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Proceedings Series 2006/040 | **Série des comptes rendus 2006/040**

Proceedings of a Workshop on Nearshore Marine Habitat Assessment and Compensation

21 March – 22 March 2006
Gulf Fisheries Centre
Moncton, NB

Tana Worcester and Ross Alexander
Meeting Co-Chairs

Bedford Institute of Oceanography
1 Challenger Drive, P.O. Box 1006
Dartmouth, Nova Scotia
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Compte rendu d'un atelier sur l'évaluation de l'habitat du milieu marin littoral et sur les mesures compensatoires

Les 21 et 22 mars 2006
Centre des pêches du Golfe
Moncton, N.-B.

Tana Worcester et Ross Alexander
Coprésidents de la rencontre

Institut océanographique de Bedford
1, promenade Challenger, C.P. 1006
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February 2007 | **février 2007**

Canada

Foreword

The purpose of these proceedings is to archive the activities and discussions of the meeting, including research recommendations, uncertainties, and to provide a place to formally archive official minority opinions. As such, interpretations and opinions presented in this report may be factually incorrect or misleading, but are included to record as faithfully as possible what transpired at the meeting. No statements are to be taken as reflecting the consensus of the meeting unless they are clearly identified as such. Moreover, additional information and further review may result in a change of decision where tentative agreement had been reached.

Avant-propos

Le présent compte rendu fait état des activités et des discussions qui ont eu lieu à la réunion, notamment en ce qui concerne les recommandations de recherche et les incertitudes; il sert aussi à consigner en bonne et due forme les opinions minoritaires officielles. Les interprétations et opinions qui y sont présentées peuvent être incorrectes sur le plan des faits ou trompeuses, mais elles sont intégrées au document pour que celui-ci reflète le plus fidèlement possible ce qui s’est dit à la réunion. Aucune déclaration ne doit être considérée comme une expression du consensus des participants, sauf s’il est clairement indiqué qu’elle l’est effectivement. En outre, des renseignements supplémentaires et un plus ample examen peuvent avoir pour effet de modifier une décision qui avait fait l'objet d'un accord préliminaire.

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ISSN 1701-1272 (Printed / Imprimé)

Published and available free from:
Une publication gratuite de:

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

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

CSAS@DFO-MPO.GC.CA

Printed on recycled paper.
Imprimé sur papier recyclé.

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

Correct citation for this publication:

DFO, 2006. Proceedings of the Workshop on Marine Habitat Assessment and Compensation; 21 March – 22 March 2006. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2006/040.

On doit citer cette publication comme suit:

MPO, 2006. Compte rendu d'un atelier sur l'évaluation de l'habitat du milieu marin littoral et sur les mesures compensatoires, les 21 et 22 mars 2006. Secr. can. de consult. sci. du MPO, Compte rendu 2006/040.

TABLE OF CONTENTS

SUMMARY

A Regional Advisory Process (RAP) workshop was held at the Gulf Fisheries Centre in Moncton on March 21 and 22, 2006 to examine approaches to Nearshore Marine Habitat Assessment and Compensation issues. The meeting was planned as a joint activity between Gulf Region and Maritimes Region and was co-chaired by Ross Alexander and Tana Worcester from the two regions respectively. The overall objective was to develop guidelines on the application of compensation measures for habitat creation, enhancement and restoration to address Harmful Alteration Disruption or Destruction of fish habitat (HADDs). The workshop included an initial review of compensation methods used elsewhere in the world; a review of HADDs approved in the Gulf and Maritimes Regions including compensation methods used and evaluation of effectiveness; and development of a workplan to address specific Management and Science questions. Because of the great interest in these topics, the meeting also included participants from Newfoundland, Quebec, Central and Arctic, and National headquarters. Small Craft Harbours was also represented.

The first day of the workshop consisted primarily of presentations followed by discussion. The first two presentations were provided by Roland Cormier (Habitat Management - Gulf Region) and Paul Boudreau (Habitat Management - Maritimes Region) who set the policy context, described the scope of the issue and provided regional examples of successful and unsuccessful compensation projects. This was followed by two short presentations by Herb Vandermeulen on the challenges of providing an international literature review and on the importance of eelgrass as sensitive habitat. Tana Worcester then provided a summary of other relevant initiatives, including the National Audit of the Habitat Compensation Program, a series of National Science advisory meetings, and regional decision-support tools. Shawn Robinson's presentation challenged our assumptions and asked us to think in new ways. He recommended moving from 2D single species/habitat approaches to more holistic, multitrophic, functionally based approaches to habitat compensation. Glyn Sharp reviewed his experiences of artificial reef creation. He noted that these are typically used to create lobster habitat but that they also benefit other organisms as well. The final presentation was made by Jessica Damon from the State of Maine to provide the US perspective. Many compensation issues were very similar to the Canadian experience although some interesting differences emerged. For example, the State of Maine has been exploring the use of habitat protection as a form of compensation.

The second day of the workshop followed a smaller working-group format. Three issues were identified for discussion by three discussion groups: pre-compensation, compensation design, and post-compensation/evaluation. The meeting wrapped up with a plenary session to present the results from the working groups and to conclude general discussion. Participants made several recommendations, including the suggestion to hold a RAP meeting in March 2007 to review experiences to date with artificial reef creation as habitat compensation and the suggestion to hold annual meetings to exchange information on activities related to marine compensation and to provide better communication among regional practitioners.

SOMMAIRE

Un atelier a eu lieu dans le cadre du Processus de consultation régional (PCR) au Centre des pêches du Golfe de Moncton, les 21 et 22 mars 2006, afin d'examiner les façons d'aborder l'évaluation de l'habitat du milieu marin littoral et les mesures compensatoires connexes. Organisé conjointement par les Régions du Golfe et des Maritimes, l'atelier était coprésidé par deux de leurs représentants respectifs, Ross Alexander et Tana Worcester. Il visait principalement l'élaboration de lignes directrices sur l'application de mesures compensatoires portant sur la création, la mise en valeur et le rétablissement d'habitats du poisson ayant fait l'objet d'actes de détérioration, de destruction ou de perturbation (DDPH). L'atelier comprenait un examen initial des méthodes compensatoires appliquées ailleurs dans le monde, un examen des actes de DDPH approuvés dans les Régions du Golfe et des Maritimes, y compris des mesures compensatoires adoptées et de leur efficacité, et l'élaboration d'un plan de travail portant sur des questions précises de la Direction des sciences et de gestion. Étant donné le grand intérêt suscité par ces thèmes, on avait invité des gens des Régions de Terre-Neuve et du Labrador, du Québec, du Centre et de l'Arctique ainsi que de l'Administration centrale. La Direction des ports pour petits bateaux était également représentée.

La première journée a consisté surtout en des exposés suivis de discussions. Les deux premiers exposés, de Roland Cormier (La Direction de la gestion de l'habitat, Région du Golfe) et Paul Boudreau (La Direction de la gestion de l'habitat, Région des Maritimes), ont servi à définir le contexte stratégique et la portée du sujet, et à donner des exemples régionaux de projets compensatoires réussis et d'autres qui ont échoué. Puis, Herb Vandermeulen a présenté deux brefs exposés, portant sur la difficulté d'effectuer une analyse documentaire internationale et sur l'importance de la zostère marine comme habitat fragile. Tana Worcester a ensuite présenté un résumé d'autres initiatives pertinentes, notamment la vérification nationale du Programme de mesures compensatoires liées à l'habitat, une série de rencontres consultatives scientifiques nationales et des outils décisionnels régionaux. De son côté, Shawn Robinson nous a fait remettre en question nos a priori et nous a incités à voir les choses sous un angle nouveau. S'agissant des mesures compensatoires liées à l'habitat, il a recommandé l'abandon de notre vision bidimensionnelle axée sur une seule espèce ou un seul habitat au profit d'approches plus holistiques, multitrophiques et centrées sur les fonctions. Glyn Sharp a ensuite fait part de ses expériences de création de récifs artificiels, faisant remarquer que ceux-ci servent habituellement à donner un habitat au homard, mais que d'autres organismes en profitent aussi. C'est Jessica Damon, du Maine, qui a donné le dernier exposé, présentant le point de vue des États-Unis. Elle a expliqué que bien des problèmes de compensation rencontrés dans ce pays sont très semblables à ceux du Canada, quoique certaines différences intéressantes soient apparues. Ainsi, l'État du Maine envisage de recourir à la protection de l'habitat en guise de mesure compensatoire.

La deuxième journée, les travaux se sont déroulés en petits groupes. Trois groupes de travail ont été chargés de discuter chacun d'un des trois sujets suivants : la phase qui précède les mesures compensatoires, l'élaboration des mesures compensatoires et la phase qui suit les mesures compensatoires ou phase d'évaluation. L'atelier s'est terminé par une séance plénière, durant laquelle on a présenté les résultats obtenus par les groupes de travail et conclu la discussion générale. Les participants ont formulé plusieurs recommandations et suggéré notamment qu'on organise une réunion du PCR en mars 2007 pour examiner les résultats obtenus jusque-là dans les expériences de création de récifs artificiels réalisées pour compenser la perte ou la dégradation d'habitats. Ils ont aussi suggéré de tenir des réunions annuelles d'échange pour échanger de l'information sur les activités compensatoires visant l'habitat marin et améliorer les communications entre les agents régionaux.

INTRODUCTION

Meeting co-chair, Ross Alexander, welcomed participants (Appendix 1), provided information on meeting facilities and then reviewed the remit for the meeting (Appendix 2). Meeting co-chair, Tana Worcester, briefly described the intent of the Regional Advisory Process (RAP) and reviewed the objectives for this workshop, which were to recommend a consistent approach and common understanding of the issues surrounding marine habitat compensation in the Maritimes Provinces and elsewhere. The agenda for this meeting is provided in Appendix 3.

PRESENTATIONS

Marine / Estuary Habitat Compensation – Gulf Region
Roland Cormier

Presentation

The Fisheries Act
The Fisheries Act prohibits the harmful alteration, disruption, or destruction (HADD) of fish habitat unless authorized by the Minister:

> 35(1) No person shall carry on any work or undertaking that results in a HADD of fish habitat.
>
> 35(2) No person contravenes subsection (1) by causing a HADD of fish habitat by any means or under any conditions authorized by the Minister or under regulations made by the Governor in Council under this Act.

Project Referrals (Assessment)

- Certain projects in the marine environment, *as proposed*, will likely result in a harmful alteration, disruption or destruction (HADD) of fish habitat.
- HADD is defined as any change in fish habitat that reduces its capacity to support one or more life processes of fish (i.e., productive capacity).

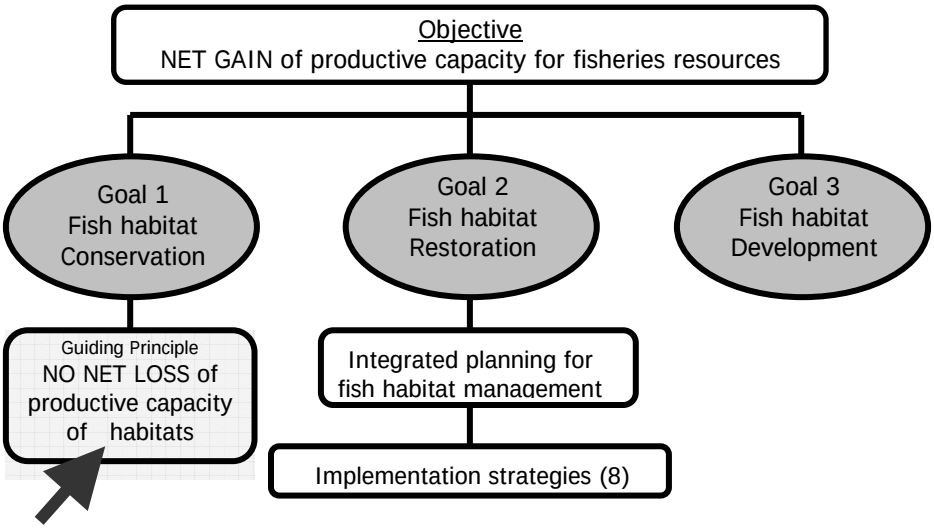

Figure 1. DFO's Policy for the Management of Fish Habitat (DFO 1986).

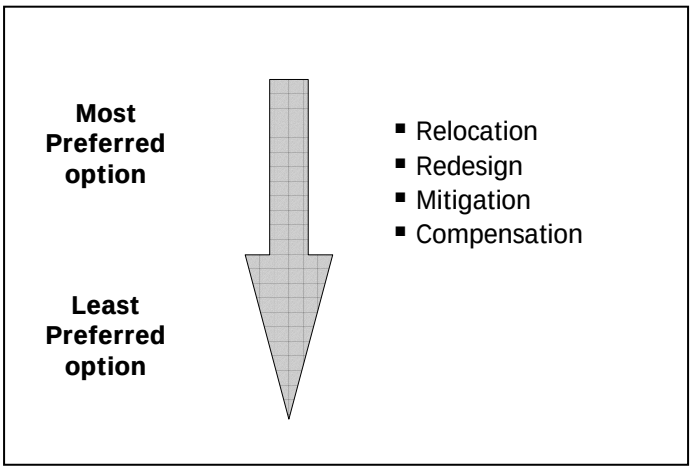

Figure 2. Hierarchy of preferences to address project components that may result in a HADD in order to achieve "NO NET LOSS"

Compensation is defined as:

"The replacement of natural habitat, increase in the productivity of existing habitat, or maintenance of fish production by artificial means in circumstances dictated by social and economic conditions, where mitigation techniques and other measures are not adequate to maintain habitats for Canada's fisheries resources."

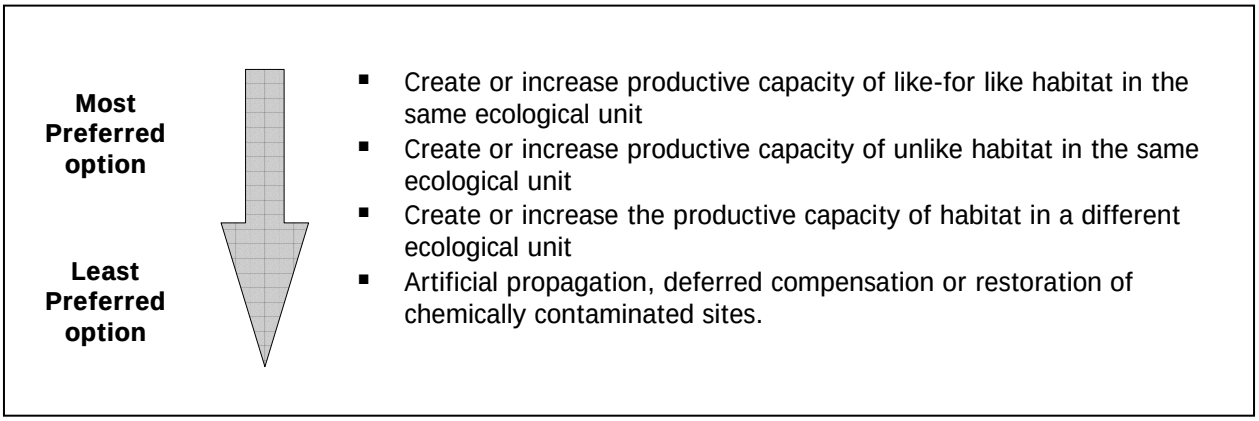

Figure 3. Hierarchy of Preferences for Marine Habitat Compensation.

Table 1. HADD Authorizations for the Gulf Region 2003-2006.

Fiscal Year	Total No. HADD Authorizations issued for Region	No. of HADD's issued in Marine/Estuarine Environment
2003/2004	9	6 (67%)
2004/2005	7	3 (42%)
2005/2006	13	11 (85%)

Examples of Recent Marine Projects Requiring Subsection 35(2) Authorizations

- Coastal infilling.
- Wharf expansion/upgrades.
- Breakwater construction.
- Dredging.

- Shore protection works.
- Causeway/bridge upgrades.

Examples of Recent Marine Compensation Projects – Gulf Region
- Artificial lobster reef creation.
- Oyster bed enhancement.
- Reclamation of old containment cells.
- Removal of abandoned wharf and boat launch structures.
- Clam tents.

Case Study 1: Grande Anse Breakwater Repairs and Basin Dredging
- Project – replace wharf with breakwater.
- HADD – infilling of 1,797m^2 marine shellfish habitat (ubiquitous).
- Compensation hierarchy – create unlike habitat in same ecological unit.
- Compensation – create niche habitat in surface of breakwater and create lobster reef (i.e., 550 pre-cast concrete structures spaced at 2m intervals) in the Bay of Chaleur near Grand Anse.

Table 2. Habitat Balance Table for Grande Anse Breakwater Repairs and Basin Dredging.

HADD	**HADD Area**	**Compensation Ratio**	**Compensation Area Required**
Infilling 1797m^2 of marine habitat	1,797m^2	2:1	3,594m^2
Total Compensation Provided : niche habitat (672m^2) Lobster reef (3,168m^2)			**Total Area:** 3,840m^2

Case Study 2: Neguac Harbour Floating Breakwater
- Project – installation of floating breakwater with associated marine infill.
- HADD – destruction of 785$m^2$of marine shellfish habitat (ubiquitous).
- Compensation hierarchy – Create unlike habitat in same ecological unit.
- Compensation – reclaim containment cell to restore tidal flushing and salt marsh habitat (increase in ~5,000m^2 of fish habitat).

