ENVIRONMENT CANADA
ENVIRONMENTAL PROTECTION SERVICE
PACIFIC REGION

Regional Manuscript Report
85-03

REPORT ON THE PACIFIC REGION WORKSHOP ON ENVIRONMENTAL EFFECTS MONITORING, MARCH 5 AND 6, 1985

By

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March 1985

REVIEW NOTICE

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PASSERBY: (To drunk searching on hands and knees beneath streetlight.) What are you looking for?

DRUNK: My keys.

PASSERBY: Where did you drop them?

DRUNK: Down the street a bit.

PASSERBY: Well, why don't you look for them there?

DRUNK: The light is better here.

- as recounted by D. Popham and recollected by R. Moody

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1.0 Introduction

The Environmental Protection Service (EPS) of Environment Canada has identified a need to better determine how environmental effects monitoring does and should fit into the overall environmental impact assessment process. To that end EPS is sponsoring a series of four workshops across Canada. The workshops are being held to provide a forum for users and practitioners of environmental effects monitoring to exchange information, ideas and concerns. The Vancouver workshop was held on March 5 and 6, 1985 and was the third in the series of four, after Halifax and Toronto. AIM Ecological Consultants Ltd. was contracted by EPS to chair and report on the Vancouver workshop.

This report is structured around a series of interrogative pronouns. Section 2.0 helps define monitoring and deals with the "why" and "whether to" questions. Section 3.0 addresses the technical factors and management issues of environmental effects monitoring programs. The key technical factors can be thought of in terms of "where", "when", "what", and "how". The critical management issues focus upon the roles and responsibilities of the various participants in monitoring programs (the "who" question).

The objectives of the Vancouver workshop appear as Appendix 1 of this report. Appendix 2 is a list of the workshop participants. The agendas for the first and second days of the workshop comprise Appendices 3 and 4 respectively.

2.0 Monitoring -- Ecological Imperative or Environmental Boondoggle?

Environmental impact assessment (EIA) in Canada is an incomplete process. Its incompleteness is rendering it inadequate. The traditional approach to EIA has been to superimpose a project description upon environmental information meant to characterize the existing environment in the immediate vicinity of the proposed project site. The baseline environmental information and the project information are then considered simultaneously and a number of key issues and factors are identified. The next step is to make predictions as to how the proposed project will affect the existing environment. The project design is then altered to avoid or ameliorate unacceptable impacts; an environmental impact statement is issued, reviewed and accepted; and project planning, construction and operation proceed.

The above scenario suggests that the major feedback mechanisms are highly attenuated and, for the most part, occur early on in the assessment process. Predictions of overt impact translate into project design modifications at the early planning stages. Predictions of acceptable impact may translate into mitigatory action during the construction, operation and decommissioning stages of the project's life cycle. Generally no attempt is made, however, to verify the predictions made during the assessment process or to test the mitigation measures subsequently undertaken.

The fundamental incompleteness of environmental impact assessment is this lack of follow-up (or, more correctly, follow-through) studies. Impact assessment has not matured into a learning process. Skills are not refined. Present practice is not altered on the basis of past experience because past performance is not measured or evaluated.

Much of the present dissatisfaction with the environmental impact assessment process can be traced to this shortcoming of not providing feedback so that the process can progress. The word assessment can mean to measure or to place a value on something. These are the meanings implied in the term environmental impact assessment. An assessment can also be a fine or

2.0 Monitoring (Continued)

other payment or penalty. Environmental impact assessment may come to be viewed more and more from this perspective if it does not prove equal to what is required.

Monitoring is measurement to detect change. It implies the determination of need for future action. As such it offers a powerful tool to lift environmental impact assessment out of the boondoggle or imperative argument.

2.1 What is monitoring?

A working definiton of monitoring was presented in the previous section. The Environmental Protection Agency's definition of environmental effects monitoring is as follows:

> "Monitoring to detect change in individuals, populations, or communities of living organisms which result from man-induced activities."

Operatively, this definition could usefully be expanded to include the ecosystem level of biological organization and to connote the end purpose, rather than the intermediate objective, of monitoring.

Three types of monitoring were identified at the workshop. Compliance monitoring is the collection of environmental information to satisfy the terms of a regulatory permit. Appeasement or concessionary monitoring is periodic data collection to satisfy the demands of a concerned public. Environmental effects monitoring is scientific research to measure and evaluate environmental change due to human action. Although the workshop focussed on the latter it was recognized that there are features common to all three types.

