NORTHEAST FISHERIES CENTER: A PLAN FOR REDIRECTION

BY COMMITTEE OF THREE

Michael P. Sissenwine,
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OF COMMITTEE OF THREE (COT)

NEFC PROGRAM REVIEW - SUMMARY OF RESULTS

AND RESPONSE OF COMMITTEE OF THREE (COT) ON RESEARCH AND STRUCTURE

The Program Review took place October 3-6, 1983. The Program Review Panel consisted of Allen Peterson, George Grice, John Steele, Izzy Barrett, Bill Aron, John Everett, Joe Angelovic, Bill Hargis, Ed Houde, Spencer Apollonio and Doug Marshall. Immediately after the Program Review, Allen Peterson prepared the summary of his conclusions and circulated them to the Panel members. Several Panel members (Spencer Apollonio, Bill Aron, Doug Marshall, Ed Houde, George Grice) provided additional written comments.

Following the Program Review, Allen Peterson established a committee to evaluate the results of the Program Review and to propose redirections in NEFC research and changes in organizational structure, if warranted. The membership of the Committee of Three on Research and Structure (COT) is Michael Sissenwine (Chairperson), Richard Hennemuth, and Carl Sindermann.

COT met on November 18, 1983, to summarize the written comments of the Program Review and to respond to them on a point-by-point basis. The comments were partitioned into three categories: Organization and Planning, Program Content, and General. There have been several additional discussions relevant to the Program Review. This document is a summary of COT's evaluation of the Program Review.

ORGANIZATION AND PLANNING

(1) Program Review Comment - There was a consensus that the heart of the NEFC Program should be the Resource Assessment activity in support of fishery management.

COT's Response - The perception of Resource Assessment as the heart of the Center is short-sighted, perhaps related to time scales. The Center's mission concerns living marine resources and their utilization, but ultimately, human activity associated with exploitation of non-living marine resources (e.g., oil and gas) and waste disposal (e.g., offshore dumping and contaminant loading from rivers) may have a greater impact on the productivity and health of fishery resources than fishing. These effects occur over a longer time scale and therefore are less obvious. Nevertheless, they shouldn't be ignored. The Center mission is probably multifaceted. At present, the Center suffers from the lack of a clear mission statement. COT will prepare a draft mission statement for consideration of the BOD and Center Director.

In order for the Center to provide a scientific basis for fishery management and habitat protection decisions, there needs to be a scientific underpinning for these studies. Academic institutions provide some of this underpinning, but some oceanographic (biological, chemical, physical) studies require the long-term commitment and broad-scale attention of a federal laboratory.

It is noteworthy that fisheries management-oriented stock assessments of the Resource Assessment Division are also necessary for Environmental Assessment and Marine Ecosytem Divisions' activities. The purpose of the Environmental Assessment Division's research is to determine the effects of habitat degradation on fish productivity. Therefore, the distribution and abundance of the fishery resource is a component of environment assessments. Furthermore, since fish populations are major component of the ecosystem, results from the Resource Assessment Division contribute to the models and analyses conducted by the Marine Ecosystems Division.

In summary, the fishery conservation and management-oriented activities of the Resource Assessment Division are the most immediate priority of the NEFC. Nevertheless, it would be short-sighted to minimize the significance of habitat protection-oriented research and the scientific underpinning for their studies. As a Fisheries Center within the National Marine Fisheries Service, the studies of fish distribution, abundance and population dynamics will be critical regardless of the sociopolitical issue (e.g., fisheries management, pollution, marine mammal preservation).

(2) Program Review Comment - There was a consensus that the present structure of the NEFC is too diffuse and complex, with too many elements reporting directly to the Center Director without adequate integration among them. On the other hand, one Panel member did not necessarily think that there were too many people reporting directly to the Center Director and did not think that there was much needed in the way of reorganization. He felt that some turf battles had to be eliminated and better cross-walking established.

There were a number of suggestions for reorganization. These called for: two major Divisions, Management and Ecosystems, with ADP included in Management; restructuring along the lines of four major activities, Ecosystem Modeling, Resource Management, Environmental Management, and Technical Support (including ADP, MURT and remote sensing); and two or three major Divisions, Assessments, Ecosystems and perhaps Environment (including AEG).

COT's Response - The specific organization of the Center must reflect its scientific mission, the Director's style, the history of the organization and the talents of the staff. It is clear that the organization must accomplish the following functions: conduct fishery science in support of resource management; conduct environmental science in support of habitat protection and environmental impact assessment; plan, coordinate, and synthesize research;

provide scientific and technical support for Center programs and some non Center programs (where the Center is uniquely qualified to provide services) and provide administrative support.

COT will make specific recommendations upon completion of its assignment.

(3) Program Review Comment - In general, the Panel felt that the Center's Programs should be better integrated, their roles and missions more sharply focused and prioritized.

COT's Response - The synthesis and coordination function should be emphasized in the Center organization and within each of its programs.

(4) Program Review Comment - It was recommended that a careful study be made of how marine ecosystems, environmental assessment and AEG interact.

COT's Response - Elements of all three programs need to be reviewed more thoroughly. COT will address the question of interactions after these studies are completed.

(5) Program Review Comment - There isn't enough communication and coordination between NEFC Programs.

COT's Response - Communication will be enhanced by a mission statement. One of the criteria for evaluating alternative organizations should be the effect on communication.

During COT's Discussion, there was particular emphasis on integration and communication with the Resource Assessment Division. It was pointed out that the other Divisions of the NEFC lack the analytical and population dynamics skills that are within the Resource Assessment Division. While ultimately most NEFC programs support the Resource Assessment Division's fishery management-oriented mission, in the short-term it will be necessary that the

Resource Assessment Division support other programs if the products of these programs are to take on population level significance.

(6) Program Review Comment - A better and more focused statement of purpose and objectives of the Center and its elements is needed. Some Panel members felt that there was a weakness in policy development and planning, particularly with regard to obtaining inputs to our priorities and plans from peer groups and constituencies. There was a general feeling that the Board of Directors was not effective as a means of setting policy, making plans and setting priorities.

COT's Response - COT will prepare a written statement of the Center mission. During COT's review, it will ask several programs to identify the relevance of their activities.

With regard to obtaining input from constituencies, it was recommended that routine lines of communication be established between the Center and Fisheries Management Councils. Similar communication networks should be enhanced between the Center and its habitat protection-oriented constituencies.

With regard to the Board of Directors, it has now been reorganized to be more issue- and decision-oriented. While this is a positive step with regard to planning and making policy, it may diminish communication on scientific issues. As noted above, such communication should be taken into account in the evaluation of alternative organizations.

PROGRAM CONTENT

RESOURCE ASSESSMENT DIVISION

(1) Program Review Comment - The Resource Assessment Division conducts too many and too frequent resource assessments.

COT's Response - Detailed annual assessments are required for some species (e.g., surf clams, sea scallops, and several others). The species will vary with time. Above and beyond these priority assessments, it would be useful to conduct assessments of the status of fisheries on a geographic basis (e.g. the Gulf of Maine, Georges Bank, Southern New England, Mid-Atlantic). These fishery assessments should include climatic data and other non-assessment-oriented information available to the Division. They could also include a socioeconomic perspective, reporting total value of the fishery, number of vessels involved, and major ports.

Single species-oriented research within the Division should focus on more time invariant results (e.g., fish biology population parameters, comprehensive historic reviews of fisheries). Other resources of the Division should be used for modeling, evaluation of fishery exploitation and management alternatives, development of new analytical methods, and more thorough analyses of fisheries statistics and research vessel survey data. In the case of research vessel survey data, there should be a more thorough analysis of sources of variability. The Division should implement a thorough evaluation of the survey (including survey design, strata definition, allocation of samples, sampling gear, monitoring of gear performance, sources of variability, data handling). Needs for additional resources should be identified.

(2) Program Review Comment - There was a perceived need to find better ways to translate stock assessments into forms useable by Fisheries Management Councils.

COT's Response - The Division has initiated several actions to facilitate communication with Fishery Management Councils and the fishing industry. The Division prepares non-technical summaries of assessments and publishes non-technical articles in Commercial Fisheries News. It should be recognized that relatively few scientist have the training or experience to communicate technical scientific results to a non-technical constituency. The Division and Center should fully utilize the few that do in critical interactions.

The Center should determine the feasibility of using Sea Grant Marine Advisory Services to facilitate communication with its constituencies.

(3) Program Review Comment - Greater interaction of stock assessment scientists with their peers outside of the Center is needed. In this regard, it was recommended that we continue substantial interaction with ICES. It was also recommended that we enhance interaction with other Centers and the US academic community.

COT's Response - At this time, ICES offers the best opportunity for NEFC stock assessment scientists to interact with their peers and maintain awareness of the state-of-the-art. Involvement in ICES is particularly important for the Resource Assessment Division since there are no comparable peer environments in the USA.

With regard to interactions with academia and other Centers, the Resource Assessment Division has been forthcoming. It has played a significant role in NEFC cooperative agreements with several academic institutions. It participated in the NMFS Stock Assessment Evaluation Working Group and the NMFS Bluefin Tuna Assessment Committee.

In the future, NAFO may offer more opportunity for further interaction with stock assessment peers. Peer review would be enhanced by the establishment of the Fishery Management Council Stock Assessment Committees.

(4) Program Review Comment - One person complained that the routine stock assessment person assumes there is nothing else in the ocean but the species they are assessing.

COT's Response - This problem will be partially alleviated by conducting assessments of entire fisheries, defined on a geographic basis.

(5) Program Review Comment - One Committee member felt that Resource Assessment staff was isolated from the rest of the Center. He noted their absence from all sections of Program Review apart from their own.

COT's Response - Certainly the leadership of the Resource Assessment Division is not isolated from the rest of the Center. The non-leadership staff of the Division could be more involved with other Center Programs, but in general they are no more or less isolated than comparable personnel in the rest of the Center.

MARINE ECOSYSTEMS DIVISION

(1) Program Review Comment - There was general agreement that the magnitude of ecosystem and environmental monitoring was not justified by the results that had been obtained to date. It was suggested that a review be made to determine how often that various surveys and monitoring efforts should be conducted. While some of the research was described as "first rate," the program seems to suffer from the "naive belief" that lots of surveys and lots

of data will lead to an understanding of the system. There does not appear to be a hypothesis to guide program planning.

COT's Response - The Marine Ecosystems Division is attempting to solve some very difficult problems (e.g., causes of recruitment variability, biological interactions between fish species). It is unrealistic to expect quick solutions. Nevertheless, the Division has been slow to analyze its vast data base.

With regard to routine monitoring, it is time to take an introspective look at the MARMAP I Program. COT recommends that a working group be established to review and evaluate the MARMAP I Program and prepare an issue paper on its utility and limitations. Resource Assessment Division staff should participate on the working group.

2) Program Review Comment - More emphasis should be placed on sampling post-larval and juvenile fish and defining their role in the ecosystem.

COT's Response - The need for greater emphasis on post-larval fish has been identified by the Marine Ecosystems Division. The Division has conducted much of the research which has led to this redirection. This is a good example of the Center's leadership role in fisheries science.

COT recommends that the Division prepare an issue paper documenting the basis of its redirection of recruitment processes research toward post-larval fish. The issue paper should address the role of physical oceanography in future recruitment process studies since post-larval fish are less susceptible to currents.

COT also recommends that the Division identify a method and strategy for sampling post-larval fish. It should also consider the appropriateness of the size fraction being sampled by current MARMAP I surveys.

(3) Program Review Comment - There was general agreement that inadequate progress has been made toward ecosystem modeling. More emphasis and resources need to be devoted to modeling in the future. In this regard, it was recommended that a top-level quantitative ecologist with some knowledge of physical oceanography be added to the effort. The modeling effort should incorporate climatic variability.

COT's Response - We need to be realistic about the potential of modeling. Modeling is the process of formalizing thinking. It should be a component of all of our research programs. Nevertheless, it is not a substitute for collecting the right data or doing the right experiments.

There is a role for a modeling unit which has the primary responsibility of synthesizing ideas and results for Center Programs. Progress in this area has been slow, and we need to get on with it. It is noteworthy that although the Marine Ecosystems Division has been given the lead in modeling, the most highly qualified staff are in the Resource Assessment Division. The current informal team approach to modeling, involving Marine Ecosystem Division and Resource Assessment Division personnel, is inadequate. COT will recommend alternative structures. The scope of modeling should be expanded from its current emphasis on multispecies fisheries models to include numerical physical oceanographic models, pollution-oriented sources and fates models, and bioeconomic models. COT will recommend that an immediate evaluation of the current multispecies fishery model (referred to as GEORGE) be accomplished.

(4) Program Review Comment - Some of the Review Panel questioned the overall relevance and soundness of Marine Ecosystems Division research.

COT's Response - By and large, the program is relevant and scientifically sound, although some redirection (as noted above) is necessary and underway. Too much emphasis on an all encompassing research product detracts from the credibility of the Division. There is not enough scientific leadership coming from the mid-level (GS-12-14) scientific staff of the Division. It is unclear whether this reflects lack of capability or opportunity.

ENVIRONMENTAL ASSESSMENT DIVISION

(1) Program Review Comment - What the Environmental Assessment Divison actually accomplishes was unclear to the Panel. A more definite focus, particularly in regard to outputs and their values, is needed. The monitoring mode alone is not seen as sufficient. It wasn't clear to the Panel how pollutants were selected for monitoring, and no system for prioritization is apparent.

COT's Response - As is the case with the Marine Ecosystem Division, it is unrealistic to expect quick solutions to difficult problems. Many of the results to date show no change; this is, in fact, a significant conclusion. One of the problems facing the Division is to determine the appropriate scale for future sampling. The Division must do a better job at synthesizing and packaging results.

COT noted that collections of benthic samples exist within both the Environmental Assessment and Marine Ecosystems Divisions. It recommends that both Division Chiefs comment on the advantages and disadvantages of consolidating these collections.

COT is concerned about the apparent lack of integration within the Division, the apparent lack of pollution-oriented modeling, the basis for prioritization of Division research directions, the validity of sampling strategies, the undefined nature of data bases, the relationship of the Division to the Ocean Assessment Division of NOAA, and the degree of interactions with other Divisions. Therefore, COT recommends that a two to three day technical program review be conducted at Sandy Hook. It further recommends that the Division Chief suggest the format and content of the review for COT's consideration.

ECONOMICS

(1) Program Review Comment - The majority of the Panel indicated that more socioeconomic studies in support of fisheries management were needed. One Panel member felt that economics expertise should be available to all the Center programs. Another Panel member had a dissenting view, and felt that economic studies should be left to the Councils.

COT's Response - The Center is already taking steps to supplement its economics capability. The Center economics research should focus on bioeconomics. Bioeconomics emphasizes the interrelationship between fish populations and fish harvesters, and the nature of self-regulation of the fish population-fish harvesting system. For this reason, NEFC economists should work closely with NEFC population dynamicists of the Resource Assessment Division. One alternative is that the economics program be included in a Center level synthesis function.

MANNED UNDERSEA RESEARCH AND TECHNOLOGY PROGRAM

(1) Program Review Comment - The current relevance of the MURT program was questioned. The Panel felt the activities should at least be integrated into other elements, and the program should not continue to set its own

priorities. The cost effectiveness of Man in the Sea research was questioned, although one individual noted that new technology may have a better cost-benefit ratio. One Panel member noted that regardless of the cost effectiveness of the program, he would rather see such needs contracted for with academic institutions.

COT's Response - The cost effectiveness of MURT is a NOAA issue rather than an NEFC issue. NEFC assumes relatively little of the operational expense. Difficulty in integrating the program is largely a result of the inadequacy of the operating budget, therefore MURT must exploit one opportunity (BLM, gear conflicts, slime, etc.) after another rather than contribute to a carefully planned program. Nevertheless, MURT has contributed to numerous NEC priority efforts (e.g., gillnet problems, lobster studies, surf clam gear development).

At present, MURT is performing two functions. It is pursuing its own program of research (e.g., submarine canyon ecology) and is providing technical support to other Center programs. The relevance of MURT's research needs to be evaluated. In the future, its research should be compatible with the priorities of the Center mission. If MURT is to function primarily to provide technical support, then this support should be allocated based on Center priorities. COT must consider whether or not MURT can effectively serve both itself and the Center.

AQUACULTURE

(1) Program Review Comment - Aquaculture was generally considered to be outside of the central mission and philosophy of the Agency, and should not be continued in its present form. Nevertheless, the Panel felt that the Milford Laboratory and its expertise are a national resource that should be

maintained. Some substantial effort should be made to redefine its role and to make it viable.

COT's Response - While the Committee accepts that aquaculture for food production is currently outside the central mission of the National Marine Fisheries Service (as stated by Dr. Gordon in a memo of November 16, 1983), it concurs that it would be shortsighted to dismantle the research capability that exists in the Milford Labortory. The resources of the Laboratory could be refocused on Center research of higher priority. These resources could be used for experimental shellfish biology, for studies of shellfish recruitment variability, or for research in fisheries genetics. Selected oyster stocks and selective breeding experiments on oysters should be maintained, otherwise many years of unique research will be irretrievably lost. Additionally, the important long-term shellfish industry liaison activity of Milford should be retained.

COT will meet with the Director of the Milford Laboratory to discuss alternative schemes for reprogramming resources. Carl Sinderman will prepare an issue paper to identify alternatives for redirecting resources of the Aquaculture Division. He will be in contact with members of the Aquaculture, Resource Assessment, and Marine Ecosystems Divisions.

AUTOMATIC DATA PROCESSING

(1) Program Review Comment - The Panel felt that the ADP Unit should be reviewed carefully concerning the services it provides and its efficiency. Some services to elements outside of the Center (Region, Council and States) are perceived as not being made in a timely and efficient way.

COT's Response - There is a plan of action that will bring major components of the Center up to speed within the next year. The plan calls for a centralized system with outlying nodes. There will be significant progress in remote data entry of fisheries statistics from the ports and regionalization of the fisheries statistics data base.

While ADP planning seems adequate, COT is concerned about the past effectiveness of implementation. There have been too many surprises (e.g., cost overruns, mid-year changes in financial responsibility for services). COT perceives that the communications with the Woods Hole Oceanographic Institution are unsatisfactory. It is unclear that the Woods Hole Oceanographic Institution computer system will have adequate capacity to accommodate all of NEFC's planned usage. There are policy issues that need to be addressed concerning ADP. To what extent should programming capability be centralized within the ADP Unit? What is the future role of micro-computers in the NEFC? How are priorities for ADP services established within the NEFC? What is the significance of the A-76 review?

COT recommends that a detailed technical review of the ADP Unit and the NEFC ADP plan be implemented.

UTILIZATION AND DEVELOPMENT DIVISION

(1) Program Review Comment - The Utilization and Development Division activities need to be examined in terms of their specific roles and missions. It is felt that some of the work should be left to industry. Nevertheless, it was agreed that the Division and Laboratory should remain in the NEFC. In particular, the work on monoclonal antibodies should be continued.

COT's Response - COT concurs with the Program Review comments. It is concerned that the Utilization and Development Division is responding to too many internal and external masters. The mission of the Division must be clarified.

The Chairperson of COT will meet informally with the Division Director and key staff to gather information. COT recommends that the Division Director prepare a brief statement of the perceived mission of the Division and how each component serves the mission.

NATIONAL SYSTEMATICS LABORATORY

(1) Program Review Comment - The Laboratory provides a useful service. It has some unique expertise. While the role of the Laboratory should not be expanded, the need for additional support was identified.

COT's Response - The perceived need for additional support should be addressed within the resource review process. The issue of NMFS (e.g. Research Council) responsibility for its National Laboratories should be addressed.

PATHOBIOLOGY DIVISION

(1) Program Review Comment - There were relatively few comments about the Pathobiology Division. One Panel member suggested that the program was more appropriate for a university. Another suggested that the Division "should focus again on inshore, manageable shellfish pathological problems rather than poke around offshore on an ill-defined mission."

COT's Response - There is a need for ongoing monitoring of diseases of valuable fishery resources. The cooperative effort between the Pathobiology

Division and the Resource Assessment Division should be continued, but the sampling design should be evaluated and the anticipated products of the research program identified. More interaction with RAD to quantify population level effects of diseases is needed.

The Pathobiology Division has evolved as a center of excellence, but it is unclear how research priorities are established and how they relate to the Center mission. COT recommends that the Director of the Division prepare an issue paper identifying the relevance of its program and NEC responsibilities. Pathobiology is one area where it may be appropriate for the NEC to provide a service for the states of the Northeast Region.

GENETICS PROGRAM, STATISTICAL ECOLOGY TASK

(1) Program Review Comment - There was only one written comment. One Panel member said that he "never quite figured out where fisheries genetics fit into the Center organizationally, but again it seemed more appropriate to a university."

COT's Response - Fisheries genetics is important. The effects of fishing upon gene pool, as it relates to productivity and robustness, may be the sleeping giant of fisheries science.

Future research in fisheries genetics should be assimilated within a major program element.

ATLANTIC ENVIRONMENTAL GROUP

(1) Program Review Comment - There was general agreement that AEG should be consolidated with the other oceanographic work of the Center, particularly if over 50% of its work is related to the Northeast.

COT's Response - AEG and the Fisheries Oceanography Program of the Marine Ecosystems Division have different focuses; broad scale climatic events and finer scale oceanographic features associated with recruitment processes, respectively. Nevertheless, since both pollution and fisheries management-oriented research require physical oceanographic support, this function may appropriately be included in a technical support unit, or consolidated with a Division.

COT recommends that the Director of AEG prepare a mission statement. Should the Center's physical oceanographic resources be consolidated within AEG? If so, could AEG provide the necessary physical oceanographic support for all of the Center programs?

FISHERIES ENGINEERING UNIT

(1) Program Review Comment - It was suggested that the gear work of the Fisheries Engineering Unit should be made part of the Resource Assessment Division.

COT's Response - The Fisheries Engineering Unit should provide engineering support for the development of scientific sampling gear. The most immediate needs are to provide these services to the Resource Assessment Division and the Marine Ecosystems Division. It may also be appropriate for the unit to provide services beyond the scope of NEC programs. Reassignment of the Unit will be considered within the evaluation of RUD.

REMOTE SENSING

(1) Program Review Comment - It was a consensus that Remote Sensing should not be an independent unit, but should be integrated within the program structure. The NEFC Remote Sensing activities should be in closer touch with activity in other Centers and academic groups. A detailed external review of remote sensing activity was recommended. Potential users of remote sensing within the NEFC need to be better informed about it.

COT's Response - COT recommends a technical review of the Center's Remote Sensing activity in order to realistically define potential products.

GENERAL

(1) Program Review Comment - Expanded communications with constituencies and academia should be fostered. In particular, the scientists at Woods Hole should communicate more with those at the Woods Hole Oceanographic Institution and the Marine Biological Laboratory. One Panel member noted that fisheries scientists don't seem to talk much to other marine or ecological scientists, and as a result they aren't taken seriously. Robert May at Princeton was specifically noted as an academic worth talking to.

COT's Response - Center scientists do a good job at interacting with academics. In fact, some have frequent contact with Robert May in particular. These academic interactions are part of the Center's over-commitment problem.

We do need more technical peer review of stock assessments so that they will be taken more seriously. Such review can be fostered through continued involvement in ICES, expanded involvement in NAFO, the establishment of stock assessment committees under the auspices of Fishery Management Councils, initiating NMFS scientific meetings, and sponsoring our own technical reviews.

There is always a need for better communication with constituencies. The Center is making a significant effort now, and can't do much more without more dedicated resources or more cooperation from Sea Grant.

(2) Program Review Comment - The Panel generally agreed that a more in-depth review should be made of all the programs to sharpen their role definition and examine their technical value and competence.

COT's Response - The Center is taking an introspective look at itself now, but tailoring the vehicle to the particular situation.

All of the Center's programs should consider the example of the Pathobiology Division which has taken the initiative to hold its own Program Reviews on a routine basis.

(3) Program Review Comment - One Panel member felt that the ratio of Administrative Service personnel to Program personnel was too high.

COT's Response - COT's perception is that the ratio of administrative personnel to the Program personnel of the Northeast Fisheries Center is no higher than in other Centers. The facts should speak for themselves. This issue is beyond COT's terms of reference.

(4) Program Review Comment - One Panel member noted that Fisheries Management Councils could benefit from similar Program Reviews, perhaps condensed to a half a day.

COT's Response - NEFC should conduct constituency-oriented Program Reviews after it has completed its self-evaluation, redirection and restructuring process.

(5) Program Review Comment - A system of redundancy and security should be established for computerized data holdings and for plankton samples that are being sent to the Polish sorting center.

COT's Response - COT recommends that the Director of the ADP Unit and the Marine Ecosystems Division, respectively, respond to these concerns.

ISSUES NOT NOTED IN PROGRAM REVIEW COMMENTS

1. Recreational Fisheries.
2. Travel Priority Policy.
3. Data Management and Access.
   - 3a. Standardization of Data Collection and Handling.
   - 3b. Status of Data Collected on Contract.
4. Definition of Program Units - Labs vs. Divisions? What is the importance of some laboratories (e.g., Chemistry, Deepwater Ports, Running Seawater, Radiation Source)?

APPENDIX II.

ACTION ITEMS RECOMMENDED BY COMMITTEE OF THREE

AND ADOPTED BY CENTER DIRECTOR

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Center
Woods Hole Laboratory
Woods Hole, Massachusetts 02543

January 3, 1984

To: NEC Board of Directors

From: Allen E. Peterson, Jr.

Subject: Action Items Recommended by Committee of Three (COT) on Research and Structure

The Committee of Three has recommended several action items (attached) based on their evaluation of the NEC Program Review. These actions are intended to gather more detailed information. I am directing you to cooperate with COT by fulfilling the responsibilities assigned to you by the list of actions items.

By necessity, these action items are along the lines of our current organization. Don't let your thinking and input to COT be constrained by our current organization. I want to know (through COT) what you think we should do and what we can do, not just a rationalization for what we are doing.

cc. Edwards
Mustafa
Cooper
Heyerdahl

ACTION ITEMS

1. Redirection of Resource Assessment activities:

   a. Detailed annual assessments of single species fisheries should be conducted as required for management purposes.

   b. Detailed assessments of single species fisheries in danger of collapse should be conducted as necessary.

   c. Annual assessments of fisheries on a geographic basis (e.g., Gulf of Maine, Georges Bank, Southern New England, Mid-Atlantic area) should be conducted. These fishery assessments should include climatic data, other non-assessment oriented information, and an economic perspective (i.e., total value of the fishery, number of vessels involved, major ports).

   d. More emphasis should be placed on time invariant results such as fish population biology parameters, comprehensive historic reviews of fisheries, modeling, evaluation of fishery exploitation and management alternatives, development of new analytical methods, and a thorough analysis of fisheries statistics and research survey data bases.

   e. In particular, there should be an evaluation of the survey (including survey design, strata definition, allocation of samples, sampling gear, monitoring of gear performance, and data handling). The need for additional resources should be identified.

   The redirection of Resource Assessment activity is the on-going responsibility of the Divison Director within the constraints of current resources. This redirection will be the basis of COT's future deliberations concerning reorganization and reallocation to facilitate Resource Assessment activity.

2. Establish a Working Group to review and evaluate the MARMAP I Program, and prepare an issue paper on its utility and limitations. Include consideration of the appropriateness of the size range sample by MARMAP I. This is an on-going responsibility of the Marine Ecosystems Division Director, but Resource Assessment Division staff should participate.

3. Prepare an issue paper documenting the basis for redirection of recruitment processes research toward predation and post-larval fish:

   a. Address the role of physical oceanography in future recruitment processes studies since predation and post-larval fish should be less subject to the effects of circulation than larval fish,

b. Define a strategy for sampling post-larval fish; identification and sampling of predators of eggs, larvae, and post-larval fish; and a method of implementing sampling.

It is the responsibility of the Marine Ecosystems Division Director to provide input to COT by 15 February, 1984.

4. Evaluate the current structure of modeling efforts between the Marine Ecosystems and Resource Assessments Divisions, and recommend alternatives if appropriate. This evaluation will be included in COT's recommendations to the Center Director (Item 17) based on discussions with Marine Ecosystems Division and Resource Assessment Division Directors.

5. Conduct a technical and organizational review of the Environmental Assessment Division:

a. Consider integration within the Division,

b. The apparent lack of pollution oriented modeling,

c. Criteria for setting priorities of Division research,

d. The relationship between the Division and the Ocean Assessment Division of NOAA, and

e. The advantages and disadvantages of consolidating benthic collections retained by the Marine Ecosystems and Environmental Assessment Divisions.

The review should be conducted by February 10, 1984. The Environmental Assessment Division Director should propose the format and content to COT. The Environmental Assessment Director will be responsible for implementing the review.

6. Prepare a mission statement for AEG. Include consideration of:

a. The possible overlap of AEG activity with physical oceanographic activity of the Marine Ecosystems Division,

b. The feasibility of AEG supporting all of the NEFC physical oceanographic needs,

c. The feasibility of integrating AEG into a major Center program element,

d. The responsibilities of AEG to the Southeast Fisheries Center.

The AEG Director should submit material to COT by February 1, 1984.

7. Conduct a review of the activities and mission of the Man Under Sea Research and Technology Program. The COT Chairperson will meet with the MURT Director by February 1, 1984.

8. Prepare an issue paper identifying alternatives for redirecting resources of the Aquaculture Division. This document will be prepared by Carl Sindermann with input from appropriate staff of the Aquaculture, Marine Ecosystems, and Resource Assessment Divisions. It should be submitted to COT by February 1, 1984.

9. Conduct a detailed technical review of the ADP Unit and the NEFC ADP plan:

   a. Consider the appropriateness of centralizing computer programming ability within the ADP Unit,

   b. The role of microcomputers at the NEFC,

   c. Criteria for prioritizing ADP services, and

   d. Mechanisms for establishing ADP policy.

   The ADP Unit Director should recommend content and format to COT as soon as possible. It is the Director's responsibility to implement the review by February 10, 1984.

10. Prepare a statement of perceived mission of the Resource Utilization Division defining how each Division component serves the mission. The Division Director should submit a document to COT by February 1, 1984.

11. Prepare a statement of perceived mission of the Pathobiology Division and how each Division component serves the mission. The Division Director should submit a document to COT by February 1, 1984.

12. Conduct a review of the NEC Remote Sensing activity at the February 1984 Board of Directors Meeting. The Deputy Center Director will have responsibility for implementing the review. The contents of the review will be based on consultation with COT and the NEC Remote Sensing Coordinator.

13. Consider the adequacy of systems of redundancy for computerized data bases. This is the responsibility of the ADP Unit Director.

14. Consider the implications of Marine Ecosystem's dependency on the Polish sorting center. This is the responsibility of the Marine Ecosystems Division Director.

15. Consider initiating routine technical program reviews following the example of the Pathobiology Division. This is the responsibility of all program leaders.

16. Prepare a document specifying the research mission of the NEC and identifying its constituency. COT will prepare the document by February 28, 1984.

17. Recommend alternative Center structures to facilitate accomplishing Center research mission and effective management. COT will make recommendations by February 28, 1984.

18. Establish more formal contact with Sea Grant, Fishery Management Councils and other Center scientific programs in order to facilitate communication with constituencies and interaction with peers. The Center Director will be responsible on an on-going basis. Responsibility for specific activities will be assigned as appropriate.

19. Conduct a constituency oriented program review after self-evaluation, research redirection, and restructuring process has been completed. This will be the responsibility of the Center Director when appropriate.

APPENDIX III.

MARMAP I EVALUATION

Item 1.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Center
Narragansett Laboratory
South Ferry Road
Narragansett, RI 02882 1199

DATE: January 20, 1984

TO: Committee of Three: Richard Hennemuth, Carl Sindermann, Michael Sissenwine F/NEC

FROM: Kenneth Sherman, Chief, Marine Ecosystems Division - F/NEC2 K Sherman /gw

SUBJECT: Working Group for MARMAP I Evaluation

Based on a request from the Board of Directors and discussion with the principal scientists involved in MARMAP I studies in NEFC, a MARMAP I Working Group has been designated with the following terms of reference:

1. Review the results of MARMAP I Ichthyoplankton and Zooplankton studies.

2. Evaluate the mesoscale strategy of MARMAP I for measuring changes within the northeast continental shelf ecosystem.

3. Prepare a report suitable for publication as a Technical Memorandum of the results of the ichthyoplankton studies dealing with spawning biomass assessments addressing what has been accomplished and outlining future studies including commentary on sources of error.

4. Prepare a report on the utility of the MARMAP I approach as a means for measuring spatial and temporal changes in the multispecies ichthyoplankton-zooplankton components of the northeast shelf ecosystem. Address in the report the application of this information as a critical basis for resource assessments and environmental assessments expected of the federal government in the normal discharge of its federal responsibility as manager and protector of the living marine resources within the Exclusive Economic Zone.

The Working Group membership includes the following staff scientists.

*** Wallace Smith	Sandy Hook/MED - Chairperson
* Wallace Morse	Sandy Hook/MED
* Peter Berrien	Sandy Hook/MED
* John Boreman	Woods Hole/RAD
* Michael Pennington	Woods Hole/MED
* John Hauser	Woods Hole/AD
** Julien Goulet	Narragansett/MED
** John Green	Narragansett/MED
** Mark Berman	Narragansett/MED

*The next meeting of the Working Group members dealing with survey evaluations is scheduled for the Woods Hole Laboratory during the week of 23 January.

**The members dealing with the utility of the MARMAP approach will meet at Narragansett in the following week.

KS/jkd

Item 2.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Northeast Fisheries Center
Narragansett Laboratory
South Ferry Road
Narragansett, RI 02882 1199

DATE: February 10, 1984

TO: The Committee of Three: Dick Hennemuth, Carl Sindermann, Michael Sissenwine - F/NEC

FROM: Kenneth Sherman, Chief, Marine Ecosystems Division, F/NEC2

SUBJECT: Issue Paper: MARMAP I Program

We have initiated a review of our MARMAP I program in parallel with the preparation of the issue paper on Recruitment. The analysis will not be completed for at least two months. However, I believe that the perception of the Review Panel "that the magnitude of ecosystem and environmental monitoring was not justified by the results that had been obtained to date" should be addressed at this time.

What appears to have been overlooked by the panel is the utility of ichthyoplankton surveys as a simple strategy that allows for indexing relative abundance levels of all fish species within a large marine ecosystem. This is not a "naive belief" but an established verifiable fact. We have established criteria for the surveys that are the basis of a sampling strategy built around logistics and the spawning of priority species. The sampling of the multispecies ichthyoplankton communities of the Gulf of Maine, Georges Bank, Southern New England, and the Mid-Atlantic Bight is accomplished with minimal cost during the autumn, spring, and summer bottom trawl surveys. The list of important species sampled during these time periods is given by Berrien in the accompanying reference. In addition, important target species (silver hake, other hakes, bluefish) spawn in summer and require a separate survey to ensure coverage of the entire spawning area to obtain samples adequate for estimating the size of the spawning biomass. The remaining critical time-frame is winter to sample sand eel larvae. Therefore, as Peter Berrien points out in his paper with relatively minimal effort we can combine Resource Assessment and Marine Ecosystems Division operations and monitor the important species with three dedicated MARMAP I surveys and three joint bottom-trawl ichthyoplankton surveys.

The survey data base is the analog to the bottom trawl survey for detecting changes in trends and for several important species. The data base represents the only means to estimate population levels of sand eel, and other ecologically-important species. In addition, the fisheries-independent ichthyoplankton data has been used to corroborate estimates of spawning biomass of herring, haddock, yellowtail flounder, and silver hake. The biases and limitations associated with these estimates are being addressed by an interdimensional task force (MED-RAD) as outlined in the accompanying memo prepared by Wally Morse. The output of reports based on the MARMAP I data base have been many and significant. I believe they, in fact, are more than commensurate with the effort expended. We have, I believe, through interresearch "trade-offs" achieved the appropriate balance between the federal responsibility for monitoring ecological change pertinent to fish-stock production and the need to improve abundance forecasts and management options through a better understanding of the recruitment process. Reports in preparation based on the data base are listed in the accompanying memo to Wally smith. And a partial listing of research papers based on the MARMAP I ichthyoplankton-zooplankton data base is given in the enclosed report of the 9th Advisory Committee of the U.S.-Polish Plankton Sorting and Identification Center.

Somehow, the review panel missed the significance of the ichthyoplankton surveys in relation to their contribution to our overall fisheries ecosystem sampling strategy, information base, an research results. The utility of the MARMAP I strategy is not lost in the other NMFS Fishery Centers, where surveys are an important part of their fisheries ecosystem studies. The SEFC is surveying the Gulf of Mexico 5 x/yr; SWFC surveys the entire California Current monthly every 3rd year, and the California Bight monthly each year; the NWAFC is surveying the Washington-Oregon coast and the Gulf of Alaska in the vicinity of Kodiak and also in the East Bering Sea. Enclosed is a summary of our collective NMFS activity. I'll spare you the voluminous reports issued from ICES each year based on the utility of ichthyoplankton surveys in assessments of fish stocks for which the landing data is unreliable, or for stocks under fishing moratoria.

We agree that it is important to get on with an in-depth analysis of how we can improve our sampling strategy and how much more information we can extract from the MARMAP I data, and will provide you with that study when it is completed.

KS/jkd

Attachments

Item 3.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Center
Sandy Hook Laboratory
Highlands, New Jersey 07732

February 1, 1984 F/NEC4:WWM

TO: K. Sherman
Narragansett Laboratory

FROM: W. Morse
Sandy Hook Laboratory

SUBJECT: Computer simulations of ichthyoplankton sampling for larval mortality and spawning stock estimations

As a followup to our meeting in Woods Hole on January 25, I will outline the results of the discussions and general steps in the proposed computer simulations.

We examined in detail the methods used for backcalculating MARMAP I larval catches. A number of critical steps in the calculations were examined in detail to define areas where computer simulations or analytical investigation could determine the variability associated with various methods. Among the most important areas include 1) effects of survey timing and frequency relative to the spawning production curve; 2) variability of larval mortality estimates; 3) effects of within-survey variances of catches; 4) effects of seasonal changes in larval growth rate and water temperature; and 5) effects of non-random distribution of larval length or age groups within the survey area. It was decided that computer simulation based upon MARMAP I sampling frequencies is the best method to answer the questions.

Simulations can best be divided into two parts. The first part will investigate cruise or survey timing by:

1. Assuming a "normal" spawning production curve with random means and variances.

2. Sampling (simulated surveys) would begin on a fixed date and surveys added at random times thereafter to reflect MARMAP I sampling intensity.

3. Total larval production would then be calculated from the samples by the "connect the dots" method and compared to the known production of larvae.

4. Within-survey variance for newly hatched larvae would then be added to the simulation to investigate its effect on the calculated production of larvae.

The second part of the simulation follows from the first but includes larval growth, water temperature and mortality to simulate the length or age distributions of the catches. Given the production curve of larvae, growth and mortality, age structured samples (surveys) are then taken as above and used to investigate mortality estimates derived from such survey samples. Additional complexity will be added by introducing temperature dependent growth coupled with seasonal water temperature changes, and by examining within-survey variances where length (or age) of samples are not randomly distributed in the survey area. The final steps would be to introduce a random component in the growth and mortality parameters to determine their effects on observed mortality and production estimation.

To accomplish the simulation, a working group is needed with people from MED, RAD and OISDM. I will function as coordinator and supply information about present methods used for biomass estimation using MARMAP I eggs and larvae data sets. Mike Pennington (MED), John Boreman and Mike Fogarty (RAD) will develop the specific algorithms and inputs of variables needed for the simulation. John Hauser (OISDM) has developed the needed computer programs and will build and run the simulation on the WHOI, VAX computer.

As a first step in proceeding with the simulation, I am proposing a 1-2 day meeting between myself and Mike Pennington to develop a detailed outline of the steps of the simulation with input, as needed, from John Boreman and Mike Fogarty. The outline will form the basis for John Hauser's computer implementation.

cc:
J. Boreman
M. Fogarty
M. Pennington
J. Hauser
M. Sissenwine
W. Smith

Item 4.

List of Studies and Reports Based on MARMAP I Survey Results

1.0 Evaluation of MARMAP Survey Methods

(W. Morse, M. Pennington, J. Boreman, J. Hauser, and M. Fogarty)

1.1 Examine the effects of sampled frequency on mortality estimates of larvae

1.2 Examine use of alternative growth estimates on spawning stock assessments with regard to temperature dependent growth and constant growth parameters

1.3 Compare within and between survey variability

2.0 Analyses Based on Ichthyoplankton and Hydrographic Data

(W. Smith, J. Colton and D. Mountain)

2.1 Retrospective analysis of distribution patterns of haddock larvae on Georges Bank in relation to horizontal circulation, 1977-82

2.2 Retrospective analysis of distribution and influence of advection on cod larvae on the northeast continental shelf, 1977-82

3.0 Assessments of Spawning Biomass for Target Species Based on Ichthyoplankton Data

(W. Morse, P. Berrien, and J. Boreman)

3.1 Haddock, 1977-82

(W. Morse)

3.2 Cod, 1977-82

(W. Morse)

3.3 *Ammodytes* update, 1977-82

(W. Morse)

3.4 Cod; based on eggs, 1979-80

(P. Berrien)

3.5 Haddock; based on eggs, 1979-80

(P. Berrien)

3.6 Comparison between larval methods and egg methods for estimating spawning biomass

(W. Morse and P. Berrien)

3.7 Investigation of recruitment failure in relation to hydrographic prey field and reproduction of haddock and cod stocks on the northeast continental shelf

(W. Morse, D. Mountain, L. O'Brien, and J. Goulet)

4.0 Distribution and Abundance

(W. Smith, J. Sibunka, A. Wells, J. Goulet, K. Sherman)

4.1 Atlas of ichthyoplankton species distributions

(J. Sibunka, et al.)

4.1.1 Evaluate use of computer graphics for producing atlases

(W. Smith, and J. Goulet)

4.1.2 Methodology and location for 1977-83 data

(J. Sibunka et al.)

4.1.3 Atlas projections of ichthyoplankton-zooplankton species (30-40 spp.)

4.2 Spawning pattern trends of bluefish, summer flounder, and sand lance on the Southern New England and Mid Atlantic shelf

4.3 Distribution and abundance of ichthyoplankton in the Mid-Atlantic Bight: RAP contribution
(W. Smith)

4.4 Communities of ichthyoplankton in the Mid-Atlantic Bight
(W. Smith)

4.5 Communities of ichthyoplankton of the northeast continental shelf
(W. Smith, and J. Goulet)

4.6 Predator-prey simulations of ichthyoplankton on Georges Bank
(W. Smith, E. Cohen, G. Laurence, et al.)

4.7 Estimate of total fish biomass based on MARMAP ichthyoplankton survey results
(W. Morse, W. Smith, et al.)

4.8 Relationship between spawning patterns of ichthyoplankton and population sizes of fish stocks on the northeast continental shelf (sand lance, yellowtail, hake, cod, and others)

5.0 Contaminants Related Technical Memoranda
(W. Smith, et al.)

5.1 RAP

5.2 Georges Bank gas and oil

5.3 Offshore pipeline
(Corps of Engineers)

5.4 Ocean disposal
(EPA)

Narragansett, RI
January 26, 1984

Item 5.

LARVAL FISH ECOLOGY WORKING GROUP
Lowestoft, Suffolk, U.K.
July 1-3, 1981

COMMENTS ON EFFICIENCY OF NEFC MARMAP SURVEYS

Peter Berrien

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Center
Sandy Hook Laboratory
Highlands, New Jersey 07732
USA

Sandy Hook Laboratory Ref. No. 82-2

COMMENTS ON EFFICIENCY OF NEFC MARMAP SURVEYS

Since late 1976, with implementation of the MARMAP program in its present form, approximately six cruises per year have been conducted in the Gulf of Maine, Georges Bank, southern New England, and Middle Atlantic Bight waters (Figure 1). These surveys are designed to sample or measure ichthyoplankton, zooplankton, and chlorophyll-*a* density, various hydrographic parameters, and primary production.

Now that some data resulting from these cruises have been analyzed it is reasonable to try and address some of the questions which always arise over such large-scale programs; namely, is sampling (in area and time) insufficient, adequate, or excessive in the attempt to attain major goals of the design?

The above question (concerning adquacy of sampling) can be addressed from three approaches, concerning the adequacy of: 1) geographic coverage; 2) sampling frequency over time, i.e. the time interval between cruises; and 3) the number of stations sampled on a cruise. My comments here are confined to the first of these three items, geographic coverage.

At the inception of any large-scale survey, such as those under MARMAP, investigators have to sample some areas out of ignorance in order to be sure of good geographic coverage of unknown spawning areas. If it later turns out that sampling, data handling, and analysis are too costly for the amount of information gained from certain areas, then perhaps the geographic coverage should be re-evaluated with possible reductions in mind. The question becomes: Can some areas sampled be eliminated, either partially or entirely in order to maximize the information gained from the resources expended? In the case of these surveys: Do we more than adequately cover spawning areas of the species of interest; or, are there areas which contribute only insignificantly to the total abundance estimate?

The accompanying tables list the relative amounts of information we have gained from four geographic areas for various species as eggs or larvae (Tables 1-4). Obviously the tables are incomplete - not all years are represented for all species; furthermore, and more importantly, not all species of interest are presented - the data were not yet available. Species omitted which would be of interest include butterfish, bluefish, summer flounder, and possible weakfish, redfish, scup, and hakes (*Urophycis* sp.). In the setting up of these tables some information from certain surveys was necessarily omitted. I only included data when all four subareas had been sampled; thus incomplete surveys were excluded from this compilation. In evaluation of the amount of information gained for a given species, it is important to compare the tabulated percent abundance against the percentages of area, stations, and survey time which each subarea comprises within the total MARMAP survey. These latter three values are given on the tables.

The Gulf of Maine appears to be quite important to the abundance estimate of herring and marginally so for silver hake and mackerel. For these three species the western portion within the Gulf of Maine contributed most occurrences while the central portion was generally quite void of eggs and larvae. The Gulf of Maine would undoubtedly be important to a census of redfish larvae also.

Georges Bank is important to abundance estimates of all species considered with the possible exception of mackerel. This area would probably figure prominently in a census of butterfish eggs and larvae.

Southern New England waters also appear to be important spawning and nursery areas for most species tabulated, except for herring. Cod and haddock vary from year-to-year in their utilization of these waters, formerly being more abundant than recently. In addition to those tabulated, this area would probably be important to census work for eggs and larvae of butterfish, bluefish, summer flounder, and weakfish.

The Middle Atlantic Bight is important to mackerel, and in some years to yellowtail flounder. This area can be expected to be important to census work on butterfish, bluefish, weakfish, and summer flounder. The high percentages under "all spp." for both eggs and larvae are heavily augmented in this area by anchovies, sea robins, hakes, bothid flatfishes, and cunner.

It is apparent from the above that each of the above geographic subareas sampled is important to some species of interest. Coverage appears to be adequate for spawning population estimates of Atlantic mackerel, yellowtail flounder, bluefish, butterfish, cod, haddock, summer flounder, herring, and sand lance. The only part of the MARMAP survey area which appears to be relatively non-productive of information is the central and north-eastern portions of the Gulf of Maine. It might be reasonable to reduce sampling intensity in that area. For two species of interest the areal coverage appears to be inadequate. We do not sample shorward enough to completely cover the spawning area of weakfish. Nor do we sample far enough seaward to completely describe the spawning area of silver hake. While we might consider a slight seaward extension of the survey area in order to adequately sample silver hake, it would be very difficult if not impossible to fully describe the spawning area of weakfish which spawns in bays and sounds as well as the near shore area of the continental shelf.

Table 1. Abundance in Gulf of Maine* waters, as percent of abundance in a total MARMAP survey.

	Spawning season ending in						
	1974	1975	1976	1977	1978	1979	1980
<u>Eggs</u>							
All spp.				7.8	10.6	5.8	
Limanda ferruginea				6.6			
Merluccius bilinearis						18.3	
Scomber scombrus				1.8			
<u>Larvae</u>							
All spp.				2.8	3.9	8.2	
Ammodytes sp.		3.2	3.0	0.2	3.4	2.5	
Clupea harengus					60.8	70.7	99.6
Gadus morhua		1.1		6.1	1.9	17.6	9.7
Limanda ferruginea				3.3	9.6	4.8	1.4
Melanogrammus aeglefinus	1.1	0.5	2.1	5.3	1.6	16.2	5.9
Merluccius bilinearis				0.5	6.0	19.8	
Scomber scombrus				5.4	30.9	2.1	

*The Gulf of Maine subarea comprised 38% of the area, 29% of the stations and approximately 32% of the sampling time within a total MARMAP survey.

Table 2. Abundance in Georges Bank* waters, as percent of abundance in a total MARMAP survey.

	Spawning season ending in						
	1974	1975	1976	1977	1978	1979	1980
Eggs							
All spp.				22.3	32.8	25.7	
Limanda ferruginea				36.4			
Merluccius bilinearis						37.8	
Scomber scombrus				0.7			
Larvae							
All spp.				28.2	13.3	18.8	
Ammodytes sp.		32.7	68.5	3.4	1.4	18.1	
Clupea harengus					30.9	28.3	0.1
Gadus morhua	24.3	66.9	47.1	85.0	95.3	72.4	87.5
Limanda ferruginea				23.2	48.7	42.3	25.6
Melanogrammus aeglefinus	44.7	53.6	96.1	84.7	98.4	75.2	88.0
Merluccius bilinearis				66.4	48.6	54.4	
Scomber scombrus				0.6	32.0	0.7	

*The Georges Bank subarea comprises 16% of the area, 16% of the stations, and approximately 17% of the sampling time in a total MARMAP survey.

Table 3. Abundance in southern New England* waters, as percent of abundance in a total MARMAP survey.

	Spawning season ending in						
	1974	1975	1976	1977	1978	1979	1980
<u>Eggs</u>							
All spp.				51.9	29.9	49.4	
Limanda ferruginea				55.5			
Merluccius bilinearis						33.1	
Scomber scombrus				89.7			
<u>Larvae</u>							
All spp.				56.4	44.3	34.2	
Ammodytes sp.		30.5	23.2	86.0	52.3	44.0	
Clupea harengus					8.3	1.0	0.3
Gadus morhua	69.8	19.7	39.7	8.2	1.5	7.8	2.6
Limanda ferruginea				49.9	39.7	44.5	67.4
Melanogrammus aeglefinus	54.2	45.9	1.7	9.9		8.7	6.1
Merluccius bilinearis				32.9	42.9	22.6	
Scomber scombrus				41.0	32.9	71.1	

*The southern New England subarea comprises 23% of the area, 25% of the stations and approximately 24% of the sampling time within a total MARMAP survey.

Table 4. Abundance in Middle Atlantic Bight* waters, as percent of abundance in a total MARMAP survey.

	Spawning season ending in						
	1974	1975	1976	1977	1978	1979	1980
<u>Eggs</u>							
All spp.				18.0	26.7	19.2	
Limanda ferruginea				1.5			
Merluccius bilinearis						10.8	
Scomber scombrus				7.8			
<u>Larvae</u>							
All spp.				12.6	38.5	38.8	
Ammodytes sp.		33.6	5.3	10.4	42.9	35.4	
Clupea harengus							
Gadus morhua	5.9	12.3	13.2	0.6	1.2	2.2	0.1
Limanda ferruginea				23.6	2.0	8.3	5.6
Melanogrammus aeglefinus							
Merluccius bilinearis				0.2	2.5	3.2	
Scomber scombrus				53.0	4.2	26.1	

*The Middle Atlantic Bight subarea comprises 23% of the area, 29% of the stations and approximately 28% of the sampling time within a total MARMAP survey.

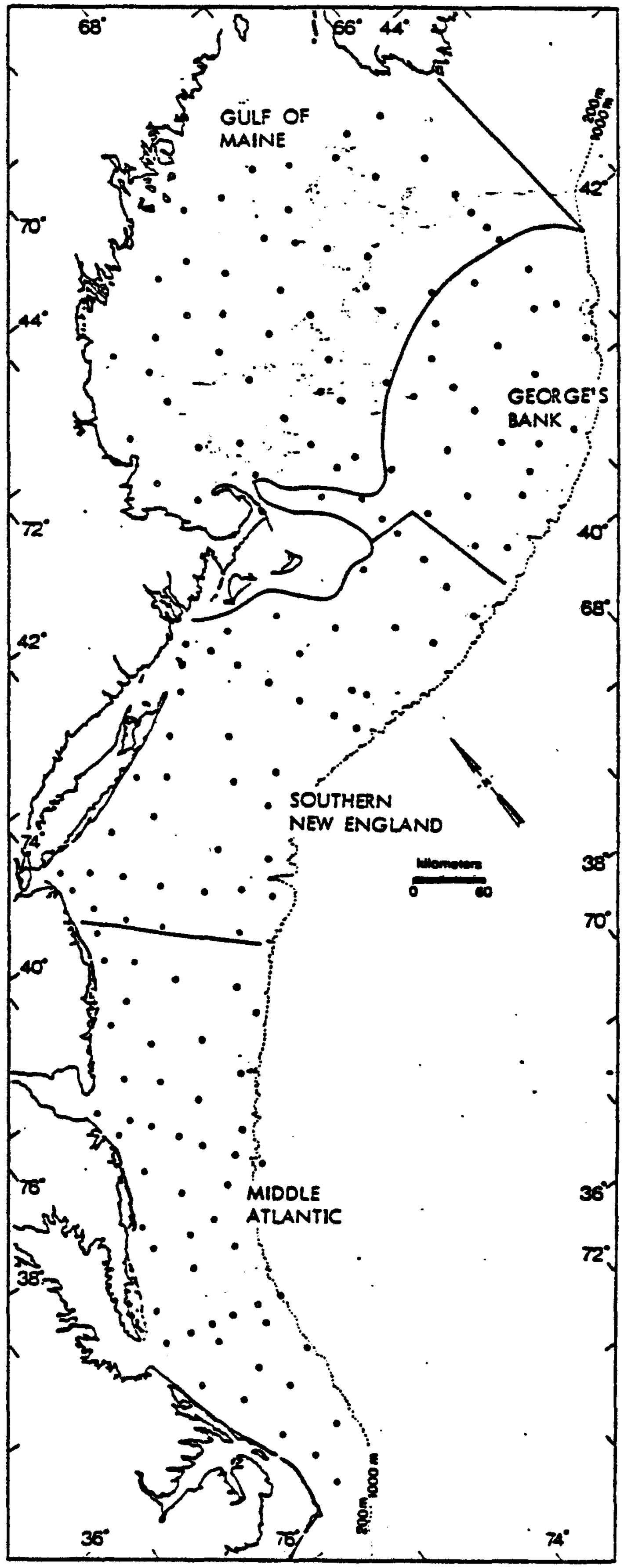

Figure 1. MARMAP survey area, showing subareas and sampling stations.

Item 6.

Measuring the Precision of Estimates of Total Egg Production Based on Plankton Surveys*

by

Michael Pennington[1] and Peter Berrien[2]

[1]National Marine Fisheries Service, NOAA
Northeast Fisheries Center
Woods Hole Laboratory
Woods Hole, Massachusetts 02543

[2]National Marine Fisheries Service, NOAA
Sandy Hook Laboratory
Highlands, New Jersey 07732

[(*MARMAP Contr. MED/NEFC 83-39)]

Submitted to: Journal Plankton Research

ABSTRACT

Methods are given to measure the effects of spatial and temporal differences in fish egg production on the precision of estimates of total seasonal egg production derived from ichythyoplankton surveys. The techniques are applied to the results of large scale plankton surveys conducted in 1977 and 1979 off the northeastern United States. For the three species analyzed (Atlantic mackerel, *Scomber scombrus*; silver hake, *Merluccius bilinearis*; and yellowtail flounder, *Limanda ferruginea*), the surveys produced estimates of total egg production having an average coefficient of variation equal to 31%. Estimates of spawning stock size based on the egg production estimates compared favorably with other independent assessments of stock size.

INTRODUCTION

Large scale plankton surveys have been conducted off the northeast coast of the United States since the autumn of 1976 as part of a long-term monitoring program (MARMAP) of the National Marine Fisheries Service. Generally, six data gathering cruises per year, at various seasons, cover the Gulf of Maine, Georges Bank, Southern New England, and Middle Atlantic Bight waters out to the edge of the continental shelf. One objective of these surveys is to produce an estimate of the total seasonal production of eggs spawned by certain fish species. From egg abundance values, estimates can be made of spawning stock size if other biological information such as the sex ratios, fecundity, percent mature, and length frequencies are available. Egg surveys often produce estimates of spawning stock size which are consistent with estimates derived from other data (see e.g., Saville, 1954; Simpson, 1959; Berrien *et al*., 1981; Lockwood *et al*., 1981; Berrien, 1981; Berrien, 1983).

