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Proceedings of the Central Coast Integrated Management Marine Environmental Quality Workshop.

Compte rendu de l'atelier de travail sur la qualité du milieu marin dans la zone étendue de gestion des océans du Centre de la côte.

June 5-7, 2002, Parksville, BC

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Table of Contents

ABSTRACT

Marine Environmental Quality (MEQ), or operational, objectives are measurable targets embedded in Integrated Management (IM) and Marine Protected Area (MPA) plans, against which management decisions are made. How MEQ objectives are being achieved is the science rationale for justifying management decisions with respect to environmental issues within an IM or MPA plan.

The goal of the workshop was to begin the process of applying the Ecosystem Objectives and Marine Environmental Quality approach, required under the *Oceans Act*, in the Central Coast Large Ocean Management Area (CC LOMA) and the Quatsino Sound Coastal Management Area (QS CMA). Here, we consider ecosystem objectives for the CC LOMA and the rationale for their unpacking to MEQ objectives, utilizing the national Ecosystem Objectives framework; and propose potential MEQ objectives and indicators for the Central Coast IM Plan that are soundly based in science and address management and decision-making needs, utilizing the national MEQ framework.

The Workshop produced the following results: 1) participants recommended approaches relating to the 'unpacking' exercise and how it should be applied in the CC LOMA, 2) participants 'unpacked' the board ecosystem objectives and developed examples of potential MEQ objectives along with possible associated indicators and monitoring, and 3) a strategic approach was recommended for the development of a comprehensive approach to MEQ in the QS CMA.

RÉSUMÉ

Les objectifs visant la qualité du milieu marin (QMM) sont mesurables et font partie des plans de gestion intégrée (GI) et des plans de gestion des zones de protection marines (ZPM). Les décisions de gestion sont fondées sur ces objectifs. La démarche prise pour atteindre les objectifs visant la QMM constitue le fondement scientifique qui justifie les décisions de gestion liées aux questions environnementales étudiées dans un plan de GI ou un plan de gestion des ZPM.

L'atelier avait pour but de lancer le processus d'application des objectifs visant les écosystèmes et la QMM, qui est exigé par la Loi sur les océans, dans la zone étendue de gestion des océans (ZEGO) du Centre de la côte et dans la zone de gestion côtière (ZGC) de la baie Quatsino. Nous examinons maintenant les objectifs pour la ZEGO du Centre de la côte ainsi que le fondement du processus de déstratification des objectifs visant la QMM en utilisant le cadre national des objectifs axés sur les écosystèmes. En outre, nous proposons des objectifs et des indicateurs potentiels de la QMM pour le plan de GI du Centre de la côte, lesquels s'appuient sur des critères scientifiques solides et répondent aux besoins de gestion et de prise de décision, et ce, en utilisant également le cadre national pour la QMM.

L’atelier a donné les résultats suivants : 1) les participants ont recommandé des approches pour l’exercice de « déstratification » et une démarche pour appliquer cet exercice à la ZEGO du Centre de la côte ; 2) les participants ont déstratifié les objectifs axés sur les écosystèmes proposés par le conseil et élaboré des exemples d’objectifs potentiels visant la QMM ainsi que des exemples d’indicateurs connexes et de mesures de surveillance possibles ; 3) une approche stratégique a été recommandée pour l’élaboration d’une approche globale entourant la QMM dans la ZGC de la baie Quatsino.

EXECUTIVE SUMMARY

The ecosystem approach within Integrated Management (IM) incorporates ecosystem considerations in management activities and ocean spaces. From the IM framework approved by Fisheries and Oceans Canada's (DFO's) Policy Committee in the summer of 2001, it was stated: "In a logical flow, ecosystem-based management objectives at the Large Ocean Management Area scale will need to be reflected in Marine Environmental Quality objectives". The ecosystem –based management approach thus addresses issues assessing cumulative impacts from a number of possible sources in the monitoring of the specific conditions of the marine ecosystem in which management actions are taken.

An ecosystem objectives framework needs provision for the setting of ecosystem-based objectives for each Large Ocean Management Area (LOMA), as part of a nested set of high-level policy to lower-level, more detailed operational objectives. The groundwork for an approach was laid by the inter-sectoral Working Group on Ecosystem Objectives (WGEO). The Feb-March 2001 "Dunsmuir Workshop" proceedings of the Working Group, available on the Canadian Science Advisory Secretariat website (Proceedings Series 2001/09), provides a good summary of discussions and thinking prior to review and acceptance by the national Policy Committee.

The ecosystem objectives framework necessitates setting ecosystem-based objectives in three key conceptual areas:
1. Maintain enough components (e.g., communities, species, populations) to ensure natural resilience of ecosystems:
2. Maintain function of each component of ecosystem to allow it to play natural role in food web (i.e., not cause any component of ecosystem to be altered such that it ceases to play its natural role); and
3. Maintain physical and chemical properties of ecosystem.

Marine Environmental Quality (MEQ), or operational, objectives are measurable targets embedded in Integrated Management and Marine Protected Area (MPA) plans, against which management decisions are made. How MEQ objectives are being achieved is the science rationale for justifying management decisions with respect to environmental issues within an IM or MPA plan.

The goal of the workshop was to begin the process of applying the required Ecosystem Objectives and Marine Environmental Quality approach in the Central Coast Large Ocean Management Area (CC LOMA) and the Quatsino Sound Coastal Management Area (QS CMA). The workshop had four more specific objectives:

1. To discuss ecosystem objectives for the CC LOMA and the rationale for their unpacking to MEQ objectives, utilizing the national Ecosystem Objectives framework.

2. To propose potential MEQ objectives and indicators for the Central Coast IM Plan that are soundly based in science and address management and decision-making needs, utilizing the national MEQ framework.
3. To identify gaps in current research, monitoring and operational activities in the Central Coast, relative to the need to further develop MEQ objectives, with associated indicators and reference points (limits and targets).
4. To develop an Action Plan for further developing and applying MEQ objectives and indicators that supports the Central Coast IM Plan.

The Workshop produced the following results:

- Participants recommended approaches relating to the 'unpacking' exercise and how it should be applied in the CC LOMA;
- Participants 'unpacked' the board ecosystem objectives and developed examples of potential MEQ objectives along with possible associated indicators and monitoring.
- A strategic approach was recommended for the development of a comprehensive approach to MEQ in the QS CMA; and
- Project proposals were solicited from participants at the workshop that supported the strategic approach recommended by the group.

A number of further recommendations emerged from the Workshop:

- MEQ objectives options for the QS CMA should be examined in more detail in the context of the development of an IM Plan in the area, Central Coast managers' identified priorities, and recent workshop discussions; and
- Criteria should be outlined for the development of MEQ objectives.

The Workshop made some other suggestions re development of MEQ objectives, but these need more development before being recommended for implementation.

Participants in the workshop recommended that local information and local experts be involved in the development of MEQ objectives. Participants also recommended that the process for incorporating social and economic values into the development of MEQ objectives be further developed.

ACKNOWLEDGEMENTS

We thank Colin Rankin of Geospatial International Inc., Salasan Operating Division, for his welcomed assistance in the facilitation, and Leanne Blackwood for her note-taking of this meeting. Jen Gold helped greatly with the organisation of the meeting.

CONTEXT AND BACKGROUND TO A WORKSHOP ON MEQ FOR BRITISH COLUMBIA'S CENTRAL COAST

Canada's *Ocean Act* was promulgated in 1997, and provided a new direction for the management of coastal and marine resources. The *Act* focused on an approach to management that balances protection and conservation of the environment with the recognition that oceans offer a significant opportunity for the generation of wealth for Canadians. Fisheries and Oceans Canada (DFO) was given the primary responsibility for *Oceans Act* implementation, as well as the lead role in the development of strategy for the management of Canada's oceans. In 2003, both Canada's Oceans Strategy and the Policy and Operational Framework for the Integrated Management of Canada's Estuarine, Coastal, and Marine Resources were released. These papers provide an overall Government of Canada approach to the management of Canada's coastal zone.

The concept of Marine Environmental Quality was introduced in Section 32 (d) of the *Oceans Act*: "For the purposes of the implementation of integrated management plans, the Minister may, in consultation with other ministers, boards and agencies of the Government of Canada, with provincial and territorial governments and with affected aboriginal organizations, coastal communities, and other persons and bodies… **establish marine environmental quality guidelines, objectives, and criteria respecting estuaries, coastal waters, and marine waters**" (emphasis added).

The Oceans Act, Canada's Oceans Strategy, and the Framework for Integrated Management all provide an overarching vision for ecosystem-based management in Canada. DFO, the lead federal department for the implementation of these objectives, has established a lead integrated management initiative on each of Canada's three oceans. In the Pacific, the lead project is Central Coast Integrated Management (CCIM). In 1999, the Central Coast Area in the Pacific Region was created when DFO moved to an Area-Based model. The Central Coast Area was established as one that would develop in an integrated management approach. The Central Coast Area was set up to cross traditional DFO sector lines, and staff were encouraged to operate in a manner that focused more on team work at various geographic levels, and less according to existing traditional management structures.

The Central Coast Area is currently facing a number of challenges. There is transition away from some traditional fisheries and the way of life that they sustained for coastal communities. Downturns in the economy of natural resource exploitation have generally reduced employment opportunities and the population of the area has decreased in the last ten years. New industries like finfish and shellfish aquaculture, ecotourism, and possibly oil and gas exploration and development are changing the way communities view their coastal environment.

British Columbia's coastal zone is an area with a high degree of jurisdictional complexity. There are four levels of government engaged in responsibilities related to coastal zone management: federal, provincial, local/regional, and First Nations. Over twenty-five First

Nations claim traditional territories within the Central Coast, some are actively engaged in Treaty processes and some are not.

The development of an IM approach in the Central Coast represents a significant shift from the historical way governments have approached their management responsibilities. The *Oceans Act* and IM outline an approach to management that is focused on a specific geographic area. This new approach will change the way that decisions are made. With Ecosystem Objectives and the development of a MEQ management approach at both the Large Ocean Management Area and Coastal Management Area levels will play a significant role in the development of this new management framework.

WORKSHOP PRESENTATIONS AND DISCUSSIONS

DAY 1: LAYING THE FOUNDATION FOR AN MEQ PROGRAMME

Introduction to the Workshop

Welcome and Introduction of Central Coast Integrated Management MEQ Sub-committee

John Pringle and Glen Jamieson

John Pringle, Manager Environmental Sciences Division, Fisheries and Oceans Canada (DFO), Institute of Ocean Sciences (IOS), Sidney, BC welcomed participants to the workshop. John briefly described the long history leading to passing of the *Oceans Act* in 1997 (harkening back to Scott Parsons, the first ADM Oceans, and the Mulroney era). The Integrated Management (IM), Marine Protected Area (MPA) and Marine Environmental Quality (MEQ) components of the *Oceans Act* have long been supported by scientists and others in DFO and beyond. This workshop – and other associated pilot efforts in the Central Coast and in BC – are important steps in putting the principles outlined in the *Oceans Act* into practice. John emphasized that MEQ and IM practices under the *Oceans Act* are in an evolutionary stage with a need to establish common understandings and to try new approaches. He wished participants the best in building these understandings and developing the approaches needed to make MEQ objectives real and practical for the Central Coast.

Glen Jamieson, DFO, Pacific Biological Station (PBS), Nanaimo, BC, introduced members of the Central Coast Integrated Management MEQ Sub-committee, was and will be responsible for planning the workshop, producing workshop results and addressing recommendations arising from the workshop. Sub-committee members include: Glen Jamieson; Brenda Bauer, Central Coast Area IM Planner; Herb Vandermeulen, National MEQ Coordinator; Don Sinclair, Central Coast Area; Dario Stucchi, IOS, Sidney; Peter Ross, IOS; Jen Gold, A/Coastal Planner, Central Coast Area; Barry Peters, Community Advisor, Central Coast Area; Gordon McEachen, A/Chief, Conservation Management, Central Coast Area; Ray Lauzier, Stock Assessment, PBS; Pat Lim, Habitat Enhancement Branch, Vancouver; John Lewis, Chief, Regulatory Affairs, Central Coast Area; and Gary Taccogna, A/Chief, Oceans and Community Stewardship, Central Coast Area.

Desired Outcome and Objectives for the Workshop

Colin Rankin, Facilitator

Colin Rankin, contracted facilitator for the workshop, reviewed the desired outcome from the workshop, workshop objectives and discussion framework. He emphasized the flexible nature of the agenda, given the early stage of development of MEQ objectives for the Central Coast IM Area and the desire of the organizers to respond to direction received from participants through the workshop. He also introduced workshop recorder Leanne Blackwood and the plans of the organizers for distributing a summary of workshop discussions.

The desired outcome from the workshop was:

> An Action Plan for the development and application of scientifically sound and managerially useful MEQ objectives and indicators in the Central Coast Integrated Management Plan based upon ecosystem objectives set for the Central Coast Large Ocean Management Area**.**

The workshop had four objectives:

1. To discuss ecosystem objectives for the Central Coast Large Ocean Management Area (and the rationale for their choice), utilizing the national Ecosystem Objectives framework.
2. To propose potential Marine Environmental Quality objectives and indicators for the Central Coast IM Plan that are soundly based in science and address management and decision-making needs, utilizing the national Marine Environmental Quality framework.
3. To identify gaps in current research, monitoring and operational activities in the Central Coast, relative to the need to further develop Marine Environmental Quality objectives, with associated indicators and reference points (limits and targets).
4. To develop an Action Plan for further developing and applying Marine Environmental Quality objectives and indicators that supports the Central Coast Integrated Management Plan.

The National MEQ Framework

Herb Vandermuelen, DFO, Ottawa, ON

Herb Vandermuelen, National MEQ Coordinator, reviewed the federal framework for Marine Environmental Quality, following notes used for presentation to DFO National Policy Committee April 17, 2002.

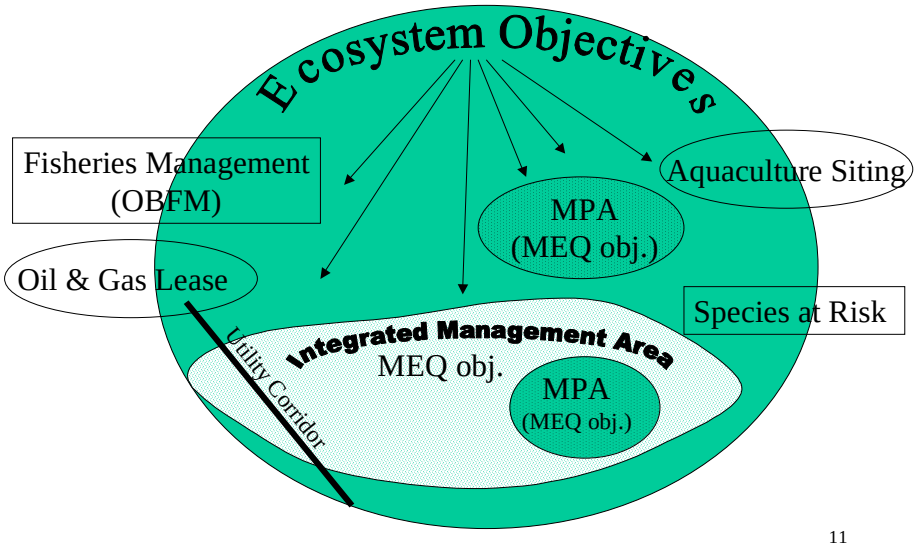
Presentation Highlights:

- **Canadian Oceans Strategy** mandated under the *Oceans Act*, has **three key principles**:
  - Sustainable Development; - Integrated Management; and - the Precautionary Approach;
  and **three key programs**:
  - Integrated Management; - Marine Protected Areas; and - Marine Environmental Quality.
- **Large Ocean Management Areas** (LOMAs) define boundaries for Integrated Management (typically extending from the coast out to the limit of Canada's jurisdiction) drawn "using a mix of ecological considerations and administrative boundaries. Four pilot LOMAs have been identified: Beaufort, Gulf of St Lawrence, Eastern Scotian Shelf and Central Coast. **Coastal Management Areas** (CMAs) are near shore areas within a LOMA.
- The **ecosystem approach** within Integrated Management incorporates ecosystem considerations in management activities and oceans space. From the IM framework approved by Policy Committee in the summer of 2001: "In a logical flow, ecosystem-based management objectives at the Large Ocean Management Area scale will need to be reflected in Marine Environmental Quality objectives". The ecosystem approach addresses issues involving cumulative impacts, as well as the specific conditions of the ecosystem in which management actions are taken.

- The **ecosystem objectives framework** has provision for the setting of ecosystem objectives for each LOMA, as part of a nested set of high-level policy to lower-level more detailed operational objectives. The groundwork for the framework has been laid by the inter-sectoral Working Group on Ecosystem Objectives (WGEO). The Feb-March 2001 "Dunsmuir Workshop" proceedings of the Working Group available on the Canadian Science Advisory Secretariat website (Proceedings Series 2001/09) provide a good summary of discussions and thinking prior to review by Policy Committee. The proceedings will be reviewed in more detail by Glen Jamieson in the next presentation.
- The ecosystem objectives framework suggests setting **ecosystem objectives in three key areas**:
  1. Maintain enough components (e.g., communities, species, populations) to ensure natural resilience of ecosystems:
  2. Maintain function of each component of ecosystem to allow it to play natural role in food web (i.e., not cause any component of ecosystem to be altered such that it ceases to play its natural role); and
  3. Maintain physical and chemical properties of ecosystem.
- The conceptual underpinning of MEQ objectives has evolved along with ideas beneath "Marine Environmental Quality" – shifting from a "pollution" or "water quality" focus to addressing the structure and function of the marine ecosystem as a whole.
- MEQ is a statement of overall condition of a marine ecosystem.
- Policy Committee wants to ensure that the regulatory implications of implementing MEQ objectives are clearly understood and practical. This is why they have requested a pilot project on the Eastern Scotian Shelf. One objective of the Central Coast IM MEQ initiative is to test and further develop the concept at an operational level.
- **MEQ objectives** are measurable operational targets embedded in Integrated Management (IM) and Marine Protected Area (MPA) plans – against which management decisions are made. MEQ objectives are the focal point for management decisions (concerning environmental issues) within an IM or MPA plan.