Success of Marine Habitat Restoration
- Containment cell successfully reclaimed (excavation of cell and berm to original depth – on land disposal).
- Tidal flushing re-established and new habitat created.
- Habitat slowly re-colonizing with macroflora and macrofauna species.

Table 3. Habitat Balance Table for Neguac Harbour Floating Breakwater.

HADD	**HADD Area**	**Compensation Ratio**	**Compensation Area Required**
Infilling 785m^2 marine habitat	785m^2	2:1	1,570m^2
Total Compensation provided: Restoration of old containment cell as fish habitat			**Total Area:** 5,000m^2

Case Study 3: Cormierville Harbour Proposed Breakwater
- Project – construct breakwater south of existing wharf.
- HADD – destruction of 1,600m^2 of marine shellfish habitat (soft mud).

- Compensation hierarchy – increase productive capacity of unlike habitat in the same ecological unit.
- Compensation – enhance 3,700 m2 oyster bed habitat with whole clam shells.

Success of Oyster Reef Enhancement
- 8 random 0.09m^2 quadrats sampled October 20, 2004.
- Recruitment success indicated mean density of 784.72 ± 348.98 (mean ± std. error) juvenile oysters/m^2 on restored beds.

Table 4. Habitat Balance Table for Cormierville Harbour Proposed Breakwater.

HADD	HADD Area	Compensation Ratio	Compensation Area Required
Infilling 1,600m^2 marine habitat	1,600m^2	2:1	3,200m^2
Total Compensation provided: Enhancement of oyster bed habitat via shelling (3kg of shells per m^2 of habitat (total of 11,130kg of soft-shelled clam shells – whole and crushed)			**Total Area:** 3,700m^2

Case Study 4: Cape Tormentine Wharf Construction and Dredging
- Project – construct 2 containment cells and dispose of spoils from inner harbour.
- HADD – destruction of 1,800 m2 of marine habitat (1,500 m2 important shellfish habitat and 300 m2 marginal fish habitat with sand bottom).
- Compensation hierarchy – Increase productive capacity in a different ecological unit.
- Compensation – Enhancement of oyster bed habitat in Shediac Bay (July 2004).

Success of Oyster Reef Enhancement
- Fall monitoring indicated zero oyster recruitment on restored shell bed.
- October 2004, 800 lb (1.6 oysters/m^2) adult oysters introduced on restored beds to encourage re-establishment of population.
- Preliminary data from 2005 monitoring indicates low recruitment of 24.44±13.33 (mean ± std. error) juvenile oysters/m^2.
- Summary 2005 monitoring report to follow.

Table 5. Habitat Balance Table for Cape Tormentine Wharf Construction and Dredging.

HADD	HADD Area	Compensation Ratio	Compensation Area Required
Loss 1,800 m^2 fish habitat	1,500 m^2 300 m^2	2:1 1:1	3,000 m^2 300 m^2
Total Compensation provided: Enhancement of oyster bed habitat via shelling (3 kg of crushed soft-shelled clam shells per m^2 of habitat)			**Total Area:** 3,300 m^2

Case Study 5: Richibucto Harbour Development Project
- Project – construct a service area and marginal wharf and extend/repair existing breakwater.
- HADD – destruction of 7,788m^2 of marine habitat (infilling) and alteration of 17,745m^2 habitat (dredging).
- Clam and eelgrass habitat impacted.
- Compensation hierarchy – increase productive capacity of like for like habitat in the same ecological unit.
- Compensation – enhancement of soft shelled clam habitat in Aldouane River.

Table 6. Habitat Balance Table for Richibucto Harbour Development Project.

HADD	HADD Area	Compensation Ratio	Compensation Area Required
Loss 1,800m^2 fish habitat	7,788m^2 17,745m^2	2:1 1:1	15,576m^2 17,745m^2 (total 33321m^2)
Total Compensation provided: Enhancement of soft shelled clam habitat with clam tents (30,133m^2) and niche habitat in breakwater (3,208m^2)			**Total Area:** 33,321m^2

Success of Clam Tents

- Fall monitoring (September 2005) indicated zero clam spat (i.e., recruitment).
- Environmental or biological factors may be responsible for lack of recruitment.
- Currently in discussions with proponent regarding whether or not to re-install clam tents in 2006.
- Summary 2005 monitoring report underway.

Issues for Compensation in Marine Environment

- Compensation focused on “like for like” habitat without full consideration of limiting factors in the affected ecological unit.
- Ecological unit is not well defined.
- Lack of policy guidance and clear methodology in determining “No Net Loss” and compensation rationale/ratios.
- Sound enhancement ideas but often unsuitable sites.
- Cost implications for proponents trying to locate suitable sites and conduct marine monitoring.
- Public/stakeholder concerns with type and location of compensation projects.
- Lack of expertise.
- Lack of coordinated vision for compensation measures conducted in a given ecological unit.
- Lack of record keeping, database mapping and protection of compensation areas.
- Lack of certainty as to whether or not we are achieving “No Net Loss” of productive capacity.
- Lack of certainty related to required lifespan of compensation habitat and duration/timing of monitoring requirements.

Proposed Breakout Topic 1: Using an Ecological Unit Approach to Marine Compensation

- Define ecological unit in a broader sense to include watershed and coastal habitat instead of focusing only on marine habitat.
- Facilitate the identification/delineation of ecological units in the regions.
- Identify and address limiting factors for habitat productivity within an ecological unit.
- Rationalize level in compensation hierarchy based on life cycle of a marine/anadromous species present in the area of the HADD instead of trying to focus directly on productivity.

Proposed Breakout Topic 2: Risk Profiling HADD and Determining Compensation Ratios

- Improve methods to assess severity and recovery potential for HADD’s to fish habitat taking into consideration:
    - Ecological footprint;
    - Number of species affected by the HADD;
    - Number and type of life processes impacted;
    - Severity/duration of the impact; and
    - Recovery potential and time to recovery.

- Base compensation ratios on the type of compensation proposed (not before) in order to ensure consideration of the following characteristics of the compensation method:
    - Success rate;
    - Life expectancy;
    - Delay time;
    - Quality of habitat created; and
    - Ability to create/improve a habitat's capacity to support one or more life processes of fish.

Proposed Breakout Topic 3: How to Manage Marine Compensation Projects

- Delineate and map ecological units within the region.
- Identify limiting factors within ecological units and opportunities for compensation.
- Compile database and/or map system to locate compensation projects already completed or underway.
- Identify methods to protect compensation habitats from future developments or other activities.
- Clarify lifespan requirements for compensation works and duration/timing of monitoring requirements.

Discussion

In the presentation, it was suggested that DFO should not have specific ratios for compensation but that we should let proponents propose something and then evaluate whether objectives have been met. A question was asked as to how the proponent would know what type and extent of measures to propose. It was suggested that guidelines could be developed.

A comment was made that freshwater systems are well understood, but the ecological success of marine compensation is not. Compensation ratios that have been established for freshwater systems may need to be altered to reflect different success rates in the marine environment.

Questions were asked about the frequency and duration of monitoring at various sites, as well as about the use of reference sites during monitoring. The response was that the Gulf Region is just starting to investigate monitoring design in a directed way with the help of Science.

A comment was made about the importance of addressing the issue of scale. For example, we are often faced with a series of small areas in need of compensation. It is not efficient to deal with each of these independently. It was suggested that we need to look at compensation from a larger scale perspective and be more strategic.

A question was asked about the best way to analyze and assess the results of compensation projects, as well as how to effectively apply these results to new projects. For example, oyster enhancement may be considered to be successful in one area, but a similar technique may not work in another area. It was suggested that we need to be careful in our evaluation of success.

A concern was raised that while many issues with marine compensation were identified in this presentation, the questions being asked of Science were still too broad. There are a variety of initiatives currently being pursued within the department (e.g., development of Ecosystem Overview and Assessment Reports, identification of Ecologically and Biologically Significant Areas), and we wouldn't want to duplicate these efforts (e.g., through the delineation of

ecological units for compensation). It will be important to learn from other initiatives; however, we may not yet have the scientific basis upon which to base all the answers.

A related comment was made that we may not be able to provide advice on complex ecosystem questions in the short-term. It was suggested that we need to focus our efforts on the critical issues. It was noted that we are also working in an existing policy environment, and some of the suggestions being made may require a change in policy rather than the application of science.

Discussion ensued on the type of information that Science can provide to Habitat Management on the issue of marine compensation, and the challenges associated with compensation monitoring. For example, Habitat Management doesn't necessarily have people with expertise in designing monitoring programs -- they need help from Science. Results tend to be better when monitoring is done by DFO Science; results are not always as useful when monitoring is done by the proponent. In addition to lack of expertise, proponents may have a lack of financial capacity to follow through with monitoring.

It was suggested that there should be information within DFO that we could use to address these types of questions; however, much of this information is not readily accessible (i.e., not published). It was noted that the Newfoundland and Labrador Region does require five years of monitoring data from the proponent, including reports.

Marine Compensation in the Maritimes Region
Paul Boudreau

Presentation

Paul started off by saying that he was glad to see the issue of marine compensation being addressed through a multi-phase Regional Advisory Process rather than as a one of workshop or meeting. However, he wanted to ensure that we focused the remit and established a manageable scope for this project; for example, we should clearly identify what part of the marine environment we are dealing with (offshore vs. nearshore).

There are a variety of issues associated with marine compensation – some of which can be addressed through Science and some through policy. It is the responsibility of Habitat Management to determine what the Science questions are. For example, Habitat Management is not looking for a definition of a HADD [i.e., what constitutes a Harmful Alteration, Disruption or Destruction under the Fisheries Act]. Questions for Science may include: what is the extent of impact, what is the scale of impact, and what is the level of uncertainty associated with an answer?

Examples of Marine Compensation from the Maritimes Region

Chevy Lake
Transport Canada did some infilling in a freshwater environment (lake). Compensation for this was conducted in an estuary in another part of the province. The public expressed some concern with this approach. Transport Canada was interested in obtaining as many credits as possible for their compensation, and questions were raised as to how far the compensation area extended (high water vs. low water mark). From a Habitat Management perspective this was a great project since some great habitat was created.

Aquaculture
The Maritimes Region is considering how to apply section 35 of the Fisheries Act [harmful alteration, disruption or destruction of fish habitat] to aquaculture sites. This highlights problems with compensation policy. For example, infilling of a lake clearly destroys habitat, while aquaculture impacts alter rather than destroy habitat. How do you compensate for this alteration? This is a question that should *not* fall within the scope of this meeting. Marine compensation is new, and it would be best to pursue a few easy first steps.

Offshore Oil and Gas
Compensation for offshore oil and gas activities is an emerging issue in the Maritimes Region. Not only do we have the potential for some new production sites, but we also have to deal with exploration drilling, which hasn't previously required Fisheries Act authorization. Do we compensate if a site is temporary? What kind of monitoring would we do? What kind of compensation would DFO require in deep water? These are questions that are outside the scope of this meeting, or are they?

At the end of the day, it is up to Habitat Management to determine if compensation is acceptable. The Minister of Fisheries and Oceans has the discretion to write off habitat, and the Minister may not always follow Science advice. Habitat Management has been asking questions about marine compensation for a long time, and it is nice to see Science become more engaged.

Discussion

A comment was made that consultation with community about marine compensation was needed. Science may not know best, and community information is useful. Also, it can be difficult to do compensation without community buy-in.

The issue of compensation for aquaculture impacts was raised in the presentation. This was thought to be an interesting question for Science, particularly in terms of addressing the incremental change characteristics of aquaculture impacts. A suggestion was made that it may be useful for a marine compensation framework to identify and distinguish between types of activities that result in permanent vs. temporary change.

While aquaculture may be outside the scope of this meeting, there are some lessons that we've learned from aquaculture that may be applicable here. For example, as aquaculture moves towards a performance-based management approach (where management decisions are based primarily on environment monitoring results) it will become necessary to address issues of statistical power. It will be important not to get hung up on measures of current performance without some temporal context since environmental parameters at natural sites can fluctuate widely through the year.

Some felt there was a need to focus *not* on the productive capacity of habitat created as compensation, but on the role of that habitat and its similarity to natural systems.

This presentation made a distinction between science and policy, and it was suggested that this RAP meeting should deal only with science. It was felt that the current meeting should not get into risk assessment and community consultation.

A question was asked as to whether the number of marine HADD authorizations were similar in the Maritimes as compared to the Gulf Region. The response was that the Maritimes Region

had slightly higher numbers of authorizations, but they were reasonably similar. The Maritimes Region also has had to deal with several Liquid Natural Gas (LNG) projects.

A question was asked about the use of proxies. Habitat Management responded that they are looking for advice from Science on this. It was suggested that it might be possible to include proxies in a marine compensation framework.

A question was asked about whether the use of HADD authorizations has been consistent, or whether its use has changed over time. It was suggested that the definition of a HADD has been changing, and there has been no consistent trend in the use of authorizations from Region to Region. For example, the Maritimes Region doesn't authorize every culvert while some Regions do. It was also noted that Regions with lots of HADD authorizations in the past have been reducing their use of authorizations, while Regions that had made minimal use of HADD authorizations in the past were now making greater use of these. It was suggested that Regions will eventually move towards common patterns of use.

A concern was raised about the use of one proponent's compensation program to fix a different proponent's problem. The response was that Habitat Management's goal is to protect fish and fish habitat. While specific guidelines and policies have been developed to help do this, it is important to have the flexibility to deal with specific issues and conditions as they arise.
It was noted that some questions related to marine habitat compensation will be very technical in nature, and some solutions will be very site specific. Some of the science that is conducted is very specific rather than directed to answering generic questions. The statistical power required to get good results is very high, and it is unrealistic to expect proponents to fund this.

A concern was raised that we are asking questions of Science before having a good understanding of the policy direction of Habitat Management on this issue. For example, if we come to the conclusion that marine restoration is not effective, DFO may decide to do something that we do understand – like freshwater restoration. It may be decided that we don't need Science advice on some marine compensation issues.

It was suggested that DFO should stick to what it knows how to do well, something that is cheap, fast, and effective. Proponents should not be burdened with activities for which there is a high level of uncertainty.

Habitat Management would be more comfortable with changing their existing policies if Science were to provide an ecosystem rationale for doing so.

Marine Habitat Compensation in North Temperate Waters: a framework for gathering and presenting compensation information from other jurisdictions
Herb Vandermeulen

Presentation

East River and Hurtle's Beach are 'typical' for Nova Scotia, but nearshore development pressures do exist (Prospect Bay and Lunenburg). What sort of compensation would you ask for if a large infill occurred here (Figure 4)?

Figure 4. Coastal estuary.

Project by project compensation leads to cumulative alterations in marine habitat for a particular area in an unorganized manner, the structure and function of that habitat may 'drift' into an unexpected (or undesirable) state.

Bay scale assessment of compensation options allows for the balancing of different habitat types at a 'landscape' level; the size, type and number of habitat patches can be managed as a whole – preserving habitat function in the face of development.

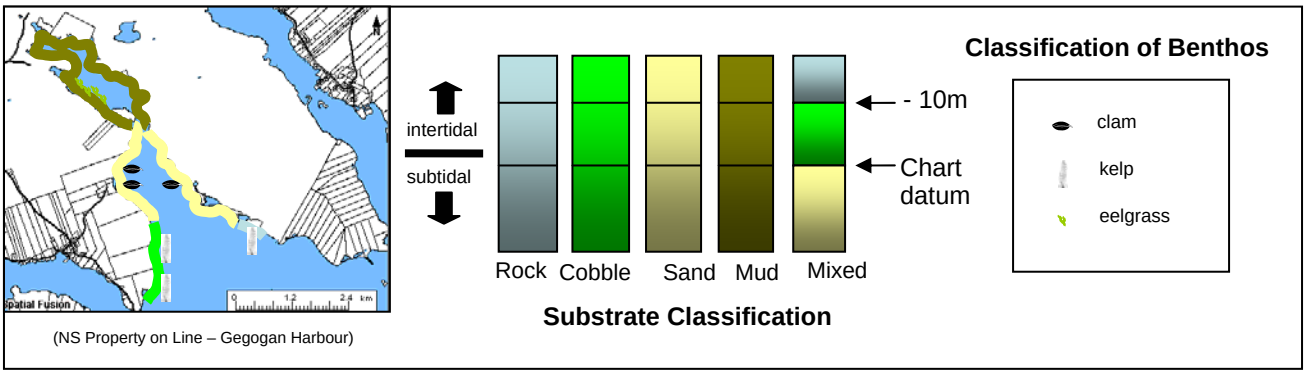

Figure 5. Bay scale assessment for compensation – framework example.

Marine Habitat Compensation in other North Temperate Jurisdictions

- United States
  - US Army Corps of Engineers responsible.
    - They offer guidance, review proposals, issue permits and keep records of compensation projects.
    - NOAA (mainly the National Marine Fisheries Service) and EPA provide advice to the Corps.