The estimated precision of egg surveys, and hence of the derived spawning stock size estimates, is usually based only on the variability of egg densities over space while the variability due to production changing over time is ignored (Saville, 1964; Lockwood *et al*., 1981). In this paper a technique is described which measures the effect of varying production over time and space on the precision of estimates of total seasonal egg production. The method is applied to survey results for three species, Atlantic mackerel (*Scomber scombus*), silver hake (*Merluccius bilinearis*) and yellowtail flounder (*Limanda ferruginea*) to ascertain the approximate precision of the estimates of total egg production.

METHODS

The Data

Data analyzed in this paper were collected during MARMAP (Marine Resources Monitoring, Assessment and Prediction) ichthyoplankton surveys in 1977 (mackerel and yellowtail) and 1979 (silver hake). The MARMAP surveys cover much (258,000 km^2) of the continental shelf off the northeast coast of North America from Cape Hatteras, North Carolina to Nova Scotia. Subareas for 1977 (Figure 1) were based on the frequency of survey cruises in each subarea. The unequal effort in each subarea resulted from vessel scheduling problems and, in some cases, from restrictions on European vessel operations in U.S. and Canadian waters (Berrien
Fig. 1 *et al*., 1981). Different subareas were used for 1979 data (Figure 1). They were based on oceanographic and biological considerations, and were selected so as to allow direct comparison with population estimates from cohort analysis.

Ichthyoplankton was sampled with 61-cm bongos fitted with 0.505-mm mesh nets. Smooth, double-oblique plankton hauls were made at each station according to standard MARMAP I procedures (Jossi *et al*., 1975). Sampling extended from the surface to within 5 m of the bottom or to a maximum depth of 200 m and was conducted at a vessel speed of approximately 1.5 kts.

Fish eggs were removed from the samples, identified and separated into developmental stages. Numbers of eggs collected were adjusted to no./day/m^2 of sea surface area. Mortality rates were calculated on the observed decline in numbers with stage mean age. Numbers sampled/m^2/day at each station were then adjusted for mortality to calculate numbers of eggs spawned/m^2/day and these adjusted values were used to derive the estimates of total egg production for the entire season. For a more detailed account of sampling and analysis procedures, see Berrien et al. (1981) and Berrien (1981, 1983).

Statistical Methods

Data from a cruise was used to estimate the mean number of eggs spawned/m^2/day at the time of each cruise. Only part of each survey area contained the eggs of any particular species, and hence the proportion of nonzeros in the sample estimates the fraction of the area in which eggs occurred. It has been observed (Berrien et al., 1981; Berrien, 1981; Lockwood et al., 1981) that the distribution of the nonzero values is often lognormal for egg data. A distribution with a proportion of zeros such that the nonzero values are lognormally distributed is called a Δ-distribution (Aitchison and Brown, 1957). The estimator (c) of the arithmetic mean (Aitchison and Brown, 1957) and its variance [var(c)] (Pennington, 1983) for the Δ-distribution are:

$$c = \begin{cases} \frac{m}{n} \exp(\bar{y})\, G_m(s^2/2), & m>1, \\ \frac{x_1}{n}\ , & m=1, \\ 0 & m=0, \end{cases} \qquad (1)$$

and

$$\mathrm{var}(c) = \begin{cases} \frac{m}{n} \exp(2\bar{y}) \{\frac{m}{n} G_m^2 (s^2/2) - (\frac{m-1}{n-1}) G_m (\frac{m-2}{m-1} s^2)\}, & m>1, \\ (\frac{x_1}{n})^2, & m=1. \\ 0, & m=0 \end{cases} \quad (2)$$

where:

n is the sample size,

m is the number of nonzero values,

$\bar{y}$ is the sample mean of the nonzero $\log_e$ values,

s^2 is the sample variance of the $\log_e$ values,

x_1 is for m=1 the single nonzero value,

and

$$G_m(x) = 1 + \frac{m-1}{m}x + \sum_{j=2}^{\infty} \frac{(m-1)^{2j-1}}{m^j(m+1)(m+3)\ldots(m+2j-3)} \cdot \frac{x^j}{j!} .$$

With a computer it is easy to evaluate $G_m(x)$ for given values of x and m. For smaller values of m and/or larger values of x, the usual approximations to $G_m(x)$ such as $\exp[(\frac{m-1}{m})x]$ (Jones, 1956) are poor. For egg surveys, c can be much more efficient in estimating the mean number of eggs spawned/m^2/day than the ordinary sample mean (Pennington, 1983).

The rate (T_t) of production for a subarea at time t (taken to be the midpoint of sample collection) is then estimated by

$$T_t = Ac,$$

where A is the area of the region, and its variance by

$$\text{var}(T_t) = A^2 \text{ var}(c).$$

To calculate an estimate of total seasonal egg production (T), the production rates are integrated over time or

$$T = a_1 T_{t_1} + a_2 T_{t_2} + \; . \; . \; . + a_k T_{t_k}$$

where $a_1, \ldots a_k$ are constants which depend on the spacing of the cruises and $t_1, \ldots, t_k$ are the times represented by each individual survey cruise.

A sequence of plankton surveys is in effect most often a systematic survey taken over time. For a sequence of k surveys conducted, for example at monthly intervals, let $T_{t_1, t_2, \ldots, t_k}$ denote the estimate of total egg production based on the k surveys. Then the variance of $T_{t_1, t_2, \ldots, t_k}$ is given by (Rao, 1973, p. 97):

$$\text{Var}(T_{t_1,\ t_2,\ldots,t_k}) = E[\text{Var}(T_{t_1,\ t_2,\ldots,t_k} \mid t_1,\ t_2,\ldots,t_k)] +$$

$$\text{Var}[E(T_{t_1,\ t_2,\ldots,t_k} \mid t_1,\ t_2,\ldots,t_k)]. \tag{3}$$

The first term on the right hand side of equation (3) is the average variance due to spatial differences in abundance, and the last term is the variance of the expected abundance for a particular sequence taken over all possible sequences of monthly surveys. Now if T_1, T_2, ... T_ℓ are estimates of total egg production based on ℓ systematic monthly surveys taken with random starts then

$$\overline{T} = \sum_{i=1}^{\ell} T_i/\ell$$

is an unbiased estimate of total production,

$$\text{var}(\overline{T}) = \sum_{i=1}^{\ell} (T_i - \overline{T})/\ell(\ell-1) \tag{4}$$

is an unbiased estimate of its variance, and $\ell \cdot \text{var}(\overline{T})$ is an unbiased estimate of the variance of a single systematic survey conducted at monthly intervals, i.e., of the left hand side of equation (3).

For the data at hand, since the nonzero values from an individual cruise were distributed lognormally, the production rate for each subarea and cruise was calculated using equation (1). Alternate cruises were then used to calculate two estimates of total production for each subarea (or a combination of subareas if production was low). The average, $(T_1 + T_2)/2$, of the two values is the estimate of egg production in each subarea and $(T_1 - T_2)^2/4$ (equation (4) with $\ell = 2$) estimates its variance. The final estimate of total production for the entire region is the sum of the subarea estimates of production and its variance is the sume of their estimated variances. One reason for calculating subarea estimates is to increase the number of degrees of freedom for the estimate of the total variance. But since the variances of the production estimates for the subareas were considerably different, Satterthwaite's formula (Cochran, 1977, p. 96) was used to estimate the effective number of degrees of freedom.

It was also desired to obtain a rough indication of the proportion of the total variance due respectively to spatial and temporal effects for the surveys. Equation (2) was used to estimate the spatial component of variance, which along with the estimate of the total variance, was used in conjunction with equation (3) to obtain an estimate of the variability due to time for the present survey design.

Finally, estimates of spawning stock size based on total egg production were calculated as described in Berrien et al. (1981), Berrien (1981), and Berrien (1983). It is assumed that the variability of the estimates were due mainly to the variability of the egg production estimates and hence the variability of the spawning stock size estimates reflect solely the variability of the egg data.

RESULTS

Tables I and II summarize the statistics used to estimate the egg

Tables I&II

production for each subarea at the times represented by the individual surveys. Also given are estimates of the standard error of the estimated rate of production (c) resulting from the spatial variability at the times sampled. The daily egg production curves for each subarea and for the entire region are shown in Figures 2-4.

Figs. 2-4

Table III contains estimates of total seasonal egg production for

Table III

each species based on treating the series as two alternating systematic samples. In parentheses, under the production estimates, are the estimates of production derived by treating the series as a single systematic sample. Also in Table III are estimates of the components of sampling variability due to temporal and spatial effects for the surveys as conducted. Column 6 gives the estimated standard error of the total seasonal egg production estimates and in column 7 are its effective number of degrees of freedom.

In Table IV are estimates of spawning stock size for each species

Table IV

based on the egg production estimates. Confidence intervals for these estimates (80% for mackerel and silver hake, 70% for yellowtail) are also presented. Again, it should be noted that the confidence intervals only take into account the variability of the egg estimates.

DISCUSSION AND CONCLUSIONS

In practice the dates at which plankton survey cruises are conducted are spread throughout a season rather than chosen randomly with respect to time. Therefore, the surveys are effectively systematic in time. For natural populations, systematic sampling can be much more efficient than random sampling, particularly so for populations which vary continuously

(Cochran, 1977, p. 221). Egg production for the three species analyzed appears to be fairly continuous over time. That is, though the estimated error of the individual production rates (c) for each subarea are relatively large, the rates (see Tables I and II) do not vary erratically over time, but for most subareas, rise to a peak and then decline.

There are various ways to estimate the variance of the results from a single systematic sample after making some assumptions (Cochran, 1977, p. 223). Where practical, unbiased estimates of the sampling variance can be made by dividing the effort into two (or more) systematic samples with random starts. Though the MARMAP surveys were not designed as two independent series of surveys, logistics and the large area covered produced alternate surveys with starts approximately random in each subarea. A disadvantage of the method used to estimate the total variance is that it may overestimate the true value, especially if the complete survey, being systematic in time, has been effective in reducing the variance.

The relative sizes of the variance components (Table III), though imprecise as reflected by the negative estimate of the time component for silver hake, indicate the sources of variability for the surveys as conducted. For example, the proportion of the total variation due to time was highest for yellowtail flounder and lowest for silver hake. This results from the fact that one cruise in a subarea accounted for 52% of the yellowtail egg production (Table I) as compared with 22% from a single cruise for silver hake (Table II). The high concentration of egg production in a short time period for yellowtail is the reason that the estimate of the total variance has only 1 effective degree of freedom, as a consequence, the estimate of seasonal egg production for yellowtail is the least precise of the three.

One way to assess the accuracy of egg surveys is to compare the estimates of spawning stock size based on the surveys with other available estimates. Table IV contains estimates of spawning stock size derived both from the egg surveys and from cohort analysis. For Atlantic mackerel the spawning stock estimates based on the egg survey (1.20 x 10^9 fish) compared favorably with cohort analysis (.96 x 10^9 fish). The estimate for silver hake from cohort analysis (.77 x 10^9 fish), though considerably lower than the estimate based on the egg survey (1.55 x 10^9 fish), is just within the 95% confidence interval for the egg survey estimate. Due to silver hake catches having sharply declined in recent years, the estimate based on cohort analysis is considered tentative since cohort analysis tends to underestimate population sizes in a fishery with declining catches (Berrien, 1983). The estimate for yellowtail (1.38 x 10^8 fish) based on the egg survey appears to be quite reasonable, although no cohort analysis is available (Berrien, 1981).

There are other possible sources of uncertainty in egg abundance estimates which have not been addressed here. Errors could result from insufficient coverage of spawning area and season due either to inadequate survey design or vessel operations and the vagaries of weather. For instance, an apparently important spawning area of silver hake in the western Gulf of Maine was not adequately sampled in the summer resulting in egg estimates that are probably low. Another possible, but less worrisome source of bias in egg census work, could arise through choice of a water column temperature which does not accurately reflect conditions experienced by an egg sample in question. The application of an inaccurate mortality rate to egg catches would bias resulting production levels. However, this effect is minimized by the use of the youngest stage eggs to derive the final egg census estimates. Beyond egg production estimates, errors in any of the following parameters on adults could bias the resulting population estimates: the length-frequency distribution, male-female ratio, percent mature at size, and fecundity at size.

For the species considered, the egg surveys provide estimates of sufficient accuracy for detecting large changes in the spawning populations. It should be stressed though, that the data are only from one year for each species. But if the shape of the production curves proves to be similar for other years, then the use of egg surveys for the estimation of fish abundance would appear to offer a feasible method of monitoring major fluctuations in spawning stocks. It represents the only way of estimating absolute abundance of species for which no fishery exists, and probably is cost effective in cases where fishery statistics are inadequate to provide an accurate cohort analysis.

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Table I. Atlantic Mackerel and Yellowtail Flounder Egg Production Estimates for 1977.

Subarea (Area km²)	Survey Cruise	Sampling Midpoint Date	Days Represented	ATLANTIC MACKEREL n	m	c	Standard Error of c	Eggs Spawned in Subarea by Survey ($\times 10^{-12}$)	YELLOWTAIL FLOUNDER m	c	Standard Error of c	Eggs Spawned in Subarea by Survey ($\times 10^{-12}$)
1 (16560)	1	24 Mar	22	15	0	0	0	0	0	0	0	0
	2	14 Apr	21	17	3	0.0	0.0	0.0	0	0	0	0
	3	5 May	35	17	0	0	0	0	0	0	0	0
	4	22 Jun	49	17	0	0	0	0	0	0	0	0
	5	11 Aug	50	17	0	0	0	0	0	0	0	0
2 (67288)	1	29 Mar	26	54	0	0	0	0	15	7.3	3.2	1.0
	2	19 Apr	14	68	44	3.3	1.4	3.2	22	16.3	6.5	1.6
	3	26 Apr	10	57	42	76.3	44.9	52.6	28	19.3	7.5	1.3
	4	9 May	13	66	34	42.0	22.8	36.6	24	11.1	4.5	1.0
	5	23 May	24	69	35	43.8	21.1	69.4	22	16.7	6.8	2.6
	6	25 Jun	42	69	7	1.0	0.6	2.9	0	0	0	0
	7	15 Aug	51	58	0	0	0	0	0	0	0	0
3 (14131)	1	7 Mar	40	18	0	0	0	0	3	0.3	0.2	0.0
	2	15 Apr	23	8	0	0	0	0	6	50.4	29.8	1.7
	3	22 Apr	13	8	0	0	0	0	3	14.5	9.1	0.3
	4	11 May	17	7	7	5.3	2.1	1.7	5	123.0	83.0	2.9
	5	26 May	24	8	6	90.9	78.1	31.3	3	82.3	57.1	2.8
	6	29 Jun	41	8	2	5.6	5.2	4.3	1	2.1	2.1	0.1
	7	15 Aug	47	9	2	0.4	0.3	0.3	0	0	0	0
4 (84794)	1	21 Mar	40	70	0	0	0	0	15	6.6	3.4	2.2
	2	30 Mar	38	54	1	0.0	0.0	0.0	24	19.7	8.9	6.3
	3	4 Jun	50	81	67	22.7	9.9	96.2	50	70.2	21.5	29.8
	4	8 Aug	64	55	1	0.0	0.0	0.0	3	0.6	0.4	0.3
5 (19137)	1	1 Apr	26	14	0	0	0	0	1	0.1	0.1	0.0
	2	27 Apr	66	12	0	0	0	0	2	16.3	16.1	2.0
	3	10 Apr	105	10	0	0	0	0	0	0	0	0
6 (29837)	1	6 May	38	19	0	0	0	0	2	0.6	0.5	0.1
	2	14 Jun	38	17	2	0.0	0.0	0.0	5	4.5	2.9	0.5
7 (9299)	1	12 May	23	5	0	0	0	0	0	0	0	0
	2	4 Jun	44	9	7	12.8	7.8	4.7	4	2.7	1.4	0.1
	3	8 Aug	65	7	0	0	0	0	2	2.5	2.1	0.2
8 (9734)	1	9 May	92	7	0	0	0	0	0	0	0	0
	2	9 Aug	92	3	0	0	0	0	0	0	0	0

Table II. Silver Hake Egg Production Estimates for 1979

Subarea (Area km^2)	Survey Cruise	Sampling Midpoint Date	Days Represented	n	m	c	Standard Error of c	Eggs Spawned in Subarea by Survey (x10^{-12})
Gulf of Maine (98026)	1	10 Mar	21	9	0	0	0	0
	2	21 Apr	36	39	0	0	0	0
	3	21 May	39	50	4	1.1	0.6	0.4
	4	8 Jul	48	11	3	13.4	10.5	6.3
	5	26 Aug	55	39	12	54.9	29.1	29.4
	6	25 Oct	47	38	1	0.2	0.2	0.1
	7	27 Nov	17	45	0	0	0	0
Georges Bank (41809)	1	10 Mar	9	5	0	0	0	0
	2	28 Mar	35	32	1	0.1	0.1	0.0
	3	19 May	52	27	6	148.6	130.5	32.1
	4	9 Jul	49	19	14	224.9	108.0	46.4
	5	26 Aug	52	19	13	31.2	11.4	6.8
	6	22 Oct	54	29	1	0.2	0.2	0.0
	7	12 Dec	25	29	1	0.2	0.2	0.0
Southern New England (59906)	1	4 Mar	20	40	0	0	0	0
	2	14 Apr	35	25	4	1.1	0.6	0.2
	3	13 May	41	44	24	63.4	26.9	15.6
	4	5 Jul	49	43	19	130.1	69.5	38.1
	5	19 Aug	50	38	21	38.2	14.3	11.5
	6	13 Oct	45	42	23	18.9	6.1	5.1
	7	17 Nov	17	27	3	1.0	0.7	0.1
Middle Atlantic (58326)	1	26 Feb	22	48	0	0	0	0
	2	11 Apr	35	2	0	0	0	0
	3	6 May	37	49	16	30.7	14.7	6.5
	4	23 Jun	50	50	7	24.4	17.6	7.2
	5	14 Aug	53	49	10	7.6	3.7	2.3
	6	7 Oct	27	48	5	2.5	1.9	0.4

Table III. Estimates of Total Seasonal Egg Production and Associated Statistics.

Species	Variation due to time ($\times 10^{-24}$)	Variation due to space ($\times 10^{-24}$)	Total Variation ($\times 10^{-24}$)	Estimated Total Production of Egg ($\times 10^{-12}$)	Standard Error of Total Production ($\times 10^{-12}$)	Effective Number of d.f.
Atlantic mackerel	14067	4974	19041	328 (303)*	138	2.2
Silver hake	---	1936	786	203 (209)*	28	2.5
Yellowtail flounder	407	107	514	58 (57)*	22	1.0

*Estimates based on treating surveys as a single systematic survey (see text).

Table IV. Estimates of spawning stock size based on egg surveys and a cohort analysis.

Species	Estimate of Spawning Stock (egg surveys)	Confidence Interval	Estimate of Spawning Stock Size+ (cohort analysis)
Atlantic mackerel	1.20×10^9	$(.31\times10^9, 2.12\times10^9)$*	$.96 \times 10^9$
Silver hake	1.55×10^9	$(1.14\times10^9, 1.96\times10^9)$*	$.77 \times 10^9$
Yellowtail flounder	1.38×10^8	$(.35\times10^8, 2.99\times10^8)$**	Not Available

*80% level.

**70% level.

+Resource Assessment Division, NMFS, NEFC, Woods Hole, MA.

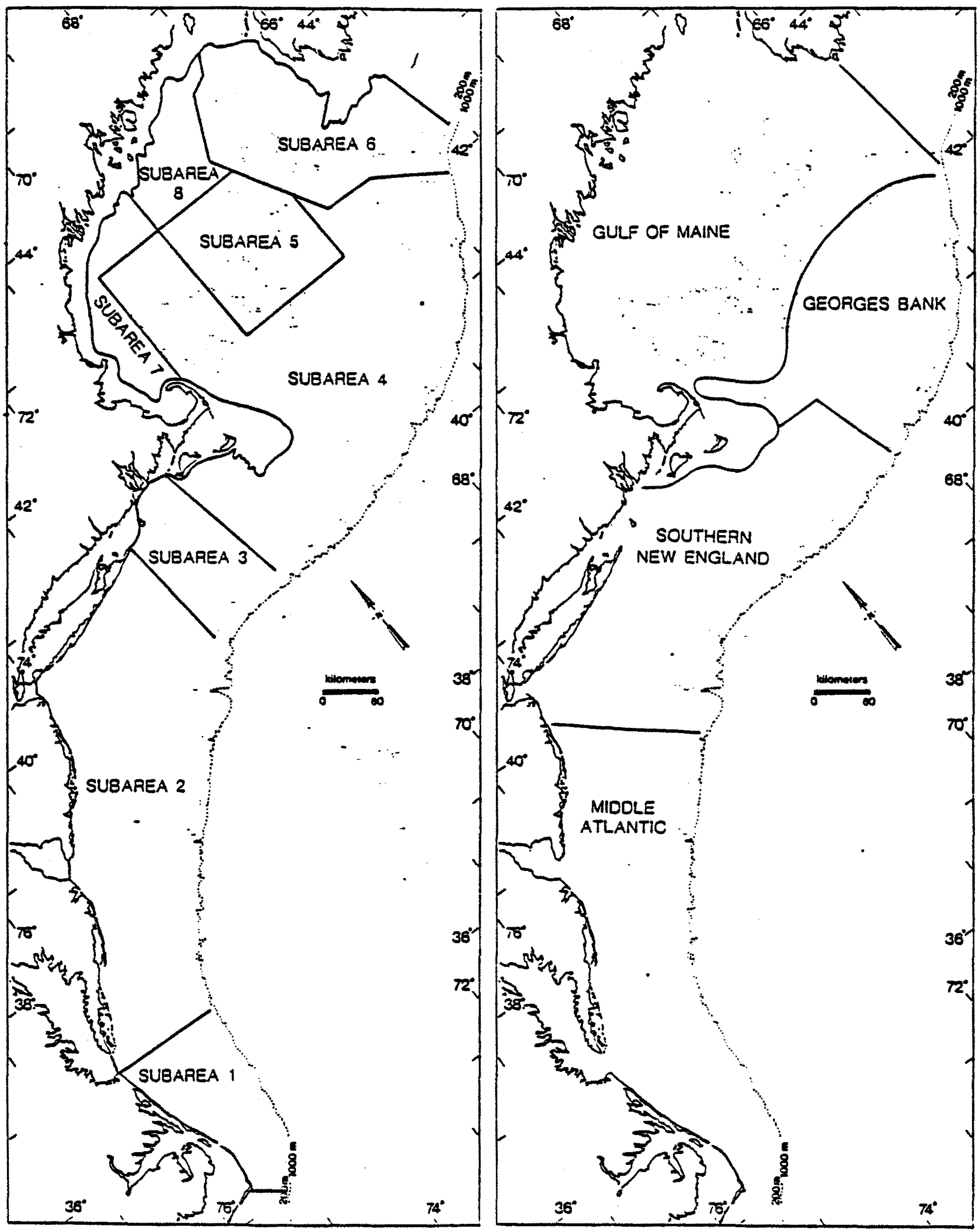

Figure 1. Ichthyoplankton survey area ; subareas for 1977 (left) and 1979 (right).

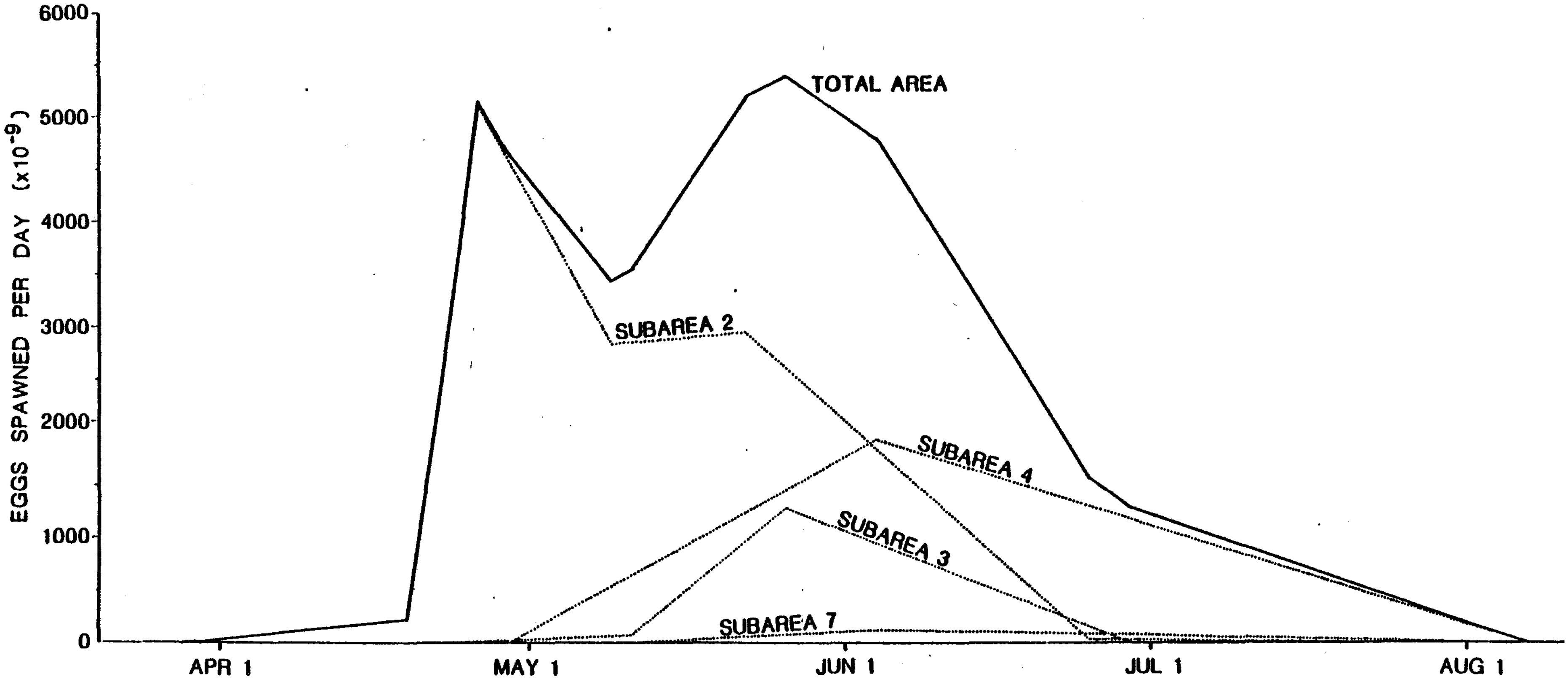

Figure 2. Estimated daily Atlantic mackerel egg production within the MARMAP survey area, 1977.

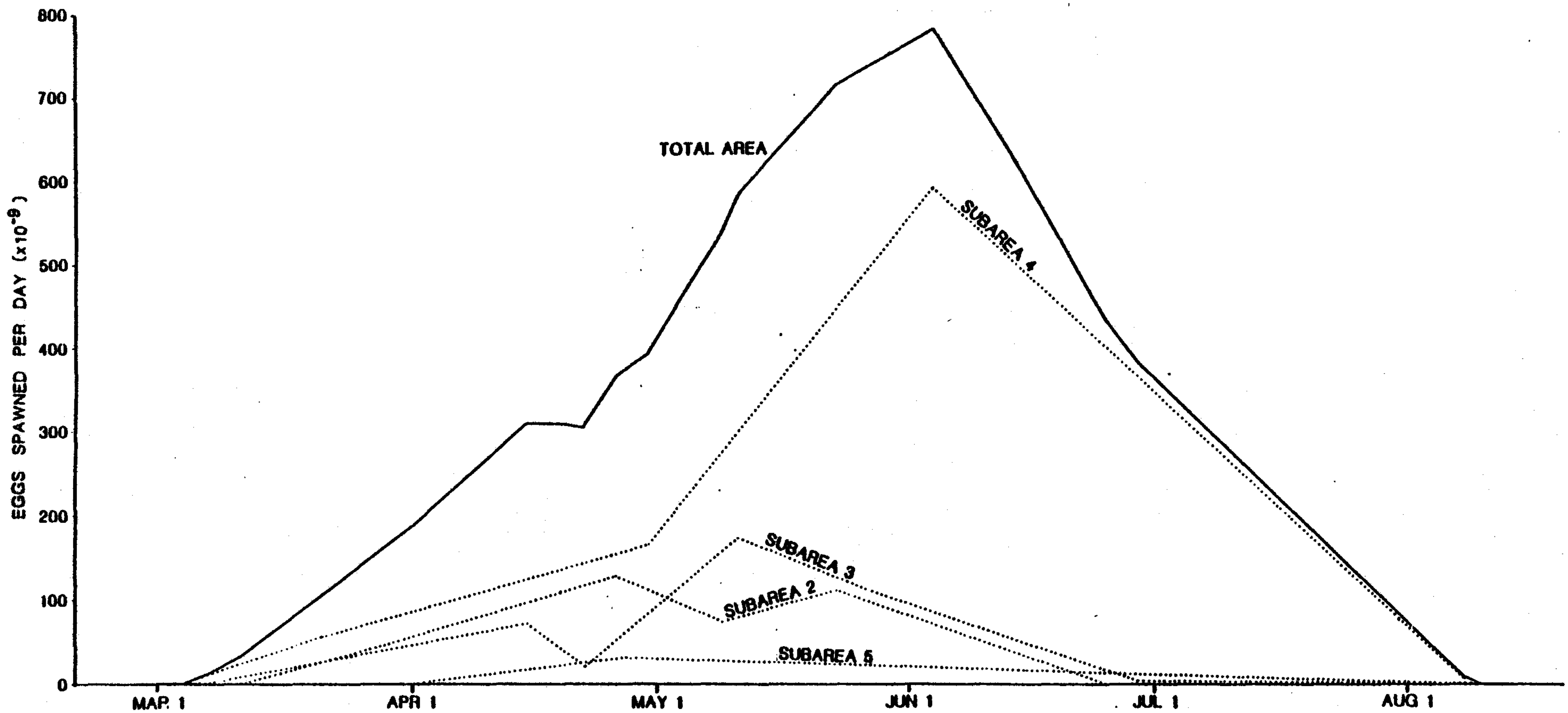

Figure 3. Estimated daily yellowtail flounder egg production within the MARMAP survey area, 1977.

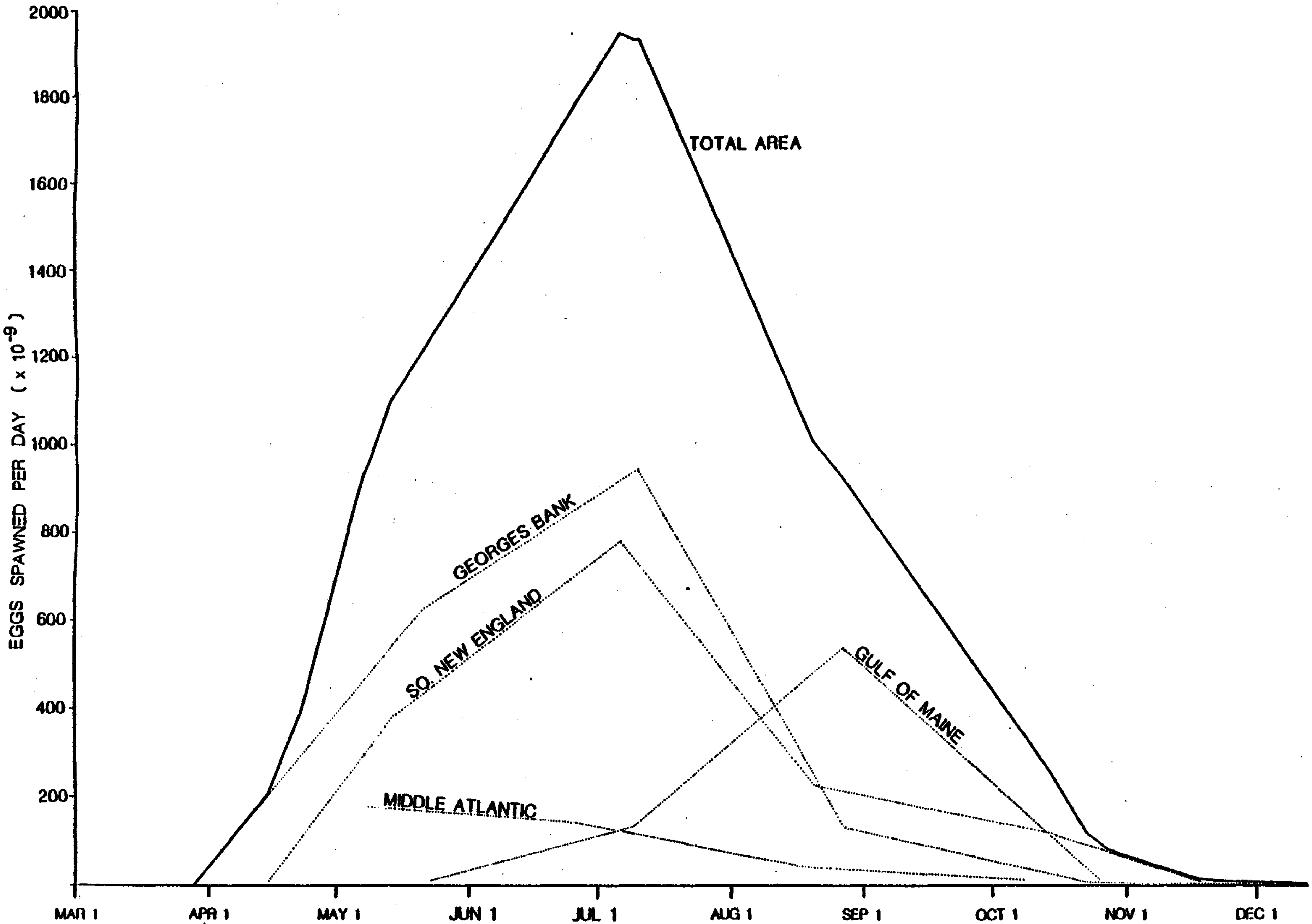

Figure 4. Estimated daily silver hake egg production in four subareas and in the total survey area, 1979.

APPENDIX IV.

REDIRECTION OF NEFC RECRUITMENT STUDIES

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Northeast Fisheries Center
Narragansett Laboratory
South Ferry Road
Narragansett, RI 02882 1199

DATE: January 20, 1984

TO: Committee of Three: Dick Hennemuth, Carl Sindermann, Michael Sissenwine - F/NEC

K. Sherman /gao

FROM: Kenneth Sherman, Chief, Marine Ecosystems Division - F/NEC2

SUBJECT: New Recruitment Initiation: Working Group

A Working Group under the chairmanship of Geoff Laurence will complete a first draft next week of the Issue Paper requested by the COT on the redirection of recruitment processes research within the MED. Scientists on the Working Group include:

Geoffrey Laurence	Narragansett - Chairperson
John Green	Narragansett
Wallace Smith	Sandy Hook
Gregory Lough	Woods Hole
Edward Cohen	Woods Hole
David Mountain	Woods Hole
Emory Anderson	Woods Hole
Steve Clark	Woods Hole

I expect that we will have no difficulty in completing the Issue Paper by 15 February.

KS/jkd

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Northeast Fisheries Center
Narragansett Laboratory
South Ferry Road
Narragansett, RI 02882 1199

DATE: February 10, 1984

TO: Committee of Three: Dick Hennemuth, Carl Sindermann, Michael Sissenwine - F/NEC

FROM: Kenneth Sherman, Chief, Marine Ecosystems Division - F/NEC2

SUBJECT: Issue Paper: Redirection of NEFC Recruitment Studies

Periodic reviews of research are an important means for evaluating progress and correcting shortcomings. I'm pleased to forward to you an issue paper that describes the importance of recruitment studies on fisheries science and outlines the redirection of the Division's recruitment studies. This paper is a development of periodic, rather critical, reviews of the Division's early-life-history research conducted by our staff prior to the October Review. These reviews were augmented by the critical synthesis and evaluation of global fisheries ecology research that took place during Fish Ecology I, II, and III symposia in which Division staff participated. The redirection set in motion prior to October is consistent with the comments of the Review Panel. As you perceptively point out in your comments dealing with this issue,

> "Program Review Comment - More emphasis should be placed on sampling post-larval and juvenile fish and defining their role in the ecosystem.
> COT's Response - The need for greaater emphasis on post-larval fish has been identified by the Marine Ecosystems Division. The Division has conducted much of the research which has led to this redirection. This is a good example of the Center's leadership role in fisheries science."*

The role of fisheries oceanography studies in the redirected effort is critical and we have addressed the importance of this role in the document. Each of the three Fish Ecology panels underscored the importance of intimate involvement of oceanographers to sort out the various sources of natural mortality associated with environmental conditions. We agree and have pursued this course vigorously during the past seven years in the descriptive mode. The new direction emphasizes the transition from descriptive models to dynamic models of water movement. Now that Steve Ramp has returned from the rigors of two-years of advanced study in marine hydrodynamics at the University of Rhode Island under Mel Stern, we are confident that we have the in-house capability and current meter data base to move ahead in this important new area.

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*NEFC Program Review - Summary of Results and Response of Committee of Three (COT) on Research and Structure.

The issue paper addresses the importance of coupling mesoscale and microscale approach to measuring variability in abundance and distribution of the target species, particularly haddock and cod. We have devised our sampling strategy to maximize both sampling strategies with back-to-back surveys in spring in an all-out frontal attack for improving mortality estimates.

The issue paper has been developed by a Task Force of staff from MED and RAD under the direction of Geoff Laurence. Each of the participants made significant contributions to what I believe is a first-class paper.

KS/jkd

cc: J. Casey
G. Laurence
M. Grosslein
D. Mountain
W. Smith

ISSUE PAPER

REDIRECTION OF NEFC RECRUITMENT STUDIES

National Oceanic and Atmospheric Administration

National Marine Fisheries Service

Northeast Fisheries Center

Narragansett, RI 02882

February 10, 1984

CONTENTS

Redirection of NEFC Recruitment Studies

INTRODUCTION

Recruitment variability is considered to be the central problem of fishery science. In fact, this variability which occurs in the early life stages of fin fishes before they enter the mature exploited stock is the major source of uncertainty that impedes the most economical and rational exploitation of marine fisheries. Justification for recruitment studies has been considered in detail and endorsed by an international group of experts (Rothschild and Rooth, 1983). The NMFS has proposed a major new initiative called FOCI (Fisheries-Oceanography Coordinated Investigations) which includes comprehensive recruitment investigations in all of the Regional Research Centers.

Previous research in the Northeast Fisheries Center on recruitment mechanisms has focused on larval mortality caused by starvation. However, recent analyses of empirical data and resultant inferential thinking by NEFC scientists has lead to the identification of new factors potentially controlling recruitment variability. The hypothetical framework developed is that recruitment variability is largely determined in the juvenile life stage and that prerecruit mortality is likely controlled by predation rather than starvation. Sissenwine (1984) has summarized the reasoning behind this recent thinking which is based on: (1) a general lack of a clear relationship between adult spawning stock size and recruitment for any species in the NW Atlantic except at extremely low population levels; (2) no demonstrable correlation between larval production and abundance and year class success which suggests that juvenile mortality must be significant and affect recruitment; (3) evidence of prey concentrations in the field which are adequate for a survival of larvae as indicated by laboratory and modelling studies; (4) lack of evidence of significant population starvation for field collected larvae; (5) a high survival rate of larvae in large, predation-free enclosures; and (6) the identification of fish and invertebrates as predators of egg, larval and post-larval stages.

This document represents inter-Divisional thinking (MED, RAD) regarding the redirection of NEFC research of recruitment processes. An appropriate research strategy is developed which includes: (1) the formulation of relevant biological and physical oceanographic hypotheses; (2) logistics of conducting field research designed to test the hypotheses; and (3) integration of this research effort with ongoing Center monitoring, assessment, and modelling studies.

BACKGROUND AND PREVIOUS RESEARCH

While mechanisms regulating recruitment have been proposed since Hjort's time (1914), several hypotheses have been advanced recently to explain the large observed fluctuations in recruitment. Cushing (1973) proposed that a fortuitous coupling of fish spawning with the onset of the vernal bloom is the key factor in determining a good year class. This theory is generally known as the "match-mismatch hypothesis." Lasker (1975) demonstrated that the local abundance of a suitable prey for larval anchovy is critical in the initiation of first feeding and consequently affects growth and survival. Recently, Iles and Sinclair (1982) have proposed that the size of a herring stock's spawning area was crucial in regulating stock size. The size of the spawning area is hypothesized to be proportional to the stock size and hence time spent in a larval nursery area. Other investigators (Bailey, 1981; Parrish et al., 1981; Bakun and Parrish, 1982) have looked at physical oceanographic indices of water transport and maintenance of eggs and larvae in nursery grounds. There has been some success (Bailey, 1981; Parrish et al., 1981; Bakun and Parrish, 1982) in correlating upwelling indices and off-shore transport with year-class strength. There is some indication that physical mechanisms are important in Eastern Boundary Currents (Bakun and Parrish, 1980). So far this has not proven to be the case on the northeast United States shelf. The shelf in the northeast is much wider than on the Pacific coast and perhaps this reduces the influence of off-shore transport. Recently, Laurence and Burns (1982) examined samples taken in an entrainment feature associated with a warm core ring for larval fish. Coastal zooplankton species were present, but coastal larval fish species were not. Also, Smith and Morse (1984) reported no evidence of significant loss of haddock eggs or larvae across the shelf break off the northeast U.S. coast potentially attributable to advective processes for the period 1977-82. The lack of correlations between physical processes and larval mortality and subsequent year-class strength for Georges Bank haddock and silver hake was also noted by Cohen et al. (1982). They looked for relationships between warm core ring entrainment, Ekman transport and position of the shelf slope front with egg, larval and post-larval mortality and subsequent, year-class strength in silver hake and haddock. The time series of data that they examined was from 1975 to 1981. The time series is short, but so far there is no conclusive evidence that physical processes set year-class strength every year on the northeastern shelf. They may, however, play an important role in particularly good or bad years. For example, 1982 was a year when virtually no gadoid larvae were found on the bank. Physical transport of eggs and larvae off of the bank may have been responsible for their absence. It is also possible that the quarterly averaged data considered by Cohen et al. (1982) obscured important events that occurred rarely and for a short time. Another possibility is that due to the shortage of data, inappropriate physical processes were considered. Recently, Koslow (submitted) has shown some correlations in year-class strength of different stocks of the same species that may be due to large-scale physical forcing (climatological-meteorological) in the northwestern Atlantic. Recruitment may also be affected by other physical processes such as the effects of temperature on growth, metabolism and subsequent survival.

Lasker's (1975) critical period theory does not seem to apply to Northwest Atlantic coastal species since very few feed to any extent on phytoplankton. Perhaps more importantly, Laurence (1983) has shown that while starvation mortality is not insignificant, especially in the early larval phase, there appears to be enough food available on Georges Bank for maintenance and growth of larval fish populations.

The match-mismatch theory seems to be weakest of the hypotheses tested to date. The argument that fish have evolved a strategy of spawning in response to a phytoplankton bloom rather than the subsequent increase in their zooplankton prey does not seem very compelling. Recently Sherman et al. (1984) have shown a correlation of larval abundance and zooplankton abundance in the Northwest Atlantic. However, it appears from Laurence's work (1983) that average prey density is in excess of requirements. Furthermore, some species (e.g., sea herring, sand lance) spawn in autumn and their larvae depend upon winter zooplankton production which is at minimum.

All of the hypotheses discussed thus far concentrate on various events in the very early life stages, i.e., eggs and larval stages. However, there is no evidence in the literature to date of a correlation of egg or larval abundance and recruitment (see Cushing, 1973; Smith and Eppley, 1982; Cohen et al., 1982). This fact has led to a reconsideration of the data and a new synthesis of ideas.

A NEW DIRECTION

In order to carry out a total program of recruitment research, extensive data on proposed target species (haddock, cod and yellowtail) and their milieu are necessary. These include abundance estimates at various life stages--eggs, early larvae, late larvae, early juveniles and late juveniles--representing a "life table" for the target species covering the critical first year of life. In addition, there is a need for concurrent measurements of physical and biological conditions. The physical conditions include measurement of temperature, salinity and wind stress, as well as direct measurements of the amount and variability in the recirculation of water on Georges Bank. Biological conditions encompass growth, biochemical condition factors, distribution, patho-biological indices, prey availability, predator abundance, distribution and food consumption (particularly from June through September). Analysis of the interannual variations in mortality during the different life stages and attendent physical biological conditions will allow an evaluation of various hypotheses about timing of mortality and relative importance of different mortality mechanisms.

The following perspectives attempt to focus and define the above generalized and extensive data needs into more specific research areas that increase the probability of determining factors controlling recruitment.

The Biological Perspective

Work at the Northeast Fisheries Center of the National Marine Fisheries Service (NEFC, NMFS) suggests that recruitment variability is determined by interannual differences in post-larval and juvenile mortality rates. Edwards and Bowman (1979) suggested that silver hake (Merluccius bilinearis) is the keystone pisciverous predator on Georges Bank. They proposed that silver hake regulated its own abundance through cannibalism as well as that of other species by predation. Cannibalism has been shown to be an important mechanism regulating recruitment in clupeoids (MacCall, 1980) and occurs in other species such as walleye pollock (Knetchel and Bledsoe, 1981). Cohen and Grosslein (1982) calculated the daily ration and preferred prey size of silver hake and concluded that a conservative estimate of silver hake consumption could equal all of the post-larvae produced on the bank by silver hake, cod, yellowtail flounder, haddock, and pollock. Cohen and Grosslein (1982) also showed that mortality rates in the post-larval phase were at least as great as in the egg and larval stage for cod, haddock and silver hake. This result was expanded for additional species and years by Sissenwine et al. (1984). Additional evidence that year-class strength is set after the larval stage comes from Cohen et al. (1982), who demonstrated a correlation between mortality from age 0 (approximately 6 months) to age 1 for silver hake based on survey indices and year-class strength based on virtual population analysis. Other NEFC data also shows correlations between survey catch during the first year of life and subsequent recruitment (Fogarty et al., in press).

Hypotheses.--Predation has been hypothesized as a key element in structuring marine ecosystems (Landry, 1976; Ohman et al., 1983) and, while the primary goal of the recruitment initiative is to investigate the role of predation mortality in setting year-class strength with particular reference to juvenile fishes, it would be premature to ignore physical processes or events occurring during the larval and egg stages. It is necessary in examining the recruitment process to take into account the various mechanisms which may be at work to different degrees in different years.

Specific hypotheses are:

1. Predation mortality on juvenile fish is the major process regulating year-class strength. This predation is influenced by numerous factors that must be elucidated. For example, predation may be enhanced or diminished by changes in growth rate due to the physical environment or biological interactions (food availability, competition). Predation may also be affected by changes in the distributions of predators and prey in space (horizontal and vertical) and time due to both biological and physical causes. Predation in the sense used here also may be interrelated with parasites and disease which sometimes have disastrous effects on fish populations. However, these two factors may also be considered co-variables in their own right.

2. In some years the survival and distribution of eggs and larvae may dramatically alter recruitment. The lack of cod and haddock larvae on Georges Bank in 1982 may have been the result of a massive mortality of eggs and/or larvae. An alternative is that variability of eggs may be a function of the condition of the spawners in some years. Also, environmental conditions may affect the fecundity of the fish. There is some evidence for significant parallel interannual differences in fecundity of haddock on Georges Bank and Browns Bank in the same calendar years, suggesting a possible region-wide environmental effect on egg production.

The Fishery Oceanography Perspective

The Oceanography Investigation will contribute to Center recruitment research in three areas combining process-oriented field work, retrospective analysis of existing data, and a circulation/physical environment component to ongoing modelling efforts.

Previous process-oriented studies have shown that cod and haddock larvae are carried southwestward from the spawning areas on northeastern Georges Bank to the southern side of the bank by the local water motions. Subsequently, the young-of-year are found in fall surveys to be concentrated on the northern side of the bank. The movement of the juvenile fish from the southern to the northern side of the bank likely occurs through some continued dependence on the mean circulation pattern and also some behavioral mechanisms. The circulation pattern over the western part of Georges Bank includes a recirculation of about 10-30% of the water from the south side around to the north in the region of Great South Channel. The majority of the flow on the southern side, however, continues westward toward the Middle Atlantic Bight. While the young possess considerable mobility, no hydrographic gradients exist between the water moving northward through Great South Channel and that moving westward past Nantucket Shoals to provide directional keys to the fish.

Hypotheses.--Specific hypotheses are:

1. Variations in the degree of recirculation of water probably results in differential retention and survival of early life stages of cod and haddock on Georges Bank and directly influences recruitment on Georges Bank.

2. The physical environment may also influence year-class strength in other ways. For example, elevated temperatures may cause eggs to hatch sooner and larvae and juveniles to grow more rapidly than usual and consequently be subject to predation for a shorter time. Colder than average temperatures could be expected to act in an opposite fashion. Temperature may also affect egg size and survival as well as affect the spread of disease or parasites. There may be other environmental linkages with recruitment such as Ekman transport, rings, and salinity.

RESEARCH STRATEGY AND FIELD LOGISTICS

Biological

Two recruitment study cruises will be conducted, 11-22 June 1984 and 6-18 August 1984, to determine the distribution and abundance of the older larvae and juveniles of cod and haddock; to investigate their vertical distribution, behavior and predator-prey relationships; and to evaluate various sampling gear for capturing juveniles. Sampling on the 11-22 June 1984 cruise aboard Albatross IV will be directed toward the pelagic larvae and young juveniles (15-50 mm), whereas on the 6-18 August 1984 cruise aboard Delaware II, the sampling emphasis will be on the demersal juveniles and predator stomach studies. From these cruises and Ichthyoplankton Survey-MARMAP cruises we will be able to estimate mortality rates on a number of developmental periods for the Georges Bank spawning population from the egg to early juvenile stage, which can be related to an index of year-class size at recruitment from the late summer, fall and spring bottom trawl surveys.

Field Operational Plan

11-22 June 1984, Albatross IV Cruise.--Approximately 6 days of the June cruise period will be devoted to a survey of the Georges Bank area within the 100 m bottom contour. A grid of 40-50 sampling stations will be occupied between 10 and 30 miles apart with stations more closely spaced in the shoal region or where high abundances of fish are observed. Post-larvae and early juveniles will be sampled by 30 min (1.5 knot) integrated hauls from surface to near bottom using the 10-m MOCNESS (3.0 mm-stretch mesh), an electronically controlled opening-closing net. After the distribution and abundance of the pelagic post-larvae and early juveniles are determined, a suitable station(s) will be occupied for the remaining 4 days of the cruise to conduct vertical distribution studies and at the same time compare the sampling efficiency of the 10-m MOCNESS vs the 6' IKMT and the Boothbay Depressor Trawl. A 36' Yankee Bottom Trawl modified with a chain disc sweep also will be used to see what portion of the population are in the demersal stage near bottom and below the maximum depth level of sampling with the pelagic trawls and to capture possible predators. If time permits, two stations should be occupied to compare and contrast distributions in the well-mixed vs stratified waters.

An EPSCO cromascope echo sounder will be used to see if juveniles can be identified with a specific return signal, and if successful, the echo traces can be used to confirm that diel vertical migration and not horizontal dispersion is responsible for changes in availability. Subsamples of fish will be preserved and later analyzed for gut content analysis, biochemical condition factor-growth analysis (RNA/DNA), pathogens, parasites, and otolith aging analysis to construct growth curves and back calculate the time of hatching or spawning.

July.--Although not scheduled for 1984, the desirability of sampling monthly from June to August should be considered in future years.

6-18 August 1984, Delaware II.--On the August cruise the same 40-50 grid stations should be resurveyed within 6-8 days using both a Yankee Bottom Trawl and a suitable pelagic trawl at each station. Juveniles should be sampled with a bottom trawl in the shoal water by day as they are reported to be concentrated near bottom, and sampled with pelagic gear at night when they come off bottom or, ideally with both gear at each time to clarify the situation. In the deeper stratified waters (>60 m) they are believed to remain up in the water column associated with a thermocline. Samples of juveniles will be preserved for the same analyses as indicated for the June cruise. The final 4-6 days of the cruise will then be devoted to an intensive station(s) study of their diurnal variability and a special effort to collect stomachs of the larger predators caught in the trawls to identify those species preying upon the juveniles. Again, depending on sampling results, it may be desirable to select stations to contrast the well-mixed vs stratified environments.

Fishery Oceanography

Process-oriented studies in two research areas will be conducted to support hypothesis testing. These studies are:

1. Use current meters and drift measurements to determine the degree and variability of the recirculation of water in the southwestern portion of Georges Bank as it pertains to the retention of juveniles on the bank.

2. Conduct cooperative work with the biological tasks to identify the existence of behavioral mechanisms that retain the young fish on the bank and any physical keys by which they are controlled.

Field Operations Plan

The field work needed in the recirculation studies above would require approximately 6 days on *Albatross IV* in the early spring of 1985 for mooring deployments and 6 days in the late summer for servicing the moorings. The behavioral work would be done as part of the biological sampling program.

1. A circulation modelling project will be carried out to include circulation and water characteristics in relation to rates of water-motion and observed distribution patterns of larval and juvenile cod, haddock, and yellowtail by size and age in an effort to measure the influence of advection on the survival of early life stages.

2. The MARMAP hydrographic data from 1977 to the present is being analyzed to describe the variability in the physical environment of the Gulf

of Maine/Georges Bank region. The result of this analysis will be combined with the fish stock statistics to search for any relation between the physical and biological variations. Highest priority will be given to examination of environmental conditions during the spring of 1982 which had unusually low cod and haddock larval populations. This work will be done in close cooperation with the Resource Assessment Division and Ichthyoplankton Survey Investigation.

3. Retrospective analyses of environmental data archives in relation to recruitment time-series will be conducted in cooperation with AEG and other NEFC units.

MARMAP-Ichthyoplankton Survey Perspective

The research strategy will continue to focus on the integration of information from three sources: shelf surveys, process-oriented field studies, and laboratory research activities. The 7-year time series of mesoscale plankton/hydrography information will be augmented by continuing the shelf surveys that began in 1977. Cruises will be conducted at monthly-to-bimonthly intervals and cover the continental shelf region from Cape Hatteras, North Carolina, to Cape Sable, Nova Scotia, an area of some 260,000 km^2. These multispecies surveys are an integral part of the proposed recruitment initiative. They provide a description of unprecedented scope and accuracy of the interannual variability in mesoscale temporal and spatial distribution patterns, abundance, production and mortality of fish eggs and larvae. These will be the only Center studies conducted on eggs and larvae and this information is essential if we are to assess the significance of mortality during the post-larval and juvenile stages. In addition to providing estimates of mortality during the egg and larval stages, the surveys produce information on the population structure of ichthyoplankton communities and their environment and thereby provide some insights into the causes of mortality over broad geographic areas.

Field Operations Plan

Plankton samples will be collected on each survey cruise at 170 stations by double-oblique tows with a 61-cm bongo fitted with 0.333 and 0.505-mm mesh nets. The 0.505-mm mesh sample will be used for ichthyoplankton analysis. Previous surveys have collected cod larvae 3-20 mm and haddock larvae 3-15 mm. Survey activity in 1984 and 1985 will emphasize the winter/spring period, the spawning seasons of two of the target species, cod and haddock. In each year we will conduct four surveys during the late autumn through spring spawning season of cod and three during the shorter winter/spring spawning season of haddock. The 1984 spring survey immediately precedes the initial post-larval/juvenile cruise and will provide strategically important information on the best location for finding young stages of the target species.

Ecosystem Modelling Perspective

The time series of available physical data and recruitment estimates will be analyzed for causal linkages. Regression analysis on recruitment of several stocks with their predators and alternative prey will be performed. This research will also involve work with Laurence's larval feeding model to further refine the estimates of the effect of different prey concentrations on larval growth and survival. Additional estimates of larval and juvenile food requirements compared with available food will be made using an analytical model of total cohort consumption. Multispecies modelling of the first year of life to examine the effects of predation, circulation and temperature on the survival of cod, haddock, silver hake, herring, mackerel, and yellowtail flounder on Georges Bank is also proposed. This model will be validated by comparing the results of the predicted recruitment with actual recruitment determined by NEFC data. Further validation will be provided by comparing the model estimates of consumption and mortality with estimates based on the food habits data base. The insights into the recruitment process from these studies will be incorporated into a larger model (GEORGE) that can be run for several years to explore the outcomes of various management decisions on target and non-target fisheries.

PERSONNEL REDIRECTION AND REASSIGNMENT

The Larval Dynamics Investigation will redirect its laboratory experimental and process-oriented field tasks to the biology of juvenile fishes. This will include all the Investigation personnel (16 positions). The research will concentrate on age, growth, and feeding studies. Periodic priority studies of larvae will be conducted if necessary. A renaming of the Investigation to the Early Life Stages Dynamics Investigation is in order.

