

**ANALYSIS OF THE RESPONSE TO THE USE OF
"ADAPTIVE ENVIRONMENTAL ASSESSMENT METHODOLOGY"
BY THE GREAT LAKES FISHERY COMMISSION**

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Members of the
Board of Technical Experts,
Great Lakes Fishery Commission

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Great Lakes Fishery Commission

1451 Green Road
Ann Arbor, Michigan 48105

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ABSTRACT

Through its Board of Technical Experts (BOTE), the Great Lakes Fisheries Commission sponsored an extensive trial of the Adaptive Environmental Assessment Methodology (AEAM), a workshop/modelling technique which has been developed over several years at the Institute of Animal Resource Ecology, UBC and at IIASA, Austria. The workshop modelling exercises are used to identify data and conceptual weaknesses in the collective understanding of how complex systems operate and to allow an exploration of the effects of alternate management strategies. The trial consisted of a training course for modellers and three workshops focussed on Great Lakes problems, Lake Trout rehabilitation, Sea Lamprey control and Fishery Management. After the workshops, it was decided there should be a review of the whole exercise.

A committee of BOTE was charged with the task of reviewing the workshops and the AEA process. The committee used questionnaires to gauge the opinions and reactions of workshop participants and of fishery agency managers who are the primary clients for such workshops. The printed reports on workshops were also reviewed.

The results showed that overall there was a majority of support among participants and clients for the past and future potential uses of AEA methodology. The results also highlighted areas where the workshops and their impact could be significantly improved e.g. by tackling smaller problems, more preparation before the workshop, greater involvement of participants in all phases of a workshop, more analysis of uncertainties

(iv)

and less of the models, and a greater effort to communicate the results to decision makers whether in research-planning or management.

Clearly, there is a strong mandate for further use of the AEA process by the Commission and its collaborating agencies.

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INTRODUCTION

In May, 1981, the Great Lakes Fishery Commission (GLFC) through its Board of Technical Experts (BOTE) arranged for a number of fishery biologists from various agencies around the Great Lakes to attend a training course on Adaptive Environmental Assessment Methodology (AEAM) at UBC, Vancouver, British Columbia. After the course, a number of individuals, who had attended the course, were recruited to conduct a series of workshops using AEAM to analyse some issues of concern to GLFC and its cooperating agencies.

The training course was conducted at the Institute of Animal Resource Ecology (IARE) and lead principally by Carl Walters and C.S. Holling with a large input from ESSA Ltd., a consulting company which is supplying AEA on a commercial basis. The AEAM workshop process was developed at IARE and at the International Institute for Advanced Systems Analysis in Vienna, Austria, partly (as a result of the failure of the IBP Program in the 1960's and 1970's to produce useful ecosystem models.

In AEAM workshops a diverse array of managers, policy makers and scientists are brought together to develop simulation models that are sensitive to policy choices. The modelling process begins with an intensive definition of the problem or scoping session where clients (managers) identify the breadth of the problem to be addressed and the individuals whose expertise bears on the problem. Later a modelling workshop is convened. The problem statement is refined and subdivided into tractable subunits, each characterized by requisite inputs and outputs. Experts in subgroups, aided by workshop facilitators, construct submodels which address the information needs of other submodels. The submodels are parameterized, tested

and then strung together as a single model. The single model is then used to generate scenarios which are the consequences of action sets or policies. The models are also examined for their weaknesses both conceptually and with respect to data. It is envisaged that after one workshop, participants will attempt through their actions to reduce the uncertainties through experimentation and improved data gathering. Later the whole process can be iterated, perhaps with changes in emphasis, to develop better models. However, it should always be remembered that it is the organizer's view that the principal purpose of an AEAM workshop is not to produce a simulation model but rather to promote communication amongst a diverse set of people, to identify gaps and weaknesses in our knowledge and to develop a common framework where the consequences of potential policy actions can be more fully appreciated.