- The following diagram depicts the relationships between ecosystem objectives and MEQ objectives and management activities in a LOMA:

Relation Between Ecosystem Objectives and Management of Activities in a LOMA



- MEQ objectives are "plan-specific" (i.e., they are set to guide management actions and decisions taken in IM and MPA plans) – they can be linked to the regulatory regime in the associated plan.
- Compliance and enforcement would be undertaken by responsible regulatory or management authorities, under their respective legislation and regulations.
- Indicators and monitoring actions would be identified and implemented as a support function.
- The "national" component of MEQ:
  - gives effect to the shared responsibility for maintaining ecosystem quality;
  - provides a uniform context for marine related guidelines, criteria or standards that may be developed by other agencies; and
  - addresses compliance and regulatory issues arising from the application of MEQ objectives and other aspects of the MEQ framework.
- The **interdepartmental MEQ Working Group** needs to be re-established in order to ensure support and consistency for this "national" aspect of MEQ.
- Currently, there is a Memorandum to Cabinet for $160M which has been approved in principle. The bulk of these funds will be to support ocean management on an area basis (e.g. CMAs, MPAs), but some will be used to deliver scientific support for specified pilot regions (including the Central Coast) developing IM plans.
- **Implications for CCIM**. The IM plan:
  - must address both broad "ecosystem-level" objectives and more specific "MEQ objectives";
  - be consistent with national frameworks and other IM areas; and
  - provide a means for inserting and applying MEQ in IM.
- In theory, the **steps in developing MEQ objectives** should be sequential:
  1. Establish the LOMA boundaries;

2. Produce an ecosystem overview;
3. Establish and provide increasing specificity to ("unpack") ecosystem objectives for the LOMA; and then
4. Establish MEQ objectives for IM and MPA plans within the LOMA.

- However, in the Central Coast we are faced with initiating all these steps concurrently – I would propose an iterative approach, examining the steps together and improving each element (step) over a series of meetings or workshops – building up the all (boundaries, ecosystem overview, objectives) over time.
- In summary, both the ecosystem and MEQ objectives frameworks are "just out of the gate" – they still require final Policy Committee approval. They will require Science support in the short and longer term (the Oceans Memorandum to Cabinet and departmental review of Science should address longer term implications but will not be available in the near term). My suggestion is to test out the preliminary suggested approach to identifying and providing increasing specificity – from ecosystem objectives to MEQ objectives – and see how it works. Improve the approach and the resulting information (e.g., more explicit or "corrected" MEQ objectives) over time ("adaptive management").

Discussion:

- **Question:** What does MEQ mean in terms of the IM framework? **Answer:** MEQ does not change the nature of the framework.. MEQ objectives are "environmental objectives**",** not social or economic objectives.
- **Comment:** I'm concerned about how you would apply the verb "maintain", as in is in many of the examples cited so far (e.g., "maintain ecosystem function"). **Answer:** It is necessary to establish limits (reference points) to be able to set standards (e.g., if we do not want to wipe out a killer whale population, i.e., "maintain the population"), since we need to set limits to acceptable change in population numbers to guide management action in response to "unacceptable" change.
- **Comment:** Humans influence the degree to which limits are pushed in an ecosystem. When we speak about ecosystem objectives, we need to have management plans to direct management actions.
- **Question:** Do MEQ objectives transpose into other management plans? **Answer:** Short answer is yes, they are intended to be complementary to other management plan objectives and direction – it will take some time though to make sure that the links are clearly understood and accepted by all managers and scientists. For example, Fisheries use the term "Biological Objective" when referring to environmental management issues. "MEQ objective" is not a term currently used in fisheries management. The term "Ecosystem Objective" is not defined in the *Oceans Act; rather,* the Act uses the term MEQ objective. MEQ objectives are set to refer to a specific IM or MPA area (e.g., Central Coast IM area or a smaller Coastal Management Area), whereas an ecosystem objective generally looks at a larger area (i.e., at a LOMA scale).
- **Question:** How would MEQ objectives be used for management? **Answer:** MEQ objectives will provide a scientific underpinning for management direction and regulation – e.g., MEQ Objective: "Maintain 100% of eelgrass habitat in *x* area

undisturbed." Management direction: "In *x* area, only allow human activities that will not damage eelgrass habitat."

- **Question:** how do we determine how much to focus on addressing immediate management needs with MEQ objectives, relative to establishing a long-term understanding of the natural and anthropogenic variability and health of the ecosystem? **Answer:** One way of thinking about it would be to use a **"70/30 Rule"** – roughly 70% of your effort and attention should be on supporting sound management and addressing immediate issues (e.g., variability due to anthropogenic factors) and 30% on building understanding of longer-term ecosystem issues (e.g., monitoring of ocean climate regime shifts).

Overview of the "Dunsmuir Workshop" (Feb-March 2001 National Workshop on Objectives and Indicators for Ecosystem-based Management)

Glen Jamieson, DFO, Nanaimo, BC

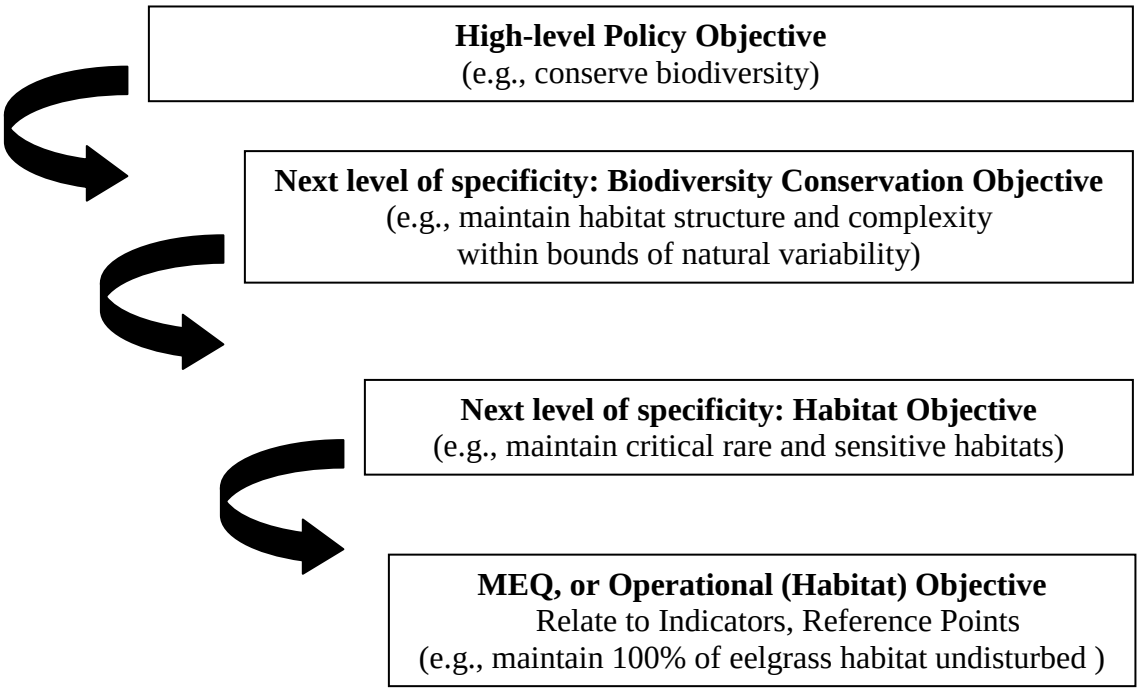
Glen Jamieson provided a brief review of key results of the national workshop on objectives and indicators held at Dunsmuir Lodge, Sidney, BC from February 27 to March 2, 2001 (often referred to as the "Dunsmuir Workshop'). The full proceedings of the workshop are available on the Canadian Science Advisory Secretariat website (Proceedings Series 2001/09).

Presentation Highlights:

- The Dunsmuir Workshop was held with the goal of identifying ecosystem-level objectives, with associated indicators and reference points, which could be used in managing ocean activities. An approach to construct objectives for Ecosystem-based Management was developed. At the highest level, conceptual objectives are stated in general terms that are intended to be understandable to a broad audience – and can be considered as policy statements. An operational level objective, however, needs more specificity – an **operational objective consists of a verb** (e.g., maintain), a specific measurable biological property or **indicator** (e.g., biomass), **and a reference point** (e.g., 50,000 t), which together allows an action statement for management (e.g., maintain biomass of a given forage species greater than 50,000 t). The process of refining conceptual objectives to successively more specific levels until operational objectives are defined is termed "unpacking".

Operational objectives are derived from high-level policy objectives by going to greater levels of specificity (a process of "unpacking")[1].

[1] Note: examples and diagrams have been revised following presentation at the workshop to incorporate suggestions made during the workshop.



- In this workshop, our goal is to develop a suite of ten to twelve operational objectives (i.e., MEQ Objectives) for the Central Coast IM area. The challenge is to take the conceptual objectives and develop MEQ objectives that are relevant for the Central Coast Area. We need to start testing and monitoring the usefulness of operational-level MEQ objectives. The Dunsmuir workshop worked from top to bottom (i.e., from "broad ecosystem" level, down). This workshop will try more to unpack from the bottom to the top.
- Terminology has changed slightly since the Dunsmuir Workshop (e.g., the use of the term "characteristic" may be confusing). It may be more clear to think of "increasing levels of specificity" rather than attempting to rigidly follow a hierarchy with defined levels and terms (the deck used for explaining Ecosystem Objectives to Policy Committee on April 17, 2002 is helpful in this regard) – it could take three steps or "x" steps to get from a conceptual level (ecosystem) objective to an operational level (MEQ) objective.
- Regions have developed or attempted different frameworks to realizing management objectives (e.g., the Integrated Biotic Index (IBI), the "Traffic Light" approach). Some of these are described in the Dunsmuir Workshop proceedings and remain very relevant and applicable within the national ecosystem-based and MEQ frameworks.
- The Dunsmuir Workshop identified three high-level ecosystem objectives and a total of eight "next level" objectives. These have subsequently been refined slightly by the WGEO and accepted in principle by Policy Committee. We have structured workshop small group discussion around these groupings:

A. Maintain Ecosystem Components

- Maintain communities within bounds of natural variability
- Maintain species within bounds of natural variability
- Maintain populations (genetic diversity) within bounds of natural variability**B. Maintain Ecosystem Component Function**
- Maintain primary production within the bounds of natural variability
- Maintain trophic structure so that individual species/stages can play their natural role in the food web
- Maintain mean generation times of populations such that population resiliency is assured

C. Maintain Ecosystem Physical and Chemical Properties

- Conserve critical landscape/bottomscape features and water column properties
- Conserve water, sediment and biota quality (contaminants)

Ecosystem Objectives Framework: Practical Examples

High-Level Objective	More Specific Objective	Operational Objective	Management Measures
Maintain components to maintain ecosystem resilience	Maintain species within bounds of natural variability	Rebuild species X above target abundance within specified time frame (e.g., rebuild northern right whale to 500 individuals within 20 years)	• Reduce/eliminate incidental mortality (fishing) • Reduce/eliminate ship strikes (transportation)
Maintain function of ecosystem components	Maintain primary productivity within bounds of natural variability	Prevent eutrophication: keep primary productivity below X mgC/yr in all coastal areas	• Keep aquaculture effluent below level to meet objective • Keep land-based effluent below level to meet objective
Maintain physi-cal and chemi-cal properties	Maintain water column properties	Keep concentration of suspended solids below X/l. in areas/times of herring spawning	• Manage dredging to meet target • Manage industrial & municipal discharge to meet target

Discussion:

- **Question:** What would you use as criteria for determining operational objectives? Is there a set of criteria? **Answer:** Operational objectives need to link back to ecosystem objectives, as well as address operational needs and be clearly understood and “actionable”.

- **Comment**: In the Arctic (Beaufort LOMA), we tried unpacking starting from the top – it got very complicated when we got a few layers down. However, in unpacking from the bottom to the top, important points related to ecosystem integrity may be overlooked. We need to use collective knowledge to build appropriate objectives both from the bottom to the top and top down.
- **Comment:** It may be difficult to set specific science-based objectives. **Response:** You could use the precautionary principle (e.g., conserve 100% of eelgrass habitat) when scientific information is unclear or unavailable.
- **Comment:** Key scientific problems need to be identified and addressed to determine ecosystem level and MEQ objectives.
- **Comment:** MEQ objectives should address both quantity and quality (i.e., numbers and functions) – ecosystem health is as important (if not more) than total biomass or productivity.
- **Comment:** As part of monitoring, we will have to establish baseline data and trends – to be able to address both natural and anthropogenic variability. Control sites are needed – both those impacted and not impacted by humans.

Central Coast Integrated Management

Brenda Bauer, DFO, Port Hardy, BC

Brenda Bauer, Integrated Management Coordinator for the Central Coast Area, provided a description of the characteristics and management structure for Central Coast Integrated Management.

Presentation Highlights:

- The *Oceans Act* provides the framework and tools for Central Coast IM. **Integrated management** (IM) is an opportunity to blend values: social, economic and environmental. IM is also an opportunity (and challenge) to develop new approaches to management:
  - within Fisheries and Oceans Canada;
  - Inter-governmental (federal, provincial, local, First Nations); and
  - within communities and stakeholders.
- BC's Central Coast area is one of six Large Ocean Management Areas (LOMAs) on the Pacific Coast. It contains many fjords and inlets (encompassing about half of BC's total coastline) and is rich in marine and terrestrial resources. A Land and Coastal Resource Management Plan is currently being prepared for the area under a process established by the provincial government (with input and involvement from other levels of government and stakeholders). The Central Coast faces growing development and resource extraction pressures (e.g., fisheries, aquaculture, forestry, tourism, and potentially offshore oil and gas development). It is also a newly established area for DFO Pacific Region, with operations in start-up phase. Although only 50,000 people live in the area, there are over 20 First Nations and more than ten local governments to work with. Communities in the area have resource-dependent economies – major communities are Bella Coola in the north, Port Hardy in the centre

of the region and Campbell River in the south (over 30,000 residents of the Central Coast area live in Campbell River).

- **Marine interests and issues** in the Central Coast include:
  - forestry (e.g., upland watershed impacts, heli-logging dumping areas and log transport);
  - mineral/chemical extraction (e.g., long-term impacts of closed copper mine in Quatsino Sound);
  - transportation; (e.g., boat and/or road access to remote communities);
  - sport and commercial fishing activities;
  - tourism (fishing related and other – e.g., whale watching);
  - aquaculture (both finfish and shellfish);
  - conservation concerns and focus on the area (as a relatively "undeveloped" area); and
  - First Nations interests (e.g., land claims, access to fisheries and economic development opportunities).
- **Central Coast Area-based Operations** for DFO are structured in a manner that is more consistent with *Oceans Act* responsibilities than other areas. The Central Coast area is playing a lead role in testing new or different forms of service delivery and is the lead area for Integrated Management in the Pacific Region. Management intention in the Central Coast is to set management level objectives by Coastal Management Area (CMA), rather than on a "top down" or area-wide basis. The Strategic Plan for the Central Coast has been approved by Policy Committee at the Regional level – the next step is to present it to Policy Committee at the National level.
- **Boundaries:** The Central Coast area boundary has expanded as consideration has been given to oceanographic and other physical and ecological factors. The current draft of the boundary extends from the coastline to Brooks Peninsula on Vancouver Island, north to the southern tip of the Queen Charlotte Islands, midway up Queen Charlotte Strait, and south to the level of Campbell River on Vancouver Island. The present proposed boundaries have not yet been finalized. (Note: all LOMA boundaries will be finalized at the national level via the joint efforts of the Oceans and Science Sectors).
- The **Central Coast Integrated Management (CCIM) Steering Committee and Working Group** is the coordinating mechanism and link between DFO's policy, program and operational requirements. The CCIM Group receives input and direction from:
  - the Area Management Team;
  - DFO regional and national Policy committees; and
  - various subcommittees, including Marine Environmental Quality, First Nations opportunities, information management and communications.
- The CCIM Group interacts with: **1) Coastal Management Area (CMA) Panels (**geographic-based); and **2) LOMA Inter-agency/Governmental Panels**. CMA Panels include First Nations, local government and aquatic resource sector stakeholders with interests in the CMA. LOMA Inter-agency/Governmental Panels provide key federal and provincial governments the opportunity to come together address communications and coordination of programs and operations. In addition,

Issue Panels (technical/scientific and social/economic) provide input and get direction from the CMA and/or LOMA Panels. Issue Panels are established to accomplish a specified goal or task within a set time period.

- The CCIM Working Group has recommended that the Central Coast be divided into between five and ten smaller Coastal Management Areas to develop IM plans – rather than considering the entire Central Coast area first. One objective of this approach is to be able to monitor fishery stocks in specific, distinct (enclosed) areas. We need also to look at issues that crossover and integrate the interests of all stakeholders – and to try to improve communications between various stakeholders.

Discussion:

- **Question:** Is the Central Coast plan ready to be submitted to Ottawa? **Answer:** A Central Coast "Strategic Plan" was developed and approved regionally in fall, 2001 – the Strategic Plan outlines the approach that will be used to develop IM in the Central Coast. IM plans are further down the road (2-3 years?) and will have input from all government levels and departments.
- **Question:** How are First Nations influenced by this plan? **Answer:** First Nations have been involved in development of the plan to date, First Nations will be invited as a level of government to a planned workshop this fall, specifically to bring up issues that are raised by the proposed planning process.

Learning from Canada's East Coast – The ESSIM Ecosystem Overview

Bob Rutherford, DFO, Halifax, NS

Bob Rutherford, DFO, Bedford Institute of Oceanography, Dartmouth, NS, provided an overview of the process used to prepare an Ecosystem Overview for the Eastern Scotian Shelf Integrated Management (ESSIM) area.

