Environmental
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137

Workshop on Cumulative Environmental Effects Assessment and Monitoring on the Grand Banks and Scotia Shelf

Canada

August 2000

Environmental Studies Research Funds

Report ESRF137

August 2000

WORKSHOP ON CUMULATIVE ENVIRONMENTAL EFFECTS ASSESSMENT AND MONITORING ON THE GRAND BANKS AND SCOTIAN SHELF

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in association with

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The correct citation for this report is:

Hatch Associates Limited and Griffiths Muecke Associates. 2000. Workshop on cumulative environmental effects assessment and monitoring on the Grand Banks and Scotian Shelf. Environmental Studies Research Funds Report ESRF137, Ottawa.

The Environmental Studies Research Funds are financed from special levies on the oil and gas industry and administered by the National Energy Board for The Minister of Natural Resources Canada and The Minister of Indian Affairs and Northern Development.

Published under the auspices of the
Environmental Studies Research Funds
ISBN 0-921652-45-3

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Executive Summary

The Environmental Studies Research Funds sponsored a workshop on Cumulative Environmental Effects Assessment and Monitoring on the Grand Banks and Scotian Shelf, in St. John's on May 8 and 9, 2000. The workshop was initiated in response to recommendations from the 1997 Terra Nova Environmental Assessment Panel on the need to address cumulative effects of offshore oil and gas development. Sixty-five representatives of the oil and gas industry, federal and provincial governments, fishing industry, researchers and non-governmental organizations participated.

The workshop provided an opportunity for stakeholders to discuss approaches to cumulative effects assessment and monitoring, and to transfer and adapt knowledge developed in western Canada and other offshore oil and gas producing areas. Speakers from western Canada, Texas and Norway presented various approaches to undertaking cumulative effects assessment and monitoring. Speakers from Newfoundland and Nova Scotia discussed oil and gas development on the Grand Banks and Scotian Shelf and cumulative effects on fish, seabirds and marine mammals from this and other industries.

Workshop participants discussed cumulative effects issues in plenary sessions and small group meetings. A broad range of issues was raised during the first plenary session on the issues, problems and opportunities for cumulative effects assessment in the East Coast context. Interactions between the oil and gas industry, fisheries and other offshore industrial activities were reviewed during a second plenary session. Participants discussed three questions in small groups:

i) What is the potential for cumulative effects off the East Coast?

ii) How should these cumulative effects be monitored?

iii) Who should do what in cumulative effects assessment and monitoring?

The overall consensus at the workshop was that Fisheries and Oceans Canada should take the lead in initiating a multi-stakeholder process to develop a feasible approach to regional cumulative effects assessment. Cumulative effects assessment is a vital tool to ensure progress towards sustainability, and all marine industries and users must be accountable for contributing to cumulative effects. Significant scientific challenges will be involved in the research and monitoring of offshore cumulative effects. Institutions will require long-term commitment through provision of human and financial resources to ensure cumulative effects are assessed and monitored.

Résumé

Le Fonds pour l'étude de l'environnement a parrainé un atelier sur l'Évaluation et la surveillance des effets environnementaux cumulatifs sur les Grands bancs et la plate-forme néo-écossaise. L'atelier, qui s'est tenu à St. John's du 8 au 9 mai 2000, a été organisé en réponse aux recommandations formulées par la Commission d'évaluation environnementale Terra Nova de 1997 concernant le besoin d'évaluer les effets cumulatifs des développements pétroliers et gaziers extra-côtiers. Ont participé à l'atelier soixante-cinq représentants de l'industrie pétrolière et gazière, les gouvernements fédéral et provinciaux, des représentants de l'industrie de la pêche et d'organismes non gouvernementaux ainsi que des chercheurs.

L'atelier a permis à chaque partie intéressée de participer aux discussions concernant les approches possibles pour l'évaluation et la surveillance des effets cumulatifs ainsi que de transférer et d'adapter les connaissances acquises dans l'ouest du Canada et dans d'autres secteurs producteurs pétroliers et gaziers extra-côtiers. Des orateurs de l'Ouest du Canada, du Texas et de la Norvège ont présenté diverses approches permettant d'effectuer l'évaluation et la surveillance des effets cumulatifs. Les orateurs de Terre-Neuve et de la Nouvelle-Écosse ont discuté du développement pétrolier et gazier sur les Grands bancs et sur la plate-forme néo-écossaise et des effets cumulatifs de cette industrie et d'autres activités sur les poissons ainsi que sur les oiseaux et les mammifères marins.

Les participants ont discuté des effets cumulatifs au cours de séances plénières et de réunions en comité restreint. Une large gamme de problèmes ont été abordés lors de la première séance plénière qui portait sur les enjeux, les problèmes et les possibilités concernant l'évaluation des effets cumulatifs dans le contexte de la Côte Est. Les interactions entre l'industrie du pétrole et du gaz, l'industrie de la pêche et d'autres activités industrielles extra-côtières ont été discutées au cours d'une seconde séance plénière. Les participants ont de plus discuté des trois questions suivantes en petits groupes :

i) Quelles sont les possibilités d'effets cumulatifs au large de la Côte Est?

ii) Comment devrait-on surveiller ces effets cumulatifs?

iii) Qui devrait faire quoi dans le cadre de l'évaluation et de la surveillance des effets cumulatifs?

Le consensus général obtenu lors de l'atelier était que Pêches et Océans Canada devrait prendre l'initiative de lancer un processus multipartite consistant à mettre au point une approche faisable pour l'évaluation régionale des effets cumulatifs. L'évaluation des effets cumulatifs est un outil vital permettant de progresser vers la durabilité dans le respect de l'environnement. Toutes les industries et tous les utilisateurs exploitant la mer doivent pouvoir rendre compte de leur contribution aux effets cumulatifs. Des défis scientifiques importants devront être relevés pour mener à bien la recherche et la surveillance de ces effets. Les institutions exigeront un engagement à long terme qui devra se matérialiser par un investissement en personnel et en capitaux pour faire en sorte que les effets cumulatifs soient convenablement évalués et surveillés.

Preface

On May 8 and 9, 2000 the Environmental Studies Research Funds sponsored a workshop on Cumulative Environmental Effects Assessment and Monitoring on the Grand Banks and Scotian Shelf. The workshop was held in response to recommendations from the 1997 Terra Nova Environmental Assessment Panel on the need to address cumulative effects of offshore oil and gas development.

Although environmental assessment has been practised in Canada since the early 1970s, the concept of cumulative effects (CE) assessment and monitoring emerged somewhat later. During the 1980s, cumulative effects research was supported by the Canadian Environmental Assessment Research Council (CEARC). In 1995 the consideration of cumulative effects became mandatory through its inclusion in the Canadian Environmental Assessment Act, and its subsequent incorporation into provincial environmental assessment processes. Methodologies for conducting CE assessment have been developed through academic analysis and practical application in a number of assessment processes, largely conducted in Western Canada for terrestrial environments.

For the purposes of this report, cumulative effects are defined as follows (CEAA 1994:135):

> *A cumulative effect is an effect on the environment which results from effects of a project when combined with those of other past, existing and imminent projects and activities. These may occur over a certain period of time and distance.*

As described in the *Cumulative Effects Assessment Practitioners Guide* (Cumulative Effects Assessment Working Group and Axys 1999), cumulative effects can occur in various ways:

- Physical-chemical transport: a physical or chemical constituent is transported away from its source and then interacts with the effects of another project or activity.
- Nibbling loss: the gradual and incremental disturbance of land or habitat.
- Spatial and temporal crowding: cumulative effects can occur when too much is happening within too small an area and in too brief a time.
- Growth-inducing potential: actions induce new actions as a spin-off effect.
- While environmental assessments of petroleum production projects offshore Canada have been completed since the early 1980s, there is little Canadian experience with the application of CE assessment in the marine environment. During the environmental assessment of the Terra Nova Development, the most recent environmental review of an offshore petroleum production project, the joint review panel made a number of recommendations regarding the need to develop appropriate assessment and monitoring approaches, and the adequacy of present criteria for determining the significance of cumulative effects (Appendix A). The Panel also recommended that the Canada-Newfoundland Offshore

Petroleum Board (C-NOPB) convene a workshop to examine the potential for cumulative effects due to offshore petroleum development and other activities, and develop best science approaches to monitoring these effects. The C-NOPB addressed the subject in its related decision (Appendix B) and brought forward this initiative to the Environmental Studies Research Funds, which sponsored the May 8-9, 2000 workshop in response to these recommendations.

Prior to the cumulative effects workshop, a workshop to discuss the environmental effects of offshore hydrocarbon development was held in Halifax in March 2000. The workshop was co-sponsored by the Sable Offshore Energy Environmental Effects Monitoring Advisory Group (SEEMAG) and the Bedford Institute of Oceanography. Over 300 people attended, with good representation from both Newfoundland and Nova Scotia.

The purpose of the cumulative effects workshop was therefore to address the recommendations of the Terra Nova Panel, while at the same time building on the information that was shared at the SEEMAG workshop. More specifically, the goals of this cumulative effects assessment and monitoring workshop were:

- to provide an opportunity for stakeholders to discuss approaches to CE assessment and monitoring for the Grand Banks and Scotian Shelf that are both scientifically defensible and fiscally and logistically achievable, and

- to transfer and adapt knowledge developed in (a) western Canada for terrestrial environments and (b) other offshore oil and gas producing areas to the East Coast marine environment.

The workshop objectives were to:

- develop a common understanding of the acceptable approaches to cumulative effects assessment and management in the offshore;

- assess the likelihood of cumulative environmental effects associated with present and reasonably foreseeable petroleum development scenarios on the Grand Banks and Scotian Shelf;

- identify and document scientifically credible spatial and temporal boundaries associated with these effects;

- identify and document the factors necessary for monitoring the potential effects in each region;

- identify and document scientifically credible means of determining "significance" of environmental effects; and

- recommend means by which potential cumulative effects may be monitored.

Sixty-five people attended the workshop. Participants included representatives of federal and provincial government agencies, the oil and gas industry, consultants, non-governmental organizations, fishery organizations and universities. The workshop agenda and participant list are included in Appendices C and D.

Acknowledgements

The workshop on Cumulative Environmental Effects Assessment and Monitoring on the Grand Banks and Scotian Shelf was initiated by the Canada-Newfoundland Offshore Petroleum Board (C-NOPB) and funded by the Environmental Studies Research Funds (ESRF). Leslie Grattan, Environmental Project Manager for the Churchill River Power Project, with Newfoundland and Labrador Hydro, served as Workshop Chairperson. The workshop was developed and facilitated by Hatch (Susan Toller) and Griffiths Muecke (Lesley Griffiths and Anne Muecke) with guidance from the ESRF Management Board.

The presentations and contributions of key speakers provided valuable knowledge and experience and stimulated workshop discussions. Key speakers included:

Peter Cranford, Fisheries and Oceans Canada

Peter Duinker, School of Resource and Environmental Studies, Dalhousie University

Don Gordon, Fisheries and Oceans Canada

Jeff Green, AXYS Environmental Consulting Ltd.

Jon Lien, Whale Research Group, Memorial University

David Luff, Canadian Association of Petroleum Producers

Bill Montevecchi, Biopsychology Programme, Memorial University

Sam-Arne Noland, Det Norske Veritas (Norway)

Jim Ray, Equilon Enterprises LLC (Texas)

Bill Ross, Faculty of Environmental Design, University of Calgary

The participation of representatives from government agencies, the oil and gas industry, consultants, non governmental organizations, universities and fishery organizations contributed to the success of the workshop.