The GLFC has conducted three workshops. The first focussed on the trade-offs among Lamprey Control, Lake Trout stocking and Fishery regulation given the objective of Lake Trout rehabilitation. The selection of participants led to Lake Michigan being the lake examined. This was a wide ranging workshop and was regarded as a training exercise. The second workshop focussed on Integrated Pest Management of Sea Lamprey in Lake Superior. The purpose here was to critically compare alternative control procedures and to identify information gaps and possibly a desirable mix of controls. The third workshop concentrated on Lake Erie and the question "What are the consequences for the fish community and fisheries of various quota management policies for Walleye, Yellow Perch and White Bass in Lake Erie?"

After these workshops had been completed, a number of questions arose concerning: (i) the success of the workshops; (ii) their impact of

research planning, issue analysis and decision making; (iii) the adaptation of the AEA Method to the Great Lakes situation; and (iv) the scope for future application of AEAM to problems large and small. As a result, BOTE decided to undertake a review of AEAM and its impact in the Great Lakes fishery milieu. To this end BOTE appointed a three man committee.

The committee decided the best way to review the application of AEAM was to:

- (i) Find out what the workshop participants thought about the process and their experience with it;
- (ii) Find out how administrators in the various fisheries agencies around the Great Lakes, perceived the AEAM process and its application/promotion by GLFC; and
- (iii) Look at the products and impact of the training course and the three workshops.

To deal with the first two issues, the committee decided to use questionnaires. The third issue was dealt with via review of documentation and other material relating to the AEAM process.

The committee was also charged with making some recommendations on the future use of AEAM.

METHODS

The committee devised two questionnaires, one to be sent to individuals who had participated in the training course and/or any of the workshops, and one to be sent to agency heads/directors/managers, those who might be considered clients for AEAM workshops. The mailing lists were compiled by the GLFC-Secretariat.

The participant Questionnaire (Q 1, Table 1) sought to gauge peoples reaction to the workshop process, the problem tackled and to find in what ways people reacted to the experience. The client Questionnaire (Q 2, Table 2) sought to detect feedback from workshops to agency thinking and to find out how clients viewed the potential application of AEAM.

The committee also read the available AEAM workshop reports and other information on the use of AEAM workshops in the Great Lakes region that were triggered by the GLFC promotion of such workshops.

The comments of respondents were compiled by question and are on file with the GLFC Secretariat along with the fists of respondents' names and addresses.

TABLE 1

Dear

As part of a B.O.T.E. analysis of Adaptive Management as used by the Great Lakes Fishery Commission, we are carrying out an opinion survey of those who participated in one of the three GLFC sponsored workshops or the training course held in Vancouver. We need your contribution. We would appreciate your filling out the attached questionnaire and its speedy return to the Commission.

Please return your-completed questionnaire and any additional observations or conclusions you wish to make to:

Dr. C. K. Minns
Great Lakes Fisheries Research Branch
Canada Centre for Inland Waters
867 Lakeshore Road, P.O. Box 5050
Burlington, Ontario L7R 4A6
Canada

Yours,

QUESTIONNAIRE 1

0. Your Name _____
1. Which of the following did you attend?
 Vancouver 81 _____ Lamprey 81 _____ Erie 82 _____ Lamprey 82 _____
2. What was your role in the above?
 Client _____ Participant _____ Observer _____ Modeller/Trainee _____
3. Do you think you were told enough before you arrived at a workshop? (Y/N) _____
4. What were your expectations when you went?
 - Working, predictive models now (or soon) _____
 - Better appreciation of the problem and priorities _____
 - Other (please state) _____
5. Did you want to go? (Y/N) _____
6. Did you think:
 a) The number of people attending was
 just right _____ too many _____ too few _____
 b) The workshop duration was
 just right _____ too long _____ too short _____
 c) The size of problem tackled was
 just right _____ too long _____ too small _____
7. When submodels were assembled, did you think:
 a) You were being railroaded by the modellers _____
 b) The subgroup contained sufficient experience and expertise _____
8. What did you get out of the workshop? _____

9. Did participation in the workshop(s) change your perception of the ecological system examined? (Y/N), comment _____

10. Was the workshop simulation model plausible? (Y/N) _____
 If not, do you think a "believable" model could be developed from existing data? (Y/N) _____

11. Do you feel the models, given further refinement, would be of use in the future? (Y/N), _____
Row? _____
12. Did the workshop alter your conception of the role and use of modelling in problem solving and management? Please Comtent: _____

13. Would you be prepared to attend another workshop? (Y/N) _____
14. Do you have any suggestions as to how such workshops might be improved? _____

15. Could you suggest some topics or problems which might be the subject of an Adaptive Management Workshop? _____

16. Did you report to your colleagues and management on your experience) at the workshop? __ _____

Thank you for your time and effort.