Presentation Highlights:

- The **primary purpose** of an Ecosystem Overview is to provide a framework to increase education and awareness of non-specialists in the communities. The ESSIM Ecosystem Overview took about three years to complete – and could be done more quickly the next time as a lot of learning was done along the way of preparing it.
- **Boundaries:** One of the first challenges was setting boundaries for the LOMA and for the purposes of the Ecosystem Overview. We used a framework with Ocean Management Areas (offshore) and Coastal Management Areas providing the first divisions. Boundaries were based on physical oceanic attributes. Large areas were then divided into "sub-areas" and sub-areas into vertical "zones." Each zone has indicator species and associated habitat variables (e.g., salinity, temperature). The sub-areas influence MEQ objectives.
- One residual issue is determining finite nearshore and offshore boundaries – we left it fuzzy at the finer scale, recognizing that boundaries would change with increased resolution and different information/issues.
- One of the areas of interest for ESSIM is how climate change will affect the region – the meeting of Arctic, Gulf Stream and Gulf of St Lawrence currents creates a high

degree of variability. Characterization of natural variability is one of the challenges for an Ecosystem Overview.

- **Lessons learned:** We learned that IM planners and managers need to work closely with scientists to produce the Overview. IM Managers have to provide the outline and in essence "hold the pen" for the Overview. One of the most challenging aspects of the task is winnowing the information and determining "what's important" to present in the Overview. Knowledge to enable interpretation of data sets is also very important, we may not know "what's out there" because we're not looking for it (e.g., we have found that snow crab inventory numbers are much lower when they are not a specific target species for the Fisheries Management data collector).

Discussion:

- **Question:** Where are you in terms of setting MEQ objectives? Have Habitat staff used MEQ objectives yet? **Answer:** We're just now unpacking ecosystem objectives to the management plan level – once we've set MEQ objectives, then Habitat staff will be able to use them.
- **Question:** Has the USA been involved with IM and MEQ (e.g., do our boundaries mesh with the US approach)? **Answer:** We're working closely with folks in the US – they are looking at the same or a similar system of classification for the Gulf of Maine and Cape Cod areas.
- **Comment:** It is very important to be able to identify regime shifts as distinct from seasonal variations – each area must be managed differently taking into account consequences of regime shifts (e.g., influence of El Niño).
- **Comment/Question:** We need to be able to know if an MEQ objective is setting a value that is damaging an ecosystem – I don't see the Ecological Overview necessarily providing this kind of information – how then will this be assessed?

Developments in the Atlantic – A Science Perspective

Simon Courtenay, DFO, Moncton, NB

Simon Courtenay, DFO, Moncton, NB, reviewed some experiences to date in developing MEQ objectives in the Atlantic region, primarily involving the Gulf of St Lawrence IM area (GOSLIM).

Presentation Highlights:

- Gulf of St. Lawrence IM area presents challenges in terms of setting **boundaries** – the present boundary extends across several DFO administrative regions and areas and five provinces. There have been fundamental differences over setting of boundaries (e.g., there has been a proposal to split GOSLIM into north and south areas based on political boundaries).
- **GOSLIM is an umbrella** – specific geographic areas can still be looked at through a series of levels (e.g., sub-areas). Basin and watershed areas could be considered to be the base units – and aggregated to larger geographic scales as appropriate.
- There is little or no credibility for MEQ objectives on the East Coast – people don't know what they are and what they are trying to do. Pilot projects are needed to build

awareness and support for MEQ approaches. Presently, for example, there are GOSLIM MEQ initiatives related to oil and gas and aquaculture industries.

- One example of MEQ work is in **Basin Head, PEI**. Work has been going on since 1960 monitoring the impacts of chemicals and sediment that flow into the estuary on growth of a rare species of Irish Moss (*Chondrus crispus*). This is an example of industry cooperation with a long term monitoring program and directed use of regulatory fines.
- **Newfoundland Experience**: The unpacking exercise for establishing MEQ objectives was successful – formed work and discussion groups along with organized workshops. One lesson from this exercise is the importance of having provincial identification of key issues at the LOMA scale.
- **"Issue-Driven" MEQ objectives.** Need to remember that MEQ objectives have to address real management issues (e.g., on the East Coast, aquaculture-environment interactions). We've been able to utilize industry-funded consultants to confirm issues and establish MEQ programs (e.g., salmon farmers). In Quebec, community studies have been initiated looking at environmental health.
- **Sentinel Species Approaches**. One example is the Pictou Harbour Biomonitoring Project. Used caged mussels to measure growth and immunological endpoints in different locations (from high pollution to relatively pristine). We've been able to establish clear correlations between key parameters of mussel growth and health relative to MEQ conditions – providing useful indicator information. The project has successfully secured additional funding to maintain monitoring effort using caged mussels. **When you select the right indicators you get reference points!** Research has also been undertaken on the affects of sewage disposal in Gulf of St. Lawrence on mussel populations.
- **Future effort:** We need to build on the direction set out in the Dunsmuir Workshop report – there are some worthwhile details in that report that are worth considering in further detail (e.g., using an **Index of Biotic Integrity approach**). I also feel that more MEQ work on pulp and paper mills on the West Coast is needed, building on some of the work in the east (e.g., use of **sentinel species**). As we are working out the details in terms of approach and terminology, we need to remember that Canada is leading the way internationally in developing ecosystem-based management applied theory and practice. We have not had money dedicated to MEQ work in the past – one current challenge is embedding MEQ into IM sites. The main challenge for this workshop, I feel, is finding a set of recommendations (e.g., on how to develop operational level MEQ objectives) that move discussion and practice forward.

Discussion:

- **Question:** Have we exceeded carrying capacity for mussel or oyster aquaculture? How do we measure carrying capacity? **Answer:** One way is using the Index of Biotic Integrity, described in the Dunsmuir Workshop Proceedings.
- **Question:** How do you draw lines on the map (i.e., boundaries)? **Answer:** Some regions have more variability than others – need to make a best approximation – any one area won't have everything within it.

DAY 1 AFTERNOON: BEGINNING THE UNPACKING EXERCISE

Developing Ecosystem Objectives for the Central Coast Large Ocean Management Area – Small Group Discussions

The afternoon session involved four small groups addressing the following discussion question:

> **Using the three broad conceptual ecosystem objectives described in the Ecosystem Objectives Framework, what "next level" ecosystem objectives can be identified for the Central Coast (i.e., how do we 'unpack' the conceptual ecosystem objectives)?**

Each group looked at one of the "high-level" conceptual ecosystem objectives, and the associated "next level" objectives, identified in the National Ecosystem Objectives Framework (two groups addressed "A" and one group each "B" and "C"):

A. Maintain Ecosystem Components
- Maintain communities within bounds of natural variability
- Maintain species within bounds of natural variability
- Maintain populations (genetic diversity) within bounds of natural variability

B. Maintain Ecosystem Component Function
- Maintain primary production within the bounds of natural variability
- Maintain trophic structure so that individual species/stages can play their natural role in the food web
- Maintain mean generation times of populations such that population resiliency is assured

C. Maintain Ecosystem Physical and Chemical Properties
- Conserve critical landscape/bottomscape features and water column properties
- Conserve water, sediment and biota quality (contaminants)Group A (1) –

Maintain Ecosystem Components

This discussion group considered the ecosystem objective of maintaining ecosystem components (biodiversity) and three "next level" objectives, how to:
- Maintain **communities** within bounds of natural variability;
- Maintain **species** within bounds of natural variability; and
- Maintain **populations** (genetic diversity) within bounds of natural variability.

Presentation of Discussion Highlights:

The group first identified a number of **issues or challenges** that are inherent in attempting the task:

- We need to **identify and establish baselines**. We need to archive baselines in order to monitor changes in an ecosystem and how they relate to the documented baselines. Cannot make an operational objective without a baseline and concrete data.
- What is **natural variability**? In order to maintain a community, we need to understand natural variability. Measure different species at various trophic levels.

- We need to understand the **causes of ecosystem changes**.
- We need to **identify and define communities** (e.g., intertidal, benthic, pelagic, estuary) in the Central Coast area?
- We need to **classify sub-areas** in the Central Coast area.

The group approached the unpacking exercise by first identifying habitats in the Central Coast, and then characteristics of those habitats and important areas where they are found in the Central Coast area. It was felt that approaching the task at an individual species or population level would simply lead to a derivative list that would be too extensive to be of use for establishing MEQ objectives.

Habitats within the Central Coast	Characteristics within the Listed Habitats
1. Banks (submerged shallow bank)	♦ Larval retention ♦ Marine birds ♦ Upwelling ♦ Fisheries (Habitat/Salmon)

Habitats within the Central Coast	Characteristics within the Listed Habitats
2. Exposed rocky intertidal – high energy	♦ California mussels, Goose Barnacle communities ♦ Productivity and diversity ♦ e.g., Brooks Peninsula
3.Lagoon system	♦ Birds, terrestrial mammals (wolves, herring, castaways) ♦ First Nation Use – e.g., fish weirs ♦ e.g., Midcoast Calvert/Hunter Islands
4. Archipelagos	♦ Habitat complexity ♦ Currents ♦ Edge habitats ♦ e.g., Broughton and Goose
5. Estuaries	♦ Eelgrass ♦ Transition zones ♦ Nutrient mixing ♦ Migrating species ♦ Deliver of sediments
6. Reefs	♦ Rockfish, kelp ♦ Complexity ♦ Mixing ♦ e.g., Queen Charlotte Strait and Goose Group
7. Tidal races	♦ Mixing ♦ Macrophytes ♦ Productivity ♦ e.g., Oksillo and Hole in the Wall
8. Kelp forests	♦ Primary production ♦ e.g., North Island ♦ e.g., Goose Group, Broughton, Rearing Areas
9. Sponge communities	♦ e.g., Queen Charlotte Sound and Hecate Strait ♦ e.g., Fjords
10. Watersheds	

The group then began to list **anthropogenic impacts on identified habitats**, beginning with estuaries and intertidal areas:
1. Estuaries: hydrologic regime, eutrophication, sedimentation, infilling, exotics, over-fishing, water quality
2. Intertidal: overharvesting, trampling, debris damage

Suggestions

- Try framing the discussion around issues. The group found that species and communities related discussions eventually got down to habitat after a few false starts:
  Species ⇒ Communities ⇒ Issues/Activities ⇒ Habitat

Group A (2) – **Maintain Ecosystem Components**

This discussion group also considered the ecosystem objective of maintaining ecosystem components (biodiversity) and three "next level" objectives, how to:

- Maintain **communities** within bounds of natural variability;
- Maintain **species** within bounds of natural variability; and
- Maintain **populations** (genetic diversity) within bounds of natural variability.

Presentation of Discussion Highlights:

The group suggested an **alternative approach** to address this ecosystem objective, involving the following actions/principles:

- To preserve/maintain ecosystem we need to preserve a balance of representative habitats.
- We need to maintain communities and living things in those habitats.
- Identify habitats that have high versus low sensitivity to disturbance/perturbations.
- Develop a matrix of habitats that are critical or important to different communities/species/populations.
- Identify high/low use of habitats by species/communities.
- Management regulation is required to protect individual and groups of communities.

- **Exotic species** are also an issue: e.g., Atlantic salmon, green crab, Pacific oyster, manila clam, Japanese eelgrass, micro-organisms. It is not a matter of maintaining these species but of managing or limiting their impacts on natural ecosystems.

The group went on to identify some representative and unique habitats in the Central Coast:

- **Representative habitats and their biological communities** would encompass species groupings, including algal species, fish (e.g., salmon, small bottom fish, pelagic fish, herring), invertebrates (e.g., shellfish), marine mammals:
  - Shelf
  - Kelp Beds: nearshore (20 m) system: *Macrocystis, Nereocystis, Eisenia*
  - Intertidal
  - Seagrass: eelgrass, surfgrass
  - Estuaries: eelgrass, mudflats, brackish marsh, rocky shores
  - Beaches: Sandy, Rocky
  - Open Ocean: Midwater
  - High current areas: tidal passes mixing and sills
  - Freshwater Lens
  - Glacial Flow influence
  - Fjord wall
  - Cold water coral (unique or rare)
  - Muddy bottom inlets

- Rocky substrate: reef and flat bottom
- High energy ocean
- Sheltered inshore

♦ **Unique and rare habitats** (sample only, more work is required to identify the full range of unique and rare habitats in the Central Coast):
- Sponge reef
- Areas of localized upwelling
- Core whale feeding/rubbing areas
- Intertidal salmon spawning areas
- Scott Island bird rockeries
- Fredrick Arm (anoxic)

♦ Example of applying the suggested approach – "**Communities within Habitats**" to **Kelp Bed Habitat**:
- **Important communities**: kelp and other algae (expansion or contraction of beds), juvenile and adult salmon, rockfish (ling cod), sea urchins/otters (and many other invertebrates), marine mammals, birds
- **Key important species**: kelp, sea urchins, otters
- **Features**: high diversity (especially fish and invertebrates), high primary productivity, nursery, spawning habitat
- **Challenges in Developing MEQ Objectives**: Huge variability – would a "Variability Index" and graph be useful? How does a kelp bed community work?

The group also identified "**challenges**" to further specifying MEQ objectives for ecosystem components:

♦ There is a need to **assess further inventories** of biota in various communities (such as algal, invertebrate, fish and animal communities) in representative habitats.

♦ It is a challenge to **characterize the health of communities** that we don't fully understand – how do we define ecosystem health?

♦ It is a challenge to recognize and **understand bounds/limits of natural variability**.

Group B – **Maintain Ecosystem Component Function**

This discussion group considered the ecosystem objective of maintaining ecosystem component function and three "next level" objectives, how to:

- Maintain **primary production** within the bounds of natural variability;
- Maintain **trophic structure** so that individual species/stages can play their natural role in the food web; and
- Maintain **mean generation times of populations** such that population resiliency is assured.

Presentation of Discussion Highlights:

The group identified a number of **concerns and themes** that are inherent in attempting the task:

♦ Without an IM plan and **better knowledge** of the CCIM area we may have trouble setting MEQ objectives to maintain ecosystem component function. We don't even know what is out there so we can't map critical habitats (e.g., new species of corals have just been found in CC area, there is much we do not know about seasonal

changes (e.g., where do killer whales go in winter?), we know nothing about many invertebrates).

- First, **inventory what data we have** and rate data quality and coverage (we have lots of info from trawling; satellite info on kelp beds etc.).
- How do we manage issues at higher than LOMA levels (i.e., involving interactions between LOMAs)? **Interactions at coastal, national and global levels** (e.g., climate change, Persistent Organic Pollutants).
- There are many stresses, **linkages**, jurisdictions – how do we address the complexity and linkages (ecosystems, species, agencies) and **cumulative impacts** (e.g., aquaculture, oil & gas, point sources of pollution)?
- Are we **missing elements**? We don't know.
- How do we separate **natural versus anthropogenic variability** (has implications for selection and specificity of indicators)?

If the group could measure only a couple of things related to ecosystem component function in the Central Coast, they would be:

- **Impacts of fishing**; and
- **Impacts of aquaculture** in Broughton archipelago: benthic loading, escape of Atlantic salmon, sealice treatments, antibiotics, antifoulants (copper), do bright lights attract natural prey? ROVs, trap fisheries, grab samples.

Comments regarding measuring/assessing natural variability:

- We could focus on primary production: nutrients, temperature.
- We have noted huge declines in nutrients in one year and impacts in subsequent years, however, do we know enough about components and variability? There is much data that has not been synthesized.
- Given the Central Coast area characteristics (fjords, big river systems, glacial melt) we need to monitor timing of spring peak flows (climate, precipitation changes, water temperature). Big rivers are flown frequently.
- About 50% of the Central Coast is wide open coast, shelf area, eddies.

Comments regarding anthropogenic impacts at the LOMA level:

- There are many activities to monitor: e.g., point sources of pollution (e.g., pulp mills, mines), shellfish and finfish aquaculture, fish-forestry interactions (e.g., effects of booming), fishing (e.g., draggers, otters – benthic impacts), oil & gas exploration, exotic species (pathogens), shipping (including cruise ships) (noise, ballast water, waste water – pharmaceuticals, exotic species), urban development (sewage, runoff), tourism (whale watching, recreational boating, scuba, cruise ship impacts).

Comments on further developing ecosystem objectives:

1. **Maintain Primary Productivity:**
   Example – use phytoplankton species assemblages and shifts (abundance and composition): monitor for toxic and other species:
   i. Bloom characteristics (frequency, species): habitats (phytoplankton) (potential indicator for global warming – could use remote sensing and/or permanent buoys
   ii. Kelp and eelgrass beds (habitat)

2. **Maintain trophic structure:**
   Concentrate on top levels – marine mammals' spatial distributions and abundance (e.g., baleen whales, sea otters) and their food (e.g., changes in diet as prey assemblages shift result in different contamination), seabirds, bear predation on salmon, fisheries data and bycatch, predator/prey interactions
   i. Habitat availability – trawling impacts on corals (dragging area)
   ii. Trophic complexity – representation by different trophic levels
   iii. Predator-Prey Relations – gut contents or dietary preference, changes in reproductive parameters

3. **Generation Times** (group did not like the connotations of this term, instead could use "demographics"):
   Could monitor growth rates (size at age) of top predators:
   i. Longevity (e.g., rockfish, killer whales)
   ii. Life history strategy (mortality and reproductive health are endpoints with population ramifications)
   iii. Reproductive potential (e.g., age at sexual maturity)
   iv. Fishing mortality (Concern that information is available for commercial species but not non-commercial ones – current management is "fishing-oriented" as is)

Group C – **Maintain Ecosystem Physical and Chemical Properties**

This discussion group considered the ecosystem objective of maintaining ecosystem physical and chemical properties and two "next level" objectives, how to:

- Conserve **critical landscape/bottomscape features and water column properties**; and
- Conserve **water, sediment and biota quality** (contaminants).

The group attempted to **describe the important physical features (including bottomscape features) and chemical properties** distinguishing the Central Coast ecosystem. It was the group's belief that these could serve as a basis for establishing sub-areas and consequent MEQ objectives within the Central Coast area.

