treatment options. The routine method of sampling is by use of an automated composite sampler which collects 100 litres over a working shift (10 hours normally) for waste characterisation and toxicity studies. A second sample of 4 litres is taken for AOX measurement.

In the laboratory bench scale tests for treatment options simulated the use of 25 mesh screens, sedimentation with alum and DAF with alum using TSS and turbidity as measures of effectiveness.

Types of processing lines sampled included Jonah crab and Lobster (from NS), Snow crab (from NL), Yellowtail flatfish (from NL) and Atlantic salmon (from NL).

As expected, in one set of experiments on Yellowtail, it was found that simply screening the effluent did little to reduce loading and in some cases may even increase the release of nutrients leading to higher BOD. SED proved much more effective (e.g. >70% reduction in TSS and turbidity) but did little to reduce Ammonia. While DAF with alum reduced all parameters even more, including Ammonia, which was reduced by 27%.

Similar results were observed in salmon except that unexpectedly overall loading reductions were better by sedimentation than by DAF.

Mirroring earlier results of similar tests carried out by Environment Canada (see report by Christine Garron), persistent toxicity is a problem in most cases however, even after treatment. In fact toxicity actually increases after treatment.

In conclusion, though both the sedimentation and DAF with alum treatments offer promise for reduction of many of the harmful elements within seafood processing effluent, the persistent acute toxicity of these effluents after treatment remains of concern and demands further research. Preliminary results from attempts to reduce the toxicity by pH adjustment were disappointing.

A question was asked if the any of the alum escapes with the effluent after treatment or if it is all captured. Graham indicated that it is all captured because of the pH adjustment they use.

Address by Byron James, Deputy Minister, NB Dept. of Agriculture, Fisheries and Aquaculture

Biographical Sketch

Byron James obtained a Bachelor of Economics and Political Science from Memorial University in Newfoundland, and has completed graduate work in Economics. He has held several positions with the government of Canada, including the Unemployment Insurance Commission and Employment and Immigration Canada in New Brunswick. Since 1987 Mr. James has served in a number of senior capacities with the Province of New Brunswick. He was appointed deputy minister of Municipalities and Housing in June 1998 and on April 1, 2000 was appointed deputy minister for the Department of Environment and Local Government. Since October 1, 2003, he has held the position of deputy minister of Agriculture, Fisheries and Aquaculture.

Mr. James thanked the NB Seafood Processors Association for the invitation to speak at the workshop and conveyed the regrets of Minister Alward who was unable to attend personally. He noted that since the recent changes in Cabinet, Minister Alward was reappointed to his present portfolio and was very pleased at this outcome since it is a function that he finds personally rewarding and enjoyable. Mr. Alward has indicated that he looks forward to continuing to work with the seafood processing sector in addressing its problems.

Mr. James note that he is personally very aware of the results at 2003 workshop because at that time he was Deputy Minister of Environment and Local Government and had heard first hand of the concerns the public was expressing as well as being kept aware of the industry's progress on this issue by Danny Stymiest and others who have been working on the front line in Lamèque and other areas to find solutions for several years.

Mr. James noted how impressed he was with how much progress has taken place in three short years, as this event has demonstrated. Three years ago there was some reluctance to face up to the issue or even admit that it is a problem. But since then industry has shown that is clearly not shirking its responsibility. It has shown that it can be viable while mitigating effects on the environment. This is not an either/or debate and is not about being for or against the environment. The six pilot projects show us where to go but there will be hard work and financial investment required. However there is no alternative as we need to protect the health of the oceans that produce our resources. Any negative effects on this industry will also affect the local communities that depend upon the industry for a livelihood. Mr. Byron commended the industry for their continuing work on this subject. In the end everyone agrees that this is a much better way of approaching the problem than top down regulation. It is far better to improve the handling of the raw product and be able to sell more of it than to have to treat the product as effluent at the end of the production line.

The NB Seafood Processing Association has shown that much more can yet be achieved by cooperation across the sector and by partnering with others such as the Coastal Zones Research Institute to improve capacity to provide a proactive approach to these issues in the province. The Association has also made a significant contribution to improvements to the Seafood Processing Act, enabling legislation for which will be introduced in the legislature in the Spring. The NB industry produces $820M in exports annually from NB and from Canada. It is known for its safe, wholesome and high quality products. Although this is a significant contribution to the provincial economy it does not make the NB industry market giants by any means. Environmental concerns, uncertainty in the supply of resources, currency fluctuation and global competition are challenges that must be faced. The industry must therefore constantly capitalise on opportunities to work together for common solutions. Minimisation of waste is the key in this case. The NB Department of Agriculture, Fisheries and Aquaculture stands ready to continue to support this project and other projects that the industry embarks upon in a cooperative manner.

Theme 4: What are the environmental effects of seafood plant effluents and other land-based nutrient sources?

Chair: Simon Courtenay (DFO and UNB)

Biographical Sketch

Simon has worked as a research scientist with the Gulf Fisheries Centre, DFO since 1990 and is presently posted to the University of New Brunswick in Fredericton NB as a Research Professor in the Department of Biology. He is a Fellow of the Canadian Rivers Institute and also serves as Professeur Associé en biologie, Université de Moncton, and Professeur invité á l'Institut national de la recherche scientifique, INRS-Eau, Terre et Environnement - Université de Québec. He has contributed to over a hundred journal articles and technical reports in the fields of estuarine ecology and ecotoxicology and since 1994 has contributed to the development of the Environmental Effects Monitoring (EEM) programs for Canadian pulp and paper mills and metal mines. Present research in Dr. Courtenay's lab includes environmental impacts of offshore oil and gas development, seafood processing plant effluents, and bivalve aquaculture.

Having spent the first day and part of this morning focused on issues inside the plant, it is now time to move to the receiving environment to see what is being learnt there. In a very real sense, as pointed out by Mike Chadwick on the first day of the workshop, that is where the impetus for all of this originated three or four years ago. It is also essential to touch base there again at this time so that we can plan for the future this afternoon.

4.1 Lamèque Harbour – an example of community and industry cooperation

Bertin Gauvin (Lamèque and Shippagan Sustainable Development Committee)

Biographical Sketch

Bertin Gauvin is the Executive Director of the Coalition for the Viability of the Environment of Shippagan and Lamèque and Miscou Islands. This community-based organisation works with government to find solutions to local environmental concerns. He represents his group as an active member of the Southern Gulf of St. Lawrence Coalition on Sustainability (Coalition-SGSL).

The Coalition for the Viability of the Environment of Shippagan and Lamèque and Miscou Islands is a community-based non-profit organisation which was created in 2001 and continues to be financially supported by the New Brunswick Environmental Trust Fund. Its territory is quite large, extending a distance of 3 km from the shore starting from Shippagan Harbour itself into the Baie des Chaleurs and around the islands of Lamèque and Miscou into the Gulf of St. Lawrence, covering many bays (e.g. Baie de St. Simon nord et sud) and harbours. The Mission is to promote environmental, economic and social viability and the mandate is to coordinate integrated management in the community, including all essential partners (e.g. the communities, municipalities, federal and provincial agencies, industry, schools and research centres etc.).

Since 2001, one of the major preoccupations of the Coalition has been responding to citizen complaints about the problem in the Lamèque area, particularly the bad odours in summertime. Local and even national media picked up on the problem, making the matter of finding a solution all the more urgent. The first step undertaken by the Coalition was to conduct an inspection of the entire surrounding coastal area to try and find the source or sources of the problem. Many potential sources were identified including the municipal treatment plant as well as the seafood processing plant effluents, the peat moss industry and the use of the harbours by commercial and recreational vessels. Effects were very obvious in the overgrowth of algae, particularly sea lettuce. Perceptible symptoms were visibly evident in the marine environment as well as in terms of air quality.

In 2002, the municipality was successful in petitioning the Department of Environment and Local Government to put in place an air quality monitoring unit in the centre of the residential area most affected which tested the air for signs of excess H_2S, ozone and other chemicals. That same year, the department of Health had issued health advisories twice cautioning people to stay indoors during the periods when air quality was most degraded. In 2002 there were 125 hours of air quality considered bad. This decreased to 113 in 2003 and 91 in 2004.

In 2005, there was a noticeable improvement in air quality with only 3 hours in which bad air quality was indicated. What has led to these improvements?

The first step under by the municipality was to fill in some of shallow shoreline areas where the dead algae accumulated and rotted. They also commissioned a study of hydrology and currents and noted that there was very limited exchange in the area. In 2003 the first workshop on seafood processing effluents took place in Shippagan and this was a significant motivator for action. The Working Group was set up and immediately began to work on the best management practices needed to reduce effluents from seafood processing in NB.

Each year a team effort has been mounted to harvest the algae from the shoreline and in the water. Some of the marine harvesting techniques have not proven more useful than others. They experimented with mechanical harvesting in 2003 but the results were not encouraging. In 2004 they used a modified scallop drag which was more effective. In 2005 they have continued testing using an amphibian machine. The processing plant has contributed to this effort by contributed the containment bins and a lift. The effort is now much more efficient than at first - 150 tonnes were harvested last year, 80 from the sea and 70 from the shore. Disposal of the algae presented a problem at first but this was resolved by finding a composting solution. It was determined that it was necessary to wash the algae to remove salt and once this was done it decomposed quickly in the peat areas set aside for this purpose.

Last year the municipality experimented with a windmill-driven circulation system in and attempt to provide better movement of water in the bay.

