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Regional Workshop on the Review of the findings from the aquaculture Drifters programme on the south coast of Newfoundland

November 30, 2010
St. John's, NL

Meeting Chairperson:
Dr. J. W. Lawson

Atelier régional sur la Revue des conclusions du programme d'aquaculture sur les bouées dérivantes dans la côte sud de Terre-Neuve

Le 30 novembre 2010
St. John's, T.-N.-L.

Président de réunion:
Dr. J.W. Lawson

Fisheries and Oceans Canada / Pêches et Océans Canada
Science Branch / Direction des sciences
80 East White Hills Road
St. John's NL / St. John's, T.-N.-L.
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May 2012 | **Mai 2012**

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.

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.

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TABLE OF CONTENTS

SUMMARY

The continuing expansion of aquaculture operations on the south coast of Newfoundland has presented a challenge to departments and agencies responsible for regulating the environmental effects of this industry, to develop management strategies, and to ensure sustainable development of the coastal marine environment. Recently, oceanographic and ecological modelling have been recognized as important tools for predictions of disease transmission as well as the nature and scale of effect, from proposed and existing farm sites on the proximal benthic environment.

Department of Fisheries and Oceans (DFO) Science, Newfoundland and Labrador Region, has acknowledged the importance of development and implementation of scientifically-validated environmental and disease management policies in support of regulatory decisions and procedures associated with site licensing, production planning, and sustainable management of the rapid expansion of the industry on the south coast. Through the Program for Aquaculture Regulatory Research (PARR) programme, the Aquaculture Section, NL Region has initiated a programme to collect oceanographic information from areas on the south coast of Newfoundland to be used in modelling efforts to provide the foundation for knowledge concerning the transport and dispersal of fish farm wastes and pathogens. The work is comparable with efforts being conducted in other areas of the country as part of DFO's regulatory Science renewal efforts. This initiative directly contributes to addressing the Sustainable Fisheries and Aquaculture and the Healthy and Productive Aquatic Ecosystem strategic outcomes of DFO. It also contributes to the Sustainability of Aquaculture component of the DFO Five Year Research Strategic Plan.

SOMMAIRE

L'expansion continue des opérations aquacoles sur la côte Sud de Terre-Neuve représente un défi pour les ministères et les organismes responsables de réglementer les effets environnementaux de cette industrie, d'élaborer des stratégies de gestion et d'assurer le développement durable des milieux marins côtiers. Récemment, les modélisations océanographiques et écologiques ont été reconnues comme étant des outils importants pour l'établissement de prévisions sur la propagation des maladies ainsi que sur la nature et l'ampleur des effets que peuvent avoir les exploitations aquacoles actuelles et futures sur l'environnement benthique proche.

Le Secteur des sciences de la région de Terre-Neuve-et-Labrador de Pêches et Océans Canada (MPO) a reconnu l'importance que revêt l'élaboration de politiques de gestion des maladies et de l'environnement validées scientifiquement pour soutenir les décisions et les procédures réglementaires associées à la délivrance des permis, à la planification de la production ainsi qu'à la gestion durable de l'expansion rapide de l'industrie sur la côte Sud. Par l'intermédiaire du Programme de recherche sur la réglementation de l'aquaculture (PRRA), le Secteur de l'aquaculture de la région de Terre-Neuve-et-Labrador a créé un programme afin de recueillir des données océanographiques dans les zones de la côte Sud de Terre-Neuve qui serviront aux exercices de modélisation prévus afin d'établir une base des connaissances sur le transport et la dispersion des déchets d'élevage et des agents pathogènes provenant d'exploitations aquacoles. Cette initiative est comparable aux efforts consentis dans d'autres régions du pays dans le cadre de l'effort de renouvellement du Secteur des sciences du MPO prévu par la réglementation. Elle aide directement le MPO à atteindre les résultats stratégiques en matière de pêche et d'aquaculture durables ainsi qu'en matière d'écosystèmes aquatiques sains et productifs. Elle contribue également au volet « durabilité de l'aquaculture » du Programme de recherche quinquennal du MPO.

OBJECTIVES

The overall objective of the workshop was to present results from the surface drifter studies on the south coast of Newfoundland and an analysis of the environmental factors forcing the surface circulation as they pertain to potential use for the development of aquaculture management strategies (see Appendices 1 and 2). The following information pertaining to the study was addressed in the draft working paper "Aquaculture Drifter Programme: Progress Update 2010" (A.W. Ratsimandresy, D. Ings, G. Mabrouk, F. Page, D. Drover, R. Losier, and P. McCurdy), and discussed at the workshop:

1. Description of the DFO drifter deployments in the study area.
2. Description of the environmental factors during deployments in the study area.
3. An analysis of the effects of the various environmental factors on the drifters' velocity and directional movement.
4. Description of sources of uncertainty of the information provided and the identification of knowledge gaps as they pertain to the current understanding of the surface water circulation in the study area.