2.0 Monitoring (Continued)

2.1 What is monitoring (continued)

Monitoring is:

- scientific research conducted with rigour
- the periodic collection of post-baseline data
- task focussed to deal with actual or anticipated problems
- measurement to detect change
- forward looking beyond documentation of change (to determination of need for further control or action)
- quantitative
- of value to the project proponent and recognized as such
- bounded spatially, temporally and fiscally
- influenced by the related concepts of risk and probability and conducted when an unacceptable degree of uncertainty exists

Monitoring should:

- be of manageable size
- build upon an adequate foundation of baseline data and demonstrate the need for same
- focus on valued ecosystem components
- be economical in the sense of minimizing waste of means and effort
- focus on unavoidable environmental impacts
- be subject to periodic review
- be flexible so that improvements can be incorporated and unproductive avenues can be dropped
- be considered in terms of the stages of the project life cycle
- contain provisions for a sunset clause for projects with an indeterminate or very lengthy lifespan
- provide timely input to decision making
- deal with what needs to be measured and not with what could be measured

2.0 Monitoring (Continued)

2.1 What is monitoring (continued)

Monitoring is not:

- baseline data collection
- predictive
- intended to set standards or criteria
- qualitative
- judgemental
- conducted for the appearance of "doing something"
- a penalty imposed for non-compliance
- a lever to gain environmental information unrelated or only marginally related to a project
- mitigation or compensation

2.2 Why monitor?

Effects monitoring:

- to measure the accuracy of impact predictions
- to improve our predictive ability
- to assess the effectiveness of mitigation and control measures
- to determine the need for fine-tuning of mitigation efforts
- to determine whether mitigation should be initiated or, conversely, abandoned
- to fulfil conditions of an approval process
- to maintain or enhance public image
- to improve relations with regulatory agencies
- to improve operational efficiency
- to avoid, or counter, litigation
- to improve quality of environmental decisions

Compliance monitoring:

- to meet permit requirements for monitoring
- to assess adherence to permitted levels for effluents and emissions

2.0 Monitoring (Continued)

2.2 Why monitor? (continued)

Appeasement monitoring:

- to placate the public, their purported spokesmen (special interest groups) and/or their elected representatives (politicians)

2.3 The "whether to" question.

Monitoring is only undertaken when the perceived or actual benefits of a monitoring program are considered to outweigh the costs. Costs are generally monetary. Opportunity costs are also important. Benefits may be economic, social, political, scientific, environmental etc. They may accrue to an individual or to an organization. Improved operations through lowered inputs or increased production is an economic benefit to an organization. So is staying out of court. Staying out of jail is a great social benefit to an individual to be achieved at almost any cost. The scientific and environmental benefits of monitoring are often hard to measure and generally not well documented or understood. For the above reasons these benefits usually represent only minor considerations in resolving whether or not to monitor.

Table 1 is a conceptual framework for monitoring showing many of the benefits which can accrue during the various stages of the project cycle. As such it is a useful tool to employ at the "whether to monitor" decision point. It also clarifies many of the management issues dealt with in Section 3.2.

Table 1: A Conceptual Framework for Monitoring (after Tywoniuk)

Project Cycle Step	Sources of Information: Operational	Regulatory	Scientific
Problem Need Definition	←	←	←
Concept Options	Design Data and Standards Feasibility Studies - economic - social - environmental	EIS data (or IEE)	New technology/ process/ methodology Innovative design Literature
Design - preliminary - development - final	Design-specific data Modeling	More extensive EIS data	- generic information - new, innovative design
Construction	Check with design Quality control	Compliance monitoring	Testing materials New materials Stress/Strength
Operation	Plant operates per design Improve plant operation/cost	Compliance to regulations and standards	Optimization research Model / Design verification EA prediction New standards Futuristic options
Decommission (abandon)	?	?	?

* Keys are feedback, integration, communication

3.0 Environmental Effects Monitoring

3.1 Technical Factors

Spatial considerations:

- monitoring should be conducted within the zone of impact and at appropriate control sites
- classical experimental design may be difficult to fit to monitoring programs as there is generally only one treated area (the zone of impact) and, hence, no true sample replication
- there is a need for a control area (several control areas preferably)
- control areas may provide an adjustment factor for changes due to forces unrelated to a project
- control areas can help identify longterm effects operating differentially on the various study sites which would tend to render monitoring irrelevant (moving baselines)
- the zone of impact depends on physical transport mechanisms acting on air and water (winds, tides, currents, etc.)
- impacts may extend beyond the physical boundaries of the project hence there may be a need to monitor far beyond the immediate vicinity of the project
- the problem of cumulative impacts is a convincing argument for monitoring being viewed in a regional context
- spatial variability (clumping, mobility) of the target population will dictate the boundaries of study areas
- there is a need to determine, define and clearly identify spatial boundaries early on
- sampling locations should be established early and should be amenable to resampling (can be accurately relocated)
- the inherent spatial heterogeneity of most populations means that study areas will generally not be small
- sampling sites must be representative
- sampling sites should be located close to the source of disruption
- the importance of familiarity with the study area cannot be overemphasized.