1 Starting with the Bottom Line: Why do we do Cumulative Effects Assessment and Monitoring? Who needs the information and for what purpose?

Summary of introduction by Leslie Grattan, Newfoundland and Labrador Hydro

Leslie Grattan introduced the concept of cumulative effects and summarized the history of cumulative effects assessment in Canada, in practice and in legislation. Workshop participants were reminded of the specific background of the workshop and its objectives. The Terra Nova Panel recommended that the C-NOPB and relevant government departments consider the importance of the interactions of multiple activities with specific reference to offshore development in the Grand Banks. The C-NOPB initiated the workshop as a response to the Panel's recommendation. While offshore oil and gas development may contribute to cumulative effects, there are other offshore industries that interact with the marine environment.

2 East Coast Offshore Context

Presenters provided background on the oil and gas industry on the East Coast. The environmental effects of offshore oil and gas development were introduced.

2.1 Offshore Hydrocarbon Development: East Coast Opportunities

Summary of presentation by David Luff, Canadian Association of Petroleum Producers

The Canadian Association of Petroleum Producers (CAPP) represents 165 natural gas and crude oil exploration, development and production companies. The petroleum industry has created 463,000 jobs in Canada. Exports are strong and should continue to grow.

Three hundred wells have been drilled on the East Coast to date. On the Grand Banks, there are 4.7 billion barrels of conventional oil and 45 trillion cubic feet of natural gas.

There are many opportunities for the oil and gas industry to address cumulative effects of oil and gas development. Petroleum companies can assist with:

- development of a consolidated resource management policy and regulatory decision-making framework;
- identification and designation environmentally sensitive areas in the marine environment;
- initiation of a national process to meaningfully address First Nations and aboriginal concerns;
- demonstration and continuous improvement of environmental performance; and
- building partnerships with other users of the marine environment.

Canada has the potential to be recognized as a world leader in oil and gas development. We must capitalize through our opportunities and grow through partnerships and alliances.

2.2 Prediction and Verification of Offshore Oil and Gas Effects

Summary of presentation by Don Gordon, Fisheries and Oceans Canada for Peter Wells, Environment Canada

The Sable Offshore Energy (SOE) Environmental Effects Monitoring Advisory Group (SEEMAG) was established in early 1998 to advise SOE Inc. on the design and implementation of its environmental effects monitoring (EEM) program. SOE Inc. has now undertaken two years of monitoring covering baseline conditions and the construction phase of the Sable Project. In March 2000, SEEMAG in partnership with the Bedford Institute of Oceanography (BIO), held an open forum for all interested stakeholders to discuss the environmental impacts of offshore hydrocarbon development in Atlantic Canada. The purpose of the workshop was to:

- share information on relevant research projects and industry sponsored EEM programs;
- review the lessons learned to date; and
- discuss the way forward.

The workshop covered findings from four EEM programs (Hibernia, Terra Nova, Cohasset-Panuke, and Sable), and research activities undertaken by Fisheries and Oceans Canada under the federally funded Program on Energy Research and Development (PERD). Detailed information is provided in the workshop proceedings (Gordon et al. 2000).

The scope and objectives of EEM in the offshore are:

- to provide early warning of undesirable environmental change;
- to verify earlier impact predictions;
- to improve understanding of cause-effect relationships (project-environment); and
- to evaluate and confirm the effectiveness of mitigation and regulatory compliance.

The workshop presentations covered research on exposure and effects, and the design and results of the EEM programs themselves. Of these, exposure is a key variable and probably the most difficult to describe.

Several presenters described their work with numerical models and emphasised the importance of modelling in understanding the impacts of offshore hydrocarbon development in the marine environment. The circulation and Benthic Boundary Layer Transport (BBLT) family of models help to determine the fate of fine particles of drilling mud, the key determinants of dispersion,

and how impacts might change with seasons. They also aid the prediction of where impacts may or may not be expected and hence where monitoring should take place. The fate of drilling waste fine particles has focussed on the BBL, but research has also shown that the drilling waste plume can stay suspended in the water column.

Studies of sediment movement show that storms dominate sediment transport, particularly in shallow waters, and that an understanding of the impact of storms on sediment movement is essential for the design of EEM programs and the interpretation of their results.

In the biological and physical context, it is difficult to separate human-induced changes (fishing activity, oil and gas) from natural variations (salinity, temperature, currents). At a population level, few biota are well known and better survey data is needed. For project-specific EEMs, a case can be made for using individual rather than population-level responses to define impact zones in water and sediment. Contamination, bioaccumulation, tainting and toxicity studies are being undertaken and laboratory work in conjunction with field studies is being used to determine the toxicity levels for various drilling muds, and feeding responses of sea scallops (as an indicator species) in the presence of drilling muds. The toxicity results from individuals can be used to model the predicted effects on populations.

While work on the fate of oil spills has been underway for some time, more work is needed to understand how the oil behaves at the shoreline. Also, a new program is being initiated to examine the impact of produced water – a very complex and variable by-product of hydrocarbon extraction. Produced water carries some particles that sink and others that float on the surface, and also contains potentially toxic chemicals. When assessing the impact of produced water, an ecological risk assessment approach is required.

The EEM results for the four offshore projects indicate that the effects fall within the predicted range and tend to be focussed on the area close to the rigs. The studies need to be designed for the specific location and seem to be particularly effective when they combine laboratory, modelling and field approaches.

At Hibernia, the zone of biological effects seems to be very localized, however further studies will be undertaken on resource species. Hydrocarbons and metals decline within 1000 m, polyaromatic hydrocarbons (PAHs) are below detection limits, the sediments are non-toxic, and there is no evidence of taint in American plaice caught within 3000 m of the platform. Overall, no significant impacts have been found. Further studies with different fish species will be undertaken and seabirds will continue to be monitored.

The Terra Nova studies are just getting underway. They are taking a Valued Ecosystem Component (VEC) – based approach to the baseline studies, building in the ability to re-evaluate the EEM approach and design, and involving many stakeholders.

At Cohasset-Panuke, mussel tainting was found within 500 m of the rig but the hydrocarbons returned to background levels after the discharges ended.

The Sable EEM studies are also VEC-based and cover the water column, sediments and organisms in a very dynamic environment. Hydrocarbons have been found to enter the

sediments but are transient. Barium (from drilling mud) has been detected out to 3000 m but most of the cuttings are found in localized mounds near the rigs. Chemical burden and taint have been monitored. Variable sediment toxicity has been found but mussel mooring studies have revealed no taint. Most of the effects detected have been found within 250 m of the rigs.

In general there is need for greater understanding of all aspects of natural variation in the offshore environment, careful statistical design, and careful selection of variables in EEM programs. Discussion in open sessions focussed on the potential for cumulative effects in general, the need for open and transparent processes, and the importance of trust between stakeholders. It was also pointed out that the industry has changed considerably over the past 30 years and that source reduction has considerably reduced the quantity and toxicity of its discharges. In the Gulf of Mexico it is very difficult to separate the oil industry effects from those of other natural, commercial and industrial influences in the marine environment.

In considering 'where do we go from here?', the following points emerged:

- ensure that monitoring can track natural change in the marine environment as well as induced change;
- separate reversible from irreversible effects;
- consider the entire chain of activities in the development process, including seismic exploration;
- count in the impact of technology change and source reduction;
- monitor individuals in a species as well as populations; and
- find better means of monitoring birds.

3. Cumulative Effects Assessment and Monitoring Approaches

Summary of presentations by Bill Ross, University of Calgary and Jeff Green, Axys Environmental

Cumulative effects assessment is currently at the same state that environmental assessment was at in the 1970s. The Canadian Environmental Assessment Act (CEAA) requires that cumulative effects be addressed. This has recently been reinforced by an April 1999 court decision by the Federal Court of Appeal. The Court found that the joint review panel had breached its duty and erred in due process in considering cumulative effects and alternative means for the Cheviot mine. The panel was ordered to reconvene to consider additional matters including cumulative effects.

The cumulative effects assessment of projects is different than regional cumulative effects assessment. This presentation focuses on project-specific cumulative effects.

Cumulative effects assessment is difficult because it:

- requires better understanding of natural and social systems;
- requires access to information: a) need regional information, b) need information about other activities, c) need information about impacts of other activities (since this is often not available, one must ask what are plans, what are the impacts, how much will occur?);
- benefits from administrative authority a) regulator of project lacks authority over other projects – ie gets understanding of impacts but no authority to act, b) need for collaboration with other regulators; and
- tends to result in competition between industries.

There are four main requirements of Cumulative Effects Assessment:

- identify VECs affected by the proposed project
- determine other human activities that have affected or will affect the VECs
- predict cumulative effects and determine their significance (there are interesting links between mitigative measures for other activities and the actual cumulative effects)
- suggest how to manage cumulative effects of the project and other activities

Cumulative effects assessment may be the way we achieve sustainable development. Usually we separate, then integrate information. Natural variation is very important. Cumulative effects assessment requires creative approaches since we may not have all the spatial or temporal information.

Scoping, the first step in conducting cumulative effects assessment, is very important. Some guiding questions might be: Will the project have a measurable effect on resource(s) in question? Will that project effect react in cumulative fashion with other land use pressures? Will that effect in combination with other effects cause measurable changes in resource(s)? i.e. the ability of a species to survive and reproduce

The selection of VECs, geographic and temporal boundaries and activities to be included requires simultaneous identification. When doing assessments, one needs to be "VEC-centric" to ensure one sees effects from VEC point of view. One should focus on an effect and then integrate all of the effects. This may require qualitative rather than quantitative methods.

Selection criteria for VECs should include:

- widely distributed species or species with big territories
- sensitivity to regional biological and physical changes

- response should be measurable
- population status
- importance of keystone species or prey
- representative of habitat requirements of other species
- socioeconomic importance of VECs
- data availability

Spatial boundaries should be designated to include the overlap between the project and other activities (projects, activities, human uses, land use). One should look from the viewpoint of the VEC – start at 'centre' and work out. It is important to remember that the VEC can link the effects even though there is no spatial overlap.

When establishing temporal boundaries, one should set bounds not just by the duration of the activity but the duration of the impact. An iterative process should be used. It is useful to consider environmental scenarios:

- pristine – without human influence
- current – existing without project
- peak construction, operation, abandonment

Examples of types of cumulative effects that may be encountered in the marine environment:

- overlap in time and space – overlapping plumes at same time or different times
- VEC moves through space and connects the two areas of effects
- mobile receptor + mobile disturbance + fixed disturbance (VEC picks up signals sequentially)

When developing the list of projects with possible cumulative effects, one should examine the CEAA Project inclusion list. There needs to be some degree of certainty about other projects included in the assessment. It may be difficult to obtain information due to the confidentiality of project information (eg. diamond mines). Future scenarios may be difficult to predict, especially in the energy sector. Generally, one should include any projects that are in the midst of regulatory approval (eg. regional planning for forestry). There is no need to assess hypothetical projects.

Thresholds should be used where possible. The selection of ecological thresholds can be difficult. One can use regional land use objectives, existing guidelines, e.g. air, no net habitat loss, drinking water guidelines (although these are often not acceptable because they are minimum standards). Health thresholds could be considered.

The most important thing is to make good development decisions. The examination of cumulative effects is inevitably anthropocentric – especially for regulator and decision-makers.

4. Lessons from Other Regions

Presenters discussed their experience with cumulative effects in the Gulf of Mexico and the North Sea.