The Local seafood processing plant has been making constant improvements in its handling of waste over this period including the installation of a DAF treatment system at considerable expense, but which has proven quite effective and also participation in the BMP project.

Also a collaborative effort involving the Coalition along with the two levels of government has been put in place to conduct analyses of the harbour sediments.

Finally, the Coalition is collaborating with a graduate student, Marie-Hélène Thériault, to carry out comprehensive aquatic biological surveys in the area which include assessments of the fish communities, macroalgae, water quality, and laboratory analysis of results.

In a related and important initiative, the Coalition also works in the educational system at schools to teach children about their environment. They have installed a small scale salmon hatchery in schools and also lead them on annual shoreline cleanup campaigns.

A follow-up question was asked on the future of sediment analysis program. The group cooperating on this work will continue with these studies. They will also continue to support the work on local aquatic life and plant to look into a restoration plan for the nearby salt marsh. But of course all of this depends on financing being found.

4.2 Observations on seasonal variability and geographic distribution of organic enrichment in sediments of Lamèque Harbour

François Plante (DFO Gulf Region)

Biographical sketch

Originally from Quebec City, François Plante studied Pure and Applied Sciences in College before pursuing a Bachelor degree in Biology at Laval University and completing his Master of Science in Oceanography at the University of Quebec in Rimouski in collaboration with the Maurice Lamontagne Institute (DFO – Quebec Region). In 2001 he moved to Moncton to work at the Gulf Fisheries Centre (DFO, Gulf Region) with the Snow Crab group where he was in charge of research projects on the biology of several species of crab. Since 2003, he has been employed as a Habitat Assessment Biologist with DFO's Oceans and Habitat program where one of his first assignments has been an environmental assessment in relation to the harvesting of algae in the Bay of Lamèque.

Fisheries and Oceans became involved in the issue of marine plant harvesting in Lamèque to combat the odour problem there initially because of concerns that the use of heavy equipment in the marine environment and the infilling of the coast may be harming fish habitat. The removal of algae from shoreline was seen as a part of a short term solution to the noxious odour problem being experienced by local residents and eventually it was necessary to extend this program out into the water since shoreline collection measures on their own were not having a substantial effect.

Fisheries and Oceans understood the link between the rotting of the vegetation and the air quality problem but felt that the contribution of marine sediments to the odour problem also needed to be assessed. The overgrowth of algae is not the cause of the problem; it is only an obvious and tangible environmental consequence or symptom of a broader underlying problem. The local seafood processing plant was one of the largest contributors of nutrients (N and P) which encourage the growth of algae. High BOD due to the effluents also reduces the O_2 available for marine life, which is further compounded when the algae die and decompose, consuming even more of the available oxygen. Much of the nutrients generated were being stored in the sediments, thus prolonging the incidents into the non-processing season.

Dominator Marine Services had carried out the first sediment sampling in the area under the ice in 2001 and 2002 for the Coalition and the Provincial Government. These surveys offered hints at a broader scale problem that needed to be isolated. Therefore the survey was repeated in 2005 first under ice in February and then later in November. The survey line to the eastward was shifted to the west into deeper water than sampled in 2001 and 2002 since the area sampled in those years was fairly clean and it was speculated that the organic contaminants were concentrated in deeper water. A line of sampling was extended farther to the west to measure concentrations in the channel and also to examine whether there was a notable change in readings between the area most affected by the seafood processing effluent and the area near and beneath the aquaculture facilities in that location. Some of the aquaculture sites in the area are active and some are not. In 2006 it is hoped to add some more sites to try and characterise the whole bay area better and to clarify some of the findings in 2005.

There is a need to sample the sediments vertically at depth as well as at the sediment water surface to find where anoxic conditions exist. Consistent reductions in levels of contamination of sediments are apparent from 2001 to 2005. REDOX Potential (Eh) readings are a good analogue or indicator of oxygen concentration; these were returning to normal levels by 2005. By November of 2005, only the stations within 10m of the outfall site showed severely anoxic conditions. It was noted also that the stations close to the aquaculture sites do add to the sediment contamination problem to some extent. Sulphide in sediments has been declining consistently and is now at near normal levels except very close to outfall once again. There are some apparent increases in contamination in the main channel that bear further examination in future sampling. These may be anomalies due to the scale and location of the sampling grid or they may be a true reflection of the redistribution of contamination with bottom currents.

There are many possible reasons for these improvements occurring. Most likely it is a combined result of the work undertaken by Bertin Gauvin’s group, the town and the seafood processing plant (DAF system, BMP etc.). But there is still a need to keep sampling to be sure this represents a permanent trend toward more normal conditions in the harbour. Also it is important to make sure that the improvements in the plant and the harvesting of algae must continue to maintain this improvement because the long term problem of higher than normal nutrient levels in the harbour still exists and will continue to promote excessive growth of algae.

In the follow-up questions it was observed that at least some of the improvements observed could be attributable to the seasonality of seafood processing operations and this would dictate the need to sample at the same time of the year each time. François agreed. The frequency and timing of sampling depends to a large degree on the budget available. But even so the November 2005 results are very encouraging because the plant was operating all summer and fall in that year.

4.3 Eutrophication of Marine Environments: Efforts to Develop Standards/Guidelines and a Framework for Canadian Nearshore Marine Waters

Sushil Dixit, Environment Canada

Biographical Sketch

Dr. Sushil Dixit is an environmental quality guidelines specialist at the National Guidelines and Standards Office of Environment Canada, Gatineau. He has been with Environment Canada for 4 years where he is leading many guidelines/standards/framework related projects covering nutrients, aquaculture, and bio-criteria. Prior to joining Environment Canada, Dr. Dixit worked as a Research Scientist at Queen’s University, Kingston, Ontario for 14 years.

Marine eutrophication is a growing concern in many estuaries, inlets and near shore coastal areas on both east and west coasts of Canada. The consequences of marine eutrophication can be quite severe. In extreme cases it can lead to finfish and shellfish mortality, elimination of benthic organisms, loss of habitat and biodiversity, and impairment of recreational value and subsequent decrease in property value of coastal areas.

Two parallel processes are unfolding to address this issue. The Canadian Council of Ministers of the Environment (CCME) has been developing a Nutrient Guidance Framework since 2002. At the same time, EC has been pursuing a project to look for a standard for coastal areas receiving agricultural nutrients. Mike Brylinsky, at Acadia University, is responsible for research on both of these activities.

In the CCME project, a scoping assessment in 2003 identified the fact that differences between the coasts (sites) make it difficult to establish a single criteria for nutrients in all parts of Canada but that coastal eutrophication is a significant concern in all parts of Canada – particularly in small inlets and bays. Important issues identified included blooms of toxic algae, over-stimulation of phytoplankton and macro-algal production, and highlighted the impacts of agriculture, finfish aquaculture and wastewater discharge as root causes.

High nutrient concentrations (Nitrogen - N and Phosphorus – P and Silicon – Si, in some circumstances) are the elements that contribute to eutrophication of coastal waters. Nitrates and nitrites are toxic to aquatic biota, livestock and humans. Ammonia is toxic to fish and invertebrates. There is a need to determine the amount of nutrients a coastal system can contain or assimilate before it begins to exhibit the characteristics of nutrient over-enrichment. There has been considerable success in answering this question for freshwater systems, but we are still in the early stages of determining this for marine systems.

Factors Influencing susceptibility to nutrient enrichment include dilution, freshwater inflow, volume, flushing rate, water residence time and tidal flushing.

Canadian guidelines are toxicity based and don't tell us much in terms of protecting from sub-lethal impacts like eutrophication. Phosphorous guidelines exist for this purpose in freshwater and but there is a need for a similar standard for nitrogen in the marine environment.

The CCME project began by looking at other programs around the world to see what would work best for Canada. The "Reference Condition" approach is most common. Also most have a technical advisory committee to develop these. Where long term data are not available there is a need to try a different approach such as using modelling and the fossil record. In Canada, a single criterion is perhaps not applicable, due to differences between coastal waters on the west and east coasts. Therefore regional working groups are required to establish the reference conditions that have historically represented the normal condition in different coastal areas.

The US EPA approach to standards development is the one recommended so far. Challenges in adopting this approach include the large amounts of data that are needed, the requirement for engagement of teams of experts and the need for case studies to test the standards. At the moment such case studies are taking place in NS and PEI.

EC's second project is the National Agri-Environmental Standard Initiative to develop Goals for the Marine Eutrophication. A case study for this exercise is also planned in NS and PEI. These will focus on Nitrogen and Phosphorous. It is planned to link biological effects data to nutrient trigger values and make necessary modifications in trigger values and then recommend threshold nutrient concentrations to prevent eutrophication in coastal waters as it relates to agricultural activity.

4.4 Oceanographic Variability: should it be factored into the determination of regulatory controls for industry?

Joël Chassé and Fred Page (DFO-BIO)

Biographical Sketch – Joël Chassé

Dr. Joël Chassé (BSc, MSc, PhD) is a research scientist in the Division of Aquatic Resources at the Gulf Fisheries Centre (Department of Fisheries and Oceans). He has used numerical modelling techniques to conduct studies in the St. Lawrence system since 1986. The range of applications varies from two-dimensional simulations of tide propagation to sophisticated three-dimensional ice-ocean numerical modelling. Over the last few years, he shifted his research interest towards biophysical modelling in order to address fisheries related issues. He is a regular contributor to stock assessment reviews and an active participant in Fisheries and Oceanography Committee (FOC) and Atlantic Zonal Monitoring Program (AZMP).