3.0 Environmental Effects Monitoring (Continued)

3.1 Technical Factors (continued)

Temporal aspects:

- monitoring should be considered with respect to the construction, operation and decommissioning phases of a project
- it can provide immediate feedback at all stages
- should begin during the early stages of a project (before construction)
- must be keyed to the life cycle of target organisms or seasonal variations in physical/chemical factors
- there should be a quantitative definition of the variation of the target population over time
- long term natural cycles and trends must be kept in mind
- sampling frequency will be dictated by the above considerations
- should be conducted for a minimum of one full year (not a calendar year) after operations begin
- should continue until impact predictions are verified or rejected
- should have a reasonably well-defined endpoint which is agreed to early on
- should be mindful of the potential for a time lag between the imposition of an impact and its ultimate expression in valued ecosystem components
- monitoring should consider the innate regenerative capacity of natural systems
- monitoring outputs must fit decision making timeframe

What to monitor:

- population parameters of target biota
- obvious physical and chemical disturbances
- problems identified during predictive exercise
- process outputs (emissions and effluents can change with time)

3.0 Environmental Effects Monitoring (Continued)

3.1 Technical Factors (continued)

- public perceptions (human values can also change with time)
- key indicator organisms (or surrogates/indices)
- lower trophic levels of food chains leading to man
- potential detrimental effects of monitoring activities

How to monitor:

- assess adequacy of baseline data for use in rigorous hypothesis testing. Rate or direction of change cannot be determined without a defensible starting point.
- where necessary and/or possible take advantage of such natural archives as sediment and pollen profiles, tree rings, historical air photos, etc. to complement baseline data.
- other techniques such as modelling, trend analysis, manipulation, and laboratory experimentation may be useful
- "baseline" data collection can begin during the latter stages of the project (construction, operation, decommissioning). Information thus generated is relative (between two points on impact continuum) rather than absolute (before/after).
- set acceptance and rejection standards/criteria before monitoring begins
- design study to ensure collection of statistically valid data
- sample systematically using consistent methodology
- where possible employ non-disruptive or non-destructive sampling techniques
- focus on valued environmental components. Desirable characteristics of target organisms include:
    - sessile rather than mobile
    - of known biology
    - common and ubiquitous
    - deposit feeders rather than selective feeders
    - sensitive to disruptive influence(s) of project
    - ecologically, socially or commercially important
    - suitable life-cycle characteristics

3.0 Environmental Effects Monitoring (Continued)

3.1 Technical Factors (continued)

- strive for efficiency throughout process
- periodic multiscans to characterize process outputs or the receiving environment can provide valuable information
- use feedback to identify need to modify monitoring program
- employ audit to assess utility of monitoring program
- present monitoring results in understandable terms/format

3.2 Management Issues

The critical issues for the management of environmental effects monitoring programs are related to the identification of the roles and responsibilities of the various participants in the monitoring process. Institutionalization of environmental effects monitoring will ultimately hinge upon the acceptance of these roles and responsibilities within some as yet to be agreed upon administrative framework. The following roles and responsibilities were identified at the Vancouver workshop:

Government Regulator

- interprets regulations
- evaluates monitoring results for compliance
- discretionary enforcement (just versus equitable redress)
- feedback to standards (standards are often equal to background levels plus some increment)
- feedback to regulation/evaluation
- some responsibility for effects monitoring costs

Reviewer/Scientist

- provides advice to regulators and proponents
- could be a review committee headed by integrator
- early input to monitoring program
- middleman (interpretor) between proponent and regulator
- must be independant and unbiased

3.0 Environmental Effects Monitoring (Continued)

3.2 Management Issues (continued)

Public advocate
- protects public interest
- may be government agency, NGO or others
- "freaks and kooks" can serve useful purpose in holding other participants accountable to public

Proponent
- generally responsible for monitoring costs
- corporate organization must be appropriate for translating monitoring results into environmental action
- has most to gain (and lose) by monitoring
- present push is to get more involved in effects monitoring (to same extent as compliance monitoring)
- social responsibility to minimize project impacts

Public
- hardest to pigeonhole
- the ultimate audience for all other participants
- should be kept informed (has right to know)
- may or may not need to be involved
- other participants suspicious or leary of public involvement
- monitoring solely on the basis of public concern is legitimate when it is paid for by the public (ie. government)