- European Union
    - Seems to be driven by the EU Habitats Directive (1992).
    - UK seems quite active.
    - Links to IUCN (the World Conservation Union).
- Australia (south temperate possibility)
- Do these jurisdictions use a bay scale assessment framework, or any other system to capture the landscape scale/cumulative impacts? Are other countries active?

Gathering Information from other Jurisdictions

- Need information on policies and regulations, plus a compilation of actual marine compensation projects (methods and effectiveness).
- Not much available in the primary literature.
- This will require:
    - Grey literature search, including websites.
    - Numerous phone and email conversations with agency representatives.
- Suggested approach:
    - Part time contract of at least three months duration, or
    - Master of Marine Management project for a student at Dalhousie (Marine Affairs Program).

Discussion

Clarification was requested on the term 'ecological unit'. The response was that this term was similar to the bay-scale concept – examine all issues within a bay, conduct a risk analysis, and then identify solutions to key issues within that bay rather than just focussing on habitat.

It was suggested that it would be more useful to evaluate what we have done in terms of marine compensation within the Atlantic Zone than to review work done in other jurisdictions. We have expertise here that we should utilize. However, it was also noted that there are only a limited number of tools/techniques that we have been using, and it might be useful to see what other people have done. It was agreed that it would be possible to review both local and international activities related to marine compensation.

A question was asked as to the amount of marine compensation work that had been done elsewhere. It was suggested that there may not be much relevant policy elsewhere. However, there is a large artificial reef literature base that has become more sophisticated over time. People within Maritimes Science have explored this literature and felt that it may help us to address some questions as it does have some similar goals.

It was noted that the next presentation will help show the overlap between the Oceans Act and the Fisheries Act. However, the challenge of how to do this effectiveness remains. What tools do we need to develop? What do we call a bay? What is priority #1 in each bay? Do we need to understand species distribution, habitat types, limiting factors, and migration of each bay? Do we need mapping and surveys? All these questions will require time and money, so we need to be sure of what is required.

It was suggested that historic context will have to be taken into account when determining whether there may be a HADD in a particular bay. For example, given the current degraded condition of some bays, an additional alteration may not make much of a difference. You may

want to evaluate the HADD against the historical shoreline, or compare to other, more pristine, bays.

Compensating for Eelgrass Loss
Herb Vandermeulen

Presentation

Eelgrass as Marine Habitat

- National DFO Science advice to departmental clients states that eelgrass (*Zostera marina* L.) is both important and sensitive marine habitat (CSAS Research Document 2005/032).
- Although eelgrass can be abundant in particular bays in Canada, the plants are in a worldwide decline.
- In the late 1990's, eelgrass beds collapsed at a number of sites in Atlantic Canada. The cause in some instances was green crab, in other cases the cause is unknown. Some beds have recovered.

Compensation Considerations

- Due to the importance of eelgrass (both footprint and links to 'offshore' production like salmon, eels and flatfish), compensation ratios should be at least 3:1
- It is difficult to force eelgrass growth at sites which do not already have the plants, transplantation projects are labour intensive and difficult, and success is usually limited

Compensation Possibilities

- Set up situations allowing for growth after colonization by drift plants or dispersed seed:
    - Practical - open up tidal barriers (e.g., inserting a Shaw span in a causeway) to allow natural regrowth of eelgrass in nearshore areas that have been cut off from the sea.
    - Experimental - build perched (terraced) sand/mud flats into construction projects like bridge footings, jetties, breakwaters – proper selection of substrate and tidal height should allow for eelgrass colonization.

Discussion

It was noted that DFO has only recently said that eelgrass and kelp is sensitive (DFO 2006).

It was explained that while there is a lot of eelgrass in the Maritimes Provinces, it is in worldwide decline and we should try to preserve what we have. It was suggested that we need a high compensation ratio of eelgrass (at least 3:1) because of its ecological significance. In addition, it is not guaranteed that transplantation will be successful. Other possibilities for compensation include opening up freshwater areas to tidal incursion and allowing for natural restoration.

It was noted that a CD has recently been published on eelgrass restoration modelling (Short and Burdick, 2005).

A question was asked as to what appropriate compensation for eelgrass loss might look like. Historically, compensation has focussed on loss of habitat for commercial species. For example, in the one project both eelgrass and clam habitat was destroyed, but only new clam habitat was provided. In the Maritimes Provinces, we don't have much experience with eelgrass compensation.

It was noted that there has been a lot of work on eelgrass in BC, and they have been successful with transplantation. On occasion, loss of mudflat habitat is compensated with creation of eelgrass habitat. There should be lots of information and expertise on eelgrass compensation available, but this has not been synthesized and published.

Related DFO National Initiatives and Tools
Tana Worcester

Presentation

National Habitat Compensation Program Evaluation
A national evaluation program was initiated by DFO in 2000 to assess the performance of compensation projects across Canada in achieving No Net Loss of fish habitat productivity. The program included four components; a literature review and detailed file review (Harper and Quigley 2005a, 2005b), and a compliance audit and effectiveness study (Quigley and Harper 2006a, 2006b). A DFO Technical Report (Quigley et al. 2006) provides a summary of the outcomes and recommendations of the evaluation program. In response to a need clearly identified during the review, a Monitoring and Assessment Guidebook (Pearson et al. 2005) was developed to provide guidance on what to consider when designing monitoring programs for habitat compensation and restoration projects.

Literature Review
- Evaluated 103 projects (4% of total).
- Of these, 19 resulted in a marine HADD and 11 required compensation.
- Projects > 95 m^2 were typically compensated at < 1:1, while projects < 95 m^2 were typically compensated at > 1:1. Most compensation was like-for-like.
- Monitoring on 50%, range from 1-15 years (3.6).
- Only 66 of 103 (64%) achieved “No Net Loss”.

File Review
- 124 files reviewed (mostly from BC).
- 80% required less than 2:1 compensation.
- 25% required less than 1:1 compensation.

Compliance Audit
- 52 projects (4 in NS, 4 in NB).
- 86% had larger HADD areas or smaller compensation areas than authorized.
- 67% net loss, 2% no net loss, 31% net gain.

Effectiveness Audit
- 16 freshwater sites were audited.

Recommendations
- Require at least 2:1 compensation ratio (possibly 5:1).
- Continue like-for-like, except in degraded areas.
- Require construction of compensation prior to HADD.
- Monitor pre- and post- construction quantitatively for more than 4 years (5-10 years).
- Use baseline (pre-impact) data and reference sites to evaluate success.
- Track habitat gains and losses by category.
- Provide authorizations that include objectives, performance criteria, goals and protocols.

- Use science-based rapid assessment procedures.
- Increase compliance and enforcement.
- Select sites based on ecological bottlenecks and potential for success, not opportunity.
- Increase consideration of ecosystem function rather than quantity.
- Recognize that some habitats can not be compensated.
- Conduct more research on compensation effectiveness.
- Select performance indicators that measure productive capacity of compensation (e.g., presence/absence of fish in new habitat).

Other Initiatives

National science advisory meetings of relevance to a discussion of marine compensation include the review of finfish aquaculture interactions (DFO 2005a), hydroelectric interactions (DFO 2005b), habitat "pathways of effects" (Sep'05) and shellfish aquaculture interactions (DFO 2006).

Hydroelectric Interactions with Productive Capacity

- No-net-loss principle of DFO's Fish Habitat Policy has not condoned the use of a habitat budget for "fish", e.g., sturgeon losses downstream not balanced with whitefish gains upstream of a dam.
- For the proposed methods to be acceptable there will have to be a shift in DFO policy, i.e., applying the no-net-loss policy on the scale of individual species.
- Science can contribute information to this dialogue.
- However, it will be a policy choice and not a Science issue to accept approaches that maintain productivity of fish biomass but not the same species composition.

Finfish Aquaculture National Advisory Process (NAP)

- Science foundation for management of ecosystem effects currently incomplete.
- National thresholds are inappropriate – but consistent approaches with quantitative, regional thresholds are possible.
- Research, analysis, modelling and monitoring will be needed to set the regional thresholds.
- Additional National Science Advisory Meetings may be required periodically.
- Provided list of suitable near-field benthic monitoring methods.
- Agreed that DEPOMOD may also be useful, but should not be used in isolation.
- Discussed ways of assessing habitat sensitivity:
    - List physical, chemical and biological factors.
    - Quantify in terms of endpoints.

Bivalve Aquaculture NAP

- Effects of bivalve aquaculture are related to scale rather than type of infrastructure.
- Modelling can help predict effects, test scenarios, and direct monitoring.
- Needing flexibility in establishing monitoring indicators – site specific.
- Need robust sampling design.
- Current management practices are focused on site-by-site assessment.
- New approaches are required to quantify cumulative effects from all impacts to coastal areas (ecosystem change).
- Provided research recommendations.

Pathways of Effects

A national DFO workshop was held in September 2005 to validate components of the pathways of effects diagrams that have been developed by Habitat Management (e.g., Figure 6). The

Habitat Management's intention is that DFO habitat biologists and proponents would use these diagrams to assess the potential effects that may result from a given project.

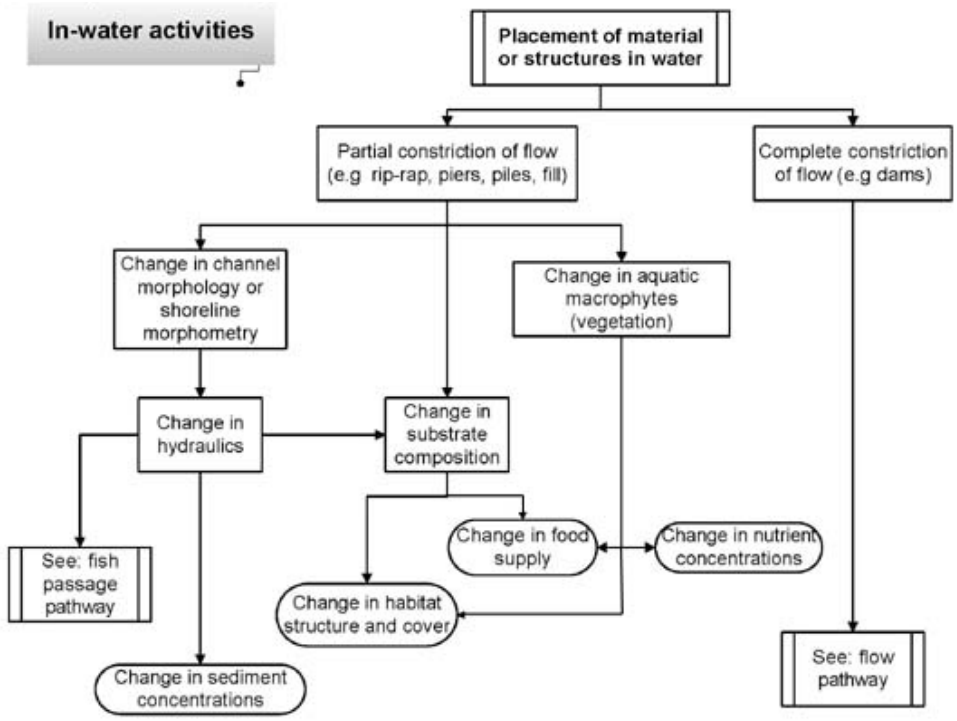

Figure 6. Effects Pathway for Placement of Material of Structures in Water.

A number of Decision Support Tools (DST) that have been developed in the Maritimes were also discussed, such as the Marine Finfish Aquaculture DST (Doucette and Hargrave 2002), the Whitefish Stocking DST (DFO 2004), and the Salmon Presence Assessment Tool.

Discussion

It was noted that the same DFO scientists have been attending all of these meetings, and each of these meetings has addressed a small part of the broader issue. However, there has been no forum to look at the big picture. It will be important to work out what the fundamental questions are and then provide time to do the science required to address these questions. It was suggested that the application of results will vary depending on the circumstances.

It was suggested that the fundamental question was: what is our capacity to understand the function and structure of the marine environment?

In reference to the compliance audit of DFO`s freshwater compensation program, it was suggested that failure reflected a lack of training and limitations on DFO`s capacity to conduct monitoring and evaluation. It was suggested that consequences of failure should not be transferred to proponent.

The importance of establishing effective monitoring through careful design, i.e., with statistical power and reference sites, was highlighted.

A question was asked as to whether infilling and dredging really affected productive capacity. No answer was provided.

Viewing Marine Compensation Issues with Integrated Ecological Approaches
Shawn Robinson

Presentation

Saint Andrews Biological Station and HADD

- Replacing lost habitat is impossible without destroying other habitat
- Most subtidal area is composed of softer sediments that is virtually impossible to recreate except in special situations.
- Site specific characteristics need to be evaluated and quantified prior to selection and size of remedial structures. Currently little scientific information on these interactions is available to make sound decisions on appropriate remedial activities.
- Soft-bottom production is basically 2-dimensional in nature due to the relative lack of vertical relief. Much of the production is usually hidden from visual surveys because it is below the sediment surface.
- One of the few options to replace the lost soft-bottom production is by augmenting existing hard bottom production using engineered structures.

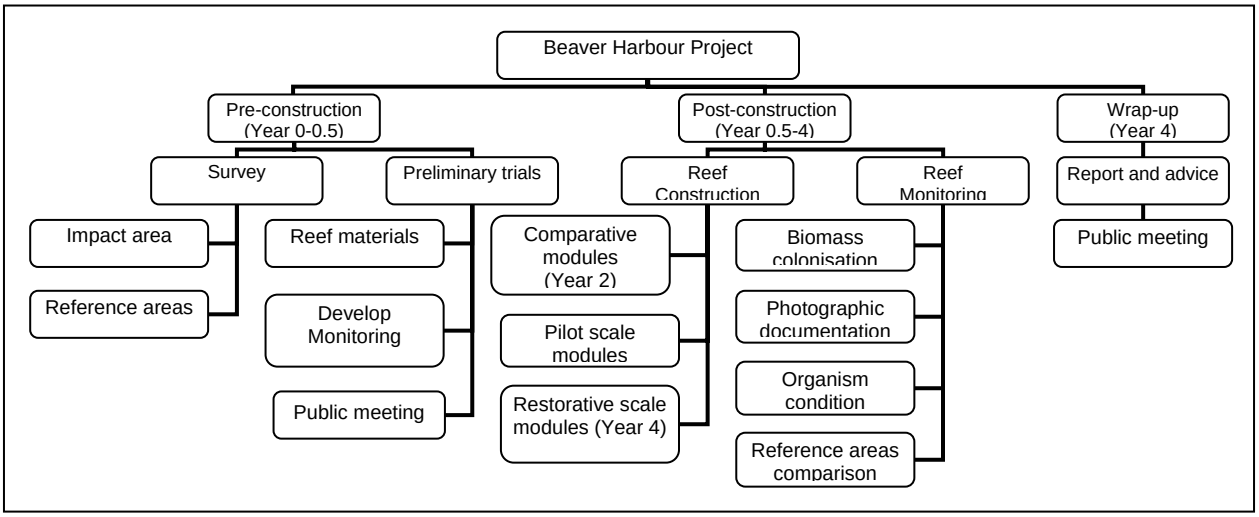

Figure 7. 2005 Artificial Reef Proposal.

Basic Assumptions

Surplus Capacity Available for Humans

- Dominant species fisheries can be regularly cropped.
- Large scale resources are robust.
- Assimilative capacity of the receiving waters can be vigorously exploited.
- Environment of aquaculture products is small relative to the whole in relation to dispersal.

This goes against the concept of ecosystems, namely the conservation of energy and carrying capacity of systems (i.e., sustainability). These relationships have developed over millions of years.

19th and 20th Century Milestones (*7% of the development time)*

- Early 1800's – canning invented (French).
- 1820 – factory-made nets (larger).
- 1850's – steam vessels were developed.
- 1859 – first ice-block machine (French).
- 1876 – steam capstan.
- 1880 – ammonia refrigeration (USA).
- 1906 – motor engines developed and enhanced over war years.
- 1950's – development of synthetic fibres and powered blocks and rollers.
- 1953 – factory freezer trawlers.
- 1970's – rapid growth in electronics.

Carl Folke and Nils Kautsky (Swedes)
Some Stressed Ecosystem Properties: *monoculture, single species fisheries*

- High dependence on auxiliary energy.
- Increase in nutrient turnover.
- Increase in nutrient loss.
- Increase in proportion of growth-strategy species.
- Increase in parasitism, diseases, other negative interactions.
- Shortening of food chains.
- Decrease in vertical trophic cycling.
- Decrease in resource use efficiency.
- Low complexity, low diversity, low system efficiency.