- **Summary**: **Key features and how they can be captured in Ecosystem Objectives**
  - One permanently anoxic basin – Frederick Sound – with Roscoe and Smith Inlets having low dissolved oxygen levels (need to monitor in particular)
  - Deep waters, lower oxygen levels
  - Passages through Central Coast are generally well-mixed.
  - Bute and Knight Inlets have lots of info – all others are under sampled
  - Tech. Report for 1986 summarizes chemical oceanography info of CC
  - Anoxic basins – not attractive to aquaculture industry
  - Logging: local sediment load
  - Prawn Fishing: good in old slide areas in deeper fjords
  - High shoreline: coastal feature
- **Important Features**
  - High ratio of shoreline water

- Rivers Inlet freshwater outflow
- El Nino (PDO): major effects in Central Coast
    a. productivity
    b. migration routes and landfall of salmon; North range of Southern Species
- Upwelling: Brooks Peninsula; QC Sound (nears Banks and Aristazable Islands)
- Cape St. James outflow plume into the Haida Eddy and dispersal
- Q.C. Strait to Campbell River: strong tidal mixing
- Johnstone Strait: "Northern Diversion"
  $\Rightarrow$ 25% salmon migration through strait
  $\Rightarrow$ Temperature: Kains Island Light Station takes daily readings
- Tidal meeting at North and South LOMA boundaries
- Winter throughflow: Hecate Strait, QC Sound flush
- Need to expand ocean-shelf boundary

♦ **Chemical Properties**
- Background cadmium levels generally high (characteristic of the Pacific} – more research needed
- Dissolved oxygen levels – have implications for anthropogenic activities (mills, fish farms)
- Algal blooms (toxic) – PSP
- Nutrients: N, P, Si
- Long range transport: PCBs, organo-chlorines, etc.
- Organic levels on bottom affecting chemicals on sediments

♦ **Important Bottomscape Features**
- Estuarine and foreshore areas
  $\Rightarrow$ limited hectares, important to protect those still intact
  $\Rightarrow$ heads of inlets, small bays
- Goose Island Bank, North Bank etc
- Geoduck habitat (depth, grain size, Temperature) – unique
- Hecate Strait/ Queen Charlotte Sound Low sediment deposition
  $\Rightarrow$ be cautious about changes, could have major impacts
- Reef habitats
  $\Rightarrow$ increase productivity
  $\Rightarrow$ important to rockfish
- Steep slide areas in coastal fjords important for prawn fishing

Other chemical and physical properties to take note of in the Central Coast include:

♦ **El Niño:**
- Major ones make it up here
- Hits in winter, carries coastal species further North
- Cyclical: every 4-6 years
- Major effect: changing migration routes for salmon (e.g., Vancouver Island "Northern Diversion")
- High temperatures lead to a decrease in production of plankton

♦ **Temperature:**

- Cold areas (upwelling areas): Westcoast, Charlottes; Eastcoast; North tip of Vancouver Island
- Warm areas: from Rivers Inlet (important freshwater outflow); Skeena – layer of opaque water absorbs solar energy

♦ **Coastal Inlets:**
- Interannual changes in productivity have been measured
- Currently no long-term time series of sub-surface: Temperature, Salinity, Currents, Nutrients; 100% natural variability; many changes
- Large scale drivers on smaller ecosystems

♦ **Note:** Natural variability through the nineties was much higher than what we've seen before.

DAY 2: DEVELOPING MARINE ENVIRONMENTAL QUALITY OBJECTIVES FOR THE CENTRAL COAST

Morning Plenary Review of Day 1 Discussions

Colin Rankin, Facilitator, Victoria, BC

Colin Rankin presented a brief summary of "noted points" from the first day of workshop discussions with corrections and additional comments made by workshop participants.

♦ **National Ecosystem Framework:**
- Fit of various plans and objectives (e.g., Objectives-Based Fisheries Management, Species At Risk Act) with ecosystem and MEQ objectives needs to be clearly articulated to reduce confusion and increase likelihood of acceptance/understanding among stakeholders.
- Regulatory implications of MEQ and role of *Oceans Act* – the *Oceans Act* provides the framework, other regulatory vehicles are generally the better choice for enforcement actions.
- It is important to be clear that MEQ objectives are "Environmental objectives" (not Economic or Social Objectives) within IM Plans.

♦ **Dunsmuir Workshop on National Ecosystem Objectives:**
- There have been important changes to terminology since report ("Table 1", for example, is illustrative only)
- Best reference for current terminology is Policy Committee approved wording from April 17, 2002 (e.g., "levels of specificity").
- Ecosystem Objectives are "unpacked" with increasing levels of specificity to "Operational Objectives" (MEQ Objectives are operational objectives because they are embedded into IM and MPA management plans).
- Proceedings of the workshop are still a very worthwhile reference (e.g., some example indicators and reference points, examples of different levels of ecosystem objectives, explanation of Index of Biotic Integrity and "Traffic Light" approaches).

♦ **ESSIM Experience in Preparing an Ecosystem Overview:**

- Scientists alone can't do it – IM Managers have to provide the outline and "hold the pen".
- Consider "what information is important" carefully for inclusion.
- Careful interpretation of datasets is essential (e.g., snow crab surveys found more crab when they were explicitly being looked for in Fisheries Management surveys).
- Set boundaries but make sure they are "flexible" and adaptable.

♦ **Science Experience with MEQ in the Atlantic:**
- Pragmatism and science – need both! – need resources to support the science and input from community groups/interests on their issues in order to set specific objectives and indicators.
- Management issue "driven" MEQ objectives can provide a good practical grounding in choosing MEQ objectives, however, need also to track overall health of the ecosystem and other "non-issue driven" MEQ objectives. Need to define a scale function that represents degrees of impact.
- Use "Herb's 70/30 Rule of Thumb" to gauge appropriate level of effort and budget but management-related MEQ objectives (about 70% of effort) and longer-term "integrated" MEQ objectives (e.g., those related to tracking climate change) (about 30% of effort) that may not be immediately apparent to CC field managers.

♦ **Additional Comments made during plenary discussion:**
- Inventory and monitoring is important: we need better information to be able to set reference points. We already set reference points for many managed fisheries (e.g., salmon). We could raise the profile of selected existing reference points for use in setting MEQ objectives. We need to initiate an inventory and monitoring program for a selected few "non-commercial" species. Another idea: we could pilot an "intensive" inventory and monitoring project for a selected area. A specific fund for addressing research and monitoring for Central Coast MEQ might also be appropriate.
- One point not to forget when considering MEQ objectives is sponge reef habitats – very rare and important aspect of Central Coast.

Review of Terminology and Examples of MEQ Objectives

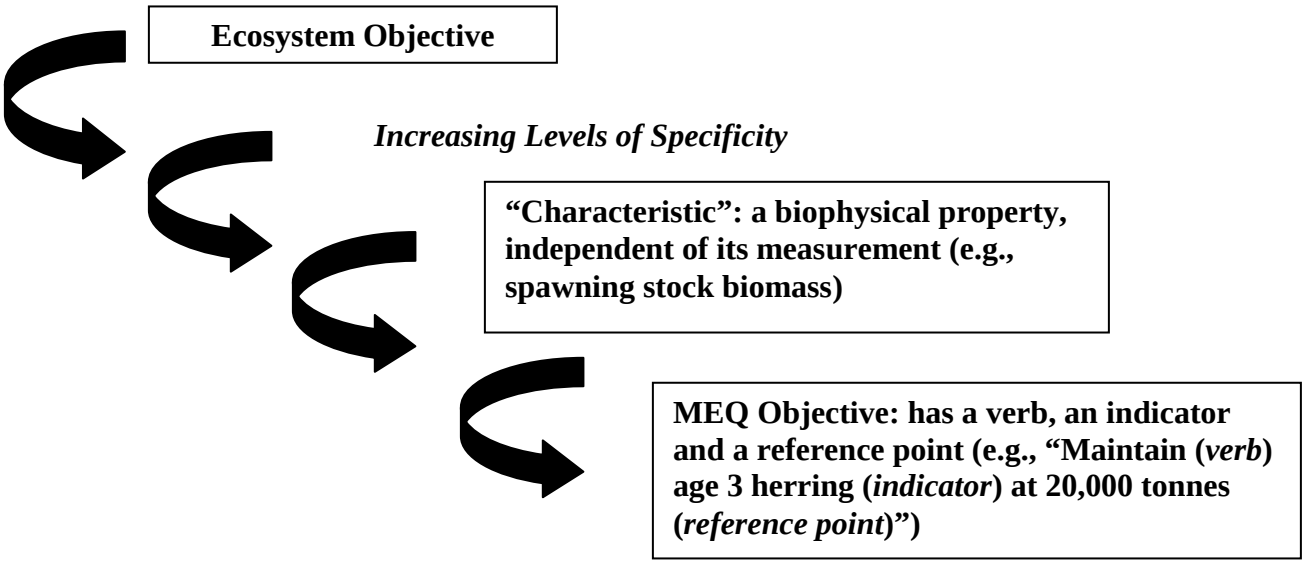
Glen Jamieson, Herb Vandermeulen, Brenda Bauer

Glen Jamieson reviewed key terms and the approach to "unpacking" ecosystem objectives. Glen Jamieson, Herb Vandermeulen and Brenda Bauer then presented examples of MEQ objectives to illustrate the approach.

♦ The "Ecosystem Objective Framework: Practical Examples" table presented on Day 1 of the workshop provides the most clear examples of the unpacking process – from a "high-level objective", to a "more specific objective", to an "operational objective", with accompanying examples of "management measures." The diagram below summarizes this process.

♦

Moving from an Ecosystem Objective to MEQ Objectives:



- Ecosystem objectives may be largely the same for all LOMAs, and quite similar for adjacent LOMAs. MEQ objectives may/will differ due to differing management needs and more localized ecological and/or physical differences. MEQ objectives may be chosen on the basis of such factors as management need, cost, utility or "representativeness".

MEQ Objective Example – "Maintain physical and chemical water qualities":

- Example of unpacking (under the ecosystem objective of "maintaining physical and chemical water qualities"):
  - Conserve water, sediment and biota quality (Ecosystem Objective – from Policy Committee);
  - Conserve water quality – dissolved gases (Increasing specificity – from Dunsmuir Workshop);
  - In the Central Coast, Frederick Sound is a permanently anoxic basin and Roscoe and Smith Inlet have low oxygen at times (Increasing specificity – from this Workshop);
  - "Roscoe and Smith Inlet should not develop permanently anoxic basins." – **MEQ Objective**;
  - Follow up to fill data gaps/research plan: What are critical low oxygen levels (and duration) for the two inlets? At what point will key aspects of structure/function of Roscoe and Smith Inlets be lost due to prolonged low oxygen?

MEQ Objective Example – "Maintain ecosystem components":

- Ecosystem Objective: "Maintain Ecosystem Components."

- Suggested approach: breakdown into representative and rare/unique habitats.

MEQ Objective Example – "Maintain ecosystem component function":

- Ecosystem Objective: "Maintain Ecosystem Component Function."
  - Next level of specificity: "Maintain trophic structure so that individual species can play their natural role in the food web."
  - Next level of specificity: "Maintain trophic complexity." This involves the number of species and their relative proportion/abundance in trophic levels. Higher trophic levels are most of concern – fishing preference, and most contaminated by chemicals.
  - Possible MEQ Objectives:
    1. Control regional sources of relevant contaminants so that killer whale's contaminant x is within y % of the accepted safe level. Possible Management Response: Tighten up pollutant discharge levels.
    2. The catches of species by trophic level in each year's Central Coast total landing statistics should reflect a balance (relative proportion) that indicates no fishing down of the food web. Top trophic level catches should be maintained at x % of the total catch. Possible Management response if not achieved: Determine reason why not, and possibly expand MPAs or equivalent rockfish protection areas (RPAs).

Discussion Regarding MEQ Objective Examples:

- **Concern:** I'm worried about the apparent lack of importance given to indicators in the National MEQ framework and in the examples provided so far. Why are the indicators secondary? **Response:** Indicators are not "secondary" – they are an essential element of an MEQ objective. Indicators are derived from MEQ objectives so that reference points can be set and monitoring can commence.
- **Question:** Who manages and enforces the MEQ objective? Aren't other existing regulatory vehicles better suited to set and enforce clear regulations? **Response:** MEQ objectives would be enforced by DFO staff and, more likely, by others with regulatory authority under relevant legislation – the *Oceans Act* is not intended as a primary vehicle for enforcement. MEQ objectives are intended to provide a more integrated underpinning to management and enforcement.
- **Comment:** At Parks Canada we're also trying to address ecosystem level management (primarily through our mandate of "maintaining the ecological integrity" of parks) – we've come to the realization that we are not "managing the ecosystem", rather **we are "managing people"** and our impacts on the ecosystem. It seems to me that this aspect is missing from MEQ objectives – there should be reference to the management actions that would be associated with an MEQ objective. **Response:** This is a debate that has been going on for some time now (managing the ecosystem versus managing people) – the current characterization of MEQ objectives is a reflection of the feeling that we first need to establish desired ecosystem conditions, then identify the people management actions (within the IM or MPA plan linked to the MEQ objectives) that are needed to achieve or maintain those conditions.

- **Comment:** It would be helpful to provide some **criteria to guide** people attempting to identify an appropriate suite of MEQ objectives for the Central Coast or any other area – it's a daunting task and there are many potential objectives.
- **Comment:** It would also be helpful to know what **degree of specificity** is appropriate for an MEQ objective.
- **Comment:** Could use past experience (e.g., South Coast pulp mills and water quality objectives) as examples to explain MEQ objectives – make the examples "more real". If the MEQ objective was to limit dioxin and PCBs flowing into coastal waters, we'd need indicators of where dioxins are in large concentrations. The management action was to monitor furans and dioxins in the bottom of the food chain. Crab, clams, seals and whales served as relevant indicators for monitoring toxins in the food web. Worked with pulp mills to eliminate release of chemicals into the environment, monitoring the resulting actions using the indicator species.
- **Comments:** There is some confusion around the term **"indicator"** (e.g., **Question:** Is an indicator a target? **Answer:** Yes). The indicator should tell you the abundance of a species in a habitat – it should be more than stock assessment. We need indicators that tell you about more than one thing – if we get too specific, we end up with too many indicators and MEQ objectives to be useful.
- **Comment:** When we do Science evaluations, we estimate biomass and develop targets. We try to determine the causes that drive a species and its populations below target levels. However, it is managers, not scientists, that make the decisions on target levels.
- **Comment:** Central Coast has had relatively little development to date, hence it is a good place to start applying MEQ objectives.
- **Suggestion:** DFO may approach other federal departments that regulate in marine environments to discuss the potential use of industry-specific MEQ guidance documents addressing the actions needed to meet MEQ objectives.
- **Comment:** I believe that **cumulative effects** are key to MEQ objectives. MEQ objectives assist in exposing cumulative effects (e.g., the effects of septic fields and sewage plants on marine ecosystems).

Central Coast Management Issues Related to MEQ Objectives

Brenda Bauer

Brenda Bauer, Central Coast Integrated Management Coordinator, reviewed some of the key current management issues and challenges for the Central Coast. Additional comments were provided by Central Coast Managers Gary Taccogna and Don Sinclair.

Presentation Highlights:

- Many roles for IM:

1. Assist in clarifying local issues of shared jurisdiction (i.e., with province);
2. Tool to examine cumulative impacts and ecosystem health and limits (i.e. water); and
3. Stewardship, education and outreach.

- Although there are areas of defined DFO jurisdiction (e.g., fisheries), many responsibilities are shared with the province (e.g., shellfish and finfish aquaculture) – cooperation is needed to support enforcement.

- **Proactive management** is one important goal for IM:
  - Objective is to make the best marine decisions to maintain marine integrity.
  - Coastal marine planning: Defining where to go and what to do (appropriate locations and activities in the marine environment).
  - DFO involved in coastal marine planning because of jurisdictional responsibilities and expertise – can provide science and management information and experience.
  - Often don't have the information, resources or authority for final decision-making – have to work with others to achieve mandate.
  - Constantly asked by community groups and First Nations for community involvement (e.g., invited to participate in a local marine stewardship council).
  - Also many calls for restoration projects (e.g., fisheries, abalone).
- **Challenges to achieving proactive management**:
  - How to bring DFO information back down to an area-based management level and reflect this knowledge in the work that we are doing in the Central Coast.
  - Have to choose where to put **limited resources**: What are the most challenging issues facing the Central Coast? Where can we be the most effective?
  - There is **limited information** about best practices as they may be applied in the Central Coast.
  - How to most effectively work with communities (e.g., what is next step for Shorekeepers and Streamkeepers)? We do not have a good sense of where people should be data or what exactly they should be doing. Where should we direct the volunteers?
  - Collecting **relevant data** (e.g., monitoring impacts on species and habitats). Central Coast Area has limited contact with Science. We do not have good mechanisms for sharing info about the area. We have established an information subcommittee involving scientist, GIS experts and habitat managers as a first step in improving this situation.
  - Looking at **management plans** – need guidance on where to find best resources and information (e.g., catch data and area statistics).
  - Need to build **relationships with all stakeholders** – develop a framework for effective consultation and collaboration.
- **Reactive management**:
  - Where should we direct our efforts? How and to whom do we report impacts of various activities?
  - Identification of habitat destruction and appropriate compensation (e.g., contaminate dumping, eelgrass beds).
- Ecosystem-Based Management approach:
  - Have to manage **impacts of human activities** (not environmental impact) (e.g., human impacts on Q.C. butter clam population).
  - How to determine and enforce **carrying capacity** given cumulative impacts of various activities (e.g., shellfish and finfish aquaculture).
  - **Aquaculture** concerns: impacts on natural stocks, transferring of disease, escapements, altering the environment. Need to focus on a process to resolve these issues.

- When **targets** are set, do we have the ability to incorporate what we see at the local level? Do we have mechanisms in place to bring down to local level management?
- Need to identify targets of different blends of activities. Pilot project: how many aquaculture farms, tourism activities, industries can be maintained sustainable in a certain area?
- Values of local **First Nations** – how to incorporate them in assessment and decision-making? We need mechanisms for effective community discussions.
- Tracking of **bycatch** in the Central Coast.
- Also, new and emerging issues such as **cruise ship impacts** – (e.g. a new stop in Campbell River is currently under construction).

♦ **Key challenge for IM and DFO**: communication and lack of understanding of processes – we need to have a better idea of where we are going with management.