Investigator
- often a consultant
- should not be advocate of project or proponent (ie. impartial)
- usually on tightrope between proponent trying to minimize cost and regulator trying to ensure scientific adequacy of monitoring program
- as agent of industry is often viewed suspiciously by other participants

3.0 Environmental Effects Monitoring (Continued)

3.2 Management Issues (continued)

Obviously there is often considerable overlap in the various roles and responsibilites of monitoring participants. The key to a successful monitoring program lies in open and abundant communication throughout the process. There must also be early agreement as to who pays for what and who does what. Clearly the following areas of effects monitoring must soon be addressed and resolved:

- cost-sharing (apportionment of both monetary and non-monetary inputs)
- responsibilities for design, implementation, review and audit
- input to decision making process
- commitment to monitoring
- feedback to EIA
- development of a strategy for general acceptance by government, industry and the public of need for environmental effects monitoring.

4.0 Summary

Environmental effects monitoring is scientific research to detect change. As such it requires at least two sets of measurements; one pre-treatment, and one post-treatment. Within the context of the environmental impact assessment process actual change can be compared to predicted change so that predictive capabilities can be improved. Monitoring is also a tool for measuring the effectiveness of mitigation measures undertaken during project development. At a higher level monitoring information provides an important yardstick for auditing the entire impact assessment process. Such feedback is essential if ennvironmental impact assessment is to be widely perceived as a learning process and capable of real progress.

EPILOG

At the conclusion of the workshop, participants were asked to identify the main issues, findings or themes which emerged during the workshop. These are outlined below:

1. Environmental effects monitoring is a legitimate and potentially important component of the environmental impact assessment process and should be formally brought into the process.
2. Significance criteria must be adopted very early in the monitoring program.
3. Adequate baseline information is essential.
4. Monitoring programs must have built in flexibility to deal with the dynamics of natural ecosystems.
5. Monitoring must focus on selected parameters and target organisms.
6. There is room for more rigour in the design of monitoring programs so they are useful to decision makers.
7. Proposed monitoring programs should be reviewed by an independant panel at an appropriate time in the project cycle.
8. The primary purpose of monitoring is feedback.

4.0 Summary (Continued)

9. There is a need for new and innovative techniques in monitoring.
10. Monitoring programs must be negotiated rather than dictated by fiat.
11. Successful monitoring requires the input of a skillful integrator.
12. Monitoring often looks at changes to the physical environment and consequently there is a need to involve physical scientists at an early stage in program design.
13. Sound monitoring programs generally require a good familiarity with the study area.

Appendix 1

Objectives

Pacific Region Workshop on Environmental Effects Monitoring

Environmental Effects Monitoring Definition - "Monitoring to detect change in individuals populations, or communities of living organisms which result from man-induced activities" EPA 1977.

Workshop Objectives and Organization

1.0 Objective

To provide a follow-up to the Beanland's Duinker report in order to further clarify our understanding of the term effects monitoring and the factors which influence the design of environmental effects monitoring (EEM) programs.

2.0 Objective

Identify technical and program management issues/factors which need to be taken into account when designing Pacific Region EEM programs which are:

(i) sound from a scientific and managerial stand-point,
(ii) relevant to those who must make project-related decisions, whether in industry or in government.

2.1 Sub-objective

2.1.1. Invite approximately 15 participants to the workshop, each with experience in effects monitoring; ensure that the private sector and government are well represented.

2.1.2. Develop a scenario for a plausible Pacific Region Marine industrial development in order to provide a concrete basis for discussion amongst those knowledgable in effects monitoring.

2.1.3. Workshop participants will be asked to outline key factors/issues which need to be taken into account by government and industry when designing EEM programs, at two levels:

a) specific to a project and the impact likely to be encountered,
b) at a broader, more generic level i.e. university/government monitoring research not tied to a specific project and dedicated to providing the background data needed to monitor some of the residual impacts likely to be encountered at the project-specific level.

2.1.4. The workshop participants will be people with experience in effects monitoring, both at the detailed technical level and at the program management level.

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2.1.5. After the presentation of the scenario, each workshop participants will identify possible environmental impacts on marine and terrestrial ecosystems and outline her/his approach to designing an EEM program with rationales.

2.1.6. In the afternoon, participants will be divided into a university, private industry and consulting group and a provincial-federal government group. The purpose will be to develop generic and project-specific approaches to EEM program design, together with rationales.

3.0. Objective

Develop a rationalized summary list of issues/factors which should be taken into account in EEM program design at the generic and project-specific level.

