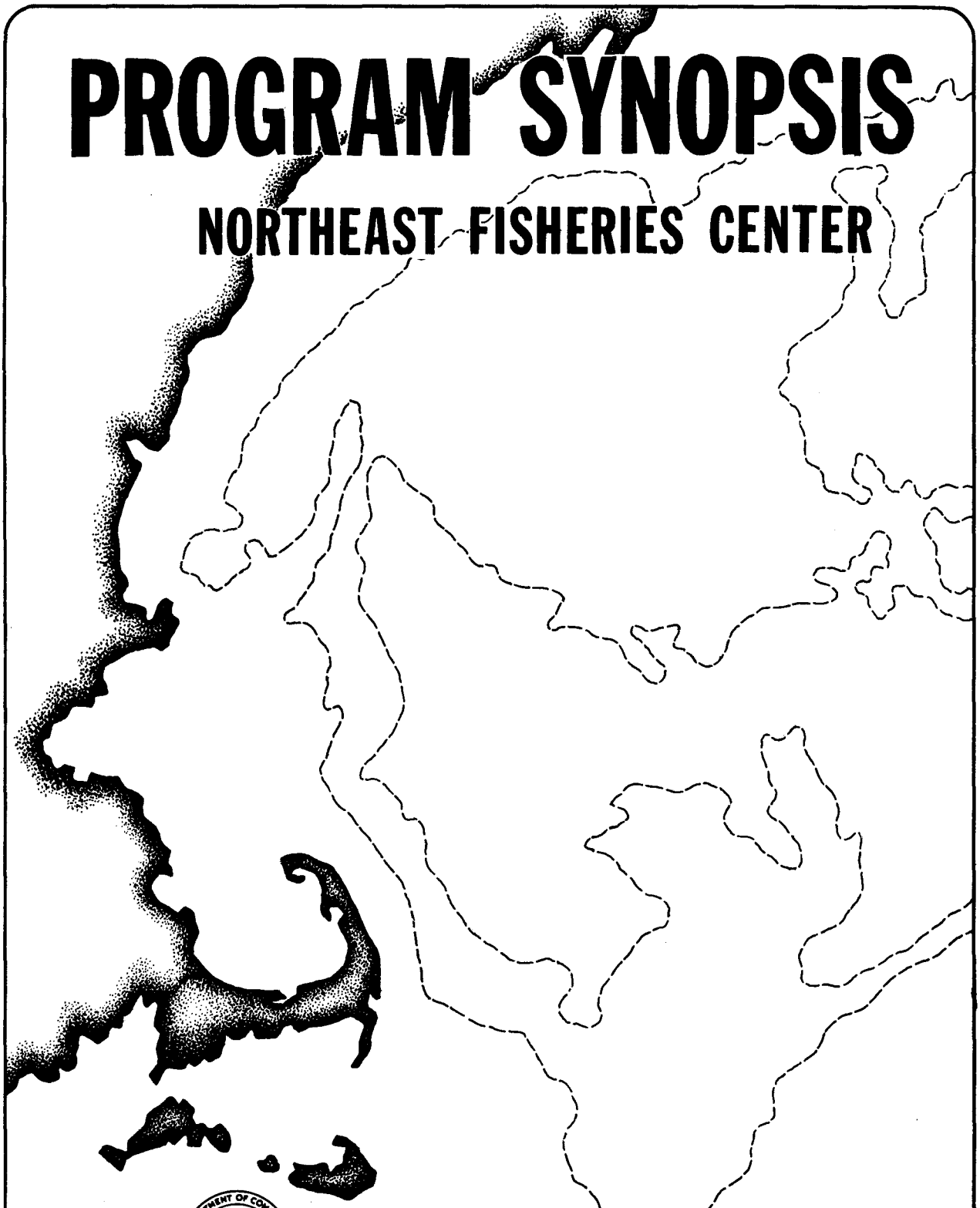
PROGRAM SYNOPSIS

NORTHEAST FISHERIES CENTER



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

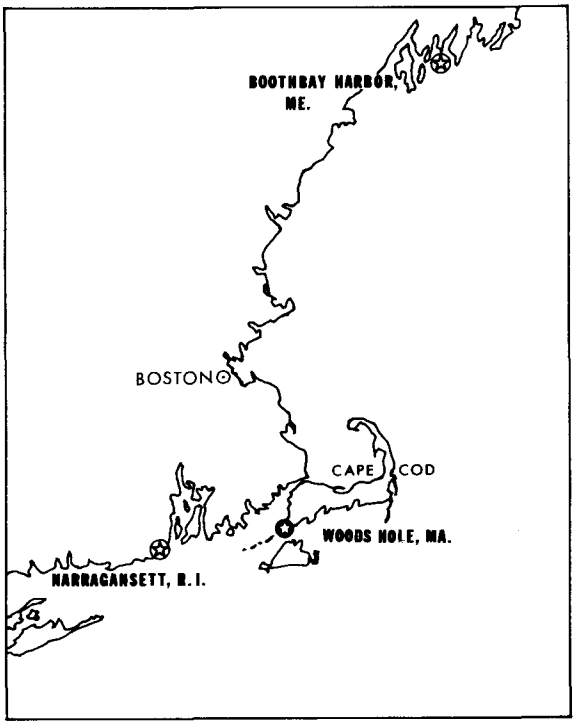
NORTHEAST FISHERIES CENTER

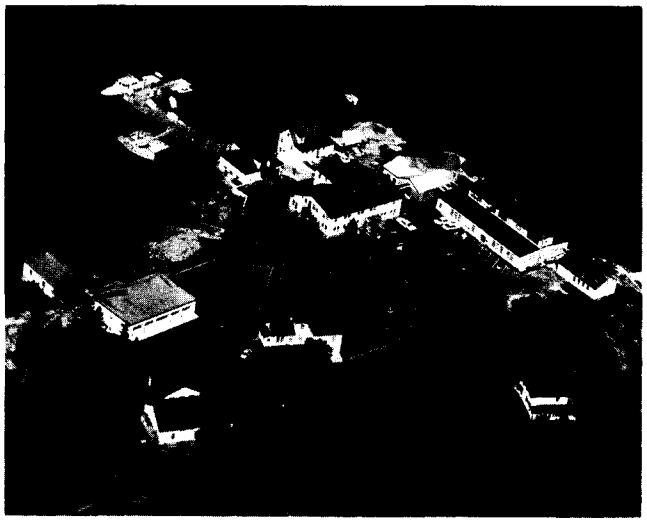
NATIONAL MARINE FISHERIES SERVICE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