4.1 Cumulative Effects Assessment and Monitoring in the Gulf of Mexico

Summary of presentation by Jim Ray, Equilon Enterprises

In the United States, the offshore cumulative effects management record has been mixed. Under the terms of the Outer Continental Shelf Lands Act (OCSLA), the Department of the Interior Minerals Management Service (MMS) must submit to Congress a yearly analysis of the cumulative effects known to have occurred due to oil and gas in the human, marine and coastal environments. In other words, the scope is broad. In order to make this a manageable task, MMS has defined cumulative effects as "the total identifiable long-term effects attributable to activities authorized under OCSLA which are in evidence at this point in time and can be quantified or evaluated."

In the US over the past 15 years, $0.75 billion have been spent on studying all aspects of the offshore oil and gas industry. For the past 4-5 years, the average yearly spending has been $19 million.

Some of the main issues around cumulative effects in the offshore include:

- variability often masking the ability to measure effects
- temporal studies requiring long time periods especially for certain animals
- dealing with the limits of detection
- the difference between marine and terrestrial environments (on land you can more easily observe changes; in the three-dimensional ocean, everything is moving)
- effects of other human activities
- interrelationships in the environment
- processes and rates of recovery
- the dynamics of a changing system; initial reference points and baselines may not provide an accurate comparison.

Two of the biggest oil and gas issues over the last twenty years have been water-based drill muds and cuttings and produced water. Secondary issues have included oil spills, grey water

and other discharges, naturally occurring radioactive materials (NORM), and impacts on birds (spills and interactions with platforms) and on marine mammals and turtles (debris and noise). Socioeconomic effects were ignored for a long time but in the last few years have started to get considerably more attention.

We need a good understanding of what is being discharged, in terms of quantity and constituents, how long it is being discharged, where it is going, and how long it persists.

In the 1970s and 80s, studies focused on the fate and effects of oil, oil in the sea (physical, chemical, biological aspects), toxicity of hydrocarbons, the use of dispersants, remediation, and water-based muds (field and lab work). In the 1980s and 90s, the focus moved to produced water (composition, toxicity, fate and effects, bioaccumulation), and NORM, and synthetic-based and other non-aqueous drilling fluids.

So where did we come up short with respect to cumulative effects? Most of the studies have been over a limited spatial scale, and for relatively short periods of time. Conclusions have to be based on what can be detected. For example, in the Gulf of Mexico there are a lot of variability issues for benthic communities and it can be difficult to accurately detect ± 100% change. MMS has been limited in it what can do because of lack of data on impacts relative to other factors, especially fishing, marine transportation, atmospheric inputs and land-based inputs (for example, the Mississippi River). Most of the impact studies to date have been restricted to oil and gas.

However, the National Oceanic and Atmospheric Administration (NOAA) initiated a successful status and trends program in 1984 to study the general health of the coastal zone and estuaries in 20 different locations. Projects include:

- benthic surveillance using histopathology approaches;
- the mussel watch program looking at both mussels and oysters in 287 sites (oysters are a particularly good sentinel species because they sequester hydrocarbons over a long period);
- an excellent Quality Assurance Program to maintain and improve laboratory standards (essential in order to integrate and compare data);
- sediment coring to pick up historical trends;
- specimen banking (tissue and sediments);
- sediment toxicity surveys; and
- use of biomarkers.

Another cumulative effects initiative is the Breton Sound Air Quality Study, looking at the effects from offshore emissions on onshore air quality. Monitoring equipment has been set up on over 100 platforms and the results will be fed into air quality models.

What Boesch and Rabelais said in their 1987 publication is still relevant:

> "...ecosystems are complex, open, and dynamic, there are fundamental problems in identifying the nature and extent of environmental effects and in determining causality. Uncovering subtle effects...requires long term observations, ...imaginative experimentation, ...to overcome obstacles provided by natural variability, statistical limits of detection, the effects of other human activities, recognition of recovery, and unknown relationships within ecosystems and their role in supporting human resources."

Cumulative effects management has to be orchestrated at some level by government, because of the size, duration and complexity of the undertaking and the number of players. All the key players should be included and everyone should have money on the table. It makes a big difference to the quality of decisions – it's too easy to spend someone else's money. You need to focus on elements that can be measured and interpreted, and are relevant to the key resources of concern; otherwise you will break the bank. Don't bite off more than you can chew; science has real limitations.

Cumulative effects monitoring is not a finger pointing exercise. It's a team effort that requires honest evaluation to understand our environment and the effects we have on it, and to use this information for the wise and integrated management of our activities and resources.

4.2 Effects on the Marine Environment – An Overview: 20 Years of Monitoring of the North Sea

Summary of presentation by Sam-Arne Noland, Det Norske Veritas

Norway has been monitoring the effects of oil and gas development in the North Sea for 20 years. Drilling began in 1965 and oil was first produced in 1969. Many of the first wells are now being decommissioned. Each polluter is required to assess the impact of their oil and gas activities and publish an annual report.

Petroleum operations in Norway contribute only 2% of the overall discharges into the North Sea. The majority (59%) is attributed to discharges from rivers. Most of the petroleum industry discharges result from ordinary operations. Spills sometimes have a large impact, but mostly for less than 10 years. The biggest source of discharge is from produced water. Chemical contaminants are mainly from drill muds.

In the 1960s, environmental assessments of oil and gas activities predicted that oil discharges were unlikely to lead to detrimental environmental effects. In the 1970s, the use of oil-based drilling mud increased. Evidence of environmental effects was found usually less than 1 km from a drilling site, sometimes up to 2 km. Environmental monitoring was initiated in the late 70s.

Later studies discovered the distribution of effects of discharges to be up to 10 km, much wider than predicted in the 1960s. Norwegian pollution authorities deemed these effects to be unacceptable. Oil-based mud discharges were prohibited after 1993. This led to the

development of new technologies (reinjection of muds, new muds) and a reduction of pollution levels.

Results of studies indicated physical and toxic effects of discharges. Effects of oil-based mud were found at 1-5 km some time later. Water-based mud, although not toxic, can bury organisms, and its effects were found at 50-100 m. The effects of synthetic-based mud were found at 250-500 m. The toxic effects of ester-based muds are greater due to high oxygen consumption.

Regional monitoring was initiated in 1995 and is fully funded by industry. The continental shelf was divided into 11 regions for monitoring purposes. While previously, each company was responsible for monitoring its activities, a new collaborative approach uses one consultant with guidelines approved by regulatory authorities, to make sure data are comparable. Sampling sites cover all fields and examine all changes, including ten reference sites. Every region is investigated every third year. Water column monitoring is also undertaken using selected organisms and fish to monitor overall conditions, sublethal and long term effects.

Monitoring programs consist of:

- chemical analysis of sediments (total hydrocarbons, metals, PAH, synthetic drilling muds);and
- benthic macrofauna - small benthic organisms larger than 1 mm living in or on the sediment (crustaceans, bristle worms, etc.).

Norway's collaborative approach to monitoring is working well. Data quality has improved and it is easier to compare data from different fields and companies. There has been excellent collaboration between all players on the mutually beneficial data collection system. Information is available to the public and an extensive database is being developed. An annual meeting is held to present results of surveys and to exchange ideas. An expert group now evaluates the reports to maintain quality.

5. The Challenges for Cumulative Effects Assessment and Monitoring on the East Coast [Plenary Session]

Summary of presentation by Peter Duinker, Dalhousie University

Peter Duinker identified the following themes that emerged from the first day of the workshop.

- There is unclear accountability for cumulative effects (because we are not good at determining the stresses on VECs) and unclear responsibility for Cumulative Effects Assessment (CEA).
- There tends to be fragmented jurisdiction for resources, environments and different types of developments.

- There are unstable and conflicting rules and regulations, which feed ongoing concern (and reality) that the regulatory ground is constantly shifting.

- Adversarial relationships underlie and undermine relationships. There is a fundamental lack of trust and collaboration between government departments, companies and NGOs.

- There is poor information-sharing within and between sectors.

- There is a lack of basic scientific knowledge, many uncertainties, and poor understanding of natural variation. In other words there are always more questions than answers.

- There are unclear rules on where and when to stop or bound cumulative effects assessment work – in time and space, and in terms of knowing which other activities to include. These boundaries can also change with the economic and political climate. Overall the other projects and/or activities that are chosen to be included should be those that are likely to have the biggest impacts. While it is difficult to obtain threshold information for biota, it is important to do more than meet minimum standards.

- Funding is fragmented and very limited, and small resources may not be spent most efficiently.

- The more we disconnect modelling from natural systems the less realistic it becomes. Modelling must work in conjunction with real life contexts and environments.

CEA is at the same stage of development in the 1990s as environmental assessment was in the 1970s. It needs a quantum leap to reach the levels necessary for effective work.

During the plenary discussion, the following comments and questions were raised by workshop participants:

- There is a point where a hypothetical project becomes more real – usually because it has achieved a level of approval or funding that makes it likely to happen. It is important in CEA to deal with real projects as much as possible because analysis of hypothetical projects can quickly become speculative and qualitative – which may not be very helpful. On the other hand, if you know, for example, that a 20 year project is likely to proceed subsequently in five year increments, because that is how the industry traditionally works, then it makes sense to include those expected additions.

- There is always uncertainty in undertaking an analysis based on insufficient details. However, it does not have to stop the assessment. One can paint a picture rather than try to pin down all the parameters.

- In vulnerable areas, such as around Sable Island where more activity is expected in the next 19 years, protected areas and buffer zones should be established to protect important and vulnerable resources. Fishery, and oil and gas priority areas should be identified. This would require a plan to be developed before leases are issued.

- For the assessment of each VEC, the time and space parameters are different and may involve very long migratory routes which cross international boundaries. How should boundaries be set?

- Even if you can determine what the reasonably forseeable activities are, how do you determine the thresholds for impacts, and how is that integrated into decision-making? Follow-up is important but the results must feed into a management mechanism.

- Who should fund these studies? There is a problem with fragmented funding which could be addressed in part through collaborative work – such as the establishment of reference sites which could be used by all.

- Are the assessment tools always being applied the same way or are they being changed all the time?

- Scientific uncertainty, particularly in the marine environment is an important issue. We do not have much knowledge of many marine organisms.

- Mechanisms are needed to include other stakeholders – the fishing industry, shipping and NGOs. Expertise, information and scientific assets in universities, government, industry and NGOs should be brought together and collaborative efforts initiated.

- The best approach may be to identify an area, bring in the stakeholders and initiate an assessment.

- Models and processes developed elsewhere are useful, even though they may not be in offshore context. The model forest program has made great strides. Similarly, the oil sands project is making good progress.

6. Designing Cumulative Effects Monitoring Programs: Some Issues

This session addressed proposed and ongoing cumulative effects monitoring programs. The challenges and essential components of monitoring contaminants and their effects on seabirds and mammals were discussed.

6.1 Program for Energy Research and Development (PERD) Funded Research

Summary of presentation by Peter Cranford, Fisheries and Oceans Canada

The strategic intent of the program is to fulfil the federal government's responsibilities while maximising economic benefits and reducing environmental consequences from the expansion and diversification of Canada's oil and gas production. It examines the basis for regulatory waste management requirements, remediation of accidental offshore discharges and spills, and the assessment of cumulative effects from drilling wastes, produced water and accidental releases.

Accidental Discharges

The accidental discharge and spills program examines the tolerance of wetland plants and recovery of wetlands after an event, surfwashing techniques, the identification of endpoint indicators, the effects of old spills, and the transfer of oil from the surface to the sea bed.