The Fishery Oceanography Investigation will direct its efforts to the initiation and carrying out of circulation modelling studies dealing with the coupling of larval and juvenile distributions in relation to vertical and horizontal advection. This will include redirection of the research of Steve Ramp and Ron Schlitz. Efforts to examine retrospectively the relationship between year-class success and environmental conditions will be accelerated under the direction of Dave Mountain.

John Green, Carolyn Griswold and Joseph Kane of the Plankton Ecology Investigation have had their positions redefined to emphasize the study of micronekton. This will direct their efforts to organisms that include juvenile fishes and potential predators of larvae.

Ray Maurer has been reassigned from the Plankton Ecology Investigation to the Ecosystem Dynamics Investigation. This changes his research assignment from image analysis development to predator-prey interactions of juvenile and adult fishes. Tom McKenney will be reassigned from the MARMAP I Investigation to the Micronekton Biomass Task. This changes his research assignment from quality control of the identification of early life stages of fish to predator-prey interactions of invertebrate macrozooplankton and juvenile fishes.

In the Ecosystem Dynamics Investigation the future modelling effort will be focused chiefly on clarifying the hypotheses outlined in this recruitment initiative. This represents a narrowing of the original scope of modelling for the Investiation, which originally involved development of multispecies fishery models, including the evaluation of alternating long-term management strategies. The management-related aspects of modelling will be done chiefly by personnel of the Resource Assessment Division.

PRINCIPAL SCIENTIFIC PERSONNEL

Dr. Marvin Grosslein--responsible for overview within the Marine Ecosystems Division and coordination and integration with NEFC multispecies modelling effort and with the Divisions of Pathobiology, Environmental Assessment, Aquaculture, and Resource Utilization.

Dr. Geoffrey Laurence--Coordinator, responsible for overall research direction and scientific operations.

Dr. R. Gregory Lough--responsible for logistics and conduct of process-oriented biological studies in the field.

Mr. Edward Cohen--responsible for biological direction and coordination with ecosystem modelling studies.

Dr. David Mountain--responsible for interaction and research direction of fishery oceanography studies.

Mr. John Green--responsible for mesoscale micronekton and macrozooplankton predator-prey studies, sampling logistics, and strategy in field research.

Ms. Carolyn Griswold--responsible for measuring predation impacts of gelatinous zooplankton on fish larvae and juveniles.

Mr. Wallace Smith--responsible for coordination with ichthyoplankton survey operations and research results.

Drs. Emory Anderson and Stephen Clark--responsible for coordination with the Resource Assessment Division.

BUDGETARY ITEMS

The "Juvenile Sampling Task Force" together with the above Principal Scientific Personnel (J. Green, Chair., Memo 11/22/83) established the following list of gear necessary to conduct initial biological sampling:

Third wire winch	$3-4 K	
Color fish finder (on loan from RAD/Draper)	9	
Nets for MOCNESS (on order)	7-10	
Boothbay trawl (on loan from State of Maine)	2	
Midwater trawl	4-6	
Conductivity sensor	12	
Miscellaneous (jars, labels, shackles, etc.)	5	
		$42-46 K

Fishery oceanography budget items will be primarily needed in FY'85 and include:

Buoy modification (FY'84)	$10 K	
Instrument preparation (batteries, servicing)	20	
Sinkers	7	
Wire, chain, hardware	10	
		$47 K
Micronekton Sampling System Development and test	$50 K	
		$50 K

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APPENDIX V.

ISSUE PAPERS ON ECOSYSTEM MODELING

Item 1.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Northeast Fisheries Center
Narragansett Laboratory
South Ferry Road
Narragansett, RI 02882 1199

DATE: February 10, 1984

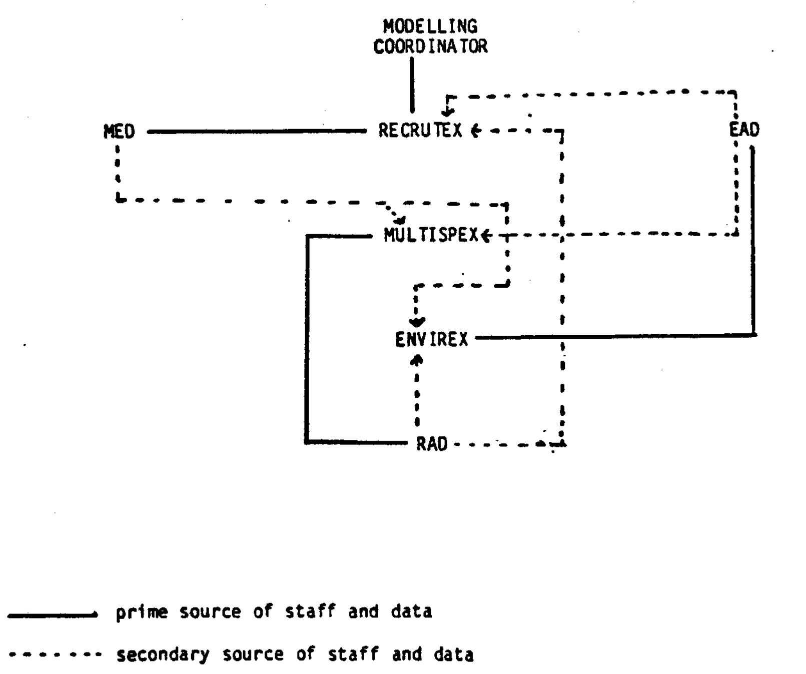
TO: Committee of Three: Dick Hennemuth, Carl Sindermann, Michael Sissenwine - F/NEC

SIGNED

FROM: Kenneth Sherman, Chief, Marine Ecosystems Division - F/NEC2

SUBJECT: Issue Paper, Ecosystem Modelling

We have completed our preliminary round of discussions on this topic. Our issue paper will include a recommendation for reallocating responsibility for the modelling effort in the Center. The MED will focus on the recruitment modules and the RAD would then assume major responsibility for moving forward with the multispecies fishery modules and EAD would be prime developer of risk assessment modules. To ensure continuity in the modelling approach within three Divisions we recommend that a modelling coordinator be designated (M. Sissenwine) to chair three modelling working groups dealing with recruitment, multispecies management, and environmental assessment:



A more complete description of the modelling effort in the MED dealing with recruitment is in preparation and will be forwarded to the COT next week for review.

KS/jkd

Item 2.

WOODS HOLE LABORATORY REFERENCE DOCUMENT NUMBER 84-08

ECOSYSTEM MODELLING IN THE MARINE ECOSYSTEMS DIVISION
A STATUS REPORT*

by

Edward B. Cohen and Marvin D. Grosslein

Northeast Fisheries Center
Woods Hole Laboratory
Woods Hole, Massachusetts 02543

March 1984

*MARMAP Contribution Number MED/NEFC 84-08

BACKGROUND

Ecosystem modelling in the Marine Ecosystems Division (MED) was a natural outgrowth of the development of multispecies approaches to fishery management begun at NEFC more than a decade ago (Grosslein, Brown and Hennemuth, 1979). Since its establishment in 1977 the Ecosystem Dynamics Investigation has been investigating various holistic approaches to fisheries problems within the framework of the total ecosystem, and has developed several conceptual models as well as some analytical and simulation models.

An initial step was the estimation of production and consumption by the finfish biomass on Georges Bank based on an energy balance equation (Grosslein et al., 1980) The next step was to construct an energy budget for Georges Bank. This provided for the first time quantitative estimates of production of the lower trophic levels with implications for fish production (Cohen et al., 1982). This approach has since been expanded to consider the magnitude of predation by adult fish on sub-adult fish and the production of pre-exploitable fish (Cohen and Grosslein, 1982; Sissenwine, Cohen and Grosslein, 1984). The energy budget approach has been carried to its conclusion in the chapter on total productivity for the book on Georges Bank (Cohen and Grosslein, in press) where all trophic levels from phytoplankton to apex predators have been included. The chapter attempts to construct a quantitative picture of the way energy is produced and utilized on Georges Bank and compares it with other well-studied shelf ecosystems. This will help establish the most fruitful lines of investigation for future field, laboratory and modelling studies. The energy budget has provided a valuable quantitative framework for understanding the limits to fish production on Georges Bank. It has also yielded major new insights into the critical recruitment process in fishes. Work on the energy budget has involved many NEFC scientists and synthesis of a large data base within the MED as well as other divisions, and has required frequent updating of estimates. Thus, it has taken a lot of time, particularly for personnel in the Ecosystem Dynamics Investigation. Concurrent with these activities, personnel the Ecosystem Dynamics Investigation were also carrying out work with the physical oceanographers on the nitrogen balance in the Gulf of Maine and on Georges Bank (Schlitz and Cohen, 1984) and the role of advection on phytoplankton, zooplankton and ichthyoplankton (Mountain and Cohen, 1982; Cohen et al., 1982).

Concurrent with work on the energy budget we have been developing a multispecies fishery research and management model called GEORGE (Hahm, 1983). Following a lengthy period of evaluating candidate models and approaches (involving several workshops including one at Harvard with Bossert, and extensive review of other models especially DYNUMES by Lavaestu), it was decided to construct our own model along the lines of the Andersen-Ursin model (Andersen and Ursin, 1977). Due to constraints on hiring we were unable to recruit an experienced modeler and obtained a graduate student (Wendell Hahm) to begin construction of the model, and initiated training in modelling for Ed Cohen.

GEORGE is a simulation model designed to help evaluate the natural biological and physical controls over fish production and for predicting long-term effects of various management strategies. Major emphasis has been on evaluating multispecies predator-prey interactions among adult and juvenile fishes since it has become apparent that predation on juvenile fishes is a key factor controlling recruitment variability. A great deal of effort has gone into evaluating the food habits data base and developing size selective feeding and electivity functions. We have patterned the feeding function after Andersen and Ursin (1977). We have worked closely with Ursin on the problem of electivity of predators for specific prey as well as the digestion and growth rates of fish in general. Hahm and Langton (1980) summarized prey size selection for major fish species of Georges Bank in a form which could be used in predator-prey simulations. We have worked with Ursin to refine these coefficients, and are completing two papers on these problems, a general digestion rate model for field caught fish (Pennington, to be submitted) and a comparison of the feeding and growth of cod from Georges Bank and other North Atlantic stocks (Ursin et al., to be submitted). Additional work that bears directly on the precision of input data for the model is that of Pennington on the statistical properties of MARMAP ichthyoplankton and trawl survey data (Pennington, 1981; Pennington, 1983) although Hahm completed the construction of GEORGE and made preliminary debugging runs we have had problems in validating the present form of the model against the available data. The model is unstable and crashes within a year. While some of this instability may be due to the input data on feeding rates, the problem is also due to the coding of the model. The processes of growth, feeding and mortality are carried out consecutively rather than simultaneously, and the order of execution influences the model results. In order to properly de-bug the model it will have to be taken apart and re-coded. The task of re-coding GEORGE or constructing an alternative model (in either case the same basic types of equations will be used) for evaluating management related problems, should now be transferred to the Resource Assessment Division (RAD). RAD has the expertise for this, and the problem of modelling the recruitment process alone (i.e. factors controlling year-class success) will require the full resources of the MED.

Although the concept of GEORGE is still valid, it is a large scale multi-purpose model of the ecosystem and is probably premature for the level of understanding we have of the ecological processes controlling production and variability in the ecosystem. Energy budget calculations are adequate for insight into gross patterns, but they are not sufficient as a basis for simulation of ecosystem dynamics. Recruitment in fish populations is the single most important process in the field of fishery ecology and until we clarify the factors controlling variability in recruitment, especially the role of predation mortality on young fish, we won't have a valid mechanistic basis for linking recruitment to lower trophic levels and the physical environment, or for predicting effects of various harvest strategies. This view was shared by the majority of modelers at the recent special workshop on application of ecosystem models to fishery management (see report Panel A in Turgeon, 1983). For the above reasons the MED and the Larval Dynamics and Ecosystem Dynamics Investigations in particular will focus modelling efforts on the recruitment problem.

THE RECRUITMENT PROCESS

General Strategy

While much of the recent work done at NEFC points to the importance of predation mortality on juveniles as the key process in regulating recruitment, other causes and life stages cannot be ruled out entirely. In fact, it is very likely that different processes act to a greater or lesser degree and on different stages during the first year of life in different years. This means we must sample all first-year stages of a cohort in order to have appropriate empirical data for clarifying mortality mechanisms and testing hypotheses. Another important aspect of our strategy is that the pace of model development should be linked to the level of understanding of the processes. In the case of GEORGE we tried to go too far too fast with inadequate knowledge of controlling processes, and we generated unrealistic expectations of predictive capability. This time we intend to use the models initially to help evaluate and describe the processes, and then begin to develop predictive models. We intend to devote sufficient resources for a thorough analysis of all the data available and relevant data archives as well as collect critical new data in order to gain adequate insight into controlling mechanisms.

We will construct several research models (small in comparison with GEORGE) that will be designed to test various hypotheses about the recruitment process. These models and the associated analytical work will be an integral part of the proposed field and laboratory studies on the first year of life for target species, as described in the MED recruitment initiative. These models will be developed to take advantage of the dynamic model processor (DMP) developed by John Hauser. Using the DMP will make it easier to code the models as the processor takes care of all the input-output chores. Perhaps more importantly, using the DMP will enforce a certain amount of standardization which will make it much easier for other modelers within the Center to use and evaluate the models.

Retrospective Analyses

We intend to carry out a comprehensive series of retrospective analyses on various physical and biological factors and recruitment success for species with long time series (e.g. Sissenwine et al., 1980; Cohen et al., 1982; Koslow, submitted; Edwards, 1984). In particular we intend to carry out a detailed regression analysis of recruitment variability for major species for the years 1977 to date when we have had intensive MARMAP coverage, analyzing abundance and distribution of larval, and juvenile stages and their predators in relation to the physical environment and to recruitment success. Haddock, cod and yellowtail (principal target species of our recruitment initiative) would be analyzed as well as mackerel, silver hake and herring (ICNAF series). These retrospective studies will help clarify the degree of linkage between recruitment and various possible mechanisms to be included in the model.

Field and Laboratory Studies

In order to adequately test hypotheses about the relative importance of predation mortality on juveniles of target species, additional data will be necessary on the various life stages within the first year of life, including abundance of eggs, larvae and juveniles at least to age 9 months, and studies on growth, condition and feeding. These data will be needed to document variations in the timing and magnitude of mortality, and whether growth rate and condition (RNA/DNA, parasite load, etc.) are related to mortality. Estimates of the distribution and abundance of the predator field, and the food consumed by the various predators (particularly those that prey on juveniles of the target species) is also required, to determine the extent to which variations in juvenile mortality can be explained by predation.

Physical oceanographic studies on the re-circulation of water on Georges Bank vis á vis the life history of the target species will also be a part of our recruitment initiative including the construction of the models. Physical parameters that should be considered include temperature, stratification, current pattern (movement of water onto, around and off Georges Bank), and vertical shear in the flow field (this for looking at behavioral mechanisms).

The studies outlined above are all necessary to evaluate the mechanisms to be modelled as well as to provide the appropriate data for the models. It is important that these preliminary studies and data collection be carried out in close cooperation at all stages between the modelers and the field and laboratory scientists involved in the recruitment task force.

Recruitment Modelling

Concurrent with the above investigations we will be constructing a series of research models for the target species, haddock, cod, and yellowtail flounder; for example, the larval growth and survival model of Laurence (1983). These models will incorporate a detailed model of the first year of life, starting with the egg stage. The growth and survival of the cohort will then be followed for twelve months. Mechanisms that will be included in the model are size selective predation modified by the ecology of the predators and prey (e.g. spatial and temporal distribution of predators and prey, pathobiology, advection and recirculation of water on the Bank, and the effects of temperature on the growth and feeding of the target species and their predators).

These models will be run one year at a time starting from egg abundance. The number of eggs will come from either MARMAP survey data or be calculated from fecundity and stock structure. The number of eggs in the model can be made to follow a spawning curve so that the survival of eggs spawned at different times throughout the season can be followed. This may prove to be a key process in recruitment as recently it has been shown that in some years, the bulk of anchovy recruits are from one portion of the spawning curve, i.e., spawned either early or late in the season. Validation of the models with respect to the timing, magnitude and causes of mortality in the first year of life will be accomplished by comparing the abundance of model cod, haddock and yellowtail during the various stages of the first year of life with the actual larval and juvenile survey data in those years for which we have data. Using the insight from these analyses, additional testing will involve comparisons of the number of recruits predicted by the model with the actual number estimated by VPA (or trawl survey) for the much longer time series based on assessment data. We are also going to test the model by looking at the model food habits compared to the empirical food habits data base.

Different modelling projects would involve different aspects of the physical environment. Some specific examples (which do not include all possibilities by any means) might be: 1) The onset of larval hatching as related to the spring warming and the onset of stratification; 2) The distribution of larvae on the bank due to circulation of water about the bank; 3) Larval losses due to cross-shelf exchange processes (storms, warm core rings, etc.) on the southern side of the bank; 4) The recruitment of juveniles to the northern side of the bank due to recirculation of water on the bank; and 5) Large-scale shifts in the distribution of larval and juvenile predators due to the inter-annual variability of ocean and atmospheric climate.

There are two possible approaches to providing physical input to the model: 1) Derive the velocity fields and/or the distribution of hydrographic variables (temperature, salinity, and nutrients) from first principles; and 2) Specify the flow field mathematically and hydrographic patterns as they are known to exist on the bank from field measurements. These two approaches in fact have different goals: The first elucidates the physical factors responsible for the circulation on the bank, while the second provides a statement of conditions as they are known to exist, irrespective of how they are caused. The first approach, i.e. starting from first principles, involves solving the properly-formulated hydrodynamic equations with the correct boundary conditions in three-dimensions, a formidable task which must be done numerically since the relevant non-linear equations cannot presently be solved analytically. Considerable effort has already been expended on this approach by other groups, most notably Applied Science Associates, Inc. (Spaulding, Swanson, et al.) of Wakefield, R.I., and the Canadian school (Greenberg, Loder, Garrett, et al.) at Bedford Institute of Oceanography and

Dalhousie University. These people have dedicated fast computers and many man-years of effort to produce models that, while valuable, still do not produce all the known details of the flow. It should be noted that all the relevant aspects of the circulation on Georges Bank are not yet known (percentage of recirculation and offshore volume transport by large storms, for instance) and our field programs will be continued to provide these important missing pieces of information. With this information we will reexamine the existing models with an eye towards validating them against the known circulation and applying them to specific recruitment hypotheses. For example, one area where a first principle approach may be useful is response of Georges Bank to severe storms (e.g. Beardsley and Haidvogel, 1981).

We think that the second approach is more likely to elucidate the linkages between the physical environment and recruitment, and it is the approach which can be most readily implemented within the Marine Ecosystems Division. Therefore, we will focus on the second approach, i.e. specify particular aspects of the Georges Bank flow field as known from existing and future field programs, as needed for input to the specific research models. This will be done in a timely way and include adequate variability to approximate the real conditions on the bank. Secondarily, we will work cooperatively with oceanographers outside NEFC on exploration and validation of the theoretical models. For example, we will carry out joint activities with Dr. John Paul and his group at EPA under our existing memorandum of understanding and also initiate joint modelling exercises with oceanographers at URI or WHOI as part of the joint NEFC-WHOI cooperative research agreement.

The research models will provide insight into the recruitment process which can then be used in a model like GEORGE, that will allow simulation for several years, with feedback from fishing as well as the environment on stock structure. We think this larger model can only be developed with confidence after the research models are tested and validated. The larger model may then be used to predict the potential long-term effects of various management strategies on the stocks on Georges Bank.

All of the above modelling activities focus on natural mortality factors for selected offshore target species on Georges Bank. Since Georges Bank is relatively free of contaminants, natural factors (including parasites and disease) can thus be assumed to be of primary importance. However in inshore areas, important target species such as striped bass and winter flounder are subject to contaminant effects which may very well be significant if not controlled. MED has unique expertise and facilties at Narragansett for investigating pollution effects on early life stages, and thus it seems appropriate for MED to play a significant role in the NEFC environmental assessment activity, and particularly within the context of the recruitment process. Both experimental and modelling capabilities are available and both need to be integrated for an effective approach to the problem. An outline of such a program and how it would be coordinated with other NEFC groups is given in a recent issue paper by Laurence (memo of 9 March).

Cooperating Researchers for Recruitment Modelling

The modelling effort will of necessity involve close working relationships with numerous researchers within the Division as well as in other divisions of the NEFC. The data on the abundance of eggs and larvae will come from the investigators of the Ichthyoplankton Investigation of W. Smith at Sandy Hook. Additionally, data on fecundity from W. Morse and others at Sandy Hook will be combined with data on the stock structure and fraction mature at age from the assessment, aging and survey groups at Woods Hole. G. Laurence's group in Narragansett, together with G. Bolz in Woods Hole, will provide data on larval growth and survival. Aging data on juveniles will be compiled by the age and growth unit in RAD and G. Bolz at Woods Hole.

The estimates of juvenile abundance will be made by the group under the direction of G. Laurence which includes G. Lough, D. Potter, J. Green and others in Narragansett and Woods Hole.

The retrospective analyses on physical forcings and recruitment will involve the physical oceanography group in Woods Hole (D. Mountain, R. Schlitz, S. Ramp) as well as AEG. Regression analysis of recruitment as the dependent variable vs. the independent variables of relative prey and predator abundance will be carried out with M. Pennington.

Determination of species groupings and predator fields will include the work by S. Murawski, W. Overholtz and W. Gabriel, and will be incorporated into the recruitment models to describe the ecological relationships between the target species and their prey. This includes overlap of predators and prey in space as well as grouping predators into functional units with similar predation characteristics. We also plan to work closely with the modelling group in the Assessment Division in formulating ideas about the recruitment process to be included in the model. The modelling effort will greatly benefit and be better able to contribute to the Center's recruitment studies if the modelling process and personnel are closely integrated with the field and laboratory studies supporting it as well as with the other modelling studies being carried out within the NEFC.

Investigation of parasite and disease conditions would be achieved through coordination with the Pathobiology Division (Oxford). Research on pollution effects on early life stages would be a cooperative effort involving the Larval Dynamics Investigation of MED and the Physiological Effect of Pollution Stress Investigations of the Environmental Assessment Division at Milford.

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APPENDIX VI.

ENVIRONMENTAL ASSESSMENT ACTIVITIES

Item 1.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Center
Woods Hole, Massachusetts 02543

March 1, 1984 F/NEC: MPS

To: Distribution

From: Michael P. Sissenwine *Mike*

Subject: NEFC Review of Environmental Assessment Activity

The NEFC Review of Environmental Assessment Activity was conducted on 6-7 February 1984, Sandy Hook Laboratory. The agenda and list of participants is attached. This memo reflects my impressions (some of which are probably incorrect) of the NEFC's Environmental Assessment Activity. It is not an attempt to summarize the enormous amount of information presented during the session. Much of this information is documented in Annual Reports of the Northeast Monitoring Program (e.g., NOAA Technical Memorandum NMFS-F/NEC-20). I welcome your comments. They will be most useful if I receive them prior to 15 March.

Problem Identification:

The ocean ecosystems off the coasts of the United States are valuable multi-use resources, e.g., food production (for commercial and recreational use), recreation, aesthetics, minerals, oil and gas, transportation, and waste disposal. Some of these anthropogenic activities may adversely affect the food production value of the oceans. The potential of adverse effects is probably greatest for the Northeast Region due to its dense population and industrial centers.

Anthropogenic activity can be categorized as (1) ocean waste disposal; (2) coastal land use, nearshore waste disposal, and ecosystem modification; and (3) ocean resource use and accidental discharge. These activities result in habitat degradation due to the introduction of metals, inorganic chemicals, synthetic organic chemicals, petroleum, microorganism pathogens, biostimulants, and physical modifications. Some of these anthropogenic agents have multiple sources (i.e. non-point source).

The actual "effects" of anthropogenic activity on the food production of the oceans depends on the biological response of organisms, populations, communities, and ecosystems to exposure. Exposure is a function of concentration, duration, and frequency. Thus, the biological effect is determined by spatial and temporal distributions of anthropogenic agents relative to the biota. The distribution of anthropogenic agents, or their "fate", is determined by physical and geochemical processes, many of which are poorly understood. It is usually difficult to determine the "source" of anthropogenic agents because of their non-point source nature and the dynamic nature of the ocean.

Thus, the scientific challenge is one of determining "sources", "fates", and "effects". It is necessary to know fates in order for society to make informed decisions concerning whether or not to proceed with a particular anthropogenic activity. It is necessary to identify sources in order for society to take a specific action necessary to remedy an anthropogenic activity that has already occurred or is ongoing. It is necessary to know effects in order to judge the cost (in terms of loss in food production) of an anthropogenic activity.

What is NEC doing?:

The Environmental Assessment Division has primary responsibility for the NEC's habitat conservation research. The budget of the Division is about 2.7 million dollars of which $600,000 was (at beginning of FY 84) allocated to support contract research. A significant portion of the research conducted by the Pathobiology Division is directly related to habitat conservation. The Aquaculture Division conducts mutagenetics studies that are pertinent to habitat conservation. The studies conducted by the Resource Assessment Division, the Marine Ecosystems Division, and the Atlantic Environmental Group are multipurpose and many of these studies (e.g., spatial and temporal distribution of organisms, physical oceanography, food chain dynamics, natural mortality rates, reproductive rates, the value of the fishery) are relevant to habitat conservation. The Resource Utilization Division supports habitat conservation research by providing analytical chemical capability.

The 6-7 February review focused on the Environmental Assessment Division and components of the Pathobiology Division and Aquaculture Division which are directly related to habitat conservation. These studies are part of the Northeast Monitoring Program (NEMP). NEMP is a unified NOAA program intended to monitor and assess various components of the marine ecosystem of the coastal and shelf waters of the Northeastern United States in order to provide a current appraisal of the "health" of these waters. The NEMP program is still in its developmental stages. The goal is to develop a prototype monitoring program that is cost effective in determining the effects of anthropogenic activity on the health of coastal and offshore systems, while providing benchmark studies which will be necessary to evaluate long-term effects.

As part of NEMP, the NEFC conducts (1) water-column monitoring and research, (2) benthic community and sediment monitoring and research, (3) contaminant analyses, (4) and research on biological effects. The object of water-column monitoring and research is to determine the annual cycle of pycnocline development, reduction of dissolved oxygen concentrations, the distribution of inorganic nutrients, the distribution of chlorophyll a concentrations, phytoplankton taxa and rates of primary productivity, and circulation patterns associated with the discharge from major estuaries. While some studies have covered the entire continental shelf from Cape Hatteras to the Gulf of Maine (e.g., primary productivity studies), the effort is concentrated on the Mid-Atlantic Bight area, where anthropogenic effects are most likely. Seabed and water-column respiration studies have been used to study the causes of hypoxia (the condition of low dissolved oxygen concentration). Remote sense imagery is used to study continental shelf plumes from major estuaries, and for coastal habitat assessment (CHARM). This technology is also promising for the purpose of identifying and monitoring areas of hypoxia.

Benthic communities and their sediment environments are monitored because (1) they are potential indicators of anthropogenic changes, (2) benthic organisms are food of many valuable fisheries resources, and (3) they are the source of contaminants of some fishery resources through food chain linkages. In the Mid-Atlantic Bight area, the NEC monitors 25 stations. Community structure is determined, and contaminant concentrations (both body burdens and sediment concentrations) are measured. The productivity of benthic communities is investigated. There are special studies on the effects of sewerage sludge on the settlement of surf clams spat.

In the Gulf of Maine, studies of benthic communities and associated sediments have been implemented for Penobscot Bay, Casco Bay, and Massachusetts Bay. The benthic communities of inshore Gulf of Maine are very rich in species. Heavy metal and synthetic organic contaminants have been identified. There is evidence of an increase in concentration of PCBs in the sediments off of Portland.

Contaminant analyses for trace metals are intended to determine benchmarks for concentrations in sediments, fish, and bivalves. Monitoring can be infrequent (5 to 10 years). Therefore, target species are rotated.

The New York Bight apex has elevated levels of nutrients and synthetic organic contaminants. A major scientific problem is to identify the relative importance of potential sources; e.g., dump sites, sewerage disposal sites, estuarine plumes. Sulfide levels in the water column are high enough to have biological effects. These result from the anoxic sediments.

The relationships between the concentrations of contaminants in the New York Bight area and the total amounts disposed of in dump sites or discharged from rivers has yet to be determined. There is a model of the residence time of PCBs in the New York Bight, but it has not yet been tested.

Studies of biological effects have focused on physiological, biochemical and behavioral responses of organisms to contaminant stresses; and the association of microbial forms, genetic mutations, pathology, and immune responses to supposedly degradated environments. Lethal and sublethal effects have been determined for a variety of contaminants and species of finfish and shellfish (juvenile and adult stages). Microbial forms, indicative of human pollution, have been identified in fish. The incidence of cytogenetic abnormalities is associated with areas of degradation. Antibodies to bacteria associated with sewerage sludge have been identified in several species of marine fish. Antibody profiles can be used to monitor contact of fish species with pathogenic microorganisms. Behavioral responses of fish to stress have been demonstrated and are relevant to increased susceptibility to predation.

What have we learned?:

Several benchmarks have been determined: e.g., primary productivity; phytoplankton species composition; benthic community structure; contaminant concentrations in sediments, water columns, and tissues; concentrations of biostimulants (nutrients). The value of these benchmarks will be fully realized in the decades to come. In addition, numerous methods for monitoring the condition of organisms and their habitats have been developed. This work should lead to more cost effective indices of biological and environmental health.

The Northeast Monitoring Program has found anthropogenic deterioration in the quality of coastal and shelf environments of the Northeast Region. There appears to be a shift in the phytoplankton community towards smaller diatoms and ultraplankton in the nearshore waters, especially near the mouth of estuaries. High levels of nutrient loading in the New York Bight apex are associated with elevated levels of primary productivity. Much of this productivity sinks to the bottom where it decays, thus contributing to the problem of hypoxia.

Potentially toxic trace metals are found in high concentrations in the sediments of several coastal areas. Concentrations of synthetic organic contaminants are also concentrated in coastal areas, but they are also found in the tissues of fish throughout the Northeast Continental Shelf.

The vast majority of mackerel eggs collected in the Mid-Atlantic Bight area suffered from lethal cytogenetic mutations. The chromosomal mutation frequency in red blood cells of summer flounder in western Long Island Sound and of red hake larvae near New York Bight dumpsites is elevated. Sand lance have an elevated frequency of skeletal anomalies in inshore areas in the vicinity of the plumes from major estuaries.

NEC Responsibility for Environmental Assessment Research:

The National Marine Fisheries Service has primary federal responsibility for conservation, management, and development of living marine resources and for the protection of certain marine mammals and endangered species according to numerous federal laws. The Magnuson Fisheries Conservation and Management Act (MFCMA) provides that living marine resource habitats should be taken into consideration in the development of fisheries management plans.

In response to this legislation, NOAA has recently established a habitat conservation policy for the National Marine Fisheries Service. The policy notes that NMFS past habitat conservation activity has been in response to the Fish and Wildlife Coordination Act and the National Environmental Policy Act. These laws gave NMFS an important advisory role, primarily with respect to reviewing and commenting on proposed federal projects. But as a result of the MFCMA, NMFS habitat conservation activity needs to be focused on fishery resources subject to management under the Act. The policy notes that the safety and wholesomeness of food and products is a relevant concern. NMFS research Centers will conduct the environmental and ecological research, including long-term studies, necessary to implement the policy. The needs of NMFS decision-makers will be an essential consideration in determining research priorities. Dissemination of the information to the public is, and will remain, one of NMFS's major objectives.

Most NEC habitat conservation activity is legitimate within the framework of the policy. Nevertheless, the policy does give a basis for prioritizing research. It indicates that habitat conservation research should be focused on (1) fishery resources subject to management under the MFCMA and (2) the advisory responsibilities of the agency under the Clean Water Protection Act and the National Environmental Policy Act. Inshore or estuarine research is appropriate, in cooperation with states, if it relates to the productivity of fishery resources within the federal conservation zone.

Concerns:

NEC conducts numerous sound scientific investigations relevant to habitat conservation. The primary concern is that these studies contribute little more than their collective sum. The goal should be to design and implement a research program which is more valuable than the sum of its parts. This is the justification for a long-term commitment to mission-oriented research within multidisciplinary institutions such as the NEC, NMFS, and NOAA. Otherwise, there is little advantage over the alternative of sponsoring numerous short-term independent university or private investigations.

NEC environmental assessment activity is too diffuse, and it lacks adequate coordination. There is research on phytoplankton, benthos, fish of various life stages, sediments, the water column, submarine canyons, open ocean regions, estuaries, coastal wetlands, metals, synthetic organics, petroleum, biostimulants, microbial pathogens, biochemical responses, physiological responses, behavioral responses, immune responses, cytogenetics, community species composition, sources, fates, and effects.

The rationale for studying specific species, life stages, anthropogenic agents, or biological effects is unclear. One way of visualizing the problem is given in Figure 1. The figure indicates the complexity of the problem in three dimensions (species, life stage and anthropogenic effect). The complexity is even greater when the biological effect dimension (e.g. biochemical response, behavioral response) is included.

There is not enough focus on solving specific problems (i.e. a symptom of indequate coordination). The coordination problem is exacerbated by the large number of organizationally independent investigations (i.e., a flat table of organization) conducting habitat conservation research. For example, there are four habitat conservation related benthic studies (led by Ried, Steimle, McKenzie, and Larson under contract) and several other benthic studies elsewhere in the NEC.

The NEC is actively involved in two entities or processes that are intended to identify problems and coordinate research; i.e., the Regional Action Plan (RAP) and the Northeast Monitoring Program (NEMP). Unfortunately, the RAP process has gone too slowly, although there is some evidence that it is accelerating now.

NEMP is a vehicle for coordinating NOAA habitat conservation research. The recent interaction between NEC and NOS (through the latter's contractor, the Brookhaven National Laboratory) is an example of the problem of coordination within NEMP. NOS developed a set of proposed indices of pollution and solicited NEC's cooperation in testing them on already existing data. The development of monitoring tools, such as these proposed indices, is one of the goals of NEMP. Yet NOS and NEC are now pursuing that goal independently of NEMP.

Some more specific concerns are as follows:

(1) Biological effects are generally only determined at the organism level. These effects have not been translated into population effects and to losses in recreational and commercial fisheries.

(2) The NEC has failed to use models to focus its studies, synthesize its data, and test hypotheses. Models are necessary if predictive capability is to be achieved.

(3) There is little evidence that statistical principles and methods are being used effectively to guide in sampling design and analysis. Some of the issues are sampling frequency, importance of replicate sampling, random versus fixed station design, identification of factors that contribute to variability.

(4) It is unclear how effective NEC is at transmitting habitat conservation information to users, e.g., the public, Northeast Regional Office, Regional Fishery Management Councils, and other agencies responsible for habitat conservation decisions.

(5) Much of the NEC habitat conservation research concerns biological effects and response to exposures. It is unclear whether or not exposures used in laboratory experiments match exposures (i.e., concentration, duration, and frequency) measured in the field or predicted by source and fates models.

(6) NEC research has identified anthropogenic effects which are associated with areas of degraded habitat. It is unclear whether or not NEC has or should conduct experiments to identify the specific anthropogenic activities that cause the effects. For example, which of the numerous contaminants of the New York Bight apex cause chromosomal abnormalities in mackerel eggs or cause skeletal anomalies in sand lance. Of course, these abnormalities may result from the synergistic effect of several contaminants.

(7) It is unclear whether or not we know which life stage of fishery resource species is most fragile with respect to contaminant stress. Intuitively, I expect that eggs and larvae are the most fragile stages. It appears that relatively little effort is directed at these stages.

(8) The NEC is assessing coastal habitats, and developing benchmarks (CHARM). It is unclear how dependent fishery resources of the federal fishery conservation zone (FCZ) are on coastal habitat.

(9) The NEC is studying contaminants that (1) have a biological effect on resource species, and (2) are a human health hazard. Both concerns are within the NEC purview according to the NMFS Habitat Conservation Policy. Nevertheless, it is unclear whether contaminants which are primarily human health hazards should be investigated from the perspective of habitat conservation or resource utilization.

(10) Several NEC investigations are concerned with the source of contaminants, particularly in the New York Bight apex. It appears that there is adequate involvement of physical oceanographers if an objective of NEC research is to determine sources.

(11) Studies of chromosomal abnormalities in mackeral eggs of the New York Bight appear to be important. Lethal mutation rates can be interpreted in terms of population and fishery impacts. Unfortunately, it is difficult to judge the validity of these studies based on the results reported at the review or on several other occasions. There appears to be more attention to genetic methods than to experimental design and hypothesis testing. It is unclear why it has taken so long to analyze samples of mackerel eggs from MARMAP I surveys.

Have chromosomal abnormalities been investigated for other species? Is it feasible to use laboratory experiments to investigate the cause? Why has the investigation shifted to mutagentics of blood cells? The results of these studies will be much more difficult to translate into population effects.

(12) It appears there is a continuing effort to identify additional indicators of biological stress. There are already numerous indicators of stress; it would seem more useful to investigate the population level significance of existing indices.

(13) Significant resources are used to study the species composition of benthic and phytoplankton communities. Apparently, changes in community structure (e.g. diversity) are indicative of anthropogenic agents. But in many cases it is more cost effective to monitor the agents directly.

Of course, changes in community structure may affect fish production indirectly. But quantification of the indirect effects is probably more difficult than quantification of direct effects. The relationship between benthic (or phytoplankton) production and fish production is a problem of trophic ecology with broader implications than habitat conservation.

In order to determine the effects of a change in species composition on fish production, investigations should focus on a specific component of the benthos that has been reduced in productivity and on the fish species which is most dependent (based on diet composition) on it. Without a frontal attack on the problem, it is unlikely that fishery effects can be estimated. Even with a frontal attack, the odds are not good.

Conclusions:

The NEC has clearly demonstrated that there are areas of degradated habitat, particularly inshore. It has demonstrated biological effects. It is now time to design and implement a more cost effective plan. The plan should have three foci; monitoring, experimental studies and synthesis. Experimental studies and the synthesis should be focused on "case studies". The results of monitoring should be instrumental in identifyng case studies. A hypothetical plan is diagrammed in Figure 2.

NEC and NEMP monitoring has already identified several indices of biological stress. Ideally, a subset should be selected which is (1) relatively easy to measure or observe, (2) clearly associated with areas of habitat degradation, and (3) has the potential of being interpreted in terms of population and fishery effects.

With respect to the third criteria, biological effects on reproduction and early life stage survival have the greatest potential. Fisheries depend on recruitment (i.e. successful reproduction and survival of early life stages). As an illustration, consider striped bass. It is frequently argued that the demise of the population and fishery has been caused by habitat degradation. If this is in fact the case, then the effect must be on reproduction or early life stage survival. It is well known that the demise of striped bass is a result of poor recruitment (since the 1970 year-class), not a result of abnormally high post-recruit mortality.

More emphasis should be put on experiments on early life stage response to stress. Pre-recruit fish may prove to be particularly sensitive. Furthermore, what are labeled as sublethal effects for experiments involving a relatively few large animals may be analogous to a low level of mortality for experiments involving numerous small animals. If experiments focus on early life stages, the latter may be feasible, and there in a greater potential for estimating population effects.

Studies to identify the causes of biological effects should be focused on the effects that are most prevalent, and that have population and fishery significance. If there is population and fishery significance, the effect is a problem, and it is logical to attempt to identify its cause.

Case studies should facilitate coordination and cooperation between investigations within NEC, NOAA, and government. NEC's strength is research concerning biological effects. As a fishery agency, this is also its primary responsibility. Thus, a cooperative approach to the case study is appropriate. The cause and effect of hypoxia in the Mid-Atlantic Bight area should be a candidate for a cooperative case study. Case studies may also be identified by species. Species should be selected based on their value and dependence on areas that have been degraded. Striped Bass and winter flounder met these criteria.

RAP and NMFS should play a significant role in the identification of case studies. A new habitat conservation research plan needs to be prepared, and circulated for peer review. As a result of the excellent research which has been accomplished to date, and a renewed commitment to problem identification, planning and coordination, a more effective program may be possible at a lower cost.

*Distribution

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P. Grose, NOAA/NESDIS
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K. Sherman
B. Higgins, Regional Office
M. Ingham

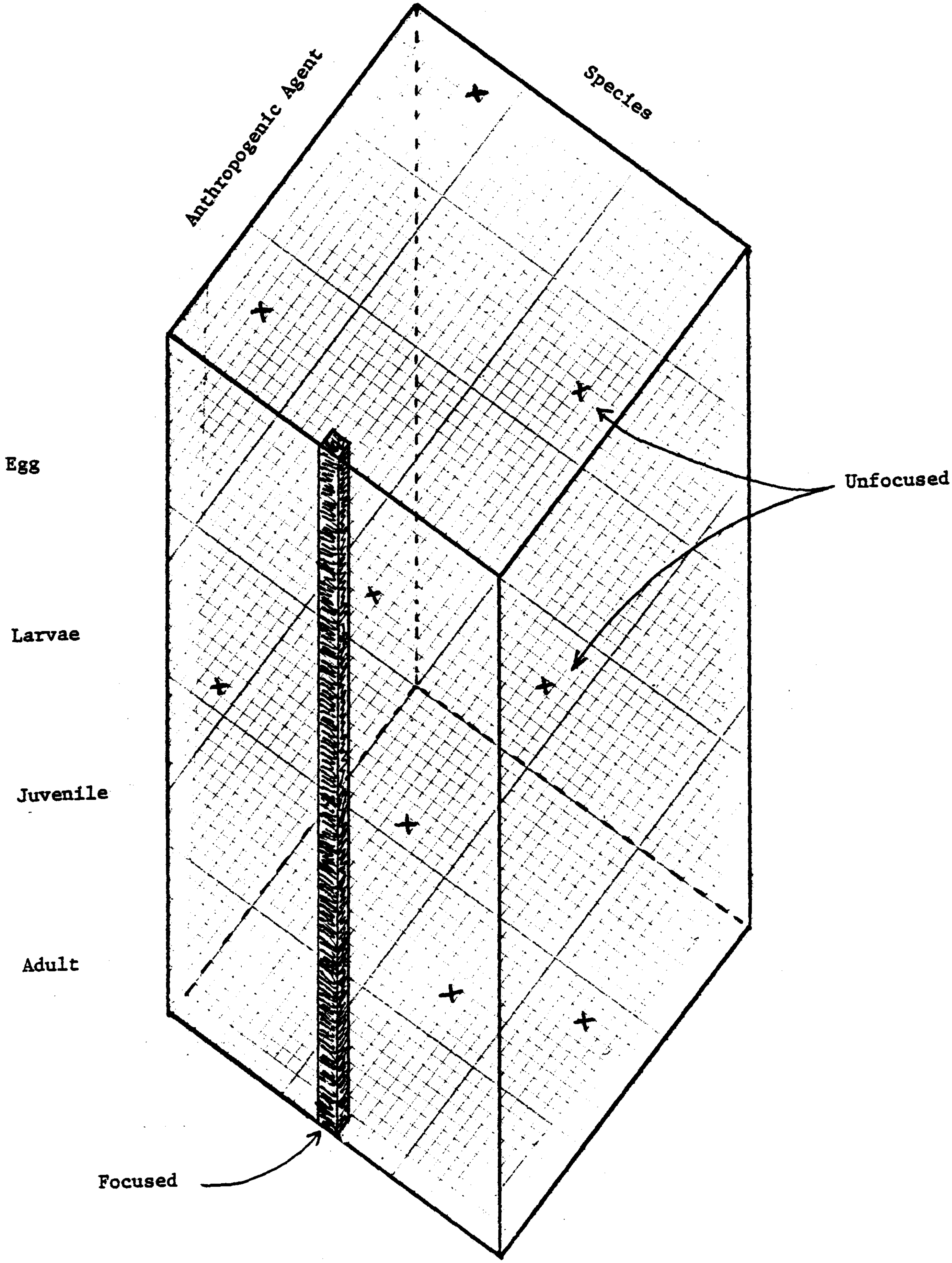

Figure 1. Three dimensional array of possible research projects with hypothetical examples of a focused and unfocused program.

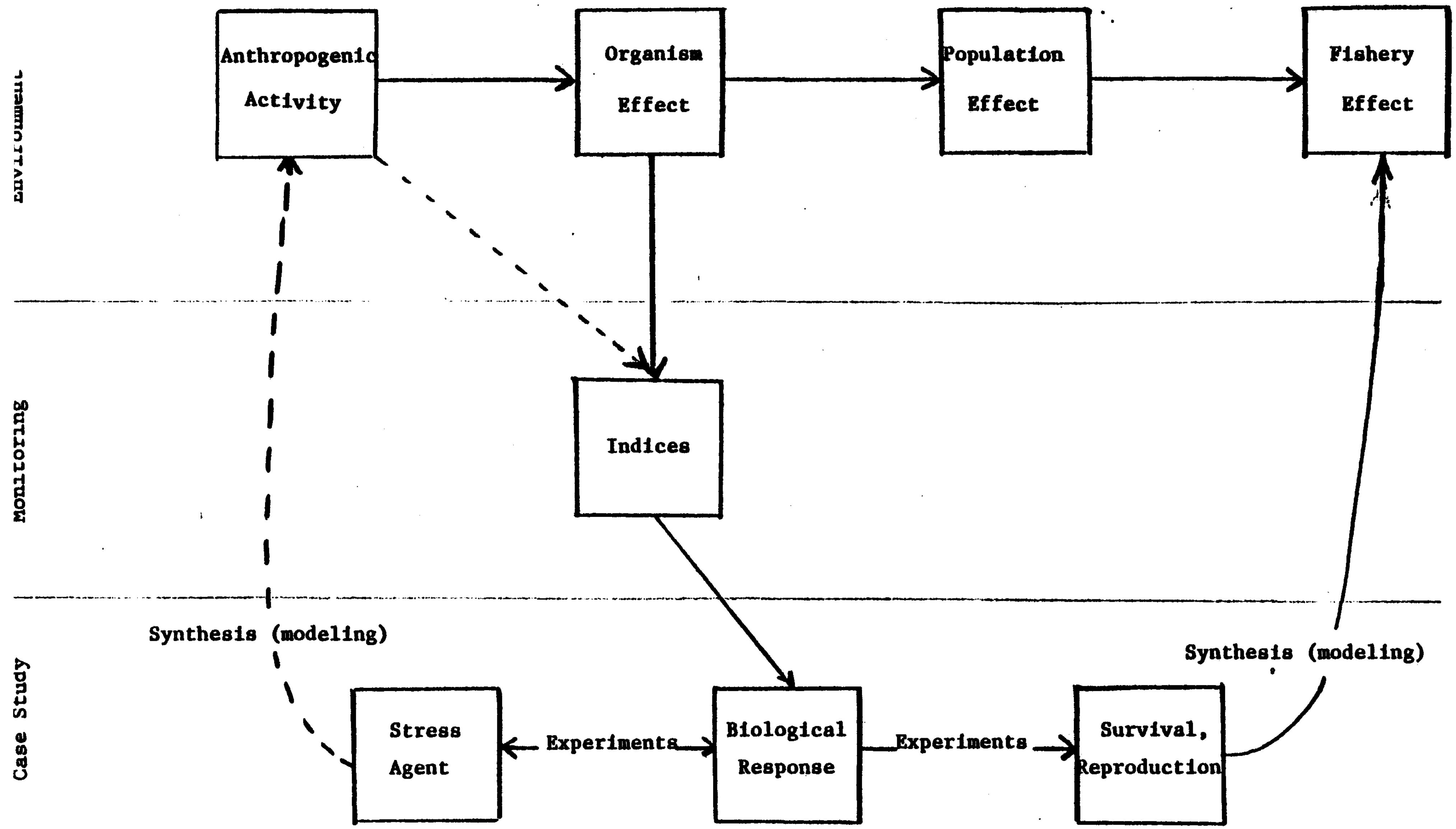

Figure 2. Hypothetical plan for habitat conservation research. Broken lines indicate activities that are beyond NEC's primary mission, therefore they should be coordinated with other agencies.

NEC Environmental Assessment Program Review

*outside reviewers

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NEC Environmental Programs Review; Sandy Hook Laboratory 6 - 7 Feb.

AGENDA

The presentations will be made by principal investigators (PI) or task leaders within NEC and selected outside contractors to the NEC and Northeast Monitoring Program (NEMP).

MONDAY, 6 FEBRUARY 1984

1130-1230	Lunch, "Deli-Style"
1230	Introduction: Sindermann, Pearce
1315	Water Column Monitoring and Research:
	Jay O'Reilly: Phytoplankton Stocks, Production and Eutrophication
1345	Jim Thomas: Seabed and Water Column Respiration; Plankton Communities; Remote Sensing
1415	Benthos and Sediments; Communities, Production. Effects
	Bob Reid: The Southern Tier
1445	Peter Larsen (Bigelow Laboratory): Gulf of Maine
1515	Contaminant Analysis
	Jay O'Reilly: Nutrients and Trace Metals
1545	Paul Boehm (Battelle NW, Duxbury): Organics
1615	Discussions/Break
1645	Biological Effects
	Tony Calabrese Fred Thurberg : Physiology and Biochemistry; Microbiology
1730	Anne Studholme: Behavior
1800:	Adjourn

TUESDAY, 7 FEBRUARY 1984

0830	Biological Effects (continued)
	Arlene Longwell: Genetics
0900	JoAnne Stolen (Drew University/NJMSC): Immunological Responses
0930	Aaron Rosenfield: Pathobiology
1000	Summary; Pearce, Sindermann
1030	Full Discussion
1200-1300	Catered Deli Lunch
1300-1500	EXECUTIVE SESSION

It should be noted that every task or subtask doing HC work in the NEC will not have a formal presentation. However, all elements will be subject to discussion.

Item 2.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Center
Sandy Hook Laboratory
Highlands, New Jersey 07732

March 13, 1984 F/NEC4:JBP

TO: Dr. Michael P. Sissenwine
Woods Hole Laboratory

Jack Pearce

FROM: Dr. John B. Pearce, Chief
Division of Environmental Assessment

SUBJECT: Comments on Your Review of DEA Activities (See Esp. SUMMARY)

I received your memo of 1 March in which you provide a review of the ongoing activities of the Division of Environmental Assessment, based on the Program Review of 6-7 February. All members of the Division appreciated the time that you and the other members of the COT put into developing the material in your memo.

You asked for appropriate responses to the summary statements for the DEA Review and I am providing these to you in this memo. My first comments will be in regard to the section on conclusions in your memo, pages 8-9. It is true that the DEA and the Ocean Pulse and NEMP Programs have demonstrated environmental effects in inshore and certain shelf habitats. It is also recognized that our past measurements provide a benchmark against which future temporal and spatial changes can be compared. It has also been determined that future monitoring can be done in a more "cost-effective" manner with resulting savings being used in experimental studies that will allow the development of models and syntheses.

It was always anticipated that some three to five years would be required for testing of the biological effects studies that had been proposed as part of a monitoring program. The ICES Workshop in Beaufort, North Carolina took note of the fact that biological effects had never been built into any existing monitoring program. The Division activities provided the basis for doing this for the first time. We are presently assessing the various biological effects monitoring studies that would be continued and eliminated from ongoing monitoring efforts! It is worth noting that a similar review is ongoing within the NOAA/OAD as well as within several ICES working groups. We have already determined that certain measurements will not be particularly useful over the long run. Certain biological effects monitoring techniques will also be conducted in the future in a research mode. As I meet with the various Investigation Chiefs within the Division to develop the future DEA programs (as requested by the Center Director at the last BOD meeting), we will include in our planning documents those activities which should be carried forward as well as those which should be conducted in a research rather than a monitoring mode.

In regard to your second paragraph, page 9, it should be noted that there are ongoing field and laboratory studies to determine the effects of contaminants on reproduction, recruitment, survival, and growth of important fisheries resources as well as principal food chain organisms. The present work being done within the benthic group includes field studies to determine how the presence of sewage sludge affects settlement and recruitment of principal bivalves species such as the surf clam.

It is also important that we begin to relate our field and laboratory biological effects measurements to changes in principal fish stocks. As you well know, this is a far more difficult problem and one that has not been successfully addressed anywhere in the world. It therefore seems important to me that within the Regional Action Plan we make the necessary adjustments so that there can be closer interface between environmental scientists that carry out their research,monitoring,and syntheses in the traditional manner with the activities of Resource Assessment scientists. Preliminary steps have been taken in this direction to identify key species that would be important in case studies. These would include the winter flounder; a pelagic, inshore recreational species such as the bluefish; and certain shellfish species. Again, as we continue our planning activities for late FY 84 and FY 85, the new ways forward will be documented in our planning materials.

In regard to your third paragraph, page 9, this Division has always put emphasis on early life history and juvenile stages. As you should be aware, much of the work done at the Milford Laboratory in an experimental mode or as part of field observation programs, has been related to gametes, larval stages, and early post-larval stages that are involved in recruitment. One has to recognize, however, that the Washington Office, Regional Offices, and numerous State and Federal agencies request information on impacts to adult organisms. The current fad of emphasizing early life history stages is an important component of a total program; it is only that, a component. We must know how pollutant effects as well as physical degradation affect the well being of adult fish; in the Middle Atlantic Bight, it is often the adult stocks that move into estuarine or coastal areas to complete various stages of their life history, including feeding, growth, etc.

The activities of the Division, Ocean Pulse, and NEMP have always focused on those effects that might have relevance to early life history or adult stages of development. Changes in physiology, biochemistry, genetic make-up, behavior, and general metabolism are all significant to survival. The task for the future has to do with integrating the various findings into an understanding of how contaminant effects are manifested in changes in populations and community structure, including all life history stages likely to be affected.

The case studies must include input from other agencies as is suggested in paragraphs 5 and 6, page 9. You mention the matter of hypoxia; at the present time, two elements of OAD as well as several elements of NEFC are presently involved in a study to gain additional insight into the development of hypoxia in the Mid-Atlantic Bight. For the first time, we are beginning to be able to model events such as run-off, stability within the water column, development of plankton populations, and other variables to understand and predict the onset of hypoxia. As has been noted during the recent Program Review as well as during previous NEMP reviews, we are moving into a position where we can model the sources, fates and effects of contaminants.

As has been noted previously, there has been a relative paucity of environmental data which could be used in developing appropriate models. Because of the recent findings and data gathering done by this Division, we are now able to "model" a number of systems. It is of interest that during the past two or three weeks the U.S. EPA and Congress have taken steps to end ocean dumping based almost exclusively on past findings of the Division and the Northeast Monitoring Program. The U.S. EPA has used the findings from our studies in a descriptive model which demonstrates impact in the 12-mile zone and permits comparison of the 12-mile dumpsite with possible effects at the 106-mile site. This is a very concrete use of our past data in terms of a "model".

Finally, the RAP process is being used to develop water management unit descriptions which will involve statements of habitat requirements for principal fish. These documents, used in conjunction with the results of long-term monitoring and research, will allow us to develop the hazard assessment documents which are essential in terms of developing cost benefit statements for management decisions. As you note in your final paragraph, there has been a significant amount of good research and monitoring and there is an ongoing commitment to problem identification and planning. This has always been part of the Northeast Monitoring Program and has been emphasized through the years as programmatic adjustments have been made as required. As you are aware, under the former Center Director, the emphasis for monitoring and research was towards the outer continental shelf. New directions within NOAA, the NMFS Washington Office, and the Center Directorate, suggest that it is important to conduct future monitoring and research in those areas which have been demonstrated as being affected. These are basically inshore areas as well as certain estuarine systems. Our plans have already resulted in increased efforts in such areas with habitats such as Casco Bay and Penobscot Bay now being censused to develop background information that will form benchmarks for future assessment. There is no doubt that an effective program is in place and that adjustments will be made to allow us to continue to monitor at lower cost with additional emphasis put on research and syntheses that will lead to the development of effective hazard assessments.

In regard to your section on page 5, what have we learned?, I believe that there is a far larger data base which is being used regularly for important management decisions. The four paragraphs that you provide include highlights of some of the recent findings, but I do not believe that it represents the totality of significant findings or generalizations that can be made from the data base which exists. As your note in paragraph 2, page 4, the various benchmarks will be far more important in coming decades. One of the problems in the past has been that proper assessments could not be made because there were no broad scale, long-term benchmarks. Much of the information which we presently possess allows us to talk about variability in things ranging from biochemical responses to community structure.