Additional Comments from Gary Taccogna, Central Coast Area Manager:

♦ **Quatsino Sound** is a proposed area for a new pilot project – smaller area management (CMA).
♦ One of the problems of working with community groups is **lack of knowledge and limited resources**, especially with watershed groups, and consequent demands on limited staff time.
♦ Difficult to set objectives without inventory.
♦ Groups are starting to see bigger picture of impacts in watershed and how it is affecting marine environments.
♦ Activities such as **salmon recovery plans** and **habitat restoration** are seen as important locally.
♦ Holes in information – marine survival is critical and there have been dramatic losses in a lot of fish populations. Lack of knowledge of fish migration. Need to pull info together to identify **critical habitats** for feeding grounds, spawning. Need to identify **areas to protect** from human activities such as aquaculture farms, industry.
♦ There is a lot of **local knowledge** that can be tapped.
♦ There is also a **history of lack of cooperation** between agencies.

Discussion Comments:

♦ **Comment:** We need to give people a better idea of what MEQ is before asking them too much about what MEQ objectives should be – key thing is putting together a rough draft of an MEQ framework for the Central Coast for distribution as soon as possible.
♦ **Question:** Will MEQ objectives address all the challenges DFO faces in the Central Coast?
♦ **Question:** How does habitat management fit into the Dunsmuir report? What are the habitat issues? Need to find other ways to address concerns.
♦ **Answer:** Need a science base to define what exists in the Central Coast (e.g., need to manage fish farms). We need some MEQs and guidelines that address quotas. We also need a mechanism to protect, as well as guide appropriate use of, areas that are highly sensitive.
♦ Central Coast area has been affected by boating.

- Need science base to back up decision-making (e.g., we need to clearly identify areas that need to be protected). Scientists need to work with the managers – build a framework for learning.
- **Question:** Is there a way that we can deal with fish farms in a group, rather than individual, basis?
- Burden of proof and the precautionary principle are becoming devalued. We need a science basis to back up management decisions (e.g., if a fish farm application is turned down due to cumulative effects concerns).
- **Knowledge gap** – there is a need for science which is good but science has been cut back at all government levels. It will be difficult to go out in the field to learn about MEQ due to lack of funding. We need to send a message out to the public that we are in a critical situation.
- **Answer:** There is some knowledge (e.g., reports, website, databases). There are resources but the challenge is delivering info to managers. Need to develop a DFO website to provide easy access to science information. Need better communication across all branches of DFO. We need ecological overview and "state of the ocean" reporting.
- **Four categories of destruction: 1) alienation** of habitat by human activities (complete disruption of sites); **2) alteration** of habitats and ecosystems (dynamic interaction); **3) contamination** (pollutants); and **4) over-harvesting** (fisheries and carrying capacity of system). MEQ can fit into these categories.
- Issues facing the Central Coast: logging, aquaculture, fishing, threatened populations (e.g., abalone, orcas), depressed populations (e.g., some salmon populations), salmon populations that have fallen in watershed areas.
- **Cumulative effects** are an issue with aquaculture: what is the carrying capacity of fish farms in an inlet? The province currently has given the green light to aquaculture in the Central Coast – DFO needs to be able to respond with science-based information (and a defensible rationale) on where and where not salmon farms can be located – otherwise it will be "see you in Court".
- **Summary of critical information needs** from my (Central Coast IM Planner) perspective:
  - Need to improve planning for the area.
  - Need to identify critical habitats.
  - Need to identify representative habitats and cumulative processes.
  - Next challenge is identifying what is relevant (i.e., what information is the most important to collect and monitor?).
  - What info do we need at different scales?
  - How are we going to use MEQ objectives and what will they be able to do?
- At this workshop we are identifying gaps in knowledge. We need to fill these gaps before we can move forward.
- We know the gaps – and the issues! To make up for depressed populations, we are opening fish farms and exploiting other species. We don't want to dig deeper into a hole. We have enough information on aquaculture, logging and industry – we need to document activities and monitor them to measure where we are in the cycle. We need to look at the **broad MEQ approach**. There are some MEQ objectives that we can use to help us to move forward.

- The idea of **important habitat** is based on species – need an inventory of species in certain areas. We know commercial species but lack data on non-commercial species.
- **Suggestion:** explore areas where there are gaps and try to figure out the parts of the puzzle that might help leading into the MEQ objectives.
- **Suggestion:** In the past we've used a **risk assessment approach** in late sockeye salmon runs – this has allowed us to look at contaminant stresses. Need to do a risk assessment and an inventory list in the CC that will allow experts to "dive in" to more detailed work when more is known about the scope of the problems.

Summary of Central Coast Management Issues Related to MEQ Objectives

Summary of Discussion:

- **Management Issues and Needs**:
  - Lack of information: current focus of information and effort is on watersheds and salmon.
  - Need to be able to support Recovery Plans (SARA), "strategic enhancement" interventions.
  - Identification of critical habitats is important.
  - Habitat Management needs to be more proactive – currently buried in referrals.
  - Need to support different ways of achieving mandate (e.g., identifying "No Go Areas"):
    - zoning $\Rightarrow$ siting; and
    - carrying capacity $\Rightarrow$ knowing when are limits reached.
  - Need a strong science base for management decisions (i.e., a strong defence "when we go to court").
  - "Results-based management" is currently a focus for provincial forest management – could we look at something analogous for marine ecosystems?
  - We need criteria for assessing proposed activities (e.g., "Ecological Integrity Statements").
  - Consider a fund for joint research as an element of compensation for regulatory offences (caution: don't want companies to see such fines as "a cost of doing business").
  - How much can DFO science provide to address management needs? (We need to manage expectations of public/interests.)
  - We need to get existing information into the hands of field managers and interests in a useful manner. One suggestion: improve the DFO website (contrast to Environment Canada website with access to site specific data sets).
  - More information is needed on stressors, appropriate to scales of management.
- **Important issues for the Central Coast:** decrease in salmon populations (as well as abalone and other species); aquaculture development proposals and cumulative effects; logging and associated impacts on marine ecosystems.
- **Relation of human impacts to MEQ:** how to address alienation, alteration, contamination and fisheries impacts?

Day 2 Small Group Discussions: Developing MEQ Objectives

Participants spent the majority of the second day of the workshop in small group discussions, working on developing MEQ objectives for the Central Coast and building on the understandings gained from the first day of discussions. Group membership largely remained as it was on the first day of the workshop – with three groups looking respectively at unpacking the three highest order Ecosystem Objectives. The fourth group (Group A (2) from the first day) worked on further developing and applying the alternative approach to establishing MEQ objectives that was identified on Day 1 of the workshop.

The first three groups addressed the question:

> **How can Ecosystem Objectives translate into Marine Environmental Quality objectives and indicators what can be linked into a Central Coast Large Ocean Management Integrated Management Plan (introducing measurable or operational aspects)?**

Small Group A: "Maintaining Ecosystem Components"

Summary of Discussion and Recommendations:

Broad Ecosystem Objective	**A. Maintain enough components (e.g., communities, species, populations) within bounds of natural variability**
Increasing Level of Specificity	**A.1. Maintain populations within bounds of natural variability**
Suggested Draft MEQ Objectives	**i. Support recovery of depressed stocks-populations** **ii. Conserve critical habitats**
Known species of concern	**a.** Abalone **b.** Owikeeno Sockeye **c.** Long Lake Sockeye **d.** Oolichan **e.** Rockfish **f.** Orca (North Coast resources) **g.** Nimpkish Sockeye, Chinook **h.** Mainland Inlets Chinook
Species of Concern: Actions/Management Measures	**a. Abalone** 1. Identify, define and inventory critical habitats 2. Assess quantity and quality of historic and present habitat range Assess stock: numbers, age structure, size &age at maturity

	3. Identify cause(s) of decline: e.g., overharvesting, habitat impacts, regime shifts 4. Monitor and protect identified and delineated habitat: - Provide Habitat staff with maps of abalone habitat - No development in critical habitats
Species of Concern: Actions/Management Measures	**1.b. & c. Owikeeno and Long Lake Sockeye** 1. Improve stock assessment information (e.g., smolt d/s program) 2. Identify critical habitats in early marine phase of rearing 3. Monitor and protect habitat: provide maps of critical early marine rearing areas to Habitat staff
Species of Concern: Rationale for Choice	**1.d. Oolichan** - Depressed stock of significance to First Nations - Population depressed through shrimp bycatch - Other issues: contaminants
Existing Information and Tools	- Bycatch records - TEK: First Nations - Contaminants: IOS
Actions/Management Measures	To reduce bycatch to an acceptable level: 1. Gear modification 2. Close shrimp trawl fishery at x% of bycatch
Species of Concern: Rationale for Choice	**1.e. Rockfish** - One possible problem is impacts of fish farms - Recreation and commercial overfishing
Existing Information and Tools	- Provincial info, flyovers - Seafloor mapping to identify habitat - TEK: fishers and First Nations - Dive logs
Actions/Management Measures	Need to know: - Impacts of log dumps, storage - Impacts of netpen farming Monitoring of recovery under management: Management Plan underway (debate on aspects of the Plan)
Species of Concern: Rationale for Choice	**1.h. Mainland Inlets Chinook** - Recruitment over-harvesting and at sea survival
Existing Information and Tools	- Standard database - TEK - Campbell River estuary studies - Carnation Creek info in relation to other stocks
Actions/Management Measures	- Delineation of habitat degradation: - Improve stock assessment: population parameters: fry -> smolt -> adult survival

	- Monitor and protect habitat

Additional Discussion Points:

- **For population-depressed species:**
  - "Maintain genetic diversity of population" (hatcheries/selected fishing) (e.g., late summer and early winter population runs)
  - For invertebrates: "fish wide" and "fish light"
- **For communities:**
  - Next level objective: "Maintain species diversity and abundance"
- Important **Management Objective: "Preclude exotics"**
  - Rationale: alter community structure and may reduce productivity capacity
  - Existing sources of information: taxonomic guides/lists, TEK, baseline studies
  - Work Required: stewardship monitoring (e.g., Shorekeepers), fishery monitoring

Small Group B: "Maintaining Ecosystem Component Functions"

Summary of Discussion and Recommendations:

Broad Ecosystem Objective	**B. Maintain function of each component of ecosystem to allow it to play its natural role in the food web**
MEQ Objective: **Rationale for Choice**	**1. Maintain abundance of higher trophic level species** - High trophic level species tell us about food webs (quantity and quality) and ecosystem function (integrators) - They may have high economic value - Potentially "charismatic" species (e.g., orca) - Measurable and approximate data available - Important to ecosystem health (i.e., predator selection of sick versus healthy prey)
Existing Information and Tools	- Catch stats - Diet composition - ECOSIM (model) - Stock assessment (Fisheries)
Actions/Management Measures	- Measures of food web complexity, status and change (e.g., trophic level of catch, stable isotopes, bycatch) - Spatial variability
MEQ Objective: **Rationale for Choice:** **Note:** Links with Broad Ecosystem Objective C:	**2. Maintain climatic features needed to support food webs** - External (likely) influence on Central Coast area - May have major impacts on ecosystem structure, salmon returns, etc. - Will interact with Central Coast issues,

"Maintain ecosystem physical and chemical properties"	management, fisheries - Need to link Central Coast LOMA to Ottawa, Kyoto
Existing Information and Tools	- Subsurface temperatures - Lighthouse records - Remote satellite imagery - Abundance of migratory species (grey whales, mackerel, salmonids, seabirds)
Actions/Management Measures	- Define "natural variability" - Ecosystem response to changes in global climate and how to monitor and reduce existing changes - Central Coast management responses (adaptive management) - Monitor dietary changes - Linkages to other areas, agencies (DFO, Environment Canada, international committees)
MEQ Objective: **Rationale for Choice:**	**3. Minimize impact of artificial light on non-target (endemic) species in local areas.** - Aquaculture, urban areas, docks, lights in the marine environment, bridges are often lit at night with unforeseen impacts such as bird hits, fatal collisions, predation increase on salmon fry, increased seal attraction and mortality, unfavourable environments - Example of technological change
Existing Information and Tools	- Impact assessments - Fatal light attraction studies
Actions/Management Measures	- Inventory of light pollution - Impact research and monitoring - Establish guidelines

Additional Discussion Points:

- **Other potential MEQ objectives:**
  - Minimize impact of (underwater) noise on ecosystem
  - Minimize impact of exotic species
  - Minimize anthropogenic causes of harmful algae bloom
  - Minimize disturbance or alienation of critical habitats for sensitive life stages (e.g., breeding bird colonies: ecotourism, aquaculture siting)
  - Minimize serial depletion of marine environment
  - Minimize non-target impacts of fishing practices
  - Minimize impacts associated with boating activities (mooring, noise, pollution, disturbances)
  - Minimize inputs of pollutants that have cumulative population level ecosystem consequences (e.g., persistent, bioacculumulative, toxic): "old": DDT (foodchains Organotins – in terms of imposex and whelks] (shellfish); "new": flame retardants, pharmaceuticals
  - Minimize habitat fragmentation (aquaculture, log booming)

- **Potential management actions** to support an example MEQ objective (Minimize impacts of exotic species):
  - Reduce abundance of varnish crab in estuary to < 1% of area
  - Eliminate ballast water releases in inshore areas
  - Eliminate accidental release of exotic species from cultures
  - Minimize impacts of exotic aquaculture installations
- Additional comments:
  - We had problems getting down to specifics: there is a lack of science to get down to the level of defining MEQ objectives in order to pull information together and provide clear MEQ objectives.
  - Oceans used to receive $12 million but cutbacks have affected the Department, we lack sufficient funding to do a good job; an environmental research fund is needed for long-term research; we don't have an applied research fund in Oceans for this fiscal year.
  - **Comment:** Could approach NGOs and First Nations to help the government. Until we have a plan in place, we should not be too perturbed by the lack of funding.
  - **Comment:** If we have limited money, let's map out the most critical areas that need a management plan.
  - One **suggestion**: start with higher trophic species – fish species, seabirds, mammals.
  - Benthic species are good indicator species in the water column.

Small Group C: "Maintain Ecosystem Physical and Chemical Properties"

Summary of Discussion and Recommendations:

Broad Ecosystem Objective	**C. Maintain ecosystem physical and chemical properties**
Increasing Specificity:	**C.1. Conserve critical landscape (nearshore and bottomscape) features and water column properties.**
MEQ Objective: **Rationale for Choice:**	**a. Maintain important and unique nearshore habitats (e.g., wetlands, fine-grain substrates) and hydrological processes as relative abundance in Central Coast is low and importance is high.** - Contaminants have huge impacts in certain habitats - Debris (hard plastics, escaped logs) is one management issue - Current uses: log handling and storage, development, tourism
MEQ Objective: **Rationale for Choice:**	**b. Maintain communities associated with unique and important habitats.** - Potential habitats: lagoon systems, sills, rocky

	reefs (rockfish), hexactinellid sponge reefs, steep slide areas in coastal fjords
MEQ Objective: **Rationale for Choice:**	**c. Maintain and protect bank and gully habitats.** - QC Sound/Hecate St. - Important habitat for juvenile fish, birds, etc. Note: relatively extensive in Central Coast but also important
MEQ Objective: **Information Needed:**	**d. Protect vents, dunes, cold seeps?** - Need more information to identify these features and their values in marine ecosystems
MEQ Objective: **Rationale for Choice:**	**e. Manage sedimentation inputs in Hecate St/QC Sound as these are low sedimentation areas.** - Focus on areas with high benthic productivity/diversity - Low sedimentation in this area leaves it vulnerable to changes (e.g., effects of oil and gas deposition of drilling cuttings and mud, etc.) - Stability of the environment (salinity, Temp) - Offshore environment: species richness
Increasing Specificity:	**C.2. Conserve water, sediment and biota quality contaminants (chemical properties)**
MEQ Objective: **Rationale for Choice:**	**a. Do not allow Cadmium levels to go above natural background levels.** - Background levels of Cadmium are high Note: Mercury also should be considered
Management action:	Do not allow any human inputs of Cadmium into the Central Coast area
MEQ Objective: **example Reference Points:**	**b. Maintain dissolved Oxygen levels, nutrients, suspended solids, and particulate organic carbon around background levels.** - Dissolved Oxygen limit of 4 mg/L (target of 8 mg/L?) – could have a great deal of discussion on these example reference points, stresses need for careful scientific evaluation of the issue
MEQ Objective: **Management Actions:**	**c. Prohibit release of toxic, persistent and bioaccumulating chemicals.** - Monitoring program necessary - For all other chemicals, actions should be taken when there are public health concerns or population level effects on biota - Need to look at long-term effects
MEQ Objective:	**d. Monitor PSP levels, domoic acid, diarrhoeic shellfish poisons, pinpoint source and take management action if above background levels.** Note: pollution in aquaculture sites can increase algal blooms, there is also the issue of algae

	harming fish
Increasing Specificity:	**C. 3. Large Scale Physical Processes and Shoreline Integrity (Supralittoral Zone – Shoreline riparian)**
MEQ Objective: **Rationale for Choice:**	**a. Monitor sea level height in Prince Rupert as it relates to groundfish recruitment (Objective: To maintain healthy fish stocks)** - sea level at that site is a measure of flushing of Queen Charlotte Sound and Hecate Strait - Recruitment low when overall flushing is high (affects groundfish stocks) - Consider this index when setting quotas for Pacific cod
MEQ Objective: **Rationale for Choice:**	**b. Monitor El Nino Southern Oscillation (ENSO) and ALPI (Aleutian Low Pressure Index) and PDO (Pacific Decadal Oscillation) events.** - Change to landfall of Fraser River sockeye and Northern diversion - Howard Freeland ENSO index should be examined - North boundaries of Southern Species affected - Kains Island Temperature in June – determines salmon migration routes (Johnston Strait diversion) - Scott Islands: high temperature waters from ENSO events reduces productivity, effect bird populations
MEQ Objective: **Rationale for Choice:**	**c. Monitor tidal activity.** - Pendrell Sound: growout for oysters, warm water as a result of minimum tidal mixing, so warm surface layer forms
MEQ Objective: **Rationale for Choice:**	**d. Minimize effects of navigation on nearshore environments (acoustics, wave effects).** - Implications for intertidal zone species composition, increase wave height and energy - Maintain noise at a level that does not adversely affect wildlife
MEQ Objective: **Rationale for Choice:**	**e. Minimize disruption of nearshore sediment transport processes due to impacts of shore structures** - Examples of shore structures: groins, docks, breakwaters - Shore structures also affect transportation

Additional Discussion Points:

- **Question:** Which department monitors chemicals in water bodies – Health Canada or Environment Canada? Answer: Both in partnership with DFO if there is a need for a fishery closure due to human health concerns.