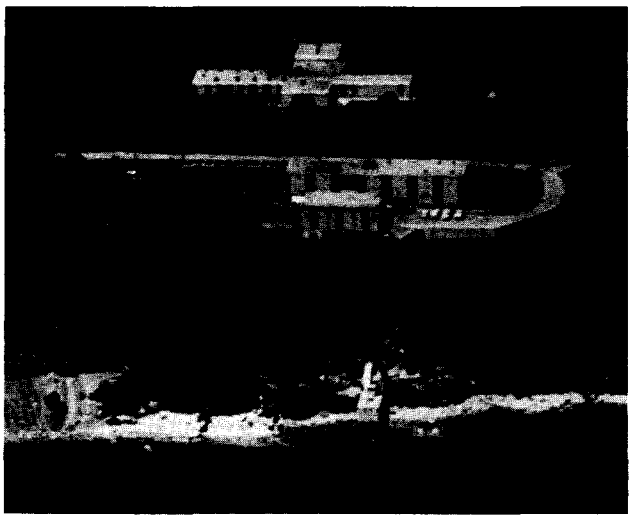
U. S. DEPARTMENT OF COMMERCE

September 22, 1972

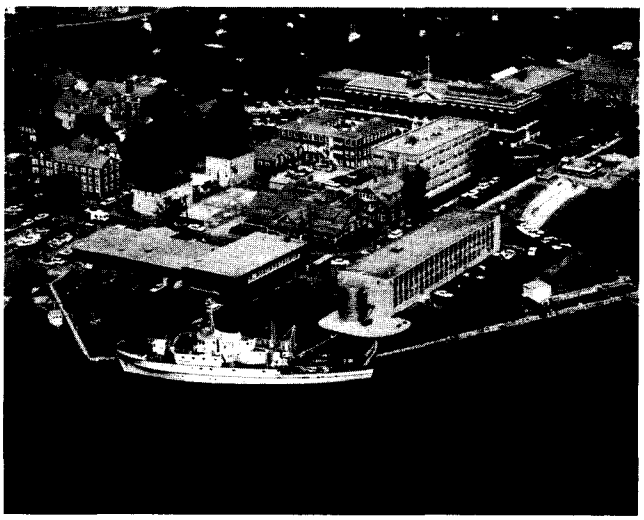




Boothbay Harbor Biological Laboratory



Narragansett Biological Laboratory (above)



Woods Hole Biological Laboratory

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1.0. Area of Responsibility

1.0. The Problem

The Northwest Atlantic from Greenland to Cape Hatteras supports a resource capable of sustaining an annual harvest of 3 to 4 million metric tons of finfish. In 1960, there were approximately 1,000 vessels in the area, 28% of which were from the United States; the total catch was 2.3 million metric tons. There are now more than 2,000 fishing vessels from 18 different nations (15% from the United States) attempting to get their share of the harvest. In 1971, the total catch was about 3.5 million metric tons.

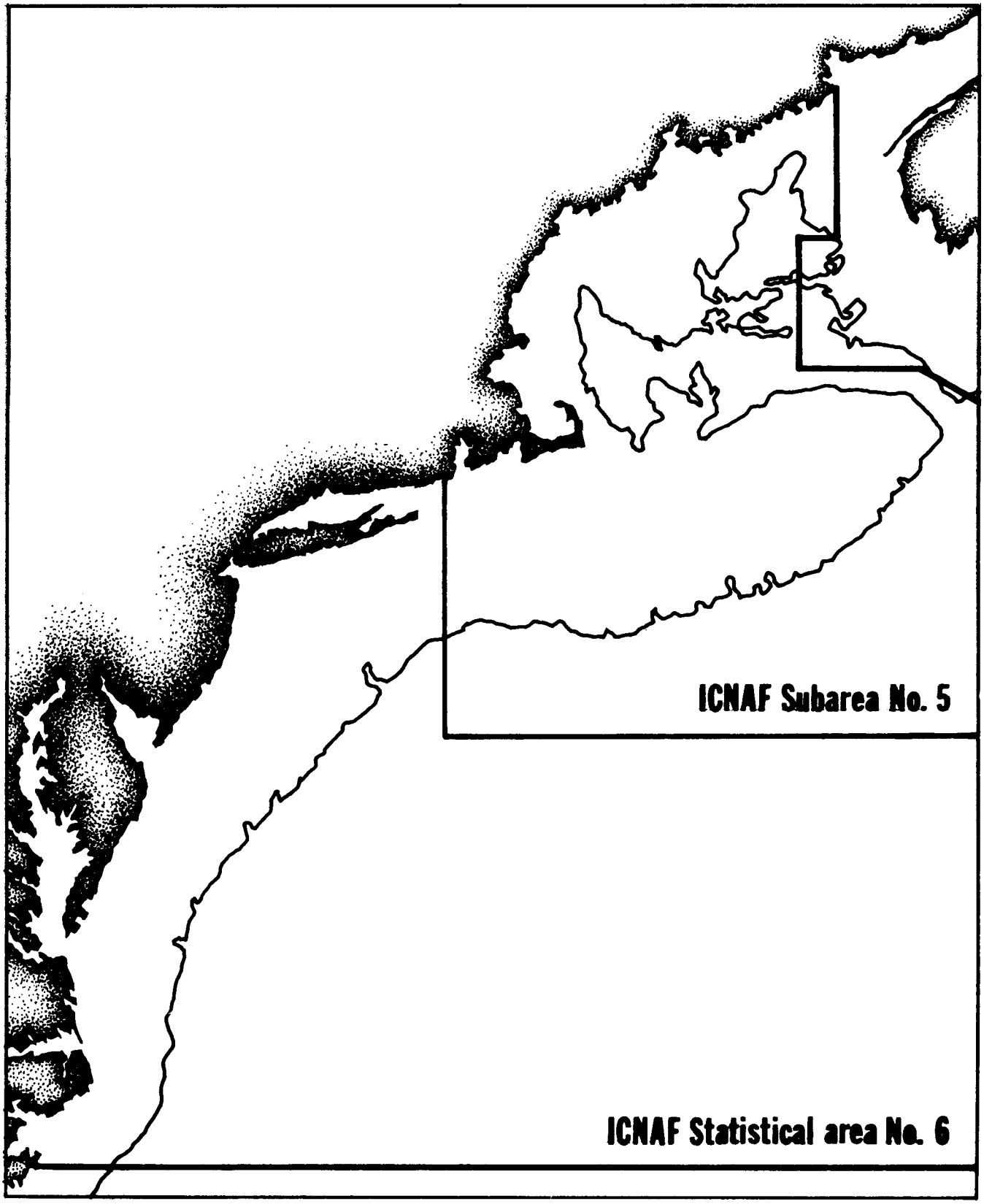
In 1960, the grounds south of Nova Scotia were fished almost entirely by U. S. vessels, with the exception of a few Canadian scallopers. In 1970, 80% of the total effort was generated by countries other than the U. S.; the U. S. effort has decreased by about 30% since 1960. Total fishing effort tripled during this period.