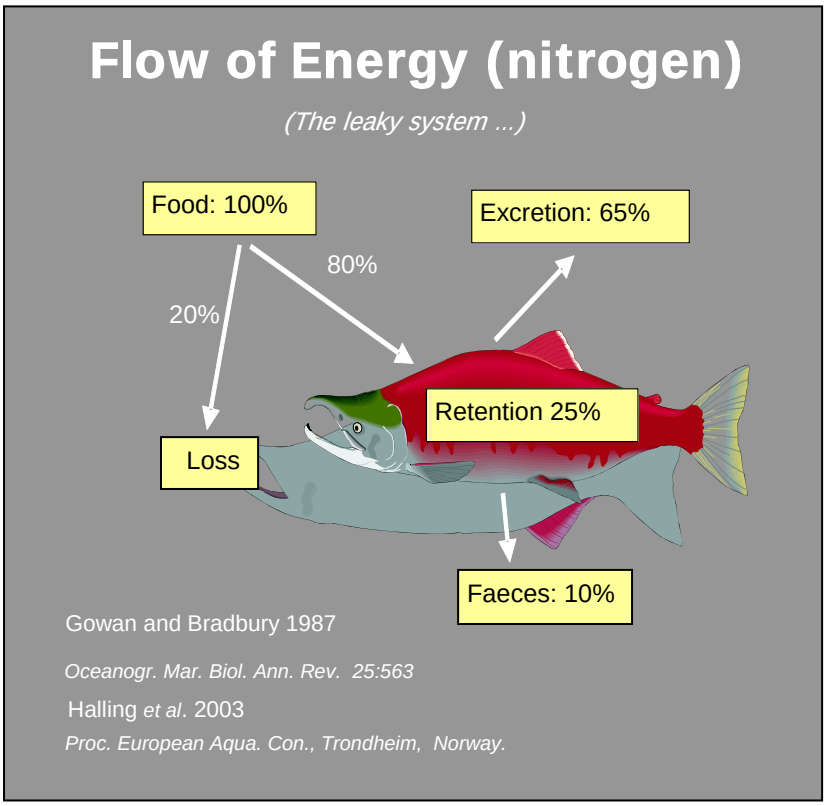

Figure 8. Flow of nitrogen in a salmon aquaculture farm (Gowan and Bradbury 1987; Halling et al. 2003).

Industrial Ecology

- Concept started in 1989 (Frosch and Gallopoulos 1989).
- An interdisciplinary framework for designing and operating industrial systems as living systems interdependent with natural systems.
- Called the “Science of sustainability”.
- Goals:
    - Minimise energy and material usage.
    - Ensuring acceptable quality of life for people.
    - Minimising the ecological impact of human activities to levels natural systems can sustain.
    - Conserving and restoring ecosystem health and maintaining biodiversity.
    - Maintaining the economic viability of systems.

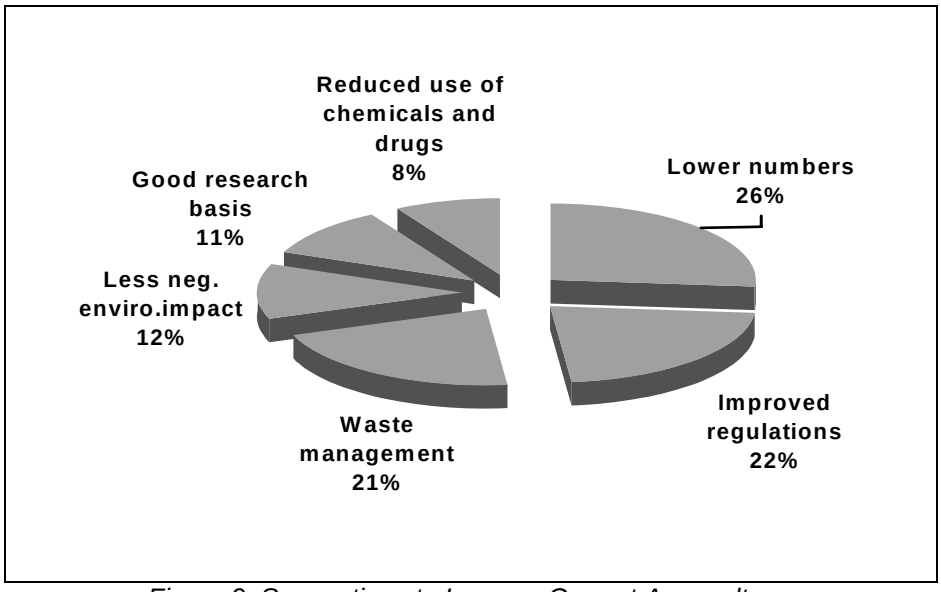

Figure 9. Suggestions to Improve Current Aquaculture.

Opportunities for Enhanced Marine Compensation

- Reduction of area required.
- Meets multiple objectives (remediation, community stability, economics).
- Generation of “credits”.
- Better understanding of functional relationships.
- Integral part of coastal zone planning.

Long-term Issues

- Developing and testing systems.
    - Science, economics, marketing, social.
    - Consensus on assessment requirements.
- Empowering legislation.
    - Dealing with waste.
    - Encouraging beneficial practices (taxes).
- Public consciousness.
    - Support of sustainable practices
    - Change in behaviours.

Discussion

A question was asked as to whether research been conducted on productivity. The response was that SABS is just starting out with trophic experiments. They have done some testing, but still have more work to do. Chris McKinsey has done some work in the Gulf Region.

It was suggested that we should be leery of monitoring based on patterns. For example, fisheries management has been based upon monitoring of the abundance and distribution of fish, but this approach has been inadequate to identify problems with long-lived species. There is a need to better understand basic underlying ecological processes.

It was asked; what then would be appropriate to evaluate and how then would you compensate given these uncertainties? The response was that it would be hard to predict what will happen with any habitat. For example, we don't know what will happen with Glyn Sharp's reef balls, but we can assume that the results will be better than the current situation.

The issue of legislative restraint was raised. There may be limited ability to change policies in a manner that would enable us to pursue new options for compensation. For example, it may be difficult for DFO to make changes to waste water treatment.

It was suggested that policy doesn't encourage innovation; rather, technology will drive innovation.

It was also suggested that there are enough immediate problems to fix that we don't need to go looking for places to enhance. Why not fix problems we already have?

Science and the Evaluation of Artificial Habitat for Lobsters
Glyn Sharp, John Tremblay, Robert Miller, Ellen O'Brian and Bob Semple

Presentation

Addition of Rocky Habitat – Summary of Knowledge to Date

- Several studies indicate the addition of rocky habitat can enhance a particular patch of bottom.
- More lobsters present than pre-reef.
- Little guidance on siting to ensure stability.
- Whether habitat addition could be scaled up to have measurable impact on stock not known.

<u>Reef Ball Habitat Monitoring</u>

Reef balls are a potential "off the shelf" habitat compensation measure. They were used to replace habitat impacted by harbour infill in the Eastern Passage area of the Harbour.

They are a made of a fibrous concrete in a mold about 1 meter in diameter and height. A central open space has many large holes to the exterior.

Project Goals

- Assess the rate and type of colonization of reef balls in stressed and unstressed marine environments.
- Determine the seasonality of immigration and migration at these sites.
- Compare the climax community on and in reef balls with adjacent hard bottom communities.

Study Sites

Two sites were selected: one very close to the impacted habitat in Halifax harbour; the other in a “pristine” area of St. Margaret’s Bay.

Paddy’s Head

The Paddy’s Head site (pristine, Figure 10) is a semi sheltered cove with a sand/gravel bottom between two sloping bed rock shorelines. It is an actively fished area and is a recreational diving site. The 12 reef balls were placed in the fall of 2004.

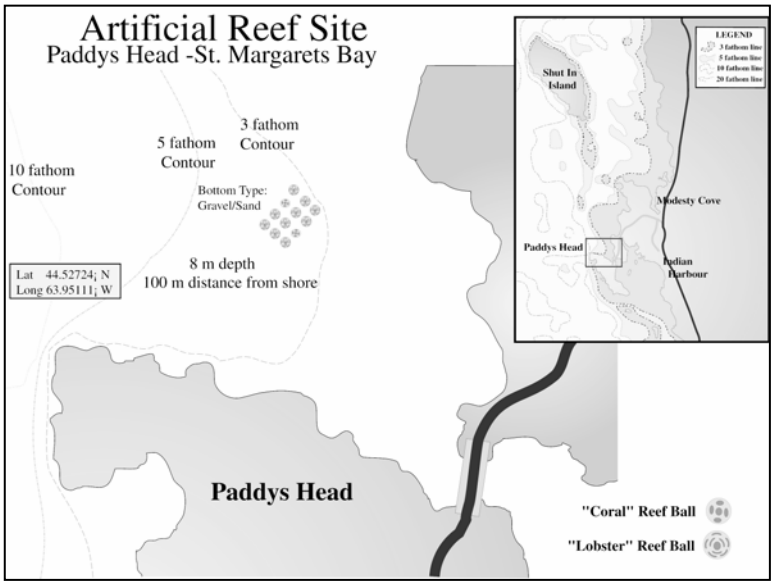

Figure 10. Artificial reef site at Paddy’s Head, St. Margaret’s Bay.

McNabs Island

The McNabs site (near impact site, Figure 11) is on the north end formally within Halifax Harbour. The bottom is gravel/sand/silt. To keep the reef balls within a 10m depth range they were arranged parallel to the shore. One set of 16 was placed in the summer of 2004 another set of 4 was placed in the fall of 2004.

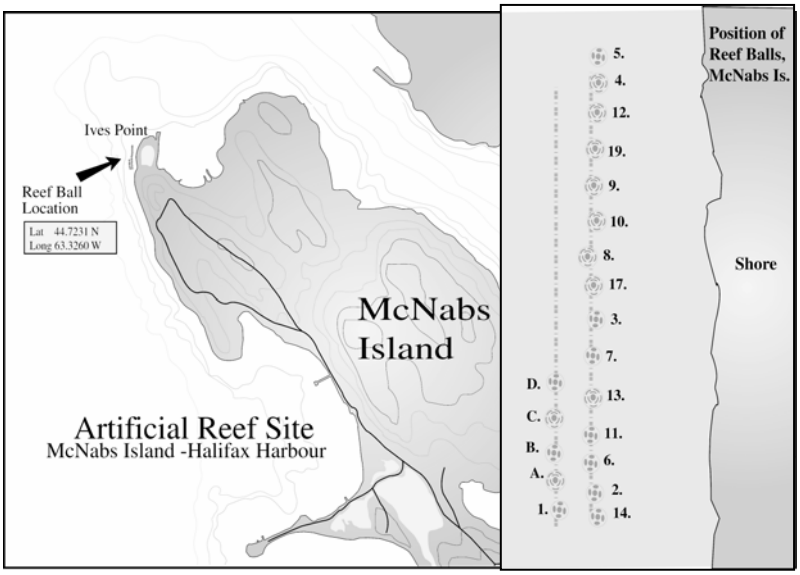

Figure 11. Artificial reef site at McNabs Island, Halifax Harbour.

Side-scan of Reef Balls at McNabs Island

The reef balls at McNabs change the bottom characteristics significantly both as individual habitats and as a reef structure as shown in this side scan image (Figure 12).

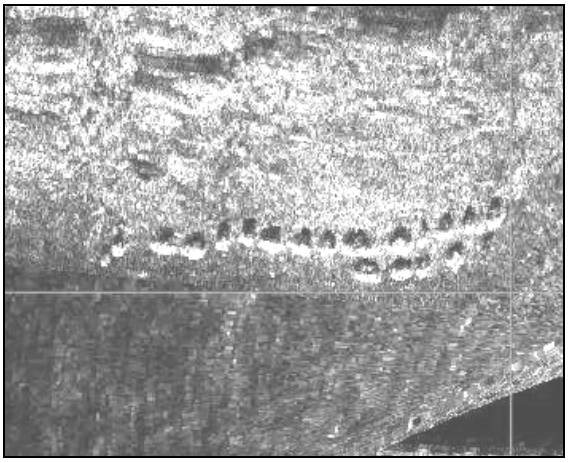

Figure 12. Side scan image of reef balls at McNabs Island.

Colonization

Data were collected with destructive and non-destructive sampling.

- Bi monthly non-destructive observations.
    - Census of plants and animals in and on each reef ball.
    - Photography of balls and marked quadrats 10 by 10cm.
- Once a year destructive sub- sampling of units and adjacent hard bottom.
    - Scraping and suctioning of 100cm$^{2.}$
    - Inside and outside of units.
    - Collection of plants .25m$^{2.}$

Meso-Invertebrate Census

Destructive sampling methods, i.e., suction, collected 55 species of micro and meso invertebrates and provided information on the diversity of amphipods, isopods, copepods and gastropods. Although there was some seasonal variation in these taxa, the differences between the sites were consistent. These differences reflected the adjacent communities. Colonization was found to be quite rapid. Over one year, a plain concrete surface becomes a biological community.

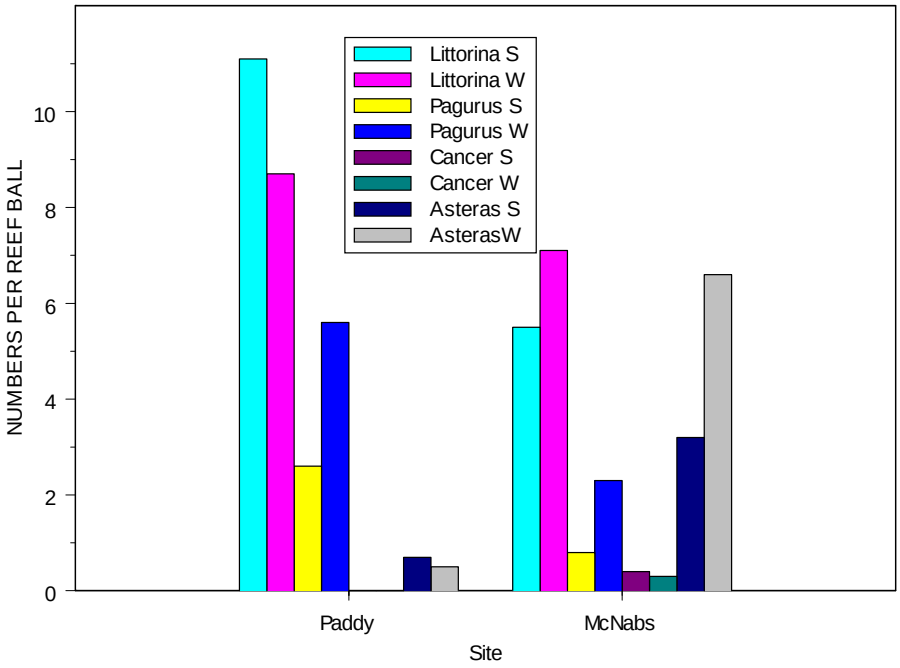

Figure 13. Numbers of species per reef ball at the Paddy's Head and McNabs Island sites.

Kelp *L. longicruris* Population

The placement date can have a significant effect on the development of populations such as kelp. The size frequency of kelp plants (*L. longicruris*) on reef balls set out in summer had fully mature plants while those placed in the fall were just beginning recruitment one year after placement (Figure 14).

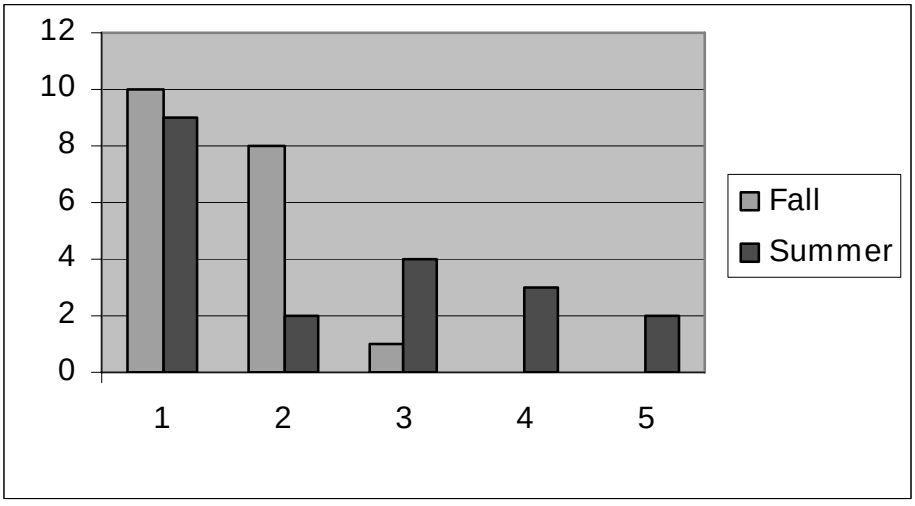

Figure 14. Size frequency of kelp (L. longicruris) on reef balls placed in summer vs. fall.

Kelp Recruitment (Photographs presented but not included here)

Kelp plants recruited in the winter after summer deployment. Initial high densities in the spring were reduced by the fall when plants were mature.

Red Algal Succession (Photographs presented but not included here)
Red algae that recruit early in the succession of algal species are ephemeral and a series of recruitment pulses are possible within one year. Eventually perennial red algae will become dominant.

Comments on results to date
- Large lobsters inhabit some reef balls.
- Reef balls do not have a good cost benefit ratio for artificial lobster habitat.
- Reef balls are rapidly colonized by macro flora and fauna.
- The biodiversity of organisms reflects the diversity in the immediate area.
- Reef balls enhance the productivity and habitat complexity of the immediate area.
- More rigorously designed experiments needed to answer basic questions for habitat compensation decisions.