Cumulative Effects Monitoring

The objectives of this work are to:

- develop cumulative effects monitoring technologies using bivalves as sentinel organisms;
- test laboratory and model predictions;
- determine the relative impact of different wastes and disposal practices; and
- assess the effectiveness and improve regulatory guidelines.

Effects of Produced Water

Produced water contains heavy metals, hydrocarbons, nutrients, radionuclides and added chemicals. Produced water studies examine the transport, fate and biological effects of discharged produced water from Canada's East Coast oil and gas production platforms.

At present the environmental impacts of produced water are unclear. The potential for toxic effects may be reduced quickly through dilution but chronic effects may emerge due to long term exposure, and inhibitory effects may be seen. Also contaminants may be sequestered in the benthic environment through physical and chemical processes (e.g. flocculation). The program will examine the chemical effects of produced water, the potential toxicity to marine biota, the transport of produced water contaminants, provide an ecological risk assessment on the probability of adverse effects with produced water disposal, and recommend changes to protocols - if needed.

Fate and Effects of Drilling Waste

The drilling waste studies focus on the dynamic area near the sea bed and are providing a better understanding of waste transport processes. Oil-based mud (OBM) and synthetic-based mud

(SBM) are being examined. Numerical dispersion models are being developed and tested and new equipment is being developed to measure waste distribution. For example, the CAMPOD incorporates a high resolution video and still cameras with a "slurper" to capture fine waste materials.

The studies are examining acute, chronic lethal and sublethal toxicity of wastes to commercial species in the laboratory. This work will lead to risk assessments for commercial species, as well as EEM tools and recommendations. Scallops have been the target organism in these studies because they have a wide distribution with commercial stocks in many production sites; they are sedentary and subject to chronic exposure; they filter large volumes of water and ingest and bioaccumulate contaminants; and are also highly sensitive to drilling waste. Exposure of test organisms to OBM and water-based mud (WBM) may find some effect in growth and reproduction compared to control organisms. They are also sensitive to barite.

In the modelling component of the work, all information on the dispersion, fate and effect of drilling waste is combined into models to determine the effect on populations. The model results are then compared to lab results and findings from field sites - such as Georges Bank. The findings are used to test regulatory guidelines. At Hibernia, the scientists looked at chronic effect indices (such as mortality and growth), contaminant distribution (such as hydrocarbon body burden) and tainting using moorings of sea scallops. They found low mortalities but a significant negative effect on their growth. There seemed to be no relationship to the proximity of the boundary layer. Work with sediment traps indicates that feeding rates decrease with an increase in drilling muds and in the presence of barium.

6.2 Determining Environmental Effects on Seabirds

Summary of presentation by Bill Montevecchi , Memorial University of Newfoundland

Seabirds are a good indicator of the environmental effects of offshore oil and gas development. There are a large number of species of seabirds that frequent the nearshore and offshore of Newfoundland. Animals living here may be thermally stressed due to the Arctic influence of the northern currents that flow past Newfoundland.

The goal of environmental assessment and monitoring of petroleum development on seabirds should be to minimize hydrocarbon-related impacts. Birds can accumulate in high concentrations in a very few areas and are therefore very vulnerable to oil pollution.

Seabirds are affected by other human activities such as sewage discharges, hunting and fishing. Many birds are attracted to sewage, a problem which could be easily addressed. Since there are no bag limits on murres, these birds have a high mortality from hunting. Seabirds also suffer injury and mortality when caught as bycatch in fishing nets. Overfishing of capelin has reduced the food supply for seabirds. On the positive side, due to the reduced numbers of cod as a result of overfishing, there is less competition for capelin as a food supply. The cod moratorium has reduced the seabird bycatch problem.

Oil spills are a chronic problem for seabirds in some areas and have increased since the mid 1980s. Oil spills and other petroleum-related discharges are likely to continue to increase as the number of offshore oil and gas developments rises. Effects of flaring need to be studied. Our challenge is to minimize effects.

Some opportunities to minimize effects include:

- Platforms - minimize anthropogenic disturbances (light and sewage); undertake platform and boat-based surveys (they haven't happened yet); weekly and monthly week-long platform surveys by dedicated trained observers; experimental and mitigative manipulations such as turning off flares and closing blinds; and

- Vessel surveys - fixed width transects; collect simultaneous fish population data and other biological and physical data to support observations; weekly supply vessel surveys etc.

The Canadian Association of Petroleum Producers (CAPP) recently commissioned a study on how to monitor birds at sea. The recommendations have not been implemented. There should be some follow up and implementation as a result of the study. One of the best ways to proceed with monitoring effects on seabirds is to establish independent observers on drilling platforms. Participants discussed the CAPP study.

Urban Williams summarized Petro-Canada's seabird monitoring program. Petro-Canada trained personnel on site to monitor seabirds and has provided the data to Bill Montevecchi. They have initiated a storm petrel recovery program to assist birds that have hit rigs.

6.3 Determining Environmental Effects on Marine Mammals

Summary of presentation by Jon Lien, Memorial University of Newfoundland

Cumulative effects monitoring has not been done very well. It is important to distinguish the effects of different offshore activities on the marine environment so that we can assign responsibility for the changes that occur.

Marine mammals, and particularly whales, provide a unique opportunity to monitor changes in the ocean environment. Some whales, such as the fin whale can live for up to 100 years. A fin whale approaching the end of its life may have experienced impacts from: whaling, fluctuations in capelin and other fish populations, injuries from fishing gear, increased toxicity from marine effluents, noise from increased shipping and whale-watching vessels, and may now be affected by the presence of offshore oil and gas activity. Many whale populations were depleted by intensive whaling and have never recovered due to added impacts resulting from overharvested fisheries. While we need to be able to measure the effects of oil and gas development, it may be difficult to differentiate the effects of this industrial activity from others influencing whales.

Whale researchers have documented a large amount of whale data. In fact, 100% of right whales are known as individuals. Large numbers of blue and bottlenose whales are known individually. Tissue archives provide an excellent source of data.

There is a need to look at all of the stresses imposed on whales by previous activities. Fisheries and Oceans Canada needs to take the lead to create partnerships, and assign responsibility.

The oil and gas industry should not be given responsibility for addressing all of the previous impacts.

7. What is the Potential for Cumulative Effects off the East Coast?

[Small Group Discussions]

Bill Ross and Jeff Green introduced some of the opportunities and challenges related to predicting cumulative effects. Jeff Green suggested that the groups look at the following factors in order to identify potential cumulative effects:

- contaminant loading (changes to air, sediment, and water quality);
- direct habitat change (e.g. sediment deposition, disturbances, natural events);
- habitat alienation (e.g. sensory disturbance);
- habitat fragmentation; and
- direct mortality.

How do these effects manifest themselves for each set of VECs, especially by affecting both the survival of individuals and their ability to reproduce?

Summary of Feedback from Small Group Discussion 1

Participants were asked to address the question, "As the offshore oil and gas industry grows, which cumulative effects are likely to be of most concern?" In order to carry out this scoping exercise, participants opted to join one of eight small groups divided into the following VEC groupings: benthic environment; fish, eggs and larvae; birds and mammals; and the fisheries. They were asked to identify both:

- interactions between individual oil and gas developments, and
- interactions between oil and gas developments and other projects, activities and influences.

7.1 Benthic Environment

The benthic environment must be an important component of cumulative effects assessment because it is directly affected and also a sink for contaminants. In terms of monitoring

cumulative effects, the benthos is also a relatively stable target, more easily monitored than some VECs. Participants identified the following potential cumulative effects from oil and gas developments.

Potential Cumulative Effects to Benthic Environment		
Physical/Chemical	**Biological**	**Contaminant loading caused by ...**
· Smothering · habitat alteration* · particle size · organic enrichment · nutrients - stimulatory/PP · chemical speciation · structure-reef effect · seabed scouring · pipeline laying · exclusion zone (fisheries)	· species diversity · food chain dynamics · tainting · settlement/recruitment · endocrine disruption · contaminant body burden · acute/chronic toxicity · effects may be lethal/sublethal · effects may be synergistic/antagonistic	(a) drilling fluids · cuttings/muds/additives · heavy metals · HC-PAHs (b) produced water · hydrocarbons · metals (speciation) · NRM (tracers) · additives · transport mechanisms (c) accidental spills (d) air emissions (e) domestic waste/deck drainage

* underlined factors were considered particularly significant by at least one of the groups

Other projects, activities or factors likely to affect the benthic environment:

- fishing (through seabed alteration, fish mortality, and possibly resuspension of contaminated sediments)
- transportation/shipping
- ocean mining
- ocean dumping
- natural perturbations (storms/waves, icebergs, natural oil seeps)
- climate change
- natural variation

7.2 Fish, Eggs and Larvae

Cumulative effects on fish, eggs and larvae may be caused by oil and gas development, in combination with other activities as listed below.

Sources of Cumulative Effects	
Oil and gas development	**Other activities**
• seismic • cuttings, muds • produced water • spills • pipeline/trenching • glory holes	• dredging • fishing • climate (ocean) • ballast water • predation

The following potential cumulative effects were identified as being of most concern:

- Localized effects on fish health caused by construction, drilling and production (need to define the extent).
- Eggs, larvae drifting through zone of potential impact
- Seismic exploration activities moving through areas containing eggs/larvae, that may cause mortality.

It was emphasized that we should not just look for population effects, other types of effects may also be significant.

Cumulative effects assessment (prediction and monitoring) needs to be holistic, using a tiered approach, from communities to populations to trophic levels, and should be integrated with existing DFO programs.

7.3 Birds and Mammals

Cumulative effects on birds and mammals may be caused by various aspects of oil and gas development in combination with other offshore activities. The major concerns identified by the groups addressing birds and mammals are summarized below.

Seabirds - Major Concerns	Mammals - Major Concerns

• operational discharge of oil, fluids and sewage
• spills (surface oil)
• attraction to platforms, resulting in
  - mortality ("hits" and flare events)
  - effects on energetics
  - effects on seasonal movements ("pulses")
• contaminant loading (body burden)
	• effects of sound/seismic activity
	• effects on habitat
	• effects on behaviour
	• collisions
	• effects on movements

Other activities contributing to cumulative effects on birds and mammals were identified as fishing, hunting, marine transportation, and tourism.

7.4 Fisheries

The groups addressing fisheries identified the following key issues related to cumulative effects.

Issues	Oil and gas activities/effects	Other projects/activities
Access to resources	Structures (-) Exclusion zones (-) Seismic activities (-)	Marine transportation (traffic, damage to nets) Fisheries Seabed mining
Quality of fish habitat	Alienation (-) Degradation by contaminant loading (-) Improvements, structures (+)	Marine transportation (air emissions and discharges into water)
Marine safety	Increased marine traffic (-)(+) Better communications and forecasting (+) Mutual aid (+)	
Fish quality	Tainting, real or perceived (-) Health of fish Size of stocks	Fisheries

Cumulative effects assessment must deal with a very dynamic environment and system. Emerging new fisheries that are replacing depleted fisheries also complicate analysis.

Approaches to managing cumulative effects could include:

- Marine Protected Areas and Codes of Practice
- mutually agreed upon changes to fishing practices
- traffic and safety zones ("buffer zones")
- integrated management plans to manage seabed footprint changes

It was also pointed out that environmental assessment processes undertaken for oil and gas projects can provide new information that is useful to the fishing industry.

8. Contributors to Offshore Cumulative Effects

The effects of trawling were presented as an example of how other industries contribute to cumulative effects. The effects of shipping and other offshore industries were considered during a plenary session.