TABLE 2

Dear

The Board of Technical Experts (B.O.T.E.) is conducting a review of the use of A.E.A.M. (Adaptive Environmental Assessment and Modelling), or Adaptive Management, as it is known, in the Great Lakes Fisheries environment. We are surveying the opinions of two groups:

i) **you**, the managers and administrators in the various agencies which are party to the management of fishery resources in the Great Lakes;

and ii) those members of your staff who attended either the training course or one of the three modelling workshops, sponsored by the GLFC through B.O.T.E.,

with a view to assessing the strengths and weaknesses of Adaptive Management as applied by GLFC.

From you we wish to gauge the extent to which Adaptive Management as a process is understood/misunderstood, and to which the methodology has been transferred or been useful to your agency.

AEAM was brought into the Great Lakes environment on an experimental basis, to see if it had anything to offer with regard to, for instance,

- SGLFMP
- the "ecosystem approach"
- "experimental management"
- improving communication
- identification of research needs
- development of management models.

As you may be aware, to date there have been three workshops related to the AEA process; two related to lamprey in 1981 and 1982, and one on Lake Erie perch in 1982.

In AEAM workshops a diverse array of managers, policy makers and scientists are brought together to develop simulation models that are sensitive to policy choices. The modelling process begins with an intensive definition of the problem or scoping session where clients (managers) identify the breadth of the problem to be addressed and the individuals whose expertise bears on the problem. Later a modelling workshop is convened. The problem statement is refined and subdivided into tractable subunits, each characterized by requisite inputs and outputs. Experts in subgroups, aided by workshop facilitators, construct submodels which address the information needs of other submodels. The submodels are parameterized, tested and then strung together as a single model. The single model is then used to generate scenarios which are the consequences of action sets or policies. The models are also examined for their weaknesses both conceptually and with respect to data. It is envisaged that after one workshop, participants will attempt through their actions to reduce the uncertainties through experimentation and improved data gathering. Later the whole process can be iterated, perhaps with changes in emphasis, to develop better models. However it should always be remembered that it is the organizer's view that the principal purpose of an AEAM workshop is not to produce a simulation model but rather to promote communication amongst a diverse set of people, to identify gaps and weaknesses in our knowledge and to develop a common framework where the consequences of potential policy actions can be more fully appreciated.

Accordingly we would like to obtain from you any observations or conclusions which you may have to offer on AEAM. We feel the attached questionnaire may be useful in facilitating your reply but we invite you to expand on question 10 in any manner you feel appropriate. We anticipate that the results of this inquiry will play a substantial role in determining the future course of action the GLFC will adopt regarding the use of the "Adaptive Management Process" in addressing Great Lakes fisheries issues.

We ask that you forward your replies to:

Dr. C. K. Minns
Great Lakes Fisheries Research Branch
Canada Centre for Inland Waters
867 Lakeshore Road, P.O. Box 5050
Burlington, Ontario L7R 4A6
Canada

Yours,

Client Questionnaire

QUESTIONNAIRE 2.

0. Your name _____
1. Were you ever invited to an AEA Scoping Session _ or Workshop? _
2. Are you aware of the use of AEA methodology in the Great Lakes fishery environment? (Y/N) _____
3. Are you aware of the commitment of funds to AEA workshops by GLFC? (Y/N) _____
4. Have you had any reports on AEA from workshop attendees or other officials in your organization? (Y/N) _____
5. Do you think the AEA process has any potential role in:
- Managing Great Lakes fishery resources (Y/N) _____
 - Clearer understanding of problems _____
 - Operational and Research Planning _____
 - Better intra- and inter-agency communication _____
6. Do you think the AEA process is potentially useful _____, essential _____, or a waste of time and money _____ other _____
-
7. Do you think GLFC should continue to promote the use of this tool? (Y/N) _____
- Do you know of any-alternative methods? (Y/N) _____
- Please specify _____
-
8. Could this process be used in the development of multi-agency Lake Management Plans, as envisaged in SGLFMP? _____
-
9. Have you, or do you have plans to incorporate the insight gained from this approach into your management process? _____
-
-
10. Do you have any comments about AEAM? _____
-
-
-

Thank you for your time and effort.