Artificial Rock Reefs - Laboratory Studies (Phase I)
Laboratory studies were conducted at the Bedford Institute of Oceanography from January 2005 – May 2005.

Lobster Habitat Lab Experiment Questions
- How can we get the best value for our artificial reef per ton of rock or other habitat?
- What is the optimal size of rocks for a given carapace length of lobsters for maximum habitat occupation?
- How important is the type of substrate under the reef for habitat occupation?
- How does the configuration of the rock pile affect the degree of habitat occupation?

Study Design
Depth and shape of the pile was controlled; two shapes were used, round and flat; two sizes of rocks were used, 10-20cm and 20-40cm; two sizes of rock piles were used (perimeter differences); and there were 20 lobsters per trial. In order to determine how the underlying substrate type affected the occupation of the rock habitat, the tank was divided into two units: one with a hard bottom and the other with a sand/gravel mix. This “soft” substrate allowed for burrowing.

Rock pile size
There were more lobsters in the large piles but on a unit area or unit circumference basis the difference is small.

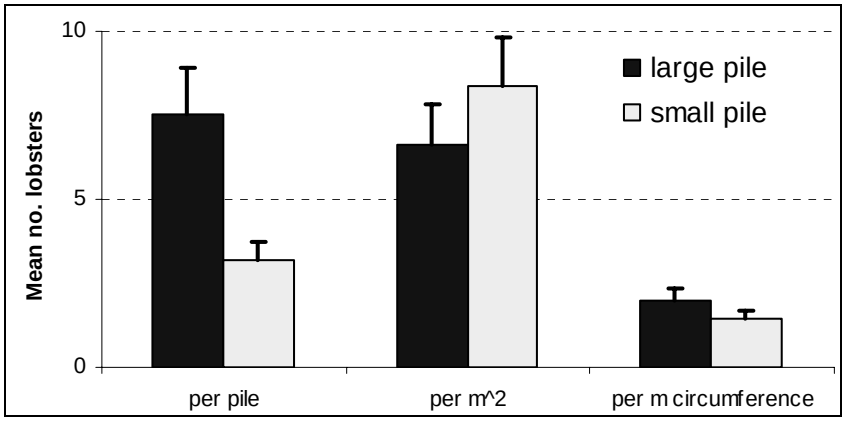

Figure 15. Relationship between mean number of lobsters and rock pile size.

Soft vs. hard bottom and rock size/shape
On hard bottom large flat rocks were selected over round rocks by both sizes of lobsters. Habitats on soft bottom were in general preferable to ones on hard bottom.

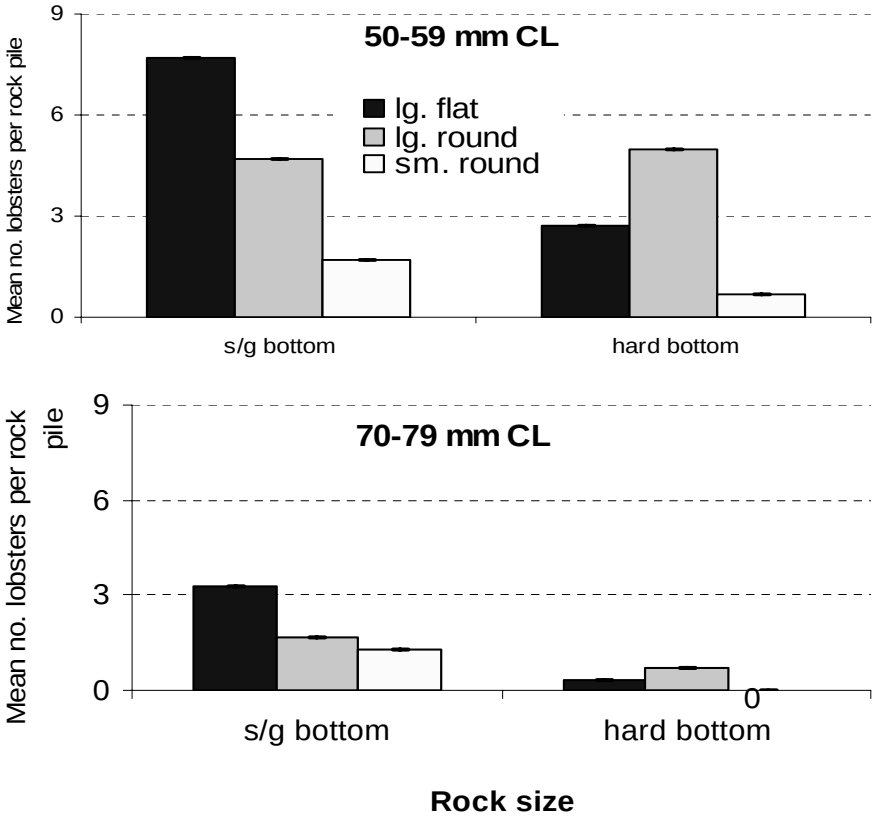

Figure 16. Relationship between mean number of lobsters and bottom type using various shapes of rocks and sizes of rock piles.

General: Lobsters 40 – 50 mm CL

- Burrowing activity is common on sand/gravel.
- There is heavy utilization of the spaces available.
- Most of the habitat occupation occurs overnight.

Shelter Height
To look more closely at the effects of the dimensions of a shelter on shelter preference and activity high and low roof shelters were tested on bottoms with several grades of gravel mixed in. These experiments were conducted in shallow tanks.

- Two lobster sizes 50-59cm, 82-89cm.
- Low entrance 37 mm high by 110 wide.
- High entrance 57 mm high by 110 wide.
- Low shelters needed excavation before occupation.
- Substrates:
    - Sand and ½ inch gravel mix.
    - Sand and 1 inch gravel mix.
    - Sand and 2 inch gravel mix.
    - Hard bottom.

Results
- Lobsters excavated low shelters to occupy them.
- Lobsters avoided low shelters on hard bottom.
- Smaller lobsters (50-59cm) had their burrowing limited by the larger gravel sizes (>1/2 inch).

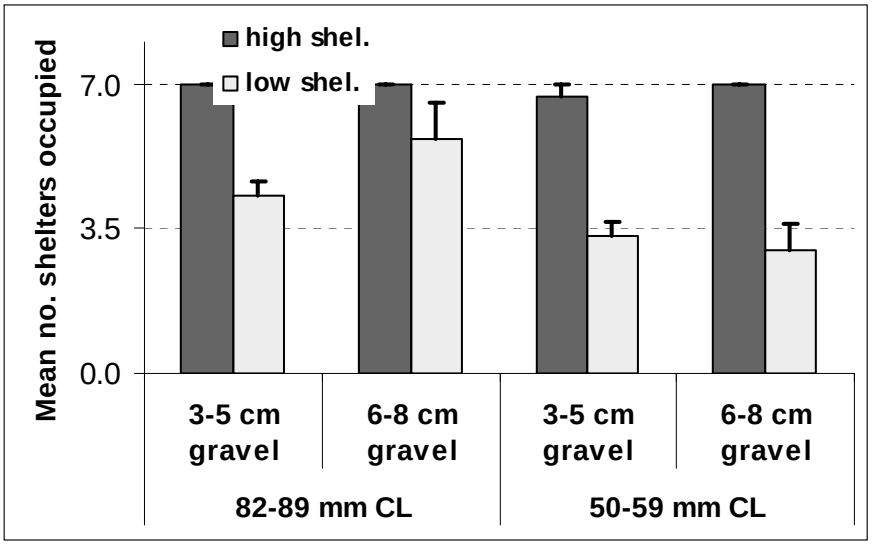

Figure 17. Relationship between mean number of shelters occupied by lobsters and substrate gravel type.

Phase I: Field Studies 2005
- There is a need for an intermediate step between laboratory experiments and full scale reef experiment.
    - We were working at a small scale relative to the real world.
    - We were controlling most of the variables.
    - We were using a high population to the habitat available.
    - We do not know all the logistics and costs of producing a full scale reef.

Questions Addressed
- Do rock piles attract lobsters?
    - What size and sex are the lobsters?
- What is the relationship between the diameter of the rock pile and its occupation rate?
- How do rocks compare to man made habitats with the same foot print on the bottom?
- How does the type of substrate the reef sets on affect the above results?

Experimental Design
The reality of logistics and site selection lead us to limit the experiment. Site location was problematic -- we needed a site that had an extensive area of bottom in the same depth range 9-10m with a relatively homogenous substrate lacking rock habitat. It was also desirable to have some evidence of nearby lobster populations, ideally juvenile.

After about 2 weeks of searching, we settled on a site to the south of the reef ball location on McNabs Island. Information from juvenile trapping suggested the population in the Eastern Passage area was near the abundance of areas close to southwestern Nova Scotia.
- Rock piles separated by 4m in 9-10m depth.
- 8 piles of rocks .5m diameter.

- 6 piles of rocks 1m diameter.
- 4 piles of rocks 1.5m diameter.
- rocks graded round 6 inches.

Observations
- Non destructive observations, divers, remote camera day/night one week, one month, two months:
    - Census of animals.
    - Evidence of burrowing behavior.
- Destructive sampling mid October:
    - Dismantle habitat.
    - Capture and measure animals.
    - Sample associated species.

Rock Pile Size: Lobster Occupancy
Looking only at the numbers of lobsters per rock pile, there was a 75% probability that large piles would have at least one lobster in residence. However, if you examine the data converted to numbers of lobsters to a unit of circumference or volume, small rock piles have equal or larger number per unit perimeter or volume. This is, of course, early in the game with only one census complete. The total numbers of lobsters in residence do not compare to the controlled lab experiments. However, the trend is similar so far on occupation.

Comeau Lobster Shelters
We had the opportunity to try artificial habitat solely designed to provide shelter for juvenile lobsters. We deployed 18 of these units at McNabs Island and 18 at Paddy's Head. At Paddy's Head, we placed them near the existing array of reef balls. At McNabs, we placed one transect at the end of the rock pile line and the other shallower in 8m of water near an eel grass habitat.

Comeau Census
Comeau shelters are easy to census because they can be bodily lifted up to examine the burrow. The bottom of these units allows a wedge shaped burrow at each end. However, to date we have found only one Comeau of 18 occupied at McNabs Island and none at Paddys Head.

Summary
In the rock piles, initial (i.e., after one week) occupants were the locally abundant rock crabs at 1.7 per rock pile with no lobsters. After 3 months, there were 2 rock crabs and 0.4 lobsters per rock pile. The density of lobsters in the study area increased from $0.006m^2$ to $0.05m^2$, which is one lobster for each ton of rock deployed. In the Comeau's structures, there was one lobster after 2 months and the same module was occupied at 3 months. Rock crab density at 3 months was 0.61 per module. Three fish were present in burrows: two blennys and one eel pout.

<u>Phase II: Full Scale Reef Development</u>
Final reef design and location will depend on results of Phase I. Its scale will involve at least 40 tons of habitat in an area of 1-2 hectares at two sites and replication of three reef units per site.

Questions
- What is the lobster occupation rate for this habitat?
- What are the origins of the lobster population on the reef?
- What is the probable life time of this reef?

- What is the community structure, succession and carrying capacity of this reef compared to control area?
- What are the final cost and benefits of developing this type of reef to the ecosystem and to the stakeholders?
- Is this type of artificial habitat development a valid approach to Habitat compensation for Fisheries and Oceans Management?

Preparation for Phase II (2006-2007)
- Multibeam survey of 2 potential sites for full scale reef.
- Discussions with stakeholders in the two areas.
- Analysis of sediments in the two sites.
- Physical oceanography of the two sites.
- Pre reef quantitative survey of control and reef sites, flora and fauna.
- Pre reef trapping study.
- Deployment of reef.

Monitoring
- Non destructive quantitative observations of biota control area and reef:
    - Species diversity and abundance.
    - Burrowing activity.
    - Day/night activity.
- Sediment transport and deposition:
    - Local effect of new habitat.
    - General sediment dynamics in the area.

Trapping/tagging
- Directed trapping with juvenile and adult traps in control and reef area.
- FRS monitoring of fishermen's catches in the area of control and reef area.
- Tagging of lobsters in adjacent lobster habitat:
    - Tag returns from fishermen.
    - U W observations for tagged animals.

A Multidisciplinary Team
- Lobster research scientists – J. Tremblay, R. Miller,
- Marine plant biologist – G. Sharp
- Dive master – R. Semple, divers, A.Reeves, S. Nolan, M. Cassista,
- lLbster technicians – R. Dugan, C. Frail,
- Sediment geologist – T. Milligan,
- Taxonomist – K. MacIssac,
- Benthic ecologist – H. Vandermuelen,
- Physical oceanographer – G. Bugden,
- Natural Resources Canada marine geologists and multibeam technicians, and
- Coast Guard, logistics and support, captain and crew – M.Rollilns, K. Fraser.

Final Comments

We have put about 150 hours of diving into the field component of this project. While it is possible to use remote sensing for some components of this study, in the end it is necessary to have diving as a direct observational tool. Hopefully when Bob and I move on from DFO there will be people with the interest and enthusiasm to continue using this methodology.

Discussion

Results from the evaluation of community development on reef balls in the Gulf Region were brought forward. These results were similar to what was observed in the Maritimes Region. A reference for these results will be available soon (PhD thesis). In this study, they followed a reef from year 1 to year 4. It was two years before kelp developed and lobsters weren't present within the artificial structure until year 3. The community at the end of study was quite different from nearshore natural reefs; however, there was a difference in depth. Up to 100-150 species of invertebrates were observed. Some surprise was expressed at the results presented for the Maritimes Region in which 50 species were observed on reef balls in the first year. The response was that these studies were conducted in the Halifax Harbour, which has a high nutrient load, and that intensive suction sampling was conducted.

Another example was brought forward where different kinds of rocks were dumped into the marine environment, which were subsequently occupied by many lobsters. However, it took a year and a half. In this study, they tried to create a link between two lobster habitats. No moulting was observed within the rock pile and no marine plants were present – nothing except worms. It was suggested that in terms of measuring success of these types of compensation projects, we need to know what the objectives are. For example, objectives of migration, predation and moulting are not objectives Habitat Management normally considers.

Glyn Sharp responded that he did think about tagging lobsters in waters adjacent to the Halifax Harbour compensation site to investigate potential effects on movement/migration. He noted that this project is still in the small-scale experimental stage. He also noted that they are also dealing with an environment that has few lobster already.

Another example of an artificial reef structure was brought forward (500 vs. 1200 logs). This is the first year of monitoring. Already, the occupancy rate is almost 80%. It was noted that the choice of substrate is very important to the success of these compensation projects.

A suggestion was made to investigate Scarratt's reef. The response was that it had been buried in sand and is gone. However, there are other historical projects that could be investigated further.

Department of Environmental Protection: State of Maine
Jessica Damon

Presentation

Under the Natural Resources Protection Act, protected resources include:
- rivers, streams and brooks,
- lakes (great ponds),
- freshwater wetlands,
- coastal wetlands,
- significant wildlife areas,
- fragile mountain areas, and
- sand dunes.

Under the Natural Resources Protection Act, activities that are regulated include:
- removing or displacing soil, vegetation or other materials,

- filling,
- draining or otherwise dewatering, and
- construction, repair or alteration of permanent structures.

"in, on, over, or adjacent to a protected natural resource."

Freshwater Wetlands
A *freshwater wetland* is an area with saturated soils, supporting wetland vegetation, and not considered part of any other water body. Note: NRPA recognizes the 1987 Corps of Engineers Wetlands Delineation Manual for delineating wetland boundaries.

A freshwater wetland must exhibit all 3 of the following characteristics to be considered a protected natural resource:

1. Has or show signs of wetland hydrology;
2. Contains a wetland plant community; and
3. Contains hydric soils.

Coastal wetlands are all tidal and subtidal lands, including:

- All areas below identifiable debris line left by tide;
- All areas with salt tolerant vegetation in primarily salt water or estuarine habitat;
- Any swamp, marsh, bog, beach, flat, or contiguous lowland subject to tidal action during maximum spring high tide as identified by NOAA; and
- Coastal sand dunes.

All coastal wetlands and ponds are considered of "special significance." Freshwater wetlands are of special significance if they include one or more of the following:

- Critically imperiled or imperiled community.
- Significant wildlife habitat.
- Location within 250 feet of a coastal wetland, or great pond.
- Contains at least 20,000 square feet of aquatic vegetation.
- Wetlands subject to flooding.
- Peatlands.
- Location within 25 feet of a river, stream or brook.

Before compensation, the Department of Environmental Protection reviews the application to ensure that the applicant does not have a practical alternative that will cause less impact to the environment and cannot minimize the impact to the natural resource in any way.

Wetland Compensation
Compensation is the off-setting of a lost wetland function with a function of equal or greater value. The goal of compensation is to achieve no net loss of wetland functions and values. Types of compensation include:

- Restoration,
- Enhancement,
- Preservation, and
- Creation.