There are over 200 different species of fish inhabiting the Northwest Atlantic area. Only 37 are of major importance in terms of harvest. In the waters off New England and mid-Atlantic states, 36 species of fish are now of some importance in the harvest. There are not many more, perhaps only four or five species, capable of providing a fishable biomass of any magnitude.

Though the present harvest of fish seems to be beyond the total potential sustainable production, demand and fishing fleets are increasing. A significant increase in the invertebrate (squid, shellfish) catch is possible, and therein lies the greastest potential for an expanding fishery.

Fluctuations in fish abundance can be caused by natural changes in the marine environment. At times these natural changes will be the predominant influence on catches. However, man's fishing activity is the pervasive and only controllable factor affecting abundance, and will seemingly persist as such for the foreseeable future. Moreover, man's use of the marine environment for waste disposal, mining, and oil extraction may be significant. The ocean is now a receptacle for synthetic substances which -- though used on land -- persist in runoff and wind-borne deposits reaching the ocean.

Our mission and objectives are rather clearly defined by this state of affairs. It will take many years to gain adequate understanding of the dynamics of the marine ecosystem as a whole, but some problems require immediate action to at least alleviate the situation. Within the constraints imposed upon the Center, we have designed the research 1) to provide advice related to detecting and solving immediate problems, and 2) to initiate longer range studies related to solution of the more general but increasingly serious problems.


ICNAF Subarea No. 5
ICNAF Statistical area No. 6

2.0. Mission and Objectives

2.0. Mission, Objectives and General Plan of Activities

Mission: Conservation of the living marine resources of the Northwest Atlantic.

Note: Conservation is interpreted as utilization in a manner which provides for maintenance of the resource and yields at levels which will provide for the needs of society.

Objectives:

1. Determine potential yields and availability of various components of the total biomass.

2. Develop management systems which will maintain biomass and yield therefrom at levels providing for needs for food and recreational fisheries.

3. Develop the technology required to promote conservation and maximize benefits therefrom.

Note: Technology refers to both hardware and software.

4. Promote public knowledge of the resource, marine environment and effects of utilization.

The required phasing of major accomplishments is about as follows:

One year - Establish status of major fisheries sufficient to form the basis of an interim management (conservation) program.

We hope with this to complete assessments required to achieve the objective of establishing (through ICNAF at present) control of fishing effort on major stocks of immediate interest to U. S. This should provide a reasonable basis for government-industry planning of fishery development.

Stocks. Cod, haddock, yellowtail flounder, redfish, silver and red hake, herring, scallops, lobsters.

An interim management capability is defined as knowing (1) the current exploitation rate relative to the rate which maximizes yield-per-recruit and/or (2) the yield which corresponds to the harvestable surplus production in the next year or (3) the long-term maximum equilibrium yield.

Two years - Establish first approximation to total biomass yield (productivity) in New England waters which will permit consideration of total effort (harvest) control.

It will be difficult to establish viable control on a species-by-species basis. We are attempting here to provide for the option of managing certain components as a whole, so that we do not just shift effort from one component to another. A given species which has been over-exploited may never recover if the effort on other species catches the former incidentally or if the redirected effort severely exploits food species of the former.

Five years - Operational management capability, the basis for which includes effects of stock density on recruitment and production, other biotic factors affecting reproduction and survival, and effects of abiotic factors.

We probably will not yet have an adequate understanding of the production processes, but we will be more certain of the efficiency of regulatory measures in achieving the objectives. We will also be able to predict with reasonable precision the transitory state of the stocks.

By this time our major activities will have shifted from assessment of effects of fishing to study of ecosystem dynamics.

Ten years - The previous work has related mostly to accruing knowledge. At this stage we should understand the process involved and the interrelations of components of the biomass.

It implies rather accurate and precise prediction of events before the fact, as opposed to monitoring and predicting impact after the event.

The time-table could be met with adequate (and reasonable) resources. It would require at least a doubling of the current level by the next two years. We would, throughout the mid-third of the period, be reassigning activity from assessment activities to ecosystem studies.

We probably will become increasingly involved in environmentally-related problems, effects of dumping, other pollution, mining, etc. In ten years, our work may be more related to the quality of human survival than fish survival.

If this is in fact true, we must, of course, start the required research now. In effect, we are - by providing advice, data, and information to other studies (Sea Grant, etc.). We should program increasing participation of this kind over the next two years. The next phase will be increasing direct studies based on the knowledge acquired in the ecosystem studies.

General comments on problem areas:

The foregoing activities are based primarily on the application of our research to management problems. Our research will be directed in 5 years to a large extent on rather basic biological and ecological problems. However, it will still be directed towards solving the problems as they exist or can be predicted. We are taking the approach that our mission requires research based on society's needs rather than research based on producing knowledge per se.

Some specific problem areas will require special attention:

1. Calibration of our sampling gear. This is especially important in the MARMAP concept. It includes studies of behavior and availability.

2. Environmental factors related to survival of fishes (extrinsic or abiotic factors). Our approach here is to determine the interactions of these with intrinsic biological factors.

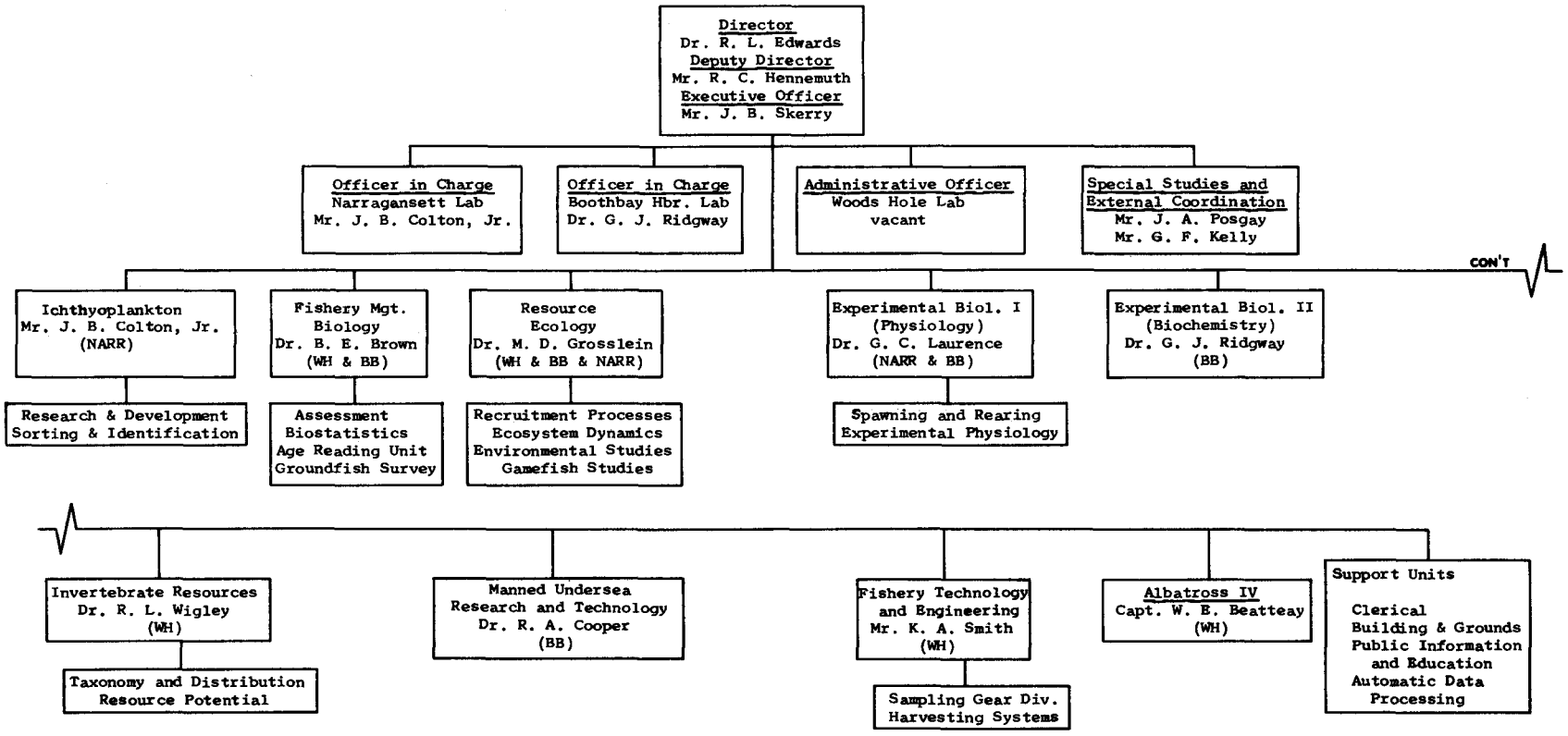
3. Physiology. Reproduction survival and growth must be understood, not just observed.