8.1 Examining the Effects of Trawling

Summary of Presentation by Don Gordon, Fisheries and Oceans Canada

There is much concern and research in Canada and other countries about the effects of fishing on marine ecosystems and communities. These concerns relate to the following issues:

- fish stocks
- by catch and discards (fish, invertebrates, sharks, marine mammals, turtles and seabirds)
- benthic habitat and communities
- species interactions
- ecosystem level effects
- fisheries management practices

In 1990, DFO in collaboration with Natural Resources Canada (NRCan) and industry, initiated a program to examine several aspects of this interaction: its effects and their significance, possible mitigation measures that could protect marine ecosystems and ensure the sustainability of fishery resources, and the difference in impact between mobile and fixed gear.

The mobile gear commonly used in Atlantic Canada consists of otter trawls, scallop rakes and hydraulic clam dredges. The otter trawls skim the surface and have least impact while the hydraulic clam dredges rake the sediment and have the greatest impact.

The experimental design adopted for this study had the following elements:

- selection of a suitable experimental site;
- pre-disturbance benthic surveys;
- disturbance with selected gear;
- sorting and classification of the catch;
- post-disturbance benthic surveys at different time intervals; and

- pre- and post-disturbance surveys in nearby reference areas to account for natural variation.

The instrumentation selected for this research included the Epibenthic sled (used for sampling epifauna and for video photography), Campod (for high resolution videos and still photography), the Videograb (for sampling infauna and video work) and navigation instrumentation. Studies were undertaken in the Minas Basin (otter trawling), on the Grand Banks (otter trawling), Western Bank (otter trawling), and Banquereau Bank (hydraulic clam dredge).

Minas Basin Otter trawling

This work was undertaken in collaboration with Acadia University. It focussed on the intertidal zone with a trawl undertaken at high tide and follow up hand sampling at low tide. The environment is already physically stressed and has few epibenthic organisms. The effects of trawling were found to be minor and not transferrable to the offshore fishing environment.

Grand Banks Otter Trawling

Trawling was undertaken on a sandy bottom which had not been trawled since the early 1980s. Three 13 km corridors were trawled twelve times in each of three years. The surveys included an assessment of: the fish catch; invertebrate fauna catch; the epibenthic biomass; sediment habitat, structure and post-trawl recovery; and damage to sand dollars, sea urchins, brittle stars and molluscs.

The fish catch was very low in this area, which was why the fishery was closed. The mean biomass, abundance and number of species was found to be lower immediately after trawling but not significantly so - the exception being a survey conducted in 1994 when significantly lower numbers were found. Overall, the most prominent signals came from changes at the reference stations that were used to track natural variations. While there are clear impacts on sediment habitat and epibenthic organisms (basket stars, snow crabs, sand dollars, brittle stars, sea urchins, and soft corals), very limited impacts were found on infauna and no detectable impacts on molluscs. There is little evidence of long term effects above natural variations and indications that recovery can occur within a year.

Western Bank Otter Trawling

The Western Bank experiment was much more limited. The gravel bottom supports a habitat and biological community that is quite different from the Grand Banks site. The trawling took place in a haddock nursery box which had been closed since 1987. The survey area was undertaken in a 2 km x 2 km area, using a single trawl corridor involving 12 sets in each of three years. The epibenthos was sampled with the Campod, and the infauna by the videograb.

The data is still being processed, but the preliminary findings are that the fish catch (mainly haddock) was large, the trawl marks are still visible after one year, and there is little evidence of disturbance in video and still photos.

Banquereau Hydraulic Clam Dredge

The Banquereau survey was initiated in 1989. The survey involved collaboration with the clam industry and will continue through 2000. It is also being conducted in a 2 km x 2 km area and involves two dredge boxes with 12 sets in each box. The areas are dredged as though they are being commercially fished, epibenthos are sampled with a Campod and infauna with a videograb.

Initial disturbance was readily visible in sidescan sonar and video surveys, and trawl marks were still visible after one year. The data are still being processed and further observations on recovery will be made in 2000.

At an international level there is a great deal of scientific interest in this subject and the scientific literature is growing rapidly. Generally, effects on benthic habitat can be seen but they depend on the type of gear, the intensity of use, the return period and the kind of habitat and species of organisms present. The issues are complex and widely debated, and substantial progress is being made in improving the understanding of the type and significance of impacts observed. More scientific information is required on long term changes to benthic habitat and communities due to natural stresses (ice, waves, sedimentation, temperature etc.). Further gear impact experiments are needed, and spatial and temporal analysis of fishing effort data. Spatial distribution of benthic habitat and communities is being undertaken in the SEAMAP project by DFO, NRCan and National Defence.

In the long term, procedures must be developed to incorporate the results of this research into fisheries, habitat and oceans management mechanisms (including cumulative effects management), with the participation of stakeholders and leadership from DFO.

8.2 Other Activities in the Offshore [Plenary discussion]

Summary of plenary discussion moderated by Dave Taylor, D.G.Taylor Inc.

Dave Taylor opened the plenary discussion with the following points. There are many resource users in the marine environment with special spatial and temporal requirements for their activities. These requirements are increasingly overlapping yet we have little knowledge about how they are affecting the environment individually and collectively. Two questions arise from this situation:

- Can the various users of a common property resource cooperate to assess, monitor and manage the cumulative effects of their projects and activities on that resource?
- If so, how can this be done?

Part of the answer to the 'how' question may include sharing knowledge, data, costs, providing logistical assistance, and cooperation in assessment and management.

- Who are the players? Fisheries and Oceans, the Offshore Petroleum Boards, the provinces, the industries (fishing, oil and gas, shipping), academe, ENGOs, the public and politicians.

- What is the legal context? The Oceans Act and Fisheries Act, the Atlantic Accord Act, the Canadian Shipping Act, Canadian Environmental Protection Act (CEPA), the Canadian Environmental Assessment Act (CEAA) and the Species at Risk Act (SARA).

- Can we expect a cooperative approach to management in the offshore?

Discussion Points

The following comments were made by workshop participants.

- The trawling impact study is not all good news. The impact on the Grand Banks may be limited but this changes as you move to different bottom types elsewhere. Other effects occur with fixed gear, and intensive fishing activity may lead to a much slower recovery rate.

- Fishers have expressed concern about resource management, particularly with respect to snow crab resource and shrimp. There needs to be more discussion of these issues and more fishing industry people involved, particularly when conflicts and competition with the oil and gas industry are under discussion. Unfortunately, fishers have neither the time nor expertise to do this. It is even difficult to communicate within the industry.

- It is difficult to get adequate discussion on the effects on fish and fish productivity around rigs and to expand the discussion beyond mortality to health and reproduction.

- The oil and gas industry will have to accept responsibility for defining its share of impact on the marine environment.

- The oil and gas industry has four monitoring programs in the offshore and will need to layer on additional studies if cumulative impacts are to be properly understood.

- The involvement of other sectors is required in order to understand the 'big picture'. Unfortunately, several industries - like the marine transportation industry - are currently not involved in the discussions at all. A multistakeholder process group is required.

- It is very important for all stakeholders to be involved, and to use the same level of detail for each type of study undertaken. This means that there need to be common standards for all studies undertaken so that they are comparable.

- Given that coordination is essential, who should undertake this central role? Should it be DFO or the Offshore Petroleum Boards? The Boards provide the rules for any offshore development but DFO has broader mandate for overall effects on the offshore.

- DFO has a mandate under the Oceans Act and should provide leadership. The responsibility of each sector must be defined but DFO needs to provide overall coordination.

- DFO needs to identify vulnerable areas and address ways in which they can be protected. One example would be a form of "zoning" through the use of Marine Protected Areas or other mechanisms.

9. Cumulative Effects Management Association (CEMA): A Case Study from Alberta

Summary of presentation by Doug Mead, Shell Canada

In the Athabasca region of Alberta there are several large shallow deposits of oil sands which are being mined as open pits. In light of reduced production costs and the introduction of new innovations, decisions were made a few years ago to expand development. Shell Canada came back into the project at that time working in conjunction with Suncor and Syncrude. There are several large projects in a small area and it became clear to all players, and the regulatory agencies that the increase in activity could have a significant cumulative effect in that region. Several hundreds square kilometres of land will be destroyed during the mining process and will have to be reconstructed afterwards.

Each company was required to undertake its own cumulative environmental assessment. Since all the players needed to collect similar data on water and air quality, wildlife etc. they decided to work together, share data and work in collaboration with local communities, regional and local governments, DFO and other stakeholders. The Cumulative Effects Management Association (CEMA) was formed as a non-profit organization to coordinate the activity. It quickly became a very complicated process. CEMA first had to decide what to include in the cumulative effects assessment and eventually agreed to include:

- the individual projects;

- other existing activities taking place in the area;

- all projects and activities which were approved but not yet initiated; and

- all projects planned for the future.

All project proponents used the same future scenario, the same assessment methodology, and shared data sets.

CEMA has evolved into a network of environmental committees – a complex, overlapping and evolving structure involving all levels of government, First Nations, communities and NGOs. A

core group provides coordination for main subgroups which undertake monitoring, research and management. When the mining is finished everything will have to be reconstructed. Research and experimentation is required to learn how to reconstruct a landscape – from lakes to wetlands, soil structure and wildlife habitat. Undisturbed reference zones have been established.

Each subgroup has many committees which undertake a wide array of activities. Independence and neutrality is essential in this work if the committees are to achieve credibility with the stakeholders. They strive to work through consensus which takes time and can be rather unwieldy, but does seem to work most of the time. Sometimes agreement is just not possible. It is important to build trust and credibility and to ensure that the process is open. Most of the companies were working with the communities beforehand so the lines of communication were already established. Also it was agreed that anyone who was interested or felt they had a stake could join the process.

As more is learned through monitoring and research, management plans are developed. No projects have been turned down by the regulators to date, although some significant project changes have been made – some quite dramatic. CEMA does not cover compensation issues. Compensation is addressed by the individual companies and is often in the form of employment and the construction of community facilities.

10. How Should these Cumulative Effects be Monitored?

[Small Group Discussions]

Jim Ray introduced the topic of monitoring cumulative effects from his perspective as a research manager and reminded participants that a good long term cumulative effects program will help all users with their environmental management challenges. When designing cumulative effects assessment programs, the questions are: how do we define the issues, get the right stakeholders, raise the money, define the scope, and get the project going?

During the early stages of a cumulative effects monitoring program it is important to conduct scoping in order to focus and gather relevant data. Testable hypotheses should be prepared and key stakeholders should be consulted. Timelines and operating guidelines should be established.

There are various challenges associated with the interactions of multiple projects. One must determine which species and populations are being affected especially where there are overlapping projects. Opinions may differ on what will be studied as different interests may be at play. It is necessary to determine procedures and standards for analytical methods to ensure consistent data.

When coordinating a cooperative monitoring program, the program partners should examine how to ensure long term budgets, who pays, and who are the partners. It is important to determine who will lead, who will do the work, and where will expertise come from.

Quality assurance, standardization and checks with other labs should be established. This will assist with the identification of scientific constraints (e.g. are the detection limits low enough).

While variability can lead to complexity, it is necessary to identify reference stations and undertake and measurements consistently.

Technical issues will need to be addressed. For example, is it necessary to determine speciation? Do we know the life cycles of the target species and are they affected by other influences? If target analytes are naturally occurring, how do you separate signals from noise? Abundance and diversity can be a problem in some areas: do you import surrogates?

- Substantive effort is required to determine what the results of monitoring programs mean. There is a cost of building statistical power.