Biographical Sketch – Fred Page

Dr. Fred H. Page (BSc, MSc, PhD) is a research scientist and Manager of the Ocean Sciences Section at the Canadian Department of Fisheries and Oceans Biological Station in St. Andrews, New Brunswick and an Adjunct Professor at the University of New Brunswick (UNB). His research expertise is in marine ecology, physical-biological oceanography and the application of these disciplines to aquaculture, fisheries and coastal zone issues. His interest in the fish processing plant effluent issue is in the transport and dispersal of plant outputs and its consideration in ICZM, environmental monitoring and decision support contexts which links directly to his current research interests.

This was a two part presentation with Fred Page presenting a coastal zone perspective, using some modelling examples from the Bay of Fundy and Joël Chassé providing the oceanographic context using modelling examples from the southern Gulf of St. Lawrence.

The process of modelling interactions in the coastal zone is extremely complex and involved many layers of information obtained from multiple sources of data. These include the underlying substrate, which forms the basic habitat, coastal marshes, freshwater inflow, currents, exchange of water with the open ocean. All of these physical variables must have superimposed upon them the various living marine resources, for which presence is often variable over time due to migration. The human influence then needs to be layered over top of the natural environment and these influences form a varied mosaic as well, each activity having its own zone of influence which intersects in most cases with those of other activities.

In the cases of activities that produce effluents from a point source, these are more complex because their plume can vary over time and space due to volume but also the physical effects of tides and currents. Thus the zone of potential influence varies over time and space and the significance or intensity of this influence varies accordingly as well. It must not be forgotten, in addition that each of these influences can be compounded when the cumulative effect of all activities is taken into consideration. The overlaps are the key to understanding impacts.

Applying this generic model to the case of a fish plant implies characterising the output in terms of strength and volume, using models and assumptions to estimate the zone of influence and overlaying this on known habitats and resources as well as other activities in the area. This allows the cumulative impact to be assessed at least in relative terms and compared against marine environmental quality objectives for that area. In some cases, monitoring programs may be required to test the assumptions made. Afterwards decisions can be made on siting, management strategies and so on.

Where oceanography can contribute to the exercise is in the determination of delineation of the plume, modelling and assessing water quality and linking to the biological/ecological effects expertise.

Dealing even more specifically with seafood processing effects, some issues of concern may include nutrient build-up and associated oxygen depletion, spread of diseases and invasives and the fouling of fishing and aquaculture gear with grease and oils. The zone of influence of a seafood processing operation will be different (usually broader) in the water column than it will be in the sediments, though the later will be more constant over time than the former, which fluctuates with the tides, currents, freshwater runoff and weather driven wave conditions. In most cases this variability demands actual monitoring of plume movement by means of various kinds of tools such as current meters, and tracking of passive drifters, though various kinds of simulation modelling may also provide clues. Often the results aren't what one would expect intuitively. For example, simply because an area is subject to intense tidal flushing doesn't mean that plumes will be quickly dispersed. Often the results show that the returning tide simply brings back with it the contaminants that were originally removed from the area. For sediments, the sampling and testing for variables such as sulphide is simple and most effective in measurement of the zone of influence.

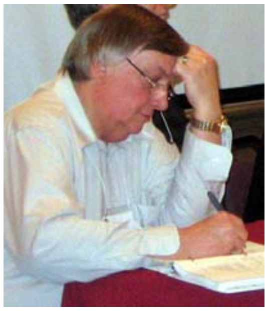
In the Gulf of St. Lawrence, four levels of simulation modelling, from simple to most complex, have been employed in the offshore and the presentation by Joël was intended to bring the benefit of this experience into the coastal area. Level I models are based on static conditions and can be used to look at flushing time based on volumetric calculations and the known or estimated rate of freshwater inflow and waste loading. The strength of Level I models is in their simplicity of application but obviously they provide only rough estimates of the real world situation. Compared to this, Level IV models are much more complex three-dimensional models that can take into account the hydrodynamic conditions based on accumulated data from many years of surveys and many much more precise physical measurements that allow improved predictability. These have generally been employed at the larger scale offshore (e.g. 4 km by 4 km scale) and there is a challenge involved in making them applicable at the narrower scale of coastal processes.

Even so, some of these larger scale models, such as one demonstrated for the current movements in the Gulf, can provide very useful input into the understanding of the oceanographic influences affecting a particular area of the coast. In response to specific needs other higher resolution models have been developed and applied to much narrower scales, for example the scale of the Northumberland Strait or even the scale of a single estuary such as the Hillsborough River estuary in PEI. Models at this scale can be used to follow particles in an attempt to follow the effects of both freshwater inflow and tidal flushing for example to define zones of influence as Fred discussed.

From models such as these it is possible to take into account advection to assess vertical and horizontal movement of particles from a source to a sink simulating the movement of an actual tracer.

The real world is far too complex to be able to simulate with total accuracy in a computer model but the estimates of real life conditions that models provide are a useful alternative to the application of vast quantities of resources needed to carry out real time sampling over a large area and an lengthy time frame. They allow us to pinpoint where monitoring is needed to validate and test scenarios suggested by the model's output.

Panel discussion on receiving environment effects
Moderator: George Lindsay (EC)



Biographical Sketch

George Lindsay, P. Eng. is a member of the Association of Professional Engineers and Geoscientists of New Brunswick, and is currently the New Brunswick Provincial Manager for the Environmental Protection Operations Directorate of Environment Canada. He is responsible for the implementation and coordination of the programs of the Environmental Protection Operations Directorate in New Brunswick. George graduated from the University of Waterloo in 1970 with a B A Sc. in Civil Engineering, and with an M A Sc. in Environmental Engineering in 1972. He joined Environment Canada in that same year and has worked in several locations and on issues provincially, regionally and nationally with that department in the intervening years. He has extensive experience in dealing with environmental regulatory issues including the food processing industry.

The panel discussion that concluded the morning's presentations included the speakers from both themes dealt with during the morning: technological advancements in pollution control and studies on measurement of receiving environment effects. Participants were asked to submit questions and make observations on both themes and the speakers from these themes were present to respond. In addition, Christine Garron, who had presented the results of EC's work on seafood plant effluent characterisation on the first day of the workshop, participated in the question and answer session.

One workshop participant enquired further on the results that had been provided on improvements in the harbour sediments in Lamèque. What was shown was very encouraging but apparently other studies had been undertaken in the receiving environment as well. What were the results in those studies undertaken this year? George Lindsay explained that the results of much of the work undertaken in 2005 was still too preliminary to report on. He noted that the work reported on by François Plante led to the recognition by EC that a more in-depth look was needed so that is why EC has become involved in a sediment study in the vicinity of all the plants involved in the BMP project.

Andy Chapman noted that the timing of sampling in the Lamèque study was important so that comparisons could be made from one year to the next but what other environmental variable like water and air temperature were being taken into consideration that could have affected the results. Algal blooms being very temperature dependent, surely these factors must be taken into consideration to be sure that the results of apparent improvements are not misinterpreted. François Plante answered that the time of year does provide a built-in level of consistency in these other parameters. Ordinarily summer temperatures and winter temperatures under the ice are within a range that is consistent year to year that should theoretically produce the similar responses in the environment. That being said, they do test for and try to take into consideration the temperature and other environmental variables. Sampling methods like REDOX are adjusted for temperature.

A question was posed in regard to regulatory matters. It is assumed that any regulations that may eventually be brought into existence would be a part of the *Fisheries Act*. But what about the toxicity results that EC is obtaining? The industry is concerned about guidelines being written for toxicity that are based on laboratory results when in fact the results in the field do not reflect an unhealthy situation. For example, in Yarmouth Harbour there is a great deal of processing going on but yet the environment supports significant lobster, clam and other resources and is clearly not unhealthy. Christine Garron noted that there are no immediate plans for regulations. Rather the initial plan is to carry out what is known as an environmental risk assessment, characterisation of the industry across the country and potential effects on receiving environments. Such assessments do take into account the capacity of the receiving environment to assimilate and reduce the toxicity of effluents. George Lindsay added that long before the idea of new regulations can even be considered, data gaps need to be filled first to understand what the cause of toxicity may be. Through the application of BMP it may be possible to eliminate the causes (for example by ceasing to use certain cleaning chemicals) without regulations being required. The receiving environment work mentioned in this workshop needs to be expanded as well in order to determine the real consequences of these effluents.

One participant complimented the processing industry for their patience in being singled out for attention in this matter and noted that we cannot forget about the many non-point sources of nutrients that play an equally large role in the coastal zone as well. Coming to grips with this issue is not as simple as resolving point source problems. George Lindsay responded that in addition, the point sources, such as municipal wastewater, are always an issue as well.

Andy Woyewoda observed that it is good to hear a common sense approach to regulating the industrial sources is coming through but raised the flag because the community concerns often take precedence and this will force the hand of government to act more rapidly than may be advisable. George Lindsay noted that response to individual incidents will always demand a more immediate enforcement response but at the moment we only have the 1970 guidelines to work with and it is to everyone’s advantage to have clearer guidance than that offered by these guidelines on which to base future responses.

Paul Boudreau wondered how common the kind of problem in Lamèque was elsewhere. François Plante noted he knows of no other comparable situation in the Maritimes but there have been a number of similar problems on the St. Lawrence estuary in Québec. Lea Murphy added that Summerside Harbour had demonstrated a similar problem. That situation was resolved by collecting the multiple drains entering the harbour, combining them and emptying the waste stream into deeper, more active water outside the harbour. In that case they also reprofiled the beach to reduce the riparian zone exposed at low tide in order to alleviate an associated odour problem similar to the case in Lamèque.