4. Logistics. To meet rudimentary needs and provide the minimum required flexibility (necessary for external credibility), we need the equivalent of one additional Albatross IV.

5. Statistical needs are severe - both sport and commercial. Probably, the only way out is mandatory log books for commercial vessels and greatly improved estimates of the sports catch. Our approach to studies of the entire biomass does not, in our view, require any special approach for species associated with commercial fisheries or recreational fisheries.

3.0. Organization

Northeast Fisheries Center Organization



4.0. Research Program

4.1. Integrated Activities

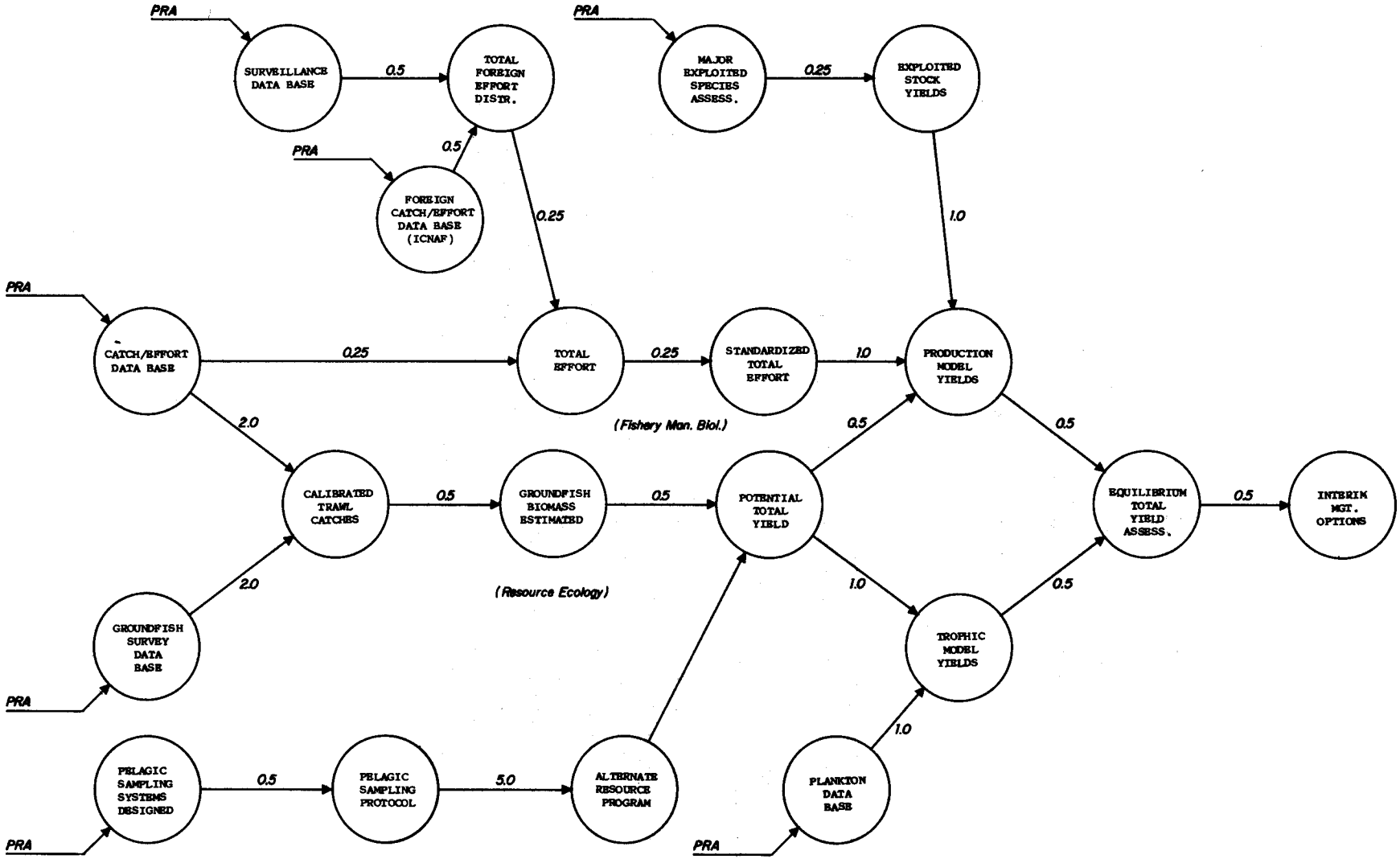
4.1.1. Total Effort Management

4.1.2. Biome Studies

4.1.3. Alternate Resources

An effective response to many of the needs of the public and private sectors of society demands a problem solving approach. This requires that we integrate the talents and activities contained within several of the Center Investigations.

The activities described in this section represent how we propose to solve three real and immediate problems. They involve both the effective utilization of the resource and the effects of man's use. They illustrate the leverage generated by applying certain related activities of ongoing investigations to a specific short-term objective. In order to effectively apply this concept, the proposed table of organization and field activities must be implemented.