In regard to NEC responsibilities for Environmental Assessment research (see page 5), it should be noted that indeed there is a new habitat conservation policy. Beyond this, reasonable management would require that periodically there be reviews which would form the basis for prioritization of ongoing or future research activities. It must be kept in mind, however, that data needs vary with time, often with very sudden shifts in emphasis being made. This can be seen in the recent PCB problem where suddenly the Washington Office is extremely concerned about having information on PCBs in finfish and shellfish which can be used to develop the basis for assessments and future planning. The same is true for many other "sudden" environmental events which are elevated to National levels.

It is therefore important that we try to anticipate what our various data needs will be in the future, based on both past experiences as well as projections into the future. At the same time that we are doing this, we must emphasize the need for certain internal flexibility which will allow us to address unforeseen problems that relate to living marine resources as these are affected by man's activities.

Under the section on concerns (see page 5), it is important to have an understanding that infact much of the past research activities have had a central focus. Numerous groups within NOAA, NMFS, and other Federal and State agencies, have looked at problems such as ocean dumping and have recommended that NMFS conduct certain studies in areas which receive discharged waste. Studies ranging from analyses of contaminants through time to changes in benthic community structure have been done. The various data sets do inter-relate and are used in a focus manner. The important thing is to continue to focus our various data sets so that appropriate assessments can be made and documents produced. Your list of activities as it was given at the foot of page 5, is relatively complete; actually more activities could be added if one wished. However, the various measurements of a range of contaminants and the various components of the biota which were studied, were all deemed to be essential to understanding environmental impacts. Some long-term planners would believe that in fact, additional elements should be measured. The thing missing from past research was the connection between components of the environment which were measured and effects on populations of interest to man!

You use the case of benthic community studies as an example of inadequate or lack of coordination: in fact, the activities which you note (those by Reid, Steimle, MacKenzie and Larsen) are all inter-related and tend to be focused. Bob Reid has had responsibility for studying long-term impacts on the benthos of the Middle Atlantic Bight. Through contracts we have had investigators studying Delaware Bay and the areas off of Chesapeake Bay, again to establish benthic benchmarks and changes in these through time. This was a decision that was made at the urging of the previous Center Director who believed that much of our environmental assessment should be done through contract. Studies by Steimle have augmented work that was done at the University of Delaware to ascertain how pollutant effects impact on secondary production within the benthic communities being studied by Reid and others. Clyde MacKenzie has carried on special studies, but again closely tied to the ongoing benthic assessments, which emphasize how sludge and other contaminants interfere with settling, recruitment, and growth of important bivalve species. Dr. Larsen has conducted studies in the northern parts of the Gulf of Maine which would have required expensive cruise time for our own people to be involved with. He has used methods identical to those being used by Reid and other benthic investigators that are conducting work under contract with the Northeast Monitoring Program. The various data sets are comparable, are being used in an integrated fashion, and are essential to the development of benchmarks for those habitats that the NEFC has responsibility for within the Northeast. Extensive correspondence in which various states, agencies, and the public are interested in our data, are maintained on file at Sandy Hook. There are obviously numerous user groups that are making decisions based on the existing data.

Your statements about RAP are true; it has taken a long time to develop a concensus about what the respective roles of the Region and Center should be. Again, as you are well aware of, there has been exceptional friction between the Region and the Center in the past. Hopefully this period of contensious behavior is over,and we have seen significant improvement in terms of planning for long-term environmental studies within the RAP program.

In regard to your statements about NEMP on page 6, this perception is based on a lack of understanding of how the various components of NEMP have interacted in the past. The Northeast Monitoring Program was set up to address problems related to monitoring. In 1979 it was mandated by the NOAA Directorate that there be a formalized,single monitoring program, NEMP. At the same time, elements of NOAA (the then OMPA program) were asked by Congress to develop a series of indices which would demonstrate unreasonable degradation. Even though NOS had been given the lead, scientists from NEFC have played a major role in formulating the indices and are presently involved in testing and assessing actual applications of the indices. If anything, this shows significant interactions between two major NOAA LOs. Thre are numerous examples of cooperation between the various elements of NOAA and there has been effective progress with various groups working together, even though there has been no structure to provide the basis for cooperative activities. NEMP is one of few examples of a cooperative program between one or more NOAA LOs.

In regard to the <u>specific concerns</u> that you expressed, I must agree that much of the effort to date has been involved with demonstrating biological effects at the species or individual level, with reasonable amounts of our findings relating to changes in populations and communities. A far greater emphasis must be placed on understanding how man's activities impact on principal fisheries. This will probably have to be done initially with shellfish and those finfish species which are resident within restricted areas. Eventually, however, <u>generic effects</u> should be found which would be applicable to highly migratory species which have extensive ranges of distributions.

In regard to models and hazard assessments, we should move in the direction of attempting to show through modeling efforts that effects on one component of an ecosystem can be felt throughout other elements of the same ecosystem. It is also important to be able to model the consequences of contaminant effects on individuals in a way that would allow assessments to be made of populations. There are a range of models and we should look at those existing models (the Spaulding and Reed model) which have shown some degree of efficacy in demonstrating pollutant effects or distributions and fluxes of contaminants in coastal environments.

In regard to items of concern, 3-13, I will provide brief responses as follows. In national and international meetings, we have addressed the problems of how best to conduct sampling. We have looked at such things as fixed versus random stations; we have also attempted to address matters such as replicate sampling; frequency of sampling in time; etc. These activities,and decisions taken,can be documented and justified.

In regard to concerns 4 and 5, there have been numerous regional and annual reports which have been prepared by the Division and NEMP which transmit information to users. The effectiveness of these reports can be demonstrated by the fact that the requests for them have generally outstripped us of all supplies of the reports within a matter of a few weeks. Large numbers of groups are using our reports on Casco Bay, the New York Bight, PCBs in Fish, etc. for decision making. Again, this can be demonstrated through our correspondence files. In regard to item 5, levels of laboratory exposures, I can assure you that the concentrations that have been used in experiments being done at Sandy Hook, Milford and Oxford are levels which have been demonstrated to have effects in the field. Generally, people that are involved in biological effects bioassays and laboratory exposures, use levels of contaminants ranging from those levels which show no effect to those levels which are lethal. By bracketing within the range of levels of contaminants, it becomes possible to project the results in terms of hazard or risk assessments.

In regard to concerns 6 and 7, it should be noted that within the frame work of biological effects monitoring, steps should be taken to show cause and effect. Both ICES and GESAMP have recommended that laboratory studies be done with various contaminants found or known to be "part of"wastes such as industrial wastes or sewage sludge. Obviously, if sludges and a range of wastes are to be managed effectively, one must know the components within the waste which cause effect. Again, it would be impossible for NEFC to conduct such research alone; we must depend upon the literature for a fair amount of information as to which contaminants have specific effects. Our research should focus in areas where others are not making such evaluations in regard to particular contaminants or exposure conditions. As has already been noted, we do work with early life history stages as well as adult developmental instars or stages. Incidentally, fish eggs and larvae are not necessarily always the most "fragile" stage. In numerous instances, the adults are affected in adverse ways prior to impacts on the eggs and larvae of the same species. The latter often have special protective mechanisms to insure their development within the habitats.

In regard to concern 8, there has been a raging argument as to the importance of the coastal zone and estuaries in terms of the life history of many marine species. I think what is quite clear is that the coastal zone and estuaries are areas that are utilized by many commercial and recreational species. It is true that the past thinking within the NEFC has been that areas such as Georges Bank, represent the more important habitats for fish. Those people studying fisheries biology within the Middle Atlantic know that most of the species within this area are dwellers within the coastal zones or estuaries. In any case, the effects,seen to date, seem to be principally in inshore areas. It should also be noted strongly that from a historical point of view, absolute degradation was first seen in areas such as Newark Bay and have over the last few decades, spread slowly seaward to the point where many habitats in the open ocean have been demonstrated to be affected by contaminants.

In regard to concerns 9 and 10, I would emphasize that Center studies should be of effects on resource species with human health hazards and an understanding of these being incidental to the first objective. We should also clearly understand that there have been numerous instances in which physical oceanographers have worked with Center scientists both within the Division as well as within the Northeast Monitoring Program. Dr. Tom O'Connor and others within NOS have been involved with developing oceanographic data to models and to assess how contaminants are spread from dumpsite or point discharge situations. Mert Ingham has been involved in the Northeast Monitoring Program since its inception in 1979, and has contributed extensive information that is of value in understanding sources, fates, and fluxes of contaminants. His participation in the assessments of the 106-Mile Site as well as in the understanding of the development of hypoxia, are well known.

Concern #11 is an important one; early on, Dr. Longwell was asked to look at a number of systems involving changes in genetic structure to form the basis for future long-term environmental monitoring. She has, given the resources that have been available to her, looked at several tissues in order to make decisions as to which might represent the best way forward in terms of biological effects monitoring. Her recent work using micronuclei, has been deemed to be extremely significant and permits the assessment of effects of habitat deterioration on both juvenile and adult individuals and, perhaps, populations.

Dr. Longwell is presently making the determination as to which of the techniques used to date would be the best to use in a long-term monitoring program. As has already been mentioned, the Northeast Monitoring Program had as a principal mission, the testing of different techniques during the first five years of program development. In the same way (concern #12), there has been a continuing effort to identify various types of indicators of biological stress. Since these techniques have never been used in a formalized way in long-term monitoring and research programs, it was only deemed important to see which ones would have the greatest degree of efficiency in terms of assessments on populations. We are reaching the point where we will be dropping various tests,using others to conduct our long-term monitoring efforts.

Finally, in your concern #13, page 8, you question the use of species composition of benthic and phytoplankton communities as a technique to show anthropogenic effects. The reason that these techniques have been used is that they offer a possibility of showing impacts on populations and community structures. Such impacts might then be used in a generic fashion to show impacts to other resource species. As has been noted in your document and the present memo, impacts on populations and communities are of greatest importance. It is important to have documentation of the build-up of contaminants in habitats; the ultimately important thing is to understand how these effect populations and communities, especially in terms of reproduction, survival, and growth. It is true that we must focus our attention on how contaminants effect various components of the food webs which lead to fish or shellfish of concern to man. Our work in secondary production and bethic studies, has emphasized the importance of understanding how changes in benthic community structure might affect fish populations and, in turn, might also result in changes in the way in which contaminants are magnified within biological systems. We do have a frontal impact on this matter and this has been part of our ongoing work.

SUMMARY

The foregoing lengthy memo has attempted to address item by item those issues which you found of concern based upon the program review and subsequent discussions. The Division of Environmental Assessment and the Northeast Monitoring Program, have long understood the necessity for translating our environmental measurements, be they of contaminant levels in sediments or changes in biolgical responses within individuals, into information which can be used to assess impacts to populations of concern to man. We are also interested in developing documentation in the form of hazard assessments which will allow managers to make better evaluations of effects of a range of man's activities, especially in multiple-use situations. There is little doubt that mankind will use estuaries, coastal and shelf waters, and even the deep sea for a range of economic purposes in coming decades. We must have in place, proper benchmarks that can be used to assess how man might effect fishery resources where several kinds of economic activities are being carried on simultaneously. The data that have been gathered to date, already permit comparisons to be made and are beginning to be focused so that hazard assessments can be developed. This is an entirely new endeavor and will require a certain amount of time. Nevertheless, given the resources that we presently have available to us, we should, through programmatic adjustments, be able to provide the kind of information that is being demanded by managers, judicial systems, and a range of Government agencies.

Again, I emphasize the importance of relating environmental changes to the fish stocks and the development of hazard assessments. Figure 1 indicates the way in which I would see the Division and its various activities being developed in the future. It shows a separation of monitoring and "quantification" activities, both of which provide information that is essential to synthesis efforts.

DIVISION OF ENVIRONMENTAL ASSESSMENT (DEA)

MANAGEMENT

ENVIRONMENTAL HEALTH

- Selected contaminant levels at limited stations

QUANTIFICATION

- Field and experimental: Studies of effects on recruitment, growth, and survival
- Sublethal effects
- Case studies (examples: striped bass/bluefish, winter flounder, New Bedford PCBs, hypoxia

SYNTHESIS

- Integration of all available historical data
- Planning
- Risk assessments
- RAP-WMU documents
- Problem/issue solutions
- Cause/effect relationships
- Formatting/packaging of data and analyses
- Relationship of degraded habitats and population effects

Item 3.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ENVIRONMENTAL RESEARCH LABORATORY
SOUTH FERRY ROAD
NARRAGANSETT, RHODE ISLAND 02882

March 12, 1984

Dr. Michael P. Sissenwine
National Marine Fisheries Service
Northeast Fisheries Center
Woods Hole Laboratory
Woods Hole, Massachusetts 02543

Dear Dr. Sissenwine:

This is with regard to my participation as an outside reviewer at the NEFC Environmental Program Review at the Sandy Hook Laboratory on February 6-7, 1984. You initially suggested that my participation in the review, and my oral comments, would be sufficient to satisfy your needs. After some reflection, I have decided that it would be best to provide you with written comments as well. These comments appear below and consist basically of a summary of my remarks at the review.

I wish to stress that my comments are primarily programmatic, and are not intended to constitute a scientific peer review of the NEFC Environmental Program. A great deal of material from many different scientific disciplines was presented in summary form during the two-day review. I understood my charge to be the evaluation of this work in relation to the NMFS Habitat Conservation (HC) goals, objectives, and policy. The NMFS HC Program is directed primarily at the health of the fishery resource and the health of the habitats. Information is needed for informed environmental decisions on multiple uses of these habitats.

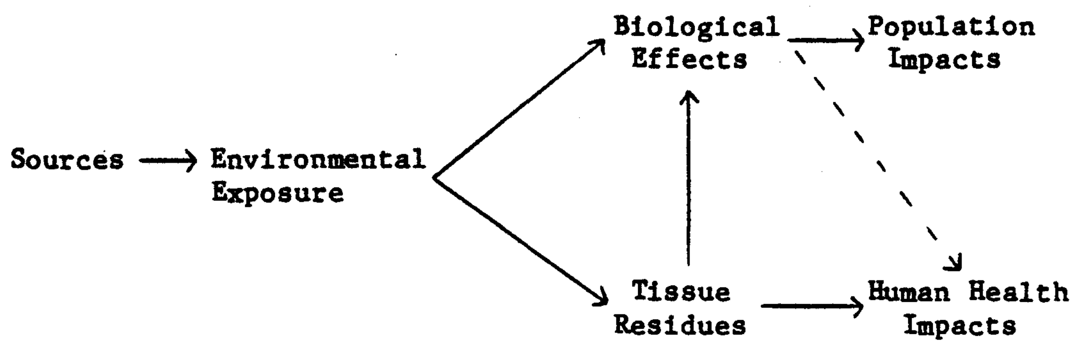
General Comments

Much descriptive information on baseline conditions has been obtained for the coastal and offshore waters of the northeastern United States. The primary emphasis to date has been on data collection, as opposed to data organization, interpetation, and synthesis. Most of this information is not in a form which can provide the technical basis for management or regulatory decisions. Few systematic attempts have been made in the program to separate effects due to anthropogenic inputs from effects due to natural environmental factors. Most of the conclusions presented with regard to causative relationships were based on simple inferences from field data, combined with some basic generic understanding of the processes involved.

The program lacks an overall conceptual strategy to provide clear objectives, and a framework for organizing the research work and synthesizing results from individual projects. The overview presented by Dr. Pearce included discussion of hazard and risk assessments, and emphasis on contaminant sources, fates, biological effects, and ultimate impacts on fishery resources. This overview contained a basis for a potential strategy, however, this appeared to be a recent development in the program.

This strategy had not been used to plan the original work, nor as a basis for organizing the individual presentations. The proposed strategy is promising, however, and it should be developed further.

A suggested development of this research strategy is the following:



Environmental exposure refers to contaminant concentration distributions in space and time, in the water column and sediment compartments. Exposure should be considered in terms of intensity, duration, and frequency. Biological effects can be considered according to a hierarchy of different levels: biochemical, cellular, tissue, species, population, and community. These effects can have population impacts on the fishery, or impacts on human health through, for example, transmission of disease. Tissue residues can be considered to have human health implications through U.S. FDA Action Limits, or to have direct effects on the organism itself.

Most of the biological effects information presented in the review was of a descriptive nature. While this information is necessary, it does not, by itself, provide the basis for regulatory actions. In the case of a threat to the fishery or the habitat by a contaminant, a regulatory action can not be directed at the biological effect itself, but must be directed at the contaminant which is causing the biological effect. The causal chain must be established from the contaminant source, through transport and fate of the contaminant in the environment, to the observed biological effect. Only in this way can the contaminant be implicated as a causal factor, and the required degree of control determined.

Another aspect of this causal chain is that results for each of the links must be expressed in compatible and quantitative terms. There must be quantitative linkages between sources and environmental exposure, and between environmental exposure and biological effects. Ideally, these linkages should be deterministic, however, the complex interactions among environmental and biological factors frequently preclude such an approach in practice. In any case, research programs should emphasize development and validation of testable hypotheses, and rigorous statistical designs of laboratory and field experimental protocols.

An important objective of biological effects research should be to develop linkages between tests at lower levels of biological organization (e.g., biochemical, cellular, tissue) and tests at higher levels (e.g., species, population, community). If the ultimate objective is environmental protection at the population level, there should be a clear rationale for conducting research at lower levels of biological organization. Tests at lower levels should be developed either as predictors of higher level effects, or as cost-effective indicators of higher level effects.

Specific Comments

Results presented for water column monitoring of nutrients included only dissolved available forms. These data by themselves are of limited value. Total nutrient forms should also be measured. It is not possible to conduct mass balance studies, or studies of nutrient cycling using only dissolved available nutrient concentrations.

Information was presented on the use of remote sensing imagery within the program. The objectives of the remote sensing work need to be coordinated more closely with those of the other proejcts. Remote sensing can be an extremely useful tool, however, without good planning, it can become merely a solution in search of a problem. Remote sensing images themselves are of limited utility. Emphasis should be placed on sea/ground truth within a quantitative context. Remote sensing can be used to do the following: first, the feasibility of spatial interpolation between field data points can be investigated using imagery corresponding to existing cruises; second, large scale water mass characteristics and movement can be investigated, and correlated with measurements of temperature, salinity, and wind speed and direction; third, land use categories associated with measured amounts of non-point source loadings can be identified. With regard to coastal zone loading, it should be pointed out that contaminant/nutrient inputs must be directly measured. Remote sensing is not a substitute. Remote sensing can only be used to identify large scale plumes and runoff events, and to characterize land use categories, as indicated.

There was no apparent coordination in the benthos and sediment work between the Gulf of Maine and the Southern Tier. Work in the Southern Tier was characterized by an awareness of a larger strategy, and an attempt to organize the results within a systematic framework. The Gulf of Maine work was almost exclusively descriptive and seemed to lack a sense of direction at a clear set of objectives.

Information was presented on contaminant distributions, including metals and organics. This information was primarily descriptive, although an argument was made for use of testable hypotheses in designing future field sampling programs. The important point was made that the water column should be included in these studies not just the sediment and biota. The water column is important because, although the ultimate fate compartment for many contaminants is the sediment or biotic tissue, actual transport to these ultimate compartments is largely via the water column. Furthermore, the transport of contaminants depends on their phase distribution between dissolved and particulate forms. These should also be determined in the water column.

An extensive amount of information was presented on biological effects. This included biochemistry, physiology, genetics, microbiology, behavior, immunology, and pathobiology. My principal comments on this work are: first, the observed biological effects need to be better-related to contaminant exposures and natural environmental factors in order to be useful; and second, effects at these levels of biological organization need to be better-related to the population level in order to provide a technical basis for assessing impacts on the fisheries. See my general comments above.

Although automated data processing (ADP) was not discussed on the formal agenda, I feel obliged to offer a comment. It is my understanding that there is no central data base management system which serves the Northeast Fisheries Center of the NMFS. I am aware that there is an ADP services contract with WHOI, however, I am told that not all of the NEFC data has been (or will be) put into this system. I wish to stress the importance of a unified data base management system to an operation as extensive as the NEFC. Such a system should include flexible storage and retrieval capability, and comprehensive statistical and graphics capability. This support effort should be directed by a core group of NEFC professionals who are familiar with the program mission and objectives. Outside contractors should be used only for support purposes. Such a system is essential for better program coordination and closer collaboration among individual principal investigators, especially in an organization with a number of different field sites.

Proposed Approach for Future Work

I suggest that NEFC consider the following broad approach to future program planning:

1. Use the existing data base to identify the most important technical issues in terms of threats to the fishery resources and habitats. Initiate an intensive, site specific case study (studies) directed at these issues.

2. Use the existing data base, and various statistical methodologies such as trend assessment and optimal sampling techniques, to determine space/time scales and sampling frequencies for future monitoring efforts. These efforts should be designed to detect statistically significant trends at prescribed confidence levels. Strong consideration should be given to monitoring particular regions on an annual rotating basis, as opposed to monitoring all of the coastal and offshore waters each year.

A site specific case study is an excellent vehicle for providing a strong focus for multidisciplinary studies which involve large numbers of investigators and institutions. It is also a very effective way to address significant technical issues, and to provide a framework for development of results which can be used for management and regulatory decisions.

Regional monitoring on an annual rotating basis might be considered a logical evolution of the NMFS monitoring program in the northeastern United States. It would appear that a sufficient data base has been collected to define baseline conditions, and that future efforts might be directed toward long-term trend assessment and monitoring of "hot spots", or areas with special problems. There is a precedent for this basic approach in the Great Lakes International Surveillance Plan.

I hope that these review comments are helpful in future program planning within the NEFC. I enjoyed the opportunity to be involved in the program review. I would be pleased to discuss any of these comments if there are questions, or if you feel that further discussions might be helpful in developing your final report.

Sincerely yours,

Victor J. Bierman, Jr.

Victor J. Bierman, Jr., Ph.D.
Environmental Scientist

cc. R. Hennemuth
C. Sindermann

Item 4.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Washington, D.C. 20235

F/S1:ADP

February 21, 1984

TO: F/NEC - Allen E. Peterson, Jr.

FROM: F/S - Joseph W. Angelovic

SUBJECT: Review of the Northeast Fisheries Center Environmental Program

I appreciated the opportunity to participate in the recent review of your Center's environmental program. Both George Knobl and Dean Parsons also extend their thanks. We were pleased with the scientific quality of the program presented and by the presenters themselves. Your staff appeared to be prepared and were adept in answering questions. In addition, please convey my thanks to Mike Sissenwine, Carl Sindermann, and Dick Hennemuth, who organized the review, and to Jack Pearce and Carl Sindermann who clearly stated what questions should be addressed and answered by the participants.

General Comments

The presentations appeared to be taken out of context, i.e., there was no discussion of a working hypothesis for the program, and hence no indication as to how the individual components would assist in testing that hypothesis. This resulted in what appeared to be a lack of cohesiveness which suggests that the program should be pointed more specifically toward solving a problem. I also found the format to be somewhat stifling. The presentations were made much as if they were a series of seminars, and the request to delay substantive questions resulted in a much less spontaneous exchange of ideas between the presenter and those asked to review the program. More time was needed to allow a thorough examination of the program.

Specific Comments

1) The NEMP "plan," while stating several general objectives, is not really a plan in that it presents no milestones or timetables to achieve those objectives.

2) The biological research presentations tend to focus on the individual response of organisms to a pollutant, and not on effects to a population or to a fishery. An environmental program should be a balance of both, with any responses noted at an organism level leading to examination of potential population fishery effects.

3) From the discussions during the meeting, it appears that there is some uneasiness in having NOAA/NMFS assume a greater role in what many view as EPA's legislated responsibilities. This concern applies to the increased emphasis some elements within NOAA have demonstrated recently regarding the routine monitoring of pollutant concentration and distribution. This is best exemplified by the recent "status and trends" initiative developed by OAD. With such emphasis within NOAA, one becomes concerned that large-scale monitoring of inorganic and organic pollutants may be done at the expense of good investigative research on the living marine resources.

4) An important element in helping to shape an environmental program are the users of that information. Other than the presence of individuals from the Northeast Regional Office and the Mid-Atlantic Fishery Management Council (two of the most important users of environmental data), there was no indication of any attempt to systematically build into the environmental programs the kind of research these users need to answer their specific concerns. To satisfy this requirement, I would urge that both the Regional Action Plan Process (RAP) and the Habitat Policy be considered the principal vehicles to proceed toward this end.

5) The informational requirements of users usually spur, in addition to research, certain analytical and synthesis work efforts on the part of a research Center. Because Washington Office representatives serve on the Regional Action Plan Board, they are especially cognizant of the many positive contributions members of the Environmental Program have made toward Regional Office issues,by assisting in analysis or synthesis of issues. Perhaps these kinds of activities should also be part of any Center program review in order to obtain the most comprehensive appreciation of the full value of a program.

6) Finally, the questions stated by Jack Pearce and Carl Sindermann were not really considered nor answered by the participants.

Al, please take these comments in the manner given, that is, we mean them to be constructive criticisms, not just Monday morning quarterbacking.

Item 5.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Center
Sandy Hook Laboratory
Highlands, NJ 07732

February 22, 1984 F/NEC4:CJS

TO: Allen E. Peterson, Jr., Director, F/NEC
Woods Hole, MA 02543

FROM: Carl J. Sindermann Carl J. Sindermann
Asst. Center Director for Environmental Management

SUBJECT: Comments on Environmental Assessment Division Program Review, 6-7 February 1984

During the EA Division review a number of hard but reasonable questions were asked by you and by others. I am sure that you have received comments from others; I want to summarize some of my thoughts. They are listed under five topic headings:

I. Why NEFC is in the habitat business.

The rate of change in coastal/estuarine fish and shellfish habitats accelerates as the United States population shifts more and more to coastal zones. These environmental changes seem associated with localized changes in fish and shellfish stocks, but evidence for direct association is weak or lacking. That evidence must come from a combination of long-term monitoring, research on species and areas affected, and continuing attempts at synthesis of available data. Only the federal government has the resources to carry out such a program, although states should be enlisted as cooperators.

II. What NEFC should be doing in habitat research.

Habitat research in NEFC has examined natural as well as man-induced environmental factors, and a good data base exists. Furthermore, we have a good long-term data base for major commercial fish stocks. Much of this work, especially the monitoring of stocks and environmental conditions, should continue at least on some minimal basis, as a core program. Additionally, greater attempts at syntheses of all available data oriented toward particular high-priority users, should be made. Also the existence and extent of possible fish and shellfish population changes as a consequence of pollution should be examined through species or site specific case studies (examples would be striped bass, bluefish, flounders, mackerel, oysters, eutrophication/anoxia).

III. What NEFC can expect to get from its habitat research

Monitoring (which is a form of research) will provide information about changes in fish stocks and habitat. Proposed emphasis on synthesis of available data should provide an interim base for management decisions about important environmental issues such as ocean disposal and industrial non-point-source pollution. The syntheses will also indicate deficiencies in currently available data. The case history studies should provide a quantitative examination of circumscribed problems, and should give a better assessment of pollution effects on resource species.

IV. How NEFC habitat research relates to fish

Survival of individual fish, and abundance of fish populations, seem directly related to effects of environmental factors--either natural or man-induced (including predation, disease, starvation, abnormal hydrographic conditions, and pollution). Stock assessments are important activities, but assessments should be supported by understanding the causes of population fluctuations, as a necessary base for prediction of changes and for effective management. NEFC has ongoing habitat research--addressing natural and man-induced causes of fluctuations in fish and shellfish stocks--to integrate with ongoing resource assessment work, and to provide a measure of understanding of causal factors.

V. How NEFC habitat research relates to Regional needs for environmental data.

The Environmental Assessment activities of the Region (inputs to environmental impact statements, comments on habitat modification proposals, habitat improvement measures, etc.) require the best and broadest available data. These data related to living resources have been generated and will be generated primarily by NEFC habitat research (although other data sources exist). With the gradual emergence of the Regional Action Plan process, we have, finally, an effective joint communication and action system for Center and Region. Part of the success of the RAP depends on strong, reactive, habitat research, including the long-term NEMP monitoring program.

Item 6.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Center
Narragansett Laboratory
South Ferry Road
Narragansett, Rhode Island 02882

DATE: March 12, 1984

TO: Michael P. Sissenwine, Assistant to the Director, NEFC

FROM: Kenneth Sherman, Chief, Marine Ecosystem Division

SUBJECT: NEFC Review EAD Activity

We are now at an important crossroads in a relatively new scientific discipline, and therefore it is appropriate to review our collective approach for developing and supporting the most appropriate science that will lead to increases in marine biomass yields. The expertise within NEFC is expected to maintain an awareness of how the best science can be brought to focus on key issues and forge new breakthroughs. Symposia are an effective means for assessing progress and examining direction. They are an especially useful means for sorting out research directions. NEFC has been instrumental in convening three Fisheries Ecology Symposia where significant conclusions confirmed our independently-derived conclusion that a full understanding of the process of recruitment is essential to improved fisheries resources management. We were also conveners of yet another symposium on the early life history of fish, where a focus on recent studies uncovered significant deficiencies in contaminant-effects studies, and emphasized the need for improving the situation through properly focused studies. Unfortunately, NMFS does not measure up on this account. The approach to date has been on the use of tractable surrogate species in toxicity-exposure studies. The exposures have most often exceeded expected environmental levels to ensure publishable results and deal with the "easy" problem first. The difficult problem involving the establishment of linkage between in-situ levels of contaminant loadings, and impact on the surrogate species, and a population-level response has yet to be demonstrated. This is difficult enough. However, the wide use of surrogate species (e.g. Fundulus) makes the results virtually useless in meeting NEFC objectives. Now that we are in the process of programmatic introspection, it is appropriate to address this issue, particularly with regard to contaminant impacts on the sensitive early life stages of marine resource species. As pointed out in your 1 March memo, the diffusivity of NEFC approach in dealing with actual and potential environmental impacts on fisheries resources is producing less than expected. The 13 examples cited are symptomatic of the shotgun approach to the problem. We concur with your conclusion that a more cost effective plan is needed with emphasis on " . . . monitoring, experimental studies and synthesis." We are cognizant of the deficiencies in contaminant effects studies on early life stages. The appropriate studies have simply not been conducted as an integrated part of holistic fisheries ecology research.

Within NEFC, the beginning that we have made in contaminant effects studies as part of our ichthyoplankton ecology program has proven promising.

particularly on striped bass. We, in fact, proposed the kind of study consistent with the scheme in your figure 2 to OMPA in 1983 at their request. But we were advised by the Center to hold the document until funding was transferred into the NEFC base at the Washington level to avoid the "reimbursable-syndrome." Unfortunately, we have not been successful in obtaining the necessary NOAA funds for moving forward in contaminant studies. WHILE WE ADVOCATE THE IMPORTANCE OF THESE STUDIES, WE RECOGNIZE THAT IT IS ESSENTIAL THAY THEY BE DONE AS AN IDENTIFIABLE AUGMENTATION TO THE RECENTLY REDIRECTED RECRUITMENT STUDIES WITHIN NEFC.

We concur with your conclusion that the early life stages are most sensitive to environmental contamination and degradation. Furthermore, we are prepared now to participate in the planning effort and get-on-with-the-job. Attached for your review is our concept of how best to move ahead in a refocusing of contaminant-related early life history fisheries research.

jm

cc: D. Busch
J. Casey
C. Griswold
M. Grosslein
G. Laurence
D. Mountain
W. Smith

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Northeast Fisheries Center
Narragansett Laboratory
South Ferry Road
Narragansett, RI 02882

DATE: March 9, 1984

TO: Kenneth Sherman

FROM: for Geoffrey Laurence
G. DeLofa

SUBJECT: Pollution Effects Studies of Early Life History Stages

MED is concerned and interested in the problems associated with anthropogenic activities on fishery resources of the northeast coastal region. It is important to emphasize a focus on finfish species and, in particular, those life stages considered most susceptible to pollutant effects. General scientific opinion is that the early life stages of eggs, larvae, and juveniles are the most sensitive. Research components within MED have an acknowledged expertise of working with and determining mortality factors of these early life stages. In fact, pollution-related research has and is being conducted by MED in cooperative studies with USFWS and NOAA-NOS, respectively.

It has been advocated that a research approach consider case studies identified by species, and that these species should be identified by fishery-economic value and association with degraded areas. Striped bass and winter flounder are considered prime candidate species. MED has demonstrated research expertise and capabilities in aspects of early life stage research of growth, mortality, and pollution effects for both of these species.

MED proposes to conduct experimental and synthesis research of pollution effects on the egg, larval, and juvenile stages of striped bass and winter flounder. The studies should be coordinated and funded within the purview of approved NEFC environmental assessment activity. The research will require personnel and budget considerations including reassignments and prioritization as well as inter-Divisional and inter-Investigational cooperation.

The most expeditious plan would be interaction and cooperation between the Larval Dynamics (Early Life Stage Dynamics) Investigation of MED and the Physiological Effects of Pollution Stress Investigations of EAD at Milford. This would bring together the appropriate research expertise in early life stage biology, culturing techniques, physiology, energetics, and biochemistry. This effort would need to be augmented with funding and personnel, in particular with a bioassay biologist, an analytical chemist, and 2 junior biological technicians. The support of a strong analytical chemical facility capable of accurately measuring trace elements, petroleum hydrocarbons, and synthetic organic compounds in both water and tissues is also necessary.

This program should be basic and long-term in scope designed to monitor not only the obvious lethal effects of various pollutants, but also to monitor sublethal consequences and to understand the functional mode of action of pollutant stress at the cellular and molecular level. Implicit in this research approach will be studies of direct transfer of contaminants from the physical environment to the early life stages, transfer through food chain dynamics, and transfer from parent to progeny via gametes.

An integrated yet focused research strategy should include the following elements: (1) lethal and sublethal laboratory bioassay studies on eggs, larvae and juveniles to identify the most sensitive life history stages and the classes of contaminants most likely to cause problems in the environment; (2) "in situ" exposure studies using open mesh bags or on site laboratories with flow through exposure systems; (3) targeted field studies of eggs, larvae and juvenile fishes in a few selected locations of suspected high contaminant impact; and (4) synthesis and modelling to extrapolate results to the population level. Elements 2 and 3 would involve control studies in relatively unimpacted areas. All this effort should be directed toward the above-named species of fish chosen because of their importance to fisheries and reliance during the early life stages on the relatively contaminated estuarine environments.

Eggs and larvae spawned from "known" adults collected in both "clean" and impacted areas should be used in elements 1 and 2 to evaluate the reproductive success of fish from impacted environments and the role of parental inheritance in contaminant effects. Survival and growth will be the primary criterion used to evaluate reproductive success in elements 1 and 2; although other sublethal effects on morphology, behavior, physiology, biochemistry, and histopathology will also be considered. The laboratory and "in situ" studies will be used to select a limited suite of variables to be measured in targeted field studies. The measurement of sublethal effects are important since pollution stress may not manifest itself in lower survival in the undemanding laboratory environment devoid of competition and predation, or until a later stage in development. Also mortality is difficult to measure in field studies. Our recent study of young-of-year striped bass (Buckley et al. 1984) is a good example of a targeted field study drawing on several disciplines, including biochemistry, physiology, and histopathology to demonstrate differences in condition of fish between locations potentially related to contaminant levels.

Buckley, L. B., G. C. Laurence, T. H. Halavik, P. P. Yevich, and S. Hamilton. 1984. Comparative swimming stamina, biochemical composition, backbone mechanical properties and histopathology of juvenile striped bass from rivers and hatcheries of the eastern United States. Narragansett Laboratory unpublished ms, 21 p.

Item 7.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Habitat Protection Branch
14 Elm St.
Gloucester MA 01930

February 16, 1984

TO: Files

FROM: F/NER54 - Bruce E. Higgins

SUBJECT: Northeast Fisheries Center (NEC) Review of Environmental Assessment Activities, Sandy Hook Lab, September 6-7, 1984

BACKGROUND

At Mike Sissenwine's invitation, and upon Ruth Rehfus' recommendation, I attended this review. Stan Gorski also attended. I consider it time well spent, and hope that Regional Office staff can continue to be involved in these kinds of activities as we proceed with implementation of the Regional Action Plan (RAP) and the Habitat Conservation Policy (HCP).

At least 40 people attended the meeting. Participants included John Bryson and Bill Hargis from the Mid Atlantic Fishery Management Council (FMC), other outside reviewers (see attached memo), and several people from F/S (Joe Angelovic, George Knobl, Dean Parsons).

GENERAL COMMENTS

The program review was very interesting and informative, but difficult to summarize. I listened to the presentations and tried to imagine how the various studies could be related to major environmental issues, how they could be related to other studies, and how they might fit together to provide the information needed to address these issues. I was also interested to see how well the RAP philosophy and the HCP were incorporated into people's thinking and planning, and to what extent research efforts are focused on species or species groups for which fishery management plans (FMPs) have been or will be prepared.

Each of the Principal Investigators (PIs) or program leaders did a good job of describing what they had done. A large amount of information was presented, but questions and discussion were restricted during and after the presentations. This made it difficult to evaluate the various studies in terms of the above considerations. However, I did form some impressions, most of which were echoed and reinforced by the participants at the meeting. Some of my main impressions and opinions, articulated with much trepidation, are as follows:

1. **Planning:** It is clear that a lot of very good environmental research and monitoring work has been done by numerous competent, dedicated people. However, it is also clear that the grand design for the Ocean Pulse/Northeast Monitoring Program (NEMP) lacks a clear focus. It is hard to understand how each investigation contributes to accomplishing the goals and objectives of this plan. Therefore, NEC is faced with a major job of creating a new plan that sets out clear goals and objectives, and then determines what studies

should be conducted to answer the highest priority questions.

2. **Relevance of Monitoring:** Most of the PIs related their work to the RAP and HCP, and to the needs of the NER, FMCs, and other "users." The results of several individual studies have been useful to NER's Habitat Protection Branch (HPB). The NEMP has documented significant pollution problems, especially in the New York Bight and other coastal areas, and several individual researchers have assisted HPB in evaluating the potential impacts of proposed projects, designing monitoring programs, commenting on EISs, etc. However, it is difficult to tell where much of the present monitoring effort is leading. Non-point source pollution and ocean disposal are major problems in the Northeast. But monitoring the demise of the environment doesn't really help much unless cause-and-effect relationships and threshold or action levels can be quantified and established.

3. **NMFS Role:** Most or all of the major ocean multiple-use issues involve, or are focused on, the perceived impacts of certain activities on living marine resources and fisheries. With the exception of fishing, NMFS has no regulatory authority to control such habitat-altering activities. Without digressing into a discussion of the proper role of NMFS in influencing other agencies in regulating such activities, it seems clear that NEC must play the lead role in trying to establish the linkages between pollutant levels and physical habitat degradation on the one hand, and fish production, mortality, and safety to the consumer on the other. Once habitat requirements of species and threshold or "action" levels of contaminants are established, at least to the satisfaction of NMFS, then advisory and regulatory agencies can make informed and rational decisions regarding waste disposal and construction projects in the marine environment.

4. **Case Studies:** Based on the above, I think that it is time for NMFS and NEMP to consider doing less broad-scale monitoring and doing (or contracting for) more site-specific field studies of the impacts of certain activities on particular, representative environments and species, especially in coastal areas subject to major anthropogenic influences. These "case studies" should be designed to test hypotheses and monitor effects of particular activities, and to produce results that can be extrapolated to other areas, not merely to describe conditions and effects in a single area. They should, of course, be designed, funded, and conducted in cooperation with those agencies responsible for regulating or conducting the activities that cause habitat alterations.

5. **Habitat Requirements:** Much more emphasis should be placed on determining critical life habits and habitat requirements of living marine resources of greatest concern to NMFS. This involves determining normal ranges and variations in animal behavior, physiology, and biochemistry, as well as doing studies on the effects and threshold levels of various pollutants. Special emphasis should be placed on the early life stages of fish and shellfish, especially the larvae, since these stages are known to be very sensitive to pollutants. High priority should also be given to studies on adults in spawning condition. (A corollary to these efforts would be to conduct studies to determine the relative productivity and importance of various coastal and offshore habitats, especially coastal marshes, wetlands, intertidal and subtidal areas, estuaries, upwelling areas, and submarine canyons. However, we seem to be even farther from achieving this goal in the

Northeast than we are in addressing some of our pollution-related problems.)

6. **Population Effects:** HPB is constantly faced with having to evaluate the potential effects of proposed actions on fish populations and fisheries. However, present NEMP studies are focused primarily on the fates of contaminants and their effects on organisms. Very little effort has been made to translate the results to effects on fish populations or fisheries. We may never be able to make the ultimate linkages, but we should be able to relate pollutant levels to effects and assume that effects on organisms (reproduction, growth, behavior, etc.) will have effects on populations. Although the logical point of focus for NMFS may have to remain on organism effects, I believe that emphasis should be shifted as much as possible toward evaluation of effects of physical and chemical habitat degradation on fish populations, as deduced from field studies of contaminant levels in sediments, water, and biota and laboratory studies of sublethal and lethal effects. I think more effort should be directed toward linking observed levels of contaminants in the environment with those in organisms, and to linking body burdens with observed effects. Special attention should be paid to the benthic boundary layer because pollutants and impacts are most likely to be detectable and measurable there.

7. **Synergisms:** More emphasis also should be placed on studying the interactions and synergisms among various chemicals and chemical species, especially as they influence behavior, physiology, and mortality by affecting the availability of contaminants, the susceptibility to predation, etc. These studies should evolve from those using "worst-case" concentrations of single pollutants to those using more realistic concentrations and mixtures of pollutants.

8. **Impacts of Fishing:** In addition to the various materials discharged from fishing vessels, several of the fishing methods themselves may have significant impacts, both positive and negative, on benthic habitats. As an aid to fishery conservation and management efforts, I suggest that NEC conduct studies on the impacts of, for example, scallop dredging, clam dredging, and bottom trawling.

9. **Syntheses:** Finally, a much greater effort needs to be made to (a) analyze the existing data, (b) integrate the information across all ecological components, (c) synthesize the information into products that adequately and accurately portray the impacts of various environmental threats to important living marine resources and their habitats, and (d) disseminate these products to other agencies and the public. To this end, much better coordination is required among the NEC laboratories, between NEC and NER, between NMFS and other NOAA components, and between NMFS and other agencies.

PRESENTATIONS & FEEDBACK

Jack Pearce led off the meeting by discussing the major environmental issues in the Northeast and describing the role of the the Division of Environmental Assessment (DEA). He then related the strategies described in the HCP to the approach used in the United Kingdom, where "the way forward" involves the following six steps:

1. **Identify "hot spots"** (where problems are).

2. **Identify trends** (spatial and temporal).

3. **Quantify effects** (sublethal, lethal; effects on stocks).

4. **Assess risks** (hazards).

5. **Analyze causation.**

6. **Manage fish habitats** (regulations, legislation, FMPs, etc.).

He emphasized that the products of DEA's efforts are used for regional environmental assessments, which are the reason for the whole program. However, the presentations that followed clearly emphasized the great disparity between (1) NER's needs for data analysis and information synthesis to support habitat conservation and management decisions and (2) the status of NEC's research and monitoring efforts. That is, NER is forced to operate at step 6 with regard to habitat matters, and to take generally conservative positions based on the best available objective information, expert opinion, and subjective judgment, whereas NEC is in the "descriptive phase" at step 1 and, to some extent step 2, at this time. Significant progress must be made on steps 3, 4, and 5 before habitat conservation and management decisions can achieve the scientific objectivity that NMFS, in particular, and society, in general, want.

I will not try to summarize what each PI discussed. Instead, I will highlight, in the actual sequence they occurred, some of the reviewer's questions and comments of general interest to HPB staff. I have taken the liberty of paraphrasing many of the questions and comments; based on my detailed notes, most of my paraphrases are close to being verbatim.

* * *

February 6. Presentations on the first afternoon were given by Jay O'Reilly, Jim Thomas, and Bob Reid (NEC,Sandy Hook Lab); Peter Larsen (Bigelow Lab); Tony Calabrese and Fred Thurberg (NEC, Milford Lab); and Paul Boehm (Battelle).

With regard to studies on Hudson River striped bass, Ken Sherman asked Fred Thurberg **whether physiological effects such as impaired swimming performance could be extrapolated to population mortalities.** Fred said "no," but indicated that such biological measures are a good index of the fishes' condition that can raise a "red flag." He also said that unfortunately, **nearshore areas don't get the attention they deserve.** Finally, in response to a question from Mike Sissenwine, Fred indicated that **they have not done similar studies on larval striped bass,** but that the Narragansett Lab has. (Mike suggested to me later that studies on larvae should be pursued, since larvae are probably the life stage that is most vulnerable to environmental stress.)

Allen Peterson asked Jay O'Reilly **"What are we doing to relate the amount of dredge spoil or sewage sludge coming into an area to levels of pollutants** in sediments and organisms so that we can make judgments for, and extrapolations to, other areas?" In other words, "How do we use this information in programs elsewhere?" "How far should NMFS go in monitoring this problem?" "How long do we work on this problem if we can't extrapolate results to other areas?" "How much is in it for NMFS to do 'postmortems'?" Dr. O'Reilly replied that they are working on several biological indices with Joel O'Connor and Garry Mayer (OAD, Stony Brook). (Allen asked me privately, during the ensuing discussion of site-specific vs. general studies led by Bill Hargis, "Does this kind of work really help HPB comment on permits and projects?" I didn't give him a complete response, but it's something for all of us (especially the RAP Board) to think about as NEC deliberates its options.)

Paul Boehm provided the following as a program rationale:

> "Chemical measurements of toxic contaminant levels in environmental samples serve as leading indicators of trends in environmental quality and can reflect trends in inputs of these chemicals into marine systems. Significant correlations have been demonstrated between contaminant levels in marine samples and the health of marine biological components and the health of marine habitats."

Dr. Boehm then posed the following six hypotheses:

1. Concentrations of pollutants in sediments are related to health of benthic populations.

2. Concentrations of pollutants in sediments are related to habitat suitability.

3. Concentrations of pollutants in sediments and/or benthic boundary layer are related to body burdens in benthic animals.

4. Concentrations of pollutants in benthic animals and/or water column are related to body burdens in fish.

5. Body burdens in fish are related to their "health."

6. Body burdens in benthic organisms are related to their health, which is in turn related to their source as food for fish.

Joe Angelovic expressed concern that NMFS has spent millions of dollars to gather data applicable to testing such hypotheses, but has not expended enough effort trying to figure out what NMFS should be doing relative to other agencies. That is, "Why should NMFS be doing monitoring studies rather than another agency such as EPA?"

Mike Sissenwine commented that the situation is analogous to that faced by the Resource Assessment Division (RAD), which decided to study the recruitment problem of certain spring-spawning species, but not all species. He indicated that the major question for the next day's session is "Now that we're on the asymptote of the learning curve, what do we do?"

Allen Peterson said that we should also decide on what it is we don't want or need to do, since we can't do everything. In other words, "**What studies will not be done next year?**" Finding more pollutants in the ocean (e.g., EDB, dioxan, etc.) will not, in his opinion, help us determine impacts on fish, or whether they're safe to eat. He feels that **we should be focusing on what NMFS should be doing in the future, not on the health of the ocean.**

* * *

February 7. Presentations the next morning were given by Arlene Longwell (NEC, Milford Lab), Anne Studholme (NEC, Sandy Hook Lab), JoAnne Stolen (Drew University/NJMSC), and Aaron Rosenfield (NEC, Oxford Lab).

Bill Hargis asked Arlene Longwell "**Can you distinguish pollution-caused mortality of fish eggs from natural mortality?**" Dr. Longwell replied that they could not.

Anne Studholme indicated that **blue crabs do not avoid heavily oiled sediment, but will move in and decimate a population of hard clams whose burial speed and depth have been affected.** Bill Hargis commented that **spot, croaker, and other fish in the Elizabeth River do not avoid areas contaminated with about 4,000 ppm petroleum.** Paul Boehm then **recommended placing more emphasis on studies that attempt to link effects to environmentally realistic levels and mixtures of pollutants.** Anne said that their next step is to do just that.

Aaron Rosenfield said that the Oxford Lab **attempts to correlate the health of fish stocks with environmental perturbation data** gathered by others. They want to find out what various neoplastic conditions mean to the affected organisms and populations. He observed, however, that there **needs to be more coordination between the NEC laboratories.** Too little coordination has occurred so far. Furthermore, he said that **most of the pathobiology work has been done on adults, rather than on the younger stages.** Since the adults are the survivors, not the ones that have already been affected and perhaps killed, he **recommended placing more emphasis on studying the younger stages.**

SUMMARY & DISCUSSION

Jack Pearce stated that **we have tremendous documentation of pollution problems through the Ocean Pulse/NEMP efforts.** However, he is **pessimistic that we'll be able to do anything to improve the situation unless we can develop better ways to display our data and make it more meaningful.** He feels **that we need to become more efficient to be more effective. RAP is in place, and perhaps should be applied elsewhere.** Perhaps our strategy should be to **select particular species or groups of species and concentrate studies on them to demonstrate effects and model cause-and-effect relationships.**

Carl Sindermann summarized his first impressions as follows:

1. He is impressed with the fact that **there has been much good, extensive research on environmental problems.**

2. **Each investigator has related his or her findings to a degraded environment.**

3. But no one has made the link between what's being done and effects on fish stocks. **We're still in the descriptive stage.** This may be appropriate (e.g., for genetic and behavioral changes), but **we need to evolve into a more quantitative approach related to fish populations.**

4. Finally, there have been a lot of rather unorganized efforts on some of our principal species. **There's something to be gained by pooling all our efforts on single species, and it may be appropriate to begin doing so now.**

PLANNING

Allen Peterson stated that he **now knows what we've been doing, but not why we've done it, or where and how it all comes together.** He has the feeling that **we've done a lot of studies because of particular people's interests, not because they fit into an overall design or plan.** He wonders what we can do with all that data. **What is NMFS's role?:** To determine the health of the ecosystem? To determine the impacts of pollutants on fish populations? He **thinks we need to develop a plan explaining why we need certain studies, and where each study fits into the overall design.** He feels **we've been in a descriptive mode, but primarily by accident.** He **wants to focus on why we've done things, what we need to do in the future, and how we can do it.** Also, we **must consider what studies could be deferred or terminated.**

Bill Hargis suggested that NMFS is involved in this work because NOAA says we're responsible. He thinks **the work should continue, but be better organized, integrated, and coordinated. Better coordination with agencies working in estuaries is required.** (Doesn't NMFS work in estuaries? No one took up this issue). Bill thinks that **NMFS is the best agency to do offshore studies, and that the HCP is the focal point now.** As Chairman of the Environmental Committee of the Mid Atlantic FMC, he's **interested in what NMFS can do to help identify and define impacted areas and the effects of pollutants on fish populations so that the Council can influence EPA and other agencies to better manage the ocean environment.** He thinks that **abundant data and information are already available,** and that **NMFS should expend more effort on analysis, interpretation, and synthesis.**

John Bryson disagreed slightly. He asserted that **much of the pollution effects work can be done in the lab rather than the field.** He thinks **NMFS should do basic laboratory analyses of biological effects and let EPA do its job of monitoring environmental quality and protecting the environment.** He also has had **problems understanding the various investigators' sampling strategies,** partly because he couldn't tell from the presentations whether all factors were considered in the design of the studies.

Dr. Pearce stated that **the HCP, especially strategies 2 and 3, points "the way forward."** NMFS has done most of the work because we've been told to do it. We hired people interested in certain specialties and trained them to do certain things. However, they can adapt to changing circumstances, as necessary. Moreover, we contract for special studies, which can be changed even more easily.

Mr. Peterson repeated his contention that **we need to develop a plan and a mechanism so that we're not just being reactive.** Then we can have a **broad framework within which we can set priorities. We need to be in environmental research, but we need to know where we're going. The plan should allow us to be responsive to immediate needs, while planning for the future.**

Dr. Angelovic complained that he **hadn't seen the RAP plan, and wondered if the document is just more bureaucracy.**

George Knobl said that **guidelines for HCP implementation strategies will be issued from Washington in the near future.**

Dr. Sissenwine expressed concern that **we haven't tied things together very well.** RAD has a clear, overall plan for its surveys, but Mike hasn't seen a recent one for Ocean Pulse. **"Do we need to reexamine the original Ocean Pulse plan?"**

Dr. Pearce stated that it has been **difficult for Ocean Pulse to carry out its plan because of logistical problems of getting access to research vessels.** Merely finding space for people on cruises has been a major problem. Nevertheless, **some site-specific studies (e.g., Pigeon Hill) have been conducted to get baseline data.**

Mr. Peterson said that this only **reinforces his view that there's no long-term plan to determine how everything fits together. We're able to respond OK to specific requests, but it's not clear that this is really what needs to be done.**

Dr. Angelovic wondered if RAP does this, or is supposed to do this. Mr. Peterson explained that **the real thrust of RAP is to develop a list of threats and prioritize them.** Then we can decide what needs to be done regarding the most important issues. RAP does not set out any particular program.

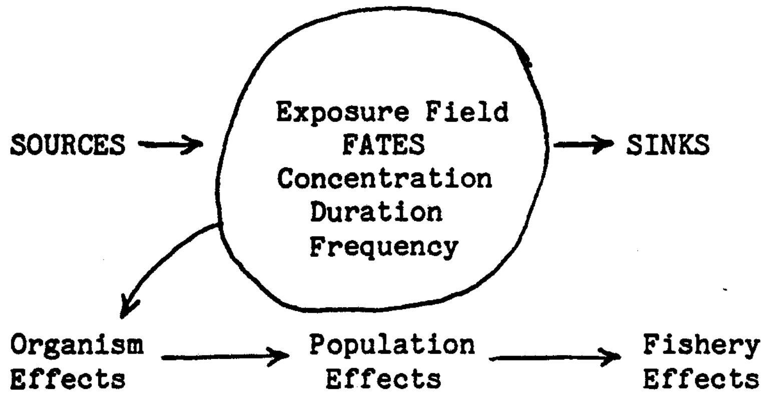
Dr. Hargis indicated that he is **confused about the entire planning and priority-setting process within NMFS** (e.g., the role of the Board of Directors vs. the RAP Board), and **can't relate what we're doing to the numbers of fish in the ocean.**

Mert Ingham reminded everyone that **there are two plans for research and monitoring: Ocean Pulse and NEMP.** Therefore, the question should be, **"How good are they for determining what we do?"**

Dr. Sissenwine agreed, and suggested that **it is time to evaluate and redesign these plans.** Also, **the RAP plan need to get very specific about threats to biological resources and where NER and NEC should focus their staff and fiscal resources in the future.**

NMFS ROLE

To address the question of whether NMFS should try to deal with the whole problem, or depend on others more than we do now, Dr. Sissenwine put the following diagram on the board:



NMFS is concerned with effects on fisheries. But **most of what we've talked about are fates of pollutants (concentrations, mainly) and effects of pollutants on organisms.** Very **little information has been translated into population effects, and none into fishery effects.** Also, we haven't worked back to sources of pollutants. "**Should NMFS try to deal with the whole problem, or should we depend on others more than we do now?**"

Vic Bierman stated that with regard to regulatory state of the art, **EPA needs help determining the linkage between pollutants and effects.** Present bioassays consist of 96-hr LC50 tests on a few species, and the limiting permissible concentration is determined merely by dividing the LC50 value by 100. Bioaccumulation tests are run for 10 days, but have no interpretive guidelines. Therefore, **the tests really can't be interpreted. No consideration is given to population level effects, especially on fisheries.** He doesn't believe that EPA will be able to establish the link between acute effects and effects of fish populations. He **urges NMFS to evaluate the effects of pollutants on fish by conducting bioassays that actually mean something.** EPA doesn't know whether a "balanced indiginous population" is being maintained or not because the present tests do not indicate threshold levels or sublethal effects. **The linkage between the exposure field and the source of a given pollutant needs to be determined to enable EPA to take regulatory action.** EPA is ready to designate the 106-mile site for ocean disposal, and is working with NMFS (AEG), URI, etc. on field verification. Vic wants to do additional collaborative research to develop indicators and thresholds; EPA researchers can't do this by themselves.

Dr. Rosenfield asked "**Don't we have enough data now to indicate that there are population effects, and to know that there's something wrong out there?**" He thinks **we need to apply our effort to the younger stages to determine effects on fisheries.**

Dean Parsons stated that **the logical point for NMFS to concentrate on is effects on organisms.**

Mr. Peterson, however, **suggested working backward; that is, concentrating on effects on fisheries. "Do we have a problem in a fishery?" "Does the striped bass have an environmental problem?"** He feels that approaching the problem from this direction would lead us to what we ought to do. For example, if mackerel stocks are OK, despite the New York Bight situation, then it isn't necessary to study them. "**If we can't see any effects on fisheries, then why do pollution studies?**"

Dr. Hargis stated that it is important to distinguish disease- and pollution-related mortality from "natural" mortality. He argues for collecting sufficient data to set standards to protect species' populations.