RESULTS

Questionnaire 1

Of the 90 questionnaires mailed out we received a response from 69 individuals, including one blank form. The breakdown of results on questions 1 and 2, 'which workshops did you attend' and 'what was your role'¹, indicates that our sample is representative (Table 3). The totals exceed 69 because some individuals attended more than one session and had more than one role.

TABLE 3. Distribution of Respondents by Workshop and Role.

<u>WORKSHOP</u>		<u>ROLE</u>	
	<u>No.</u>		<u>No.</u>
Vancouver-81	21	Client	10
Lamprey- 81	31	Participant	37
Erie-82	23	Observer	12
Lamprey-82	32	Modeller	17
	107		76

Most attendees felt they were told 'enough before arriving at a workshop (Q1 - 3, 63%). 3 percent of respondents were not sure.

On the question of expectations (Q1 - 4, there were a number of multiple responses but overall 27 percent expected 'working, predictive models now', 54 percent expected a better appreciation of the problem and priorities. 17 percent offered other responses, which were fairly evenly divided among (i) to learn more about the AEA workshop process, (ii) to learn more about the process of modelling, and (iii) to communicate with fellow scientists and managers.

The vast majority wanted to attend (Q 5 - 94% vs 4%).

The response on the questions (Q1 - 6a, b, c) about the number of attendees, workshop duration and the size of the problem drew a majority view in each case. 67 percent thought the number of attendees was just right, versus 32 percent who thought there were too many. 60 percent thought the workshop lengths were about right, 22 percent thought they were too long and surprisingly, 18 percent thought they were too short! While 28 percent of the participants considered the problem tackled was the right size, 68 percent thought it was too large. None thought it was too small!

A large group, 46 percent (Table 4, Q1 - 7) felt they were rail-roaded by the modellers and 22 percent were not sure or ambivalent. However, 75 percent felt that the necessary expertise was present for subgroup activities.

All respondents had something to say about what they got out of the workshop(s) (Q1 - 8).

Quite a few (43%) felt that the workshops altered their perception of the ecological system examined but a majority (50%) did not. Nearly half (47%) thought the workshop model was implausible while 49 percent thought a believable model could be developed from existing data, versus 29 percent who did not. 87 percent felt that the models given further refinement, would be of use in the future (Table 4, Q1 - 11). Only 40 percent felt that their conception of the role and use of modelling in problem solving and management was changed.

A majority (85%) would be willing to attend future workshops. Most (94%) had comments on how the workshops might be improved and a majority (66%) had suggestions for future workshops.

Most respondents (96%) reported back to their colleagues and management on their experience at the workshops.

While the numerical results from the survey gave some indication of the response(s) to the AEA process, the comments on various questions gave us

TABLE 4. Responses by Percent to Questions 7 Through 16 on Questionnaire 1.

Question	Yes	No	?
7a	46	32	22
b	75	13	12
8	100	0	0
9	43	50	7
10a	41	47	12
b	49	29	22
11	87	9	4
12	40	51	9
13	85	10	5
14	94	6	0
15	66	29	5
16	96	4	0

more insight into the impact of the workshops.

Asked 'what did you get out of the workshop?', the responses could be lumped as follows:

- (i) An appreciation of the complexity of problems facing Great Lakes fishery agencies.
- (ii) A recognition of the need for an overview, a top down analysis, so that priorities can be set.
- (iii) The AEA process offered an effective means of tackling problems to identify data and concept needs, and evaluating policy options.
- (iv) The recognition of the power of communication in depth among managers, researchers, policy-makers, etc.