PRA
SURVEILLANCE DATA BASE
0.5
TOTAL FOREIGN EFFORT DISTR.
PRA
MAJOR EXPLOITED SPECIES ASSESS.
0.25
EXPLOITED STOCK YIELDS
PRA
FOREIGN CATCH/EFFORT DATA BASE (ICNAF)
0.5
0.25
1.0
PRA
CATCH/EFFORT DATA BASE
0.25
TOTAL EFFORT
0.25
STANDARDIZED TOTAL EFFORT
1.0
PRODUCTION MODEL YIELDS
(Fishery Man. Biol.)
2.0
0.5
0.5
CALIBRATED TRAWL CATCHES
0.5
GROUNDFISH BIOMASS ESTIMATED
0.5
POTENTIAL TOTAL YIELD
EQUILIBRIUM TOTAL YIELD ASSESS.
0.5
INTERIM MGT. OPTIONS
(Resource Ecology)
2.0
1.0
0.5
GROUNDFISH SURVEY DATA BASE
PRA
TROPHIC MODEL YIELDS
PRA
PELAGIC SAMPLING SYSTEMS DESIGNED
0.5
PELAGIC SAMPLING PROTOCOL
5.0
ALTERNATE RESOURCE PROGRAM
PLANKTON DATA BASE
1.0
PRA
(Fishery Eng. & Tech.)
(Ichthyoplankton)
TOTAL EFFORT MANAGEMENT
JUL 72
JUL 73
JAN 74
APR 74

4.1.1. Total Effort Management

The objective of this activity is to provide the scientific basis for an interim total effort management scheme. It represents the first step in achieving one of the major objectives of the Center - establishing options for management of the fisheries which allow for planning and development within the framework of an adequate conservation program. By interim we mean that explicit interspecific relations are not taken into account. Also, it will apply only to the finfish biomass.

As indicated in the event diagram, the solution of this problem requires the integration of four major Center activities - Fishery Management Biology, Resource Ecology, Fishery Technology and Engineering, and Ichthyoplankton. Most of the work outlined is of the nature of synthesis of information supplied by the related activities which are indicated on the diagram by the term prior related activities (PRA's).

There are seven such PRA's which lead to achieving the following events:

1. Surveillance data base
2. Major species assessment (includes mesh work, see below)
3. Foreign catch/effort data base
4. U. S. catch/effort data base
5. Groundfish survey data base
6. Pelagic sampling protocol
7. Plankton data base

Of the seven PRA's, #1, #6 and #7 are not currently advanced enough to provide the requisite information, and will require special emphasis if the objective is to be achieved.

PRA #2 includes mesh experiments, proposed to be carried out on chartered fishing vessels, operating out of Pt. Judith, New Bedford, Provincetown, and Gloucester. These experiments are to be carried out throughout the fishing season.

The three events indicated for trawl calibration, pelagic sampling, and trophic modeling represent studies which require significant further development of technology and methodology before we can accomplish them. Calibration means relating what we catch on our surveys to the total available population. We have no existing basis for sampling pelagics. Both of these aspects require considerable work at sea and careful studies of fish behavior.

4.1.2. Massachusetts Bay - Stellwagen Bank Biome Study*

The purpose of this study is to survey and evaluate the living marine resources of Massachusetts Bay and vicinity (see map) and to develop a prototype of methods to study the ecosystem as a whole. Baseline data resulting from this work will be used to assess the effect of man-made influences on this environment and these resources. Procedures will be established and tested which may be used elswehere to determine priorities among conflicting uses of the marine environment.

The history of Massachusetts Bay since the arrival of the Pilgrims is a chronicle in miniature of the impact of man on the environment. The question of how the waters and shores of this bay will be used in the future is a timely one and should be addressed now, so that traditional oceanic activities -- such as fishing -- are not smothered or lost under the impact of new uses of the waters and mineral resources by shore-based industries.

The scientific literature will be searched to establish prior patterns of change in hydrography, water quality, abundance of marine plants and animals and other factors. These data will aid in determining present sampling requirements. Sampling will be done from surface vessels, aircraft, moored buoys, and submersibles using photography, underwater television and SCUBA divers in addition to conventional trawls, plankton nets, dredges, water samplers, and other collecting equipment.

At a network of stations from ten meters seaward, salinity temperature, nutrients contaminants, benthic organisms, groundfish, and pelagic species will be sampled regularly. Inshore of ten meters will be sampled from small boats working from the shore at selected locations. Records of the quantities of commercial and sport species removed from the area will be obtained from cooperative commercial and sport fishermen recording detailed data on their catches. Records of sightings, and regular aerial surveys of the whole area, will provide a means of estimating the quantities of marine mammals and sea birds present.

These studies will be integrated with others already in progress conducted by universities, private research groups, state or other federal agencies. We are also trying to make arrangements with the International Institutes of Mathematical Ecology at Pennsylvania State University to participate in the study.

Successful completion of this biome study will result in improved management of the fish resource. This type of study is necessary to gain better understanding of how to deal with conflicts generated by man's activities.