Andy Chapman recommended a Precautionary Approach in regard to regulations. What approach will EC take while the studies are continuing? Will they be re-visiting the 1970 guidelines and when? George Lindsay repeated that they have to do the risk assessment first before the management approach is decided upon. It could be a new guideline, regulations or other means of controlling the situation. He is encouraged that it is being addressed nationally now and recognised as not just being an Atlantic issue. At our next workshop in three years time or so we may have something to add.

A question was raised regarding saltwater wells and the manganese and iron that are associated with these sources. They use UV technology on the water to remove these elements. Has the effect on surrounding sediments of all of this precipitate going out been the subject of any studies? François Plante mentioned that the slides were presenting the evolution of the iron in the sediment in relation to the availability of the oxygen. This slide wasn't a representation of the situation in Lamèque. He also mentioned that the analysis doesn't present any iron accumulation in the sediment. But the questioner wondered again if it shouldn’t be researched and François said it was a good idea but this would be an additional cost.

Chapter

5

Theme 5: Funding change – opportunities for financial support to research and implement process improvements in the NB seafood industry.

Moderator: Angélina Brideau, ABC Zenith Management Ltd.

Biographical Sketch

Angélina Brideau is the Coordinator for the NB Seafood Processors Association Best Management Practices Project. Prior to taking on this challenge she had occupied the position of Executive Director for a number of New Brusnwick based organisations including the NB Seafood Processors Association, the Fonds de solidarité pour l'industrie du crabe des neiges and the NB Labour Force Development Board. Angélina was in private industry for the ten years prior to these appointments.

The purpose of this Theme session was to afford an opportunity to a variety of funding agencies to explain the programs that they offer that may be of interest to the seafood processing sector in pursuing some of the further developments suggested by the work that has been carried out so far or that recommends itself as a result of the discussions at this workshop. Each speaker was given only ten minutes to outline their relevant programs and after all had spoken the floor was opened to questions.

NOTE: The future programming offered by ACOA was under review at the time of the workshop and as a result this agency did not participate in the panel. But it should be noted and acknowledged that ACOA was a significant participant in most of the work described at this workshop.

5.1 An Introduction to NSERC's Research Partnerships Programs

Biographical Sketch

Catherine Vardy completed her Bachelor of Science degree at Queen's University and her Bachelor of Journalism degree at the University of King's College. She is a member of the Canadian Science Writers' Association. As the Promotion and Research Development Officer for NSERC's Atlantic Regional Office, Catherine Vardy is responsible for promoting regional research achievements and NSERC's Research Partnerships Programs. She also coordinates NSERC's involvement in regional events throughout Atlantic Canada and acts as a link for science education. Before joining NSERC, Ms. Vardy worked as a Science Liaison Officer for Fisheries and Oceans Canada in Moncton and as a science journalist for the Discovery Channel, CBC Radio, the Times & Transcript newspaper and several magazines. She spent many years working as a scientific research assistant in the lab and in field camps throughout the Arctic.

NSERC is often confused with the National Research Council (NRC). The two organisations perform quite different functions. NSERC is the Natural Sciences and Engineering Research Council and it funds university researchers and students in natural sciences and engineering.

Twenty percent of the budget funds the Research Partnerships Programs which support applied research collaborations between universities and industry.

A simplified division of NSERC's activities would be to group them as "people programs" and "project programs".

Under the category of "people programs" one would include

- Undergraduate Research Awards – the student becomes an employee of the company; industry must pay the student but gets back $4500
- For Masters and Ph.D. students there are Industrial Post-graduate Scholarships –industry can arrange with a professor to provide a student to work on a research project; NSERC pays $15K per annum and the industry must contribute at least $6K; there must be no degree delays for the student due to confidentiality issues; the university can help with paper work
- Industrial R&D Fellowships for Post-Docs - $30K per year for 2 years from NSERC and the company puts in $10K per year; the Post Doc is considered an employee of the company

In the category of "projects programs" the following are included:

- Strategic Project Grants: the industry partner doesn't have to put in money in this one, but it is highly competitive with all projects across the country vying for the same funds. The subject has to be an important area for Canada's economy (list on web site). Proposals have to go through a university but that is good because they can help formulate it correctly. The average grant is about $130K per year for 1-5 years.
- Collaborative R&D Projects (CRD): Here industry must put in 50% of which 25% can be in kind. These projects deal with more basic questions rather than commercial application, which is left up to the company at the end of the project. The value can be $10K - $500K. If it is over $200K, a committee will review the project on site before awarding the grant. There is no submission deadline and the success rate for submissions is 80-85%.
- Research Partnership Agreements (RPA) are a partnership with university, industry and either Agriculture Canada, the Canadian Forestry Service or National Defence on a special range of topics of interest to them.
- Industrial Research Chairs (IRC) are set up at a university to provide support to exceptional researchers for large scale and long-term (5 to 15 years) research programs in areas of industrial interest (e.g. hydro, forestry). Each Chair is co-sponsored with 50% funding coming from the company.
- Idea to Innovation (I2I) is a technology transfer program to accelerate the pre-competitive development of promising technology at a university and transfer it to Canadian companies. NSERC shares funding with an early stage investment partner or Canadian company, up to $350K for 2 years

In summary, NSERC offers programs that support research, applications development, and technology transfer. To the extent possible, they provide flexible deadlines, funding levels and project duration. Staff at NSERC can provide advice and constructive feedback on ideas before they are submitted. The idea is to share the costs and risks of innovation with industry.

5.2 National Research Council's Industrial Research Assistance Program (IRAP)

Andy Woyewoda

Today businesses are faced with the combined realities of rapidly increasing globalisation and technological change as a result of which only about 32% of businesses survive their first five years. Innovation is crucial if a company is to compete and survive yet the costs and the know-how to innovate are challenges to small to medium-sized enterprises (SMEs). NRC's IRAP program is aimed specifically at the needs of SMEs and endeavours to assist them with both knowledge and funding support to stimulate innovation and promote growth.

The NRC structure consists of three pillars: Research Institutes, the Canadian Institute for Science and Technical Information (CISTI) and IRAP. There are 19 Research Institutes and 5 Advanced Technology Centres across Canada. The NRC Institute for Marine Biosciences in Halifax is one example. It has a strong focus on aquaculture and seafood safety. A new institute in PEI will deal with Nutrisciences and Health. IRAP links to all these institutes.

IRAP's 280 Industrial Technology Advisors are all chosen because of their intimate familiarity with the industrial realities and they provide technical information and also help to develop a plan of action to access IRAP funding. They help small companies to find ways to improve technology, increase efficiency, use raw materials more effectively and bring new products to commercial realisation. The goal is to reduce the risk of technology development. IRAP maintains strict confidentiality on all projects unless the industrial partner has itself chosen to go public with the results of the cooperation.

Technical risk is a key requirement for IRAP funding. Projects supported must contain a true research element in that they are innovative and lead to new ideas that would not have emerged otherwise. Companies supported are those Canadian companies with 500 or fewer employees. Information developed is proprietary and belongs to the company.
Up to $350K is available for support on an individual project. 80 % of the company's own labour costs associated with the project and 50% of any sub-contracted labour costs can be reimbursed but no other government agency can pick up the remainder. Other government support is also allowed for travel, equipment, capital costs and lease costs and in support of university research teams working along side of industry as well as any other costs that are outside of the IRAP project funding area such as parallel / linked projects and / or more routine data collection outside of the main IRAP-funded project.

A special case relates to working with industry associations on generic problems. In those cases it is permissible to stack funding with other government agencies to a somewhat greater extent than implied by the general rules above. In these cases the information belongs to the Association for sharing with the industry.

Projects can include feasibility studies, technology assessments, early investigation of concepts, adapting existing technologies to new applications, R&D to advance unproven technologies and R&D up to the point of performance testing of a model or the pilot prototype stage. Projects can carry on for up to 3 years.

In this region (which includes all of Atlantic Canada plus Nunavut) there are 36 Industrial Technology Advisors (ITAs) and in 2005/2006 there was $12.5 million in the budget, but it should be kept in mind that ITAs can work in their field all across Canada and the funds can be expended anywhere in Canada.

It is crucial to contact the ITA as early as possible to determine if the proposal is fundable and, if so, to assist in development of the proposal.

5.3 The Canadian Centre for Fisheries Innovation (CCFI)

Andy Chapman

The Canadian Centre for Fisheries Innovation (CCFI) was established in 1989 at Memorial University in cooperation with its Marine Institute. CCFI can tap into the expertise of over 100 scientists, engineers and technologists engaged in fisheries related R&D at Atlantic universities and colleges. CCFI is dedicated to solving industry problems and realising opportunities. To date over 600 projects, valued at in excess of $76M have been undertaken by CCFI in cooperation with industry.

In 2003, CCFI was expanded into the Maritimes when an office was opened in Bedford, NS. Projects that have developed as a result of this expansion involve most of the major universities and colleges in the Maritimes as well as research institutes like the Huntsman Marine Laboratory in St. Andrew's and the Coastal Zones Research Institute in Shippagan. Since 2003, 43 projects valued at almost $9M have been initiated in the Maritimes (42% of CCFI's entire portfolio of projects).

CCFI is able to use its funding to leverage investments from other institutions, government and industry. Industry alone has committed an additional $10 million in support of projects undertaken from 2002-2006.