- **Question:** Sulphite build up in sediments around fish farms – responsibility of provincial Waste Management Branch?
- **Question:** If we want to develop MEQ objectives, do we share jurisdiction (based on objective 2)? Answer: DFO or volunteers can measure parameters – however, regulatory management doesn't have to be DFO, it can be another department.
- **Question:** How many kilometres (or hectares) do we have of some habitat?
- **Question:** Who prioritizes MEQ objectives?
- **Comment:** We have MEQ objectives but we have a long way to go before regulation and management actions occur. Answer: MEQ objectives should first be set, and then track ecosystem behaviours over time.
- **Comment:** Need more specific rules and regulations in the Central Coast that are relevant to a specific local area. Answer: Make own regulations under the *Oceans Act*.
- **Comment:** Attributes of shoreline? Need MEQ objective that deals with buffer zones to maintain integrity near the shoreline (supralittoral zones).
- **Comment:** There is research on Cadmium concentrations in water – apparently it is coming from a natural source (deep Pacific waters). Contact person for Cadmium research in George Kruzynski.
- **Comment:** Preservation – look at species associated with habitats.
- **Comment:** We lack information and data on bottomscape features – location, importance and abundance.
- **Comment:** Need to preserve bottomscape features.
- **Comment:** We need zero tolerance on damaging some habitats – need to prioritize preservation needs.

Small Group D: Alternative ("Information-based") Approach to Address "Maintaining Ecosystem Components"

This group tested an alternative ("Information-based") approach to developing MEQ objectives – rather than "unpacking" general level ecosystem objectives, the group:

1. Identified existing tools, data and knowledge about higher level ecosystem objectives, relative to the Central Coast (e.g., existing decision rules for species/stock management);
2. Identified gaps in the existing knowledge base;
3. Discussed how to better integrate existing tools to develop appropriate MEQ objectives;
4. Summarized key points; and
5. Suggested "next steps" or an "action plan" where discussed.

Broad Ecosystem Objective	**A. Maintain Ecosystem Components**
Increasing Specificity:	**A.1. Maintain communities within bounds of natural variability.**
Existing	- There are regulatory options for the protection of

Tools/Data/Knowledge	habitat or species - A tool we have for protecting unique/rare/valued communities is regulatory exclusion (e.g., MPAs or zones or human activity restrictions)
Gaps	- No decision rules based on communities - Lack of data on what factors would affect the existing communities and to what extent - Need to better define (DFO) consensus on what a community is (e.g., depends upon perspective, sampling method) - Do we need to manage communities? Can we manage community through its parts? - To manage we need to understand what makes it up and how it functions
Better Integration/Recommended Actions	- Identify and classify where to protect communities and to what extent - The tools we have to protect things are currently based on species or habitats but the *Oceans Act* allows a broader interpretation - Consider use of *Canadian Environmental Assessment Act* (CEAA)
Summary	- Need reference point development for communities Tools: - DFO could be using both MPAs and restriction/protection of a community; arrange levels of protection - DFO needs to define/identify and classify communities - Study unique or set of representativeness
Increasing Specificity:	**A.2. Maintain species within bounds of natural variability.**
Existing Tools/Data/Knowledge	- Integrated Fisheries Management Plans - Objective-Based Management Plans - Lots of data on commercial fisheries/industry generated data - SARA (*Species at Risk Act*): Species Recovery and Action Plans - Bycatch/selective fishing data and methods - Research on ecology of species - CEAA - *Fisheries Act* – Protection of critical habitat for a species - Transfer and Transplant Committee - Also COSEWIC (Non-DFO) pending implementation of SARA
Gaps	- Need info on non-commercial species (e.g.,

	nudibranch/coral) - Insufficient info on even some commercial species (fishery dependent data, spawning, rearing) - Don't understand influence of environmental variables to integrate this info - Condition, health, disease info - No exercising our responsibilities - No prosecution or requirements enforced for finfish aquaculture
Better Integration	- Need to make linkages in DFO (e.g., Habitat, Science, Assessment, Management) - IM: on smaller geographic scale, should integrate all existing fishing plans currently in development in the IM plan.
Summary	- Integration of species planning should take place on smaller scales - There are lots of existing tools and criteria/evaluation that have been developed but there is still a gap in info for non-commercial species * We have MEQ and reference points for most endangered commercial species – we need reference points for other things
Action Plan	- We can't set MEQ for non-commercial because we don't know enough: 1. What data is available: museums, First Nations, universities, databases? 2. Inventory Species: What? Where? How Many? (Could we tag on to existing work?)
Increasing Specificity:	**A.3. Maintain populations within bounds of natural variability.**
Existing Tools/Data/Knowledge	- Closures - Genetic/stock id - Strategic stock enhancement - Lake fertilization - Stock assessment finer scale (most of species) - Stat/management areas - Habitat restoration - GIS – finer scale
Gaps	- Information mainly applies to salmon - Need other species info (e.g., migration, variability) - Knowledge needed related to sequential depletion of stocks
Better Integration	- We would like to apply tools to other species but don't have resources - Get users to pay

	- Need integration within divisions of stock assessment

Summary	- Two key gaps are:
	  - a lack of knowledge related to genetic diversity for almost any species in Central Coast; and
	  - the need for reference point development for key populations.
	- Build an infrastructure by building a test case of a workable size
	- Inventory: tabulation of existing reference points (matrix); habitats; communities; species; populations
	- Monitoring program
	- Mapping
	- History
	* Last three relate only to selected non-commercial species and unique/representative habitats

Next Steps	**Set reference points** accounting for IM principles and known cumulative effects of the impacts of human activities. **Future:** Once we have reference points we can put on onus on users to monitor and report. Criteria for choosing reference point (indicator) species: - non-destructive sampling - use as index for impacts of human use - range of representation - focus on species that integrate a whole variety of influences

Additional Discussion Points:

- **Question:** Are we getting specific enough for direction?
- **Question:** Do we have enough information?
- **Question:** When are we doing an Ecosystem Overview? We are missing too much information.
- **Question:** Difference between data and metadata?
- **Comment:** Ecological Overview needs to be updated regularly.
- **Comment:** Fisheries management needs a higher profile. We need to identify the types of habitats in the Central Coast.

Final Plenary Review and "Homework Assignment"

Colin Rankin, Facilitator

Prior to adjourning for the day, the facilitator reviewed a sample project proposal for consideration in the Action Plan for developing MEQ Objectives for the Central Coast IM area. The proposal was roughed out during a one-day meeting, held the week prior to the workshop, with DFO staff who were unable to attend the workshop. As an overnight

"homework assignment" workshop participants were asked to consider potential projects that could be discussed and considered in the Action Plan during the final morning of workshop discussions.

Sample Action Plan Project Proposal – see Appendix 1, # 6.

DAY 3: FURTHER DEVELOPING MEQ OBJECTIVES – FINALIZING THE ACTION PLAN

Morning Plenary Review of Workshop Discussions

Colin Rankin, Facilitator

Colin Rankin reviewed a table summarizing the work of the discussion groups on Day 2 of the workshop. This information has been more fully incorporated in the notes for each of the discussion groups, rather than in a summary table, for this report as each of the groups used differing approaches to preparing and presenting their discussions. In reviewing the agenda for the final morning of the workshop, the steering committee proposed that participants work further to refine and develop potential MEQ objectives, as well as recommended actions (and estimated time and budget needed to undertake the actions) necessary to establish MEQ objectives for the Central Coast (for inclusion in the proposed Action Plan).

Workshop participants divided into two small discussion groups for the morning. The first group was charged with looking at developing MEQ objectives for a specific area within the Central Coast (Quatsino Sound) using the process developed by "Group D" on Day 2 of the workshop (existing tools/data/knowledge => gaps in information => integration of tools => actions to develop MEQ objectives) to develop an Action Plan of tasks and estimated cost for this fiscal year. The second group was assigned the task of using the results of MEQ objective discussions to select and further specify MEQ objectives most relevant to two management issues in the Central Coast: 1) aquaculture; and 2) cruise ship (vessel traffic) impacts – and identify recommended actions with time and cost estimates for this fiscal.

Plenary Discussion Points:

- **Question:** How were the issues for discussion chosen? **Answer:** CC MEQ Sub-committee chose the two issues to provide the discussion group: 1) a current "hot" management issue (aquaculture siting and cumulative impacts); and 2) an emerging management issue with potentially broad implications (cruise ship traffic).
- **Overview of concerns regarding cruise ship traffic:**
  - Discharge of waste – pharmaceuticals, sewage, garbage, potential for release of exotics
  - They do go slow in the area, but marine environmentally quality knowledge is lacking – we don't know the impacts of bow wave impacts on the shore, for example.

- Concern is that there are presently no guidelines for Cruise Ships (note: federal sewage guidelines are being considered)
- Concern about the growing industry and increase in numbers of Cruise Ships
- Potential impacts of stopovers in Campbell River (and other Central Coast communities in the future?)

♦ **Overview of concerns regarding aquaculture in the Central Coast (finfish in particular):**
- Siting and ongoing monitoring of aquaculture
- Current expressed desire of the Province for expansion of aquaculture – fish farms are going somewhere – where do we OK siting? Under what criteria?
- DFO needs to identify critical habitats so we know "no go" areas
- SARA species are reappearing in the Central Coast (abalone, sea otter) – does that mean we can't open a fish farm because abalone do or could inhabit a potential site?
- Other issues: disease (sealice, parasites), predators, noise, escapements, pharmaceuticals and antibiotics, light

Small Group 1: Considering Quatsino Sound Using "Information-Based" Approach to MEQ Objective Development

Summary of Discussion Points:

♦ **Overview of Issues and Activities in Quatsino Sound:**
- Human communities: roads and towns
- Copper mine (mine closed but there are residual impacts)
- Finfish aquaculture
- Shellfish aquaculture
- Ecotourism
- Sports fishing
- Shellfish harvesting
- Fishing: shrimp, crab, clam, sardines, cod, halibut, geoduck, urchin
- Ports
- Plankton blooms
- Sea otters
- Log dumping
- Pulp mill
- Logging
- Log blooms
- Log salvage

♦ **Overview of Features**:
- Parks: Brooks Peninsula, etc.
- Salmon runs – Chinook
- Killer whales
- Rich species and diverse habitats
- Freshwater: terrestrial, brackish, marine, shelf

- Mud substrate, low current
- Has been mapped using BC provincial (Land Use Coordination Office) definitions – BC marine ecosystem class system
- Eagles
- Impacted (logging, mining, pulp) but recovering

♦ **Goals** (for the Action Plan?):

1. Consider Central Coast MEQ objectives: can they apply to the Quatsino Sound Coastal Management Area?
2. Develop site-specific MEQ objectives for Quatsino Sound

♦ **Gaps in Knowledge** for Quatsino Sound

*** Ecosystem overview**

⇒ using existing data and info (lighthouse water readings and tide gauge)
⇒ using knowledge from elsewhere
⇒ field/remote etc work/research

1. Physical/oceanographic features (currents, depth, upwellings, salinity using coring, lighthouse, temporal satellite, line "P")
2. Critical habitats
3. Biological communities
4. Stresses/impacts
    - B.O.D, physical disturbance, chemical pollution, removal of biota

♦ **Towards MEQ objectives for Quatsino Sound:**

Objective A. Recover populations within bounds of natural variability

- Data for commercial species but not for non-commercial species

Objective B. Recover function of each component of ecosystem

- Data gaps
- Changes happening now
- High trophic level numbers

Objective C. Recover ecosystem physical and chemical properties

- Synthesize data: B.O.D (pulp effluent versus flushing rate), lighthouse SST, tidal data, remote sensing (1980- present), depth, salinity, dioxins
- * Reduce release of pollutants that increase B.O.D. (in Quatsino Sound) to aid recovery of: a) populations; and b) ecosystem/function
- Cumulative impact of pulp and aquaculture and sewage
- Dissolved Oxygen Rationale: B.O.D reduces oxygen levels and that kills shellfish, bad for migrating salmon

Objective D. Identify and assess stressors to the ecosystem (risk assessment)

- No collated information or assessment

♦ **Action Plan for Objective A:**

- Lead: MEHS,Partners: CCA, HEB, STAD

1. Community/DFO/First Nations/Province: Summary of communities/species and populations of significance in Quatsino Sound
2. Inventory/survey to characterize info on non-commercial (including exotics) species-

3. From assemblage of species/populations/communities characterize habitats including unique or rare habitats. “Hot Spots”
4. Recommend MEQ objectives

- **Action Plan for Objective B:**
  - Lead: MEHS,Partners: STAD, CWS, CCA, MSRM

1. Collect information on high trophic level species: historical abundance, spatial distribution, recent changes (map food webs and food web functions)
2. Linkages between land-based and marine environments in terms of function (not human impact)
3. Examine trophic levels
4. Recommend MEQ

- **Action Plan for Objective C:**
  - Lead: OSAP, Partners: MEHS, HEB, MSRM, CCA

1. Pull together existing water quality guidelines and rationale and relevance to Quatsino Sound (temperature, dissolved oxygen, contaminants, turbidity). Lead: HEB?
2. Develop oceanographic model to characterize inlet (# of subsystems). Lead: IOS (OSAP)?
3. Recommend what MEQ factors could be (are being?) monitored and where they should be.

- **Action Plan for Objective D**

1. Link together physical/chemical ecosystem components and ecosystem function with info on anthropogenic stresses. (characterize stressors: “risk assessment”)

- **Summary:**
  1. We are recommending an Action Plan that is specific to Quatsino Sound
  2. The plan may not be transferable to other CMAs.
  3. We have not factored in ongoing management and monitoring costs or information.
  4. One aspect of the Action Plan could be assessment of the “transferability” of the approach to other areas:
     - Process; and
     - Institutional cooperation.

Plenary Discussion Points:

- Looking at human influences on Quatsino Sound: area impacted from logging, fisheries etc. but it is recovering
- Gaps in knowledge – there is existing data but not summarized: mapped specific ecological units that can be divided into oceanographic important areas; need history of area; need to know restrictions in certain areas; need to look at Quatsino Sound environment as a whole; need info on non-commercial species; need to know stressors in area

- One potential concern with this proposed Action Plan is putting too much money in one site. How do we use Quatsino as a starting point for the Central Coast?
- Another project could be taking the info gained from this smaller area (Quatsino) and applying it on a broader level (Central Coast)
- Generally don't have people in Central Coast with detailed technical knowledge
- Look at the Ecosystem overview – get info from all experts on area. Agencies could develop a liaison person who is in charge of contacting to access information. Need someone who knows how DFO at provincial and national level to do the job.
- **Comment:** practical process: research projects/tasks and Action Plan looks feasible

Small Group 2: MEQ Objectives Related to Aquaculture and Cruise Ship Management Issues in the Central Coast

Summary of Discussion Points:

- Note: The group did not have sufficient time to cost out an Action Plan, rather time was spent first identifying the tasks that would be needed to achieve MEQ objectives related to the two assigned management issues. The bulk of the group's time was spent discussing the first issue (aquaculture).
- **Aquaculture:**

I. Conserve critical habitats (at species and community levels)

1. Classify salmon migration routes and protect those with the highest priority.
2. Classify and protect salmon staging and rearing areas, especially of threatened populations.
3. Limit density of aquaculture sites in refuges along high priority migration routes and other critical areas (issues with respect to quiet water are, hydrogen sulfide (negative redox) etc.).
4. Protect community level habitat (use BC government survey):
    - 100% eelgrass beds
    - kelp beds (could classify these, identify those with highest priority relative to salmon staging and rearing areas)
    - natural shellfish beds
    - rocky reefs

    Include activities like shellfish bed modifications for 'ranching' (e.g., grooming, netting, channelization)

    * Research needed: extent and importance of habitats
5. Protect habitat of groundfish, especially rockfish and abalone.

II. Maintain abundance of high trophic level organisms (Habitat +)

6. a. Do not allow increase of exotic species in the Central Coast.
    b. Do not allow increase of diseases in wild organisms above natural level

III. Cadmium

7. Do not allow Cadmium concentrations to go above natural background levels or do not allow human discharge of Cadmium to Central Coast.

IV. Oxygen, Nutrients, etc.

8. Establish reference levels and maintain oxygen, nutrients, suspended particles, Particulate Organic Carbon and Hydrogen Sulphide below target level in water and sediments. (Research needed).

V. POPs, etc,

9. Prohibit release of compounds which are toxic, persistent, and bioaccumulative.
10. For other classes of chemicals including metals such as Zinc, take management action when population level (biota) or human health effects observed.

    *Research Needed: farfield effects, acceptable sediment concentration guidelines (e.g. CCME) and sub-population effects

- **Cruise Ships (noise, HADDs, pollution – also with respect to aquaculture)**

I. Noise

1. Minimize displacement or injury of animals due to underwater noise (decibel level could be regulated using *Canada Shipping Act*).
   * Research needed on decibel limit

II. Harmful Algae Blooms (HABs)

2. If PSP, DSP, ASP or other HABs occur beyond natural extent or frequency, identify cause and take management action.

III. Research needed on effects of light and inventory of use

Discussion Points – Aquaculture:

- Focused our effort not on getting to an Action Plan but on how to come up with MEQ objectives.
- Went through general objectives that related to aquaculture and cruise ships first.
- Current information: know threatened populations but lack info on staging and rearing.
- Owkissollo Diagram: embayments are taken over by fish farms where they could have been resting sites for salmon migrations.
- Not sure if kelp beds need to be protected – need more info. (extent of beds in the area, value as critical habitat)
- Rocky reefs used by fish farms.
- Fish farms can damage these habitats.
- Need to understand the importance of these habitats.
- Can aquaculture activities transfer disease to wild species? – need more research.
- High concentration of Cadmium: used human and environmental objectives.
- Toxic and persistent chemicals: aquaculture can release chemicals but not if toxic, persistent and bioaccumulative.
- Chemicals are by-products from food and sewage, not released intentionally.
- Zinc: above parent affects threshold in sediment.
- Need research not only on human health defects from chemicals also on effects to other Central Coast species (i.e. population level effects).