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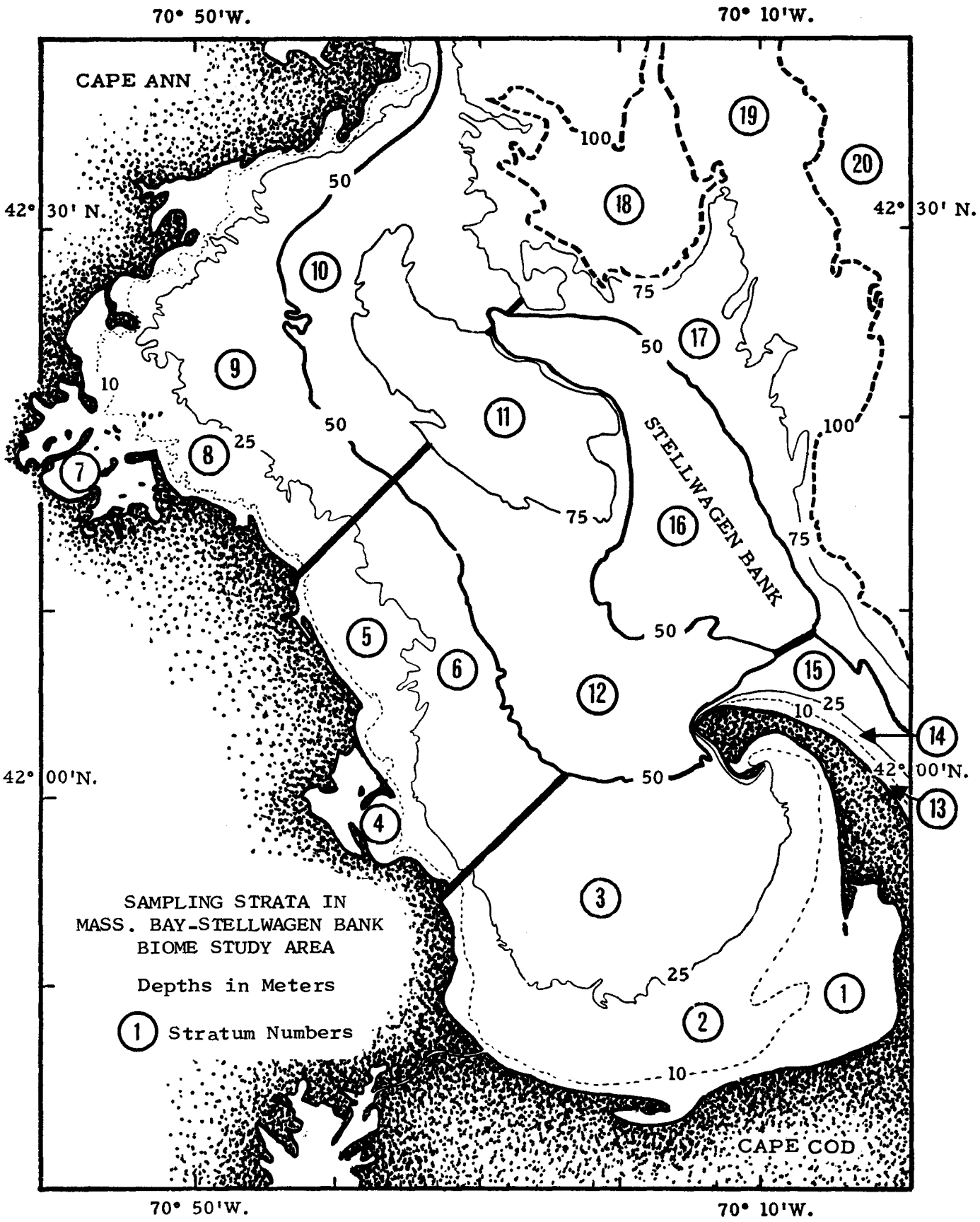
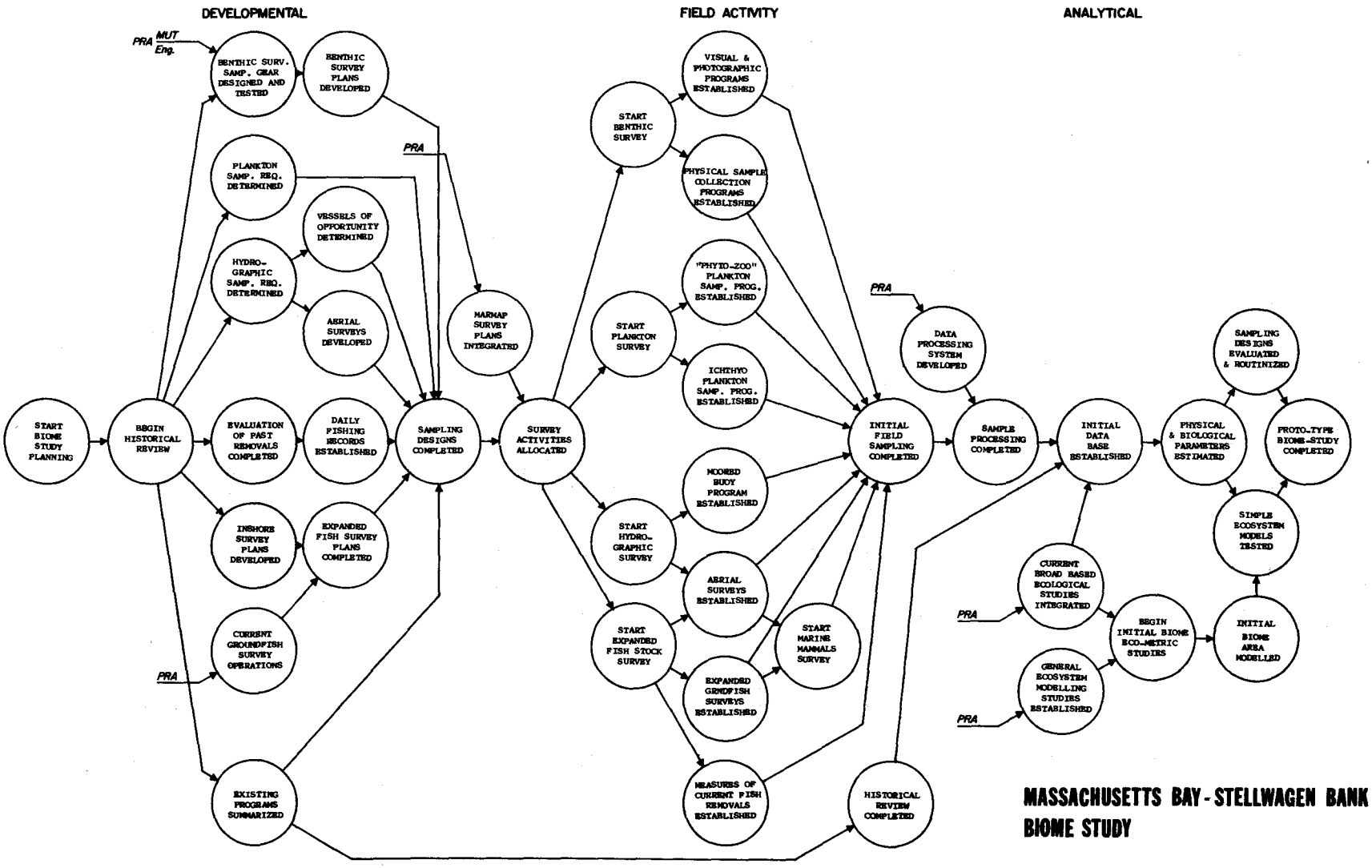
*Biome is an ecological term which denotes a complex community of organisms within a defined environment.


70° 50'W.
70° 10'W.
CAPE ANN
42° 30' N.
42° 00'N.
STELLWAGEN BANK
CAPE COD
SAMPLING STRATA IN
MASS. BAY-STELLWAGEN BANK
BIOME STUDY AREA
Depths in Meters
1 Stratum Numbers



MASSACHUSETTS BAY - STELLWAGEN BANK BIOME STUDY

4.1.3. Alternate Resources

Northeast Fisheries Center has proposed an intensive Alternate Resources Development Program. This is designed to assess the availability of certain fish and shellfish populations that have apparent potential for increased production. Early development of improved survey techniques and efficient harvesting systems are essential components of this program. The study is designed to extend survey activities to permit adequate assessment of such species as mackerel, butterfish, scup, squid, crabs (rock and red), shrimp, pollock and sharks.