To date about 30% of the overall budget has been spent in the processing sector, mainly on development of new products. The current projects related to seafood processing effluent are in support of the installation of the DAF system at the Lamèque Coop and the project to implement BMP. In the latter case, CCFI funding was directed at building capacity at the CZRI by supporting a junior engineer and laboratory analyses for the project.

The CCFI Advisory Committee recommends the kinds of projects that CCFI should be actively looking for and needs to be apprised of the industry's interest in following up on some of the leads resulting from the present work in NB. Others such as Agriculture and Agri-food Canada can help as well for example in looking for overseas markets for sludge from DAF systems. Similarly Provincial departments of fisheries are keen on secondary product development and can also assist to some extent.

At this time CCFI is pursuing an Atlantic Innovation Fund proposal for a further $42.5 Million with half to be spent in the Maritimes. If successful this will necessitate opening a second office with bilingual capability, possibly in Moncton.

CCFI is open and eager to develop further partnerships with industry and can provide the full range of expertise of Maritimes and Newfoundland colleges and universities to regional industry. A project valued at under $25 K can normally be turned around in a couple of days; larger projects may require a couple of weeks.

5.4 Canada Revenue Agency's Scientific Research and Experimental Development Program

Biographical Sketch

Jacques Fournier has been a public servant for over 26 years at both the provincial and federal level. He has spent his entire career in tax administration with the past 6-½ years as a Team leader in the Scientific Research and Experimental Development program, which is administered by Canada Revenue Agency. He works out of the Fredericton Office and reports to Halifax. He is responsible for a team of financial reviewers whose territory covers all of New Brunswick and PEI. He is part of a team that has performed internal quality assurance audits and program monitoring audits across the country.

The Canada Revenue Agency (CRA) Scientific Research and Experimental Development (SR&ED) Program is Canada's largest single program for providing assistance for industrial R&D performed in Canada. It provides approximately $1.8 billion distributed annually in the form of individual tax credits (ITC) among 11,000 SR&ED performers. What makes the program perhaps unique among R&D funding systems is that it never runs out of money – as long as industry is prepared to carry out R&D, they will be compensated in the form of these tax credits to the full extent permitted.

CRA considers it their objective to promote the program and to stimulate Canadian SR&ED by quickly and consistently delivering these incentives to all companies that carry out eligible work. Eligibility criteria are very broad. In the *Income Tax Act* SR&ED is defined as: "A systematic investigation or search carried out in a field of science or technology through experimentation or analysis".

Applications require nothing more than a 4 page submission giving financial data and details of the work carried out.

Individual Tax Credits for SR&ED exist at both the federal and provincial levels with SMEs benefiting somewhat more than large corporations. For SMEs the refunds amount to 35% from the federal level and 15% from the provincial level while large corporations may receive 20% and 15% respectively. It is important to note that the industrial performer may also get funding from other sources as well but of course these amounts must be declared and are deducted from the qualifying expenses eligible for rebate.

It is part of the service provided by CRA to inform interested individuals and companies of this program through seminars and to assist first time claimants in particular in completing their pre-claim project review. These free services should be taken advantage of when doing planning. They provide more up-front certainty about the eligibility of R&D projects for SR&ED tax incentives and also afford the opportunity to receive a preliminary opinion without having to generate extensive paper work, thus, potentially reducing claim preparation costs By having an open and informal discussions about the eligibility of R&D work for SR&ED tax incentives a better understanding is provided of the SR&ED program and of the type of R&D projects that qualify.

Even if a project results in a failed experiment this proves that something cannot be done in that manner and that in itself is a successful result allowing the industrial performer to test other options.

Everything is confidential under *Income Tax Act*.

5.5 Business New Brunswick

Biographical Sketch

Mr. Larin grew up in the fishing community of Richibucto, NB. He graduated from l'Université de Moncton with a Bachelor degree in Business Administration and has since worked in economic development assisting entrepreneurs and businesses in the areas of business planning and financing. He worked for approximately 15 years with Community Business Development Corporations in South-eastern New Brunswick. Six years ago, he joined the provincial department of Business New Brunswick and has helped deliver a number of financial programs. Mr. Larin currently manages the fisheries and aquaculture portfolio representing over 250 loans and $70M.

Business New Brunswick is the province's economic development department, providing services to help entrepreneurs grow their businesses. They offer consulting and counselling services, financing and assistance with partnering. Their target sectors include manufacturing, value-added and information technology industries.

Their purpose is to assist industry to develop markets making the most of their opportunities both at home and abroad and to modernise their operations.
To further their efforts Business NB links with Agriculture, Fisheries and Aquaculture to promote development of this industry.

They also assist with financing to fisheries among other industries in the form of loans and loan guarantees to assist businesses in establishing, maintaining, growing and improving their productivity and export efforts.

Business New Brunswick offers a number of financial assistance programs:

- **Technical Adoption and Commercialization Program** provides funding for direct costs associated with identifying and securing technologies and processes for firms addressing technological innovation and pre-commercial product development needs.
- **Trade Assistance Programs and Services (TAPS)** introduces New Brunswick companies to exporting, and assists in the development of "new" export markets outside Atlantic Canada.
- **Financial Assistance to Industry Program (FAIP)** provides funding for capital expenditures and working capital to enable the establishment, expansion or maintenance of eligible industries.

In regard to the fishing industry more specifically there are also a number of direct programs including:

- **Fisheries Financial Assistance** provides funding to the commercial fishery and the aquaculture industry in order to establish, maintain and expand.
- **Loans for Commercial Fishing**
- **Loans and Loan Guarantees for Aquaculture**

Partnering is as important as access to financing in making progress. They help to form partnerships with university, research organisations, government departments and industry.

New Brunswick's Innovation Agenda is another major push by Business NB. In addition they provide directed assistance to the industry through support to participate in such events as Boston seafood show.

All interested companies are encouraged to speak with them or with their partners in DAFA.

Questions and Answers

A general question and answer session followed these presentations.

The first question of interest to all was how to match funding from more than one agency. Andy Woyewoda responded IRAP's rules have been simplified to allow this now. In general 20% cannot be funded by anyone else but the industrial partner. 50% of subcontractors salaries and 35% of other services may not be reimbursed but all the rest is eligible for total government funding. Catherine Vardy noted that in the case of NSERC the portion of the project funding designated as the industry contribution must come from the industry's own funds. There are ways to tap into other government sources but it is a bit difficult. Also you can break off certain parts of a project for funding by other agencies. Andy Woyewoda emphasised again that when working with Associations stacking is more feasible but then the project is not eligible for the Revenue Canada R&D tax incentives. But Jacques quickly added that Revenue Canada will still provide 35% on the industries own funding regardless of where the rest of the funds have come from. Richard Larin added that it is difficult to avoid the 20% equity component but the other 80% can come from anywhere.

The question of capital expenditures was raised. If there are capital costs associated with the project can these in some way be cost-shared as R&D? Jacques Fournier suggested that it is not possible under present rules and that the industry may need to present this as a difficulty requiring changes to the regulations. Andy Woyewoda noted that IRAP can assist with the labour costs on the introduction of new technology. There is also a new fund in the form of Sustainable Development Canada which has $500 million to spend on clean water technologies including water conservation and wastewater. There is deadline for application by March 15 but another intake of proposals will take place in August. Catherine Vardy added that the true research that is required to make the technology fit can also be assisted by NSERC.

Panel Discussion: Directions and mechanisms to move forward

Moderator: Paul Boudreau, McGraw Seafood

Panel members:

- **David Giddens (N.B. Seafood Processors Association)**
- **Andy Woyewoda (NRC-IRAP)**
- **Gastien Godin (CZRI-Shippagan)**
- **Nadine Gauvin (Southern Gulf of St. Lawrence Coalition)**
- **Joseph Labelle (NBDAFA)**
- **Perry Haines (NBDELG)**
- **Mike Chadwick (DFO)**
- **George Lindsay (EC)**

The Moderator and three of the panelist were not previously introduced. These were:

Biographical Sketch – Paul Boudreau

Paul Boudreau was born in Bathurst N.B in 1949. He joined the Canadian Forces in 1966 as part of the Regular Officer Training Plan (ROTP), graduating from Université de Moncton in 1970 (B. Comm.), after which he completed his first year of Master Business Administration (MBA) University of Ottawa in 1973. He retired from the Canadian Forces in 1974 with the rank of Captain and joined the Island Fishermen Cooperative Association of Lamèque, N.B as Production and later Assistant Manager from 1974 to 1987. Since then he has been the owner and General Manager of McGraw Seafood (1995) Inc. McGraw Seafoods operates plants in Tracadie-Sheila, and on Lamèque Island in N.B. His was one of six companies that participated in the Best Management Practices project.

Biographical Sketch – Gastien Godin

After his university studies at Moncton (political science) and Ottawa (law), Gastien Godin returned to the Acadian Peninsula to occupy various functions in the fishing sector, notably with l'Association professionnelle des pêcheurs acadiens. He is presently the Executive Director of the Coastal Zones Research Institute. The Institute includes centres focused on research and development of marine products, peat and peatlands and the Shippagan Marine Centre. The institute offers specialised scientific services to industry and the business community including laboratory analytical services for quality control, informatics, technology transfer and R&D on new products and services through projects implemented in partnership with various government departments and industry.