PRODUCTS AND PARTICIPANTS

The workshop provided a mechanism for presentation and expert review of the working paper, and this proceedings report summarizing the deliberations of the participants. A CSAS Research Document will be produced from the working paper. Participants at the meeting included staff from DFO Science, DFO Oceans, Habitat and Species at Risk, DFO Ecosystem and Fisheries Management, the provincial Department of Fisheries and Aquaculture (DFA), Memorial University, industry and stakeholders (Appendix 3).

PRESENTATION

Presentation: "Aquaculture Drifter Programme: Progress Update 2010" by A.W. Ratsimandresy, D. Ings, G. Mabrouk, F. Page, D. Drover, R. Losier, and P. McCurdy.

Presenter: Dr. Andry Ratsimandresy

Abstract:

The aquaculture industry in Newfoundland is currently expanding rapidly with an increasing number of finfish sites being developed. To conduct a preliminary investigation of the marine circulation along the south coast of Newfoundland, 14 deployments of a total of 68 CAST drifters were released and monitored at different locations in Bay d'Espoir and Fortune Bay in summer 2009 and 2010. The information was used to assess the circulation of the surface layer of the area. The influence of wind forcing, tidal exchange, and freshwater discharge on the surface water transport was estimated. Most of the drifters were at liberty for more than one semi-diurnal tidal cycle. The wind driven circulation may predominate over tidal mechanisms. During the experiments, the river discharge did not show any clear effect on the surface movement of the water. All together, the average velocity of the drifters was between 0.10 and 0.25 m/s and the typical zones of influence ranged between 5 and 18 km over a period of 24 h.

Discussion Points:

- Given that in many cases the drifters moved against tide and wind patterns, at some points in their deployment, could there be issues with the wind models used, e.g., the tidal data was based on Foreman's model of tides and the authors were not able to compare this to local measurements of tide gates or tide gauges. Dr. Ratsimandresy thought it possible that the upper layer of water might be moving as a "slab" since there is a difference between the 1 metre surface layer and deeper water; there may be a large difference in the movement patterns of these two types of water mass. There are plans to analyse the other data available (such as ADCP), and also plans to deploy subsurface drogue drifter systems to better understand what is happening in deeper waters. In addition, more studies to refine microclimate effects on current models are also planned.
- Although a nearby tidal reference was used (St. Albans), it is known that the tidal passages and complex submarine structures have potential impacts on currents. It was suggested that the authors calculate the tidal velocity (the ADAT) and correlate that to the drifter velocities. If this was done using spatial analyses the authors could look at areas where they find places and times with correlation, suggestive of catabatic cycling of wind force in the area. The presenter stated that local effects are always important, and felt that looking at the orientation of the Bay relative to the wind, in addition to smoothing or filtering the data to better tease out spots where the system appears to match predictions would be another approach.
- A participant asked how the current velocity patterns could be influenced by the stratification of the water that the industry finds in some places, and if additional studies of local bathymetry, and nearby topography, of those bays are in order to help determine velocity. The authors will understand more about the current systems with additional modelling, and including the potential influences of bathymetry and topography. The current study concentrates on the first meter of the water so it does not yet represent the whole water mass. The plan is to study the deeper aspects of the water mass and integrate that with bathymetric and topographic data.
- A participant suggested taking the velocity data and the boxes representing the zones of influence where the authors attempt to show the character differences and plot the mean and standard deviations for the velocity for areas within the data set that exist. It was suggested that given there are a number of drifter tracks within one study area (i.e., identified by box) in one of the passages, where there are 20 or 30 points, you can calculate the mean and standard deviation. While there is a limited amount of data for some areas, if additional data is collected you may generate characteristics where you define certain parts of the system. This would also show the places with long channel velocities and those with cross channel velocities, and it is useful for people to know. This is another way to aggregate the data and is a non-trivial task to calculate because of the need to convert velocities spatially.
- The suggestion (above) will give some valuable information on the differences of drifter speeds among areas; however, by dividing the whole region in sub-domains, the number of available data was not enough for such type of analysis. It will be performed upon carrying more drifter experiments in the area
- A participant asked if the same drifters were used for each deployment. It was responded that they would deploy clusters of five (half of drifter complement), with no evidence of gear-related differences (e.g., the drift behaviour of each device was consistent in consistent contexts over the experiment). In this study the authors present 68 drifter tracks, but these were based on 10 drifters. It was noted by a participant how

cohesive the drifter clusters were as they moved along, and that is indication that all the drifters are behaving rather the same.