Summary of feedback from Small Group Discussion II

During the second round of small group discussions, participants assembled in small groups organized by VECs, to address one of two questions:

- What are the challenges associated with determining both the significance of cumulative effects and the likelihood that they will occur?
- Which monitoring approaches and techniques would give the most valid and useful information?

10.1 Benthic Environment and Fish, Eggs and Larvae

The following issues were identified with respect to likelihood, significance, and monitoring approaches and techniques:

Likelihood

- every time another project or resource user comes into the picture, uncertainties compound
- different effects may each have a different likelihood of occurring
- information from environmental effects monitoring may not always get transferred into resource management decision-making or into the prediction of impacts for the next project
- it is important to reduce likelihood of impact through improved technology and regulatory regimes.

Significance

- we need better knowledge of the duration of cumulative effects and of recovery time
- how much impact is too much? We don't know for most species, especially in marine environment; we don't know thresholds even for commercial species.

- we don't test predictions over long enough time and in large enough area
- significance means different things to biologist, fisher etc. - we need to build trust.

Monitoring Approaches and Techniques

In order to monitor cumulative effects to the benthic environment successfully, there needs to be a consensus driven monitoring process involving all stakeholders, with common goals, agreed objectives, and testable hypotheses. We need more information on the sea floor. There is already much information from the fishing and oil and gas industries; it needs to be organized into a common data base that all can share.

We should build on present knowledge and monitoring activities. We need long term reference stations that are protected from other activities, and should also address impacts of future activities, such as mining.

Benthic community analysis is expensive to do; as an alternative it may be possible to analyze at the family, rather than the species level. We need to address chemical distribution: where it is in the environment and its bioaccumulation potential. Bioassays are being used; other techniques such as video can be used. Three-dimensional dredge for benthos and infauna is better than grab sampling. Monitoring should use both caged creatures and wild species.

10.2 Birds and Mammals

The group identified a number of challenges with respect to determining the significance of effects and appropriate monitoring approaches and techniques.

Significance

- noise versus signal (natural variation may be greater than the effect)
- lack of basic information on VECs and their interactions
- determining human values as they relate to significance
- weighing ecological significance against social significance
- the impact may be more subtle than mortality, making detection difficult
- significance may vary seasonally and temporally
- chronic/operational spills are additive and have unknown significance
- will effects from multiple platforms be additive or more than additive?
- a rare event that is insignificant for a single well can become significant when multiple wells are involved

- intermittent events (e.g. flaring, spills) may be additive
- data may be suspect (e.g. reported spills)
- when species are migratory it is difficult to set boundaries
- lifecycle issues (age/status) may make determination of significance difficult; long term studies required for some species.

Monitoring Approaches and Techniques

When developing monitoring approaches and techniques, it is important to develop a clear question or hypothesis that can be rejected if necessary, for example:

- platforms do not attract birds on a seasonal basis
- there are no seasonal trends in abundance (platforms, ships)
- there is no effect associated with flaring
- there is no impact from noise

Suggestions for monitoring approaches included:

- a pilot study to establish the range of noise from rigs/platforms etc.
- observers at different times of year on rigs/vessels/fishing boats/other transport vessels including DFO survey vessels
- using DFO's oceanographic data (temperature, hydroacoustics, salinity etc.)
- marking/identifying birds and mammals to determine return or residency
- determining body burden of contaminants
- determining bird mortality by-catch
- determining marine mammal by-catch
- experiment with or obtain data from other sources of light (lighthouses, refinery flares etc).

10.3 Fisheries

The issues discussed by groups focused on fisheries are summarized below.

Significance and Likelihood

The group addressing significance and likelihood discussed and agreed with Jim Ray's list of challenges. They also agreed that there are real problems with not having a truly integrated management plan. We can only look at effects of a specific project on a specific sector. An overall strategy is needed that includes input from all stakeholders. We also need cumulative effects assessment information from all industries operating offshore, including the fishing industry. We need to go beyond a project by project basis, and species-based management.

Monitoring Approaches and Techniques

A second group addressed assessment and monitoring issues related to the four main cumulative effects identified on Day 1. DFO should play a lead role in monitoring using the information they have through geo-referenced catch data, historical trends, research trends, licenses, and habitat studies.

Under DFO's No Net Loss policy, it is necessary to determine the area of fish habitat affected by a project, its productivity and the productivity of any replacement area. Effects on access to fishing resources need to be monitored in order to determine mitigation or compensation programs. Marine transportation effects should be monitored in order to reduce interference and the risk of collisions, and to improve safety. Monitoring should look at Canadian Coast Guard traffic management, traffic patterns, exclusion zones, shipping lanes, and existing protocols.

Tainting should be monitored through use of taste panels. It is also important to consider possible effects on the survival of eggs and larvae, and the health of fish.

11. Who Should Do What in Cumulative Effects Assessment and Monitoring?

[Small Group Discussions]

Bill Ross reviewed some key issues related to responsibilities, partnerships, management and funding for cumulative effects assessment.

Summary of feedback from Small Group Discussion III

All the groups addressed one question:

- Do we need co-operative or regional assessment/monitoring programs to address cumulative effects?

All groups agreed that new programs were necessary, and it was suggested that the process should be multi-stakeholder, avoid duplication, and have shared accountability. One group pointed out that there are already a number of programs in place that may address some pieces of the puzzle, for example:

- DFO's Eastern Scotian Shelf Integrated Management (ESSIM)
- Existing oil and gas EEM programs
- DFO's continuing database programs
- The fishing industry liaison programs
- Living Marine Resources - Global Ocean Observing System (an international monitoring program).

Since most of the discussion appeared to focus on regional rather than project specific cumulative effects assessment, most of the groups identified DFO as the most appropriate lead agency because of its mandate under the Oceans Act. Other options included an independent entity, or an advisory group struck to advise DFO. Recommendations directed to DFO included:

- appointing a lead to ensure that discussion around cumulative effects assessment continues;
- establishing a working group to evaluate cumulative effects management models for the east coast offshore; and
- organizing a multi-stakeholder group to develop a process.

Potential stakeholders included:

- oil and gas industry;
- fishing industry marine transportation sector;
- federal and provincial bodies;
- municipalities; and
- ENGOs.

One group stressed the importance of using the report from this workshop as a tool to promote the development of new cumulative effects assessment programs. Another group recommended that the first step should be to carry out a regional cumulative effects assessment for a specific area such as the Grand Banks, and that Marine Protected Areas should be established to act as long term control areas.

The important issue of limited resources was acknowledged. While there was support for the principle of shared funding -"everyone at the table should ante up" - there was also the opposing view that this is something that government should fund in the public interest, in order to ensure relative neutrality for the process.

12. Closing Remarks

Summary of closing remarks by Leslie Grattan

Leslie Grattan summarized the workshop presentations and discussions. She reminded participants that this workshop is a first step towards a regional approach to addressing cumulative effects. Representatives of many marine industries and users attended the workshop. However, there may be many more who will need to become involved in any regional cumulative effects process.

13. Summary

The main conclusions of the workshop are outlined below according to the workshop objectives.

13.1 Acceptable Approaches to Cumulative Effects Assessment and Management in the Offshore

A number of approaches to undertaking cumulative environmental effects assessment and monitoring were reviewed and discussed at the workshop. Speakers described efforts initiated in western Canada, Texas, and Norway. The cumulative effects assessment of the Cheviot mine in Alberta was judged to be unacceptable through a court challenge, resulting in the federal panel being reconvened to review further cumulative effects assessment, among other aspects of the environmental assessment. All of the other initiatives appeared to be acceptable approaches led by industry or government, incorporating multi-stakeholder processes that had evolved over a number of years.

Workshop participants favoured the establishment of collaborative approaches to monitoring cumulative effects. While some suggested Fisheries and Oceans Canada should take the lead in forming a multi-stakeholder initiative, others thought an independent group should be formed with representation from all users of the marine environment. Another possibility was the creation of an independent advisory body to Fisheries and Oceans Canada.

While there was some feeling that all parties should fund a collaborative process to ensure they all had a stake in the outcome, it was recognized that governments and oil and gas companies were the most likely sources of funding. There was some support for limiting funding to government sources to ensure neutrality of results. The importance of dedicating long-term financial and human resources to assessing cumulative effects was emphasized.

There was wide agreement that the workshop proceedings should be circulated to all stakeholders. Participants suggested that the ESRF Management Board should communicate the workshop findings to all stakeholders and possibly convene a meeting to chart the way ahead. More specifically, one discussion group recommended that:

- the C-NOPB and the ESRF Management Board should send a letter to DFO asking them to take a leadership role;
- a multi-stakeholder group should be organized;

- an MOU should be established to enable management; and
- the multi-stakeholder group should operate on consensus.

While monitoring the marine environment is necessary to document changes, participants recognized the importance of managing cumulative effects. Approaches to the management of cumulative effects could include:

- establishing marine protected areas and codes of practice;
- improving fishing practices;
- identifying traffic and safety zones; and
- developing integrated management plans to manage seabed footprint changes.

13.2 Likelihood of Cumulative Effects

Every time another project or resource user initiates activity, new uncertainties are introduced to compound the problem of cumulative effects. Each effect may have a different likelihood of occurring. It is important to reduce the likelihood of impacts occurring through improved technology and regulatory regimes. Information from environmental effects monitoring should be integrated into resource management decisions and future impact predictions.

13.3 Spatial and Temporal Boundaries

The selection of spatial and temporal boundaries is critical to determining cumulative effects. However, the continuous movement of almost all components of the marine environment makes it very difficult to choose appropriate boundaries. When selecting spatial boundaries, it is important to :

- monitor overlapping effects;
- consider projects, human activities and land uses;
- view the world from a VEC perspective; and
- appreciate how a migratory species can link effects occurring in various places.

When selecting temporal boundaries, it is important to:

- focus on the duration of effects on a VEC;
- consider pristine, current, peak construction, operation and post-abandonment scenarios; and
- establish thresholds.

13.4 Factors Necessary for Monitoring Potential Effects

The following factors should be considered in the design of any cumulative effects monitoring program:

- contaminant loading (changes to air, sediment and water quality);
- direct habitat change (sediment deposition, disturbances, natural events);
- habitat alienation (sensory disturbance);
- habitat fragmentation; and
- direct mortality.

Workshop discussion focused on five main environmental components: the benthic environment; fish, eggs and larvae; seabirds; mammals; and fisheries. Cumulative effects studies undertaken in the East Coast offshore should include these components because offshore activities interact directly with these components of marine life and their habitat, and because they are valued (VECs) by humans.

The benthic environment is directly affected by many offshore activities and is a sink for contaminants. Benthos can be relatively easily monitored. The most significant potential cumulative effects to benthos identified by discussion groups were: habitat alteration, effects due to pipeline laying, effects on species diversity and food chain dynamics, endocrine disruption, and contaminant loading caused by drilling fluids and produced water. Fishing and climate change are two of the most critical other activities affecting benthos.

Fish, eggs and larvae may be affected by the combined development of oil and gas projects as well as dredging, fishing, climate, displacement water and predation. Discussion groups identified the following as the potential cumulative effects of most concern: localized effects on fish health caused by construction, drilling and production; effects from eggs and larvae drifting through zones of impact; and mortality caused by seismic exploration activities. Monitoring of effects should not be limited to population effects as other types of effects may be significant.