Biographical Sketch – Nadine Gauvin

For the past twelve years, Nadine Gauvin has worked for multi-stakeholder groups and non-government organizations in the environment sector. She is presently the Executive Director of the Southern Gulf of St. Lawrence Coalition on Sustainability. As former coordinator of the Shediac Bay Watershed Association, she spearheaded the NB Provisional Water Classification Program in Shediac Bay and initiated a Shellfish Restoration project. Nadine has served on the New Brunswick Conservation Council as Executive Member, on the Environmental Committee of the Greater Moncton Airport Authority and on the Greater Moncton Chamber of Commerce Environment Committee.

Biographical Sketch – Joseph LaBelle

Joseph LaBelle is a Senior Project Executive with the Strategic Marine Initiatives Branch of the NB Department of Agriculture, Fisheries and Aquaculture. Prior to joining the department, he was the Executive Director of the New Brunswick Seafood Processors Association. He came to the trade association from the retail food and food service/hospitality sector.

Within the Department of Agriculture, Fisheries and Aquaculture, he is responsible for intergovernmental and intragovernmental coordination on marine resource issues, as well as specific departmental strategic issues.

The purpose of this final session was to provide directions and mechanisms to move forward with this issue. Each member of the panel was asked to put forward one idea ony in the five minutes allocated to them to initiate discussions. Then the discussion will be opened to all participants to obtain their observations and to involve the entire group in the debate and the decision making process.

David Giddens
Michaela’s presentation focused on BMP and that is what it all comes down to, if all processors get on the band wagon. That is step one and step two is the educational process through the seminars promoting BMP which will be available in the coming months. Management also has to accept responsibility in order to ensure that they truly buy into it and take the message to the plant floor.

Andy Woyewoda
Communications is the key. This starts in the plant to build awareness. Then the Association must share good news and ideas with other groups across the industry. Regulators also need to improve communications among themselves to harmonise their activities and to share these valuable ideas. We must also communicate with universities to encourage them to increase the level of their research in this area. And finally the word needs to be spread to equipment manufacturers to get them to invest in the necessary R&D to provide the tools needed to deal with this issue.

Gastien Godin
Any industry that can show it is making a meaningful effort to deal with the environmental problems it partially creates will be supported by the public and the regulators. CZRI has been involved in this process from the start and has played and will continue to play an important role in three areas. First of all, the Institute is pleased to have played the key role in producing the BMP manual and in initiating and working within this project. Secondly, with thanks to James McClare and Boris Allard, the Institute has been able to develop the expertise of one of their engineers in this field so that this knowledge will stay in the organisation and be available to promote these technologies in future. Finally, the Institute is now ready to go forward with the information seminars based on this research. As others have observed at this workshop the issues of quality control and effluent management are intimately connected and both begin on the deck of the fishing boats that harvest the raw product, carry on through the design of optimal holding technologies and right through the entire processing cycle. The Institute has been aware of this for some time and will soon be publishing results specifically on the handling of herring in this regard. The Institute has recently hired an expert in this field, Dr. Jacques Gagnon, which will enhance further their ability to provide assistance in future.

Nadine Gauvin
One thing that has somehow escaped receiving full attention at the workshop is the question of what is the water quality now? If we don't know where we are beginning we have no way to plan where we hope to be five years from now. The Southern Gulf of St. Lawrence Coalition on Sustainability represent 69 environmental groups that collectively are responsible for more water quality monitoring than all the government agencies combined. But they often lack the volunteers needed to do an effective job. Why not link up these groups with industry? The plant staff could join in carrying out monitoring around the plant that can be combined with the rest of these groups' data and the NGOs can also provide training to the industry personnel. CZRI should also include training on monitoring in their seminars.

Joe LaBelle
What has been achieved to this point is directly the result of an industry Association being available in this province. This organisation needs full industry support. NB is not that big an operator in the global seafood market and there is a need for unity in the industry if it is to survive and prosper. There has been much talk about regulations at this workshop. Regulations aren't the problem. The industry needs to be able to demonstrate its environmental sustainability and to profit from it globally. Today the Marine Stewardship Council has certified two fisheries in Japan as sustainable giving them a market advantage over other nations. NB needs to pursue such certification of its fishing and processing operations in a way that gives them an advantage in the global market. The bottom line is that there must be an industry association in order for these common issues to be pursued effectively.

Perry Haines
It would be good to see if market requirements will drive the industry in the direction of environmental approval. In future the NB Department of Environment and Local Government will be promoting the uptake of these ideas on BMP during their site visits. The initial audit phase of this methodology is so important. You cannot move ahead without knowing where you are now. The national committee is something the province also supports. This is not a NB issue only, it just seemed that way because this province issues approvals and others do not and also because of the notoriety that the situation in Lamèque brought. But if real progress is to be made it must be made at the national level.

Mike Chadwick
So much good has been done in so little time but the bottom line is that we must keep the momentum going by expanding the team and increasing integration. Now we have the advantage of being finally out of the starting gate. Three years ago we knew almost nothing. We have learned so much and gotten to understand each other's needs and concerns as well. François Plante's work is on only 20 sites but this is a good start. Sampling is expensive however and we need to find ways to increase our capability to monitor the environment as Nadine has suggested. Government and Industry have worked together well for three years. Nutrients and BOD were the focus in this initial phase but there are other issues we know about now such as chemicals in use and invasive species that we must be prepared to work on together in future. And there are also other things that are beyond even our collective reach, such as changes taking place in the global climate, that we need to be prepared for by cooperating with others beyond our boundaries. In three years from now we should be able to look back and see that we have made improvements in perhaps three dozen plants. We should also expand the process of making improvements to the harvesters as Gastien and others have said. The industry could develop its own environmental targets.

George Lindsay
One of the strengths of this process is the multi-stakeholder Working Group that keeps the dialogue ongoing. The momentum on this issue started here in NB and is now regional and national. The Working Group is a great means for maintaining communications here at the local level. In regard to EC's national process, there will be many opportunities to speak with this group at stages along the way as that process unfolds. The industry should not be concerned that there

will not be an opportunity to have input into where things are headed. There is still a lot of missing information on plant outputs, chemical use and other important subjects, not to forget the receiving environment. Implementation of BMP is still in its infancy here in NB. So there is lots that can be done now and whatever is done now will make things go a lot easier whatever happens in future. Industry needs to support government with good information as we fill these data gaps.

Participants' feedback

Marcel Duguay noted that these have been two good days of information exchange with much good information and ideas on BMP. But the industry should not sit back now and wait until they are forced to act again.

Angélina Brideau posed the question 'What do we do now?' Is there funding available for progress on recommended work for Phase III? Is there a way to expand on what has been done to other processing lines? What will the Working group take on next?

Andy Woyewoda noted that the goal of the project was to determine if BMP made a difference. The theory has been tested and the results are now known. This project is expandable to a certain degree but it has to cover some different questions and risks and of course matching funding from industry is needed too.

Mike Chadwick replied that of course we have to continue. In response to Marcel's observation, there is already an ongoing experiment on environmental responses set up in the Lamèque Bay – we can expand that to work on the bigger question of all sources of nutrients so that we really understand what is going on. Other issues like invasives are on the horizon and we need to discuss how to deal with this before it too becomes an emergency demanding attention.

Joseph LaBelle added that his Deputy Minister certainly gave the clear signal that his department supports this process. He also agreed that invasives and the chlorine derivates are two things that need to be look into soon. As far as ways and means are concerned, if industry pushes government will respond.

James McClare observed that we've heard that funding is available and we've heard that people want to move on. In these six reports there are ideas that need to be prioritised into a Phase III part of this work. The issue of iron and manganese may be something that should be looked into as well. The industry, via the association, needs to drive this. Boris Allard and he could put down a list of the things they think need to be done soon and if they need to be done in this processing season then we must move fast.

Andy added that the project belongs the Association and it is up to them to decide where they wish to go with it. The management team for the project is comprised of the funding agencies and Angélina is the project manager. Andy agrees that the first step is for Boris Allard and James McClare to put out their ideas together and for others to add to them.

Ernest Ferguson (DFO Tracadie) made the commentary that the progress of the last three years is truly impressive. But in Europe we see what may be facing us in the future. Six plants have been brought up to speed now need to get all the others on board. There is a need to set hard goals that in two or three years all the other plants in the province will be as advanced. There need to be many more plants involved if this is to make a significant difference at the regional scale. We also need to look at the big picture, at the ecosystem level.

Gastien Godin noted that they already have a budget to disseminate these BMP ideas through seminars across the province. The original manual will be augmented with the information learned from this research.

Paul Boudreau added that as Marcel has said traditionally industry reacts. Maybe the province could use this example to encourage others to follow this lead and become more proactive.

Joseph LaBelle agreed that a self-proclaimed industry code of practice is a very worthwhile idea. It is a process that would take 3-5 years of consultation to put in place. But it is far better to do this than to have a regulation imposed.

Gastien Godin note that the dream is to find the solutions that make more beneficial use of all the raw material harvested so that little of what now goes to waste stream will be lost.

A fish meal plant owner agreed that their business gets a lot of product that should have been converted into primary and secondary products. He also agreed with Joseph LaBelle that the New Brunswick industry needs to be recognised for its reputation as a sustainable industry. Code of practice and approvals stamp for marketing purposes are tools that can greatly assist in marketing globally.

Mike Chadwick recalled that the visitors from the UK told us that what you need is a national oversight committee. Seafish does this in the UK. Canada seems to be lacking such a body and this is something we need to work towards as well.