Mr. Peterson countered by saying that if we can explain population fluctuations on the basis of natural environmental perturbations without considering pollution, then NMFS should focus on other things we can better influence, such as overfishing.

Dr. Hargis argued that NMFS has the responsibility to inform others and to work with them on pollution-related problems.

Mr. Peterson indicated that PCBs are a problem for people, not fish. Therefore, the PCB situation is a problem for FDA, not NMFS. If we are to continue studying the "health of the ocean," we need to find better ways to determine what are the best indicators. We could do this by starting at effects on fisheries.

Drs. Parsons and Sissenwine wondered if this is really a viable approach for species other than perhaps striped bass. Perhaps it couldn't be done.

Dr. Sissenwine then stated that much of what we do is "reactive." He asked, "Should we should continue to operate this way?" "To what degree is NEC prepared to continue helping NER respond to requests for information, data, and advice?"

Mr. Sherman pointed out that Ocean Pulse was formed to deal with both fishery effects and the health of the ocean. "Key indicator species" and biological indices have been lacking. NEC would have to focus more effort near shore to really address important questions and be of the most assistance to NER.

Dr. Pearce stated that coastal shellfish fisheries have been affected by pollution, and that losses have been identified. It is possible to extrapolate from lab studies, but scientists haven't had the courage to do so very often. "Expert witnesses" should be prepared to say what they think, not just what they know for sure. We should be able to tell the Councils what the habitat standards are for each species so that we can tell when they're in jeopardy.

Dr. Longwell asked "How long would it take to detect a fishery effect of, say, a 20% deviation from the mean." Dr. Sissenwine replied "decades or never." Dr. Ingham pointed out that you can have "fishery effects" without having population effects (e.g., PCBs in bluefish).

Dr. Hargis urged NMFS to expend more effort on analyzing existing data. Dr. Sissenwine agreed that NMFS should spend more time synthesizing information and incorporating it in an appropriate modeling framework.

CONCLUSION

Dr. Ridgway wondered what could result from this meeting with regard to "a way forward." He made three points:

1. **Planning:** We've had many plans, but they've not been completed with regard to **experimental design.**

2. **Quantification of Effects:** We will never reach this stage without good experimental design. **We're not paying enough attention to this issue.**

3. **Public Perception: We can't address our planning efforts only to those things that have fishery effects because society perceives that we are responsible** (e.g., for responding to the **Argo Merchant** spill, where NMFS was expected to have the answers). We have to do these kinds of studies, but we haven't developed good strategies yet. Ocean Pulse was supposed to phase into "indicator" activities, but hasn't done so. **Everyone here is justifying their programs and activities, and not working on an overall strategy.**

Dr. Sissenwine agreed that **we need to focus on analyses, syntheses, indices, and strategies.** He can identify **three main areas of research;** namely,

1. Monitoring program.

2. Assay methods (lab and field).

3. Site-specific case studies (e.g., Hudson River plume and hypoxia).

Dr. Pearce agreed, but would **add estuarine degradation due to nutrient stimulation from non-point sources.** However, Mr. Peterson asked **"Is this our proper role?"** and **"Can we do anything about it?"** Jack responded that we're in an academic paradigm, and that we need to break out of it. We need to reform and do a plan.

Dr. Sissenwine **will prepare a summary and send it out for review.**

Mr. Peterson sounded a final note of caution: He **wants to see some very good arguments explaining exactly why we need to be in this business.**

Attachment

cc: Bob Lippson, Bob Hanks, Bob Temple, Jon Rittgers, Ruth Rehfus, Jack Pearce, Carl Sindermann, Mike Sissenwine,
3 HPB Field Stations

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Center
Sandy Hook Laboratory
Highlands, New Jersey 07732

REVISED AGENDA

January 18, 1984 F/NEC4:JBP

TO: DISTRIBUTION

FROM: John B. Pearce, Chief
Division of Environmental Assessment

SUBJECT: NEC Environmental Programs Review, Sandy Hook Laboratory, 6-7 February 84; Agenda

The subject review will present major elements of the Center's research and monitoring activities which relate to the NMFS Habitat Conservation (HC) goals, objectives, and policy. These emphasize sources, fates and biological effects and impacts on resources. Presentations on the first day (6 Feb.) will provide information on "what, where, how, why, and who" in regard to the major HC issues. Individual presentations will be made so that during the second day (7 Feb.) round table discussions can take place which address questions such as: 1) What are the major issues in HC? How are the issues identified? 2) What are the basic sampling strategies? How are spatial and temporal stations or sampling sites selected? 3) How do laboratory and field experimental studies relate to broad-scale, long-term monitoring? 4) What are the priority contaminants and how are these selected? 5) What are the key species and/or communities which are considered in HC monitoring and research? 6) What is the NEC HC role in estuaries? on the shelf? 7) What are the present applications of NEC HC data in management of the fisheries and their habitats? In the development of risk assessments? 8) How are future assessments to be made? 9) What is the NEC HC role relative to other NOAA LOs (OAD, EDIS, etc.) and other Federal and State agencies? How do the various tasks and PIs relate to one another? 10) How much HC effort is enough -- are we doing too little or too much? What are the products? and 11) How does NEC HC monitoring and research relate to previous national and international efforts, recommendations and directions? What are the ways forward?

During the afternoon of the second day a closed executive session will provide an opportunity for the program reviewers to identify critical gaps, the efficacy of NEC activities in the context of the Regional Action Plan (RAP), etc. Also it will allow for discussion about new ways forward in HC research and monitoring.

Proposed outside reviewers will include Dr. V. Bierman (US EPA, Narragansett), Dr. Scott Nixon (URI), Dr. Garry Mayer (OAD, SBO), Dr. G. P. Patil (Penn State University), Dr. W. C. Boicourt (Johns Hopkins), and Mr. Fred Godshall (NOAA, EDIS). The NEC BOD will constitute the remainder of the Review Panel. One or two NMFS WO staff (probably Dean Parsons) will also attend and participate.

Item 8.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Services Division
Habitat Protection Branch
14 Elm Street
Gloucester, MA 0L930

February 24, 1984

TO: F/NEC - Allen E. Peterson, Jr.

Edward J. Macleod for

THRU: F/NER - Richard H. Schaefer
F/NER5 - Robert F. Temple

FROM: F/NER54 - for Ruth Rehfus

SUBJECT: Recent NEC Review of Environmental Assessment Activities

I would like to express my appreciation for inviting us, and to add a few comments to Bruce Higgins' summary of this meeting (see attached memo).

First, his analysis reinforces my own impressions regarding the generally high quality and usefulness of NEC's environmental research and monitoring efforts. A lot of excellent work has been done and many studies have produced useful information. The Habitat Protection Branch has received much advice and assistance from many NEC staff on important habitat conservation issues. The input from the NEC has often been complementary to that from the States on projects and area-wide management plans. This has helped to avoid uncoordinated, piecemeal activities in coastal and offshore areas that would have adversely affected fish habitats and other public resources.

Second, it is evident that we are all interested in better planning, better coordination, and greater efficiency. Our efforts in RAP have helped, but we obviously need to do much more to improve the way we analyze options and develop strategies for addressing the most important environmental problems.

Finally, I'd like to emphasize a point that may not be clear in Bruce's memo. It has to do with NMFS's ability to solve the various environmental problems that may affect fish populations and fisheries. Although NMFS cannot actually solve these problems alone, NMFS plays an essential role by doing research, analyzing data, assessing impacts, providing information, giving advice, and providing recommendations that contribute, directly and indirectly, to influencing others to solve the problems. In this respect, our role in environmental research and habitat conservation is really not very different from our role in fisheries management, especially now that the Fishery Management Councils must consider habitat requirements in their plans.

With increased effort on effective, realistic strategic planning, including more interactive program review sessions such as this one, I believe we can increase both the relevance and usefulness of our future environmental research and management efforts. Doing so would increase the predictability of support, which in turn, would help program leaders plan their activities more effectively.

I would appreciate any thoughts you might have on how we can strengthen our present efforts.

Attachment

Item 9.

Battelle
New England Marine Research Laboratory
397 Washington Street
Duxbury, Massachusetts 02332
Telephone (617) 934-5682

March 13, 1984

Mr. Alan Petersen
Director
NOAA
National Marine Fisheries Service
Northeast Fisheries Center
Woods Hole, MA 02543

Dear Mr. Petersen:

I would like to thank you and NOAA/NMFS/NEFC for giving me the opportunity to present an overview of my research and monitoring activities conducted for your center over the past four years.

Looking back on my activities, and those of the other principal investigators in NEMP, I believe that I have been privileged to be part of a unique effort which focused on 1 - defining the criteria for degradation of benthic fisheries habitats; 2 - defining the location of these degraded and pollutant impacted benthic fisheries habitats; 3 - developing new and sensitive techniques for assessing pollution-induced stress in shellfish and finfish through measuring behavioral, physiological, and biochemical parameters. As is often the case for such studies not all information generated is immediately useful to environmental managers and the public. Some of the information may not be useful at all. However an extraordinary amount of these data can be immediately used as benchmark information to define degraded and, as yet, unimpacted habitats, against which future trends can be assessed. The data has not been fully synthesized, within each discipline and across interdisciplinary lines, but this does not detract from its value. Such synthesis activities should be funded. The projects overseen and coordinated by Dr. Pearce and his senior staff at Sandy Hook represent a unique scientific effort that NMFS should be proud of and should publicize in defense of wanton budgetary cuts.

The question of "what to do next?" should be central to NMFS activities in these areas. Of course, what NMFS is most interested in vis-a-vis pollutant impacts is the effects of pollution on fish populations. However, while many aspects of fisheries population biology are amenable to study, study of the direct impact of chronic pollution on fisheries stocks is, in my opinion, not amenable to any study design. Indeed, as a loose analogy with pollutant impacts on humans, the most significant problems (effects) ascribed to PCB, EDB, dioxin, etc. in the human population are those that affect the individual. Indeed regulations are based on individual reactions to pollutants. If we could indeed conduct such a study on a fishery level and then monitor the approaches to pollutant impacts on fisheries, such an approach would not allow for any margin of safety (i.e. early warning signals) to be observed. I believe that the measurement of fisheries habitat degradation as mandated by the Habitat Conservation Policy for NMFS, serves well as valid "early warnings" (i.e. leading indicators of problems) to future population scale problems. NMFS "management decisions" should focus on monitoring these habitats and suggesting remedial action should habitats become threatened. Indeed, to the individual fisherman in the Gulf of Maine, Massachusetts Bay, New York Bight, Long Island Sound, Chesapeake Bay, etc. it is the degradation and destruction of these definable benthic habitats (i.e. his fishing grounds) that are of greatest immediate concern. Such destruction of habitat may take place without any detectable, or indeed for that matter, without any real effect on overall fisheries populations. Habitat destruction or degradation in nursery areas however can directly be applied to fish population-type problems.

The approaches and methods developed in NEMP during the past five years which focus on detecting and defining these habitat modifications and also on early warning stress signals in fish, are precisely the methods which can measure significant degradation and effects of pollutant inputs.

We should modify, cull and coordinate those sets of biological and chemical measurements which have been shown to be sensitive indicators of pollutant inputs and effects, and we should define reasonable time scales over which to make these measurements. I believe that NOAA/NMFS must continue to undertake these programs. I don't see much help coming from other agencies (e.g. EPA) although NOAA/OAD efforts are certainly quite relevant to your efforts.

Thank you for your support in the past. I hope to continue my work with the interdisciplinary group in NMFS/NEFC in the future.

Sincerely,

Paul D. Boehm

Paul D. Boehm, Ph.D.
Senior Research Scientist

PDB:sjs

cc: Dr. Joseph Angelovic
Dr. Michael Sissenwine

Item 10.

INTERNATIONAL STATISTICAL ECOLOGY PROGRAM

STATISTICAL ECOLOGY SECTION

INTERNATIONAL ASSOCIATION FOR ECOLOGY

LIAISON COMMITTEE ON STATISTICAL ECOLOGY:

INTERNATIONAL STATISTICAL INSTITUTE
INTERNATIONAL ASSOCIATION FOR ECOLOGY
BIOMETRIC SOCIETY.

A PROGRAM devoted to the studies of quantifiable ecological problems and relevant quantitative methods.

DATE: March 13, 1984

FROM: G. P. Patil

TO: Michael P. Sissenwine

SUBJECT: NEFC Review of Environmental Assessment Activity

1) I have received your memo of March 1. I find it to be a good perceptive summary of the review meeting.

2) Because we were rather short on time toward the end, I did not get to offer comments and suggestions that I had in mind then. I am glad, however, to note that you have some of them in. Broadly speaking, this pertains to the needed focus, direction, and the synthesis, which in turn need appropriate conceptualization, quantification and validation to generate scientific predictive capability and the management perception for decision making. The Environmental Assessment Activity does need, during this year itself, an overdue shot in the arm in this respect. Your items (2), (3), and (11) on pages 6-8 may be suggestive of this. If you should find it possible, it would be good to see this pitch as it came out time and again at the review.

3) I like your figures. For Figure 2, you may wish to consider dotted lines between Indices and Population Effect, and also between Indices and Fishery Effect.

4) I like your last paragraph also. A good end of the review memo for an immediate start off.

If I can be of any assistance, please do not hesitate to let me know.

GPP/ba

Item 11.

DRAFT TWO

ISSUE PAPER
ENVIRONMENTAL STUDIES IN THE NORTHEAST FISHERIES CENTER

by

Carl J. Sindermann

January, 1984

CONTENTS

BACKGROUND

A principal research function of NEFC has been and should continue to be the collection and analysis of information relevant to management of fish stocks. But the continued productivity of fish stocks is dependent on the quality of the environment. Thus a major commitment has been and is being made to research concerned with habitat conservation or environmental matters.

This issue paper attempts to examine what NEFC is doing in habitat conservation research, and then proposes options for an action plan for the future. Since NEFC programs must be consistent with NMFS and NOAA objectives, broader considerations should help to shape the nature of research to be conducted.

The Role of NMFS in Habitat Conservation Studies

NMFS has recently published a definitive and far-reaching Habitat Conservation Policy (Federal Register, Nov. 25, 1983, Vol. 48, pp. 53142-53147). An active and enhanced role in habitat conservation has been outlined; some salient features include:

- ensuring that habitat conservation is appropriately considered and integrated in all of NMFS programs;
- maintaining or enhancing the capability of the environment to support fish and shellfish populations;
- conducting environmental and ecological research and monitoring, including necessary long-term studies;
- including habitat considerations in Fishery Management Plans; and
- cooperating with other NOAA program elements in environmental activities which affect living marine resources for which NMFS has primary responsibility.

This clear statement of NMFS responsibility and involvement in habitat conservation activities reaffirms the necessity to understand not only the fish stocks, but also the ecosystems of which they are an integral part, and upon which they depend.

Looking at this essential role for NMFS, several questions arise:

- What should be the size of the NMFS commitment to environmental monitoring?
- What is the role of NMFS in pollution studies as compared with that of NOAA-OAD and USEPA?
- What is the role of NMFS in estuaries where pollution problems are most severe?

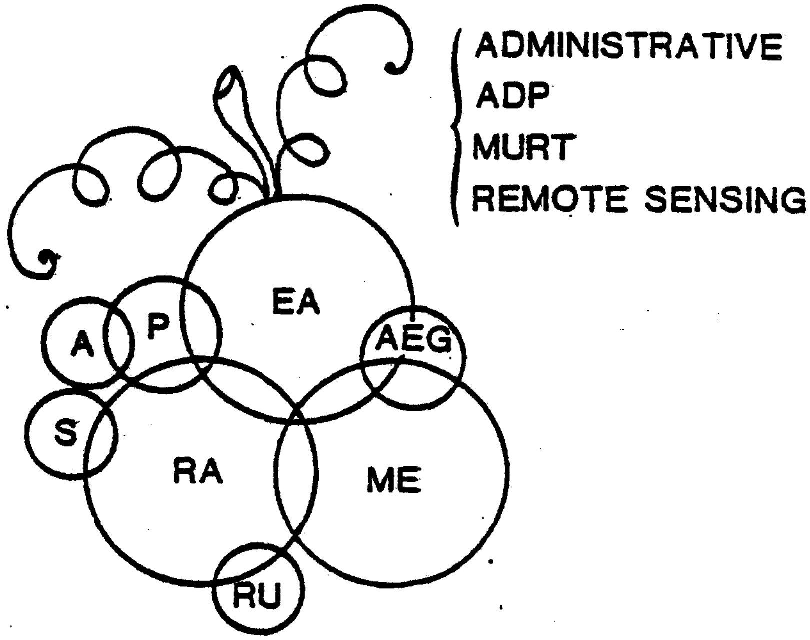
The Role of NEFC in Environmental Studies

The Northeast Fisheries Center, as organized in 1976, has had and continues to have strong and substantial environmental programs. Some of this emphasis was based on pre-existing programs and competencies of the research groups and laboratories which were incorporated into NEFC; but, more importantly, the emphasis was also based on the conviction that studies of habitats were essential to understanding fluctuations in fish stocks.

NEFC has proportionally a greater investment in environmental assessments than any other Center--and rightly so--since here in the Northeast is where human impacts are greatest because of sheer numbers of people and the extent of industrialization. Additionally, it is here where we are apt to learn the most about effects on resources and habitats--hence methods of environmental management should be explored intensively here too. Resource management is of course a universal job--now shared with the states and FMC's. Environmental management--as part of habitat conservation--is also shared with states and EPA, but that part that is especially directed to resources should logically be a major concern of NMFS and NECF.

Divisions of NEFC with principal environmental foci are Environmental Assessment (concerned principally with effects of degradation of estuarine/coastal waters on fish and shellfish); and Marine Ecosystems (concerned with productivity and natural factors which affect abundance of fish). Other Divisions of NEFC with environmental research components are Pathobiology (with a program on pollution-associated diseases); Resource Utilization (with part of its program on product safety concerned with contaminants in seafood); and Aquaculture (with part of its genetics program concerned with contaminant-induced genetic abnormalities in fish and shellfish). The Atlantic Environmental Group (AEG) also supplies important oceanographic expertise for addressing environmental problems. The Resource Assessment Division has also made significant contributions to environmental impact analyses since a major question in any environmental issue is the assessment of resources at risk.

All the Divisions and principal operating units of the Center are well-integrated, with overlap zones which provide mutual support and communication, as outlined in Figure 1. Of particular relevance to the environmental issue addressed in this document are relationships of Environmental Assessment Division, Marine Ecosystems Division, and (to a lesser extent) the Atlantic Environmental Group.



<u>Key</u>

RA	=	Resource Assessment
EA	=	Environmental Assessment
ME	=	Marine Ecosystems
RU	=	Resource Utilization
P	=	Pathobiology
A	=	Aquaculture
AEG	=	Atlantic Environmental Group
S	=	National Systematics Laboratory
MURT	=	Manned Undersea Research and Technology

Figure 1. An attempt to visualize the principal operating components of NEFC--their relative sizes (in terms of funding and staff), and their areas of overlap and interaction.

The Role of NEFC in Monitoring

NEFC conducts major monitoring efforts in Northeast waters--trawling surveys, ichthyoplankton surveys, and "Ocean Pulse" surveys of the relative health of coastal waters. Oceanographic data are collected routinely on these surveys. The efficacy of this extensive monitoring effort is reviewed and reassessed periodically. One of its fundamental premises is that continuous long-term monitoring is a clear federal responsibility, which is not apt to be assumed by any other group; that data from monitoring programs form an integral base for other research programs; and that understanding of fish stocks and their fluctuations will be derived in large part from analysis of long-term data sets.

Recently, several important changes in the monitoring have been proposed. One is to move away from larval fish sampling to more intensive studies of post larvae and juveniles, as better indicators of annual recruitment. Another is an expansion of the Ocean Pulse program inshore and into the principal estuaries (the rationale being that this is where critical pollution problems exist, and that cooperative estuarine programs could be initiated with the states).

Care must be taken, however, to insure that monitoring does not become an end in itself, and that it does not expand at undue expense to other research programs. Monitoring is critical to determination of conditions which exist at the time of sampling, but understanding of causation requires a concurrent research program.

The Role of NEFC in Pollution Research

An important consideration in this document are the effects of pollution on living resources and ecosystems, and the extent to which NEFC should be committed to pollution-oriented studies. One entire Division (Environmental

Assessment) is involved in pollution-related research and monitoring; components of other Divisions are involved, but to a lesser extent. The immediate question arises "Is pollution overemphasized in the Center, and what is the proper NEFC investment in pollution studies?"

Research to date has provided evidence for effects of selected pollutants on survival and physiology of marine animals in experimental situations, and some evidence for localized effects on fish and shellfish populations, but clear associations of pollution and species abundance have not yet been demonstrated, except in the most heavily polluted zones. This remains a major research and monitoring problem to be addressed by NEFC.

It should be pointed out that marine pollution and habitat degradation problems are most severe in estuarine/coastal waters adjacent to human population and industrial centers. The Northeast is obviously the area of greatest impact, so it is logical that NMFS programs in this area emphasize effects of environmental changes.

The Relationship of NMFS/NEFC and OAD in Habitat Studies

The Office of Ocean Assessment of NOAA, particularly its Northeast Office at Stony Brook, NY, has had continuing environmental research programs in New York Bight waters since 1973. Acting principally through contracts, OAD has facilitated expansion of knowledge about sources, fates, and effects of pollutants, and has acted as a NOAA focus for dissemination of environmental data.

NMFS (and predecessor agencies) has conducted environmental research in the New York Bight since the early 1960's. Beginning in 1976, NMFS began an ocean pollution monitoring program called "Ocean Pulse," which in 1979 was incorporated into a larger NOAA monitoring program called the Northeast

Monitoring Program (NEMP). Several NOAA groups, including NMFS (NEFC) and OAD have been and are participants in NEMP, although most of the funding was from the NEFC Ocean Pulse program.

OAD has had and has a wide range of environmental studies, including development of indices of unreasonable environmental degradation, the Hudson-Raritan Estuarine Program, and contract support to universities for many studies of pollutants and their effects. Some of the biological studies were carried out by NEFC (Sandy Hook) under contract to OAD; other studies were carried out by outside contractors, using NEFC data. Many of the pollution studies of OAD complemented those on resources and habitats being conducted by NEFC.

It seems reasonable to ask, though, about the appropriate roles for each NOAA element in habitat studies. The responsibility of NMFS/NEFC in understanding effects of habitat loss and degradation on living resources seems clear, but OAD has interpreted its role in ocean assessment broadly enough to include fish and shellfish resources, as well as their habitats. There are definite areas of overlap and fuzzy responsibilities in NOAA habitat studies that need clarification and policy determinatins at the highest levels. In the interim it is important for NOAA field elements (particularly NMFS/NEFC and OAD) to communicate and cooperate to the fullest extent possible.

<u>The Role of NMFS/NEFC in Studies of Pollution Effects on Resources and on Humans</u>

Contaminants in estuarine/coastal waters may exert effects on fish and shellfish by causing disability and death, and on humans who eat seafood containing the contaminants. Clearly, understanding of contaminant effects on resource populations is the purview of NMFS/NEFC. Knowledge about lethal or sublethal effects of contaminants is important to our understanding of fluctuations in abundance--as one of the many factors affecting fish and shellfish stocks. Body burdens of contaminants are important to consumers of seafood, especially since recent publicity about mercury, kepone, and PCBs in fish. Concern for contaminant levels in seafood seems to be a logical part of product quality and safety, in terms of public health, but the extent of responsibility of NMFS (as compared to that of FDA and USPHS) is not clear.

NMFS scientists have collected extensive data on contaminants in seafood, as have some of the states, but relationships of observed tissue levels to survival of fish and shellfish are still uncertain. Pressure continues to collect further data, but the interest is principally public health oriented and not resource oriented (except indirectly, as public concern about contaminants affects sale of seafood).

OPTIONS

In view of the need to understand how environmental factors, including all natural phenomena as well as pollution, affect survival and abundance of fish and shellfish stocks, and in view of the strong habitat conservation policy of NMFS, a number of options for future NEFC research present themselves.

Review of environmental research in NEFC exposes the question of a discipline versus a problem basis for Center programs and organization. At present we have a mix of the two. A problem basis would emphasize the following:

- What is the status of principal stocks of concern to US fishermen in the Northeast, and what is the effect of fishing?
- What natural environmental factors (predation, starvation, disease, physical stress, others) affect abundance and distribution--and how much?
- What are non-fishing effects of humans on resources and habitats?

A discipline orientation of programs would emphasize physiology, chemistry, pathology, physical oceanography, ecology, and others. Some examples of discipline-oriented research would be

- A study of the role of disease in mortality of fish and shellfish.
- A study of contaminant levels in fish tissue.
- A study of the physical oceanography of the Gulf of Maine.

Examination of existing NEFC research divisions discloses that some are problem oriented and some are discipline oriented. Some include combinations of disciplines, but retain a discipline orientation (ex. Aquaculture). This lack of uniformity produces minor conflicts, but has proven to be reasonably workable over the past seven years (the present Center was formed in 1976), and the existing structure could be maintained. This would be Option One.

Option One would continue with only minor modification the present NEFC commitment to environmental research and monitoring, but would not increase the relative proportion of funds or staff over present investments. Understanding of effects of environmental factors on survival, recruitment, and abundance should continue to be a principal research objective of the Center. A logical subdivision of effort would be to have AEG responsible for physical factors, ME responsible for biological factors exclusive of pollution, and EA responsible for all pollution-related environmental research and monitoring (Pollution-related diseases would continue to be the responsibility of the Pathobiology Division).

One significant modification of present emphasis in the Environmental Assessment Division would be to extend the present Ocean Pulse monitoring effort into coastal/estuarine waters through cooperative programs with the States, other NOAA elements, and EPA. This augmented monitoring effort could be supported in part by reprogrammed funds from present research in support of monitoring, being careful, however, not to let monitoring dominate all the Center's environmental efforts. Most of the existing Ocean Pulse stations have a good rationale for continued sampling, but some consolidation might be effected if the coastal/estuarine phase of the program is implemented.

Consequences of Option One

Positive	Negative
° Minor perturbation of existing programs and staff.	° Perpetuation of present inadequate linkage of habitat programs with resource assessment.
° Clearer definition of inter-divisional responsibilities in pollution research.	
° More complete monitoring coverage of Northeast coastal/estuarine waters, with opportunity for more effective cooperation with states in environmental studies.	

Option Two, which would involve elements of the Resource Assessment Division as well as Marine Ecosystems and Environmental Assessment, would be to form an analytic group within the Center to deal with population dynamics and ecosystems modeling and analyses beyond the assessment level (Figure 2). This quantitative group would work closely with ME, RA, and EA Divisions, but would be independent of any single division. The analytic group would carry out modeling and other analytic efforts that would be integrated with activities of OAD and EPA, and would insure full internal exploitation of the extensive NEFC environmental data base. Products of the analytic group should be displayed and discussed liberally with all constituencies, including the concerned public. The environmental data base of the Center would be augmented by continuing monitoring efforts at present levels.

Orientation of the analytic group would be toward quantifying impacts in terms of definable and measurable risks to society. Results would be directly applicable to requirements of the Regional Action Plan (RAP).

NEFC HABITAT CONSERVATION

ANALYTIC GROUP

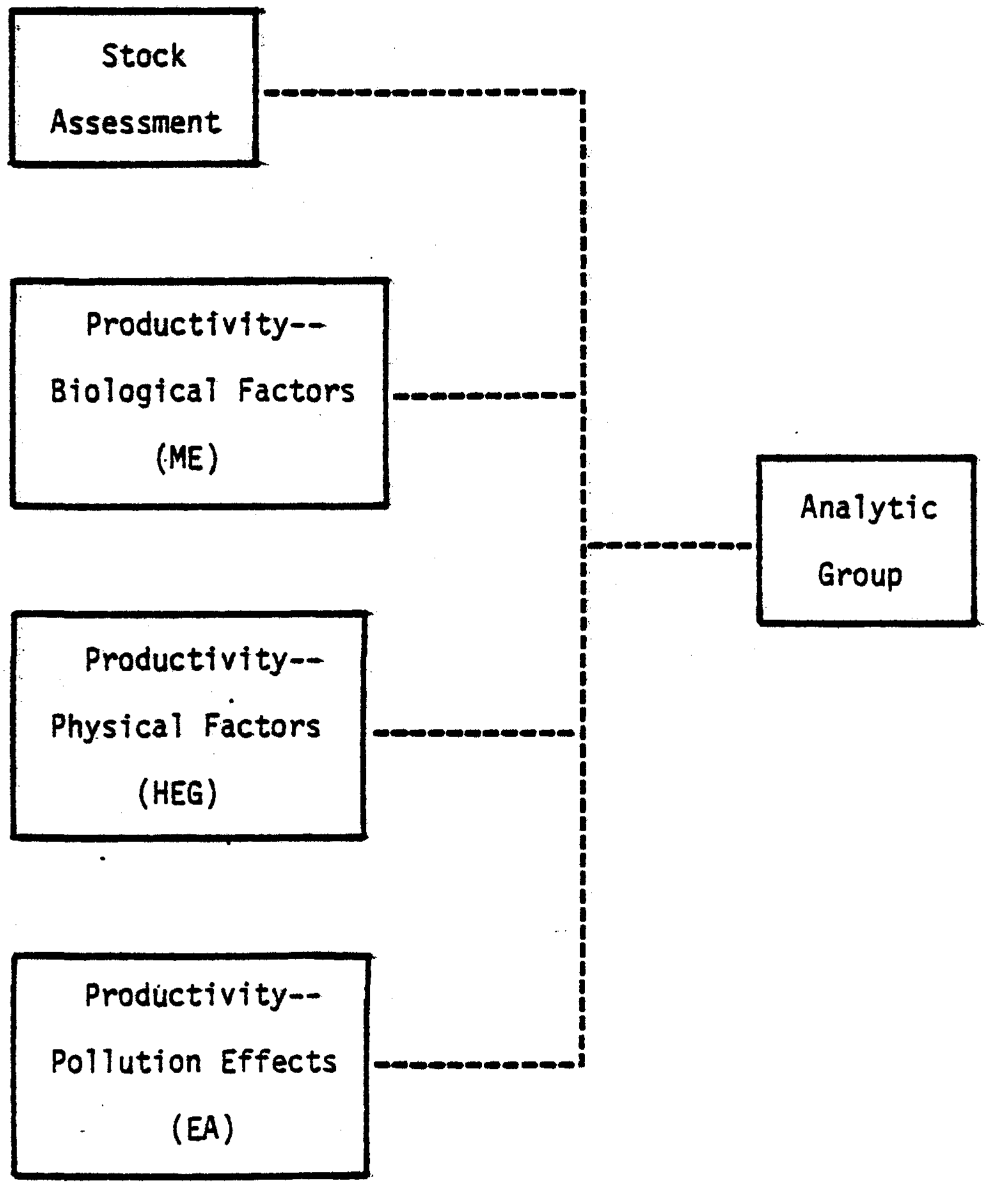


Figure 2. Proposed integration of analytic responsibilities within NEFC.

Consequences of Option Two

Positive	Negative
° Would provide integrated NEFC effort in data synthesis and modeling efforts.	° Would require sensitive approaches to data analysis, insuring priorities of individual research staff members.
° Would reduce present OAD usurpation of analytic responsibilities of NMFS/NEFC.	° Would separate higher analytic/synthetic activities from more routine resource and environmental assessment work.
° Would insure continuing effort for full utilization of NEFC data by NEFC scientists.	

Another option, Option Three, could also be instituted with only restricted impacts on the two divisions most directly concerned with environmental matters (Marine Ecosystems Division and Environmental Assessment Division).

Option Three would reorient some of the ongoing research of EA and ME Divisions toward a frontal attack on the problem of quantification of effects of pollutants on abundance and survival of fish and shellfish stocks. With existing information about effects of some natural factors (ocean currents, predation, temperature, food supply) on abundance, it should be feasible to begin such an analysis with selected species or in selected areas. Close cooperation and joint task forces of EA, ME, and RA Divisions would be required.

Consequences of Option Three

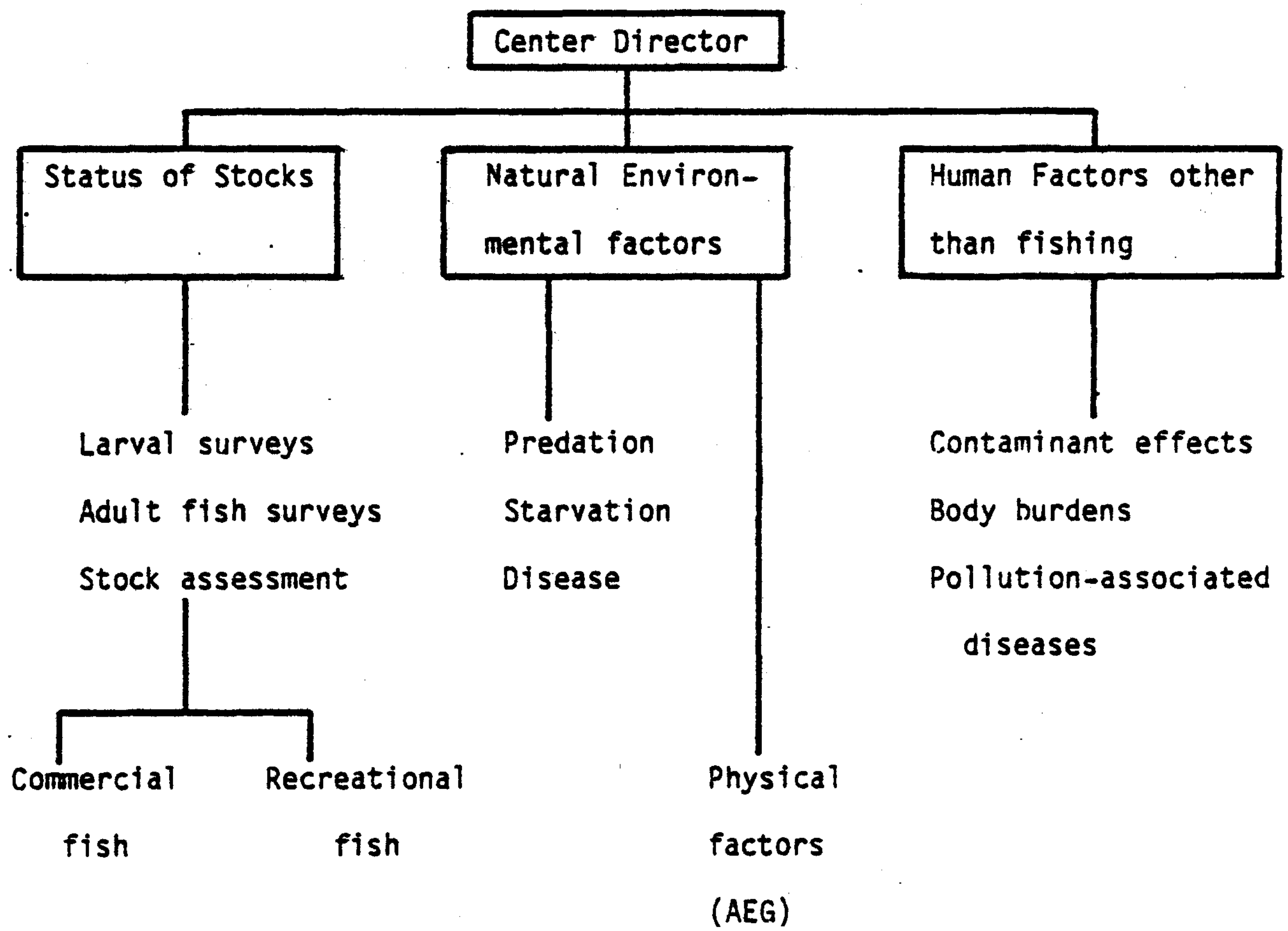
Positive	Negative
° More rapid and complete evaluation of pollution effects on abundance of fish and shellfish. ° Opportunity for in-depth comparisons of natural and man-induced environmental changes on abundance of fish and shellfish.	° Requires voluntary cooperation of diverse program elements.

It seems, though, that by careful definition of basic problems which should be addressed by NEFC research, it would be possible to restructure Center divisions significantly to deal with major problems more effectively. The restructuring proposed under Option Four would group all direct fishery related research under "status of stocks", but would continue to separate studies of natural factors of the environment from man-induced factors (other than fishing). This restructuring would affect the Marine Ecosystems Division most of all, orienting it toward studies of natural environmental factors affecting abundance and distribution of fish. Restructuring might include the following:

- Transfer of ichthyoplankton surveys to the resource assessment group as part of long-term monitoring of stocks.
- Transfer of oceanographic studies to AEG, which would then serve as a single focus for oceanography related to fisheries.
- Transfer studies of pollution effects on fish larvae to the Environmental Assessment Division.
- Transfer climax predator work to a recreational fish unit within the Center (probably as a subdivision of the resource assessment group).

Reorientation of Center programs to a problem basis might also result in division of disease studies. Those concerned with effects of disease on natural populations could become part of a larger group concerned with effects of natural environmental factors on abundance, while those concerned with pollution-associated diseases would become part of a larger group concerned with effects of humans on resources and habitats.

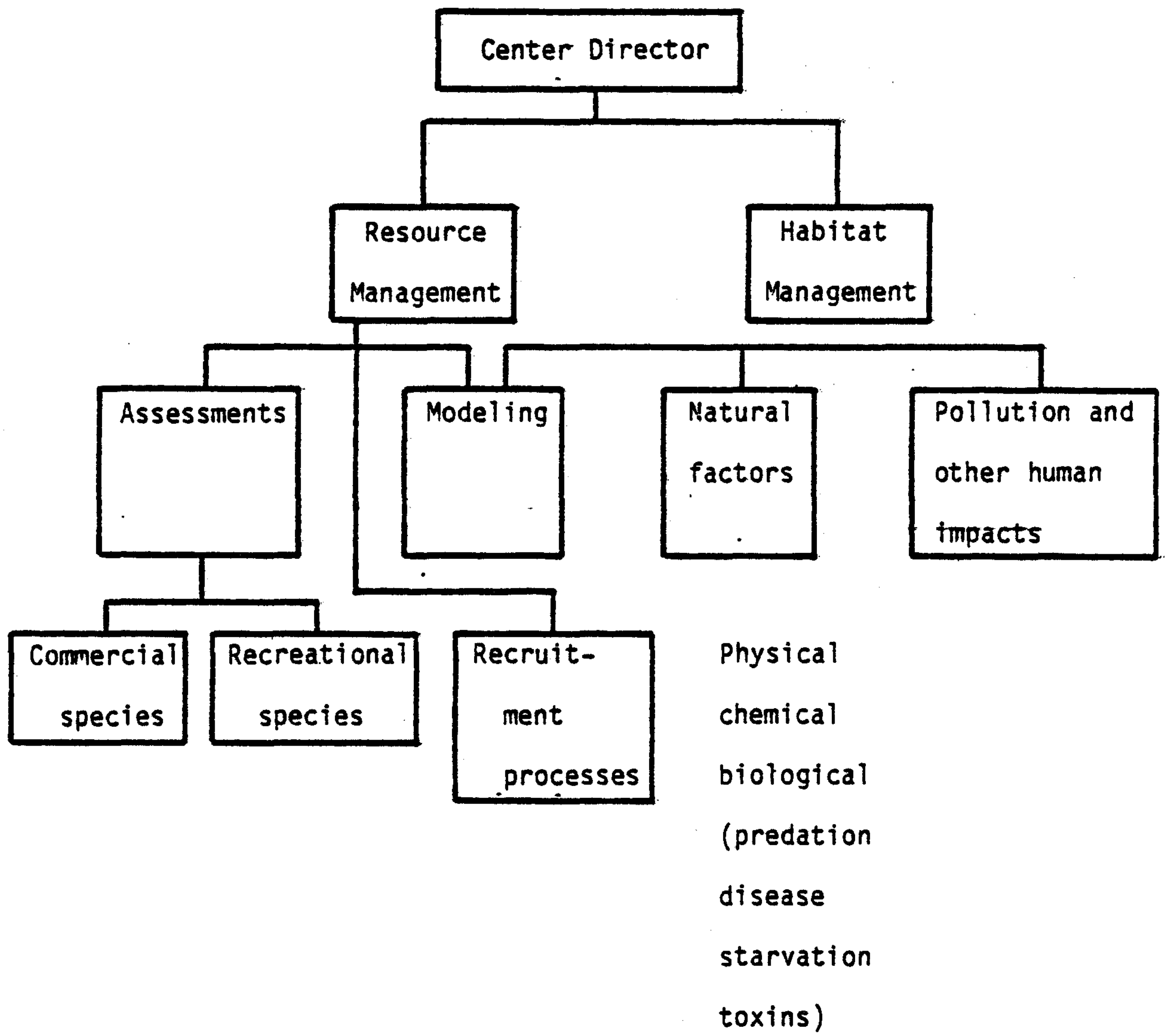
According to this major restructuring, the Center's core programs could be visualized as:



Consequences of Option Four

Positive	Negative
° Would for the first time bring all direct fishery-related activities of NEFC into one major operating unit.	° Involves significant re-organization of several divisions, with potential staff disruptions.
° Would unite all physical oceanographic research in a single unit (AEG).	° Would result in dissolution of Pathobiology Division and severe reduction of Marine Ecosystems Division.

Another method of major problem-oriented restructuring, Option Five, would place all direct fishery research into one unit labelled "Fishery Management" and all habitat research into another labelled "Environmental Management":

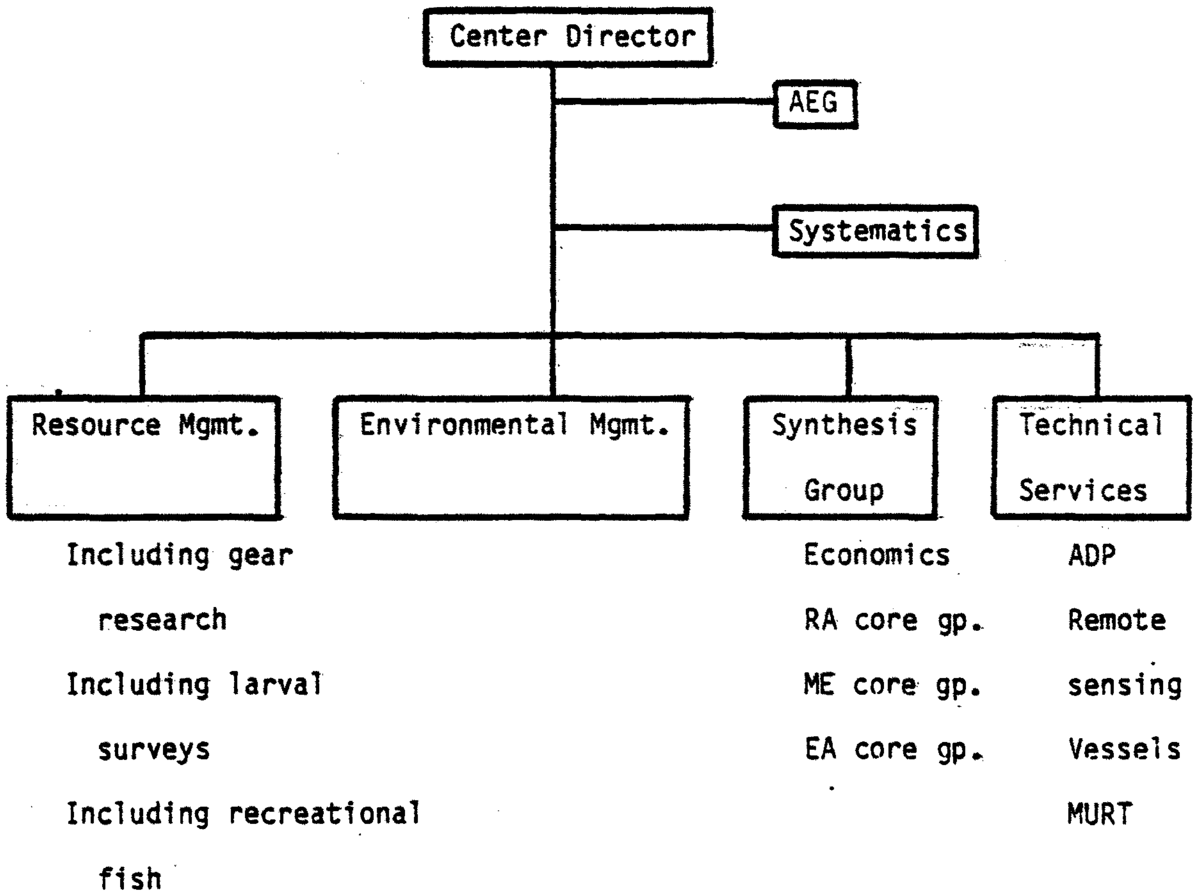


Insofar as environmental studies are concerned, Option Five would integrate all habitat research of NEFC into one large program wich would deal simultaneously with productivity and with environmental factors, natural and man-induced, which affect recruitment and abundance. Such an integration, although it might produce a group of unwieldly size, should insure that all components of the environment which affect abundance would receive attention in relation to perceived impacts on stocks.

Consequences of Option Five

Positive	Negative
° Would for the first time place all resource assessment and all environmental activities into two major units.	° Could produce research management groups which are too large to be most efficient (this effect might be minimized by appropriate subdivisions).
° Would permit more effective communication among all resource assessment groups and among all environmental groups of NEFC.	° A persistent problem, even with this radical restructuring, would be the best organizational position for the larval energetics and behavior programs, which have aspects important to recruitment processes as well as environmental effects.

If Option Two is combined with Option Five, a final structural diagram of NEFC might look like this:



(Note: The five options discussed here are described from an organizational (structural) perspective, but they really relate to <u>program activities</u> and not merely to structure. The basic research problems to be approached remain the same, and in many instances the research activities are consistent, but the ways in which the activities are managed, coordinated or integrated may vary).

ANALYSIS

Examination of the nature and extent of environmental research in NEFC discloses several major problem areas which must be addressed:

(1) The role and operational position of AEG. This group is a national one, with responsibilities for the entire Atlantic coast. Thus its programs should augment those of NEFC, but must have broader objectives as well. Assuming that the organizational status of AEG will not change, and that it will remain semi-autonomous but responsive to NEFC needs in physical oceanography, it would seem logical to concentrate any NEFC physical oceanographic research in this Group, rather than to have a separate effort in ME Division.

(2) The proper focus for pollution-related environmental studies. At present the entire resources of EA Division are focused on effects of environmental degradation. In view of possible impacts on resources and habitats, this seems like a logical emphasis, although greater attention should be paid to quantifying effects. It does not seem logical, however, to have pollution-related environmental research also carried on independently by ME Division, which has responsibility for examining effects of natural factors on survival, recruitment, and abundance. Pollution effects on eggs and larvae should be within the purview of EA Division, and not ME. Better definition could be achieved by transfer of ME staff now involved in pollution studies to EA Division, or by redirecting their efforts to the needed examination of effects of natural factors. the ultimate solution would of course be to combine all environmental research into one large unit, as suggested in Option Five.

(3) The necessity of quantifying pollution effects on living resources and habitats. It is difficult to identify and measure the effects of environmental degradation on fish stocks and on their supporting ecosystems--and yet this is clearly a necessity to justify major emphasis on this area of research. That such effects are occurring is clearly indicated from experimental studies, yet the translation of experimental findings to field observations is very incomplete and inconclusive at present. It is obvious that descriptive and monitoring efforts must continue, but it is also obvious that the EA Division must focus more directly on quantifying pollution effects on local stocks and species.

Each of the five options presented has positive as well as negative aspects, as outlined in the preceding sections. Selection of a course of action must depend in part on the degree of perturbation of the existing system that is desired and can be tolerated. Evaluation based on selected ranking criteria (Table 1) suggests that major integration of environmental and resource assessment programs would be desirable and efficient. Other considerations, especially impact on existing staff, might call for reduction in the extent of tolerable perturbation, favoring Option Four, which would group resource assessment activities, but keep pollution-related research distinct from other environmental studies.

A combination of Options Two and Three--formation of a separate analytic group and a joint frontal effort toward quantifying pollution effects--might be less disruptive and might best serve future needs of NEFC. This choice would, with minimal disruption of existing divisions, insure that a proper balance was retained between studies of natural and man-induced factors, and would accelerate a more quantitative examination of all factors.

Table 1. Ranking criteria for selection of option

OPTIONS \ RANKING CRITERIA	Impact on existing structure and staff	Management efficiency	Logical combination of elements	Effective response to basic problems	Satisfactory constituent needs
One: Retain existing division structure	Low	Moderate	Moderate	Moderate	Moderate
Two: Form analytic group outside the divisions	Low	Moderate	Moderate	High	Moderate
Three: Reorient toward frontal attack on quantification	Moderate	Moderate	Moderate	High	High
Four: Group all direct fishery-related activities	Moderate	High	High	High	High
Five: Group all fishery and all habitat activities into two major units	High	High	High	High	High

Final but important considerations in the selection of options are needs of constituents--groups such as EPA, COE, States, Regional Habitat Conservation offices, Fishery Management Councils--who expect substantive data to support advisory, managerial, and regulatory actions.

APPENDIX VII.

ATLANTIC ENVIRONMENTAL GROUP

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Atlantic Environmental Group
RR 7, South Ferry Road
Narragansett, RI 02882

Date: 30 January 1984

To: M. Sissenwine, Chairman, Committee of Three, NEFC

From: M.C. Ingham, Director, AEG M.C. Ingham

Subject: Action Items Requested by Committee of Three

In response to your request transmitted by the Center Director's memo of 3 January 1984 we submit the following:

Mission Statement for AEG:

Assemble, portray, analyze, and synthesize longterm meteorological and oceanographic data useful for describing environmental features, processes, and trends which may influence distribution or abundance of living marine resources, and habitat quality.

Provide information concerning environmental variations to fishery scientists for use in research and management activities, and to commercial or sports fishing interests as an aid to locating concentrations of pelagic fishes or avoiding hostile conditions for their operations.

Assist in the development of diagnostic and predictive models of fish stock abundance or habitat quality which include environmental trends and variations.

Possible Overlap with Physical Oceanography Activity in the Marine Ecosystems Division: There is very little overlap between the activities of the two groups, because those of Dave Mountain's group in MED are based mainly on data they collect at sea on survey cruises or process-oriented studies. AEG's activities are based mainly on time series data obtained from archives or processing centers in other branches of NOAA or outside, except for the data we obtain from our Ships-of-Opportunity program. There is a small amount of overlap (cooperation) in SOOP activity; both groups work together to acquire and process data from the Ship-of-Opportunity transect in the Gulf of Maine. Occasionally in the past the two groups have worked cooperatively on specific, short-term projects, but that does not represent duplicative overlap.

Feasibility of AEG Supporting All the Physical Oceanographic Needs of the NEFC: It would not be feasible for AEG to do this without major increases in staffing and funding. At present the staff of AEG is fully committed to programs related to our stated mission (see attached organizational chart).

Feasibility of Integrating AEG into a Major Center Program Element: Such an integration would be feasible, only if AEG's mission were revised to contribute directly to that of the program element with which integration occurred. If integrated with one of the Center's divisions, such as RAD,MED, or DEA, then AEG should serve just that division and not the whole NEFC, as it does now. If AEG's mission continues to involve it with all divisions, then it should remain separate from them.

Responsibilities of AEG to the Southeast Fisheries Center: At present there are no significant interactions or responsibilities extant between AEG and the SEFC. In addition, the probability of significant interactions with the SEFC in the near future seems small.

Proposed January, 1984

ATLANTIC ENVIRONMENTAL GROUP
M. C. Ingham, Director

GRAPHIC ARTS SERVICES
L. D. Armstrong
Scientific Illustrator, PTP

CLERICAL SERVICES
M. J. Denecour
Secretary, FTP

D. G. Wheaton
Clerk-Typist, PTP

OCEAN CLIMATOLOGY
AND
MONITORING TASK
M. C. Ingham, Director

OCEAN ENVIRONMENT
ANALYSIS PROGRAM
R. S. Armstrong
Oceanographer, Chief

* Vacant
Oceanographer, FTP

P. J. Celone, LTJG
NOAA Corps

C. A. Price
Oceanographer, PTT

SHIPS OF OPPORTUNITY
OCEAN MONITORING PROGRAM
S. K. Cook
Oceanographer, Chief

** R. L. Benway
Technician, PTP

S. P. Matteson
Technician, PTT

M. J. Lussier
Phy. Sci. Aide, PTT

OCEAN ECOLOGY
ANALYSIS PROGRAM
J. W. Jossi
Oceanographer, Chief

** D. E. Smith
Technician, PTP

** G. B. Wood
Technician, PTP

R. H. Rubinstein
Comp. Programer, FTT

* Requested waiver from hiring
freeze on November 1, 1983

** Requested authority to convert
to FTP (2080) on November 22, 1983

APPENDIX VIII.

MOLLUSCAN AQUACULTURE IN THE NORTHEAST AND FUTURE RESEARCH DIRECTION FOR MILFORD (CONNECTICUT) LABORATORY OF THE NORTHEAST FISHERIES CENTER

ISSUE PAPER

MOLLUSCAN AQUACULTURE IN THE NORTHEAST, AND FUTURE RESEARCH DIRECTIONS FOR THE MILFORD (CONN.) LABORATORY OF THE NORTHEAST FISHERIES CENTER

January, 1984

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BACKGROUND

This issue paper is designed to offer options for reorientation of research programs at the Milford (Connecticut) Laboratory of the Northeast Fisheries Center. It is based on the perception that a shift away from an aquaculture program emphasis is necessary at present. This is in turn based on (1) the fact that molluscan aquaculture was not included in the last two administration budget submissions (but funds were added by Congress), and (2) a statement of NMFS position on aquaculture by Mr. Gordon (dated November 16, 1983) that "....NMFS aquaculture efforts will be directed to managing common property resources and endangered species, not for food production." Mr. Gordon also stated in the same memo ..."NMFS will disseminate aquaculture-related information and technological advances gained from its fishery research."

It might be relevant in this background discussion to consider very briefly a few basic questions about aquaculture:

° <u>Is there a federal role in molluscan aquaculture, and if so what is it?</u>

Molluscan aquaculture research at Milford has been conducted for the past five decades in the belief that there was a continuing need for federal involvement. Some of the premises were that long-term basic studies (genetics, disease, nutrition) were essential to the technological base of marine aquaculture and could not or would not be done by states or industry; that marine aquaculture will one day provide a significant national source of high-value food, but its existing technological base is inadequate; and that marine aquaculture efforts are national in scope and should be addressed nationally. Principal arguments against a federal role hinge on the extent to which federal research should be conducted in direct support of industry, and whether industry should be expected to support research which benefits it.

° <u>What should be the NMFS role in marine aquaculture?</u>

NOAA has had and still has two major involvements in marine aquaculture--Sea Grant (which invests about $9KK in aquaculture-related university research and extension) and NMFS (which has had major ongoing research on molluscs (Milford), shrimp (Galveston--until recently) and salmon (Manchester, Washington and Auke Bay, Alaska). Additionally, the Department of Agriculture has become interested in, and has made a minimal investment in, marine aquaculture.

To many people, marine aquaculture is a logical, even essential, part of food production from the sea, and a mandated responsibility of any national fishery agency. This view has apparently been accepted by most fishing nations, where marine aquaculture activities are within the purview of the national fishery agency.

Marine aquaculture in United States has developed slowly, and still contributes relatively little to total fish production. A large part of this slow growth can be attributed to unfavorable economic position of its products, which are generally in direct competition with those from fisheries on wild stocks and from imports. An inadequate technological base for culture of some marine species (shrimp, pompano, lobster, and others) has further impeded progress. The rate of development of marine aquaculture in this country is also dependent to some extent on existence of an adequate infrastructure of loans, grants, and crop insurance, as well as relief from multiple and often confusing regulations.

The principal past contributions of NMFS and predecessor agencies have been in research information contributing to the technological base of production--still a critical need of a developing fishery-related industry. The future of molluscan aquaculture in NMFS could take several courses:

- The Shellfish Institute of North America several years ago strongly endorsed a federal role in basic studies of molluscan genetics, nutrition and disease control. A similar endorsement was made by NAS in a recent report.
- The states have recently asked for federal assistance with problems concerned with transfers and introductions--a code of practice, certification of stocks, etc.
- There may be a federal role in population enhancement--augmentation of shellfish and other stocks similar to current Japanese efforts with shrimp and sea bream.

° <u>What should be the NEFC (Milford) role in molluscan aquaculture research and development?</u>

With a distinguished history of almost half a century of aquaculture-related research, Milford has emerged and is known worldwide as a center of excellence in molluscan culture. Shellfish hatcheries, using methods developed at Milford, are now in operation on both coasts of United States, and much of what is known of oyster biology has been derived from its research.