- Need more research on antibiotics in fish farms.

Discussion Points – Cruise Ships:
- Noise: set a decibel level, there is a decibel level set by US…but need more research for central coast area…once set, create a regulation under Canada Shipping Act
- Try to discuss the effects of light but need more research.

Plenary Questions and Comments:
- Finfish aquaculture seems to be currently the biggest issue that has been discussed: Siting ⇒expected expansion; impacts on habitat; cumulative effects; SARA species (e.g., Abalone); lack of clear identification of critical habitats; effects/impacts of practices (e.g., fish food) and ongoing management; disease transfer; light, noise; anti-fouling substances on nets (e.g., Copper); invasive species; sealice – parasites.
- Aquaculture: Could bring groups together to set guidelines on spacing a farms, then set standards (reference points)… standards could then be assessed through MEQ objectives.
- Need to be clear on the link between Quatsino Sound and Central Coast – how do we "scale up" the approach and findings.
- Johnstone Strait: migration route for salmon: How to protect migration route…ensure no fish farms?
- Some fish farms have moved from salmon migrations…trying to stay away from sockeye migrations.
- Two sets of info on salmon…have least info on fry but more info on mature fish going back for spawning.
- Level of detail of salmon routes needs some study. Right now info is too general.

Final Plenary Review of Workshop Discussions

Colin Rankin, Facilitator

Plenary Questions and Comments – Advice to the CCIM MEQ Sub-committee:
- What is the process for "shrinking the list" of Potential MEQ objectives and actions? How to determine priorities among management needs?
- Choice of issues to address with MEQ objectives: What is an MEQ issue?
- Coordination/linkages (e.g., among DFO Branches, other government agencies, communities): will be important in developing MEQ objectives.
- "Getting Real" – having a "Pilot Area" at various scales would help (e.g., Quatsino, as well as Central Coast)
- Need different "ways in" to developing MEQ Objectives (e.g.. start with physical/chemical suite of ecosystem objectives).
- Link MEQ Objectives to guidelines, Management Actions.
- Overlaps when approaching MEQ objectives from different methods (area or issues) ⇒ consolidate and can largely cover important management needs.
- A formal (i.e., scientifically rigorous) "unpacking" of MEQ objectives may be useful.
- Hydrocarbon exploration (offshore oil & gas) is an emerging issue that MEQ could help to address.

Plenary Questions and Comments – Next Steps:

- **Inputs from Area Chiefs needed** ⇒ familiarity with areas involved (e.g., Quatsino).
- **Audience for workshop report**?
  - informal (draft) soon
  - more formal ⇒ broader audience (more work – later)
- **Individual Project Ideas**
  - Natural variability
  - Effect of Climate Change on contaminant transport
  - Use of BC Ferries to Ground Truth Data (ocean birds, mammals
  - Maintain Natural Variability of zooplankton
  - Application of ecosystem matrix of IBI in Central Coast
  - Collaborative study with DFO and Environment Canada
  - Sealice
  - Need more background on water properties…no baseline info
  - Use apex predator…sea lion indicator of forage fish (non-commercial fish)
  - Inventory of TEK that have been down on certain areas
  - Concern science might not find that TEK is enough
  - Hydrocarbon exploration???
- **Summary of Progress made through this Workshop:**
  - We are a few more steps down the road from the Dunsmuir Workshop.
  - One theme coming out of workshop is to get a better handle on gaps.
  - An Action Plan is needed to further develop MEQ objectives – the workshop raised a few ideas that need to be looked at systematically.
  - No completed Action Plan from this workshop.

CLOSING COMMENTS

John Pringle (DFO, Sidney, BC) and Garry Taccogna (DFO, Port Hardy, BC)

- **Comment:** people in their own areas need to generate some thought and management – be more aware of what is going on in their community.
- **Comment:** Quatsino Sound as a pilot area is a potentially useful project – we need experts for that area.
- Need to tighten up this project with Central Coast and other managers.
- Draft report of the workshop will done by the end of June:
  - Who is the audience for the report? Need the people to be aware of MEQ in the Central Coast…need more people involved but it is still a bit too soon – we need to spend a bit more time making sure that we are clear on the process of developing MEQ objectives.
  - Draft report first for scientists and people at the workshop, then prepare a report or information for a broader audience.
- There will need to be a more formal unpacking of ecosystem objectives to MEQ level at a future date.

Gary Taccogna formally thanked all participants for their good work over the three days of the workshop on behalf of the Central Coast staff. The results and subsequent projects to pilot MEQ in the Central Coast will be keenly anticipated.

APPENDIX 1: WORKSHOP AGENDA

Marine Environmental Quality Workshop, June 5-7, 2002
Tigh-Na-Mara Resort, Parksville, British Columbia

Day One

Laying the Foundation for an MEQ Programme

Opening Remarks & Introductions:	John Pringle	8:30 a.m.
Integrated Management and Marine Environmental Quality Pacific Region efforts to move forward		
National Approaches to MEQ Ecosystem-objectives and MEQ Frameworks Canada's Oceans Strategy linkages Science, Management, & Operations implications	Herb Vandermeulen	9:00 a.m.
Refreshment Break		10:00 a.m.
Dunsmuir workshop: Summary and overview of unpacking process	Glen Jamieson	10:15 a.m.
Central Coast Integrated Management MEQ in the Central Coast Integrated Management picture Opportunities for linking MEQ with management and operations objectives	Brenda Bauer	11:00 a.m.
Learning from Canada's East Coast MEQ developments in the Atlantic – Oceans perspective	Bob Rutherford	11:30 a.m.
MEQ developments in the Atlantic – Science perspective	Simon Courtenay	11:50 a.m.

Day one – afternoon

Beginning the Unpacking Exercise

Review of Workshop Objectives related to the identification of appropriate MEQ ecosystem indicators

Break-Out Groups:

Unpack the three broad objectives described in the Dunsmuir report (see below) with the goal of identifying next level objectives

Create linkages with Central Coast management and operational objectives

Plenary Session with Break-Out Group summaries

Day Two

Applying MEQ Objectives to Case Study Area

Recapitulation of ecosystem objectives and MEQ objectives.

Discussion relating to Central Coast Large Ocean Management Area ecosystem objectives, setting the stage for integration of MEQ into IM Plan, MEQ priorities (8:30 – 9:30)

Discussion of regional and local issues, and their management concerns and implications (e.g., fish farms, log booms, etc.) (9:30 – 10:00)

Refreshment Break (10:00 – 10:15)

Current research/ monitoring/ management or operational activities (10:15 -11:00)

Gap analysis (11:00 – 11:20)
What are monitoring approaches, issues

Develop proposals to fill in gaps: research on new programs, and what existing programs could be adapted to fill in what is now needed for MEQ (11:20 –12:00)
What are useful, relevant and appropriate indicators, what indicator development and evaluation may be needed

Lunch

Break-Out Groups:

Initiate Development of an action plan (1:00 – 4:00)
For each category of ecosystem objectives discussed on Day One, propose and develop 4-5 MEQ objectives that can be inserted into the IM Plan, with specific reference to (but not limited to) applications in the Case Study Coastal Management Area (Quatsino Sound)

Plenary Session with Break-Out Group summaries (4:00 – 5:00)

Day Three

Next Steps in the Development of a Successful MEQ Programme for CCIM

Finalization of Work Plans (8:30- 12:00)

APPENDIX 2: List of participants (PBS = Pacific Biological Station, Nanaimo, BC; IOS = Institute of Ocean Sciences, Sidney, BC; NHQ = Ottawa; C&A = Central and Arctic; CCA = Central Cast Area; WVL = West Vancouver Laboratory, West Vancouver, BC.

Name	**Organization**	**E-mail Address**
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Leanne Blackwood (Recorder)	SALASAN-Geospatial	salasan@salasan.com

The following PBS staff attended a one day meeting prior to this workshop, and contributed ideas at that time, as they had other commitments at the time of the workshop: Doug Hay (hayd@pac.dfo-mpo.gc.ca), Linda Nichol (nicholl@pac.dfo-

mpo.gc.ca), John Ford (fordjo@pac.dfo-mpo.gc.ca) and Ian Whyte (whytei@pac.dfo-mpo.gc.ca).

APPENDIX 3: LIST OF PROJECT PROPOSALS CRAFTED DURING THE WORKSHOP

1. Study of Natural Variability of Deep-Water Nutrient and Contaminant Input to Central Coast.

Proposers: William Crawford –DFO, IOS and Brenda Bauer –DFO, Central Coast 2002/2003

Project Purpose: Measure seasonal and interannual variability of nutrient and cadmium concentrations in the waters of Queen Charlotte Sound and Hecate Strait.

Proposed Activities:

1. Sample nutrient levels and cadmium concentrations from surface to bottom on a John P. Tully cruise on its return to BC from station Papa in September, February and June. Sampling will take place along a east-west line near Cape St. James, across Hecate Strait, and south into rivers inlet then through Queen Charlotte Strait.

2. Place a continuously recording nutrient analyzer on a mooring in Hecate Strait or Queen Charlotte Sound to monitor nutrient concentrations during the time between cruises to evaluate the impact of storms and upwelling winds on these levels.

3. Use nutrient, temperature, salinity and cadmium measurements from John P. Tully and moorings to determine a proxy measurement for cadmium levels.

4. Undertake analysis of measurement, together with winds, sea levels, El Nino and Allusion Low Pressure Index (ALPI) indices to determine seasonal and interannual variability of nutrients and cadmium.

Links to other projects:

- Hecate Strait Program – Jeff Fargo leader
- Line-P sampling program
- Canada Wildlife Program study of impact of interannual variability of nutrients on Scott Island bird populations – Doug Bertram
- Aquaculture especially – oysters

2. Prepare Numerical Model of Quatsino Sound Seawater

Proposers: William Crawford, DFO- IOS, and Quatsino Sound Study Group 2003/2004

Project Purpose:

- The MEQ process addresses cumulative impacts to a marine system from many individual sources. Therefore, a numerical model is needed to determine spreading, residence times and depth of input pollutants and their combined impact on the system
- Model will simulate natural and anthropogenic influence on Quatsino Sound system, and enable DFO managers to distinguish these influences.

Proposed Activities:

1. Develop numerical model with following characteristics:

- 3-dimensional
- primitive equation
- fully baroclinic
- evaluated against historical observations
- realistic fresh water inflow
- run model with a variety of pollution inputs and eliminate variability to determine impact of these factors

Links:

- Successful model requires prior assembly of historical data on temperature, salinity, oxygen, pollution source, winds and especially river runoff into each of Rupert, Neurotsis, Holberg Winter Harbour and Quatsino Inlets

3. Steller Sea Lions – Using An Apex Predator to Monitor Forage Fish

Proposers: Dario Stucchi, DFO/IOS

Although ecologically important, very little is known about the biology, distribution and abundance of small forage fish (capelin, sandlance, smelts, herring, anchovy, sardines) that constitute the mainstay of the diet of a variety of marine piscivores (seals, sea lions, whales, seabirds, predatory fish). Many of the forage fish are not commercially utilized, or are consumed by marine predators prior to being recruited into fisheries. Directly monitoring forage fish would be difficult and prohibitively expensive, especially in the absence of fishery statistics.

Steller sea lion populations have declined precipitously in western part of their range (Russia, Bering Sea and Gulf of Alaska) since the 1970s and are now considered to be *endangered*. The listing has prompted intensive research efforts to determine the cause of decline and to identify critical habitat. There is now evidence of a decrease in body growth rates and an increase in the incidence of reproductive failure (premature abortion), both indicating the animals are nutritionally stressed. There is also evidence of a shift in the diet from being dominated by small forage fish one dominated by pollock, leading to the "junk food hypothesis". Recent studies have also established that, geographically, the rate of population decline was inversely related to diversity of diet on breeding rookeries. Declines have been observed in other apex predators in this area, and it is now widely regarded these are symptomatic of some broad change in ecosystem function, although it is still not clear whether this is the result of a natural process (e.g. regime shift) or human impacts (e.g. large groundfish fisheries or impacts on other ecosystem components). The general lesson is that we are far more capable of monitoring sea lion populations than measuring and understanding the ecological systems that support these apex predators.

We propose to establish a long-term program to annually monitor the status and diet of breeding concentrations of Steller sea lions in the Central Coast LOMA, and use it as an indicator of the availability and quality of forage fish. Aerial surveys will be used to monitor population size and pup production at breeding rookeries, and scat analysis to monitor diet composition.

- Steller sea lions are high-profile apex predators – they represent the largest otariid species and only one that resides year-round and breeds on the B.C. coast.
- Steller breeding rookeries on the Scott Islands (Triangle, Sartine and Maggot) and at Cape St. James are critical sea lion habitat. They represent the 2nd and 6th largest Steller sea lion breeding aggregations in the North Pacific, and together support over 90% of total sea lion pup production in B.C.
- Sea lions return to their natal rookery to breed, and during the breeding season cows make a series of short, local feeding trips to forage between suckling their pups, which are confined to the rookery. During winter, animals disperse from rookeries and movements are related to distribution of prey. Annual pup

production is thus an indicator of local feeding conditions, whereas longer-term trends in abundance of breeding populations are indicative of regional foraging conditions.

- Sea lions are opportunistic predators, so diet composition reflects local abundance of prey.
- Developments in aerial survey techniques now allow both non-pups and pups to be surveyed without disturbance. Developments in scat analyses provide a benign tool to look at quality of diet (species composition and indirectly caloric content, diversity indices, size and age composition).

Timing:

Timing of aerial surveys critical (last few days in June or first few days in July). Scat collections in mid-July.

4. Fish Communities of the Broughton Archipelago CMA

Proposers: C. Levings and Jen Gold

General objective:
To provide CC ocean managers working in the Broughton Archipelago CMA.(BA CMA) with:
1. A quantitative description of the fish communities in the CMA; and
2. Scientifically defensible protocols for assessing fish communities in specific habitats.

Relationship to Ecosystem Objective Task:
A description of fish communities in marine habitats is a necessary first step to achieve the ecosystem objective "maintain communities within bounds of natural variability". Scientifically defensible protocols are needed for sampling to assess the spatial and temporal differences inherent in natural variability.

Approach:
Existing data on species composition and abundance of all species of fish from a wide variety of surveys would be compiled in the BA CMA. These would be compiled, tabulated, and placed in Excel and Arcview files. The data would be arranged by habitat type, which in turn is reflected by catch methodology. For example purse seines assess the pelagic habitat, trawls assess sand and mud habitat, and traps assess rocky habitat. Data sources reviewed would include: museum records, early exploratory trawling (see Levings and Chilton, 1969), shrimp bycatch data from stock assessment surveys (pre and post extruders), purse seine surveys for juvenile salmon (Argue, 1969), studies on effects of trawling (Ong et al 2001), black cod trap surveys, fisher's knowledge, and other reliable data sources that can be located.

Deliverables: Arcview files with distribution data. CD ROM of compiled data on fish communities. Statistical analysis if data warrants. Descriptive narrative of fish communities arranged by habitat type and discussion of prevalence of particular habitats (e.g., migratory passages, spawning, rearing) in the Broughton Area. Discussion of unique and representative communities. Discussion of how sampling and observation methods determine the species composition of a community.

References:

Levings, C.D., and D. Chilton. 1969. An index to trawling activity in British Columbia inlets by the Fisheries Research Board, 1944-66. Fish. Res. Bd. Canada. MS Rep. 1016: 25 p.

Ong, S., Levings, C.D., Sutherland., T.F., Piercey, G.E., Keong, V., and R. Davis, 2001. Data record on trawling and trapping effects on humpback shrimp and bycatch organisms in Simoom Sound and Northumberland Channel, British Columbia. Can. Data Rep. Fish Aquat Sci 1084. 114 p.

Argue, A.W. 1969. Juvenile salmon surveys in south central coast (unpublished DFO data)

5. Compilation of Herring and Eulachon Data for the Central Coast

Proposer: Doug Hay

Project Purpose: compile existing herring and eulachon data for the Central Coast in order to inform setting of one or more MEQ objectives for the CC IM area.

Note: The current Central Coast Integrated Management Plan area includes pieces of every herring stock assessment area, including the Strait of Georgia, West Coast of Vancouver Island, Central Coast, North Coast and Queen Charlotte Islands.

Proposed Activities:

1. Provide a time series of data on herring sampling by geographic area (most likely at the level of DFO statistical area), including size at age (for ages 3-8) by year and area. This could also include initial analyses to determine potential episodes, and/or areas, of "good" or "bad" growth (taking into consideration that herring are migratory).
   Note: It would be interesting to compare geo-referenced herring growth data from other species (e.g., crabs?).
2. Provide a time series of locations of herring spawn areas. The output could be in the form of an approximate spawning biomass (and could include temporal and spatial breakdowns).
   Note: this information is largely available on the web now but the project could enable addition of more information.
3. Provide an overview of key eulachon spawning rivers, with approximations of spawning biomass. This could be accompanied by temporally static analysis of larval distributions.

APPENDIX 4: RECOMMENDED MEQ ACTION PLAN FOR CC MEQ IN JULY, 2002, DEVELOPED BY THE CC MEQ SUBCOMMITTEE, JUNE 26, 2002.

Recommended proposals for immediate funding:

Project	Proponent
1. Quatsino numerical hydrographic model	Crawford
2. Pinniped population dynamics	Olesiuk and Jamieson
3. Contaminant sources, types and risks	Ross and Levings
4. Shorekeepers' Guide modification	Jamieson and Levings
5 Species characterisation of CC habitats	TBD

Broader questions that will be considered by the Subcommittee over the summer, given that the workshop didn't include all DFO research sectors, include:

1. A review of MEQ objectives options in the context of CC manager's identified priorities and recent workshop discussions. This review would focus on further development of suggestions made at the workshop, since we don't want to start from scratch again. Relevant staff in the various disciplines referred to in the quatsino.doc below would be approached.

2. Identification of opportunities for MEQ monitoring collaboration with other agencies, etc., re the higher priority MEQ objective options identified in 1.

3. Developing recommendations for other specific indicators for CC MEQ objectives monitoring, based on the above, and cost-effectiveness, applicability and relevance to managers

These discussions may result in the submission of additional project proposals in the fall for consideration of funding by the CC Working Group.