David Giddens closed the meeting by offering special thanks to those agencies that have offered both technical and financial support to see this project and the workshop become a reality. He also offered his thanks on behalf of the participants to the organisers of the workshop, Angélina Brideau and Chris Morry, to the principal consultants on the project Boris Allard and James McClare and to the six processing plants and their management teams who assisted in completing the research. The Working Group will meet again soon to decide how to expand and move on from here.

Annex I Workshop Program

Workshop Program

The New Brunswick Seafood Processors Association Presents:

Practical Best Management Practices for Reduction of Effluent from Seafood Processing in Atlantic Canada:
Results of research to develop BMP methods designed to control effluents and to conserve water, raw material and energy in the seafood processing industry.

Ramada Plaza Crystal Palace Hotel, Dieppe (Moncton), N.B.
http://www.crystalpalacehotel.com/
February 15/16, 2006

This Workshop represents the culmination of an industry-led process to develop, test and perfect Best Management Practices for the effective use of fish products, water and energy leading to a reduction in organic waste entering the environment. This process of study began in February 2003 when a first workshop on the same subject was held in Shippagan, NB. Over the course of the three years since then, a multi-stakeholder working group has continued to make advances. Together with several Provincial and Federal government agencies, the NB Seafood Processors Association and several seafood processors in NB have funded and undertaken a study examining Best Management Practices as applied to the six major product lines in NB: shrimp, sardines, herring roe, snow crab, and fresh cooked and frozen lobster. After 18 months of study the results of this research are now ready to be made public and the lessons learned will be disseminated to processors across NB and elsewhere. The results could constitute a major advancement in the way that seafood processing takes place in plants that embrace the innovative ideas that have emerged from the study.

Wednesday, February 15

08:30 **REGISTRATION**

09:00 Welcome and Opening Address:
David Giddens, President of the NB Seafood Processors Association

09:15 Introduction to the Workshop Agenda and Proceedings
Angélina Brideau, (ABC Zenith Management Limited, Workshop Chairperson)

Theme 1: What can be done to reduce environmental impacts?
Implementing BMP through in-plant modifications & material recovery
Chair: Andy Woyewoda (NRC-IRAP)

09:30 Application of BMP to pollution prevention in the seafood processing industry in six processing lines in NB - Introduction
James McClare (James McClare Consulting) and Boris Allard (ADI Limited)

10:00 **HEALTH BREAK**

NB: **Each of the six segments of the presentation of results will be followed by 15 minutes for Questions and Answers**

10:30 Lessons learned from in-plant audits and the application of BMP in individual seafood processing operations in NB:

I – Observations on improvements in **shrimp processing lines**
James McClare (James McClare Consulting), Boris Allard (ADI Limited) and Marcel Duguay

11 :00 II – Observations on improvements in **sardine cutting lines**
James McClare (James McClare Consulting), Boris Allard (ADI Limited) and David Giddens

11:30 III – Observations on improvements in **herring roe processing lines**
James McClare (James McClare Consulting), Boris Allard (ADI Limited) and Rémi Roussel

12:00 **LUNCH and Historical Background Presentation by Mike Chadwick**

Theme 2: A brief update on regulatory and industrial design strategies for management of seafood processing effluent in Canada and abroad
Chair: Perry Haines (NBDELG)

13:00 Assessing the Environmental Risks of Fish Processing Effluents
Christine Garron, Environment Canada

Theme 1 (cont.): What can be done to reduce environmental impacts? Implementing BMP through in-plant modifications & material recovery
Chair: David Giddens, President, NBSPA

13:30 IV – Observations on improvements in **cooked lobster processing lines**
James McClare (James McClare Consulting), Boris Allard (ADI Limited) and Marcel Richard

14:00 IV – Observations on improvements in **raw lobster processing lines**

James McClare (James McClare Consulting), Boris Allard (ADI Limited) and Maurice Babin

14:30 VI – The experience in **snow crab processing lines**
James McClare (James McClare Consulting), Boris Allard (ADI Limited) and Paul Boudreau

15:00 **HEALTH BREAK**

15:30 Feedback Session – audience response to the results of the BMP Study

Theme 2 (cont.): A brief update on regulatory and industrial design strategies for management of seafood processing effluent in Canada and abroad
Chair: Perry Haines (NBDELG)

15:45 Environment Canada's national working group on seafood processing effluents.
MT Grant (EC)

16:00 Compliance auditing: Benefits of increased inspections of New Brunswick fish processing facilities.
Danny Stymiest (NBDELG)

16:15 **KEYNOTE PRESENTATION:**
Management of seafood processing waste in the EU
Michaela Archer (UK Sea Fish Industry Authority)

18:00 Cash bar reception

18:30 **DINNER --** Richard Watson (UK Sea Fish Industry Authority)

Thursday, February 16

Theme 3: What more can be done to reduce environmental impacts? Conventional and interesting new technological advancements
Chair: Andy Chapman (Canadian Centre for Fisheries Innovation)

09:00 Treatment technologies for seafood processing effluents - advantages, disadvantages and impediments to their broad-scale implementation.
Adrian Desbarats, Atlantech Companies

09:30 New and improved industrial approaches to wastewater treatment
Graham Gagnon (Faculty of Engineering, Dalhousie University)

10:00 **HEALTH BREAK**

Theme 4 : What are the environmental effects of seafood plant effluents and other land-based nutrient sources?
Moderator: Simon Courtenay (DFO)

10:30 Lamèque Harbour – an example of community and industry cooperation
Bertin Gauvin (Lamèque and Shippagan Sustainable Development Committee)

10:50 Observations on seasonal variability and geographic distribution of organic enrichment in sediments of Lamèque Harbour
François Plante (DFO Gulf Region)

11:10 Eutrophication of Marine Environments: Efforts to Develop Standards/Guidelines and Framework for the Canadian Nearshore Marine Waters
Sushil Dixit, Environment Canada

11:30 Oceanographic Variability: should it be factored into the determination of regulatory controls for industry?
Joël Chassé and Fred Page (DFO-BIO)

11:50 Panel discussion on receiving environment effects
Moderator: George Lindsay (EC)

Panel members:

- **Speakers from Morning Themes 3 and 4**

Kiosks and Posters (In Foyer all day):

Coastal Zones Research Institute - Kiosk

Preliminary observations on an environmental effects monitoring strategy for seafood plant effluents
Marie-Hélène Thériault (Graduate Student, Université de Moncton)

12:15 LUNCH

Theme 5 : Funding change – opportunities for financial support to research and implement process improvements in the NB seafood industry.
Moderator: Angélina Brideau, ABC Zenith Management Ltd.

13:15- 14:15
Speakers (10 minutes each):

Catherine Vardy, NSERC
Andy Woyewoda, NRC-IRAP
Andy Chapman, Canadian Centre for Fisheries Innovation
Jacques Fournier, Revenue Canada Agency
Richard Larin, Business NB

14:15 Panel Discussion:
Directions and mechanisms to move forward
Moderator: Paul Boudreau, McGraw Seafood

Panel members:

- **David Giddens (N.B. Seafood Processors Association)**
- **Andy Woyewoda (NRC-IRAP)**
- **Gastien Godin (IRCZ-Shippagan)**
- **Nadine Gauvin (Southern Gulf of St. Lawrence Coalition)**
- **Joseph Labelle (NBDAFA)**
- **Perry Haines (NBDELG)**
- **Mike Chadwick (DFO)**
- **George Lindsay (EC)**

15:30 **ADJOURNMENT**

Annex II Acknowledgements

The New Brunswick Seafood Processors Association would like to thank the following individuals and organisations without whose valuable assistance the best management practices study itself and this workshop would not have been possible.

First, we must acknowledge the ongoing efforts of the NB Seafood Processing Effluent Working Group. They were the original driving force behind the study and continue to provide guidance on this and possible future related work. The names of past and present members are listed below.

The study on *Best Management Practices for the Management of Effluents from Seafood Processing in Atlantic Canada* was undertaken by ADI Limited and James McClare Consulting as a team under the able leadership of Boris Allard and James McClare.

This study was built on earlier work in the form of the report entitled: *Best Management Practices: Marine Products Processing - Guide For Best Management Practices Of Raw Product, Process Water And Effluent For Marine Products Processing Plants Of The New Brunswick East Coast* which was prepared by the Coastal Zones Research Institute in Shippagan involving the combined talents of Dr. Sylvain Poirier and his team, including Nadia Tchoukanova and Mauricio Gonzalez.

Several member companies of the New Brunswick Seafood Processors Association and their staff were instrumental in seeing this study undertaken. They include:

Marcel Duguay	Island Fishermen's Cooperative Association Ltd.
David Giddens	Connors Brothers Ltd.
Rémi Roussel	St. Paul Fisheries (1989) Ltd.
Paul Boudreau	McGraw Seafoods (1995) Inc.
Marcel Richard	B. A. Richard Ltd.
Maurice Babin	Cape Bald Packers Ltd.