There is still, however, much that remains to be learned about the biology of other molluscs now subjects of culture development. Species such as surf clams, bay scallops, and calico scallops differ in some respects from one to another, and require research attention before culture technology can be considered adequate. Thus there is a continuing need for research information which can be applied directly.

Beyond this, there is a continuing need for long-term basic research in genetics, nutrition, resource enhancement and disease control--research that can only be done by an institution such as Milford--which has the expertise, the flexible extensive facilities, and the continuity of programs which are required. There is at present some limited aquaculture research and development, principally through States and Sea Grant, in the Northeast. Aquaculture production is limited largely to Long Island oysters and clams, and a small European oyster culture development in Maine.

(Budgetary issues need to be reviewed in the context of Milford Aquaculture. The program is now funded at $1.3KK as part of an Aquaculture line item. Some of this funding has been used as Washington Office and NEFC support in the past. Any major shift in program emphasis and funding would probably require DOC approval).

OPTIONS FOR REORIENTATION OF

MILFORD PROGRAMS

The present research program at Milford is divided roughly 2/3 under the Aquaculture budget item, and 1/3 under Habitat Conservation. Programs labelled "aquaculture" include spawning and rearing, nutrition, pathology, and genetics. Principal species of interest are oysters (nutrition, pathology and genetics), as well as surf clams and bay scallops (spawning and rearing). Programs labelled habitat conservation emphasize laboratory and field research on physiological effects of contaminants (but include biochemical and genetic effects). Thus the research activities at Milford extend far beyond those which can be considered aquaculture-oriented.

Activities at Milford which should continue, regardless of changes in programs, are (1) the long-term shellfish industry liaison activities (indicated as being within current NMFS purview by Mr. Gordon); and (2) the maintenance of selected stocks and the selective breeding program for oysters (a unique effort, which has required years to develop to its present stage, and which would be lost irreversibly if the selected stocks are abandoned). Milford shellfish liaison has a long history; its principal components are periodic meetings with the shellfish industry and prompt response to crises, as well as training programs in molluscan culture techniques. Selective breeding work has focused on hybridization of oyster species, and selection of stocks for rapid growth.

Considering the resident expertise and the facilites of Milford, a number of options for reorientation exist:

(1) The present program mix could be retained, with suppression of the term "aquaculture."

(2) A new program thrust, called "Experimental Shellfish Biology" could be planned and instituted. The program could emphasize recruitment variability, its causes and possible effects of human interventions.

(3) Ongoing research in genetics could be augmented. Present emphasis on mutagenesis and selective breeding could be expanded to include population genetics and genetic engineering.

(4) All Milford research could be reoriented toward pollution effects.

(5) Ongoing aquaculture-funded programs could be integrated with those of other Center divisions.

(6) Research could be reoriented toward coastal/estuarine ecology, with major attention to Long Island Sound, and including fish as well as shellfish.

Each option, together with positive and negative consequences, is discussed briefly in the following sections:

OPTION ONE: Retain the present program mix at Milford, but suppress the term "Aquaculture".

Rationale: Aquaculture research at Milford has suffered repeatedly from changing administration (principally OMB) attitudes about the proper federal role for research which is directly in support of industry. The present administration view seems to be that private industry should support such research. Accordingly, molluscan aquaculture funding has been deleted from the administration budget for the past two years (but restored by Congress).

The present program mix at Milford includes spawning and rearing, genetics, nutrition, and pathology--much of which is long-term research, but some of which has had and continues to have immediate payoff in application to the shellfish industry. Research on oysters has been and may continue to be a focus under this option.

The shellfish industry is politically cohesive, speaking through the Shellfish Institute of North America (SINA) which is now an affiliate of the National Fisheries Institute (NFI). SINA has had continuing concern for Milford research, and was instrumental in obtaining, through congressional action, specifically designated molluscan aquaculture funding in the mid-1970's.

Consequences:

Positive	Negative
° This option requires no major reorientation of a research staff already exposed to repeated programmatic shifts.	° This is principally a cosmetic move, and is not in accord with policies of the present administration or with statements enunciated by the Assistant Administrator for Fisheries. (It should be noted, however, that the shellfish industry liaison activities of Milford are still within his stated guidelines).
° Industry support should continue, once assurances are given that research will continue to identify with shellfish industry problems.	

OPTION TWO: Plan and institute a new program thrust, called "Experimental Shellfish Biology".

Rationale: Many aspects of shellfish biology, except those concerned with oysters, are still poorly understood. The biology of many of the principal commercial species, such as sea scallops, bay scallops, surf clams, ocean quahogs and commercial gastropods, is is still poorly known and requires study, whether for aquaculture or management of wild stocks. This is especially true in areas such as causes of recruitment variability, an understanding of which would lead to greater predictability. Included here would be field and experimental studies of factors affecting setting of spat, role of predation and disease in causing mortality, genetic effects, and effects of pollution on survival, growth, and reproduction. It would be possible to look at methods of population stabilization and enhancement. Understanding of factors affecting survival might offer insights on how to level off extensive periodic fluctuations.

The laboratory has a fifty year history of excellence in experimental shellfish biology; it has always been oriented toward invertebrates; and most staff members consider themselves as experimental biologists. Emphasis would shift away from oysters to other molluscan species under this option.

The laboratory experimental work could be broadened and augmented by field experiments, possibly with MURT and the Environmental Assessment Division providing support for field studies. Such studies would relate well with a proposed center for undersea work at Avery Point (U. Conn.). Milford has an excellent vessel available for any field experimental work.

Consequences:

Positive	Negative
° This option would require only minimal reorientation of Milford staff, and would probably be acceptable (after suitable briefing to the shellfish industry).	° The program might be vulnerable to criticism by some as being too basic and of a kind which should be carried out by universities. It would, however, relate to variability in stocks over entire ranges of economically important species
° This option would address genuine information gaps in shellfish biology--gaps with practical significance in terms of understanding fluctuations in abundance.	° Any substantial reprogramming away from aquaculture at Milford could expect to encounter "constituency backlash", especially from SINA. Also, key legislators with interest in aquaculture and/or Milford would naturally be concerned and must be consulted.
° This option would provide at least partial relief from continuing bureaucratic maneuvers related to aquaculture (What agency should have the lead? How direct should industry support by? etc.).	

OPTION THREE: Reorient much of Milford's research toward marine genetics

Rationale: Marine genetics, as a research specialty, is at present surprisingly small on national and international scales. The program in genetics at Milford has principal foci on selective breeding of oysters and on mutagenic effects of pollutants on eggs and larvae of fish and shellfish. This highly productive group has achieved international recognition for its work, and its techniques are being used by other developing marine genetics research groups. The greatest hindrance to expansion of marine genetics is non-availability of experimental populations; this is not a problem at Milford, where several shellfish species can be reared through entire life cycles. There is also the possibility of cooperative work on genetics of fish species utilizing the rearing capabilities of the Narragansett Laboratory.

Additional areas which could be explored by an augmented genetics group at Milford might include population genetics--especially the selective effects of fishing on genetically-influenced characteristics and on genetic drift in sub-populations.

Work with selective breeding and hybridization of oysters should be continued, and the third generation stocks should be maintained. Also, selective breeding might be expanded to develop a standard stock for experimental purposes--similar to inbred strains of other laboratory animals.

An expanded program in marine genetics would require cooperation with university and other genetics research groups, since present capabilities are principally in mutagenesis and selective breeding.

Consequences:

Positive	Negative
° Milford could easily develop into a center of worldwide excellence in marine genetics.	° Basic marine genetics research might be considered too fundamental and unnecessary in a time of fiscal restraint and reduction of federal non-defense budgets and programs.
° Basic research as well as genetic engineering of marine species are needed and feasible if the research group has critical mass.	° There has been no clearly demonstrated application of marine genetics research to major fisheries problems in the United States.
° Funding for population genetics research presently exists at Woods Hole; this could be redirected to support an expanded NEFC genetics program.	° The Milford Laboratory is not ideal for work with marine fish, because of salinities and water quality; an integration of the fish spawning and rearing competence and facilities of the Narragansett Laboratory would be necessary for a broad program in marine genetics.

OPTION FOUR: <u>Reorient all Milford research toward pollutant effects on living resources.</u>

<u>Rationale</u>: The two principal research areas at Milford at present are aquaculture and physiological effects of pollutants. It would be feasible, with relatively minor changes in emphasis, to redirect the focus of all programs toward pollutant effects. The spawning and rearing efforts could be focused on supplying large numbers of early life stages for studies of contaminant effects on genetics, reproduction, recruitment, growth, and survival. The genetics group could be entirely focused on pollutant effects (except for limited necessary maintenance of selected stocks). The nutrition work could emphasize contaminant effects on algae, and the pathology group could examine pollutant-related diseases of larvae. All of these programs would relate well with the ongoing physiological effects research at Milford, providing a major pollution research effort. Additionally, behavioral work at Sandy Hook could be further associated with expanded physiological effects work at Milford.

Consequences:

Positive	Negative
° Reoriented aquaculture research at Milford would blend with and augment ongoing field and laboratory pollution research, forming a major research effort on pollution effects.	° There is a very real problem of the extent to which this Center should be involved in pollution related research. We already have major segments of two laboratories involved (Sandy Hook and Milford). This option would add significantly to that emphasis, and would raise questions about overall program balance in the Center.

OPTION FIVE: <u>Integrate ongoing aquaculture oriented programs with those of several other Center Divisions</u>.

<u>Rationale</u>: All of the ongoing aquaculture research at Milford could, if necessary, be integrated with ongoing work in other divisions, with the exception of the selective breeding and maintenance of selected stocks of oysters. The spawning and rearing work could be a part of Resource Assessment, examining factors which affect setting and survival of shellfish, including predation. The genetics work could be reoriented exclusively to mutagenic effects of pollutants under Environmental Assessment (part of the effort of the genetics group is already in that area). Alternatively, the genetics group could turn to population genetics of fished stocks, under Resource Assessment. The pathology group is already a component of the Pathobiology Division, even though it is supported by aquaculture funds. The work of this group could be reoriented toward diseases of fish larvae and juveniles, as well as shellfish larvae. The nutrition group could emphasize effects of pollutants on algal reproduction and growth, under Environmental Assessment (some of this kind of research is already being done).

Consequences:

Positive	Negative
° Two divisions of the Center could gain unique expertise. Resource Assessment could gain in population genetics and recruitment variability in shellfish; Environmental Assessment could gain in further emphasis on genetic and physiological effects of pollutants.	° The present Milford staff in aquaculture is a highly integrated one; fragmentation into several divisions could have negative effects on productivity.
	° The laboratory has had a fifty year history of experimental research on molluscan shellfish; reorientation would destroy this productive focus.
	° Research direction and supervision from a distance are among the less-desirable aspects of a matrix organization, but this Center has a decade of experience with it.

OPTION SIX: Reorient research toward coastal/estuarine ecology, with major attention to Long Island Sound.

Rationale: The laboratory is located adjacent to Long Island Sound, a major productive arm of the sea, heavily impacted at its western end by the New York metropolitan population. It is an important recreational fish area and (at its eastern end) commercial fisheries are significant. Long Island Sound, with its gradients and its circumscribed waters, can be considered as a large-scale field experimental facility.

The Center (and its predecessors) has carried out environmental research in the Sound, but not extensively and not continuously. There is opportunity, with the cooperation of the bordering states of New York, Connecticut, and Rhode Island, to develop such a program, including related experimental studies. The emerging Marine Science Center of the University of Connecticut at Avery Point could be an effective partner in such an effort.

A major, but not exclusive focus of a Long Island Sound program could be habitat conservation and the effects of combined human pressures on resources and their supporting ecosystems.

Fish as well as shellfish would be considered and this effort could contain a significant portion of shellfish enhancement activities; as well as research on how temperate, east coast estuaries can be upgraded to provide for shellfish rearing in a multiple-use mode.

It may be that a stronger relationship between MURT and Milford could be developed--especially for on site evaluation of field experiments, and assessment of shellfish growing areas. Such a relationship could also capitalize on the development of the Avery Point facility as a center for manned undersea research Additional support for field activities could be provided by Environmental Assessment Division (Sandy Hook).

This option would envision a continuing shellfish emphasis but with a habitat and geographic overlay.

Consequences

Positive	Negative
° Long Island Sound is an important fishery area which has received minimal attention to date; the location of the Milford Laboratory is ideal for field work in the Sound. ° Effective cooperative research arrangements could be developed with Sea Grant supported groups at UConn (Avery Point) and possibly URI and SUNY Stony Brook. ° Senator Weicker of Connecticut has been a strong supporter of NEFC,including aquaculture and Ocean Pulse, and would be very interested in programs relevant to Connecticut waters and Long Island Sound generally. ° It might be feasible to develop a joint Long Island Sound program with NEFC's Narragansett Laboratory--to balance fish and shellfish related studies.	° Pesent laboratory staff interests are principally in experimental rather than field studies; any major reorientation of programs toward environmental studies would be difficult. However, it should be emphasized that field studies are necessary to relate laboratory findings to effects in open environments. Risk assessment mandates the bridging of field and laboratory research efforts.

ANALYSIS

It is tempting to cling to the status quo, especially when administration views on federal involvement in aquaculture seem to vary drastically with time. It seems clear, however, that aquaculture is unpopular with elements of the present administration, and that it is expedient to propose a program shift away from that title. Mr. Gordon's position statement is helpful but not definitive. He stated that ..."NMFS' aquaculture efforts will be directed to managing common property resources and endangered species, not for food production." "...NMFS will disseminate aquaculture-related information and technological advances gained from its fisheries research." These statements indicate that our shellfish industry liaison at Milford can continue and possibly be expanded, but that our aquaculture research programs do not fit any current stated role for NMFS."

The complete text of Mr. Gordon's statement of the NMFS role in aquaculture is as follows:

NMFS and the Role of Aquaculture

NMFS seeks to optimize the use of its fiscal resources in carrying out its basic mission of managing, protecting, and developing our Nation's living marine resources. To this end, NMFS is striving to complement State, other Federal, and private sector activities, and to reduce duplication. Accordingly, NMFS' aquaculture efforts will be directed to managing common property resources and endangered species, not for food production. NMFS will continue to utilize aquaculture to: (1) support and/or contribute to management objectives defined in fishery management plans developed under the Magnuson Fishery Conservation and Management Act or the interjurisdictional coastal fisheries program in cooperation with States; (2) contribute to the restoration and protection of endangered species or stocks under programs authorized by the Endangered Species Act; and (3) respond to Indian treaty obligations, legislative mandates, and court orders, e.g., the Boldt decision. NMFS will disseminate aquaculture-related information and technological advances gained from its fisheries research. NMFS will continue to cooperate, within its fiscal limits, with Federal and State agencies, international bodies and foreign governments, and university and private interests. NMFS also will share scientific and technological knowledge applicable to aquaculture, and will promote the development and expansion of domestic and international markets for products produced by the U.S. aquaculture industry." (Mr. Gordon pointed out in a covering memo that "The purpose of this memorandum is to enunciate NMFS' position on aquaculture. It is not intended to result in any program changes, but merely to serve as general guidance for future planning. It also provides insight to my personal philosophy should we need to respond to budget changes or Administration directives").

Faced with these pronouncements and constraints, and trying to assess all positive and negative consequences of each option, it seems that Option Two--"A new program thrust in Experimental Shellfish Biology" would be the option of choice. Principal reasons are that it takes full advantage of existing expertise at Milford; it provides continuity for an integrated group; it is responsive to National Priorities (Goal A, Objective A, concerning recruitment of stocks); and it should not arouse any significant constituency or legislative backlash.

Implementation of a new program titled "Experimental Shellfish Biology" would have an added advantage of forcing a detailed examination of the appropriate NEFC (and NMFS) role in molluscan shellfish research. Such an examination must include evaluation of Sea Grant and State research efforts, and would attempt to develop some integrative process for all of them.

It should be clear that any one of the six options could be viable, but some may have more justification than others. It should also be clear that present Milford funding of $1.3KK is designated "Aquaculture," so any changes could not be effected until the 1985 budget without DOC approval. Political and industry consequences must be considered.

Based on the preceding, the following prioritization seems warranted:

Priority (1): Option Two -- Experimental Shellfish Biology

" (2): Option Six -- Coastal/Estuarine Ecology

" (3) Option Three -- Augment Genetics

" (4) Option One -- Retain Present Programs

" (5) Option Four -- Augment Pollution Effects

" (6) Option Five -- Integrate with other Divisions

The second priority--"Coastal/Estuarine Ecology emphasizing Long Island Sound--deserves mention with specific reference to Milford and with general reference to all NEFC laboratories. Implementation of such an option would add geographic area emphasis to the existing discipline focus of Milford. It would encourage attention to the geographic area, from the point of view of fish and shellfish production as well as habitat deterioration/improvement. Such an approach would result in greater local and regional support for NEFC programs. Thus it might serve as a model for all NEFC laboratories by serving three needs--(1) a geographic area emphasis, (2) a discipline focus (in this case shellfish biology), and (3) a broad perspective in a particular specialty area (in this case food production from estuarine waters). Probably each laboratory should have such a tripartite role (some already do, to some extent).

This examination of options should also include the possibility that combinations of options might be viable--for example a combination of experimental biology with a strong genetics emphasis. Any option selected should have as one goal the enhancement of interactions among NEFC divisions (this would of course be maximized by Option Five).

An examination of options for Milford also exposes a more generic problem which should concern the entire Center--should a laboratory be discipline or problem oriented. (Example: Experimental Biology versus Pollution?). Another generic issue exposed by examination of options for Milford is that some NEFC laboratories (such as Milford, with its seawater system and extensive wet labs) are important as facilities, and not just as office space.

Table 1. Evaluation of options, using selected criteria.

CRITERIA FOR SELECTION / OPTIONS	Option One Retain Present program mix	Option Two Experimental shellfish biology	Option Three Augment genetics research	Option Four Reorient toward pollution effects	Option Five Integrate with other Divisions	Option Six Coastal/ estuarine ecology
Relevance to NOAA/NEFC mission	Low	High	Medium	Medium	Medium	High
Relevance to NEFC mission	Low	High	Medium	High	Medium	High
Effective use of existing staff competency	High	High	Medium	High	Low	Medium
Amount of reprogramming required	None	Low	Medium	Low	High	High
Degree of legislative/ constituency resistance to proposed change	None	Low	Low	Medium	High	Medium

APPENDIX IX.

NEFC AUTOMATIC DATA PROCESSING TECHNICAL REVIEW

Item 1.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Center
Woods Hole Laboratory
Woods Hole, Massachusetts 02543

March 1, 1984

To: Distribution Only

From: Michael P. Sissenwine Mike

Subject: NEFC Automatic Data Processing Review

The NEFC Automatic Data Processing Review was conducted on 28-29 February, 1984, at the Woods Hole Laboratory. The agenda and a list of participants are attached. This memo reflects my impressions of the NEFC's ADP capability. It is not an attempt to summarize the enormous amount of information presented during the session. I welcome your comments. They will be most useful if received prior to March 15th.

The NEFC has made significant progress in achieving its ADP needs. Approximately three years ago, it was faced with the retirement of the Woods Hole Oceanographic (WHOI) SIGMA VII computer, an ineffective data base management system on the University of Rhode Island computer system, and a batch-oriented computer with limited capability at Fort Mommouth, New Jersey. Since then, the Center has converted to a new VAX at WHOI. During the conversion it achieved significant improvement in its data base systems. The Sandy Hook Laboratory will begin using the WHOI system soon. Through a Memo of Understanding, the Narragansett Laboratory has access to the Environmental Protection Agency's PDP-11 computer. The Laboratory is in the process of converting. This progress has been achieved as a result of the combined efforts of the Center's ADP Unit and Program staff.

Nevertheless, there are some concerns:

1. System stability - The Center is usually in a catch-up mode. Part of this reflects past and present inadequacies in planning and in implementing plans. Implementation is frustrated by an inordinate amount of difficulty in procurement.

2. Costs have exceeded budget allocations. This implies that either cost projections were inaccurate and/or the ADP Unit has not communicated the magnitude of the problem to the Center and Programs. The result has been unfulfilled expectations, and severe disruption. One major cause of the problem has been centralization of the ADP resources and responsibilities. As a result, programs have not been held accountable.

3. Communications have been poor. Programs are not well informed of plans, implementation status, and budget status (see item 2). Two examples of the communications problem became apparent at the review. Apparently, Programs were unaware that a VAX 11/750 might be temporarily substituted for the planned addition of a VAX 11/780 (see item 11). Furthermore, RAD has not been kept informed about the actual status of implementation of remote data entry from ports (i.e. funds allocated for this purpose have been identified to offset the ADP Unit's deficit).

4. The Center is lagging behind in its use of microcomputers. This may reflect a deficiency in technological expertise within the staff.

5. Since resources are limiting, it is necessary to prioritize. There hasn't been a clear basis for prioritization (i.e., lack of communications). This has led to frustration and dissension within Programs. The problem is exacerbated by the continuous evolution of fishery statistics data bases (e.g., the three-tier system, joint venture data). As a result, even the perceived top priority ADP projects are never completed, and lower priorities cannot be addressed.

   The problem of priorities is related to ADP centralization. If ADP responsibility was within programs, ADP capability would reflect priorities of the Center, and the cost of ADP would be viewed as integral with the cost of data collection.

6. There is a tendency for Programs to put more priority on access to data for their own use than for archiving data and making it accessible to a broader user community. This problem reflects the centralized nature of ADP capability. As a result, Programs are not viewed as accountable for developing and managing data bases.

7. The Center uses a variety of data base management languages. This is particularly a problem when systems are not stable. Furthermore, it impedes interfacing of data bases.

8. There should be a common link between research vessel data. The Center conducts multipurpose research vessel cruises in which several types of data are collected simultaneously at the same time and at the same location (e.g., bottom trawl hauls, bongo net tows, and fish stomach collections). It is difficult to link data bases for the purposes of simultaneous analyses.

9. The Center has made little progress in the application of ADP at sea. One of the problems has been that the Center has looked to NOS to take the lead.

10. The Center's use of leased MBI word processors is not cost effective and the current capability (the number of entry ports) is inadequate. One of the causes of the problem is that the Center has been waiting for NMFS and NOAA to take the lead.

11. At present, the WHOI VAX 11/780 is saturated. As a temporary solution, the leasing of a VAX 11/750 is being contemplated. If the NEFC users are restricted to the latter, they may be more limited than they are at present, particularly if additional users from the Sandy Hook Laboratory are added.

12. The Center frequently uses the computer in "on-line" mode when the "batch" mode would be more appropriate.

13. Much of the increase in ADP cost can be attributed to the increased use of graphics. In general, it is more cost effective to use microcomputers for graphics.

14. There are specialized ADP needs for economic studies. Economists need vendor supplied data bases (e.g., the Consumer Price Index) and specialized analytical software packages. The latter is not available on any of the computers accessible to the NEFC. The former is only available on ADP NET, which is very expensive to use.

15. At present, the Oxford, Gloucester, and Milford Laboratories lack cost effective ADP. Phone connections to WHOI are high and much of the work does not require a main frame.

Many of the problems relate to the centralization of ADP capability and responsibility. With centralization, the cost of ADP is not viewed as part of the cost of collecting data, it is difficult to set priorities, and hold someone accountable. ADP needs (both usage and software development) are probably inflated because Programs do not perceive that they are paying the cost, or had not until recently.

While it is appropriate to decentralize much of the ADP responsibility, there will still need to be Center control. Programs should be accountable for making data accessible to the broad user community.

There will still be a role for a Center ADP Unit. The Unit should be responsible for designing and implementing a system that meets the Center's needs. The Unit should address many of the concerns raised above (e.g., a common data base management language, a relational data base for research vessel data, ADP needs on ships). In addition, the Unit should evaluate alternative software packages, develop generic programs, provide the expertise to monitor ADP contracts, help to educate users, facilitate standardization of ADP activity throughout the Center, and increase communication.

The Center should reexamine (via contract if internal expertise is lacking) the role of microcomputers. Micros can help to solve the ADP problems of the Gloucester, Milford, and Oxford Laboratories. Economists might also use micros. Micros could relieve much of the problem of saturation on the WHOI system (how effective would the purchase of 20 micros be compared to the purchase of an additional VAX 11/780?) They could help to reduce the cost of graphics and provide word processing to scientists. They are essential for remote data entry. The Center should establish standards for microcomputers in order to avoid future problems of interacting data bases and redundancy in software development.

Concern about the role of micros within the NEFC raises the question of the adequacy of ADP expertise. Advances in ADP have been rapid. As a result it is difficult to be current with the state-of-the-art. In the case of ADP, state-of-the-art usually equates to cost savings.

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Center
Woods Hole, MA 02543

February 14, 1984 F/NEC:EGH

TO: Participants - NEFC "ADP Issues: A Technical Review"

FROM: Allen E. Peterson, Jr., F/NEC
Center Director

SUBJECT: Agenda for February 28-29 Review

Tuesday - February 28, 1984

10:00	NEFC Committee of Three Review Objectives	Sissenwine
10:15	Data Management Division Review	Heyerdahl
	Current Status - Overview of data bases and users, system distribution	
	Current Long Range Plan - Description, time table, NOAA policies	
	NMFS "Post '86 Study" - National Data Management Committee involvement	
	DMD Responsibilities - Meibohm/Leitzel Charter, NEFC Proposal	
	Resource Requirements ($'s/FTE's) - Now and projected	
	Discussion - Clarification/Enumeration	
12:30	Lunch	
2:00	Program Needs for ADP Support	Individual Programs
	Identification of data/software needs, current capability and lack thereof, future needs, access by external constituents	
2:00-3:30	RAD, EAD, MED - 20 minute presentations with 10 minutes for discussion	
3:30-5:00	RUD, PBD, AQD, Councils, MUST, Economics - 10 minute presentations with 5 minutes for discussion	
5:00	Adjourn for the day	

Wednesday - February 29, 1984

8:30	Discussion		
		NEFC Management Goals for ADP Support	Sissenwine/Discussion Leaders
		General Discussion of Needs and Support Requirements	
		Role of Micro Computers - Standardization, Support, Cost, Application	
		Adequacy of Current Plan and Resources to Accomplish Objectives within Proposed Time Table	
10:15	Coffee		
10:30	Continuing Discussion		
		Integration of Goals and Resources	
		DMD Responsibilities	
		Program Responsibilities	
		Need for Inhancements/New Initiatives	
		Priority Assignments	
12:30	Lunch		
1:30	Executive Session		Committee of Three, Participating Reviewers, Center Directorate, Washington Office, Council, Regional Office Invited Expertise
		Summarization of presented materials describing existing, planned, and projected future requirements for Data Management, Information System Development, and Scientific Analyses within NE NMFS.	
3:30	Review Adjourns		

Item 2.

NEW ENGLAND FISHERY MANAGEMENT COUNCIL
SUNTAUG OFFICE PARK, 5 BROADWAY (ROUTE 1)
SAUGUS, MASSACHUSETTS 01906
SAUGUS 617-231-0422 FTS 8-223-3822

March 9, 1984

Michael P. Sissenwine
National Marine Fisheries Service
Northeast Fisheries Center
Woods Hole Laboratory
Woods Hole, Mass. 02543

Dear Mike,

I have enclosed a memo to Doug Marshall in reply to your follow-up letter for the NEFC Automatic Data Processing Review.

We appreciate the opportunity to participate and hope that our somewhat limited ability to comment on such a broad based review may be useful. We have certainly benefited from learning more about the system at the Center and the problems with making it more responsive.

Very truly yours,

Louis J. Goodreau

NEW ENGLAND FISHERY MANAGEMENT COUNCIL
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MEMORANDUM

DATE: March 1, 1984

TO: Doug Marshall, Executive Director

FROM: Lou Goodreau, Economist

SUBJECT: ADP Issues; February 28-29 Review

The Automatic Data Processing (ADP) Review included a description of the Center's computer capabilities, the Divisions use of those capabilities, and a discussion of the problems associated with coordinating these uses (agenda enclosed). I will highlight the areas which may affect the Council's use of the subject data, rather than to describe the review completely.

The Center's personnel are currently saturating their portion of the WHOI-VAX computer, to the point where they are engaged in purchasing an additional central processing unit (CPU) and more hard and mountable storage disks. However, their interim solution of purchasing a smaller VAX for their exclusive use, given then the type of interface with the WHOI-VAX, may decrease their CPU capacity by 50% (more disk storage will be available, though) according to outside experts. Additionally, they intend to move the outlying labs onto the VAX, thus creating more demand. Within the next year it appears that Council staff access to the VAX system for all our computer needs is unreasonable. I should note that the VAX system, although small, does include most of the peripherals such as printers and plotters that we have used at BU and URI.

The NMFS contract with ADP Network Services (Waltham) will end and a new one with ICI in Washington, DC will begin on July 1, 1984. This means that Chris should complete his work on the processor file out of the Regional Office proir to that date, to avoid the messy system change.

Statistical packages available on the VAX include SPSSX, BMDP, and TSP, however SAS will not be available for at least 6 months, and because it is a new version of SAS for the particular system on the VAX I would expect that another 6 months will be required to dig out the bugs.

The second day's discussion revolved around questions which had arisen during the first day, most notably standard microcomputers for all of the Center's labs and a common data base management language. More relevant to us were: remote data entry from ships and ports, which would reduce the time we wait for landings data (especially since NMFS is pushing to eliminate the hand calculations made by port agents for the bi-weekly landings reports we get currently for cod, haddock, yellowtail, and squid-mackerel-butterfish); graphic software development of contour maps (we could look at landings by port-area on these maps rather than in voluminous tables); requirements for

NMFS economic studies which may lead to retention of more vessel ID's. Additionally, I stated that the NE Council would not require that they retain any special data files or respond to any data requests if we were given raw data tapes to develop ourselves. We may now wish to request the 1980 and 1981 weigh-out tapes for development of the ADF impact analysis as well as the Interim and Scallop amendments, since we have the understanding that this would be a continuation of our use of the 1965-79 data series.

During the executive session the discussion was again mostly concerned with microcomputer aquisition and data base management language. My only comments were specifically geared towards file structure. First I recommended that their summary files, which are almost the same as state landings maintained in Washington, be removed from expensive disk storage, and that requests for such summary information be referred to Washington. Second I commented that the vessel ID removal policy was costly in both extra file generation and storage as well as in lost information, and that this policy should be reviewed annually to assess that cost. Third I recommended that they consider aggregating their basic record stored on disk to a trip, similar to ours, rather than the current species record. This final recommendation may reduce I/O costs by a factor of ten, with the loss in convenience only being little used species such as cunner (this information would still be stored on tape and not lost). Finally, I indicated that our letter-mailing campaign to fishermen for retention of their vessel IDs, with a 70% "yes" response, be looked on as a vote for such retention in any review of that NMFS policy.

Item 3.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

March 5, 1984

TO : F/NER - Richard H. Schaefer

FROM : F/NER - Kenneth L. Beal

SUBJECT : Technical Review of ADP issues and needs

The subject technical review was held at Woods Hole on 28-29 February 1984. A list of attendees is attached. Roughly 30 people attended at various times during the session. Several handouts are also attached. The technical review was called by Allen Péterson because of his perception that funding is not adequate to meet the existing demands. It was his hope that the technical review would help him to identify whether the Data Management Division was overcommitted with inadequate funding and manpower, or if excessive data was being stored to the detriment of the overall mission of the Center.

Gene Heyerdahl, the Regional Data Base Administrator, gave an excellant overview of the data management tasks he and his staff are involved with, and the various computer systems they are working with. The Sandy Hook Lab has been using an IBM computer at Fort Monmouth, NJ; the Narragansett Lab has been using the University of Rhode Island computer until recently, and they are now switching over to the EPA Lab computer in Narragansett, RI (a PDP 1170); the Woods Hole Lab is concluding a new agreement with the Woods Hole Oceanographic Institution's computer (a VAX unit produced by Digital Equipment). Access to the VAX unit is via telephone, dedicated lines, local WHOI telephone lines, or local area network. There are 96 access ports to the "Red VAX". A new unit is being added by WHOI which will be known as the "Gray VAX", and this will be the one which NMFS will use in the future. The existing contract with ADP Network Services cost the Center about $350,000 in 1983. The extimate for the VAX is roughly one-half that level.

Several agencies (NOAA, WHOI, and EPA) have focused on the IBM-PC as the standard micro-computer. The Center is in Phase II of their effort to get the Statistical Agents remote terminals for direct entry of landings and biological information. Two "dumb" terminals have been installed for data entry only, and three micros have been ordered. The State-Federal data system should be completely designed by the 2nd quarter of FY 1984. The commercial data entry system for the ports should be completed by the 3rd quarter, but implementation of the entire system will be somewhat later. The "dumb terminals" are slow and result in rather costly transmission charges. It would be more efficient to have micros at the field stations, which can act as both terminals and computers. The cost is about $7000 for each IBM-PC. The savings of buying a non-IBM product which is "IBM-compatible" is relatively small, and Allen Peterson feels we would be better off if we went first class, ie. buy the IBM-PC's.

The budget for the Data Management Division is $1,600,000. This is split up into the following segments: Overhead - 11.0%; Resource Assessment Division - 30.6%; Marine Ecosystem Division and Atlantic Environmental Group - 19.6%; Center Administration - 9.6%; Environmental Assessment Division - 9.1%; CODES (Commercial Data Entry System) - 6.5%; Resource Utilization Div. - 2.0%; AOD - 2.0%; PBD - 2.0%; SSS - 2.0%; Massachusetts contract 2.0%; and Other - 3.4%. There are about 200 daily users of the NMFS files in the WHOI VAX computer system, with about 40-50 simultaneous users. If a job is longer than 5 minutes, it must be run at night. The costs of jobs run at night are considerably less expensive than those run during the day.

Resource Assessment Division (Dr. Steve Clark): Some of their assessment work must be completed in a short time-frame for management purposes; the majority of their work has a longer schedule. The lion's share of the ADP budget is in support of this division, primarily for the landings data and the biological data collected during the research cruises.

Environmental Assessment Division (Jay O'Reilly): The Sandy Hook Lab has used the ADP Net for single investigations and multiple investigations, and the IBM 360-65 at Fort Monmouth. It will be using the VAX in 1984. There are different data bases in Sandy Hook, in Narragansett, and in Woods Hole; but only one scheme should be used when all these data bases are put on the VAX.

Marine Ecosystems Division (Dr. Kenneth Sherman): A Memorandum of Understanding was recently concluded with EPA which allows free use of their PDP-11 computer. The plankton data collected at Narragansett should be correlated with the chlorophyll, nutrient and primary productivity data collected by the Sandy Hook Lab, and with the stomach, benthic and hydrographic data collected at Woods Hole. If these data bases are not in the same format and easily accessible, there will be a loss of resolution.

Gloucester Laboratory (Robert Learson): There are no full-time computer people at the lab; a contract employee is hired occassionally. A small micro would be desirable, and should be capable of handling the majority of the workload. He recommended an IBM-PC.

Oxford Laboratory (Fred Kern): The lab has no word-processing capability, and it is needed. The Habitat Protection Branch staff located at Oxford do have this capability, but the unit is located in another building. They have a very minimal need to log onto the VAX computer. Nevertheless, a micro would be a distinct advantage to the lab operations.

Economic staff (James Kirkley): He feels that when economists are added to the Center staff, computer usage will go up geometrically.

Shipboard computer capability (LCDR Ronald Smolowitz): One research vessel currently has a CAMAC Crate into which the ship's sensors are wired. The CAMAC Crate is the same device which all nuclear power plants use for controlling their functions and recording their data. Hard-wired cards are inserted into the crate. The Northwest and Alaska Center has a van with an HP 1000 computer in it which is loaded aboard ship for data entry at sea. Cost of this computer is about $125,000.

General discussion:

Word processing: EPA recently purchased 1000 Lexitron word-processing units and distributed them to their 10 regional offices and the Washington, D.C. headquarters. The cost was $6500 per unit. The substantial savings from the regular list price of $17,500 was achieved because of the large purchase.

Bob Crowell says most programming will be done by contract soon, as a result of the A-76 review.

Allen Peterson says storing landings by trip with vessel identifiers is costly, and may not be needed for most purposes. The "Fishery Statistics of the United States" probably does not need that level of detail. B.G. Thompson responded that the Center should not let the ADP function set the priorities. The Center should set its priorities first, and then determine how the ADP system can help in reaching the objectives.

Marv Grosslein feels data bases generated by a research program need to be shared more efficiently; there needs to be a dialogue with other Center users to determine how and where the data bases will be stored. If a data base is not going to be shared, does it need to be stored on the VAX? would a micro be adequate?

Allen Peterson asked if the estimates used for deciding to end the contract with ADP Net were valid and still support going with the WHOI VAX computer. Heyerdahl responded that they are still valid. The bulk of the users and the data are in Woods Hole; therefore, these users will be in close proximity to the computer, and the telecommunications costs will be minimal. Other Centers have high telecommunications costs. The Southeast Center paid about $100,000 last year for 2 dedicated 5600 baud transcontinental lines to the Burroughs computer in Seattle.

Executive Session:

There was strong sentiment in favor of acquiring micro computers, specifically the IBM-PC, to help solve some of the data processing needs of the laboratories located outside of Woods Hole. There was also a strong recommendation that a common data base language be used to allow access to the data files by other laboratories. Lou Goodreau (New England Fishery Management Council staff) said the Council really has an interest in only two of the Center's data files: the commercial landings and the assessment files. He emphasized the Council does not intend to perform its own assessments. Their interests are geared toward the species for which assessments are prepared. A sub-file by species is actually better for them than access to the entire landings data file, as they invariably are only interested in one species or a small group of species. In practice, this is what the Center staff do as well. It is really very economical to set up these smaller files, as the user does not have to search through the mass of data in the VAX to get the information wanted. And the sub-file can actually be stored on a smaller computer than the VAX, if the researcher wishes. For instance, a sub-file could be set up on the VAX using stored data, then transferred to a micro-computer for subsequent storage and use.

The NW Region and Center have joined with the SW Region and Center to hire a contract Data Base Manager whose job it is to collect and protect all landings in California, Washington and Oregon. He maintains the confidentiality of the data, and allows access only by appropriate staff. There is a $220,000 contract with these states which helps pay for the costs of data collection, entry and verification as well as entry onto the Burroughs computer for NMFS use.

Sam Bledsoe (NW Regional Data Base Administrator) says that if you delegate the responsibility for controlling the data bases down to the program level, the risk is greater for potential screw-ups by the staff. The operating budget in the NW Center is about $2,300,000, of which only about $600,000 is allocated for operating the Burroughs computers. An additional $400,000 is provided by assessing the operating divisions. Allen Peterson feels a better approach would be to plan ahead so the divisions have line items in their budgets, based on their reasonable ADP usage.

Bob Paine (EPA, Narragansett) stated that EPA purchased 35 IBM-PC-XT computers in FY 1983 and an additional 35 in FY 1984. These were distributed to the field to see if the staff can develop new ways to do their work more efficiently using the micros. The initial reports indicate this concept has been quite successful. Paine says that the number of published papers by staff at the EPA Narragansett Lab have increased greatly, with no increase in staff; he attributes the increase to the scientists having hands-on experience with the micros for both data manipulation and word-processing.

In answer to Allen Peterson's request for regional recommendations, I responded that the region will continue to need landings information for quota-based management measures which require the Regional Director to take specific actions when landings reach certain levels. When this decision point is approaching, up-to-date landings data are critical. However, when the port agents are on line with their terminals, it will be a relatively easy task to get the data, and in fact regional staff should be able to access it, as well.

Attachments

cc: F/NER - Rittgers, Linehan, Lippson
F/NER5 - Temple
F/NER51 - Mueller, Terrill
F/NER7 - Grice
F/NER72 - Nicholls

ATTENDEES

Northeast Fisheries Center:

Allen Peterson
George Ridgway
Herb Stern
Dick Hennemuth
Gene Heyerdahl
Mike Sissenwine
Vaughn Anthony
H.C. Boyar
Jim Kirkley
Ron Smolowitz
Marv Grosslein
Joan Palmer
Steve Clark
Ralph Mayo
Art Neill
Ken Sherman, Narragansett
Donna Busch, Narragansett
Bob Learson, Gloucester
Mert Ingham, Narragansett
Aaron Rosenfield, Oxford
Jay O'Reilly
Jim Thomas
John LeBaron
Fred Kern, Oxford

Northeast Region:

Kenneth Beal
John Linehan
Jack Terrill

Washington Office:

Bob Crowell
B.G. Thompson

New England Council:

Lou Goodreau

Northwest & Alaska Center:

Sam Bledsoe

Environmental Protection Agency:

Bob Paine

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Center
Woods Hole, MA 02543

February 14, 1984 F/NEC:EGH

TO: Participants - NEFC "ADP Issues: A Technical Review"

FROM: Allen E. Peterson, Jr., F/NEC
Center Director

SUBJECT: Agenda for February 28-29 Review

Tuesday - February 28, 1984

10:00	NEFC Committee of Three Review Objectives	Sissenwine
10:15	Data Management Division Review	Heyerdahl
	Current Status - Overview of data bases and users, system distribution	
	Current Long Range Plan - Description, time table, NOAA policies	
	NMFS "Post '86 Study" - National Data Management Committee involvement	
	DMD Responsibilities - Meibohm/Leitzel Charter, NEFC Proposal	
	Resource Requirements ($'s/FTE's) - Now and projected	
	Discussion - Clarification/Enumeration	
12:30	Lunch	
2:00	Program Needs for ADP Support	Individual Programs
	Identification of data/software needs, current capability and lack thereof, future needs, access by external constituents	
2:00-3:30	RAD, EAD, MED - 20 minute presentations with 10 minutes for discussion	
3:30-5:00	RUD, PBD, AQD, Councils, MUST, Economics - 10 minute presentations with 5 minutes for discussion	
5:00	Adjourn for the day	

Wednesday - February 29, 1984

8:30	Discussion	
	NEFC Management Goals for ADP Support	Sissenwine/Discussion Leaders
	General Discussion of Needs and Support Requirements	
	Role of Micro Computers - Standardization, Support, Cost, Application	
	Adequacy of Current Plan and Resources to Accomplish Objectives within Proposed Time Table	
10:15	Coffee	
10:30	Continuing Discussion	
	Integration of Goals and Resources	
	DMD Responsibilities	
	Program Responsibilities	
	Need for Enhancements/New Initiatives	
	Priority Assignments	
12:30	Lunch	
1:30	Executive Session	Committee of Three, Participating Reviewers, Center Directorate, Washington Office, Council, Regional Office, Invited Expertise
	Summarization of presented materials describing existing, planned, and projected future requirements for Data Management, Information System Development, and Scientific Analyses within NE NMFS.	
3:30	Review Adjourns	

ADP DISCUSSION ITEMS

1. Remote data entry from ships?
2. Remote data entry from fishing ports?
3. Word processing?
4. Contracting for ADP personnel?
5. Graphics- How expensive? How valuable?
6. Special ADP requirements for economic studies?
7. User efficiency-control of "batch" versus "on-line" jobs?
8. A common data base management language?
9. VAX 11/750 for remote sensing-relationship to NEC remote sense activity?
10. Adequacy of VAX 11/750 or 11/780 to handle all planned expansion?
11. Micros-standardization? Role for ~~outlined~~ remote or experimentally oriented laboratories? The future?
12. Prioritization of data processing versus data usage?
13. Setting priorities for ADP services?
14. Personnel losses, what is the effect? What should we do?
15. Cost accounting-centralization versus distributed?
16. Programming capability - centralized versus dispersed? Systems capability versus applications needs?
17. How much ADP can we afford?
18. Role of Regional Data Base Manager?
19. Software packages

Table 1.

Computer Time Sharing
Cost Comparison Table

	Cooperative Agreement NEFC/WHOI 1/	NOAA ADP Network Services, Inc.	Commercial Computer Time-Digital	Government Smithsonian Astro. Obs.
CRU's	$9.37/Hr	$11.13/Hr 2/	Combined with Connect Time	$17.14/Hr 4/
Connect Time	$2.472/Hr	$ 1.5765/Hr	$27-35/Hr	Combined with CRU's
Storage (fixed)	$ .00046/1000 Char/Mo	$ .02353/1000 Char/Mo	$ .02667/1000 Char/Mo	$ .01669/1000 Char/Mo

FY 84 Oct-Nov WHOI cost projected for ADPNS

	WHOI (actual)	ADPNS (projected) 3/	CTD (projected) 3/	SAO (projected) 3/
CRU's	$32,588	$ 38,710	-	$ 59,609
Connect Time	$ 8,598	$ 5,483	$ 93,906 (@$27/Hr)	-
Storage (fixed)	$ 1,884	$ 96,379	$109,240	$ 68,362
	$43,070	$140,572	$203,146	$127,972
Computer	VAX 11/780	DEC 10	VAX 11/780	VAX 11/780

1/ FY84 Oct - Nov average.

2/ Average over NOAA wide use Oct 82 - Nov 83.

3/ Projected cost calculated by applying respective rates against actual use of NEFC/WHOI system during October and November.

4/ SAO rate algorithm applied to NEFC/WHOI VAX system use statistics to approximate a "CRU" rate for comparison.

Item 4.

D R A F T

NEFC "ADP ISSUES: A TECHNICAL REVIEW"

MEETING REPORT

The meeting of the Committee of Three (COT) to review the Northeast Fisheries Center's ADP issues was convened on Tuesday, February 28, 1984, by Chairman Michael P. Sissenwine.

Dr. Sissenwine welcomed the participants (see Appendix I) and briefly explained the function of COT. It was established by a directive from the NEFC Director, Allen Peterson, as a program review board charged with investigating individual programs, seeing where they're at and identifying needs and areas for improvements.

The following summarizes the specific issues discussed at the meeting. The Agenda is attached as Appendix II.

Current Status of the Data Management Division

Dr. Eugene Heyerdahl, Regional Data Base Manager, began with a history of NMFS cluster arrangement of five data base management centers (Northwest, Northeast, Southwest, Southeast and Headquarters) which were instituted in the late 70's to emphasize regional needs. It's eventually anticipated that the five centers will be linked to each other.

Dr. Heyerdahl noted that the NEFC upgraded its data base management system in 1982. Categories of the major data bases are:

1) Commercial landings
2) Bottom trawl surveys
3) Icthyoplankton
4) Benthic
5) Oceanographic
6) NEMP, et. al.
7) Recreational catch
8) Foreign catch

At present, ADP is only meeting the needs of commercial landings. All others are in various stages of completion. Program implementation has been frustrated by procurement difficulties. And, ADP costs have exceeded appropriations. This has resulted in unfulfilled expectations and severe disruption within programs.

The NEFC has recently made significant advances in achieving its ADP needs. Dr. Heyerdahl reported that about three years ago it was faced with the retirement of the Woods Hole Oceanographic Institute's (WHOI) SIGMA VII computer, an ineffective data base management system on the University of Rhode Island computer system, and a batch-oriented computer with limited capabilities at Fort Mommouth, New Jersey. Since then, a mixed bag of computer systems have been developed throughout the NEFC. The Center has converted to a new VAX at WHOI which achieved significant improvements in its data base system. In addition, the Center has acquired a few microcomputers. The Sandy Hook Laboratory will soon be connecting to the WHOI system. And, through a Memorandum of Understanding, the Narragansett Laboratory has convenient access to the Environmental Protection Agency (EPA) PDP-11 computer. Presently, the Gloucester, Milford and Oxford laboratories lack cost effective ADP.

Dr. Heyerdahl noted, however, that even with its tremendous power and capabilities, problems have been encountered with WHOI's VAX 11/780. Connections to remote data bases are costly, not all programming support is available and there is saturation of the system at peak periods. As a temporary solution to the latter problem, the leasing of a VAX 11/750 is being contemplated in place of an additional VAX 11/780. The NEFC would be the sole user of that system. Concern was expressed that if the NEFC had restricted access to only the VAX 11/750 it could be more limiting than at present, particularly when the Sandy Hook Laboratory enters the system.

Due to limited resources, costs associated with ADP is a major concern and requires close monitoring. In July of '83, the total use of the VAX system was trimmed in half as a cost savings measure. It initially resulted in the more efficient use of the system. But, lately, due to the increase in demand for user time, the costs are starting an upwards trend to a point where we find ADP again nearing its budget ceiling. The goal is to limit use to approximately 1,000 Charge Units (C.U.) per day. (The cost of a C.U. is $1.17 or about $65.00/hour). Dr. Heyerdahl anticipated that when the NEFC connected with the VAX 11/750 the cost of ADP may not be such an overriding factor. It would free the NEFC from the current WHOI monetary system.

Gene Heyerdahl also noted the excessive cost of ADP NET which is continually rising. Connect time is about double that of the VAX. The biggest user of ADP NET is the Environmental Assessment Division (EAD), which is basically due to the fact it has not as yet converted to the VAX. Plans call for ADP NET to be abandoned following this conversion.

Long Range Plan

Dr. Heyerdahl next reported on the NOAA/NMFS/NEFC Long Range ADP and Telecommunication Plan. It's a multi-year document which is annually updated and addresses such issues as on-going processes, program implementation, identifies integrated programs for meeting special needs and a time table for entering into new programs. The Long Range Plan sets up an evolutionary process for various programs going from the study phase, to the initiative stage, to finally the actual procurement. It also establishes a time table for achieving specific objectives (e.g., the Sandy Hook Laboratory tie in with the VAX) Based on the 1981 updated plan, ADP is currently on target with the NEFC food habit and state/federal data system programs, but is behind schedule on most others.

Post '86 Study

Heyerdahl explained that the purpose of the Post '86 Study is to forecast trends, needs and the type of ADP support needed after the Year 1986. Microcomputer needs is one such item being addressed. To date, over sixty (60) trends have been identified.

It was noted that by 1990 70 percent of the programming will be done by the user rather than the central core. Dr. Heyerdahl explained the programs available to users through the WHOI system (and are maintained by WHOI). Gene felt that the software packages are meeting the needs for most analytical programming. However, many participants believed that SAS was essential. Heyerdahl pointed out that it is expected to be available through WHOI by early summer. About the only other piece lacking from the VAX is word processing capabilities.

Resource Requirements

Dr. Heyerdahl reported on the Data Managemnt Division's distribution of the 1984 FY budget which amounts to approximately $1.59 million. It breaks down as follows:

ADP - 11%

RAD - 31%

Joint Bottom Trawl Survey with Massachusetts - 2%

CODES - 6.5%

MED - 19.6%

RUD - 2%

AQD - 2%

PBD - 2%

Special Scientific Staff - 2.2%

Administration - 9.6%

EAD - 9.1%

Other - 3%

Approximately 33 percent of the 1984 FY budget for ADP goes to cover salaries, 15% for equipment and 2.6% for capital investment.

Dr. Heyerdahl reported that ADP was about two years behind in getting the present work load done. He based the reason behind this on the resignation of some key personnel. Gene passed out a proposed organizational chart, see Appendix III, showing the number of positions needed to fully centralize ADP and releave some of this backlog. It was made clear that there was little chance he would get the number needed and, therefore, must prioritize the present work load.

This concluded Dr. Eugene Heyerdahl's presentation.

The afternoon session was devoted to explanations of individual programs and the ADP support needed. There were a number of common problems among programs. Rather than addressing each presentation separately, this report would be best served by concentrating on mutual and specific problems and needs:

1. The application of ADP at sea. Little has been done since the Center has looked to NOS to take the lead.

2. Greater system stability. This reflects problems in planning and implementing the plans. It also relates to procurement problems.

3. User parity within programs.

4. Remote data entry from fishing ports.

5. Additional word processing capabilities.

6. There should be a common link between research vessel data. The Center conducts multipurpose cruises in which several types of data are collected simultaneously. It is difficult to link data bases for the purpose of simultaneous analyses.

7. Because of limited resources, it is necessary to prioritize.

8. Education of ADP users. There is an expressed need for programming talents to assist scientific interests.

9. Better graphic capabilities. This problem could be addressed by additional micros. It would also alleviate some of the connect time cost on the VAX.

10. Use of micros at the Oxford, Gloucester and Milford Laboratories which are now without cost effective systems.

11. When ADP NET is abandoned the specialized needs of economists such as access to vendor supplied data (e.g., the Consumer Price Index) will no longer be available to them. Their specialized software packages are not on any other system available or accessible to the NEFC.

12. Establish standards for microcomputers to avoid future problems of interacting data bases and redundancy in software development.

13. Develop a common data base management language.

14. Explore the potential use of micros within the NEFC.

15. Inadequate number of printers within the NEFC.

The above information is presented as an overview of the problems and needs. These will be explained in more detail further in this report. Mike Sissenwine adjourned the first day meeting with instructions to reconvene the following morning at 8:30.

LCDR Ronald Smolowitz led off the morning session with a discussion of the present ADP capabilities aboard the Albatross IV. In 1977 the on-board system was replaced with a CAMAC system at a cost of $30,000. Since that time, the system has functioned well and is still recognized as state-of-the-art. One problem that was encountered was the need for far more software packages than initially anticipated.

The CAMAC is currently used to record ship position, depth, time, relative wind direction, wind speed, water surface temperature, air surface temperature, barometric pressure, vessel speed, salinity, and T-drop.

There has been a demonstrated need for scientists to get real time information while at sea, particularly with shellfish surveys. Information from bottom trawl and shellfish surveys are currently being hand tabulated and sent out for key punching when the vessel returns to port. The CAMAC could be utilized for recording survey information, but it would require an additional C.P.U. since it is now a logging and not a computing system. The system also provides hard-copy, however, it would require close monitoring to verify that the information coming out is, in fact, accurate.

One major drawback of the CAMAC is that it's only on the Albatross. Before the system were to be duplicated on other vessels, it should be determined if the CAMAC is giving the sought after information or could the scientists needs be best met with micros and the appropriate software. It was decided to establish a task force to study the actual ADP support needed at sea and the type of eguip-ment that would best meet those needs.

The remainder of the morning, and final, session was devoted to a discussion period on matters raised the previous day. Dr. Michael Sissenwine chaired this session.

Remote Data Entry From Ports

The planning and implementation program for data entry from ports was set up as a three phases process:

1) Test phase - set up two dumb terminals in the field linked with WHOI's VAX. This has been achieved. One initial problem was the excessive cost of the phone connections which was partially due to the lack of experience by the user. This cost has been substantially reduced now that the users are familiar with the system.

2) Phase two included contracting through the Data Management Division for developing software packages for use with microcomputers, installing two micros at fishing ports and begin data entry. In the FY '84 budget, $100,000 was appro-priated for the contract ($70,000 to 80,000) and the micros (approx. $7,000 each). For the time being, the data will be entered on either disks or cassetts and mailed to the Center.

3) Phase three involves entering biological sampling data collected by the

port agents as well as landing information.

Plans call for nine (9) microcomputers to be in place at ports throughout the Northeast. In compliance with NOAA's regulations, the micros will be IBM compatable.

Word Processing

The Center is currently leasing MBI word processors, on a lease/buy arrangement, at a cost of $70,000 to 80,000 annually. This is not cost effective and the current number of entry ports is inadequate. One of the causes of the problem is the Center is waiting for NOAA to take the lead in developing a standard NOAA-wide system.

Contracting for ADP Personnel

The cost of such services is about double that of in-house capabilities. The question was raised that should the Center be contracting service even though it's allowed under the A-76 Regulation. Significant savings could be realized by reducing this in favor of in-house expertise. But concern was expressed due to the present staffing problems and backlog of work in ADP. The question was again raised that perhaps a good deal of the programming should be removed from ADP Central and put within the various divisions and they could determine the type of data needed. The Center ADP Unit could then be free to concentrate on such matters as a common data base management language, a relational data base for research vessels' data, ADP needs on ships, help to educate users, evaluate alternative software packages, develop generic programs, investigate more fully the role of microcomputers, and facilitate the standardization of ADP activities throughout the Center.

Three options regarding ADP personnel were identified:

1) Expand ADP personnel

2) Leave it the same and place a larger burden at the program level

3) Contract ADP and again put more burden on programs.

Dr. Eugene Heyerdahl noted that the Centralized ADP Unit has been more responsive and efficient when directly involved at the programming level. Dr. John LeBaron countered by saying that the various Divisions need more involvement in program development and application. Those working on specific projects want more imput on the data being extrapolated. It was generally felt that programs should develop the priorities of the data needed based on objectives. In the past, the actual data needs has been very different from what ADP has determined it should be.

A Common Data Base Management Language

It was emphasized by the participants that data bases which are shared should have common data base languages. Higher level data base languages have their place in specialized cases.

ADP Communications

Communications in ADP have been poor. This is one of the underlining reasons for many of the problems put forward in this report. Two examples became apparent at this review. Programs were not aware that a VAX 11/750 might be temporarily substituted for the planned second VAX 11/780. Further, more, RAD has not been kept informed of the actual status of implementation of remote data entry from ports. It was also suggested that ADP develop an in-house newsletter to keep users abreast of programming breakthroughs.