Wetlands are considered *restored* if the applicant returns a damaged wetland as closely as possible to its original condition. Wetlands *enhancement* is any activity that increases the net value of a wetland, e.g., increase the size of the wetland to provide additional wildlife habitat.

Wetland *preservation* may involve deed restrictions on the title to prevent development in perpetuity or donation of an area to be protected to a local land trust or to a conservation organization. The Department of Environmental Protection must be listed as an enforcing agent. Wetland creation involves creating a new wetland area to compensate for the impacted wetland area. The functions of the impacted wetland must be replaced.

When is compensation required?
Compensation is required when the Department determines that a wetland alteration will cause a wetland function or functions to be lost or degraded.

Functions and Values of Wetlands:
- Groundwater recharge/discharge.
- Floodflow Alteration.
- Fish and Shellfish Habitat.
- Sediment/Toxicant/Pathogen Retention.
- Nutrient Removal. Retention and Transformation.
- Production Export.
- Shoreline Stabilization.
- Wildlife Habitat.
- Uniqueness/Heritage.
- Recreation.
- Education/Science.
- Visual Quality/Aesthetics.
- Endangered Species Habitat.

Coastal Wetland Assessment
Any project impacting coast wetlands must fill out an Appendix: MDEP Wetland Characterization: Intertidal and Shallow Subtidal Field Survey Checklist. If the project is impacting more that 500 sq. ft of coastal wetland, the applicant must also include a functional assessment performed by a professional wetland scientist. The Appendix includes information on:
- Habitat Types.
- Energy.
- Drainage.
- Slope.
- Shoreline Character.
- Marine Organisms.

Exceptions for freshwater wetlands
- Alterations of less than 500 square feet in a freshwater wetland of special significance
- Alterations of less than 20,000 square feet in a wetland not of special significance

Other Exceptions
- A coastal wetland alteration that doesn't fill more than 500 ft^2 of intertidal or subtidal area.
- Walkways and access structures.

Compensation Amounts
The amount of compensation required to replace lost functions depends on a number of factors including: the size of the alteration activity; the functions of the wetland to be altered; the type of

compensation to be used; and the characteristics of the compensation site. Compensation shall be performed to meet the following ratios at a minimum:

- 1:1 for restoration, enhancement or creation to compensate for impacts in wetlands NOT of special significance.
- 2:1 for restoration, enhancement or creation to compensate for impacts in wetlands of special significance.
- 8:1 for preservation, including adjacent upland areas, to compensate for impacts in all wetlands.

An applicant must meet the following Natural Resource Protection Act criteria:

- Expertise,
- Financial resources,
- Persistence.

Table 7 shows the amount of wetland compensation provided under each category type for the State of Maine from 2001 to 2005. Note the increased use of preservation in 2005.

Table 7. Amount of wetland compensation in Maine from 2001-2005 (in acres).

	2001	**2002**	**2003**	**2004**	**2005**	**Total**
Restored	9.21	12.02	6.21	3.68	5.72	36.84
Enhanced	35.44	2.31	13.77	4.75	5.8	62.07
Created	68.6	2.41	11.3	9.28	1.61	93.2
Preserved	280.37	207.3	259.36	120.11	1,116.95	1,984.09
Total	393.62	224.04	290.64	137.82	1,130.08	2,176.2

Table 8 shows the amount of coastal wetland impacted during the same period.

Table 8. Coastal wetland impacts from 2001-2005.

	Acres filled	**Acres altered**	**# projects**
2001	0.93	2.06	36
2002	16.44	76.23	31
2003	0.54	1.72	38
2004	0.48	1.36	27
2005	0.1	0.14	21

<u>Examples of compensation plans for projects impacting coastal wetland areas</u>

Merepoint Boat Ramp
Maine Deptartment of Inland Fisheries and Wildlife proposed to construct a public boat ramp and appurtenant facilities. Project included boat ramp and floats anchored with pilings. The project also included installation of 20 ft of gravel at the end of the boat ramp. Total = filling 11,493 sq. ft of coastal wetland and altering 13,633 sq. ft. of coastal wetland (through indirect impacts from boat traffic and shading of floats on the subtidal eel grass bed). Site is valuable because of a combination of mixed intertidal area that includes spartina marsh, mudflat, mixed cobble, ledge habitats and the subtidal mudflat and eelgrass bed.

Compensation Plan:

- Restore and enhance coastal salt marsh and mudflat habitats.
- Restore eelgrass habitat by implementing mooring replacements that minimizes impact.
- Restore eelgrass habitat by closing a boat ramp to propeller driven boats.

- Moved small population of ribbed mussels from salt marsh proposed to be filled.

Golden Anchor Dredge Project
Facility wanted to expand the marina by dredging additional areas and constructing a seasonal dock. A loss of the existing rock/cobble habitat will result in loss of functions and values, including attachment sites for marine algae and invertebrates, interstitial space between and underneath cobble and rock for juvenile lobsters and other invertebrates, and habitat that juvenile fish use to forage and escape predation. Eelgrass beds in the vicinity.

Compensation Plan
Applicant proposed to spread a rock/cobble/gravel material over a large restoration area and include some larger flat stones. Both the restoration site and adjacent eelgrass beds will be monitored.

Bass Harbor (in the works)
Proposed maintenance dredge project: 0.9 acre intertidal is proposed to be converted to subtidal. Intertidal area includes mudflats which support clams, worms, snails, and amphipods. Function – fish and shellfish habitat and wildlife habitat.

Compensation Plan
Preservation of Sawyer Island and parcel of land and associated intertidal areas – 7.2 acres total.

Mill Pond Lobster Pound
Project: development of a new lobster pound, including an earthen dam, impoundment area, dock and seasonal floats. This would results in conversion of mudflats and ledge outcropping to rocky intertidal and upland habitat. Lost functions include shoreline stabilization, fish and wildlife habitat and production export.

Compensation Plan
- Replacement of two 12 inch culverts that were blocking tidal flow.
- Enhancement of wetlands at a dump site by removing fill that is restricting the inlet to a cove, and removing solid waste debris.
- Monitoring program to evaluate the success of the restoration and enhancement plans.

Discussion

A suggestion was made that habitat restoration should take priority over habitat creation.

Surprise was expressed that the State of Maine was able to ban propeller-driven vessels based on the presence of eelgrass.

In the presentation, it was mentioned that the state had set compensation ratios, monitoring requirements and other types of minimum requirements. It was asked whether these requirements had ever been questioned by proponents. The response was that the requirements were treated as guidelines with some flexibility. For example, proponents may try to submit projects just under the 20,000m^2 limit; however, these projects may still be required to meet the requirements. Proponents don't typically question the decision.

It was asked what the requirements were for expertise in a wetlands biologist. The response was that there are no specific requirements but they do request a resume. In practicality,

anyone can do wetland delineation. The biologist must describe what projects they have worked on in the past. If the department is not satisfied with the proposed compensation plan, they will recommend something else.

It was asked whether compensation ratios were based on footprint, and whether there was any move toward a more ecosystem-based approach. The response was that Maine is still at the project-by-project stage. However, they are working on "in-lieu" fees for freshwater wetlands and intend to use this to preserve large areas rather than to preserve a small area with impacts all around it. Large-scale projects are preferred but more for freshwater.

An observation was made that the presentation talked about "functions and values." It was noted that Canada is now pursuing the delineation of Ecologically and Biologically Significant Areas that are more directly linked to fish habitat. It was asked what the process for evaluation of function and "like-for-like" is in Maine. The response was that they are more interested in maintaining ecosystem function and value. At present, the Department of Marine Resources consults and determines whether functions and values are met. An applicant may argue that they aren't eliminating functions, but they have to prove this. The department is not necessarily interested in creating like-for-like habitat.

Clarification was requested on the term "enforcing agent." The response was that the government has the responsibility for enforcement (fines) on lands that had been preserved as compensation.

Clarification was requested on the rationale for a 500 and 20,000m^2 minimum size requirement. The response was that the rationale wasn't clear and may have been somewhat arbitrary. These projects are considered to be small and it was decided not to expend effort on them.

Surprise was expressed at how close the Maine and Federal compensation programs were. The response was that everyone works together so that the process is streamlined. There can still be problems when there is a different ratio or when two agencies don't agree. In general, they go with whoever has the tightest regulations or requirements, which is good since the federal government is becoming less stringent. Typically, if a proponent meets Maine's guidelines, they will definitely meet federal guidelines.

A comment was made that it would be hard to make a minimum area requirement work in Canada, e.g., 500m^2, since a proponent will probably just submit projects of 499m^2 each year over a number of years. The response was that in Maine these minimum area requirements are only a guideline and the department still uses its discretion on a project-by-project basis. They still look at every project.

PLENARY DISCUSSION

How to Determine the Level of Compensation?

There was some discussion about outstanding issues related to determining the level of compensation required by a particular project. It was recognized that impacts to habitat can extend much beyond the footprint of the impacting activity, e.g., changes to the distribution of sand after building a wharf. However, efforts are being made by some (e.g., small-craft harbours) to reduce these impacts at the outset.

Suggestions included:

- Conduct a risk assessment to determine the sensitivity of various habitats.
- Develop a relative index for values, species, and functions and where they are.

Objectives of Compensation?

There was much discussion on what we are actually trying to achieve with compensation. A related question is, "how do we evaluate success of compensation"?

In the past we have designed compensation for commercial species, e.g., focus on designing lobster habitat. Does this reflect an objective of trying to increase lobster productivity? If not, we may end up somewhere we don't want to be. By doing lobster compensation, we may inadvertently get other benefits, like increase in biodiversity at reef-ball sites.

Another example of a focus on commercial species is in Baddeck Bay. This area was initially producing 400,000 pounds of oysters. Enhancement efforts have increased this production to 4 million pounds. Some felt that this was a desirable goal and that these methods should be applied elsewhere as a means of increasing productivity in a cost effective manner. Others suggested that possible ecosystem interactions of these activities needed to be taken into consideration.

It was suggested that we should be moving away from traditional compensation and enhancement of commercial species towards a more ecosystem-based approach, which would take into account things like community structure.

Are we trying to design the best natural habitat possible? DFO is certainly not trying to engineer pristine habitat. Everything that we create will have an impact or footprint, so we should ensure that the benefits of what we create outweigh any impacts.

Can we use complexity as a proxy for habitat creation? Our objective then would be to increase complexity and provide niches. Small changes in benthic habitat type can result in large 3D habitat changes due to changes in plant communities.

In the freshwater environment, we have a good understanding of what to protect, but in the marine environment we are trying to protect what we don't understand. For example we don't fully understand the key drivers of marine ecosystem structure and function. Perhaps migration is critical, in which case we should protect migration pathways.

Habitat Management reminded the group that their objective was "Habitat Management and Sustainable Development." Their intent was not to create pristine habitat but to enable sustainable development while maintaining habitat function. For example, breakwaters may be good habitat even though they are artificial. What is productive capacity and how do we compare these ecosystems? Not every habitat is comparable, and not every habitat requires the same level of protection.

It may be driven by what is practical and possible. Science needs to engage in a technical discussion of approaches that have been used, and their ability to achieve objectives under different conditions. Should also try new approaches and evaluate these as they emerge. Where do we direct our resources?

At What Scale Do We Tackle Marine Compensation?

The scope of the problem at hand was put back to Habitat Management: "at what scale does Habitat Management want to address the issue of marine compensation, e.g., at a project-scale, at a bay scale or at an ecosystem scale?" Habitat Management in the Maritimes Region responded by saying that the National Advisory Process on the Effects of Finfish Aquaculture demonstrated that Habitat Management was not ready to deal with issues from an ecosystem perspective. At present, Habitat Management is really only equipped to deal with site specific questions. However, the National Advisory Process on the Effects of Shellfish Aquaculture demonstrated that Habitat Management is prepared to start taking into consideration broader ecosystem concerns. They recognize that they will have to move towards a more Integrated Management approach. It was suggested that we should address the issue of marine compensation from an intermediate perspective, somewhere between the footprint scale and the ecosystem scale. The scale of the solution should be relative to the scale of the impact.

Timelines

Some concern was expressed about the timelines required to answer some of the questions that have been raised. If we ask questions that are too complex, we won't get a timely answer from Science and coastal development is occurring quickly along the Atlantic coast. In the past, fisheries have been initiated before we were ready to regulate them. It was suggested that the same thing might happen with habitat. It was also suggested that we are dealing with a moving baseline. What was pristine today may not be pristine tomorrow.

Thinking in New Ways about Compensation

There was some debate about how to move forward with marine compensation. Some felt that we should stick to methods that were tried and true (like freshwater projects and oyster enhancement). The intent here is to keep costs low and foster a high likelihood of success for each project. Others were interested in pursing new techniques that may require development in the short-term but could be more efficient in a technical and ecological sense in the long-term, e.g., highly engineered multi-trophic systems.

A number of other suggestions were offered, which included:

- Balancing of inputs vs. outputs – e.g., you could try to reduce wastewater input at some sewage outfall by the same level you expect to add nutrients at some aquaculture facility. Should take into account principles of full-cost accounting.
- Education as compensation – education was included as one component of a compensation program, but would not be considered as a substitute for compensation. For example, in Shippigan there was recognition by the proponent that they were having an impact. Fishermen started to ask questions, such as "what is in dredge spoils and where is it going to go." Education was thus included as a large component of the compensation program. Money went towards education and compensation. However, it would require a shift in policy to contribute money towards research.
- "In-lieu" compensation – e.g., give money to those who know how to compensate.
- Preservation of habitat instead of habitat creation (preferably preservation of habitat that is in imminent threat of destruction).

Outstanding Policy Questions

It was suggested that we still haven't figured out the management questions related to marine compensation. For example, are we going to continue to follow the existing hierarchy of preferences? Are we going to change policy? Once we figure this out, then we can go to Science with specific questions. There is a lot of planning and education that needs to be done. However, it was noted that policy questions have come up in the past, and the policy has proven to be flexible in application. Habitat Management practitioners should be encouraged to try new things.

Links to Other Activities

It was suggested that while other DFO initiatives such as the development of Ecosystem Overview and Assessment Reports and identification of Ecologically and Biologically Significant Areas will continue, and we need to be aware of these activities, we don't need to deal with them directly at this point. In the future, we will want to ensure that the Oceans and Habitat approaches are consistent and complementary.

Monitoring and Evaluation

There seems to be a need for improved monitoring and evaluation of marine compensation programs. It was felt that we need to do additional work to evaluate techniques for marine compensation and designs for monitoring of evaluation of effectiveness. It was suggested that it is up to the Regions to evaluate how well we've done so far.

It was suggested that a first step towards improving the monitoring and evaluation of compensation programs would be to clearly identify the location of these programs.

A representative from DFO National Headquarters noted that efforts are currently being made to enhance a national monitoring program. Ottawa wants to target more resources towards compliance and effectiveness monitoring. There is also interest in monitoring of ecosystem health, i.e., quantity and quality of fish habitat. Science may be expected to take the lead on this.

Some concern was expressed as to the Science capacity to undertake such monitoring.

A question was raised as to whether it would be useful to conduct an environment scan of how well we are doing with fish habitat. The Maritimes Region is not far from being able to describe bay-scale habitat as a course scale, e.g., by sediment type and possibly depth/complexity. We are a long way from being able to describe marine habitat at any finer resolution. While course scale descriptions of habitat won't help us to understand absolute trends and levels of impact completely, we may be able to use proxies to track relative trends.

Summary of Day One

A summary of Day One is provided in Appendix 4. This summary was provided to the group at the start of Day Two.

BREAKOUT GROUPS

Instructions

Three breakout groups were established on Day Two of the workshop and instructions, including a list of relevant questions and topics for discussion, were provided:

Group 1 - Pre-Compensation

Marine Habitat Delineation
- Do we have good descriptions/characterization of marine habitat?
- Do we distinguish between critical and non-critical habitat?
- Do we have an understanding of habitat values and functions?
- Do we need maps?

Determining Need for Compensation
- Use of risk management framework?
- Minimum area requirements?

Determining Compensation Requirements
- Hierarchy of preferences in marine environment?
    - Limiting factors.
    - Issues within "ecological unit".
    - Preservation, restoration, creation, etc.
- Compensation ratios?

Group 2 – Compensation Design

Site Selection
- Hierarchy of preferences?

Compensation Methodologies
- What techniques are we using?
- How effective are they?

Compensation Objectives
- Is DFO achieving its objectives?
- What are these objectives?
    - Enhanced productivity?
    - Enhancement of commercial vs. non-commercial species?
    - Biodiversity conservation?

Issues of Scale

Group 3 - Post-Compensation and Evaluation

Measures of Success
- How do you measure success? Thresholds and indicators (do we have enough to define them?), criteria and rationale?

- Timeframe for evaluation of effectiveness?
- Techniques to use?
- Links to objective – What are we trying to measure? Present options.

Monitoring
- How do you distinguish between natural variation and artificial enhancement?
- Do we have capacity to do baseline monitoring of fish habitat quality and quantity?

Habitat Protection
- Do we allow fishing on these habitat compensation projects?