Seabirds link the marine and terrestrial environments. Monitoring programs should focus on measuring impacts of operational discharges of oil, fluids and sewage; surface oil spills; and attraction of birds to platforms and related mortality, effects on energetics and seasonal movements, and contaminant loading. Fishing, hunting, marine transportation and tourism activities combine with oil and gas development to cause cumulative effects.

Marine mammals may be affected by numerous offshore activities. In addition to oil and gas development, fishing, hunting, marine transportation and tourism contribute to cumulative effects on mammals. Of most concern are effects of sound and seismic activity, effects on habitat, effects on behaviour, collisions, and effects on movements.

Fisheries may be affected by the cumulative interaction of oil and gas development with other activities such as marine transportation, fishing, seabed mining, and marine transportation. Key issues are access to resources, quality of fish habitat, marine safety and fish quality.

13.5 Scientifically Credible Means of Determining "Significance" of Environmental Effects

The significance of cumulative effects is difficult to determine. Significance has different meanings for a biologist than for a fisher. There are many species for which thresholds are unknown. Generally, we need better knowledge of the duration of cumulative effects and their recovery time.

13.6 Means by which Potential Cumulative Effects May be Monitored

Generally, workshop participants suggested that monitoring should be undertaken using a consensus-driven approach. A monitoring program should build on existing knowledge and monitoring and identify long term reference stations. Clear questions or hypotheses should be established.

Specific monitoring approaches included initiation of a pilot study; placement of observers on rigs, fishing and transport vessels; and use of DFO oceanographic data and Coast Guard marine traffic information. DFO could play a lead role due to its mandate.

Monitoring studies could include marking and identifying birds and mammals; determining body burden of contaminants; estimating bird and marine mammal mortality by-catch; and calculating survival rates of eggs and larvae, and health of fish. Fish tainting should be monitored using taste panels. It may be possible to experiment with or obtain data from other sources of disturbance (i.e. other sources of light that may attract birds and result in their injury).

14. The Way Forward

The goal of cumulative effects assessment is improved cumulative effects management leading towards sustainability. Cumulative effects assessment can be applied:

- on a project by project basis through existing environmental assessment processes, driven by the federal and sometimes provincial legislation;
- on a regional planning basis; or
- through a blended project and regional planning basis.

On the Grand Banks, the White Rose project may soon be developed, joining Hibernia and Terra Nova. On the Scotian Shelf the Sable Offshore Energy project has plans for a second phase of development and PanCanadian has made a significant gas find at the site of the former Cohasset Panuke development. Further exploration continues in both these offshore areas and there is also considerable interest in other East Coast locations. At the workshop, participants heard how regulators and operators in the North Sea and Gulf of Mexico have had to address

issues of cumulative effects after hundreds of wells have been drilled and platforms installed. In Atlantic Canada we obviously have the opportunity to learn from this experience and to move forward with developing sound approaches to cumulative effects assessment and management in a timely fashion.

This workshop was organized to respond to several recommendations from the Terra Nova environmental review panel. The panel concluded that a forum was needed in which to determine what constitutes good practice for project-specific cumulative effects assessment in the offshore context. Since the Terra Nova review, the Cheviot Coal Mine court challenge and subsequent legal decision in Alberta has underscored the necessity of ensuring that project specific cumulative effects assessment is thorough and meaningful.

In the same year that the Terra Nova panel completed its report, the Government of Canada adopted its new Oceans Act that commits the government to developing an oceans strategy for the management of marine ecosystems. This Act clearly gives Fisheries and Oceans Canada a mandate to address cumulative effects management on a regional basis.

The key themes that emerged from the workshop were:

- General agreement that cumulative effects assessment is a vital tool to ensure progress towards sustainability, and support for continuing to explore ways to make it happen effectively in the East Coast offshore.

- Awareness that, while the oil and gas industry has both a legal and moral responsibility to address the implications of its ongoing development, (a) many other parties are either contributing to or have significant interests in offshore cumulative effects, (b) cumulative effects assessment must ultimately engage all relevant stakeholders, some of whom were not present at the workshop and (c) other marine industries and resource users, besides the oil and gas industry, must become accountable for their impact on the environment

- Agreement that new regional and cooperative programs will be needed to carry out cumulative effects assessment effectively, both on a project specific and a regional planning basis. Meaningful regional cumulative effects studies will require a long-term commitment of financial and institutional resources as well as dedicated personnel. In absence of the establishment of regional cumulative effects programs, project proponents will need to continue to assess cumulative effects on a project-specific basis, as required by the Canadian Environmental Assessment Act

- Agreement that DFO is the logical agency to lead the development of cumulative effects assessment on a regional planning basis.

- Awareness of the significant scientific challenges involved in research and monitoring offshore and interest in exploring how cumulative effects assessment approaches and techniques, developed for terrestrial environments, will translate to this highly dynamic and comparatively less understood environment.

- Agreement around the need to improve communications and information accessibility to ensure that maximum use is made of what we already know

- Agreement that this workshop was a good start but only that, and that sustained effort will be required to make progress in both answering the Terra Nova panel's questions and in moving cumulative effects assessment forward on a regional basis.

On the second day of the workshop, participants were asked to make recommendations with respect to the development of new cooperative and regional programs. The resulting recommendations all related to cumulative effects assessment on a regional planning basis; the groups did not address the project-specific assessment issue. Nevertheless, both are vital elements and for each new offshore hydrocarbon project, the oil and gas industry will be challenged to demonstrate that they can effectively predict and manage the cumulative effects.

Under the mandate of the Oceans Act, DFO has already embarked on a number of planning, research, and monitoring programs that relate to cumulative effects assessment. Of particular relevance is the Eastern Scotian Shelf Integrated Management initiative (ESSIM) intended to develop, through a collaborative process, an integrated marine ecosystem management project. This project highlights many cumulative effects issues on the Scotian Shelf. As yet, there is no comparable Oceans Act initiative underway for the Newfoundland and Labrador region.

There was general consensus at the workshop that DFO be requested to take the next step in sponsoring a multi-stakeholder process to develop a viable approach to regional cumulative effects assessment. The ESSIM initiative could provide the vehicle to carry this out in Nova Scotia; a similar vehicle may be needed in Newfoundland.

The suggestion was also made that a regional cumulative effects assessment should be carried out as soon as possible in at least one East Coast region in order to see what types of information are available and where the gaps are, to "test drive" the methodology in the offshore context, and to identify the most critical issues and areas. Funding for such an assessment might reasonably be drawn from a number of sources including (a) DFO since it would be an integral part of the Oceans Act implementation program and (b) the oil and gas industry since it could offset some of the costs otherwise incurred in carrying out project specific cumulative effects assessments.

The central recommendation that emerged from the workshop was as follows:

> *That, as soon as possible, C-NOPB and/or ESRF should write to DFO to (a) convey the conclusions of the workshop, and (b) request that DFO take the lead in convening one or more follow-up meetings involving representatives from all relevant stakeholder groups to discuss how cumulative effects assessment should be pursued on a regional basis.*

15. References

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APPENDIX A

Terra Nova Panel Report On Cumulative Impacts

Excerpted from:

Terra Nova Environmental Assessment Panel. 1997. Report of the Terra Nova Project Environmental Assessment Panel, pages 45 - 48.

5.4 Cumulative Impacts

Cumulative impacts from developments occur when anthropogenically induced changes happen frequently in time and space so that the effects of an individual project cannot be assimilated, or when single projects interact synergistically to produce effects. Incremental changes, such as threshold events that establish new activities, industries or practices are also typically considered as cumulative impacts.

Analyses contained in submissions from the public emphasized synergistic effects including fishery depletions, oceanographic changes, seabird hunting, climate change, and transportation. Future petroleum developments on the Grand Banks, including other specific developments in the Jeanne d' Arc Basin and general plans to establish an offshore industry were also identified as matters that should be considered in evaluating cumulative impacts. One participant suggested that an additional comprehensive environmental assessment of all the proposed and potential offshore developments was necessary.

One particular effect of offshore petroleum developments that should be noted is the pre-emption of ocean areas from other uses. The *Oceans Act* charges the Department of Fisheries and Oceans with the lead agency role in the establishment of a system of marine protected areas. At present it is developing policies for such sanctuaries and is devising guidelines for their establishment both inshore and offshore. At an early date the Department should inform the Board regarding its intentions for the establishment of a system of marine protected areas on the Grand Banks. The Board should remain aware of progress and plans for reserves and consider the impact of petroleum project developments on these plans.

Clearly, a precautionary approach to the assessment of the Terra Nova Development demands an examination of cumulative effects. However, given large uncertainties in regard to the nature, speed and scale of future petroleum developments by the Proponents, and by other offshore petroleum operators, and considering additional anthropogenic changes on the Grand Banks deriving from other sources, the Panel must admit that it is difficult to be clear about how these activities and changes might be monitored.

Evaluation of cumulative impact considerations in environmental assessments is an area of emerging law, policy and practice. Development projects usually occur in an environment where changes from natural and anthropogenic sources have occurred or are taking place. Some of these changes are obvious, others are not. In any case, a fair, even-handed evaluation of the potential impact of a specific project must be balanced with a reasonable assessment of the

Project's impact given significant, induced changes over a broader geographic area and longer time scales than may be envisaged for the Project itself.

In literature cited in the EIS and by participants, the evidence for and significance of such longer-term, cumulative change associated with offshore petroleum development are often challenged and the contribution of any specific project to detected or suspected changes may be difficult to assess.

The Panel is, of course, aware that it is not possible to hold the Proponents responsible for future developments beyond their control that may interact with the Terra Nova Development to produce cumulative environmental effects. Nevertheless, the gradual accumulated degradation of ecological integrity of areas of the Grand Banks owing to collective anthropogenic impacts is a major environmental concern which must be avoided. Such cumulative effects will often involve more than one administrative area. This would imply a necessity for co-operation in monitoring and mitigation.

During hearings there was a lack of agreement about what factors should be considered in evaluating potential cumulative impacts. The Proponents argued that cumulative impact should be considered only in terms of specific, planned petroleum projects on the Grand Banks; other participants looked at rapidly changing fishery conditions as an additional factor which should be considered. Still other participants identified generalized global events as factors which would interact cumulatively with the impact of the Terra Nova Development.

Cumulative anthropogenic change is clearly a significant area of concern. This is attested by recent recognition by the Government of Canada in legislation, such as the *Oceans Act*, in international agreements such as the *Convention on Biological Diversity*, the *Agreement for the Implementation of the Provisions of the United Nations Convention on Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks*, and the *United Nations Framework Convention on Climate Change* and by the United Nations Conference on Environment and Development.

Environmental assessment panels have also recognized and identified cumulative impacts in their evaluations and recommendations. About half of the panels reporting to the federal government since the 1980s have mentioned cumulative impacts in combination with other environmental factors. In most of these reports, the information about future projects was insufficient to allow the panels to make definitive recommendations.

It is important to note that these panel reports were from reviews conducted under the *Environmental Assessment and Review Process Guidelines Order* (EARP), which did not include any requirement for assessment of cumulative environmental effects. Nevertheless their identification and management has become such a critical issue in Canadian environmental policy that the CEAA of 1992 specifically requires that cumulative environmental effects be considered.

In spite of uncertainty, concerns about cumulative effects have led panels to recommend that a variety of studies and research be undertaken. The Lancaster Sound Regional Study was undertaken as a result of a recommendation of the 1979 Lancaster Sound Drilling Panel Review.

During the Hibernia project hearings in 1985, participants expressed the view that the panel's mandate was too restrictive in examining strategic issues for area-wide planning of offshore development. That panel recommended that review of future developments should take into account cumulative effects and that research should be conducted under the Environmental Studies Revolving Fund to assist governments in wider planning issues. This research was not undertaken.