This concluded the technical review session of the NEFC's ADP issues. Dr. Michael Sissenwine adjourned the meeting at 12:30 p.m. and called for an executive session of the Committee of Three and invited participants.

Names	Addresses
Bob Learson	NEFC Gloucester
Dick Hennemuth	" W.H.
John F. Linehan	NMFS Liaison, New Bedford
Jack Terrill	NMFS NERO Gloucester
Lou Goodreau	NE Fishery Mgt. Coun.
Robert R. Payne	EPA Research Lab, So. Ferry Rd Narragansett, RI 02882
John O'Reilly	NEFC, Sandy Hook
Sam Bledsoe	NWAFC, Seattle
Merton Ingham	NEFC/AEG
George Ridgway	NEFC Woods Hole
Jim Thomas	NEFC Sandy Hook
John LeBaron	NEFC Sandy Hook
Kenneth Beal	NER Gloucester MA
Ralph K Mayo	Res. Assmt Div Woods Hole
Stephen H. Clark	Res Assmt Div. Woods Hole
Joan Palmer	Res. Asmt Div. Woods Hole
Donna Busch	NEFC, Narragansett
Bob Sand	Computer Sciences Corp, Narragansett
Al Peterson	NMFS - Woods Hole
Herb Stern	NEC
Carl Sindermann	NEC - S.H.
Mike Sissenwine	NEC
Ken Sherman	NEC/MED Narr
Bob Crowell	NMFS F/MB
B. G. Thompson	" F/S

APPENDIX II

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Center
Woods Hole, MA 02543

February 14, 1984 F/NEC:EGH

TO: Participants - NEFC "ADP Issues: A Technical Review"

FROM: Allen E. Peterson, Jr., F/NEC
Center Director

SUBJECT: Agenda for February 28-29 Review

Tuesday - February 28, 1984

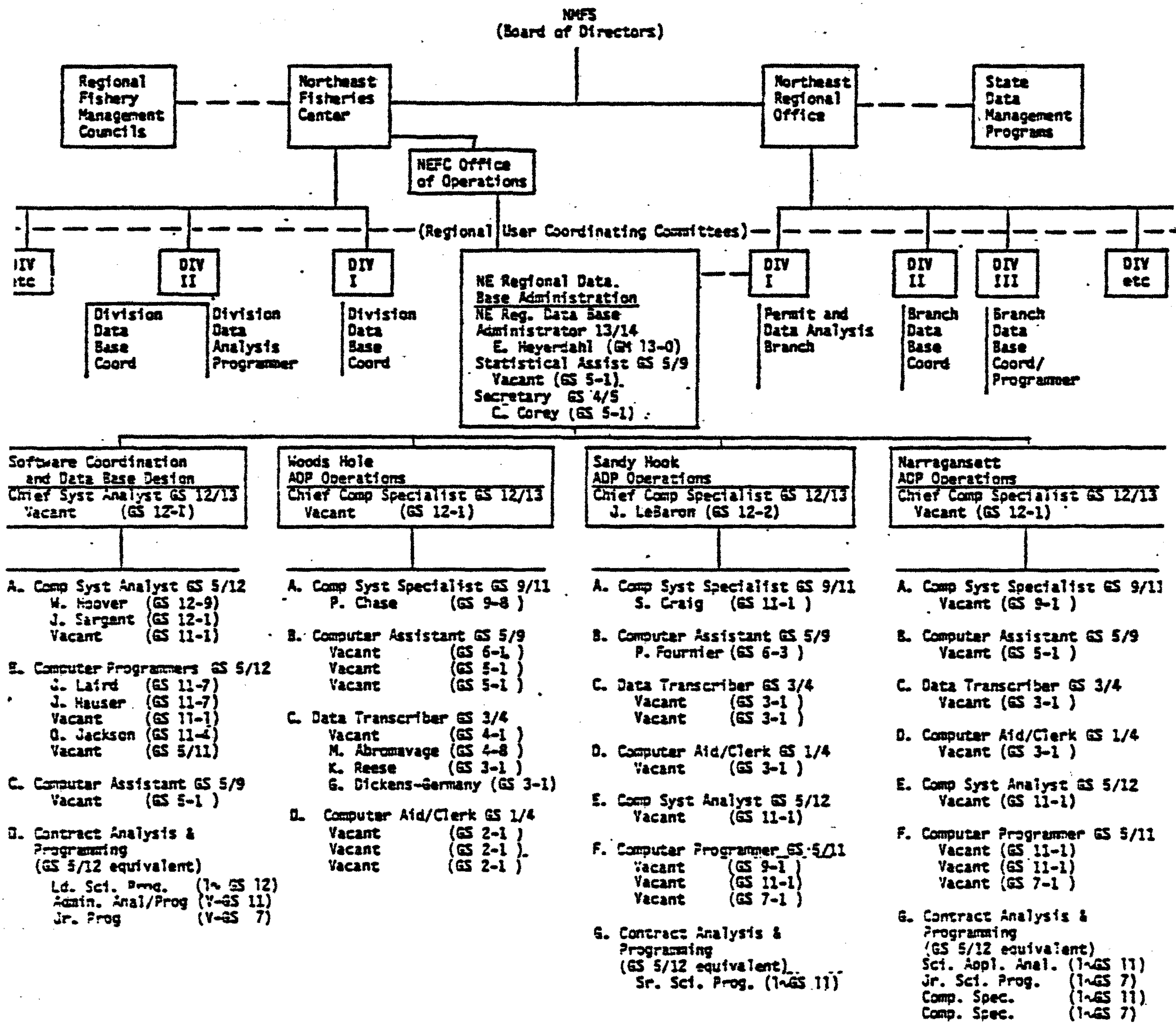
10:00	NEFC Committee of Three Review Objectives	Sissenwine
10:15	Data Management Division Review	Heyerdahl
	Current Status - Overview of data bases and users, system distribution	
	Current Long Range Plan - Description, time table, NOAA policies	
	NMFS "Post '86 Study" - National Data Management Committee involvement	
	DMD Responsibilities - Meibohm/Leitzel Charter, NEFC Proposal	
	Resource Requirements ($'s/FTE's) - Now and projected	
	Discussion - Clarification/Enumeration	
12:30	Lunch	
2:00	Program Needs for ADP Support	Individual Programs
	Identification of data/software needs, current capability and lack thereof, future needs, access by external constituents	
2:00-3:30	RAD, EAD, MED - 20 minute presentations with 10 minutes for discussion	
3:30-5:00	RUD, PBD, AQD, Councils, MUST, Economics - 10 minute presentations with 5 minutes for discussion	
5:00	Adjourn for the day	

Wednesday - February 29, 1984

8:30	Discussion	
	NEFC Management Goals for ADP Support	Sissenwine/Discussion Leaders
	General Discussion of Needs and Support Requirements	
	Role of Micro Computers - Standardization, Support, Cost, Application	
	Adequacy of Current Plan and Resources to Accomplish Objectives within Proposed Time Table	
10:15	Coffee	
10:30	Continuing Discussion	
	Integration of Goals and Resources	
	DMD Responsibilities	
	Program Responsibilities	
	Need for Inhancements/New Initiatives	
	Priority Assignments	
12:30	Lunch	
1:30	Executive Session	Committee of Three, Participating Reviewers, Center Directorate, Washington Office, Council, Regional Office Invited Expertise
	Summarization of presented materials describing existing, planned, and projected future requirements for Data Management, Information System Development, and Scientific Analyses within NE NMFS.	
3:30	Review Adjourns	

APPENDIX III

NMFS
Northeast Regional
Fishery Information System (NERFIS)



APPENDIX X.

ISSUE PAPER ON THE ROLE OF PATHOBIOLOGY IN THE NORTHEAST FISHERIES CENTER

DRAFT TWO

ISSUE PAPER

THE ROLE OF PATHOBIOLOGY IN THE NORTHEAST FISHERIES CENTER

Carl J. Sindermann

February 1984

CONTENTS

BACKGROUND

Disease is obviously an important factor in determining population abundance. Evidence from studies of terrestrial species provides clear documentation of its importance. There is every reason to assume that population control mechanisms in the marine environment operate in a similar fashion, but until recently, little attention has been given to the subject, insofar as marine species are concerned.

Within the past two decades, however, increasing scientific attention has been paid to the role of disease in the sea, and evidence of severe effects have been derived from major epizootics in several commercial species as well as in marine aquaculture. Research has been conducted in United States, Europe, and Japan, with four principal objectives:

(1) understanding effects of disease on abundance of natural populations;

(2) understanding the role of disease in aquaculture populations;

(3) understanding the relationship between pollution and disease (including use of diseases and abnormalities as indicators of pollution); and

(4) understanding the relationship between diseases of marine animals and diseases of humans.

Research in marine pathology in the United States has been carried on by the federal government (at NMFS laboratories in Oxford, Galveston and Seattle), and by states and universities (the latter funded principally by Sea Grant). In the Northeast, marine disease studies are carried on by the States of Maine and Maryland, and (through Sea Grant) at the University of Rhode

Island, Rutgers University, University of Maryland, and the Virginia Institute of Marine Sciences. Most of these studies are responses to critical disease problems (usually epizootics and mortalities) in species of local economic significance. Sea Grant funded projects are usually short-term.

Disease Research in the Northeast Fisheries Center

Research in NEFC on diseases of fish and shellfish is carried on by the Pathobiology Division located at Oxford, Maryland, with subunits at Milford, Connecticut and Sandy Hook, New Jersey. Emphasis is divided between diseases of fish and shellfish, although earlier research (beginning in the 1960's) concentrated on invertebrates (oysters and crab mortalities). Since 1976 research has focused on diseases, parasites, and abnormalities in offshore fish populations, as an approach to environmental monitoring.

The present research of the Pathobiology Division is divided into the following programs:

- Disease and Environmental Stress (pollution-related diseases)
- Fish Pathology
- Shellfish Pathology
- Microbial Ecology and Parasitology
- Diseases of Larval Molluscs (Milford)

The Pathobiology Division, though relatively small in comparison to some other divisions of the Center, is still the largest single assemblage of people in NMFS or elsewhere, devoted to understanding the role of disease in the sea. Such a role seems to be a legitimate federal responsibility and an important one for NEFC in view of the magnitude of disease problems in oysters, crabs, menhaden, flounders, herring, and other species. Some specific management oriented aspects of pathobiology research include:

- accumulation of information on the role of disease in population reductions;
- advice on the public health significance of marine diseases (ex. fish cancer);
- advice to states and industry on stock management in the presence of an epizootic;
- pathological indicators of pollution; and
- advice on disease control in marine aquaculture

Considering the available competence of the Pathobiology Division, investment has been made in a number of research areas. These include effects of disease on survival and abundance of eggs and larvae; (1) effects of disease on juveniles and adults of fish and shellfish; (2) disease in marine aquaculture, and (3) pollution-associated diseases. Each area is discussed in more detail in the following sections.

(1) Effects of Disease on Juvenile and Adult Fish and Shellfish

Although much of natural mortality occurs in the early life history stages, events affecting survival of post-larvae, juveniles, and adults are also important to recruitment and exploitation of stocks. Disease is a factor in continuing background mortality at any life history stage, but the epizootic outbreaks of specific pathogens which occur irregularly in some species can also be of great short-term significance to population abundance.

Some data exist on effects of epizootics in herring, crab, lobster, plaice and haddock populations, but necessary long-term studies have rarely been carried out. Usually research interest peaks during actual disease outbreaks, but wanes quickly when epizootics subside. Dramatic effects of epizootics on abundance of juvenile and adult fish and shellfish have been demonstrated, but infrequently (probably because some outbreaks escape scientific scrutiny).

Intensive studies of the epizootiology of major pathogens of resource species are worthwhile objectives of pathological studies, since the best documentation of disease effects will come from such examinations. They must be conducted over many years, though, to understand how disease affects and is maintained in fish and shellfish populations, studies should include the enzootic as well as the epizootic phases. The chronic aspects and effects of disease should not be underestimated, however, since such effects on population abundance may be as important or more important than the outbreak effects. Chronic effects are more difficult to document.

(2) Disease in Marine Aquaculture

Based on experience in this country and elsewhere, it can be stated with some assurance that disease is one of the most important deterrents to successful marine aquaculture. Wherever estuarine or marine species of fish or shellfish have been grown or held in captivity, disease has emerged as a primary limiting factor to survival and economic viability. Many of the diseases are of microbial etiology; all life history stages may be affected; but larvae and post larvae seem most vulnerable.

Unlike the situation in natural waters, diseases in marine aquaculture can be controlled by prophylactic immunization, chemotherapy, or manipulation of water quality. Thus the objectives of disease research in aquaculture extend beyond understanding effects on survival, to include diagnosis, prophylaxis, and treatment.

The NEFC laboratory at Milford has had a long-term program to examine microbial diseases of molluscan larvae. A number of diseases have been described, and effective control measures have been developed. Much remains to be learned, however, particularly about viral diseases. Other NMFS and Sea Grant programs have examined diseases of crustacean larvae; described microbial diseases, and recognized virus diseases as a continuing problem.

A special area of disease research associated with aquaculture development concerns possible problems caused by transfers of fish and shellfish across state borders and imports from foreign countries. There is increasing traffic, and a corresponding increase in demand for inspection and certification as well as diagnostic services. The Pathobiology Division has attempted to fill the need on an ad hoc basis, but additional resources would definitely be required if expansion of these activities should occur, as part of a broader program of diagnostic services (to be discussed under "Options.")

(3) Pollution-Associated Diseases

During the past decade significant new information has been developed (by NEFC's Pathobiology Division and by other research groups worldwide) which indicates an association of certain fish and shellfish diseases with environmental degradation. The association is strengthened in some instances by results of experimental exposures to contaminants which produce disease conditions similar to those seen in wild populations. Fin erosion, ulcerations, and certain kinds of tumors show some statistical relationships to the extent of habitat degradation by industrial contaminants, and the Pathobiology Division of NEFC has been one of the leaders in this research.

More extensive data are needed, however, to provide convincing evidence for the associations seen, and for the use of pathology as an indicator of the extent of habitat change. In particular, the association of fish and shellfish tumors with environmental contamination requires greater attention to exploit the numerous insights achieved so far.

Disease Research Areas Deserving Greater Attention

Considering the entire discipline of Marine Pathology, it is possible to identify several major gaps in our research effort. These gaps are understandable, in view of the total investment of people and funding that would be required. Research areas considered worthy of greater attention include (1) effects of disease on survival and abundance of eggs and larvae, (2) mechanisms of resistance to disease in marine fish and shellfish, and (3) virus diseases of marine animals. Each subject is discussed briefly below:

(1) Effects of Disease on Survival and Abundance of Eggs and Larvae of Marine Fish and Shellfish -- The Recruitment Problem

Natural mortality is an important component of population dynamics research and stock assessments of economic marine species. It is obviously a complex variable, changing with age, location, and time. Some principal causes of natural mortality are predation, starvation, abnormal physical or chemical environmental conditions, and disease. Each factor has received research attention, in NEFC and elsewhere, but much remains to be learned--particularly about the importance of disease in causing mortality. At present, much of egg and larval mortality for some species can be attributed to predation, and quantitative information exists in results of food habit studies. Counterpart information does not exist for disease effects, except for a few instances of epizootics which have been studied in some detail. The best disease data have been derived thus far from experimental studies of contained populations in tanks or ponds.

It is clear that better understanding of disease effects on eggs and larvae of marine fish is required. Field observations will be important, but studies in rearing facilities such as those at Narragansett will be required also--particularly for viral and other microbial diseases of early life history stages. Diseases of shellfish larvae have received greater attention because of aquaculture studies. So more information is available than is the case for fish.

(2) Mechanisms of Resistance to Disease in Marine Fish and Shellfish

Animals have an impressive array of cellular and humoral responses to infection. These mechanisms--generally referred to as immune mechanisms--are part of the dynamic processes which determine whether the animal will survive infection or will die. Immunology as a science is important in understanding the effects of disease in human populations, and great progress has been made in vaccination, tissue rejection in transplant operations, and development of specific antisera. The immunology of marine animals, particularly of marine invertebrates, is poorly understood, but is important to understanding the disease process in marine populations.

Some limited research on mechanisms of resistance have been and are being carried on by NEFC. A small effort on immune responses of shellfish is conducted at the Milford Laboratory, and another study on effects of pollutants on immune responses of fish is carried on under a university cooperative agreement at Sandy Hook. The latter study is also examining fish antibodies as indicators of the extent of environmental contamination.

A greater and more unified effort in immunology is clearly indicated, if we are to exploit fully the insights already gained. Additionally, NEFC is in good position to examine genetic components of disese resistance, and even to explore genetic engineering approaches to disease control by enhancement of internal resistance factors.

(3) Virus Diseases in Marine Animals

During the past decade there has been a virtual explosion of interest in and information about marine virus diseases. Viruses have been recognized or implicated in previously unexplained mass mortalities of fish and shellfish (such as whirling disease of menhaden and sporadic mortalities of soft-shell clams). With improved methods of cell culture, the extent of virus infections in marine fish species is beginning to be realized, and electron microscopy has pointed to widespread occurrence of virus infections in mollusks and crustaceans of economic importance.

Virology will thus be an important discipline in marine pathology of the immediate future; it is a complex area of research, requiring unique equipment and expertise. Fortunately, techniques developed in human medical research can be and are being adapted to studies of marine animals. Federal (NMFS) involvement in virus research can be critical to development of information.

OPTIONS

Disease research in NEFC has demonstrated the importance of continuing efforts in marine pathology. With strictures of existing and projected funding, and with evolving program emphasis in the Center, a number of options exist:

(1) Continue present program emphasis, except for reduction in commitment to aquaculture diseases.

(2) Reorient a substantial part of the program toward quantitative studies of disease effects, particularly on early life stages.

(3) Reorient a substantial part of the program toward diagnostic services to states and industry.

OPTION ONE. <u>Continue present program emphasis, except for reduction in commitment to aquaculture diseases.</u>

The present Pathobiology Program is almost evenly divided between fish and shellfish, and includes studies of pollution indicators, pathogen life cycles, histopathology, diseases of shellfish larvae in culture and environmental influences. The current administration's policy of deemphasis on marine aquaculture would seem to dictate a decrease in studies of larval diseases related to aquaculture at Milford, but other studies seem balanced and in accord with national objectives in habitat conservation and resource management.

OPTION ONE. Evaluation

Positive	Negative
° Relatively minor effects on existing staff or program emphasis.	° Progress toward essential quantification of disease effects on recruitment and abundance is slow.
° Insures orderly acquisition of qualitative information on diseases of economic fish and shellfish in broad research areas.	° Staff size, now of minimum critical mass, dictates that progress in some present research areas will be slow.
° Research now oriented toward aquaculture diseases can be redirected toward diseases in natural populations.	

OPTION TWO. Reorient a substantial part of the program toward quantitative studies of disease effects, particularly on early life stages.

Much of marine pathology to the present time has been descriptive, in view of limited information available about pathogens, their life cycles, and their environmental requirements. It now seems to be time to begin moving to more quantitative studies, assessing disease impacts on populations. Such a movement would concentrate on a number of approaches: (1) documentation of quantitative effects of disease outbreaks on population abundance; (2) examination, through field and laboratory studies, of quantitative effects of egg and larval diseases on survival and abundance; and (3) a study of effects of pollution-associated diseases, closely integrated with diseases in natural populations, since the interactive component is large.

These quantitative approaches must be closely associated with NEFC stock assessment work; and joint task forces or recruitment of pathologists with quantitative backgrounds could be envisioned. Additionally, quantitation must extend to assessment of effects of pollution-associated diseases, and better statistical association of disease and environmental effects of pollution stress.

OPTION TWO. Evaluation

Positive	Negative
° Represents an attempt to confront a basic and persistent problem in fishery biology--effects of environmental factors on recruitment and abundance.	° Will result in reduction of descriptive work on new or inadequately understood marine diseases.
° Will enable close integration of pathology research with resource assessment.	° Will require substantial reeducation of pathologists whose background and training are primarily descriptive.
° Will result in healthy re-orientation of pathologists toward quantitative methods.	

OPTION THREE. Reorient a substantial part of the program toward diagnostic services.

The Pathobiology Division has a long history of providing diagnostic services and training to states, universities, industry, and even foreign governments. These activities have been on an *ad hoc* basis, but could be formalized. A structure similar (where feasible) to that of the USPHS Communicable Disease Center (CDC) in Atlanta could be envisioned, to provide for marine diseases the range of services and related research that is provided for human diseases by CDC. Included would be diagnostic services, epidemiology, disease inspection and certification, rapid responses to disease outbreaks in economic species, advice to states and industry on disease control, and training in marine diseases for specialists and state biologists. The Division could thereby become the national focus for many marine disease activities, with possible specialization in epidemiology.

OPTION THREE. Evaluation

Positive	Negative
° Will move an excellent pathology group toward greater national visibility and influence.	° Will result in more short-term projects and a reduction in long-term data acquisition on life histories and disease etiology.
° Will provide a more direct basis for state and industry support in what are now perplexing problems.	° Will result in shift from research orientation to a service orientation for the pathology group.
° Will utilize the broad expertise of the present pathology program in addressing crises and current problems.	

ANALYSIS

The Pathobiology Division has sufficient critical mass of expertise (supported by other NEFC elements) to make focused attacks in two closely related research areas--quantification of disease effects on stock abundance, and pathological effects of pollutants on fish and shellfish. Quantification of disese effects on abundance should include field observations and experimental studies of diseases of larval populations in contained environments. Pathological effects of pollutants should emphasize the possible relationship of tumors and contaminants. Fortunately the two foci--quantification and pollution effects, are to some degree interdependent.

These focused efforts will require (in the absence of new funding) some reprogramming away from coastal and offshore monitoring of adult stocks, and away from aquaculture disease research. The extensive existing competence in microbiology should be brought to bear specifically on diseases of early life history stages, with particular attention to viruses. Close cooperation with the States should be sought, especially in studies of pollutant-tumor relationships, since pollution problems are most severe in estuarine/coastal waters.

It will be apparent from the listing of options and this analysis that the research areas of immunology and microbiology (virology in particular) are not seen as requiring reinforcement with existing and projected funding of pathobiology. This is not because they are considered unimportant. Some dispersed research is ongoing in both areas; it could be consolidated and focused in one location; and it would thereby increase greatly in effectiveness.

APPENDIX XI.

UTILIZATION RESEARCH

UTILIZATION RESEARCH

The living marine resources have two major uses, food production and recreation. Assuming that Federal and State governments are the custodians of this common property resource, the people of the U.S. in both the public and private sectors have certain expectations relating to the proper utilization of the resource.

The basic expectations of private industry are a constant supply, reasonable access to the resouce, the availability of wholesome raw material, and in some cases the preservation of a way of life.

The public sector expects conservation of the resource, equal access, and the availability of wholesome nutritious seafoods. Fulfilling these expectations is the primary mission of the NMFS.

One of the major tasks in dealing with the management of any resource is a proper inventory of the resource in terms of total abundance, potential abundance, present ecomomic (or aesthetic) value, and potential future value. The major role of the Utilization Division relates to the determination of the value of the resource now and in the future. Fishing resources are known to fluctuate widely with alternating booms and busts. Many of the reasons for these fluctuations are not well defined; and, therefore, not predictable. Fluctuating resources can rapidly affect the total value of the resource for both private and recreational interests. The industry's basic capital investment is based on traditional resources, and they do not have the capability of rapidly converting vessels and plants to new species or products. The general lack of technical sophistication in the industry can be attributed to the fact that the majority of the industry are small businesses and cannot afford to maintain research capability. Even the largest fish companies perform very little research and almost none of this ongoing research goes beyond basic quality control. According to Chemical and Engineering News, the U.S. food and beverage industry will spend 1.0 billion dollars on Research and Development in 1984. In discussions with fishing industry research and quality control people, it is estimated that the seafood industry will represent less than 1 million dollars of this total.

This situation leads to major time lapses and serious financial difficulties when converting from one species to potential replacement species or developing new processes or products. The Utilization Division's role in developing data and information relating to the value and potential value of fisheries' resources helps reduce the effect of resource fluctuations on the economic viability of the industry. By providing on hand technical information on harvesting, onboard handling, processing and preservation of potential supplies, the industry can be provided with a major head start.

A good example of this is the research carried out at Gloucester on the ocean quahog. In the mid 1960's, based on some commercial interest in New England and assessment data indicating an extremely large resource, we began to examine the potential value of the ocean quahog as a clam product. Research on handling and processing, product concepts and quality criteria was carried out to estimate the potential value of the resource. At that time, the majority of the U.S. clam industry had no interest in the ocean quahog since the surf clam stocks were considered healthy, and the ocean quahog was reputed to be too tough and have a strong "iodine taste." In the mid 1970's, however, it became evident that surf clam resources were in trouble and severe restrictions were placed on harvesting. Immediately, the industry was forced to search for replacement raw materials. Because of our research on processing and handling, especially in the areas of flavor and color, the industry was able to use this resource as a replacement for the surf clam almost immediately.

From 1975 to 1980, landings of ocean quahogs increased from an insignificant level to more than 35 million pounds. This type of research effort has somehow become labeled as "Fishery Development," an activity carried out by the Federal Government. This is not true. The development of this fishery was carried out entirely by the industry. Our research effort provided basic information to get them started, and we became a catalyst because of our expertise. Without our information, the ocean quahog fishery would have been developed anyway. However, the time frame would have been a lot longer at a much greater expense to industry. Similar case histories can be cited; e.g. red crab, squid, pollock, and minced fish, where the basic information on potential uses, quality criteria, and processing and marketing impediments developed through laboratory research have resulted in industrial development.

Since one of the major functions of technological research is to look to the future, our current work on recovering and using processing wastes and biochemical and technological research on species such as red hake, dogfish, and sand lance should provide the basis for future development of the fisheries.

The major utilization issues facing the private sector in the near future relate to: 1) optimizing the use of traditional resources, 2) expanding the use of nontraditional species, 3) maintaining a share of the marketplace through the improvement of seafood quality and wholesomeness, and 4) remaining competitive with foreign products through technological advances to increase productivity and efficiency.

The major utilization issue related to the public sector is the continued access to high quality, wholesome seafoods either in the marketplace or through recreational fishing.

The programs of the Utilization Division all relate to these major issues.

Fishery Engineering

The Fisheries Engineering Program at Gloucester was recently moved to the University of Rhode Island at Narragansett to form the NMFS-URI Cooperative Fishery Engineering Unit. This group of fishery engineering specialists which operates the MV Gloria Michelle, a 65-foot fishing vessel, now have access to computers, electronic gear and the URI Tow Tank for research and demonstration purposes. The program engineers have worked on harvesting gear modification to improve size and species selectivity which should result in a reduction of discards at sea. Another study carried out to examine the efficiency of existing scallop gear has resulted in a design for a more efficient, less destructive scallop drag. Present work includes studying existing nets and testing potential modifications to improve energy efficiency. The vessel will also be used for (quality) preservation studies at sea to improve landed quality.

Fishery Biochemistry

The Fishery Biochemistry Program is primarily devoted to studying the chemical and microbiological aspects of quality preservation, wholesomeness, and nutrition. Much of the effort of this group is related to studying the quality problems of underutilized species. In fact, one of the main reasons why certain species are not fully utilized is that they are more prone to quality degradation than traditional species. Current activities relating to quality include preservation of red hake, ammonia development in dogfish, preservation of minced fish and developing edibility characteristic data relating to different species. All these studies relate to increasing the use of less traditional species for both export and domestic markets.

A second aspect of this program is to develop information on potential harmful chemicals in seafoods which could affect the marketability of fishery products. This effort in cooperation with the NEFC Ocean Pulse Program is monitoring polychlorinated biphenyls (PCB) and polynuclear aromatic hydrocarbons (PAH) in the tissues of fish and shellfish. These compounds which are persistent in the environment are being monitored to develop baseline information on marine contaminants and eventually trends relating to the effects of ocean dumping and energy exploration.

This group is also developing nutritional data on the amounts of cholesterol and fatty acids in seafoods, primarily shellfish. Historically, doctors and nutrition experts have advised consumers to abstain from shellfish in order to lower their blood cholesterol levels. Recent advances in analytical techniques allow for more precise measurements of sterols and fatty acids. Data obtained from these studies indicate that much of the previously reported cholesterol data is erroneous and that many species of shellfish contain significant levels of highly polyunsaturated fatty acids which may be beneficial in preventing heart disease.

Processing and Preservation Technology

This program represents the bridge between laboratory research and industry application. The group carries out applied research in the areas of preserving quality, reducing processing waste, increasing plant efficiency and process and product development for underutilized species. This activity has resulted in the implementation of many new technological developments which have resulted in increased utilization. These include meat/bone separation for recovering edible material from crab and fish processing waste, mechanical methods of crab meat processing, a handling protocol for quality fresh fish and a modified cutting board to increase fillet yield. Present studies include the evaluation of squid processing machinery, the testing of potassium sorbate for quality improvement and developing/time temperature tolerance data for frozen products as it relates to fish quality and edibility characteristics.

This group works directly with the harvesting and processing industry. Sea Grant Institutions, Fishery Development Foundations, and a variety of local industry associations and cooperatives providing technical advice and assistance on utilization problems primarily related to quality processing waste and underutilized species.

Standards and Specifications

The Standards and Specifications Program is a national program charged with the formulation of all U. S. Standards and Specifications for fishery products. The U. S. Standards for Grades of Fishery Products are the basis of the USDC Inspection Program, a voluntary program funded by industry users. The program also develops purchasing specifications for federal users of fishery products such as the USDA and the military. Through Memoranda of Understanding this group also develops Commercial Item Descriptions for federal purchasing of fishery products. These activities relate to optimum utilization in terms of quality improvement, standards and specifications for non-traditional species and products (e.g. squid, minced fish blocks) and promotion of non-traditional species for menu items in the military.

Although each program within the division is somewhat of a separate entity, they are integrated in terms of overall missions. Basic biochemical information on quality, safety, and nutrition are used in the applied areas dealing with processing and preservation technology and much of the information from both of these is incorporated in the Standards and Specifications work.

In all the Gloucester Laboratory represents an integrated program dealing with the major issues of optimum utilization. Efficient vessels and harvesting gear lead to more quality product at less cost with reduced discards at sea. Improved handling systems lead to better landed quality, greater landed weight, and better processing yields. Recovery of processing waste leads to more quality protein and a broader product base and market expansion. Quality improvement leads to better consumer value and expanded foreign and domestic markets.

All this is potentially achievable without significantly increasing harvesting effort, just making better use of what we now catch.

APPENDIX XII.

ISSUE PAPER ON NEFC RECREATIONAL FISHERIES PROGRAM

ISSUE PAPER

NEFC RECREATIONAL FISHERIES PROGRAM

7 March 1984

CONTENTS

BACKGROUND

On October 12, 1981 the National Marine Fisheries Service (NMFS) formally adopted the following policy:

> "NMFS, through its various programs will protect, conserve, enhance, manage and develop fishery resources of importance to the nation in order to increase the nation's food supply; promote increased opportunity for both commercial and marine recreational fishermen consistent with the concept of optimum yield; and promote activities which will assist the commercial and marine recreational fishing industries to thrive and expand."

This first-time policy gives equal recognition to the importance of recreational fishing as a legitimate use of US marine fishery resources. By design, implementation of the policy will result in full recognition of marine recreational fisheries (MRF) interests in all of NMFS's major program offices and activities.

More recently a marine recreational focus was made in the NMFS Habitat Conservation Policy (November 1983) which credits the marine recreational harvest with 30 to 35 percent of the US finfish total used for food. It also recognizes the monetary value of associated expenditures directly at approximately $5 billion annually and the aesthetic value of fishing as significant components of the US economy.

Similar to other regions of the country, MRF in the northeast were largely ignored in federal and state fishery management programs until the late 1950s. Marine commercial fisheries were identifiable, better understood, quantifiable, and appeared to require management. Prevailing social values dictated that fishing for food and profit was more important than fishing for fun -- a sentiment still expressed in many circles. As participation and catch dramatically increased after World War II, MRF gained visibility, responding to increases in leisure time and discretionary income. Mushrooming coastal populations seized on MRF as a water-based form of recreation. From studies made during the past 20 years, trends are of progressively higher estimates of participation, catch, and related expenditures. Addressing identified needs and desires of the MRF participant and associated industry items being given increased attention in state, national, and international circles.

In 1970 when NMFS took MRF responsibilities under the Migratory Game Fish Study Act most of the 60 people associated with the MRF program were in the Northeast Region at Sandy Hook and Narragansett. When the decision was made to integrate all fishery research activities, fisheries centers were created, the MRF laboratories abolished and MRF visibility diminished. Integration of MRF into all program activities was a desirable objective; however, the effect of these changes resulted in a fragmented and almost invisible approach to stated MRF goals and objectives. Attention given to MRF in the northeast has been primarily in biological research, with most data collection geared to conservation and management ends. However, marine recreational fishing is now recognized as a factor in management plans prepared by the management councils, although its impacts upon resources are difficult to assess due to poorly contoured data acquisition and untimely release of data.

In 1981 when the NMFS MRF policy was drafted by a task group, they included the following recommendations:

1. NMFS should develop a comprehensive MRF data acquisition and analysis system (participation, catch, effort, and socio-economic data) on a regular, continuing basis.

2. NMFS should undertake a vigorous program of communication and coordination with MRF interests -- fishermen, industry, constituency groups, and other Government agencies (federal, state, and local).

3. NMFS should expand its traditional role of considering _only_ the fishery resources upon which marine recreational fishing depends and move toward a broader and more integrated approach to MRF, which also considers MRF users and supporting industries. With respect to the MRF industry, NMFS should identify and recognize that industry as a constituency, and develop a strategy to assist the MRF industry in overcoming problems and achieving greater efficiency and productivity.

4. NMFS should examine its product quality and safety and consumer programs to determine how these programs can contribute to the information and education needs of MRF users.

5. NMFS should undertake a comprehensive assessment of existing fishery management plans and regulations to insure that they do not place the burden of unneccessary or ineffective regulations on the US fishing industry (commercial and recreational). Further, NMFS should insure that the benefits of such regulations justify the costs.

6. NMFS research activities in support of conservation and management should continue and, where possible, be improved, recognizing MRF biological and ecological information needs which have been identified and that are also important to MRF development.

7. NMFS should continue to work with states and foreign nations to improve interjurisdictional conservation and management of fishery resources.

8. NMFS should continue, to the extent possible, efforts to minimize destruction and impairment of coastal and marine resources resulting from habitat alteration. More attention should be given to balancing mitigation and enhancement with development.

9. NMFS should play a catalytic role with other government (federal, state, and local) and private entities in facilitating improved access to provide increased opportunities for MRF users and to stimulate MRF industry growth.

10. NMFS should work with MRF interests to seek innovative funding mechansims for MRF activities, including expansion of the Dingell-Johnson program, in which the user benefits and pays. NMFS should also aggressively promote approporiate legislation to obtain sufficient fiscal and programmatic capability needed to fulfill its MRF responsibilities.

In 1982 the Northeast Regional Office (NERO) circulated a five-year plan targeting the services available to MRF components. Specific objectives of the Region's program were listed:

1. Increase communication and coordination with the marine recreational fishing community and ensure appropriate consideration of recreational fishery interests in all of the Region's programs.

2. Enhance the effectiveness of conservation and management from the marine recreational fisheries perspective.

3. Ensure that recreational needs and interests are considered in planning coastal use strategies by state and local governments.

THE ROLE OF NEFC IN MRF RESEARCH

The needs of MRF in the northeast are no different than elsewhere. They can be succinctly stated as:

1. A resource consisting of species available to the marine angler public and valued for aesthetic "fun-to-catch" and edible qualities

2. Access to the resource

3. Scientific information relative to recreational target species necessary for informed management decisions

4. Timely information on status of species abundance and availability

5. Improvement of quality of the aesthetic experience related to MRF, including environmental quality

6. An understanding of the economics generated by and associated with MRF

Other than the topic of access the NEFC is or is capable of addressing each of these needs particularly with the expertise available in the Resource Assessment (RA), but also within elements of the Marine Ecosystems (MA), and Environmental Assessment (EA) divisions.

Despite continuing involvement in MRF studies there is a continuing perception of NEFC bias to commercial fishing interests. Above all, this perception must be changed. This can only be accomplished by effective communication with and education of the MRF public as well as associated elements of the MRF industry. There is a real need to address this problem and simultaneously enhance our ability to deal with the MRF scientific problems.

Current Emphasis: The RAD has done some soul-searching and prepared a five-year plan to satisfy NEFC subobjectives of the national plan.

A. To improve communication links with MRF interests relevant tasks include:

1. Preparing annual status-of-stocks reports with the latest catches abundance and recruitment estimates for recreationally-caught fin and shellfish.

2. Annually prepare stock assessments for Atlantic cod, bluefish, black sea bass, pollock, red hake, summer flounder, silver hake, Atlantic mackerel, winter flounder, spiny dogfish, skates, weakfish, striped bass, American shad, river herring, and Atlantic salmon.

3. Participate in Scientific and Statistical Committees for the New England and Mid-Atlantic Fishery Management Councils, the Atlantic States Marine Fisheries Commission and other management forums.

4. Present research and survey findings to participants (e.g. NERO) in recreational fishing forums and symposia.

5. Work with the NERO in preparing a display for recreational fishing shows and assist the NERO in presentations of display at recreational fishing shows.

6. Prepare news releases and information bulletins of interest to recreational anglers.

B. To improve precision and accuracy of the MRF data base:

1. Enhance the current intercept survey design for collection of MRF statistics in the northest and conduct the survey in cooperation with state marine conservation agencies.

2. Assist New England party-boat captains in developing a system of documenting gill net operation interactions.

3. Work with New York metropolitan area sportfishing clubs to develop a coordinated system of tallying bluefish catch and effort.

4. Conduct a bluefin tuna recreational fishing survey.

5. Through the NERF management system, coordinate fishery statistics collections with state agencies.

C. Continue special studies to improve knowledge and understanding of population dynamics of recreationally-caught species.

1. Conduct a stock analysis of black sea bass with meristic techniques.

2. Evaluate methods for distinguishing high seas salmon stocks; develop a protocol for the preferred method and test.

3. Compare bluefish catches in NEFC surveys to environmental variables.

4. Define age structure of the bluefish population from NEFC survey and port samples.

5. Examine weakfish and bluefish stock differences.

6. Analyze American Littoral Society tagging data base for movement and mortality patterns of bluefish, striped bass and weakfish.

7. Develop and implement method of estimating spawning stock size of bluefish from egg and larval sampling.

8. Assess consequences of species changes in fishing mortality on other species in mixed and multispecies yields.

It should be noted here that many of these RAD objectives cross traditional interdivisional lines.

Perhaps the most visible of the Center's MRF activities is the apex predator investigation of the MED. The approach has been to emphasize the resource value and vulnerability of large pelagic species and to gather biological information necessary for any management initiatives directed toward these speces. It has documented the movements of blue, hammerhead, mako and sandbar sharks and in the process has organized 2,500 fishermen, mainly recreational, as collaborative volunteers who annually tag thousands of sharks and swordfish (results are communicated to volunteers through biannual newsletters). Current plans are to continue these cooperative efforts with both recreational and commercial fishermen. Studies are designed to provide an understanding of stock structure, migrations, distribution, reproductive habits, growth, food habits and predator-prey interactions of large oceanic species. Data gathering and biological sampling are conducted at tournaments and aboard research vessels. Shark tournaments from New Jersey to Massachusetts are monitored regularly (in 1983 data were obtained from 13). While these studies have been "highly visible" and have enjoyed some success, in the future they will be coordinated more closely with the Assessment Division of the Northeast Fisheries Center and with the Southeast Fisheries Center. Our apex predator studies are primarily directed toward sharks. Additional work on tunas, swordfish, and billfish in the Mid-Atlantic Bight could be incorporated into the present program with respect to recreational catches and biological studies. This would require additional emphasis and assistance from Assessment Divisions at the Northeast and Southeast Fisheries

Centers. The tagging and attendant biological studies listed above could serve as the "core-activity" in a serious effort to focus on large pelagic species that are important to our recreational fishery.

NEEDS FOR IMPROVEMENT

Three targets are worthy of improvement -- abundance estimates, recreational statistics, and information transfer.

1. Improved abundance estimates and environmental measurements are necessary for coastal waters. The inshore limit of NEFC survey sampling is approximately 15 fm. This leaves a coastal and estuarine strip completely unassessed in which perhaps 90 percent of recreational fishing occurs as well as the majority of environmentally degraded areas. Here is a wonderful opportunity to conduct a cooperative inshore survey with the appropriate Center divisions and coastal states in a state/federal research initiative. NEFC could provide a small vessel to ensure compatibility of gear and sampling with states providing scientific crews supported through D/J funding. This effort could be highly visible as a special program, provide a focus for environmental issues, and be a source of material for basic biological studies of fecundity, age, and predator/prey relations relevant to recreational species. Coordination could be affected through the ASMFC and appropriate Center divisions.

Similarly, estimates of the pelagic fishery are possible from a program involving observers on party and charter boats. Apex predator species important to MRF for which biological assessment studies are currently neglected include albacore, yellowfin and bigeye tunas, and several large shark species offshore. Inshore species include bluefish, bonita, and little tunny. For assessments of all tunas our relationship with the SEFC should be clarified. For assessments of large sharks for which there is no commercial fishery, the collection of catch/effort data should be expanded by obtaining catch data from domestic and commercial longline fisheries and the initiation of cooperative surveys (states, NEFC and SEFC) for both assessment and biological data .

2. A larger commitment should be considered in improving the accuracy and precision of recreational fishery statistics. In the past this statistical survey has been the purview of the Central Office (CO). By accepting regional responsibility we can obtain better quality control of intercepts for desperately needed catch data and also enhance data collection for those species of special interest. It should be noted, however the monies received from the CO will probably be substantially inadequate (90-100K?). Additional resources probably matching the CO input must be earmarked.

3. Improvement is needed in information transfer. The NEFC should provide tangible products to the public. Examples may include a five page quarterly bulletin and public information document distributed from the NERO to trade publications, and available at trade shows. It is generally felt that we effectively transfer information to institutions such as the regional fishery management councils and the ASMFC through the development of management plans and participation on advisory groups and committees. Realizing there is no one source to reach the sportfishing population, we should pursue this end through the contracting of outside sources to produce public information releases. Suggested targets include:

   a. National groups, sportfish dedicated (i.e. Sportfishing Institute), to receive press releases.

   b. An annual status-of-stocks report available for the National Fisherman's Yearbook and similar publications.

   c. A regular information column available to newspapers to sustain and direct a regional interest in species and management as well as printing quality pamphlets useful to head and charter boat operators.

ORGANIZATION

Under the present NEFC matrix system the integration of sportfish activities into various investigations serves to suppress a visible presence to the sportfish interests; however, there is definite difficulty and danger in breaking out components and creating a separate sportfish program. The matrix arrangement should prevail, but with sportfish activities identified and included as a budget line item. The presence of a sportfish information transfer coordination office could provide the response to queries and source requests necessary for visibility.

A mass disentangling of sportfish related projects from the matrix into one unit would not serve the Center objectives since many activities are directly or indirectly related to sportfish interests in subtle ways and need only some awareness-building and interpretation to make appropriate information available to the recreational fishing community. One example would be the focusing of fishery oceanography personnel to provide timely reports of sea temperature, gyre processions and upwelling events, all of which benefit both inshore and offshore fisheries. Other NEFC relevant studies would include (1) assessing natural mortality of recreational species attributable to disease and the relation of water quality to survival rates and abundance, (2) determining sublethal effects which may be compromising growth, reproduction, and general well being of the resources in question, and (3) information on the uptake and subsequent body burden of contaminants. This latter topic has a direct impact on public attitude of resources as food and carries over to recreational participation and the aesthetics of fishing.

ACTION ITEMS

The Center should squarely face its responsibility to provide timely scientific information to the management bodies and the general public, fill the coastal resource/environmental data vacuum which presently exists with a state/federal program, implement a recreational fishery-oriented information flow, obtain appropriate statistical data from an improved regionalized survey, and encourage economic studies by appropriate NEFC, NERO, university, and state interests to identify the magnitude of resources expended. A core program should be identified and funded with joint projects (within NEFC and the SEFC and with the NERO) fleshing out the total effort with visibility in applied biological science. <u>Our main job is to provide adequate biological and environmental information relative to living marine resources.</u>

EPILOGUE

The activity, often frenzied, surrounding MRF in the NEFC suggests there must be something so wrong with our present program(s) that new research initiatives and associated public relations are necessary. While some might agree on both counts there are no "quick fixes" to establish NMFS as a champion of MRF. During the past 10 years we (NMFS) essentially lost most of our identifying marks as a conservation agency. Right or wrong, we are regarded as an arm of the utilizers, developers and traders in international fisheries, rather than stewards of the nation's renewable fishery resources. Moreover, much of our research in the last decade is perceived by fishermen and others as being aimed at the scientifically fashionable rather than what might be beneficial to the resources, fisheries or general public. One approach is to be a strictly scientific body. Certainly that is one image NMFS has instilled in some of its younger scientists. If so, we need not worry about recreational or commercial factions because our prime concern is satisfying other scientists, however we will continue generating adverse public sentiment. As an alternative NMFS can reestablish itself as a conservation agency in the thought priorities of its employees. When this happens, many of the "MRF problems" are then likely to solve themselves. The reexamination of issues, such as MRF, in a responsive and conservation mode can only contribute to a better philosophical base for NMFS activities.

Panel Members

Dr. J. G. Boreman, Jr.

J. G. Casey

S. J. Wilk

Convened by A. L. Pacheco

at the direction of Dr. R. C. Hennemuth

APPENDIX XIII.

FUTURE NEEDS OF THE NATIONAL SYSTEMATICS PROGRAM

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
SYSTEMATICS LABORATORY
NATIONAL MUSEUM OF NATURAL HISTORY
WASHINGTON, D. C. 20560

DATE : December 16, 1983

TO : Michael Sissenwine, NEFC Committee of Three

FROM : Bruce B. Collette

SUBJECT: National Systematics Laboratory

Following the October NEFC program review, I considered NMFS-NOAA goals and the present and potential capabilities of the National Systematics Laboratory. I conclude that NMFS needs three systematists (an ichthyologist, a carcinologist, and a malacologist) plus the Laboratory Directory and a support staff of five. This would give NMFS expertise in the three major animal groups that supply most fishery products. We could then answer specialized questions and advise on solution of taxonomic problems in all three groups.

To arrive at this goal expansion is needed as follows:

1. FY 85 - add 1 technician (part time sufficient for FY 85): + $10K, 0.5 FTE.

2. FY 86 - add one systematist (ichthyologist or malacologist); convert part-time technician to full time: + $30K, 1.5 FTE.

3. FY 87-88 - upon retirement of one of present carcinologists, replace with systematist (opposite of FY 86 discipline): - $25K, no FTE change.

Additional funds and personnel should be a matter of NMFS concern not just the NEFC.

cc: Hennemuth, Sinderman

APPENDIX. XIV

NEFC REMOTE SENSING ACTIVITY

Item 1.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Center
Woods Hole, MA Ø2543

February 21, 1984

TO: Board of Directors

FROM: Allen E. Peterson, Jr.

SUBJECT: Minutes of Board of Directors Meeting, 1 February 1984

A BOD Meeting was held on 1 February at the Woods Hole Laboratory. The meeting was chaired by the Center Director. All members were present except for Dr. James E. Hanks (represented by Dr. Frederick Thurburg) and the Regional Director. The entire meeting was devoted to Remote Sensing. Presentations were made by Dr. Robert L. Edwards, Helen Mustafa, Dr. Reed S. Armstrong, Donna Busch, Dr. James P. Thomas, and David Mountain. Other invited guests were David H. Rand and Leo J. Fisher from NMFS Science and Technology, and LCDR Robert J. Pawlowski.

Opening Remarks. Mr. Peterson stated that this BOD meeting is being devoted to Remote Sensing because of budget concerns. After the presentations, the BOD will have to make some hard decisions regarding Remote Sensing activities and decide how much to spend on them.

Edwards. Dr. Edwards distributed a briefing book on the topics to be discussed and a booklet entitled "NEFC-CSDL Remote Sensing and Distributional Data Analysis System." He then discussed the broad background of Remote Sensing and NEFC involvement to date. His recommendations for the future were that NEFC should help the New England region pull itself together, support NEARSS, and explore and use these interactive systems.

Mustafa. Ms. Mustafa discussed the history and NEFC involvement with the Northeast Area Remote Sensing System (NEARSS), cooperative agreements and contracts, and recommendations for the future.

Discussion Period on Above.

The question was raised as to how we might convince NMFS/NOAA to take a more active role in supporting Remote Sensing activities in the northeast. Since under the Carter Administration cooperative agreements and interactions with academic institutions were encouraged, Dr. Edwards pulled together the outside community (federal, academic and private not-for-profit institutions) into the Northeast Area Remote Sensing System (NEARSS) Association. Shortly thereafter we had a new administration and the guidelines changed. NESDIS, faced with the problem of looking at the feasibility of selling the satellites to private companies, was distracted from properly addressing regional needs. Although NESS (now NESDIS) was established to explore the usefulness of Remote Sensing, it does not seem to be able to deal effectively with user needs. Because NESDIS has a global mandate and a primary responsibility to serve the real-time needs of the National Weather Service, the oceanographic needs of the northeast have a low priority. Although the northwest is receiving remotely sensed data, they are not set up to help institutions such as NEARSS. Scripps received remote sensing funds from the Navy to set up a satellite reception and processing facility, but were soon overwhelmed with users. Services associated with such a facility take a toll on academic staff and should be the role of institutions outside of acdemia. If we put a receiver at Narragansett, then NOAA should supply the data we need.

Mr. Fisher discussed what is happening in other Centers with regard to Remote Sensing. In the Southeast, Dr. Kemmerer has directed his efforts toward specific problems concentrating on one species, shrimp. In the Southwest, Dr. Laurs is working with tuna, anchovies and marine mammals. The Northwest and Alaska are concentrating on fisheries oceanography, salmon and marine mammals.

Although the SEASAT satellite is dead, other scatterometers are available. Data from these instruments are classified; therefore, to date we have not obtained them. In the NEARSS mode, they can be obtained only to be used retrospectively. We would have to make arrangements to spin off specific data sets. NOAA does not receive these data.

Eric Schneider put forth an initiative for millions of dollars for remote sensing but this was turned down by OMB and Commerce. Although NOAA has a fairly large budget for Remote Sensing, NEC does not receive any of these funds directly. As new satellites are developed, if the proper systems were in place it would not be necessary to continually expand the central system, except for ocassionally upgrading NOAA's computer.

<u>AEG Remote Sensing Activities</u>

Dr. Ingham explained how AEG was involved with remote sensing, their interaction with URI, and recommendations for the future. Dr. Armstrong distributed and briefed from memo dated 23 Jan, "Issue Paper: AEG Remote Sensing Activities."

<u>Discussion on Above</u>

The Marine Advisory Service approached TV Channel 6 in Providence regarding televising products such as the URI/NMFS Sea Grant Temperature Chart, but when they realized that there were one-half million potential users, they backed off due to logistical problems. The charts produced at AEG would be of interest to recreational fisheries if we could zero in on a smaller area such as Cape Cod Bay. However, providing charts to fishermen would be difficult to justify to NMFS; that is why Sea Grant is paying for them at the present time. Sea Grant has considered charging for the product and they are planning to take a survey to see how many fishermen would be willing to pay. The URI equipment is used by AEG six hours per day and then it takes two more hours to produce the charts.

Dr. Ingham discussed SORT (Synoptic Oceanography Research Team), a cooperative agreement with URI. Its objective is to increase understanding of the dynamics of the western Atlantic Ocean from Cape Hatteras to Nova Scotia.

Cost of the cooperative agreement with the URI Remote Sensing Laboratory is $35,000 yearly for access to the system and this is expected to remain stable in FY-85. AEG is paying only 10% of the facility's operating investment. If specific requests are received for data which is not in the archive, we may have to purchase it. Dr. Ingham stated that the next step forward is to obtain some means of getting direct communication of the data, which would solve a lot of problems. We would then get real-time data in real time and not have to depend on mail from Suitland.

Marine Ecosystems Division Remote Sensing Activities.

Dr. Sherman distributed the following material: 19 Jan memo from Dave Mountain, "Remote Sensing Operations"; 27 Sep memo from Donna Busch, "Remote Sensing Summary: Marine Ecosystems Division, AEG, Oceanographic Remote Sensing Laboratory, FY 1983"; 24 Sep memo from URI, "Progress at Oceanographic Remote Sensing Lab". Donna Busch presented an overview of specific MED ongoing projects. Dave Mountain briefed on oceanographic projects.

Discussion on Above.

If we had the capability to receive data at AEG, we could eliminate the GOES-tap cost of $7000 per year. The URI contract this year is $50,000, $35,000 of which is to provide AEG access to thermal data and processing. We are in the third year of $50,000 under the cooperative agreement. This year $15,000 of the total contract is earmarked for support of a Ph.D. level student to look into the circulation on Georges Bank. At the present time, neither the Narragansett Lab nor AEG can afford to use the Draper Lab service.

Environmental Assessment Division Remote Sensing Activities.

Dr. Pearce distributed ICES Document CM 1983/C:23, "On the Potential of Remotely Sensed Data in Conjunction with Fish Surveys." He called attention to the 3rd paragraph on Page 3, "Significantly more involvement of fishery biologists in remote sensing is essential before the full value of remote sensing for fisheries research can be achieved." Dr. Thomas then presented EAD's remote sensing program and discussed CHARM (Coastal Habitat and Research Mensuration), a project to map wetlands.

Discussion on Above.

Landsat MSS scenes for the CHARM Program are classified at U/Mass. U/Mass also provides land cover statistics by scene. Statistics by state, county and water catalogue units are developed at the Oak Ridge National Laboratory where scenes are merged and may be geographically corrected as needed. ONRL has an extremely competent Geographic Information System capability. The estimated cost to continue CHARM at a minimum in FY 84 is: U/Mass - $10-25,000; ORNL - $40,000. The benefit to continue the classification scenes at U/Mass is their expertise in coastal wetlands. As far as facilities are concerned, all CHARM-related processing could be performed at ORNL, and even Draper if necessary. Classification of Landsat Thematic Mapper data has been initiated at the University of Rhode Island. Although this work could also be done at ORNL or Draper, here again we have the benefit of wetlands expertise and URI is already active in performing these analyses. Past work on the CHARM Program has been largely developmental. It is proposed that a survey be conducted every five years (base year being 1978, the retrospective change analysis is presently being conducted for 1972). The estimated cost for MSS tapes for another survey year is approximately $14,000 and approximately $60,000 will be required for processing.

Estimated FY 84 costs for the Environmental Assessment Division to continue work on satellite data (CZCS and AVHRR) relative to the analysis and distribution of phytoplankton and the analysis of ecological regimes (Water Management Units) at Draper Laboratory is $60,000. The terms of the Draper contract also include the archival of our satellite data and the maintenance of derived products.

ACTION ITEM - Thomas - Provide the Center Director with a budget breakdown for future CHARM surveys.

ACTION ITEM - Sherman - Provide the Center Director with a proposal for FY-84 regarding involvement with Draper.

It was asked if NEFC was at the cutting edge of the state-of-the-art and if anyone else was at a further stage of development. Dr. Sherman referred back to the ICES Document he distributed earlier, which indicates that we are at the cutting edge. Many people in the center were involved with NASA during the planning stage. China, Finland and Denmark are all working with remote sensing. Mr. Fisher added that NEFC is not duplictating anything being done elsewhere in the fisheries area. CHARM is standardized and applicable to the entire coastline; we are in a good position at the moment and we have to capitalize on what we have.

At a recent wetlands meeting, there were representatives from NSF and NASA, but none from NMFS/NOAA, although NMFS had been approached to help finance that particular meeting.

It seems like the other agencies are waiting for NEFC to develop something that they can use. We are faced with a multi-agency problem, and if all of these other agencies were contributing, we wouldn't be looking for money. Mr. Rand stated that if NEFC thinks that NOAA should take the lead in remote sensing, we should pursue it. Dr. Sherman suggested that we present a briefing to Dr. McElroy (NESDIS) and also formally address Sea Grant. If we could demonstrate to Sea Grant that we are closely involved with URI, which is a Sea Grant institution, they might be willing to support our joint efforts. We should point out to NOAA that NEFC can no longer push remote sensing and convince them that they should assume responsibility for further development. Mr. Rand wondered if other people thought that they were on the cutting edge of taking the lead, such as Kemmerer or Laurs or other parts of NOAA. For NEFC to just continue on an individual basis is not sensible--management should decide if NEFC is going to take the lead or not. Before approaching NOAA, however, NMFS has to get its act together.