Reporting

Presentations

Group 1: Pre-Compensation
Roland Cormier (Chair), Linda MacLean (Rapporteur)

A) Marine Habitat Delineation
The current state of knowledge in coastal areas is or will be contained within Ecosystem Overview and Assessment Reports. These are an Oceans Management product, but they can be also used by other sectors, such as Habitat Management, for assessment purposes. However, information contained within EOARs may not be detailed enough for Habitat Management purposes. Information, including Ecologically and Biologically Significant Areas, should also be put into a GIS database for sharing among sectors within DFO. The criteria used for evaluating EBSA may be a useful tool for Habitat Management in assessment. The Canadian Hydrographic Service (CHS) has Traditional Ecological Knowledge (TEK) on areas that has been gathered from fishermen and others. This information could also be added to a GIS database. A habitat suitability index and associated characteristics needs to be developed and then mapped. This index could be based upon bottom type, functionality (e.g., nursery areas) and other baseline information. The potential to make use of seabed mapping in the future was identified. A GIS database should also include compensation sites on an ongoing basis. Cumulative effects need to be considered.

In freshwater, habitat compensation has been prioritized: provision of passage to conduct/complete stages of life-cycle, sedimentation issues, and flow issues. There is a need to identify primary focus points for marine areas, i.e., what is most important such as eel grass, nursery areas, and salt marshes. For marine areas, perhaps priorities include larger issues of water quality (e.g., nutrient enrichment). Can Science help to determine or rationalize priority marine areas?

B) Determining the Need for Compensation
What are the important criteria, thresholds and indicators for the marine environment? Species at Risk activities include development of status reports, recovery plans, and identification/protection of critical habitat. These existing Science approaches could be used by Habitat assessors. Science can help to evaluate the risk management framework. Criteria are built into the framework, but have these criteria been tested? There is a need to focus on ecosystems rather than species specific compensation packages. However, if a fishery is displaced, there is a need to replace that fishery area somewhere else.

C) Questions for Science
Can Science provide a rationale and/or criteria to assess habitat based on type and function (physical and biological)? It is recognized that habitat value will also depend on location. Can a hierarchy of criteria/functions be identified within the marine environment?

Are there existing tools, indices or synthesis of knowledge/information on coastal systems that Science can convert into a framework for Habitat Management?

Can Science provide a decision support tool for Habitat Management related to marine habitat compensation (e.g., risk characterization)?

Can Science prioritize locally and regionally significant habitats so that Habitat Management can fix problems (degraded areas) and have an identified list of what needs to be protected (EBSA)?

D) Other Issues
There is a need for cross-sectoral review of DFO's capacity for integrated GIS and information management. The proponent has information on species and fisheries present within their area of interest. This information is typically provided within their Environmental Impact Statement and should be added to a GIS map layer.

Group 2: Compensation
Ross Alexander (Chair), and Melanie MacLean (Rapporteur)

Hierarchy of Preferences; Selection of the Appropriate Compensation Option
The decision on whether or not to use the hierarchy of preferences for compensation of a HADD is a Habitat Management decision and is policy rather than regulation. In general, the use of the hierarchy of preferences was concluded not to always be the best way to select a suitable compensation mechanism. For example, "like for like" which is most often used now is not always the best option. If the work is in a low productivity offshore area, it may be more useful to carry out the compensation project in a more productive nearshore environment (in the particular case that was mentioned, fish biomass from trawler surveys was used to estimate productivity). If the work is being conducted in a heavily impacted marine harbour, it may be more beneficial to move the compensation project to a more pristine area since like for like compensation would not be representative of the original productive capacity. Sometimes, a compensation project undertaken in an area different from where the work was conducted can prove to be more effective in achieving the no net loss objective (e.g., salt marsh restoration).

Some participants would prefer that the first compensation option be "restoration\re-establishment of a process" rather than "like for like". It was also mentioned here and at other times during the meeting that protection needs to be emphasised over compensation. The hierarchy should be based on "ecological process". It was noted that there is flexibility in applying the hierarchy of preferences as it has been applied in freshwater and wetland environments. There needs to be even more flexibility in the marine environment. Good compensation options could include such things as removal of a causeway or dealing with acid generation. Looking at "ecological process" may justify moving compensation from offshore to inshore sites.

Dealing with inputs into the marine environment which result in the degradation of fish habitat, such as improving the treatment of sewage, was discussed as a compensation option. To date, there doesn't seem to be any support for proceeding in this direction. Part of the reluctance to proceed in that direction is related to governance complications since sewage treatment and

discharge of deleterious substances tends to fall under Section 36 of the fisheries act where responsibility has been delegated to Environment Canada. There were discussions about whether or not it was appropriate to fix “other people’s problems” using fish habitat compensation projects. Nevertheless this can be done in “orphaned” sites and the focus should be the benefits to fish habitat that are achieved by carrying out the compensation project, not necessarily who owns the problem.

Work in the marine environment can impact on diadromous fish species. Therefore, it would be appropriate to look at fish passage issues in search of a compensation project.

Participants felt that it is important to look at the watershed or some ecological area rather than to focus only on the species being affected. When assessing on a watershed basis, the social units (e.g., fishermen) should be taken into consideration in the review. Even if targeting one species for compensation projects, there are usually benefits for many species.

One should compare compensation projects on an economic basis (e.g., assess the value of opening up a barrier beach) to ensure that it is realistic.

How to Determine the Level of Compensation?
The area ratio approach has often been used in determining compensation requirements for freshwater environments. It may not be the best way to determine the level of compensation required in the marine environment.

Biomass could be used to determine the level of compensation. There are many ways to measure biomass (e.g., rates). One could look at multi-species, sensitive habitat, process versus habitat, and\or multi life stages. However, this can easily become too complex for normal application.

Gulf Region has developed something called a severity potential which looks at the following in order to assess the impact of a work or undertaking and select the best compensation option:

1) What is being impacted (e.g., all biological processes)?
2) What is the ecological footprint of the impact (e.g., impacts all species and all life stages)?
3) How long does it take to have a response from the impact (e.g., immediate or delayed)?
4) What is the longevity or duration of the impact (e.g., forever)?
5) What is the certainty or probability that it will happen which includes looking at how much we know about what we are doing (e.g., 100% certainty which may seldom be achieved)?

It is important that the compensation project take into account the length of time the work or undertaking will impact on fish and fish habitat and whether all or only some of the productivity in the impacted areas is lost over what time.

Pooling of Resources
Small Craft Harbours has pooled the compensation resources associated with several relatively small authorizations into one compensation project for a larger area thus making substantial savings on the process. This may be an option for other proponents.

Monitoring
It is important when conducting compensation projects, to determine that there is actually a positive effect (e.g., removal of barrier beaches). In general, monitoring work which is a requirement on compensation projects has been weak, sometimes due to lack of compliance or due to poor design and lack of scientific input.

Participants suggested that Science could look at ongoing compensation projects to evaluate monitoring programs. Science could review the literature including the grey literature to look at monitoring that has been undertaken in the past and develop a monitoring framework.

Compensation Incorporated into the Design of the Work
Compensation can be incorporated into the physical work by taking fish habitat into consideration, when designing the structure (e.g., changing the slope of a breakwater to maximize its use by lobsters). Science may be able to provide advice to incorporate habitat creation or improvement in the design of structures.

What Needs to be Compensated For in Relation to the Work?
The question of whether or not compensation should be required only in relation to the in-water footprint of the structure was discussed. There are frequently impacts outside the footprint of the structure. It appears that these may not be taken into consideration when deciding upon compensation requirements. Some of these impacts may be short term or long term and some may be minor by themselves but cumulative.

Compensation Techniques
We need new techniques to use for compensation projects. The research work being done on artificial reefs is assessing the “like for like” hierarchy of preferences option. Despite the amount of work done to date on artificial reefs it has not been thoroughly reviewed and in later discussion the term “Reef RAP” was coined as a potential Science requirement.

Investigating the design of breakwaters to maximize habitat creation would be useful. The work being done on artificial reefs may assist with determining improved designs for breakwaters.

Participants felt that there are categories of compensation projects that are being overlooked. It would be useful to have a list of options. Science could also identify information gaps. Some of the compensation options include barrier removal, reducing inputs from nutrients, creating habitat (e.g., reefballs, placement of clam shells, gravelling of beaches), restocking, cleaning up of degraded sites (e.g., old mill sites) and aeration of waterbodies. There are several main categories of compensation projects (e.g., restoration, remediation, fish passage, artificial reefs, and project redesign although that is normally applied to the extent possible in order to avoid a HADD and the need for compensation but there may still be some residual impacts).

The group discussed whether or not education and outreach could be considered as a compensation option. In general, this is not considered for compensation projects. This is more closely aligned with the Oceans Sector mandate, possibly as part of a watershed plan but the two could come closer together in the application of integrated management. If education is being considered, who should be targeted (e.g., proponent, workers, community)?

Could compensation monies be used for research projects? Overall the discussion here and elsewhere in the meeting seemed to be no but research projects could be tied opportunistically to some compensation projects. It was also noted that research should not be a burden imposed on proponents.

In simple terms what about a dummies guide to compensation in the marine environment? Since Science capacity is limited by resource issues, staff strength and interests of individual scientists DFO needs to focus research on specific compensation techniques. There is a huge amount of effort required for Science projects and they are seldom achieved in short terms. Science does not support the "quick and dirty" approach. Answers are usually obtained through a variety of research projects but it was also noted that as complexity increases and high tech approaches are applied costs escalate.

A tool box for assessors would be useful.

Participants noted that there is quite a bit of information already available from compensation projects undertaken in the past (e.g., lobster habitat creation in Belledune and elsewhere). The measure of success is often fishing effort but this may not be a good measure. Perhaps there should be a better tie in between Science and ongoing compensation projects. (See the comment above regarding the suggestion for Science to hold a "REEF RAP").

The cost effectiveness of the compensation project should be a consideration. This is especially important to the proponent and increasingly proponents are exchanging information on relative costs and discrepancies in requirements.

Habitat management personnel expressed a need for Science to look at broad categories of compensation projects, give examples where the technique is being applied, and describe how effective they are. There is a need for improved design of monitoring to be able to determine the effectiveness of the compensation technique. Science can provide advice on assumptions made by Habitat Management.

Science has tools such as models that could assist Habitat Management in making decisions, evaluating effectiveness of compensation projects, etc. For example, hydrodynamic models have been used in relation to tidal barriers. Models can be more effective than small studies.

Habitat Banks

Habitat banks can be useful but are only appropriate in certain circumstances (e.g., used within a restricted geographical area: used by repeat proponents such as departments of transportation, Small Craft Harbours and in some cases industrial proponents). In the Maritimes Region, habitat compensation practitioners are reducing their geographical restrictions on the use of habitat banks and have included transference across the province although this often leads to the question of "how does this benefit or compensate me" and requires public education. The question came up on whether a habitat bank could be sold but was not discussed at length.

Participants felt strongly that there is a need for a guidance document on habitat banking. The rules are not clear and guidance from various levels has not been consistent. The information that presently exists is being interpreted differently by different regions.

Two examples of habitat banks were discussed. The first was Cheviot Creek. The proponents are Small Craft Harbours and the Nova Scotia Department of Transportation. The second was the Brunway Highway Development. The proponent is the New Brunswick Department of Transportation.

Information Needed to Assess Compensation Plans

Examples of required information include:
- Distribution and abundance of species,
- Growth (e.g., clams),
- Reproduction,
- Species diversity, and
- Seasonal component (e.g., areas used for spawning at certain times of the year).

The pattern based approach, with underlying ground-truthing, was mentioned. This involves assessing compensation based on patterns and relationships. Studies would show that "this approach" would result in "these effects". An example is a breakwater. If vegetative material is established, some species will move in to that area or colonize it. Higher level carnivores may move in depending on the quality of the environment. We don't need to know everything but just have a general idea on how to proceed. Are we going in the right direction?

Participants felt that Science should receive formal requests when Habitat Management wants them to get involved. Habitat Management must take work planning and the capacity of Science into account when requesting their involvement.

It would be useful to choose a range of projects and do a thorough evaluation on categories rather than evaluate many projects in a cursory manner (i.e., not quick and dirty). In regards to compensation projects, DFO must make a clear separation between Science research and the proponent's legal responsibilities. This again relates to the previous comment with regard to not imposing scientific studies as a burden on proponents.

Regional Advisory Process (RAP)
Participants felt that there should be a RAP for each category of habitat restoration, creation, etc. In relation to compensation projects, costs versus benefits should be taken into consideration. How do we evaluate cost?

Can DFO look at new ways of doing things? For example, would it be useful to blast existing rock rather than dump rock when creating artificial reefs? This gets into a very sensitive area since the Gulf Region has one example of a proponent blasting rock in his development and subsequently charged and fined for causing a HADD that was not approved under Section 35(2). Nevertheless, many development projects may result in some level of compensation either by chance or design.

Despite a previously expressed suggestion that we concentrate on the Canadian experience participants felt that there is a lot of experience in other countries that might be worth investigating. For example, Japan has altered much of their coastline (e.g., re-establish wave breaks) and should have excellent examples of compensation.

Group 3: Evaluation and Monitoring
Tana Worcester (Chair and Rapporteur)

There was some initial discussion of people's experiences with marine habitat compensation and monitoring.

Potential monitoring indicators could include: macro fauna community development or recruitment. Where there is a decline in recruitment, there may need to be follow-up monitoring. For reef structures, proponents may not be counting lobster but they do tend to provide a video.

It would be useful to know how much it might cost to monitor each indicator that is developed. It was suggested that DFO may choose not to require monitoring of proven measures.

Concern was expressed about how to monitor when there are so many uncertainties. The importance of site selection was identified. It was felt that there have not been enough marine compensation projects to do a proper evaluation or comparison.

What is the minimum number of years needed for monitoring to determine success? It was felt that proponents should only be asked to monitor for 2-3 years. Long-term monitoring should be conducted by DFO Science or Habitat Management (10 years).

Which technique is the best in a given environment? Standardized protocols could be developed for each restoration method. Guidelines for video monitoring, including updates and links to GIS, would also be helpful.

Monitoring design should be based upon the area of impact and the significance or function of the habitat.

Need to improve design of baseline monitoring, e.g., use of reference sites, control sites, duration and frequency, sample size. Proponent should be expected to come up with a preliminary design for review.

How do we measure No Net Loss?

What are the resources required to do effective monitoring?

Evaluation
It was suggested that DFO should be using a consistent approach to monitoring so that we can compare across projects. However, it was noted that monitoring is not required in all cases. How do we evaluate sites that don't require monitoring? Use of an adaptive management approach was encouraged.

Reporting
Need to report on results.

Cumulative Effects
Habitat banking might be an option for the North where it is difficult to do compensation given the remote location of many sites. Habitat banking would allow you to save up "credits" until you had enough to put together a large, comprehensive mitigation site.

Monitoring Techniques
What techniques are being used? Suggestion of a literature review by Science to address questions such as:

- What are we using?
- What else is possible?
- What is missing?

Habitat Management should provide a list of compensation measures that have been applied.

Need a habitat classification system for the nearshore environment based on sediment parameters and indicator species, e.g., soft-bottom, eelgrass habitat versus soft-bottom, clam habitat versus hard-bottom, lobster habitat. Also need to characterize pelagic habitat, such as migration routes. It would be useful to have a database of ecological information.

DFO should try to link the pathways of effects to monitoring requirements, if possible.

A suggestion was made to develop a hierarchy of monitoring preferences (Figure 18), from least complex to most complex (including costs associated with each option). Science would describe options and Habitat Management could select their preference based on a number of parameters. This hierarchy could then be related to Habitat Management's risk matrix. There should be some minimum requirements, though. This was thought to be similar to advice provided on impacts of shellfish aquaculture.

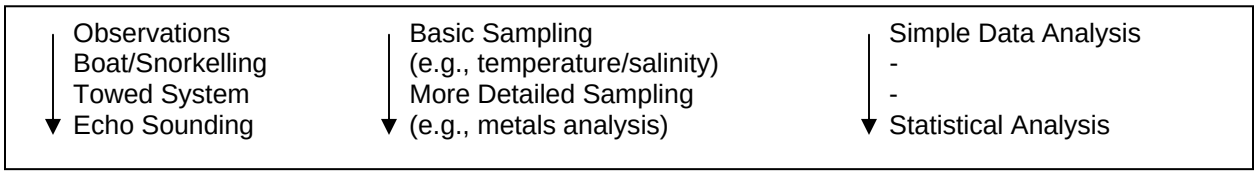

Figure 18. Example of a monitoring hierarchy from least to most complex.

Protocols/Guidelines
Scale: Should be developed zonally with national consistency. However, don't want to slow development of guidelines down and also want to allow for regional differences.
Scope: Should include guidelines for use of video monitoring, sampling, population analysis, and other types of analysis.
Process: NAP to develop draft guidelines and a working group to finalize, test and evaluate these guidelines.

Communication
Need to figure out a better way to maintain communication between meetings, either using shared folders, the internet, EKME (not available in the North).

Indicators of No Net Loss
Should be tied to the monitoring technique you are using.
Need to define objectives for comparison, such as similarity of parameters to natural environment.

May want to establish site specific limits, reference points or trends.