Some work is scheduled for FY 73 using allotted funds and existing facilities. Pelagic survey cruises aboard the Delaware II are planned in cooperation with the NMFS Center at Sandy Hook, for a three-week period during the late winter of 1973 and for up to 30 days in mid-summer. A two-week period aboard the Albatross IV is scheduled in June, 1973, for a survey of large shellfish (crabs and lobsters), and a similar period is scheduled in August for a survey of deep-water shrimp (royal red and scarlet prawn).

We propose to supplant the minimal effort noted above with a year-round active program along lines shown on the PERT diagram (next page). Additional funding, a staffing pattern as indicated in section 5.0 of this book, and a full 12-months per year of research vessel operation will be required to adequately prosecute this program.

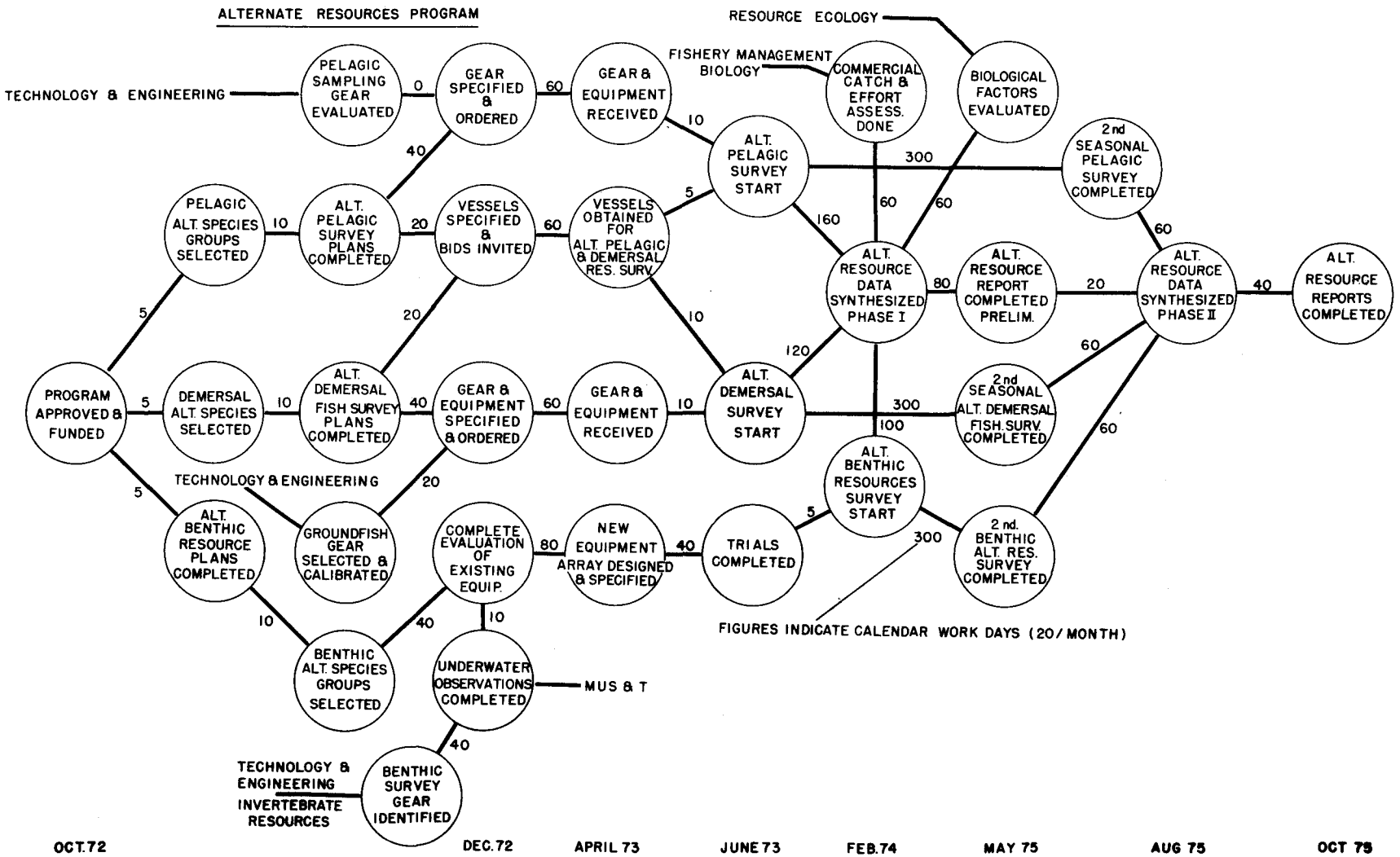
Initial effort and emphasis must be placed upon development of reliable and accurate sampling systems. Pelagic trawls and off-bottom trawls appear the best current candidates for direct pelagic sampling, but better methods may be possible. Hydroacoustic systems will be employed for detection and also for quantification as improved systems become available.

Current ongoing work is expected to produce a superior standard otter trawl for groundfish surveys.

Following evaluation of existing units a new benthic survey equipment "array" will be required for rapid and accurate assessment work. Underwater TV and photographic systems mounted on special carrier vehicles will be investigated.

It is anticipated that full scale survey work could be initiated in nine to twelve months following approval and funding of this program.

The program represents an integration of activities within several of the Center's Investigations - Fishery Technology and Engineering, Invertebrate Resources, Manned Undersea Research and Technology, and Fishery Management Biology.


ALTERNATE RESOURCES PROGRAM
TECHNOLOGY & ENGINEERING
PELAGIC SAMPLING GEAR EVALUATED
GEAR SPECIFIED & ORDERED
GEAR & EQUIPMENT RECEIVED
FISHERY MANAGEMENT BIOLOGY
COMMERCIAL CATCH & EFFORT ASSESS. DONE
RESOURCE ECOLOGY
BIOLOGICAL FACTORS EVALUATED
ALT. PELAGIC SURVEY START
2nd SEASONAL PELAGIC SURVEY COMPLETED
PELAGIC ALT. SPECIES GROUPS SELECTED
ALT. PELAGIC SURVEY PLANS COMPLETED
VESSELS SPECIFIED & BIDS INVITED
VESSELS OBTAINED FOR ALT. PELAGIC & DEMERSAL RES. SURV.
ALT. RESOURCE DATA SYNTHESIZED PHASE I
ALT. RESOURCE REPORT COMPLETED PRELIM.
ALT. RESOURCE DATA SYNTHESIZED PHASE II
ALT. RESOURCE REPORTS COMPLETED
PROGRAM APPROVED & FUNDED
DEMERSAL ALT. SPECIES SELECTED
ALT. DEMERSAL FISH SURVEY PLANS COMPLETED
GEAR & EQUIPMENT SPECIFIED & ORDERED
GEAR & EQUIPMENT RECEIVED
ALT. DEMERSAL SURVEY START
2nd SEASONAL ALT. DEMERSAL FISH. SURV. COMPLETED
TECHNOLOGY & ENGINEERING
ALT. BENTHIC RESOURCES SURVEY START
ALT. BENTHIC RESOURCE PLANS COMPLETED
GROUNDFISH GEAR SELECTED & CALIBRATED
COMPLETE EVALUATION OF EXISTING EQUIP.
NEW EQUIPMENT ARRAY DESIGNED & SPECIFIED
TRIALS COMPLETED
2 nd. BENTHIC ALT. RES. SURVEY COMPLETED
BENTHIC ALT. SPECIES GROUPS SELECTED
UNDERWATER OBSERVATIONS COMPLETED
MUS & T
TECHNOLOGY & ENGINEERING
INVERTEBRATE RESOURCES
BENTHIC SURVEY GEAR IDENTIFIED
FIGURES INDICATE CALENDAR WORK DAYS (20/MONTH)
OCT. 72
DEC. 72
APRIL 73
JUNE 73
FEB. 74
MAY 75
AUG 75
OCT 75