Glen Jamieson
Chair, CC MEQ Subcommittee
June 28, 2002

1. Preparation of numerical model for Quatsino Sound Seawater (Bill Crawford)

Project Purpose:

The MEQ process addresses cumulative impacts to a marine system from many individual sources. Therefore, a numerical model is needed to determine spreading, residence times and depth of input pollutants and their combined impact on the system

Model will simulate natural and anthropogenic influence on Quatsino Sound system, and enable DFO managers to distinguish these influences.

Year 1: Prepare historical data

The data archives at the Institute of Ocean Sciences have listings of all DFO CTD (Conductivity-Temperature-Depth) surveys through Quatsino Sound, and through waters outside this system of inlets. In addition there have been some sampling programs by private companies under contract to the mill and mine. It might be possible to get these secondary sources. Some current meters have been installed here, and several Ph. D. studies have been devoted to studies of mine tailings transport through the inlet.

Prior to development of a model, it is necessary to gather these data together to prepare databases of temperature and salinity for initialization of the model, and to determine the influence of water exchange with seawater on the continental shelf, and the influence of mixing in Quatsino Narrows on the distribution of water masses through the inlet. I propose to do this data inventory and interpretation this fiscal year, using university students, and private contractors. Output will be a report of the historical trends of bottom water temperatures and salinities, and detailed databases of distribution of temperature and salinity and nutrients through these waters.

Selected References

Physical and chemical oceanographic data from the west coast of Vancouver Island and the northern British Columbia coast, 1957-1967, Waldichuk, M.; Markert, J.R.; Meikle, J.H., Fisheries Research Board of Canada, 1968.

Chemical delineation of a submerged mine tailings plume in Rupert and Holberg Inlets, B.C., J.A.J. Thompson and D.W. Paton, Pacific Environment Institute, Technical report (Canada. Fisheries and Marine Service. Research and Development Directorate); 506, 1975.

Deep water exchange in Rupert-Holberg Inlet, D. Stucchi and D.M. Farmer, Pacific marine science report;76-10, 1976.

Physical and chemical oceanographic data from Quatsino Sound - Neroutsos Inlet (1973-1976), Davis, J.C.; Shand, I.G.; Christie, G, . Corporate Manuscript report series (Fisheries Research Board of Canada);1415, 1977.

Environmental improvement at Neroutsos Inlet, B.C. Volume 2, water quality and biological studies in Neroutsos Inlet, B.C., Corbett, P.G.; Campbell, J.P.; Olsen, S.H., Rayonier Canada (B.C.) Limited, Port Alice, B.C. : Rayonier Canada, 1978.

Biological and oceanographic observations in the Neroutsos Inlet area with emphasis on the effect of sulfite pulp mill waste on Pacific salmon, 1973-1977, Davis, J.C.; Shand, I.G.; Cristie, G.; Kosakoski, G., Fisheries and Marine Service manuscript report;1447, 1978,

Biological oceanographic observations, Rupert Inlet, Holberg Inlet and Quatsino Sound, B.C., Stephens, K.; Sibert, J. Fisheries and Marine Service data report;28, 1977.

Selected physical and chemical oceanographic data from Quatsino Sound-Neroutsos Inlet, March 1979 survey, Greer, G.L.; Futer, P.G.; Shand, I.G., Canadian data report of fisheries and aquatic sciences;172, 1979.

Arsenic in marine sediments, Quatsino Sound/Rupert-Holberg Inlets 1981-83- Alice-Hastings Arms 1983, Reimer, K.J., Royal Roads Military College, 1985

Stream summary catalogue. Subdistrict 27, Quatsino Sound, Responsible G. Kapahi and subsequently updated by SHIP Environmental Consultants Ltd. under contract. The project was directed by B.D. Tutty, Department of Fisheries and Oceans, South Coast Division, 1990.

Proposed Activities year 2:

1. Develop numerical model with following characteristics:
    - 3-dimensional
    - primitive equation
    - fully baroclinic
    - evaluated against historical observations
    - realistic fresh water inflow
    - run model with a variety of pollution inputs and eliminate variability to determine impact of these factors

2. **A pilot study to assess factors affecting the level of predator control at fish farms and the impact on local seal populations (**P.F. Olesiuk and G.S. Jamieson)

Salmon farming has emerged as an important industry in coastal areas of B.C. and is expected to expand, particularly in the central coast region. There are, however, a number of environmental issues and ocean management concerns associated with salmon farming, including lethal removal of seals and sea lions. A recent assessment of the predator control program in B.C. noted that the numbers of pinnipeds being killed at salmon farms varied widely among sites, with a relatively small number of sites accounting for the vast majority of kills (Jamieson and Olesiuk 2001). Unfortunately, the reasons for the disparity in kill rates among sites could not be evaluated due to a lack of information on the type of infrastructure installed at each site, other predator defense mechanisms being deployed at each site, and lack of baseline information on the distribution and abundance of pinnipeds in the vicinity of many sites. Understanding why some farms seem to operate successfully while killing few if any seals, while others seem to need to remove large numbers of predators on an ongoing basis, could be important and useful in mitigating the need for lethal removals (for example, by locating farms appropriate distances from pinniped haulout sites, or mandating the use of non-lethal predator control mechanisms that have proved effective). In addition, although holders of predator control licenses are required to submit quarterly reports on the numbers of seals and sea lions being killed, there is no way of validating the accuracy of these figures. It is therefore important to have some independent means for assessing the impact of lethal predator control, such as monitoring the status of pinniped populations in areas of high densities of salmon farms.

In this pilot study, we propose to begin to assess the factors affecting the level of predator control at salmon farms, and the effects of lethal removals on local harbour seal populations, by establishing baseline levels of pinniped abundance and spatial distribution in the following CC areas. The pilot study will be conducted in two areas: Quatsino Sound and the Johnstone Strait - Queen Charlotte Strait area that has finfish aquaculture sites, extending from Quadra Island off Campbell River to the Broughton Archipelago. Quatsino Sound was selected as it has been designated a pilot area for developing a MEQ program, and as is typical of long narrow inlets most seal haulouts are found in semi-exposed areas near its entrance. In contrast, the protected waters in the maze of islands and channels between Discovery Pass and the Broughton Archipelago provide ideal habitat for harbour seals, and we expect harbour seal haulouts to be more widely distributed. Both areas support high concentrations of fish farms. The study will consist of two components.

First and foremost, we will conduct aerial surveys to obtain information on the abundance and distribution of harbour seals. Quatsino Sound has only been surveyed once previously, back in the mid-1990s. Except for a portion of the Broughton Archipelago which was surveyed in both the late-1980s and mid-1990s,

the inside waters have never been surveyed, but was identified as a priority for conducting baseline surveys in the PSARC assessment (Jamieson and Olesiuk 2001). It would be impossible to undertake any meaningful analysis of the effects of pinniped predator control among salmon farms without up-to-date information on the location and size of nearby haulout sites. The baseline survey data will also provide a benchmark on the status of seal populations by which future impacts could be evaluated (e.g. expansion or relocation of salmon farming, change in predator control practices). The limited survey data which already exists for the Broughton Archipelago and Quatsino Sound will be used in evaluating changes in the status of seal populations in relation to recent changes in the number of seals reported as being killed in the area.

The second component of the pilot project, subject to funding, will involve visiting salmon farms in these same regions to conduct onsite inspections and interviews, and obtain first-hand information on the type of predator control infrastructure being used, predator defenses currently deployed (and their condition), and information on lethal predator control from field staff. The field work would be done in conjunction with aerial surveys, which would reduce travel costs. The objective would be to solicit the views and knowledge of onsite staff as to the factors that may affect the numbers of seals being killed. Onsite interviews could also solicit information on other environmental issues, such as possible use of artificial lighting to attract feed organisms to supplement the diet of penned fish, and use of anti-foulants. We would hope this would lead to the design of questionnaire and database that could be funded by the aquaculture industry and implemented on a coast-wide basis in future years.

3. —Marine environmental quality in Central Coast: A review of contaminant sources, types and risks. (Peter S. Ross and Colin Levings)

Objective: to provide a "State of the environment" overview of contaminant sources, types and associated risks to biota by synthesizing and interpreting information on the Central Coast area.

Deliverables: A Canadian Technical Report of Fisheries and Aquatic Sciences which synthesizes anthropogenic contaminant stressors in the Central Coast area.

Activities: Information sources will include published scientific articles, technical reports, consultant reports, industry reports, conference proceedings, and other grey literature. Information will be collated, synthesized and annotated in order to provide the reader with an understanding of pollution issues in the Central Coast area. Contaminant issues will be prioritized, where possible, and knowledge gaps and research needs will be itemized. Efforts will be made to interpret information in the context of CCIM MEQ Objectives, such that the Integrated Management process is provided with input and feedback that is informative and relevant. This project will provide an annotated overview of such issues as municipal sewage, industrial effluent, motor vessel releases, agricultural runoff, forestry applications of chemical products, and long-range transport of atmospheric pollutants. Contaminant types to be addressed include both chemicals (metals, anti-fouling agents, persistent organic pollutants (POPs), new chemicals, pharmaceuticals, and flame retardants) and biologicals (bacteria and viruses).

A contractor will be hired to conduct this research project. Information will be gathered through online literature searchers, library work, and contact with key people and agencies in British Columbia and elsewhere. References will be entered into a Reference Manager database. A report synthesizing the knowledge available will be written and published as a Canadian Technical Report of Fisheries and Aquatic Sciences. We have carried out two similar exercises on previous occasions to inform decision makers on contaminant issues of concern (Grant and Ross. 2002. *Southern resident killer whales at risk: Toxic chemicals in the British Columbia and Washington environment*. CTRFAS No. 2412 in press. Johannessen and Ross. 2002 *Contaminant risks to late-run sockeye salmon: A review of contaminant sources in sockeye habitat*. CTRFAS in press.).

4. **Modification of the the Shorekeeper's Guide to Central Coast ecosystems and outer coast habitats** (G. Jamieson and C. Levings)

General objective:
To provide CC ocean managers working in the Central Coast CMAs with:
1. A quantitative protocol for describing intertidal communities in the CC CMAs; and
2. Some selected initial assessments of intertidal communities in specific habitats, determined in conjunction with CC managers

Relationship to Ecosystem Objective task:
A description of intertidal communities in various marine habitats (sheltered, exposed, soft substrate, rock, pristine, impacted, etc.) is a necessary first step to achieve the ecosystem objective "maintain communities within bounds of natural variability". Scientifically defensible protocols are also needed to assess the spatial and temporal differences inherent in natural variability.

Approach:
Sampling at control and impacted sites will be used in assessments with a modified Shorekeeper's protocol, adapted to CC communities. Non-destructive sampling methods would be used. Collaboration with the acting regional MEQ coordinator will be required.

Survey sites would be selected in collaboration with CC ocean managers, and would be based on both need for sampling and logistic issues. The basic approach would be sample intertidal communities over a depth gradient from the high water mark to near Chart Datum. Options that will be considered are the sampling of only 30-50 "indicator species" that can be readily identified, or all macro-species present in the survey area. Also, in biologically complex habitats (e.g. sea mussel – goose barnacle matrix), the quadrate sampling approach may have to be significantly modified.

Deliverables:
Data sets on intertidal communities will be provided that characterise the study areas at the survey times. A review of sampling procedures will be undertaken to determine the most appropriate methodology, both from a science perspective and in terms of future survey completion, possibly using community volunteers. A modified Shorekeepers' Guidebook tailored to CC will be produced.

Time Frame: This work would be conducted in late August-early September, when annual macrophytes are present.

5. **Characterisation of the biological communities (species likely present), with identification of species of particular interest, in the more common physical habitats (substrate, depth, exposure, salinity, temperature), perhaps using the provincial habitat classification system.**

Proponent TBD – possibly contracted out

APPENDIX 5: GLOSSARY OF TERMS USED IN REFERENCE TO MARINE ENVIRONMENTAL QUALITY

Term	Definition
Action Plan	Summary of MEQ Objectives for the Central Coast. It should include an outline of current research, monitoring, or operational activities, a gap analysis, and the development of proposals to fill in the gaps. (also see work plan)
Central Coast Integrated Management (CCIM) Initiative	Pacific Region's lead Integrated Management initiative that is working to develop and implement a comprehensive and participatory planning and management regime that will maintain the integrity of Central Coast ecosystems while minimizing user conflicts and fostering ecologically sustainable economic development.
Coastal Management Area (CMA)	Management area, nested within a LOMA, comprising a more restricted geographic space. Ecosystem-based objectives will be reflected as Marine Environmental Quality objectives in a CMA Integrated Management plan.
Dunsmuir Workshop	Multidisciplinary workshop held in Sidney B.C. from Feb.27 – Mar 2, 2001. Sponsored by DFO to identify ecosystem-level objectives, with associated indicators and reference points, that could be used in managing ocean activities.
Ecosystem	"Any unit that includes all of the organisms (i.e. the community) in a given area interacting with the physical environment so that a flow of energy leads to a clearly defined trophic structure, biotic diversity, and material cycles (i.e. exchange of material between living and non-living parts) within the system." – Dunsmuir The system of interactive relationship among organisms (e.g. energy transfer), and between organisms and their physical environment (e.g. habitat) in a given geographical unit. – IM framework
Ecosystem objective	A narrative or numeric statement on the desired condition of an ecosystem, or of one of its constituents. Objectives may be set at various levels of detail, for example conceptual objectives that establish desired conditions, measurable objectives that allow for monitoring and operational objectives relating to concrete implementation measures. Ecosystem objectives will be set for Large Ocean Management Areas.

Ecosystem Overview	Characterises the status of the ecosystem prior to management actions and establishes baseline data against which the success of management plans can be assessed. A comprehensive overview is essential to evaluate ecosystem health, identify resources in need of special protection, and to determine management actions required to maintain healthy marine ecosystems.
Integrated Management (IM)	A continuous process through which decisions are made for the sustainable use, development, and protection of areas and resources. IM acknowledges the interrelationships that exist among different uses and the environments they potentially affect. It is designed to overcome the fragmentation inherent in a sectoral management approach, analyzes the implications of development, conflicting uses and promotes linkages and harmonization among various activities.
Large Ocean Management Area (LOMA)	An area covering a large portion of one of Canada's three oceans or coastal zones, typically extending from the coast out to the limit of Canada's jurisdiction, with boundaries that are drawn using a mix of ecological considerations and administrative boundaries. The area will be sufficiently large so as to provide an appropriate context for management action in consideration of ecosystem characteristics.
Marine Environmental Quality	"is an overall expression of the structure and function of the marine ecosystem taking into account the biological community and natural physiographic, geographic and climatic factors as well as physical and chemical conditions including those resulting from human activities" (Skjoldal, 1999)
MEQ indicator	A measure (physical, chemical, or biological) or parameter that provides evidence as to the condition or state of specific components of the ecosystem.
MEQ objective	A numerical value or narrative statement describing a desired condition for a given ecosystem, taking into account ecological characteristics and uses.
MEQ guidelines	Generic numerical values or narrative statements that are recommended as upper or lower limits to protect and maintain healthy marine ecosystems. These values are not legally binding.
MEQ standards	A legally enforceable numerical limit or narrative statement, such as in a regulation, statue, contract, or legally binding document, that has been adopted from a criterion or an objective.

MEQ criteria	A numerical value or narrative statement for physical, chemical or biological characteristics of water, biota, soil, or sediment that must be respected to protect and maintain healthy marine ecosystems.
Marine Protected Area	An area of the sea that forms part of the internal waters of Canada, the territorial sea of Canada or the exclusive economic zone of Canada; and has been designated for special protection under the *Oceans Act* for one or more purposes.
National Integrated Management Framework	"Policy and Operational Framework for Integrated Management of Estuarine, Coastal and Marine Environments in Canada". Frequently referred to as it contains substantive information regarding concepts put forth in the *Oceans Act.*
Work Plan	After the action plan is completed specific MEQ objectives will be identified as requiring more attention, laid out in a work plan. They could include milestones, roles and responsibilities, budgets, partnerships and prioritization of activities.

APPENDIX 6: LIST OF ACRONYMNS USED.

ALPI: Aleutian Low Pressure Index

ASP: Amnesiac Shellfish Poisoning

BOD: Biological Oxygen Demand

CCA: Central Coast Area

CCIM: Central Coast Integrated Management

CCLOMA: Central Coast Large Ocean Management Area

CCME: Canadian Council of Ministers of the Environment

CEAA: Canadian Environmental Assessment Act

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

CTD: Conductivity Temperature Depth

CWS: Canadian Wildlife Service

DDT: Dichloro-diphenyl-trichloroethane

DFO: Department of Fisheries and Oceans

DSP: Diarrhoeic Shellfish Poisoning

ENSO: El Nino Southern Oscillation

ESSIM: Eastern Scotian Shelf Integrated Management

GIS: Geographic Information Systems

GOSLIM: Gulf of St. Lawrence Integrated Management

HADD: Harmful Alteration, Disruption or Destruction of fish habitat

HEB: Habitat and Enhancement Branch

IBI: Index of Biotic Integrity

IM: Integrated management

IOS: Institute of Ocean Sciences

LOMA: Large Ocean Management Area

MEHS: Marine Environmental Health Science Division (DFO)

MEQ: Marine Environmental Quality

MPA: Marine Protected Area

MSRM: Ministry of Sustainable Resource Management (BC)

NGO: Non-Governmental Organisation

OSAP: Oceans Science and Productivity Division

PBS: Pacific Biological Station

PCB: Polychlorinated Biphenyls

PDO: Pacific Decadal Oscillation

POP: Persistent Organic Pollutant

PSP: Paralytic Shellfish Poisoning

QC Strait or QC Sound: Queen Charlotte Strait or Queen Charlotte Sound

QSCMA: Quatsino Sound Coastal Management Area

ROV: Remotely Operated Vehicle

RPA: Rockfish Protection Areas

StAD: Stock Assessment Division (DFO)

SARA: Species at Risk Act

SST: Sea Surface Temperature

Sub-OMA: sub Ocean Management Area

TEK: Traditional Ecological Knowledge

WGEO: Working Group on Ecosystem Objectives