- (v) An appreciation of the techniques of modelling resulting from hands-on exposure.
- (vi) Recognition of the need to get good functional descriptions of systems and to get good useful data.
- (viii) A minority expressed concern about the lack of model realism and applicability, and a frustration with the process.

Responses to question 9 - 'Did participation in the workshops change your perception of the ecological system examined?'- echoed those to the previous question, to some extent. Some of the key responses were as follows:

- (i) Realisation that models can be built.
- (ii) The importance of forage in most situations.
- (iii) The lack of key data e.g. Lamprey abundance.
- (iv) Recognition that these are multi-resource management problems and that the actions of many agencies do have an impact.
- (v) The importance of looking at processes, e.g. Predator/Prey, Lamprey parasitism.
- (vi) The gaining of an overview and an understanding of a large problem.

In response to the question 10 - 'Was the workshop simulation model plausible? If not, do you think a 'believable' model could be developed from existing data?', many felt that substantial improvement was feasible with existing data but also that the insights of these preliminary models identified substantial research needs.

Most felt that 'the models, given further refinement, would be of use in the future' (Q1 - 11) to:

- (i) Examine arrays of policy options, e.g. Integrated Lamprey Management

with several control methods, Stocking policies vs. forage, fishing.

- (ii) Teaching people about complex systems, promoting an appreciation of complexity and effects of interactions.
- (iii) To aid the management decision-making process.
- (iv) To focus and direct research and identify critical data needs.

Most did not think that the workshop altered their 'conception of the role and use of modelling in problem solving and management' (Q1 - 12). However comments suggested AEA workshops had modified the views of both proponents and sceptics of modelling. For some, modelling had to be viewed with greater caution but for many, there was acceptance that a model did provide a clearly defined tool whose strengths and weaknesses could be taken into account when used. Others gained new appreciation of AEA as a forum for exchange of ideas.

Most respondents had suggestions as to how the workshops might be improved (Q1 - 14):

- (i) There needed to be better scoping of the workshop problem at the onset and problems should be smaller, i.e. bounded more ruthlessly.
- (ii) More data gathering and analysis before the workshop convenes to make sure the right stuff is available.
- (iii) Use a split session, allowing more time for model construction but do it in such a way that there is greater participation by participants.
- (iv) A more rigorous analysis of alternate conceptual approaches, e.g. Disk equation vs. Bioenergetics.
- (v) Smaller groups to go with smaller problems.
- (vi) Put more emphasis on communication and try to ensure there are more policy-makers and fewer observers.

- (vii) Use the full iterative process envisaged by AEA, a simple model is succeeded, after a due interval for new data gathering and analysis, by a better model.
- (viii) More gaming with the model and a clearer definition of the testable hypotheses that must be pursued if resolution of a problem is to be clarified.

Topics suggested for further workshops (Q1 - 15) included:

- (i) Habitat conflicts.
- (ii) Salmonid - Lamprey interactions.
- (iii) Lampreys in specific areas, e.g. St. Mary's River, Lake Ontario.
- (iv) Percids in Lake Erie again.
- (v) Cold water species (indigenous vs. exotic) and predator-prey.
- (vi) Forage capacity to support stocked fish.
- (vi i) Fish population genetics.
- (viii) Impact of toxics/contaminants.
- (ix) Sport fishing economics vs (V)
- (x) Allocation/Stocking.
- (xi) Lamprey control strategies.
- (xi i) Strategic management plans.

Questionnaire 2

We received 17 of 27 questionnaires sent to clients but it needed a second mailing because of a poor response to the first. The numerical results produced some insight into agency views (Table 5). Less than half had been invited to a scoping session or workshop, All were aware of the AEA application and all but one knew of GLFC's financial support. All but two had had feedback from individuals exposed to AEA. On question (Q2 - 5), the majority thought AEA has potential for management, classification, planning

and communication roles. All thought the AEA process was at least useful and one thought it essential. A majority thought that GLFC should continue to promote the use of AEA and less than half offered alternatives for consideration. Again, most thought AEA had a role in the development of Lake Management Plans. Almost half of the respondents indicated that there was some effort to take advantage of AEA in their agency. 71 percent offered comments on AEA.

TABLE 5. Results of Questionnaire 2 - Client Survey.