- A participant wondered if the apparent variance in the movements of drifters could be attributable to differences in the way the drifters react due to wind effects on the structures above the water surface; in other words to what extent was the pressure of wind influencing drifter movement. It was suggested a way to ascertain this by calculating the ratio of wind stress and water stress - ideally the system would benefit from having a much larger drogue surface underwater relative to the structure above water. One participant suggested that there would be some wind-nulling effect on drifter movement (15% contamination), which would again support the utility of using a larger subsurface area/drogue to overcome wind effects. Another consideration is the water mass contained in the drifter barrel below the surface (approximately a 1 tonne mass) should act to dampen the effects of wind.
- The presenter was asked if, given the drifter data that has been gathered with 14 releases over 2 years, were there any similarities with data from other jurisdictions employing drifter release programmes (e.g., Norway, other Atlantic provinces, or B.C.)? At this time a comparative analysis has not been initiated.
- It was questioned why the freshwater input data from Conne River was discounted in the process (i.e., was this data expected to be a low level effect as opposed to the Nalcor development)? The amount of water input by Nalcor sources ranges from 100 to 160 m^3/s while Conne River discharges 1 m^3/s; this was one of the reasons the input from Conne River was discounted. In addition, the Conne River source is 20 km from the experimental site, and could already have mixed with sea water in the area by the time it enters the area of study.
- In response to a query, it was noted that for Harbour Breton the precipitation data were collected on the same date as this study. Further, based on the precipitation data of Environment Canada, collected during the experimental period, the authors looked for some kind of peak during the period immediately before the period of deployment. There were not any peak rainfalls during the period so it was assumed there was no rain during the deployment periods.
- A participant suggested that for small bays like Roti Bay and Western Bay, where there are a lot of aquaculture sites and cages, in future the authors might consider performing drifter experiments.
- Another participant suggested that the authors might consider putting an anemometer on the drifter itself in order to ascertain the local wind conditions as these drifters are moving around rather then relying on more distant weather stations. A concern in this case is that an added anemometer might add additional wind loads to the drifter that could influence its movement.
- In response to a question, the presenter stated that in 2009 the drifters were deployed for a week and a half in June (Bay D"Espoir). In 2010 the drifters were deployed for a week in July (Harbour Breton).
- The authors computed an R^2 value from the scatterplots; for wind speed there was a correlation with drifter movement, whereas for wind direction there was no correlation.
- The choice of Priority Area 3 was based on budget limitations and the Shamook's schedule. Additionally, with the challenges and logistics of having a team in Newfoundland and a team in New Brunswick the authors had to work out the best way to complete such a study so that in the future they can deploy subsurface drogues and drifters in other areas as well.

- The Department of Environment and Conservation have stream flow stations and also precipitation, temperature, and water flow gauge data online. These data may provide additional value to further studies. Given the conclusion that there are very poor correlations between Sagona Bay and Harbour Breton current patterns with wind speed and direction, would it be useful to have weather stations set up in the bay? The presenter felt that it would indeed be useful to have stations inside the bay to have better information, however that this would be expensive. At times when there is not good flow data, it may be possible instead to examine salinity records as a proxy for flow volume given water mixing.
- Could the drifter data be used to predict disease outbreaks? They responded that they hope this work will benefit veterinarians with respect to bay management and benefit industry, and habitat management before any decisions are made. The goal of the Aquaculture Section is to provide as much knowledge as needed; as of now they are not tackling disease issues.
- A participant felt that drifter studies such as this would need to be continued for a long term to adequately report the variability in current systems on the south coast, and ascertain what factors influence it. DFO (NL Region) did a study tracking wild salmon in and out of the bay in 2006-08. Two St. Alban's releases showed a possible response to discharge from Nalcor hydro and Conne River and seemed to be important for smoult getting ready for sea. There may be some information from this study to use to look at water flow variability. It was stated that studies are underway (DFO NL Region) to highlight possible interaction issues as part of another project; and in addition, placing fixed current moorings may shed some light on the interactions.
- The Chair asked if in the future aquaculture operations become more numerous, is there a possibility than this man-made gear could obstruct or modify the movements of the surface layer. It was felt this would not be likely at large scales given the localized factors that seem to be influencing currents, rather than the overall flow patterns at larger time and space scales; the authors plan to replicate the study in other areas and at different scales to better assess this kind of effect.
- A participant suggested that oceanographic data collected by DFO NL in the 1980s found high levels of current variability between basin structures separated by sills. This information would be available to the authors. If the drifter data characterize the top 1 metre of a water mass, and aquaculture cages are normally set at 10-20 metres, can the drifter data represent that volume of water? It was stated that the drifters only obtain information from the top 1 metre of water. The authors do not have information below this depth until they collect data from subsurface drogues, at which point they can learn if there is a big difference between the movements of the surface and the deeper water. A participant stated that DFO NL has a drifter data set from the late 1990s for depths of 10-12 metres below the water surface, and this will be made available to the authors.
- A participant asked the authors about future objectives for the next year. In terms of drifter-based research, they would like to augment drifter data with subsurface drogues and integrate this information into the models to get a better picture of what is happening in the area. Dependent on funding, the Department would like to investigate deeper current activity, additional sites, and repeat experiments for replicate data. In the Program for Aquaculture Regulatory Research (PARR) plan, DFO has drogues to deploy by next year and will explore salinity patterns. The fall/winter plan is that DFO wants to cover more geographic area, and conduct winter deployments to study seasonality. Priority areas will be informed by consultations such as this workshop.