Timelines
There are difference types of monitoring. Compliance monitoring should be done in the first 2-3 years. Effectiveness monitoring should be done over 5-10 years. DFO has greater potential for continuity than proponents, but even DFO may suffer from loss of continuity of staff. Audits should be conduct with less frequency. This is definitely a DFO function, but should use the same techniques that the proponent has been using. Habitat Management may need to develop greater capacity to do audits.

Constraints
Proponents and DFO both have financial constraints. Proponents may not have expertise. However, if standardized protocols are developed, people will develop the expertise required more readily. Simple, cost effective methods are best. DFO could purchase expensive equipment and lend this to proponents as required.

Toolbox
Should develop a toolbox of 2-3 monitoring techniques (by habitat type, activity type and by size). Could incorporate these into a registry of techniques.

Compensation
Need to establish compensation and monitoring requirements *prior* to authorization.
It was suggested that DFO should explore alternatives to compensation, such as buying up of fishing licences, creation of MPAs, or fisheries closures. However, this would run contrary to DFO's other mandate of sustainable fisheries. DFO's intent should be to protect habitat while allowing for sustainable harvest to continue. However, it was felt that stronger links could be made between Fisheries Management and Habitat Management.

A summary of each break out group discussion was presented to all followed by a discussion in Plenary.

Plenary Discussion

Identifying Priority Areas for Restoration
It was suggested that the criteria for restoration should be: functions, habitat, and then species (in that order). Another suggestion was that criteria should take into account the ecological unit (scale). It was suggested that there is no need to map everything (i.e., all habitat types), but it may be useful to map priority areas for restoration.

Habitat Characterization
Some felt that a coordinated Science approach to habitat classification is needed and a recommendation was made to develop a National Benthic Ecosystem Project. Use of predictive modelling was supported; however, it was recognized that methods need to be developed and applied in the coastal environment. Modelling results may still not be at the resolution needed by Habitat Management.

Lobster Compensation
It was suggested that lobster compensation projects may be quite useful from an ecosystem perspective since they require complex habitat and they are relatively easy to monitor. However, evaluation is critical. Lobster was felt to be a good indicator of ecosystem health. It would be useful to know under what conditions artificial lobster reefs would increase productive capacity. In fact, it would be useful to know this for all kinds of compensation techniques. It was noted that lobster fishermen were likely to be supportive of lobster compensation projects for fishing purposes but that Habitat Management might have other objectives.

Literature Review
The need for a literature review was discussed further. It was generally agreed that a literature review of international experience would be useful, and it was suggested that a request for proposals to conduct such a literature review be developed.

Learning from Past Experience
It was recognized that there are some things that scientists have learned from their regional experiences. For example, scientists have learned that in order to be successful with compensation projects, there is a need for good baseline information, good protocols and clearly defined criteria for success.

New Science
It was suggested that new science was required in addition to a literature review. For example, Habitat Management might be interested to know if there were other ways of looking at or portraying existing information, and that this type of advice wouldn't be found in the literature. It was suggested that a current project requiring HADD authorization could be used as a demonstration project.

The need for a better understanding of the costs of benefits related to tidal excursion and barriers was identified. It was suggested that, with funding, Science could answer this question and some of the other questions that have been identified; however, the Science basis for these topics was not sufficiently developed to invite a RAP.

Role of Science
It was generally agreed that Science should play a role in developing compensation methodologies and designing/conducting monitoring. Another important role for Science is in the synthesis and translation of information into something useful for management. There are good examples of this in the freshwater environment.

Capacity
Scientists stressed the importance of maintaining DFO's capacity to conduct field research. It will also be important to examine the Science capacity to provide advice; otherwise, this will just be a paper exercise with no results. Provision of Science advice on marine compensation will require effort by people who are interested and willing to do this work. Provision of advice on this topic may come about as a "spin off" of things that Science is more directly involved in.

National Involvement
It was generally agreed that the issue of marine compensation was National in scope, i.e., all regions have similar problems. It was suggested that DFO needs a broad suite of tools that can be tested for different regions. When someone asked whether Ottawa would be funding some of these initiatives, the response was that there was no reason why they should not. It was suggested that the group bring to Ottawa's attention the fact that every region has been doing things outside the current habitat framework. Re-writing of the habitat guidelines would likely be a National Habitat Management initiative; however, Science would also likely be involved. Regional pressure for this initiative would help.

Communication
It was suggested that Habitat Management practitioners should meet more regularly to discuss common issues and to share information, perhaps through the establishment of a zonal working group. This would require buy-in from senior levels of DFO. Better linkages between Habitat Management, Oceans Management and Science activities were also recommended.

Regional Reporting
It was recommended that one of the key deliverables of a monitoring framework would be regional reporting. However, even with regional reporting, DFO may not know when it has

achieved “No Net Loss.” It was suggested that there were minimum compensation requirements that could be developed, which would still allow for scaling to the size of a project.

Program Assessment
It was recommended that Habitat Management should continue to audit its compensation program to determine how effective they have been. This may consist of a field audit or a paper audit.

Potential RAP Topics

Review of Regional Experience with Artificial Reefs
Science proposed a RAP this fiscal year (March 2007) to review existing projects related to the creation and monitoring of artificial reeds and to develop recommendations on these techniques. It was recognized that the Gulf Region has done a lot of work on this topic (Michel Comeau et al.). The work that the Maritimes Region (Glyn Sharp et al.) has done to date was also considered to be relevant, and preliminary information would be available for review at the end of this fiscal year. Other studies of relevance include: Penny Barnes’ work on oyster reefs on the Pacific Coast and Chris McKinsey’s work on biodiversity production at mussel farms.

It was asked whether the socio-economic aspects of compensation would be considered at a RAP. The response was that only Science issues would be addressed within the Science Advisory Process; however, there is no reason why a management workshop could not be held the next day.

If was noted that even a RAP on existing projects would take time. There was some concern about whether this should be done before or after Habitat Management discusses incorporation of an ecosystem-based approach and new options for compensation.

Characterization of Coastal Habitat
Another potential topic for a RAP is the characterization of coastal systems. While specific regional research on this topic may not be available, it may be possible to develop advice based on the experience of the Science community. This RAP might discuss what is currently known about coastal habitats to assign functions and values. Some participants had been involved in previous descriptions and characterizations of non-reef habitats.

Ecosystem-Based Approaches to Compensation
It was suggested that DFO could do a NAP on novel projects, such as examples of an ecosystem-based approach to compensation. This would require funding to conduct a new project and then to monitor it. It was recognized that this might be a project to be tackled in a few years.

Timing and Resources
It was suggested that before work planning on this issue commences, there needs to be a commitment for funding and staff time. It was also suggested that this year might be a planning year with a target of next fiscal year to start doing the work. There was some recognition of the relatively slow pace of Science and a recommendation was made that DFO not move on to something else before existing projects have been evaluated.

NEXT STEPS

Proceedings will be circulated to the participant list for comment. Additional items to be included in the proceedings:

- Reference for the eelgrass CD has been recorded.
- Maritimes, Quebec, and NFLD to provide summaries of compensation projects.

The RAP Office will meet with Gulf and Maritimes Habitat Management to develop a remit for a RAP meeting to be held in 2007. A working group will then be struck to develop the workplan for this meeting.

Participants are encouraged to take the discussion of this meeting into consideration in their own work planning and day-to-day activities.

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Appendix 1: Remit

Workshop on Marine Habitat Assessment and Compensation
February or March 2006
Gulf Fisheries Centre, NB

Background

DFO Habitat Management reviews project proposals under the habitat provisions of the *Fisheries Act.* If DFO authorizes a harmful alteration, disruption or destruction of fish habitat (HADD) under Section 35(2) of the *Fisheries Act,* then compensation is required in order to achieve no net loss (NNL) of productive capacity. Compensation is defined in the Habitat Policy as:

> "The replacement of natural habitat, increase in the productivity of existing habitat, or maintenance of fish production by artificial means in circumstances dictated by social and economic conditions, where mitigation techniques and other measures are not adequate to maintain habitats for Canada's fisheries resources."

Habitat's first preference in the review of any referral is to avoid a HADD of fish habitat through relocation, redesign and mitigation. As a consequence, the number of referrals likely to result in a HADD requiring compensation is small (approximately 10%). The decision to authorize a HADD is at the discretion of Habitat, and is based on the acceptability of the HADD. The use of compensation to achieve NNL is only considered after it proves impossible or impractical to avoid a HADD of fish habitat through project relocation, redesign, or mitigation. Cash in lieu of compensation is not acceptable - habitat compensation does not include financial means for compensating economic losses but deals only with actions intended to maintain the net production potential of fish habitat. DFO has the discretion to not authorize a HADD where adverse impacts to fish habitat are deemed unacceptable. However, what defines compensation for a given HADD appears to vary among assessors. This might partly be due to perceptions on the relative effectiveness of different compensation methods and/or scientific knowledge on these methods.

Objectives

The overall objective is to develop guidelines on application of compensation measures for habitat creation, enhancement and restoration to address Hades. This will be achieved through a multi-phase process. Phase I will be a review of current compensation methods, both here and elsewhere with the aim being to develop consensus on the issues requiring resolution and a workplan to address these. Phase II will consist of one or a series of RAP meetings to review a decision support tool to help guide habitat assessors on compensation decisions. The geographic scope of the review will be Maritimes and Gulf regions.

Phase I (this meeting) will address the following:

Objective 1. Review of compensation methods that have been used elsewhere in the world

Objective 2. Review of compensation methods currently used in the regions and evaluation of their effectiveness

Objective 3. Development of work plan to address specific management questions

Products
Proceedings of workshop

Appendix 2: Participant List

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Appendix 3: Agenda

Workshop on Nearshore Marine Habitat Assessment and Compensation
March 21–22, 2006
Gulf Fisheries Centre
Moncton, New Brunswick

Tuesday, March 21

10:00 Welcome and Introductions

10:05 Co-Chairs' Review of Remit and Outline of Workshop Purpose and Process – Ross Alexander (DFO Gulf) and Tana Worcester (DFO Maritimes)

10:20 Presentations of current regional processes with project examples – Roland Cormier (DFO Gulf) and Paul Boudreau (DFO Maritimes)

- number of HADD authorizations issued per year
- number of marine HADD authorizations per year
- decision process for HADD authorization
- description of selected or all marine projects requiring HADD approval
- description of compensation requested and case histories
- assessment examples for compensation – what works and what does not

11:30 Content outline for a contract paper on international/north temperate waters experience and summary of concerns e.g., eelgrass compensation – Herb Vandermeulen (DFO Maritimes)

12:00 Lunch (hospitality not provided)

1:00 Related DFO National Initiatives and Tools (e.g., risk assessment, decision support) – Tana Worcester (DFO Maritimes)

1:20 Viewing Marine Compensation Issues with Integrated Ecological Approaches – Shawn Robinson and Peter Lawton (DFO St. Andrew Biological Station)

1:40 Reef Balls and Rock Piles: Progress toward Artificial Reef Design – Glyn Sharp (speaker), Robert Miller, John Tremblay, Ellen O'Brien, Robert Semple, BIO

2:00 US Habitat Compensation and Restoration – Jessica Damon (Maine Department of Environmental Protection, Bangor, Maine)

2:45 Break (hospitality not provided)

3:05 Plenary Discussion

5:00 Wrap up

Dinner (hospitality not provided)

Wednesday, March 22

9:00 Summary of Day 1 and Identification of Questions for Breakout Group Discussions (Co-Chairs)

9:15 Breakout groups – Moving toward future compensation advice and future RAP workshop(s)

12:00 Lunch (hospitality not provided)

12:45 Plenary – Discuss research recommendations and workplan development

3:00 Adjourn

{The meeting will be conducted in English}

Appendix 4: Summary of Day One

Presentation 1 – Regional Experience

Started off with regional HM presentations that set policy context, described possible scope of problem, and gave examples of regional compensation projects, successful and unsuccessful. Introduced concept of "Ecological Unit" for assessment.

Discussion

Context – Good understanding of freshwater environment, not so good for marine. Recognition that these questions are part of broader DFO discussion of IM, EBM, etc. – as well as recognition that in order to be effective, need to focus questions for Science. This is first opportunity for folks to talk about this issue – of course there will be outstanding policy and management questions. Remember that we're not here to set or change policy but people are encouraged to take what they can from this discussion. Reflection on national and regional trends -- changing environment.

Scope – still need definition of "nearshore", activities (are Pathways of Effects flowcharts useful?), consideration of temporary vs. permanent HADD, etc.

Science Questions:

- What is the extent of impact from nearshore activities on productive capacity? E.g. do small scale projects really influence productive capacity?
- What are the options available for compensation?
- What are uncertainties/limitations associated with these options?
- How to design effective monitoring programs?
- How would you evaluate effectiveness in marine environment ? (need objectives)

Challenges:

- Lack of published information – may have past experience to draw upon - not published. Community may have information to draw upon.
- Capacity – issues of capacity within DFO and by proponent. E.g., directed research towards answering site specific questions or addressing broader, more generic issues.
- Dealing with uncertainty - do we use measures we know and understand or do we try new methods?
- Scale – are we addressing these questions at the right scale?
- Statistical power

Presentation 2 – International Literature Review

Challenges of an international literature review and proposal for how this information might be compiled (proposal for summer student project). Need for an overall framework to ask these questions. Introduced concept of bay-scale assessment, which seems to be similar to Ecological Unit concept. Classify habitat by depth, substrate type, benthos. Track by type to determine when larger-scale approach is required.

Discussion

Some people had reservations with going outside the Canadian experience, though our limited experience with marine compensation methodologies seems to require a broader look (if we can find the information).

Bay-scale approach – discussed information requirements. Links with OAP initiatives? limitations: how to compensate within highly disturbed environments? Not at all, outside the bay, other options?

Presentation 3 – Eelgrass
Short presentation on eelgrass as sensitive habitat. References available. Recommendation of higher compensation ratios. Recommended natural restoration rather than transplantation.

Discussion
Identified other references, such as BC examples. Lots of info, but not synthesized. Have historically focussed on creating habitat for commercial species. Other sensitive species or habitat types we should be flagging?

Presentation 4 – National Initiatives
Summarized major conclusions of National Audit of Habitat Compensation Program, series of NAPs, and examples of regional DSS tools. Don't want to re-invent wheel. Can learn from other processes.

Discussion
Good or bad that same people are involved in lots of these meetings. No process is looking at big picture.

Fundamental Question for Science: What is our capacity to understand function and structure of the marine environment?

"Experiments" of DFO should not become burdens for proponent.

Presentation 5 – SABS
No answers, but provided some provocative questions. Challenged our assumptions and asked us to think in new ways. Move from 2D, single species/habitat approaches to more holistic, multitrophic, functionally based approaches to habitat compensation. E.g., polyculture (engineered systems). Think long-term about raising public consciousness and developing empowering legislation. Policy doesn't lead – technology leads. Learn something from failures of fisheries management…

Discussion
Monitoring – be wary of monitoring trends in environment. Hard to distinguish natural variation from habitat changes.

Compensation Options – Fix existing problems rather than creating new ones (footprint of compensation programs). Legislative constraints.

Presentation 6 – Artificial Reefs
More technical presentation on Maritimes experience with artificial reefs. Challenges and benefits. Focussed on creation of lobster habitat, but monitored community changes – greater benefits here. Using cost/benefit analysis, are reef balls best? Other methods may work as well. Importance of site specific characteristics (what works one place may not work in another) and oceanography.

Discussion
Others shared their experience with artificial reefs. Talked about revisiting some of the old sites. Usefulness of monitoring in determining long-term effectiveness. Question again of whether we should focus on creation of habitat specific to commercial species.

Presentation 7 – Maine Wetlands Compensation Program
Summary of Maine's wetland compensation program, with examples from the marine environment. Points of interest: minimum area requirements, set ratios for compensation, moving towards protection instead of restoration (8:1 ratio), 5 year monitoring requirement, compensating for functions and values.

Discussion
Surprise that propeller-driven vessels banned from an area because of eelgrass presence, management decisions not questioned. Asked about rationale for minimum area requirements, but didn't know – would this be possible here? Proponent may get around it, so would still need to review everything and have flexibility to make decisions.

Summary of Plenary Discussion

Issues
- Objectives - Ecosystem functions and values vs. commercial productivity – Paul reminded us that the mandate is Habitat Management and Sustainable Development, not creation of pristine environments. Can we move forward without resolving this?
- Spatial scale – footprint of site too small, ecosystem too large. What's in the middle? How to deal with habitat "patchiness."
- Temporal scale – rate of habitat destruction may drive need for fast solutions.

Suggestions
- Explore new options: e.g., wastewater treatment to correct for addition of nutrients, education (policy more than science, though Science can provide suggestions).
- Stick to what we know and what works (e.g. freshwater, oyster).
- Develop proxies – complexity as a proxy for habitat, or depth (data limited systems).
- Develop habitat index: values, species, functions (information rich requirements).
- Mapping (where are habitats) – what scale can we do this at? Landscape scale too large, not realistic. Course level bay-scale mapping may be possible.
- Do bay-scale issue identification and risk assessment (links to OAP).
- Develop compensation hierarchy for marine environment.
- Make use of technology (engineered systems).