3.1 Sub-Objective

3.1.1. Workshop participants will "test" the summary list of issues/factors identified on day one by designing a hypothetical marine EEM program (both project-specific and generic). The programs will be developed to deal with impacts associated with the project scenario and will be prepared by two groups, each consisting of representatives from industry, government, university and the consulting field.

3.1.2. In the afternoon of day two, time should be spent on key issues and factors in EEM program design which have not been discussed yet or need more elaboration. These factors/issues will likely be managerial rather than technical in nature.

Management role playing can be used to determine the roles of government and private sector managers and their interactions with technical staff in designing EEM programs. The role playing session would centre around a controversial predicted impact associated with the project scenario. Workshop participants who are not taking part in the role playing would be expected to act as observers and would be expected to report on several management principles or guidelines revealed by the various "managers".

4.0. Objective

To prepare a report which:

- identifies the key issues/factors which need to be taken into account when designing EEM programs in the Pacific Region,

.../3

- places effects monitoring in the context of the information needs for the assessment process overall,

- provides guidance to Government agencies when advising on the design of EEM programs eg. when establishing baseline information needs, when reviewing impact assessment documents, when preparing briefs to EARP Panels etc.,

- provides an improved understanding and appreciation of the contribution which EEM programs can and should be making in advancing the field of EIA,

- provides a partial basis for the development of DOE policies on EEM. The Altantic and Ontario Regions have already provided some input (see attached.) and additional information is expected from tthe Pacific Regional workshop. Once the three regional workshops have been held a policy level workshop will be held in Ottawa and following that a draft policy statement on EEM program design will be tabled at an Environmental Impact Policy Committee meeting.

Appendix 2: Workshop Participants

Name	Agency
Ian Birtwell	Fisheries Research Branch, D.F.O.
Monica Gewurz	Environment Canada, EPS
Larry Giovando	Institute of Ocean Sciences, D.F.O.
Ken Hall	Westwater Research Centre
Lee Harding	EPS - Marine Programs
Paul Harrison	Dept. Oceanography, U.B.C.
Bruce Kay	EPS - Marine Programs
Bob Langford	MOE - Planning and Assessment
John Luternauer	Geological Survey of Canada, EMR
Eric McGreer	DFO - Habitat Management Division
John Millen	EPS - Referral and Impact Analysis
Anne Moody	AIM Ecological Consultants Ltd.
Bob Moody (Chairman)	AIM Ecological Consultants Ltd.
Bruce Morgan	Planning & Assessment, MOE
Nina Munteanu (Rapporteur)	AIM Ecological Consultants Ltd.
Mike Nassichuk	DFO - Habitat Management
Martin Pomeroy	EPS - Marine Programs
David Popham	Seakem Oceanography Ltd.
Craig Runyan	Municipality of Richmond
Nick Tywoniuk	Corporate Affairs - DOE
Phil Whitehead	Canadian Wildlife Service

Appendix 3: Environmental Effects Monitoring Workshop

AGENDA

DAY ONE - TUESDAY, MARCH 5, 1985

08:30 - 09:00	Introductory Remarks (R. Moody)
09:00 - 10:00	Presentation of Scenario (L. Harding)
10:00 - 10:20	Coffee
10:20 - 11:30	Discussions of Environmental Components

A. Physical Environment
   1. Oceanography
   2. Sedimentology
   3. Water Quality

B. Biological Environment
   1. Primary & Secondary Production
   2. Fisheries Resources
   3. Others

11:30 - 12:00	General discussion of component interactions
12:00 - 13:30	Lunch
13:30 - 13:45	Discussion of group objectives
13:45 - 15:30	Group discussions
15:30 - 16:00	Coffee
16:00 - 17:00	Presentation of group results/concluding remarks

Appendix 4: Environmental Effects Monitoring Workshop

AGENDA

DAY TWO - WEDNESDAY MARCH 6, 1985

08:30 - 09:00	Recapitulation of first day activities and results Presentation of summary of impact predictions (hypotheses)
09:00 - 11:30	Group discussions 09:00 - 10:30 Development of monitoring programs 10:30 - 11:30 Application of specific EEMP to general situations
11:30 - 12:00	Presentation and comparison of group results
12:00 - 13:30	Lunch
13:30 - 15:00	Identification and discussion of program management factors
15:00 - 16:00	Identification of roles of principal actors in EEM - Government regulator - Reviewer (government/academic) - Public advocate (government/NGO's) - Project proponent - Public - Investigator
16:00 - 16:30	Identification of main issues, findings or omissions of workshop
16:30 - 17:00	Concluding remarks