APPENDIX 1: Agenda for DFO Aquaculture Workshop: Review of the findings from the drifter programme on the south coast of Newfoundland

Salon C, Holiday Inn, 180 Portugal Cove Road, St. John's, NL
November 30, 2010

Chairperson: Dr. Jack Lawson

0900	**Opening remarks (introduction of Chair, rapporteur, presenter and proposed agenda)**	Dr. Jack Lawson
0930	**Presentation of draft working paper "Aquaculture Drifter Programme: Progress Update 2010" by A.W. Ratsimandresy, D. Ings, G. Mabrouk, F. Page, D. Drover, R. Losier, and P. McCurdy.**	Dr. Andry Ratsimandresy
1030	**Coffee break**	
1045	**Review of working paper**	Plenary
1130	**Wrap-up and drafting of summary remarks and compilation of suggested modifications to the draft working paper**	Plenary
1200	**Close of meeting**	

APPENDIX 2: Terms of Reference

Review of the findings from the aquaculture drifter programme on the south coast of Newfoundland

Newfoundland and Labrador Workshop
St. John's, Newfoundland
November 30, 2010

Chair: Dr. Jack Lawson

Context

The continuing expansion of aquaculture operations on the south Coast of Newfoundland has presented a challenge to departments and agencies responsible for regulating the environmental effects of this industry, to develop management strategies, and to ensure sustainable development of the coastal marine environment. Over recent years, oceanographic and ecological modeling have been recognized as important tools for predictions of disease transmission as well as the nature and scale of effect, from proposed and existing farm sites on the proximal benthic environment.

DFO Science, Newfoundland and Labrador Region, has acknowledged the importance of development and implementation of scientifically-validated environmental and disease management policies in support of regulatory decisions and procedures associated with site licensing, production planning, and sustainable management of the rapid expansion of the industry on the south coast. Through the Program for Aquaculture Regulatory Research (PARR) program, the Aquaculture Section, NL Region has started a program to collect oceanographic information from areas on the south coast of Newfoundland to be used in modeling efforts to provide the foundation for knowledge concerning the transport and dispersal of fish farm wastes and pathogens. The work is comparable with efforts being conducted in other areas of the country as part of DFO's regulatory Science renewal efforts. This initiative directly contributes to addressing the Sustainable Fisheries and Aquaculture and the Healthy and Productive Aquatic Ecosystem strategic outcomes of DFO. It also contributes to the Sustainability of Aquaculture component of the DFO Five Year Research Strategic Plan.

Objectives

The overall objective of the meeting is to present results from the surface drifter studies on the south coast of Newfoundland and an analysis of the environmental factors forcing the surface circulation as they pertain to potential use for the development of aquaculture management strategies. Therefore, it is expected that the following information pertaining to the study will be addressed:

1. Description of the DFO drifter deployments in the study area.
2. Description of the environmental factors during deployments in the study area.
3. Analysis of the effects of the various environmental factors on the drifters' velocity and directional movement.
4. Description of sources of uncertainty of the information provided and the identification of knowledge gaps as they pertain to the current understanding of the surface water circulation in the study area.

Products

The workshop will generate a proceedings report summarizing the deliberations of the participants. This will be published in the Canadian Science Advisory Secretariat (CSAS) Proceedings Series on the CSAS website. A CSAS Research Document is expected from the working paper submitted for review.

Participation

DFO Science, DFO Oceans, Habitat and Species at Risk, DFO Ecosystem and Fisheries Management, provincial government, academia, industry, aboriginal groups and stakeholders

APPENDIX 3: Workshop Participants

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