Question	Percentage		
	Yes	No	?
1a	35	59	6
b	47	47	6
2	100	0	0
3	94	6	0
4			
5a	88	0	6
b	94	6	6
d	82.76	6	12.18
6	94 (useful)	6 (essential)	
7a	88	6	6
b	42	29	29
8	88	0	12
9	47	29	24
10	71	12	17

The comments offered by clients can be summed up fairly easily. The primary alternative to AEA seen by clients is interagency technical committees. Some looked for variants of AEA and one suggested the Delphi method. Most clients felt that there was a place for AEA in the development of multi-agency Lake Management Plans, particularly in developing the overview. Some clients said that there was some effort underway in their agency based on AEA. The final client question produced a wide range of comments. Most thought it should be pursued but that the computer aspect should be de-emphasized and the follow through strengthened. One comment (12) expressed the viewpoint well - 'if the process is meant to identify research and monitoring needs and priorities, as well as allow evaluation of policies, there should be a follow-up by the workshop sponsors to the agencies with advice and guidance'.

Workshop Reports

When this analysis was undertaken, only two of three workshop reports were available. Both reports were sparse. The documentation focussed on the mechanics of each workshop and consisted mostly of lists and technical modelling material. The scoping material was fairly well covered. Comparative runs of policy scenarios were presented. The Lake Erie report (Spec. Publ. 83-1) concentrated on scenario comparisons and met the policy analysis objectives of AEA more fully.

Both DFO and OMNR have gone on to use AEA workshops to examine their Acid Rain/Fisheries research priorities and to develop a framework for assessment of large scale potential impact. Michigan DNR has used AEA mini workshops for management training purposes.

DISCUSSION

The Adaptive Management workshops were first brought to bear on Great Lakes fisheries issues with the intention of exploring management options. As the cycle of workshops progressed, it became obvious that research and assessment planning would derive greatest benefit. Analysis of policy options would have to be deferred until the necessary iterations of alternating workshop and improved information gathering had occurred. This situation did create some confusion.

However, there can be no doubt of the majority support among participants and clients for the past and potential use of AEA methodology. There are also a reasonably unanimous set of recommendations, based on the respondents' comments :

(1) Tackle smaller problems

This means that the process of problem definition and bounding undertaken in the scoping session must be more ruthless/rigorous.

(2) Do more homework

Between the scoping session and the convening of the workshop, greater efforts must be made to ensure that the best data and ideas will be brought to the workshop.

(3) Make the participants work harder

Once submodel groups have been formed, participants must be fully involved in the submodel definition, construction and especially the testing. Too often participants felt like blood-donors, they gave up ideas and data and never saw them again. It may also make more sense to split the workshops so that participants are not idle while the actual model assembly is underway though they must be prepared for

impromptu phone consultations when problems arise.

(4) Analyse the uncertainties not the model

Too often the final stages of a workshop focussed on gaming without anyone fully appreciating the role of uncertainties or the structure of the overall model. Much of what goes into the model is supposition and the implications of the associated uncertainties are likely more important than the implications of different policies. More recent ESSA AEA workshops elsewhere are emphasizing a rigorous analysis of hypotheses, their implications, evidence for and against, identifying critical test(s) and who will do the tests.

(5) Telling the folks back home

Some participants would return to their agencies bubbling with the stimulation generated at a workshop but would have no impact on decision-making in either research planning or management. This can be solved in two ways:

- (a) Formal communication by the Commission of the recommendations derived from an AEA exercise, to the agencies, and
- (b) Promotion of a higher level of commitment on the part of more senior agency staff to act on sound recommendations.

By most accounts the AEA workshops have been highly successful . Any failure lies in part in the lack of follow-through by the agencies. Most recognise that AEA workshops are not a panacea but they do offer a well-founded approach for identifying information needs and priorities, and for evaluating policy options.

CONCLUSION

This review committee concludes that GLFC has a strong mandate from its cooperating agencies to continue the promotion and use of AEA methodology. There are still a few doubters but future AEA efforts will draw on the experience and wisdom gained so far to satisfy them. The results of the review offer several constructive points.