It was suggested that we not attempt to standardize remote sensing nationally, but develop it regionally. Maybe our role is not to tell other people how development should be perceived, but to stay involved and make a reasonable commitment. Our responsibility should be more intimate contact with the fish rather than with the environment. Dr. Brown stated that we should be on the cutting edge in the application of remote sensing to fisheries problems. It is a tool we should all learn to use. However, some of the tool should be made accessible to us and that is where we should hone in on NOAA. Not every hospital has CAT scanners. It is critical for us to define that break point. Mr. Peterson asked if we were a big enough market to assume that anyone would be willing to service us. At the present time we are not even able to obtain all the remote sensing data that is available within the system. Dr. Sherman stated that we are reasonably convinced that we have an important tool, since there has not been one document produced on remote sensing that does not mention its applicability to fish in the ocean.

Dr. Sissenwine stated that even though remote sensing is a useful tool, we have not put it into perspective with our other tools. Remote sensing is the tool if you want to study warm core rings, but how important are warm core rings to studies of fish? Monitoring of temperature on fronts is important, but in this particular case the cloud cover issue is also very important. Can we predict recruitment using remote sensing? The Antarctic program is a valid use, but this is a NMFS/NOAA mission and we cannot carry the ball ourselves. We don't have that many vessel trips that would depend on remote sensing; we have managed in the past. It is important to find out where estuarine plumes are going, but when once you have defined those plumes, the future evolutions become less valuable. We should be using remote sensing, but we should also be realistic and not just look for justification to use the tool. We have to tie this package up and we can only do it through NOAA.

A discussion was held as to how much of what we are doing is developmental and how much is operational. Outside of Antarctic work, MED is still in the developmental stage, particularly as it relates to the recruitment problem and cloud cover. The weekly charts for fishermen and the monthly charts for the Coast Guard are operational. CHARM is operational. Dr. Ingham stated that we are talking about development of applications and not development of sensors. Mr. Rand added that Gordon and Angelovic would agree with supplying charts to fishermen, but OMB would not.

Dr. Sindermann stated that we should look at the effect of the natural environmental factors and pollution on recruitment of fish--we should take the lead in this rather than in developing a tool. He doesn't think we have exploited the tools we already have, the standard things we have been doing for years. Dr. Sherman stated that we need to maximize use of our data base; it would be tragic if someone else came along and used our data.

Mr. Peterson asked if we could assess the best way to solve a problem if the tool is not yet fully developed. Dr. Brown replied that since remote sensing is relatively operational, we should be able to make that decision. Dr. Ridgway agreed that the problem has to come first and cited two examples. A recent New York Times article about Laurs work on the west coast asked the question "How do you help fishermen find fish?" You don't see similar articles about the east coast. Woody Chamberlin received an award from a fisheries group because he used remote sensing to solve a problem in which they were interested. Priorities should be controlled by fisheries problems we are addressing--not the technology.

Mr. Peterson summarized remote sensing expenditures. Ms. Mustafa's budget went to support the Draper Lab, part of which was for US/Canada. Dr. Thomas is using Oak Ridge to support CHARM, which is nearly operational. AEG and Narragansett have a contract of $50,000 to URI partly to support production of operational charts supplied to fishermen. What are we doing in remote sensing that is not applicable to Fisheries? Mr. Rand stated that he believes the Antarctic will not be funded in the future, although NEFC has contributed very little to the Antarctic. Mr. Peterson stated that the current NEARSS budget is only Ms. Mustafa's salary and support services for a Secretariat function.

Discussion - BOD resolution of questions posed in 5 Dec 83 memo from Peterson regarding budget for NEFC Remote Sensing activities.

Question 1. How important is NEARSS beyond NEFC? If significantly so, how much of its support should come from us?

How much from NESDIS and from other users?

It was agreed that it would be advantageous for NEFC to maintain association with NEARSS at a minimum cost, since NEARSS should be able to provide less-expensive access to information in the future. Ms. Mustafa will continue her rôle as Executive Secretary to NEARSS. NEARSS should continue to push NOAA for further funding; NEFC should not be mistaken for NOAA per se in the eyes of the NEARSS Association.

Question 2. How much accessibility to real-time data is needed by NEFC? And at what cost? Who uses it and for what purposes?

At the present time we are spending $165 per week for real-time access (3 tapes at $45 plus $30 for Federal Express). The receiving station at URI with technicians to operate it is a $150,000 capital cost. If NOAA elects to bounce signals, it will be a $50,000 capital cost. If the signals are sent directly from the satellite to URI, we will have to process the tapes ourselves and the cost will be much higher. If AEG gets the $50,000 receiving station, the only additional operating cost other than someone to operate the equipment will be $10,000 annually, but this will be a much better system than we presently have. NEARSS member institutions might pay their fair share by buying some of the tapes. URI would probably be willing to archive data. After 90 days, tapes could be given to the national archives for safekeeping.

Question 3. Should remote sensing at NEFC be broadly integrated and prioritized within the programs as a tool or should it be combined in a single unit?

The consensus was that remote sensing should remain within the programs, with the understanding that everyone should have access to URI and Draper archives. Funds should remain in the Divisions that are involved in the actual operation or development. One person should track those funds from year-to-year so that they remain identifiable and the Center knows the extent of its commitment. It was agreed that AEG should be the central coordinating remote sensing unit for data base archiving. AEG is prepared to provide access and service functions for the URI archives providing it is a short-term problem; if a Division has a long-range problem, it will have to provide the manpower.

Question 4. How much can NEFC afford given the current budget situation and policies? Input from the full Board of Directors on this question must be facilitated.

The amount requested for this year's NEARSS Remote Sensing budget is $130,000. Consensus was to fund the communications network and buy one terminal to support the upcoming NOAA experiment (approximately $65,000). Although NEFC will do its best to communicate to NMFS the importance of Remote

Sensing support, NEARSS should take the lead in continuing to push NOAA for future continued capital outlays.

In conclusion, Mr. Peterson thanked the speakers for their worthwhile presentations and the Board for their enlightening discussions.

Next Meeting. The next meeting will be held on Wednesday, 7 March, at the Narragansett Laboratory.

Item 2.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Center
Woods Hole, MA 02543

December 5, 1983

TO: Helen Mustafa
Robert L. Edwards

FROM: Allen E. Peterson, Jr.

SUBJECT: Managing and Budgeting NEFC's Remote Sensing Activities

I have studied the package sent to me by Helen with her memo of November 28 entitled "Modified FY 84 CYOP for Remote Sensing at NEFC". I have also studied the background paper sent to me by Bob concerning the NEFC-CSDL remote sensing system also the proposal from URI for the Northeast Area Remote Sensing System: Experimental Satellite Receiving Station. An additional interacting document I have studied is the prioritized list of proposed contracts submitted by Jack Pearce for the Environmental Assessment Division. I was also present at the NEFC BOD meeting at which an attempt was made to resolve the Remote Sensing budget issues, before I was assigned as Center Director.

I am a strong believer in remote sensing and its value for various marine research, monitoring, management and development applications. I have supported remote sensing efforts in the past while Regional Director. Nevertheless, the present situation concerning remote sensing in the Northeast Fisheries Center is so complex with so many different proposed interactions, both in-house and on contract, and with so many differing problems and priorities, that I cannot develop a firm basis for making management decisions. I have come to the conclusion that I cannot fully resolve these problems and priorities by dealing with you (Bob and Helen) alone.

I have been able to sort out certain actions that I believe are appropriate to make at this time. Remaining actions could be made after consideration of the remote sensing topic as a theme for our February BOD meeting.

The interim decisions I propose are as follows:

1. Since CHARM is an Environmental Assessment activity which involves Dr. James Thomas of our Environmental Assessment Division, and is related to the Regional Action Plan (RAP) and depends on EAD funds substantially, I believe it will be appropriate to place the lead responsibility for CHARM in EAD under Dr. Pearce. He may well want to appoint Dr. Jim Thomas as coordinator of this program. In order to move ahead with CHARM, I would release $15K from the Center reserve funds held in CYOP # NEC 147. This, along with the $50K already dedicated by Pearce (40K Oak Ridge Contract and 10K URI remote sensing water column) should allow the CHARM program to move forward at a rate satisfactory to all concerned.

2. $50K has already been released from the Remote Sensing reserve

to cover both Sherman's and Ingham's interaction with URI. The Sherman-Cornillon interaction covers many of the concerns about mechanisms of larval survival and drift included in both Helen's memo of November 28 and Bob's background paper.

3. The developmental work on remote sensing under NEARSS would remain under Helen's coordination in CYOP # 154. The total available budget for now is not to exceed $100K, including personnel and travel costs. This amounts to a release of approximately $11.1K from the Center reserve funds in that task. Further release of funds would depend on the outcome of the February BOD Meeting. Note that some of these funds are already committed to cover part of the Unifax network costs. An issue paper or analysis on the need for and extent of that network is needed as soon as possible.

4. I will instruct Pearce and Sindermann to hold back the $60K for support of the Draper contract. This is the lowest priority item on the list of proposed contracts for the Environmental Assessment Division and as such must be held back until our budget situation becomes clearer.

During the February BOD meeting, at least a half day should be devoted to laying the groundwork for final decisions on this fiscal year's remote sensing budget. The preliminary outline submitted by Helen with her memo of November 30 would need to be modified from a seminar format to a format that will support decision making. In particular, the following questions should be addressed:

1. How important is NEARSS beyond NEFC? If significantly so, how much of its support should come from us? How much from NESDIS and from other users?

2. How much accessibility to real-time data is needed by NEFC? And at what cost? Who uses it and for what purposes?

3. Should remote sensing at NEFC be broadly integrated and prioritized within the programs as a tool or should it be combined in a single unit?

4. How much can NEFC afford given the current budget situation and policies? Input from the full Board of Directors on this question must be facilitated.

Issue papers that facilitate decisions on the questions above and on whether or not each element should be funded would need to be prepared and circulated to the Board of Directors prior to January 25, 1984.

I would appreciate your views on these proposals by December 12th.

cc: G. Ridgway
R. Hennemuth
C. Sindermann
J. Pearce
K. Sherman
M. Ingham
H. Stern

Item 3.

Robert L. Edwards
Helen Mustafa
December 9, 1983

ISSUE PAPER

NEARSS Communication Network

The NEARSS Communication network will make it possible to communicate and interact with various systems within the region, using data sets from polar orbiting and geostationary satellites in the analog or digital mode. The network and associated equipment may also be used in connection with the transmission and analysis of other desired data sets. The maximum baud rate will be 9600 and the total cost is expected to be between $50K and $65K per year. The cost per terminal will depend on the number of terminals on the net. The more terminals within the region (approximately N.Y., N.Y. to Portland, ME) the cheaper the cost per terminal.

The Chairman of the NEARSS Association has requested members to confirm the number of terminals that each institution expects to install for digital communication at the next NEARSS meeting, 12 January 1984. Discussions with various persons indicate that NEFC may need terminals at Woods Hole, Sandy Hook and Narragansett. The cost of each terminal is approximately $10,000.00. (See Attachment I, Brief Description of the NEARSS Terminal).

At the present time NEFC is supporting an analog communications net, the GOES-tap net. The master receiver for this net is at Narragansett (AEG) with stations at Woods Hole, Sandy Hook and Boothbay Harbor. A description of the GOES-tap is attached (Attachment II). We are now carrying out negotiations with GSA and the Telephone Company to include the above stations into the total NEARSS Network. This would cut the line costs of the present GOES tap receivers as well as the line costs of the proposed digital terminals.

The GOES-tap is also potentially useful for communicating charts and other products developed in the region. As a matter of fact, this may be the part of the total communications network that will be used to communicate routine operational products e.g. the AVHRR products produced at Narragansett now. We are looking into what is required to transmit data from AEG. Once this is accomplished, NOAA's Marine Advisory Service units, NWS, the Coast Guard and others may also wish the regional products. The addition of these potential stations will further cut line costs per individual receiver.

The Airforce Goephysics Laboratory will be an important node of the network since it will be the data flow control as well as the source of digital GOES-East data through the NEARSS interface at this reception facility. The hardware for the interface is in place at this time, the software almost complete, and the documentation for the NEARSS interface and protocols for communications are in preparation.

It is proposed to test the communications net in April 1984. A workshop for the evaluation of the NEARSS physical system, including the communications network, is proposed for September 1984. (See Attachment III, "NEARSS Data Network Demonstration and Evaluation").

Whenever real-time data reception from polar orbiting satellites is achieved, that data may also be transmitted over the network. This is the first regional (non-commercial) effort for data transmission and data interaction in the United States, if not the world. Other consortia and societies with similar interests are looking to us as a pilot for their activities.

"The value of data is proportional to its accessibility."

7-27-83

DRAFT

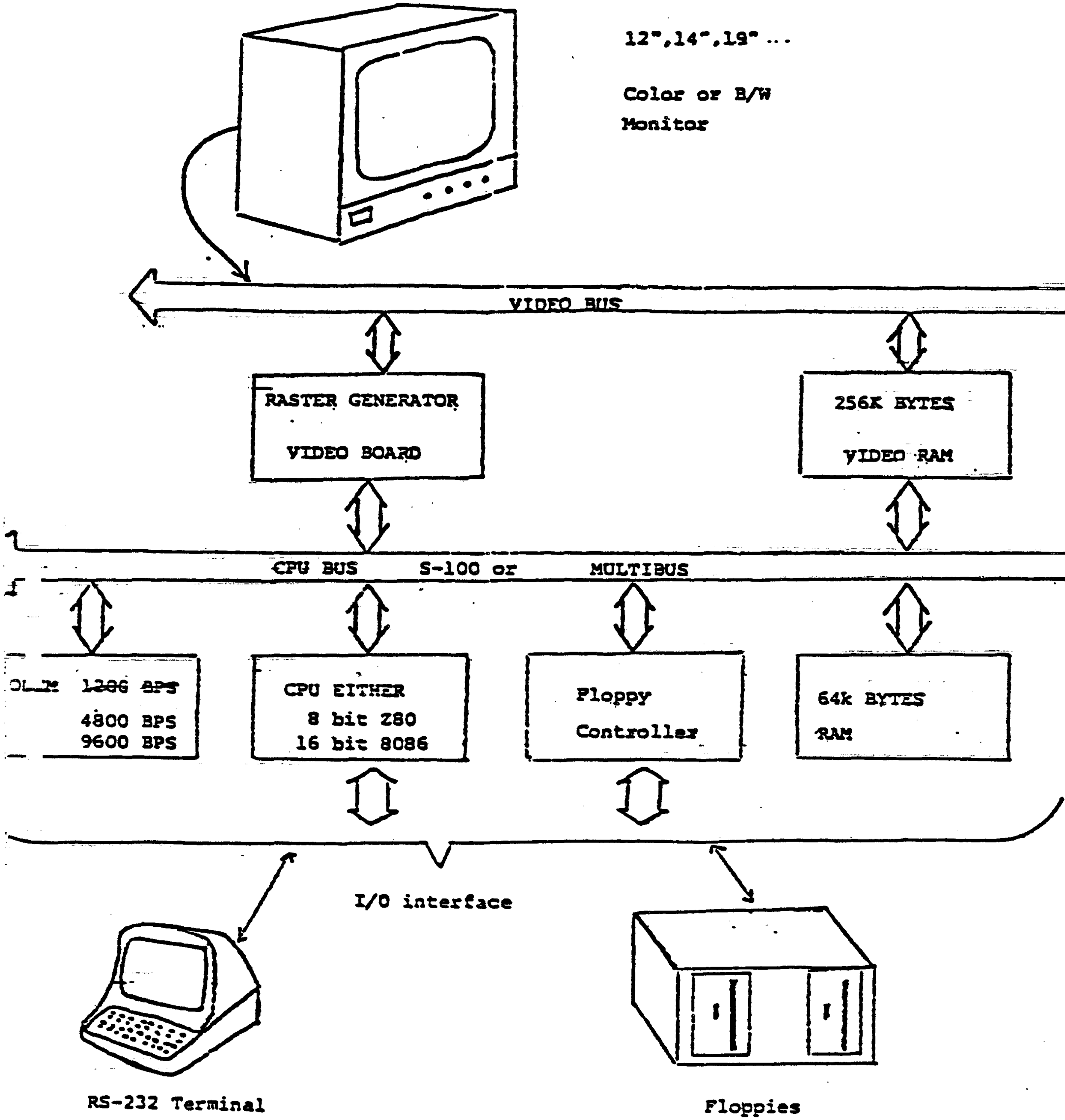
NEARSS RECEIVING TERMINAL AND INTERCONNECTION SYSTEM

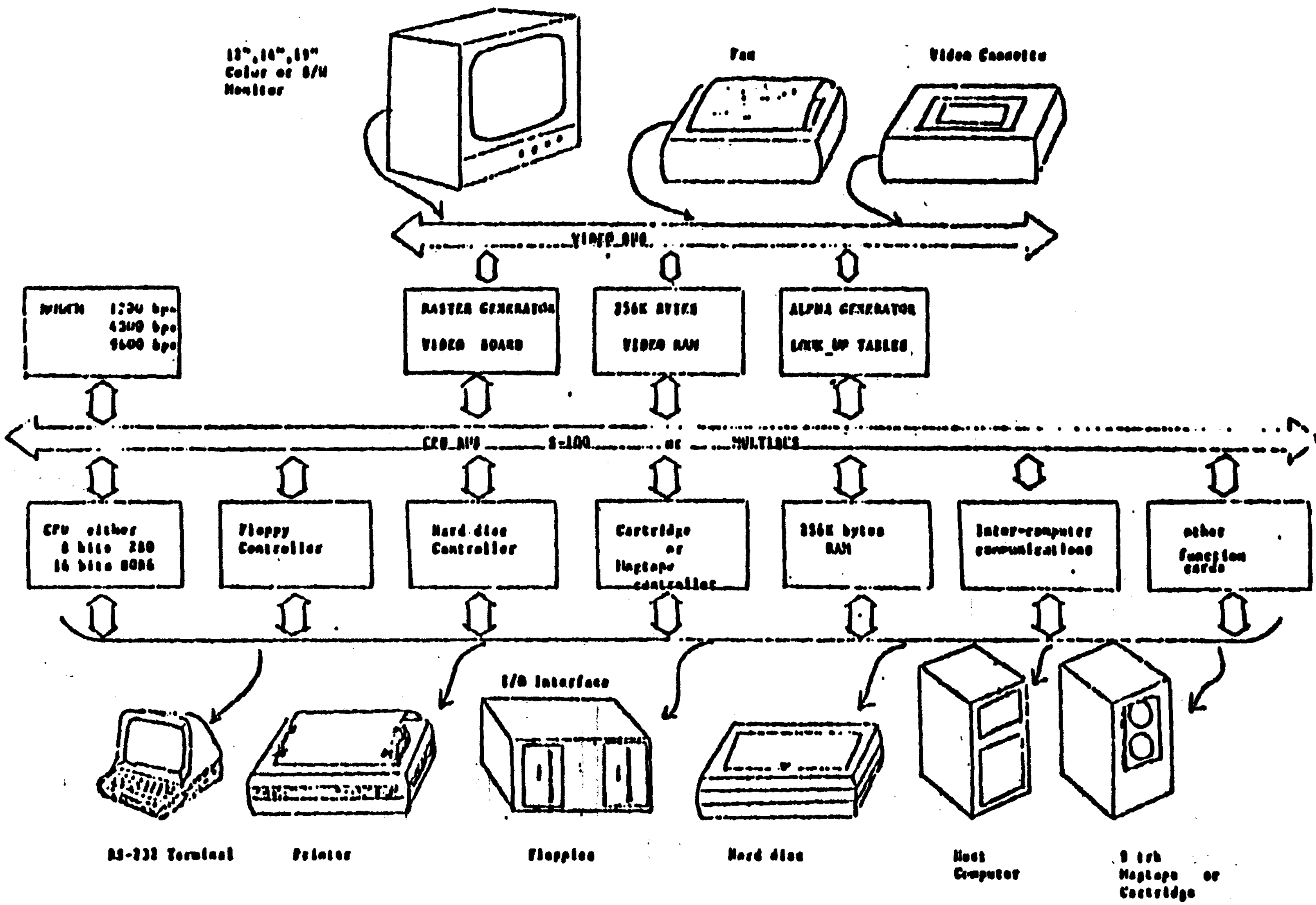
The terminal for reception of digital data via telephone lines consists of a modem, microprocessor, a memory device, a device to control the flow of data, a dual floppy disc unit, a video board, a video monitor, and a terminal (Fig. 1). The resolution on the monitor is 480 by 480 pixels. The display may be used in color or black and white. Basic software will be available. The cost is approximately $10,000.

This system is capable of generating an archive on floppy discs, doing enhancements, superimposing images, contouring, sectoring, some statistical analysis and filtering of the simplest kind.

The bus system (S-100) can accommodate a variety of additional peripherals. Figure 2, with an added Input/Output interface, shows a great variety of possible peripherals that can be accommodated on the bus.

This approach to a data-receiving terminal system provides great flexibility and expansion possibilities. It is neither recommended nor necessary for any one user to acquire all the possible peripherals. A hard disc may be useful for rapid recall from a limited archive, while a tape cartridge or 9-track tape deck may be used for accessing a large archive.


12",14",19" ...
Color or B/W
Monitor
VIDEO BUS
RASTER GENERATOR
VIDEO BOARD
256K BYTES
VIDEO RAM
CPU BUS
S-100 or
MULTIBUS
4800 BPS
9600 BPS
CPU EITHER
8 bit Z80
16 bit 8086
Floppy
Controller
64k BYTES
RAM
I/O interface
RS-232 Terminal
Floppies



13",14",19"
Color or B/W
Monitor
Fax
Video Cassette
VIDEO BUS
RASTER GENERATOR
VIDEO BOARD
256K BYTES
VIDEO RAM
ALPHA GENERATOR
LOOK_UP TABLES
1200 bps
4800 bps
9600 bps
CPU BUS S-100 or MULTIBUS
CPU either
8 bits Z80
16 bits 8086
Floppy
Controller
Hard disc
Controller
Cartridge
or
Magtape
controller
256K bytes
RAM
Inter-computer
communications
other
function
cards
I/O Interface
RS-232 Terminal
Printer
Floppies
Hard disc
Host
Computer
9 trk
Magtape or
Cartridge

Appendix C. Description of prototype user terminal hardware and software .

Hardware.

The hardware consists of a microcomputer, a display system and a modem for communication.

The microcomputer was acquired as separate components, they are listed below, with their current prices (as of April 28, 1983)

Mainframe board:ECT 10 slot mainframe (motherboard) cost	$ 425.-
Lomas board set, consisting of:	
8086 CPU	$ 525.-
Floppy disc controller LDP72	$ 275.-
Hazitall I/O	$ 325.-
256 kilobyte RAM	$ 795.-
Lomas 8087 coprocessor option	$ 360.-
CP/M-86	$ 300.-
Disk Data Cable	45.-
Integration and burn in	$ 150.-
Shugert Streamline case with two disc drives	$1175.-

This was purchased from John D. Owen Assoc., Inc. 12 Schubert Street Staten Island, NY 10305 (212*448-2913)

Display system.

VX384 Color Graphics Machine	$3995.- (until May 1)
VXM High resolution color monitor	$1295.-
VXK keyboard	$295.-

The above was purchased from Vectrix Corp. 700 Battleground Ave Greensboro, NC 27401
1-800 334-8181

Cathode ray tube operators console with keyboard:
Telray 800, cost approximately $ 1100.-

Prices are of course subject to modification, and vendors specifications also tend to vary with time, prices go up and specifications become better and better.

Software .

The following software is being developed.
Connect to NEARSS network.
Receive and store data
Save data from memory to disc.
Load data into display system.
Display data.
Enhance display.
Save display into disc or processor memory.
Print out selected data.

Software may be written for additional functions as time and

THE GOES-TAP NET

Reed S. Armostrong
Atlantic Environmental Group
National Marine Fisheries Service, NOAA

The GOES-tap is a direct telephone facsimile link to the National Earth Satellite Service (NESS) dedicated to the reception of satellite imagery. GOES-tap has 24 channels for the reception of full resolution black and white geostationary (GOES) and polar orbiting (AVHRR) satellite imagery that has been processed by NESS real time. There are 16 channels established for the transmission of standard processed GOES products. One channel is devoted to transmission of processed AVHRR infrafed imagery from the polar orbiting NOAA 7 and 8 satellites. The remaining 7 channels are "floater channels", which are reserved for special GOES product requests called in to NESS. Meteorological interests predominate at NESS: thus most of the routine transmissions are not apprppriate for oceanographic purposes, but rather meet the needs of local weather service offices with specialized images showing cloud patterns.

At the Atlantic Environmental Group (AEG), we use a touch tone phone controlled by an automatic timer with a 24 hour programmable schedule to select any of the 24 channels available on the GOES-tap line. The typical, or routine schedule for receiving imagery is as follows:

0000-0130 GMT: GOES, NE coast (IR)
0130-1430 GMT: Polar orbiter (AVHRR)
1430-1540 GMT: GOES, Western N. Atlantic (IR)
1540-1600 GMT: GOES, NE coast (Visible)
1600-1800 GMT: GOES, full disc (IR)
1800-2400 GMT: Polar Orbiter (AVHRR)

Other GOES-tap receivers on the NEARSS Net are located at Bigelow Lab for Ocean Sciences , Boothbay Harbor, ME and at NMFS Laboratories in Woods Hole, MA and Sandy Hook, NJ. These operate as satellites to the AEG GOES-tap and receive images on the channels selected at AEG.

GOES Products:

Full earth disc data from the geostationary satellite located over the equator at 75°W longitude in an orbit at about 35,800 km are received, processed and transmitted every half hour. The full disc image is divided by NESS into standard sectors that cover various geographic areas. Full disc picture element (pixel) resolution is 1 km for visible data and 8 km for infrared data. The standard sectors are transmitted over the GOES-tap at 1,2 and 4 km spacial resolution for visible or 2 and 4 km for infrared. Standard sectors are sent by NESS over 16 channels on a regular schedule of IR and visible images.

Infrared images sent by NESS are digitally enhanced by assigning shades of grey to the different temperatures sensed by the satellite. Infrared intensity value or input count (X = 1-255) received by the satellite is assigned an output value (Y = 1-255) representing a shade of grey. A steeply sloped IR enhancement curve, for example, effectively distinguishies summer ocean surface features, when a narrow temperature range exists by assigning perceptible changes of grey shade to small temperature differences. The convention for water enhancement is to assign progressively darker shades as surface temperature increases.

Visible imagery is good for delineating highly reflective clouds which often imitate water features in IR. The ocean has lower reflectance of visible light and appears as a dark background to the clouds.

Requests for special geographical locations at selected resolutions are made by calling NESS. Various IR enchancements are available and a preferred curve must be requested as well. Images can be transmitted with or without a computerized grid (overlay of latitude, longitude, and political boundaries).

At AEG we routinely receive a GOES visible or infrared DB-5 sector image near local noon to show the distribution of clouds along the east and Gulf coasts of the United States. This provides an image file which can be consulted at a glance to find when cloud-free scenes are available on the higher resolution orbiter images.

Polar Orbiting Satellite Products:

The NOAA Satellites are in near polar 800 km orbit. The orbital period is about 1.5 hours so that the earth's rotation causes the satellite to progress about 25° of longitude west at the equator on each revolution. The polar orbiting satellites each routinely transmit 1 km resolution images of the Northwest Atlantic twice a day (an ascending and a descending orbit). Three frames of enhanced infrared imagery are transmitted on the GOES-tap for each pass over the western North Atlantic from Newfoundland to Florida. Typically, the image is sent with a triple enhancement curve for detecting water features, clouds, then very high clouds. The imagery is rectified (corrected) for the earth's curvature, but not for the skew caused by the earth's rotation under the satellite. Transparent plastic overlays, printed with lines of latitude and longitude are available at AEG and can be used for geographically locating features on orbiter images.

Polar orbiting satellite images revealing parts of the Northwest Atlantic west of about 60°W are maintained in a file at AEG. Images resulting from passes over other areas of the globe are sent to Peter Cornillon at URI-GSO, where a filing system is being developed. The polar orbiter images kept by AEG are filed chronologically and clipped together in bundles by month. Duplicate copies of images are not available at AEG, but with the information provided in the legend of each image, copies can be ordered from:

National Climatic Center
Satellite Data Services Division D56
World Weather Building, Room 100
Washington, DC 20233

Photocopies of images are usually unsatisfactory. Photographic copies can be made from borrowed images.

Oceanographic Analysis Charts:

Charts showing the position of ocean thermal fronts along the east and Gulf coasts are prepared daily at NESS from satellite imagery and some shipboard observations. The charts prepared on Monday, Wednesday, and Friday cover the area north of Cape Hatteras and the southern chart is produced on Tuesday and Thursday. The charts are routinely available by mail from NESS (full address given above). All of the charts are received at AEG by mail. However, in order to avoid postal delays a copy of the Monday chart is sent over telephone facsimile shortly after it is completed. The Monday chart is compared to imagery received at AEG over the GOES-tap and appropriate changes, additions and deletions are made to it, particularly with regard to warm core rings. AEG assigns a unique label to each warm core ring with a number for the year of formation and a letter referring to the order in which the rings formed during that year. The modified charts then are mailed to about 100 fishermen and scientists who may wish to adjust their shipboard operations and fishing strategy with regard to ring positions. The movements of warm core rings and the position of the shelf water/slope water front are analyzed from the charts and imagery by AEG and are compiled and issued in annual reports.

NEARSS DATA NETWORK DEMONSTRATION AND EVALUATION -Jim Gallagher, Naval Underwater Systems Center

The NEARSS Technical Research Challenges and System Evaluation Committee has proposed a Phase I system demonstration and evaluation workshop for 1984. The subject system focuses on the following elements: the primary ground receiving station, the user computer terminal at each participating site, and the land-line communication link that ties the network together.

A one-day workshop on the optimum uses of the user computer terminal, system engineered by MIT, is planned for April 1984, at MIT. The two-day demonstration and evaluation of the entire system is planned for September 1984. The first day will be devoted to a final review of the field demonstration. The general scenario of the second day will address a complete data cycle. Imagery data will be broadcast by the primary ground station at the Air Force Geophyscal Laboratory (AFGL) to various users in the network. Users will receive and process the data to meet their own special requirements, and, interact as necessary with AFGL to request modified imagery data. Other satellite data sets available to the system will also be broadcast by the respective user receiving station(s) to all other users. If possible, each user site will then exchange its selected data products with the other users over the communication network; appropriate user information feedback time will be allotted.

System performance will be collectively evaluated and a full report produced.

Item 4.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Center
Narragansett Laboratory
South Ferry Road
Narragansett, RI 02882

DATE: September 27, 1983

TO: Ken Sherman

FROM: Donna Busch D.A.B.

SUBJECT: Remote Sensing Summary: Marine Ecosystems Division, AEG, Oceanographic Remote Sensing Laboratory, FY 1983.

Attached are a summary of the integration of remote sensing satellite data which have been integrated with ground observations during the recent past in our division and the Atlantic Environmental Group; and a review of current and proposed studies. Peter Cornillon has summarized the operational capabilities, as well as current projects and future possibilities at the Remote Sensing Laboratory in a second memorandum.

We are now at the point where Lt. Peter Celone, AEG, is familiar with the procedures of the system and can advise anyone in the Center how to obtain and use data of interest. Every investigation within the Division has now integrated remotely sensed data with other tools available for studying fishery oceanography, and it appears there will be an ongoing need for these products and capabilities especially considering the U.S. commitment to participation in Antarctic research. It is clear that remotely sensed data, combined with in situ measurements on the continental shelf off the U.S., or in Antarctica, provide results significantly more useful than either type of data used alone. AVHRR satellite data for 1983 and going back to as early as 1978, are archived at the Oceanographic Remote Sensing Laboratory. Selected CZCS data are also available. Regarding Antarctic research, plans have been made to receive AVHRR data in near real time from NESDIS, with telemetry of the processed data to the ships.

Given that Peter Celone is a NOAA Corps officer and as such is temporary, we should consider training one of our permanent personnel on the system as well, which would maintain continuity when Peter is reassigned.

Plankton Ecology

1. We are utilizing archived AVHRR data to compare satellite derived temperatures with actual data collected on U.S.S.R. Belogorsk, September 1979, on the continental shelf off southern New England. Slope water species of zooplankton were found in an area where the shelf-slope front had been displaced by a warm core ring. Report and image are attached (Busch, Green, Cornillon).

2. Cooperative Study with Marianna Pastuszak, MIR and Marine Ecosystem Division, NEFC, fall 1983. The MARMAP hydrographic, zooplankton and

ichthyoplankton data bases will be used to study the recirculation of water on Georges Bank. The ichthyoplankton and zooplankton data will be reviewed by Donna Busch, Wally Smith and Dave Mountain to identify cruises when expatriated slope species were observed extending through Great South Channel and on to the northern side of Georges Bank, as was observed on larval herring cruises in the mid 1970s (Boltz and Lough 1983). For these cruises, the hydrographic data will be analyzed by Marianna Pastuszak to confirm recirculation or input of slope water characteristics did occur. Having identified times of greater recirculation, the broadscale hydrography, meteorology and warm core ring occurrence (satellite imagery) can be reviewed for possible causal factors related to the variability in recirculation of water on Georges Bank (Pastuzak, Busch, Mountain, Smith).

3. Antarctic Investigations, 1984. Jack Green will request that CZCS, AVHRR and SMMR data be collected during krill studies in February and March, 1984 in Antarctica. Possible exchange of data with NASA will be discussed (Green, Celone, Cornillon, Gloersen).

4. Prepared handbook "Satellite Data and Imagery for Antarctic Investigations." for Commission meeting, Tasmania, August-September 1983. Provides detailed instructions for acquisition of satellite data of interest in Antarctic investigations (Cornillon, Busch).

5. We are comparing CZCS derived pigment values from April 1979 with chlorophyll a and total pigment concentrations from MARMAP cruise, Mid Atlantic Bight portion (Busch, Cornillon, ground truth data, Evans-Zetlin, O'Reilly).

6. There is considerable interest in integrating historical data from MARMAP surveys with archived satellite data (Possible Sherman, Goulet, Santoro, Cornillon, graduate student, others?).

Larval Dynamics

7. The investigation has used imagery depicting sea surface temperature to locate positions and paths of warm core rings in investigations of effects of entrainment on populations of larval fish on Georges Bank (Laurence et al., Plankton Ecology personnel, Chamberlain, Celone).

8. The satellite data will continue to be necessary to locate fronts and rings for future recruitment studies.

Apex Predators

9. Near real time thermal imagery has been utilized by shark and swordfish taggers, shark tournament participants, and the personnel of the Apex Predator investigation conducting cooperative research aboard the Polish vessel Wieczno (Casey et al., Cornillon, taggers).

10. This kind of satellite data will continue to be necessary for similar future investigations.

11. Cooperative study: An Acoustic Telemetry Experiment with Swordfish. See attached report of recent experiment. Imagery was provided by

the Remote Sensing Laboratory, URI (Apex Predator personnel, Frank Carey/WHOI, Peter Cornillon/URI).

Fisheries Oceanography

12. The Fisheries Oceanography investigation has utilized satellite derived sea surface temperature charts during the warm core ring investigations. Investigation personnel are comparing in situ observations of the extent of entrained shelf water around the ring with remotely sensed data products to determine the accuracy of predictions using these images to determine the effects of the entrainment on larval fish populations of Georges Bank (Mountain et al., Laurence et al., Sherman et al.).

13. MIR/NEFC Cooperative Study. See No. 2, Plankton Ecology.

14. Investigation personnel have requested satellite information to be collected for upcoming Antarctic cruises, fall 1983, which will be part of a study of the increase in productivity associated with the retreat of the Antarctic ice cover (Mountain, Schlitz, Ramp).

Atlantic Environmental Group

15. AEG/MAS/GSO cooperative project - sea surface temperature charts to aid fishermen in locating fronts. The fourth and fifth mailings of the satellite derived sea surface temperature charts went to about 650 users. The fifth chart also contained a questionnaire to be filled out and returned by the users. The charts will be mailed to those interested in the future. The possibility of reaching a broader constituency via newspaper or television is under consideration (Ingham et al., Cornillon et al., Grey et al.). See attachment, Cornillon summary.

16. An investigation is underway of the utility of AVHRR in studies in the Atlantic City upwelling. There appears to be a strong correlation with wind direction and speed, and water temperature. The effects of the upwelling are apparent into the surf zone. It is expected to see a manifestation of the phenomenon in the imagery which will aid in determining how widespread the phenomenon is (Ingham, Meteorologist, Atlantic City Weather Station).

17. AEG is attempting to use AVHRR tapes with added enhancement to describe the circulation of shelf water, Cape Hatteras to Nova Scotia (Celone, Armstrong).

18. Work is underway to incorporate sea surface temperature observations (real time) from buoys, etc. into SST analyses from satellite imagery to identify any satellite bias.

19. AEG continues to produce reports as follows:

a. Cumulative histories of conditions using satellite derived data such as: a 10-year (1974-83) position of the shelf water front; and a record of warm core ring locations and trajectories.

b. Fishermen data products (see No. 15).

c. Weekly and monthly oceanographic analyses (see attached).

d. Semi-annual (NEMP) and annual (Annales Biol.) reports of warm core ring positions and shelf water front positions.

Attachment

cc: R. Armstrong
J. Casey
P. Celone
J. Colton
M. Grosslein
R. Hennemuth
M. Ingham
G. Laurence
D. Mountain
H. Mustafa
J. O'Reilly
A. Peterson
B. Skud
W. Smith

Observations on the Slope/Shelf Front in the Immediate Vicinity of a Warm Eddy

Observations made on the outer continental shelf off southern New England aboard the R/V *Belogorsk* on September 9-19, 1979, indicated that the slope/shelf front was displaced significantly from its normal configuration. Expendable bathythermograph (XBT) traces at stations 18 and 19 (Fig. 1) showed mixing of shelf and slope waters in the surface layer. Neuston samples taken at these stations contained a mixture of shelf and slope water forms. Slope water species found at stations 18 and 19 included copepods, *Temora stylifera* and *Corycaeus speciousus*; chaetognaths, *Sagitta enflata*; siphonophores, and clumps of sargassum. More than 3,000 larvae of red hake, *Urophycis chuss*, (5-25 mm) were taken in a single 10-minute neuston tow at station 18. The temperature profile and surface salinity at station 20 indicated a warm, well-mixed saline (34.4 ppt) surface layer, which is characteristic of slope water. Neuston samples at this station were dominated by slope water and Gulf Stream copepods, such as *C. speciosus*, *Eucalanus attenuatus*, and *T. stylifera*; pteropods, *Creseis* sp. and *Cavolina* sp.; and chaetognaths, *S. enflata*.

Sea surface temperature maps derived from satellite imagery (interpreted by Dr. J. L. Chamberlin, Atlantic Environmental Group, Narragansett, Rhode Island) showed that a warm water eddy (78-I) was centered directly south of stations 18, 19, and 20 (30°30'N, 71°00'W) during the cruise period (Fig. 1). The rotating eddy would explain the movement of slope water onto the shelf along the eddy's west side. Previous analyses have shown that when this occurs the shelf water is displaced seaward along the eddy's opposite side, occasionally being entrained as a cold ring around the eddy.

These observations support the hypothesis that shelf water containing larvae of commercially important species may be advected off the shelf when an eddy is present. Higher temperature and lower food density, resulting from such a movement, may be detrimental to larval survival.

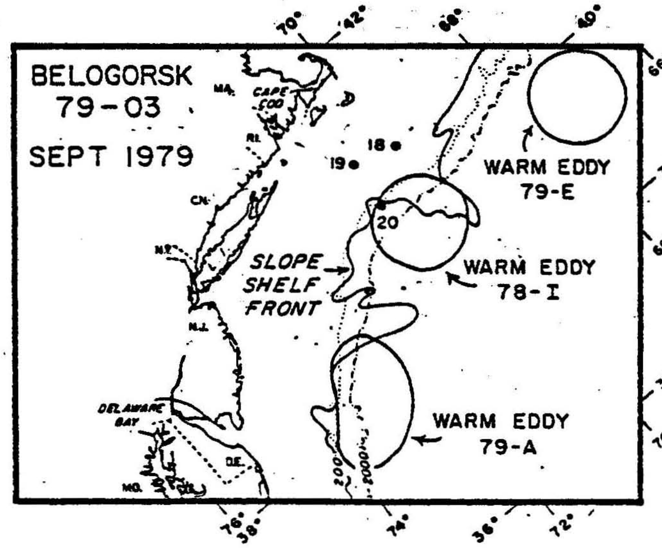


Figure 1. Location of warm water eddy and slope/shelf front in relation to R/V *Belogorsk* stations 18, 19, 20, mid-September 1979. The slope/shelf boundary is taken from NOAA-NESS-EPB satellite observed sea surface temperature and analysis. The eddy location was determined by the National Marine Fisheries Service, Atlantic Environmental Group, Narragansett, Rhode Island.

Ray Maurer
Donna Busch
Jack Green
National Marine Fisheries Service
Narragansett Laboratory
Narragansett, RI 02882
401-789-9326

Item 5.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Center
Woods Hole Laboratory
Woods Hole, Massachusetts 02543

January 19, 1984 F/NEC1:DGM

TO: Kenneth Sherman

FROM: David Mountain

SUBJECT: Remote Sensing Operations

The following comments are supplied in reference to budget considerations and to the upcoming BOD meeting.

1. I intend to terminate the Unifax Recorder operation that the Oceanography Investigation now supports. This instrument makes paper copies of satellite infrared images on a near real-time basis for the east coast of the U.S. I will take this action unless you feel that to do so would be unwise for some reason I have overlooked. The operation is redundant in the Center since the same images are received and stored at AEG. To maintain the system in Woods Hole will cost me $7K in FY84, about a third of which can still be recovered. For the inconvenience of driving to Narragansett when the need arises, I would prefer to apply the savings against the ever increasing costs and budget cuts I am facing. I realize that this facility is for the whole Center to use, but in one year of operation, no Center components outside of our Division ever requested data from us.

2. I still feel that the incorporation of remote sensed information into our studies is very useful. I believe that it can be best accomplished by access to digital satellite data processing capabilities such as those being developed at URI. If after the capital investment we have made there we can have regular and inexpensive access to the URI facilities, we should be able to meet our needs with high quality, state of the art products at a low recurring cost.

   A part of this arrangement that is unclear to me, however, is who should actually produce the needed product. Peter Cornillian is not a service organization, so we need our own people to push the buttons. Is this to be a dedicated person who fills all requests or should each group have their own person. I prefer some combination where some service could be provided, but for large or indepth jobs groups would do much of the work themselves.

3. For this year we will want to use the URI facility to process some CZCS data from the Antarctic. We had a few clear days and CZCS data from our area was collected on those days. We may also have some thermal images to be processed for the recirculation study with Marianna Pastuszak. Remote sensed data is still being used in the warm core ring study analyses. It should also be used in the recirculation work associated with the proposed recruitment studies, providing the broad scale background into which our observations are made.

cc: M. Grosslein
D. Busch

Item 6.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Date: January 23, 1984

To: Allen E. Peterson, Jr., Center Director, NEFC

From: Reed S. Armstrong, Oceanograper, AEG

Reed S. Armstrong

Thru: M. C. Ingham, Director, AEG

Subject: Issue Paper: AEG Remote Sensing Activities

Introduction

Activities in AEG using satellite data are conducted in the Ocean Environment Analysis Program and are centered around a UNIFAX GOES-tap unit and the facilities of the Remote Sensing Laboratory of the University of Rhode Island (URI). A set of standard products are derived from interpretation of GOES-tap imagery and various analyses are generated from computer enhancement and processing of digital AVHRR data.

Staffing, Funding and Facilities

Staff in AEG involved in remote sensing applications amounts to one NOAA Corps officer (Lt.JG Celone) and one PTT GS-5 Oceanographer (Price). In addition one GM-13 Oceanographer (Armstrong) participates in the interpretive analyses of satellite derived products. Funding comes from NEFC Remote Sensing funds for (1) GOES-tap expenses (about $9K/year) and (2) $35K to the Remote Sensing Laboratory for training and assistance by Peter Cornillon, URI and for use of the laboratory facilities (VAX computer and IKONOS display system for AVHRR processing using software based on the RSMAS system of the University of Miami). The GOES-tap unit is located and office and work space are provided in a trailer co-located with the Remote Sensing Laboratory. GOES-tap imagery and AVHRR digital data taps are archived for retrospective applications at the Remote Sensing Laboratory.

Products and Applications of Remote Sensing Data in AEG

A. Current projects
   1. Weekly charts showing locations of ocean fronts and areas of strong currents (Gulf Stream and rings), derived from GOES-tap imagery. In addition to applications in AEG, this chart is mailed to about 60 (winter) to 110(summer) fishers, mariners and scientists and fisheries managers.
   2. Monthly charts of locations and expected movements of warm core rings, from GOES-tap imagery. Chart is published in U.S. Coast Guard "Atlantic Notice to Fishermen" and distributed by mail to about 50 - 60 interested parties.

3. Gray-scale, image charts of sea surface temperature field off southern New England and for Georges Bank; computer enhanced AVHRR digital data produced cooperatively with the Marine Advisory Service, URI and the Remote Sensing Laboratory. Chart is generated periodically, depending on clear-sky conditions and is mailed by the URI Marine Advisory Service to about 130 subscribers.
4. Annual summaries of warm-core ring movements, published in Annales Biologiques and NAFO SCR Documents, and semi-annual summaries for NEMP Environmental Data Compilations, compiled from AEG weekly charts and from AVHRR digital data.
5. Annual summaries of position and variability of the shelf water front published in Annales Biologiques, and NAFO SCR Documents, compiled from weekly charts of AEG.
6. Climatological summary of warm core ring movements, 1974 - 1983.
7. Climatological summary of the position of the shelf water front, 1974 - 1983.

B. Special requests (summer 1983 to present)

8. Computer enhanced images from AVHRR digital data associated with station data for transect off Long Branch NJ (J. O'Reilly, Sandy Hook).
9. Enhanced images from AVHRR digital data for NMFS warm-core ring cruises (R. Schlitz, Woods Hole).
10. Sea surface temperatures from AVHRR digital data for Massachusetts Inshore Fall Bottom Trawl Survey, Gloria Michelle cruise of September, 1983 (A. Blott, Narragansett).
11. Enhanced imagery fron AVHRR digital data depicting coastal upwelling off Atlantic City (M. Ingham, AEG).
12. Enhanced color imagery from AVHRR digital data of scenes for the 12 months of the year, and for June in 4 years, Cape Hatteras to Cape Cod (H. Mustafa, Woods Hole).
13. Provide most recent information on ocean frontal positions, ring locations and current patterns to fishers, mariners and scientists via telephone, mail or in-person requests. Requests average about 2 - 3 per week and information is given from weekly charts, GOES-tap images and Ship-of-Opportunity (SOOP) data.

C. Proposed, developmental projects

14. Merge buoy and ship sea surface temperature (SST) observations with AVHRR digital data for calibrating satellite SST field.
15. Combine SOOP XBT data with AVHRR digital data for 3-dimensional analyses, particularly for shelf waters.
16. Monitor position and variations in shelf water front and Gulf Stream North Wall from AVHRR digital data.
17. Investigate use of GOES-tap network of leased phone lines for transmitting computer enhanced imagery from AVHRR digital data from Narragansett to Bigelow Laboratory, Woods Hole and Sandy Hook.

Needs for AEG Remote Sensing Applications

1. Continued funding support to the Remote Sensing Laboratory, URI, which provides AEG with access and use of computer and display facilities for AVHRR digital data.
2. Continued operation of the UNIFAX GOES-tap.
3. Grant of waiver from hiring freeze to fill FTP GS-9 Oceanographer position (reference memo to Peterson from Ingham, November 3, 1983). Lt. JG Celone is the only staff member in AEG who can work with digital AVHRR data and his time is fully committed to the current projects. Additional requests and developmental projects, outlined above, cannot proceed. If Celone were reassigned, we would no longer have means to work with digital satellite data.

University of Rhode Island

office memorandum

to: Ken Sherman **date:** 8/24/83

from: Peter Cornillon

re: Progress at Oceanographic Remote Sensing Laboratory

I thought that it would be instructive for me to summarize where we are in Remote Sensing at the Narragansett Bay Campus and where I see us going.

I. Where Are We?

1. Our remote sensing processing capability is operational. Although we have some hardware constraints, we are capable of performing most of the fundamental image processing functions that we want to. More importantly, we can do scientific work with our system as it is. Table I lists the Oceanographic Remote Sensing Laboratory hardware either currently operational or on order.

2. We have in our archive of satellite data about 1000 passes of the East Coast. Of these we have processed over 400. For each of the 400 passes we have developed 8 standardized images: 3 quick look quarter resolution images of the pass (one of the north, one of the south and one of the middle), 2 half resolution sectors (one of the Northeast coast from Cape Hatteras to Nova Scotia and one of the Sargasso Sea from the Gulf Stream south) and 3 full resolution sectors (one of the Gulf of Maine, one of the New York Bight and one of Cape Hatteras). By standardized images I mean that except for the quarter resolution images, the five other data sets have been remapped to five corresponding common coordinate systems. This allows for quick comparison and analysis of the data. Examples of the five are shown in Figures 1 to 5.

3. We are now receiving in near Real time digital data from NESDIS in Washington. Pete Celone of the AEG has arranged with personnel in NESDIS to send us near real time digital data. URI purchases the tapes and pays the air express bill and Pete has data put on the tapes. At present we are receiving data on a daily basis in this mode with a delay of three to ten days. This week we will begin generating SST maps from thse tapes and mailing them to approximately 600 fishermen in the region. Figure 6 is an example of the product.

4. We are currently involved in a half dozen research projects other than the one described in 3 above. These are:

   (a) Meandering of the Gulf Stream north and east of Cape Hatteras
   (b) Shelf circulation from Cape Hatteras to Nantucket Shoals.
   (c) Gulf Stream dynamics immediately south of Cape Hatteras.
   (d) Mesoscale activity in the Sargasso Sea at 34°N, 70°W.
   (e) Horizontal structure of the Brazil Current.
   (f) Horizontal structure and scale in the Gulf of Maine.

5. We have converted VERTSEC to run on the VAX. We expect this to facilitate the section plotting done by Steve Cook as well as to provide us with in situ data of the shelf, shelf/slope front and slope waters to aid in our work in these regions.

6. We have provided access to the system and training in its use to NMFS personnel. Pete Celone has been making increasing use of the system and is currently using about two hours a day of display time. I expect Dave Mountain or someone working with him will begin using the system this fall.

7. EPA has recently joined forces with us. At present they have loaned us some much needed hardware, a second display system, with other equipment on order. They have also indicated that they will provide money in the near future. To date they have not made use of the system, although I expect this will change this fall.

II. Where Are We Going?

From my perspective, despite some hardware limitations listed below, things are progressing very well. In fact a more significant shortage at present is that of experienced personnel to use the system. In order to increase the effectiveness of our operation I am taking the following steps:

1. Increasing the pool of trained personnel.

   Starting in September, we will have one student whose primary function will be interfacing with new and potential users. At the same time two more students will begin working in a research capacity on the system. Three other students will continue work previously begun. In addition we have a systems manager and two programmers who are rapidly increasing their familiarity with the system. See Table II for a list of people involved with the system. This list only includes those people making significant use of the system, i.e. averaging (or who I expect will average) more than one hour per day. The philosophy in encouraging students to use the system is to produce over the next six months a group of individuals who will be familiar with the system and eventually available to work on funded projects. I am confident that this will benefit all of us in the long run, although at present it is placing a significant burden on me and on the system.

2. Increase the Funding Base.

By the end of October, I hope to have submitted a half dozen proposals to spread out our funding base. (I already have three submitted, one of which, very small, has been funded). These are in addition to my ongoing Sea Grant and NSF grants. The proposals, if funded, will contribute toward system hardware support, personnel and (not to be overlooked) data acquisition. The students now being trained will slip quite smoothly into the slots provided by those projects which are funded. These new projects will also provide capital to increase the hardware base of our system.

3. Address Current Hardware Constraints.

Any new project is an experience. If it fails, the project should be terminated or significantly altered while if it succeeds, one might expect the project to grow. In either case there will be continuous adjustments. Our system is succeeding and will grow to accommodate our needs. At present we are faced with and beginning to address a number of hardware constraints. These are in order of decreasing importance:

a) Minimal disk space - We are currently in the process of doubling our disk capacity and although this will help significantly, we could easily use as much again as we now have. This will remain our number one problem for a while to come.

b) Communications - Our second most pressing need is for communications hardware and software to allow us to send/receive data to/from other systems.

c) A single tape drive - With only one tape drive we cannot perform tape-to-tape copies and we are extremely dependent on our drive, if it goes down we are stuck.

d) Image memory in the display units - Each of the IKONAS has two image planes, one for graphics and one for images. Additional memory here would allow us to display full resolution movie loops as well as provide workspace to store images that we are working on.

e) High quality image products - We are now at the point where we could use quality photographic output. EPA is ordering a unit capable of this, so this problem should disappear before long.

f) Processor capability - The CPU on our VAX 11/750 is at present used about 50% of the time. By early next year I would expect the useage to be near 100% for a large fraction of the time. We must begin to address this problem now.

III. NEFC/URI Cooperation

I would like to see the NMFS continue its involvement both in terms of use and funding in the laboratory much as it has over the past six months with some slight modifications. My perception of its involvement thus far has been that complete access to the system and the data has been provided on an equal footing with all of the other funded users. This has amounted to from zero to four hours of display time a day averaging on the order of two hours a day. In addition, access to the computer other than the display system has also been granted on much the same basis. This has amounted to approximately one additional hour a day of terminal time.

The modification that I see to NMFS's involvement is twofold. First, I would like to see more diverse useage by NMFS of the system. I believe that this will happen quite naturally with the Antarctic research that David Mountain and Donna Busch are planning. My understanding is that the NMFS will provide the personnel to do this work. Again our role will be to provide access to the system and to the growing expertise that we have in our group. The second modification is that I would like to see a project in addition to the Sea Grant/AEG SST chart project that we (GSO) would supervise but would be performed jointly with NMFS. In particular, an ideal project would be to integrate both CZCS and AVHRR data with the MARMAP data base. Chris Brown, a student at GSO in biological oceanography, familiar with the remote sensing system, has expressed an interest in doing his Master's on a project related to the above.

IV. The Bottom Line

I suggest the following:

NMFS provide the Oceanographic Remote Sensing Laboratory (ORSL) with $55K to be added to the current grant.

Of this, $40K goes into the general ORSL kitty for system support and in return NMFS will be granted "reasonable" access to the system much as it has been over the past six months. If a problem arises with regard to access, it will be addressed by SORT (the Synoptic Oceanography Research Team).

The other $15K be used for salary support, supplies, data and travel related to the integration of MARMAP data with CZCS and AVHRR data. This be viewed as a two year effort with an equivalent amount of money the second year.

V. Finally

Could we get together soon after you return from your travels to discuss all of this and in particular to discuss the formal submission of a proposal.

Encls..
PC/la.

Table I. Oceanographic Remote Sensing Laboratory System Configuration as of August 22, 1982

VAX 11/750 Computer

3 megabytes of VAX memory

570 megabytes of on line disk storage

1 6250/1600/800 125 ips tape subsystem

10 terminals

6 modems

* 2 Adage RDS 3000 display systems (IKONAS)

1 bit pad digitizer

+ 4 monitors

1 Tektronix hard copy unit

1 Tektronix sync. generator

1 Fernseh color encoder

Hardware on order

++ 2nd bit pad digitizer

410 megabytes of online disk storage

++ 1 Polaroid hard copy unit

* 1 on loan from EPA

\+ 2 on loan from EPA

++ will be on loan from EPA

Table II. Oceanographic Remote Sensing Laboratory Personnel

		Name	Position
		Drs. Peter Cornillon and David Evans	Co-PI's
		Ms. Eva Griffeth	Systems Manager
		Mr. Jerry Epstein	Programmer (Cornillon)
		Ms. Anne Monaghan	Programmer (Evans)
	+	Mr. Rick Weyer	Grad. Student (Cornillon)
	++	Mr. Craig Gillman	Grad. Student (Cornillon)
	*	Mr. Duraisingh Ebenezer	Grad. Student (Cornillon)
+	++	Mr. Steve Parent	Undergrad. " (Cornillon)
	+	Mr. Chris Brown	Grad. Student (Cornillon)
		Ms. Amy Friedlander	Grad. Student (Evans)
		Mr. Pete Celone	AEG/NMFS

++ Starting in the Fall

* Starting either Fall or Spring

\+ Students using the system for course work or degree but with no support for this work.