Finally it is important to acknowledge a number of agencies without whose strong support and encouragement we would no have been able to carry out this study or present the workshop. These include:

National Research Council Canada — Conseil national de recherches Canada
Industrial Research Assistance Program — Programme d'aide à la recherche industrielle

Atlantic Canada Opportunities Agency — Agence de promotion économique du Canada atlantique

Canadian Centre for Fisheries Innovation

Fisheries and Oceans Canada — Pêches et Océans Canada

Environment Canada — Environnement Canada

New Nouveau Brunswick Canada

- Environment and Local Government
- Agriculture Fisheries and Aquaculture

Members of:

NEW BRUNSWICK SEAFOOD PROCESSORS ASSOCIATION
ASSOCIATION DES TRANSFORMATEURS DE FRUITS DE MER DU NOUVEAU-BRUNSWICK

Present and Former Members of the New Brunswick Seafood Processing Effluent Working Group and their Advisors:

Bernard Albert	National Research Council-IRAP
Boris Allard	ADI Services Ltd.
Louis Arsenault	NB Department of Agriculture, Fisheries and Aquaculture
Tom Arsenault	Cape Bald Packers Ltd.
Wade Aucoin	Atlantic Canada Opportunities Agency
Arthur Austin	Coastal Zones Research Institute
Maurice Babin	Cape Bald Packers Ltd.
Gérard Benoit	Town of Lamèque
Paul Boudreau	McGraw Seafoods (1995) Inc.

Michael Chadwick	DFO Gulf Region
Andy Chapman	Canadian Centre for Fisheries Innovation
Angélina Cool	ABC Zenith Management Ltd.
Jeffrey Corkum	Environment Canada
Simon Courtenay	DFO Gulf Region and University of New Brunswick
Jean-Yves Daigle	Peat Research and Development Centre Inc. (CZRI)
Marcel Duguay	Island Fishermen's Cooperative Association Ltd.
Ernest Ferguson	DFO, Gulf Region NB Area Office, Tracadie-Sheila)
Paul Fournier	NB Department of Environment and Local Government
François Jargaille	Canadian Food Inspection Agency
Graham Gagnon	Dalhousie University
Bertin Gauvin	Lamèque and Shippagan Sustainable Development Comm.
Luc Gauvin	S.O.S. Lamèque Bay
Dave Giddens	Connors Bros.
Gastien Godin	Coastal Zones Research Institute
Charles Goguen	ADI Limited
Mauricio Gonzalez	Coastal Zones Research Institute
MT Grant	Environment Canada
Henri-Paul Guigard	Town of Lamèque
Paulette Hall	Canadian Food Inspection Agency
Claude Hamel	Atlantic Canada Opportunities Agency
Charles Harn	Atlantic Canada Opportunities Agency
Suzie Keténé	National Research Council –Indust. Res. Assist. Pgm.
Barry Hargrave	DFO, Bedford Institute of Oceanography
Kalie Hatt-Kilburn	Atlantic Canada Opportunities Agency
Joe LaBelle	NB Department of Agriculture, Fisheries and Aquaculture
Carole LeBlanc	Centre for the Env. Of the Acadian Pen. & its Environs Inc.
Patrick Lacroix	Atlantic Canada Opportunities Agency
Claude Lapointe	Atlantic Canada Opportunities Agency
Réginald Larocque	Island Fishermen's Cooperative Association Ltd.
Johannes Larsen	National Research Council –Indust. Res. Assist. Pgm.
George Lindsay	Environment Canada
Pierre Mallet	DFO Gulf Region
James McClare	James McClare Consulting Ltd.
Chris Morry	DFO Gulf Region (Retired)
Daryell Nowlan	Atlantic Canada Opportunities Agency
Réginald Paulin	Town of Lamèque
Raymond Peron	Canadian Food Inspection Agency
Krista Peterson	DFO Gulf Region
François Plante	DFO Gulf Region
Sylvain Poirier	Coastal Zones Research Institute
Marcel Richard	B. A. Richard Ltd.
Pierre Rioux	NB Department of Agriculture, Fisheries and Aquaculture
Jean Robichaud	St. Paul Fisheries (1989) Ltd.
Rémi Roussel	St. Paul Fisheries (1989) Ltd.
Steven Stehouwer	Canadian Food Inspection Agency (Animal Feeds)
Danny Stymiest	NB Department of Agriculture, Fisheries and Aquaculture
Nadeja Tchoukanova	Coastal Zones Research Institute
Margaret Walsh	Dalhousie University
Andy Woyewoda	National Research Council –Indust. Res. Assist. Pgm.
Élise Young	Atlantic Canada Opportunities Agency

Annex III Participants

Julien	Albert	Produit du Golfe Saint Laurent
Roger	Albright	Environment Canada
Ross	Alexander	Fisheries and Oceans Canada
Boris	Allard	ADI Limited
Michaela	Archer	UK Sea Fish Industry Authority
David	Arsenault	Canada Revenue Agency
Arthur	Austin	Coastal Zones Research Institute
Maurice	Babin	Cape Bald Packers Ltd.
Gérard	Benoît	Town of Lamèque
Paul	Boudreau	McGraw Seafood (1995) Inc.
Maurice	Bourque	Fisheries and Oceans Canada
Donald	Breau	Supreme Sturgeon & Caviar Ltd.
Angélina	Brideau	ABC Zenith Management Ltd.
Ken	Buckle	Centre for Aquaculture & Seafood Dev.
Mike	Campbell	South Shore Trading
Elaine	Castonguay	Coastal Zones Research Institute
Mike	Chadwick	Fisheries and Oceans Canada
Andy	Chapman	Canadian Center for Fisheries Innovation
Joël	Chassé	Fisheries and Oceans Canada
Lewis	Clancy	NS Dept. of Agriculture and Fisheries
Jean	Cormier	Atlantic Canada Opportunities Agency
François	Cormier	Comeau's Sea Foods Ltd.
Roméo	Cormier	Produits Océaniques Canadiens Ltée
Simon	Courtenay	Fisheries and Oceans Canada
Adrian	Desbarats	Atlantech Companies
Sushil	Dixit	Environment Canada
Marcel	Duguay	Island Fishermen's Co-operative Ltd.
Glenn	Feltmate	Barry Group Inc.
Ernest	Ferguson	Fisheries and Oceans Canada
Melissa	Fleming	NB Dept. of Environment & Local Gov.
Paul	Fournier	NB Dept. of Environment & Local Gov.
Jacques	Fournier	Canada Revenue Agency
Jacques	Gagnon	Coastal Zones Research Institute
Graham	Gagnon	Dalhousie University
Christine	Garron	Environment Canada
Nadine	Gauvin	S. Gulf of St. Lawrence Coalition on Sust.
Bertin	Gauvin	Comité développement durable Lamèque
David	Giddens	Connors Bros. Ltd.
Gastien	Godin	Coastal Zones Research Institute
Charles	Goguen	NB Dept. Of Agric., Fisheries and Aquaculture
Mauricio	Gonzalez	Produit du Golfe Saint Laurent
M.T.	Grant	Environment Canada
Don	Grass	NB Dept. of Environment & Local Gov.
Perry	Haines	NB Dept. of Environment & Local Gov.
Paulette	Hall	Canadian Food Inspection Agency
Annie	Hall	Le Groupe Roy Consultants
Venitia	Joseph	Fisheries and Oceans Canada
Barry	Justason	Connors Bros Ltd
Suzie	Kéténé	National Research Council - IRAP
Joseph	Labelle	NB Dept. Of Agric., Fisheries and Aquaculture

Snehal	Lakhani	Environment Canada (Pacific & Yukon)
Mathieu	Landry	Cape Bald Packers Ltd.
Gaétan	Landry	Coastal Zones Research Institute
Claude G.	Landry	Leslie Léger & Sons Ltd.
Wade	Landsburg	Fisheries and Oceans Canada
Richard	Larin	Business New Brunswick
Francis	LeBlanc	NB Dept. of Environment & Local Gov.
Bernard	LeBlanc	Paturel International Co
Gilles	LeBlanc	Westmorland Fisheries
Sylvio	Léger	Leslie Léger & Sons Ltd.
George	Lindsay	Environment Canada
Roger	Maillet	NB Dept. of Environment & Local Gov.
Pierre	Mallet	Fisheries and Oceans Canada
Heather	Manuel	Centre for Aquaculture & Seafood Dev.
James	McClare	James McClare Consulting
Michael	McGinnis	PEI Seafood Processors Association
Wilson	Methven	High Liner Foods Inc.
Chris	Mills	PEI Dept. of Agric., Fisheries & Aquaculture
Denny	Morrow	Nova Scotia Fish Packers Association
Chris	Morry	Avalonia & Hibernia Enterprises
Lea	Murphy	Fisheries and Oceans Canada
Lloyd	Murphy	PEI Dept. of Agric., Fisheries & Aquaculture
Tom	O'Rourke	National Research Council - IRAP
Collins	Onodenalore	Marine Institute (Memorial University)
Fred	Page	Fisheries and Oceans Canada
Laura	Park	Fisheries and Oceans Canada
Krista	Peterson	Fisheries and Oceans Canada
François	Plante	Fisheries and Oceans Canada
Terry	Polley	South Shore Trading
Kevin	Power	Environment Canada
Robert	Robichaud	Environment Canada
Mario	Roussel	NB Dept. Of Agric., Fisheries and Aquaculture
Rémi	Roussel	Pêcheries St-Paul Ltée
Oliver	Savoie	Barry Group Inc.
Sam	Stevens	National Research Council
Danny	Stymiest	NB Dept. of Environment & Local Gov.
Nadia	Tchoukanova	Coastal Zones Research Institute
Marie-Hélène	Thériault	Université de Moncton
Trevor	Thomas	NL Dept. of Fisheries and Aquaculture
Catherine	Vardy	Natural Sciences and Engin. Research Council
Richard	Watson	UK Sea Fish Industry Authority
Tim	Williston	Barry Group Inc.
Andy	Woyewoda	National Research Council - IRAP
Doug	Wright	Atlantech Companies