The Fraser-Thompson Corridor panel report of 1986 indicated that existing management systems were unable to identify properly and hence to prevent or to mitigate future cumulative environmental effects. They found that monitoring programs were required to determine the cumulative impact of future developments. They further indicated that simulation models should be developed to identify possible changes and to focus data collection and monitoring.

The 1990 Arctic Pilot Project panel report noted that other proposals would likely follow that pioneering venture, particularly if it were successful. Recognizing that an individual proponent could not be held responsible for future developments beyond its control, the panel suggested that the government, in consultation with stakeholders and industry, should be responsible for long-range planning and determination of priorities. Such research and monitoring over the life of the projects was viewed as an opportunity to determine trends, problems and solutions to projected larger scale activities in the Northwest Passage.

The panel evaluating the Northumberland Straight Crossing Project in 1990 indicated a concern for cumulative effects, noting particularly the possible synergistic effect of global warming on the project. Despite the realization that global changes might be unpredictable locally, they did recommend that the bridge design should incorporate a safety factor to accommodate conditions that could occur as a result of climate change.

In the 1991 panel report of the Rafferty-Alameda Project, it was acknowledged that concern about cumulative impacts was relatively new and that reliable methodologies to assess such effects had not yet been fully developed and tested. The panel observed that neither the proponents, nor participants dealt with aspects relating to cumulative impact of the project, but concluded that a detailed assessment was necessary. They emphasized the importance of a comprehensive, well-designed monitoring program to accomplish this.

The recommendation in the 1993 report on Uranium Mining Proposals in Northern Saskatchewan (Dominique Janine Extension, McLean Lake Project and Midwest Joint Venture) led to the establishment of cumulative effects monitoring programs to assess regional environmental effects resulting from multiple mining operations.

The importance of cumulative impacts on the environment, and the difficulty in identifying and measuring them, causes the Panel to believe that experts with experience in environmental monitoring, sampling and measurement are in the best position to advise the Board on potentials for cumulative impacts on the Grand Banks and their monitoring. The Board should therefore convene, in the near future, a workshop of recognized experts to examine the potential for cumulative impacts in the Newfoundland offshore due to petroleum development and other activities, and to develop best-science approaches to monitoring them. Adequate assessment of

cumulative impacts will require identification of, and integration with, other research and monitoring efforts.

Once factors necessary for a cumulative monitoring program in the Newfoundland offshore have been identified, an implementation plan for their monitoring must be designed. Individual development projects in the offshore must be required to incorporate into their monitoring plan standards and measures consistent with this cumulative effects monitoring program.

Recommendation 46:

The Panel recommends that the Board convene, in the near future, a workshop of recognized experts to examine the potential for cumulative impacts in the Newfoundland offshore due to petroleum development and other activities, and to develop best-science approaches to monitoring them.

Recommendation 47:

The Panel recommends that the Board identify the factors necessary for a cumulative effects monitoring program on the Grand Banks and design an implementation plan for such a program; and that future projects be required to incorporate measures consistent with this program into their monitoring efforts.

Recommendation 48:

The Panel recommends that reviews of regulations, standards and guidelines by the Board and relevant government departments explicitly take into account cumulative impacts of all petroleum projects and other probable developments on the Grand Banks, and potential synergistic effects of other activities in the area; and that the Board advise all future proponents that it will not accept environmental impact statements that do not include a thorough and broad analysis of possible cumulative impacts.

APPENDIX B

C-NOPB Decision on Terra Nova Cumulative Effects

Excerpted from:

> Canada Newfoundland Offshore Petroleum Board. 1997. Decision 97.02 – Application for Approval. Terra Nova Canada-Newfoundland Benefits Plan. Terra Nova Development Plan.

4.4.5 Cumulative Environmental Effects

The Proponent predicts in its EIS that cumulative effects upon the environment associated with the Terra Nova Development will be negligible, and asserts that the likely zones of influence associated with the Terra Nova and Hibernia developments were sufficiently circumscribed as not to overlap nor to augment one another, and that effects of the Terra Nova Development were not of a sufficient scale to cause any adverse effects on present or future fishery activities.

The Panel stated that it believed the consideration of cumulative effects is an important part of the environmental assessment of projects such as Terra Nova, but also that the area of cumulative effects assessment is a relatively new field of endeavour which is continuing to evolve. It expressed the opinion that a proper consideration of cumulative effects would be necessary for the future environmental management of anthropogenic activities, including those associated with the offshore petroleum industry, on the Grand Banks. It recommended [46] that the Board convene a workshop to examine the potential for cumulative impacts due to petroleum development in the Newfoundland Offshore Area and to develop approaches to monitoring them; [47] that the Board identify the factors necessary for monitoring cumulative effects associated with offshore activities and design a plan for implementing a monitoring program which included these factors; and [48] that reviews of regulatory instruments explicitly take into consideration cumulative impacts and that future environmental impact statements be explicitly required to incorporate a consideration of cumulative effects. It also recommended [49] that the cumulative effects workshop include a discussion of present criteria for determining the "significance" of environmental effects and the development of any additional criteria which would assist in prudent environmental management.

The Board observes that the difficulties associated with the proper scientific assessment of cumulative effects are not limited or unique to the Grand Banks, nor for that matter to petroleum-related activity. The Board believes that experience which is gained in other applications and jurisdictions will assist the Board, its advisory agencies, and Proponent in developing techniques which are appropriate for the particular case of the Grand Banks.

The Board believes that the time is right for an examination of the topic, with particular application to present and potential future petroleum developments on the Grand Banks.

The Board will propose a study which will incorporate a workshop similar to that recommended by the Panel through the Environmental Studies Research Fund to examine experience elsewhere in the area of cumulative effects assessment and to evaluate the applicability of this

experience to the Grand Banks in light of actual environmental conditions and realistic development scenarios. The objectives of the study will include the provision of recommendations for "best-science" approaches to cumulative effects monitoring, and a consideration of appropriate criteria for determining the "significance" of environmental effects. The Board will ensure that effects monitoring programs of present and future petroleum producers on the Grand Banks are consistent with any scientifically credible principles or criteria devised.

The Board's 1988 *Development Application Guidelines*, which were appended to the Panel's terms of reference, state on page 30, that a Proponent's assessment of environmental effects should include a discussion of

> *any cumulative effect of the proposed project together with the demonstrated or predicted effects of other existing or confirmed offshore projects.*

Further, Section 16 of the *Canadian Environmental Assessment Act*, which also was reflected in the Panel's terms of reference, requires that any environmental assessment which is carried out pursuant to that Act include a consideration of

> *any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out.*

The regulatory structure, therefore, already requires consideration of cumulative effects in the manner which the Panel recommends.

The Board, when it participates in the review of regulations, standards, or guidelines, considers applicable experience in other jurisdictions (including Canadian jurisdictions where such experience exists) which indicates the potential for cumulative impacts or synergistic effects under conditions which prevail, or which are likely to prevail, in the Newfoundland Offshore Area.

APPENDIX C

Environmental Studies Research Funds
Cumulative Environmental Effects Workshop - The Battery Hotel, St. John's NF

Agenda - *May 5, 2000*

Monday May 8

0800	Registration
0830	**Welcome and opening remarks** *Workshop Chair: Leslie Grattan, Newfoundland and Labrador Hydro*
0840	**Starting with the bottom line** Why we do Cumulative effects (CE) Assessment and Monitoring Who needs the information and for what purpose *Leslie Grattan*
0900	**The East Coast Offshore Context** Offshore hydrocarbon development: history and trends *David Luff, Canadian Association of Petroleum Producers*
0920	The prediction and verification of offshore oil and gas effects: what we do and don't know (summary report from the March, 2000, workshop "Understanding the Environmental Effects of Offshore Hydrocarbon Development") *Don Gordon, Fisheries and Oceans Canada and member, Sable Offshore Energy Environmental Effects Monitoring Advisory Group*
1000	**CE Assessment and CE Monitoring: Approaches** (1) Definitions and key components (2) Spatial and temporal boundaries (3) Different approaches - the Canadian Experience *Bill Ross, faculty of Environmental Science, University of Calgary, and Jeff Green AXYS Environmental Consulting Ltd.*
1035	Break
1050	**Lessons from other regions** CE Assessment and Monitoring experience in the Gulf of Mexico *Jim Ray, Equilon Technology*
1135	CE Assessment and Monitoring experience in the North Sea *Sam Arne Noland, Det Norske Veritas*

1220	Lunch
	The Challenges for CE Assessment and Monitoring on the East Coast
1320	Themes from the morning session *Peter Duinker, SRES, Dalhousie University*
1330	Plenary discussion - what issues, problems and opportunities do participants see for CE Assessment and Monitoring in the East Coast context *Moderator, Peter Duinker*
	Designing CE Monitoring programs: some issues
1410	What PERD funded research has been looking at *Peter Cranford, Fisheries and Oceans Canada*
1430	Determining environmental effects on seabirds *Bill Montevecchi, Memorial University of Newfoundland*
1450	Determining environmental effects on marine mammals *Jon Lien, Memorial University of Newfoundland*
1510	Break
	What is the potential for cumulative effects off the East Coast?
1530	Predicting cumulative effects *Bill Ross and Jeff Green*
1545	Small Group Discussions I: As the offshore oil and gas industry grows, which cumulative effects are likely to be of the most concern? Groups should address: • interactions between individual oil and gas developments, and • interactions between oil and gas developments and other potential projects/activities/influences?
1645	Small group feedback and discussion
1730	**Closing remarks Day One and adjourn** *Leslie Grattan*
1730-1900	Light refreshments and a chance to talk informally

Tuesday, May 9th

0830	**Day Two Opening remarks** *Leslie Grattan*
0835	**Feedback and main points from Day One** *Anne Muecke and Lesley Griffiths, Griffiths Muecke*
	Contributors to Offshore Cumulative Effects
0850	Examining the effects of trawling *Don Gordon, Fisheries and Oceans Canada*
0920	Other Activities in the Offshore *Plenary discussion moderated by Dave Taylor, D.G. Taylor Inc.*
0950	Case Study: Cumulative Effects Management Association A Regional Approach to CE Assessment *Doug Mead, Shell Canada*
1015	Break
1030	**How should these cumulative effects be monitored?** A research manager's perspective: scientific and resource constraints and opportunities *Jim Ray*
1045	Small group discussions II[1]: *Groups will discuss either quesion #1 or question #2 (not both). Participants will choose which group to join.* Taking the cumulative effects of most concern identified on Day 1, (1) when carrying out CE assessment, what are the challenges associated with determining the significance of these effects and likelihood that they will occur? (2) when developing a CE monitoring program, which monitoring approaches and techniques would give the most valid and useful information, taking into account limited resources and the current state of scientific knowledge about the East Coast marine environment?
1200	Small groups feedback and discussion

[1] Groups may also be divided by VECs.

1230	Lunch
	Who should do what in CE Assessment and Monitoring
1330	Responsibilities, partnerships, management, funding *Bill Ross*
1345	Small group discussions III: (1) do we need co-operative or regional assessment/monitoring programs to address cumulative effects? Who should be involved and who should fund? (2) How can we ensure that the results of monitoring programs are effectively integrated into environmental management?
1500	Small groups report back and discussion
1545	**Summary and closing remarks** *Leslie Grattan*
1600	Adjourn

APPENDIX D

Workshop Presenter and Participant List

(Note: Presenters are listed in italics; phone numbers precede fax numbers)

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