4.2. Investigations

4.2.1. Fishery Management Biology

4.2.2. Resource Ecology

4.2.3. Fishery Technology and Engineering

4.2.4. Experimental Biology I - Physiology

4.2.5. Experimental Biology II - Biochemistry

4.2.6. Ichthyoplankton

4.2.7. Invertebrate Resources

4.2.8. Manned Undersea Research and Technology

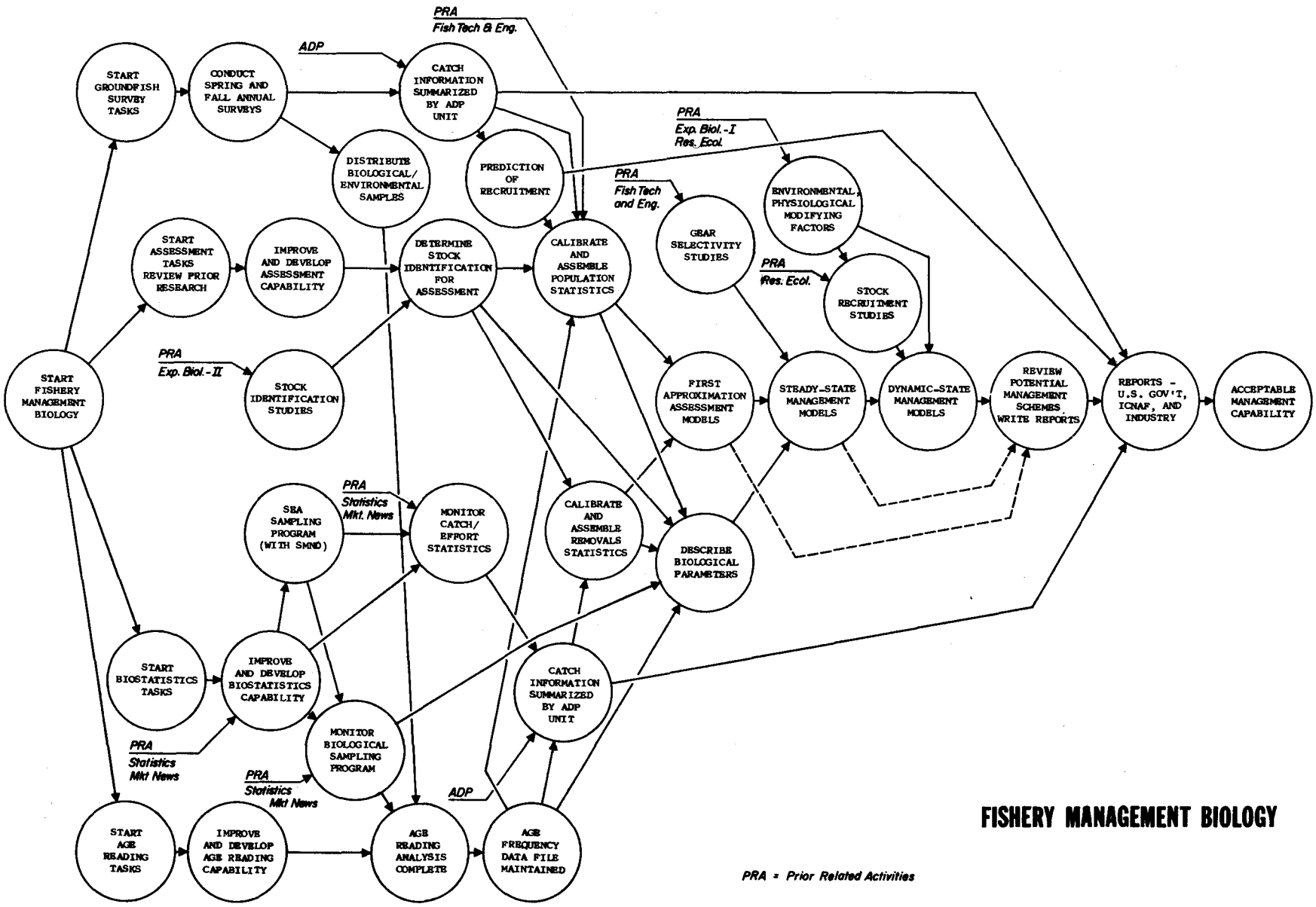
4.2.1. Fishery Management Biology Investigation

The Fishery Management Biology Investigation is responsible for 1) assessing the status of the stocks of fish and shellfish in the offshore areas of the Northwest Atlantic and 2) providing advice concerning the effects of different management regimes from a conservation standpoint. This means determining the effect of fishing on these stocks and the yields they can sustain, and continuous monitoring of the fishery.

Several separate tasks have been organized within the Investigation. Biostatistics is concerned with measuring the rates of catch, fishing intensity, and mortality, and with monitoring the effects of regulatory measures. This group works primarily with the information collected by agents of the NMFS Port Pool and by sea samplers. The Goundfish Survey Cruise Unit is responsible for the conduct of twice yearly groundfish surveys from Cape Hatteras to the Scotian shelf. These surveys provide baseline measurements of the magnitude and age composition of the populations. A third unit is Age Reading, which has the responsibility of aging fish collected from landings and research cruises so that the age composition of both the removals and the population can be estimated. The above tasks are largely routine but they are essential. A historical time series of data is needed to make an initial assessment of a fishery, but also continual current information is required to monitor changes and update the assessments. These tasks are shown in the PERT diagram in the upper and lower left hand corners. Efforts are being made to automate some of the age reading through the use of optical scanners and computers, and to improve the measurement of fishing effort by determining the time and depth a net actually fished with fishnet bathykymographs (commonly called "the Black Ball") tied to trawl headropes.

Assessments of effects of fishing are done at various levels of sophistication as indicated in the PERT chart by the terms "first run assessment", "steady state management regime", and "dynamic state management regime". First level models utilize data based on survey cruise standing crop estimates and catch/effort relationships from the commercial fishery. The second stage involves biological parameters such as growth and mortality rates. The third requires more complex understanding of ecological factors and population processes.

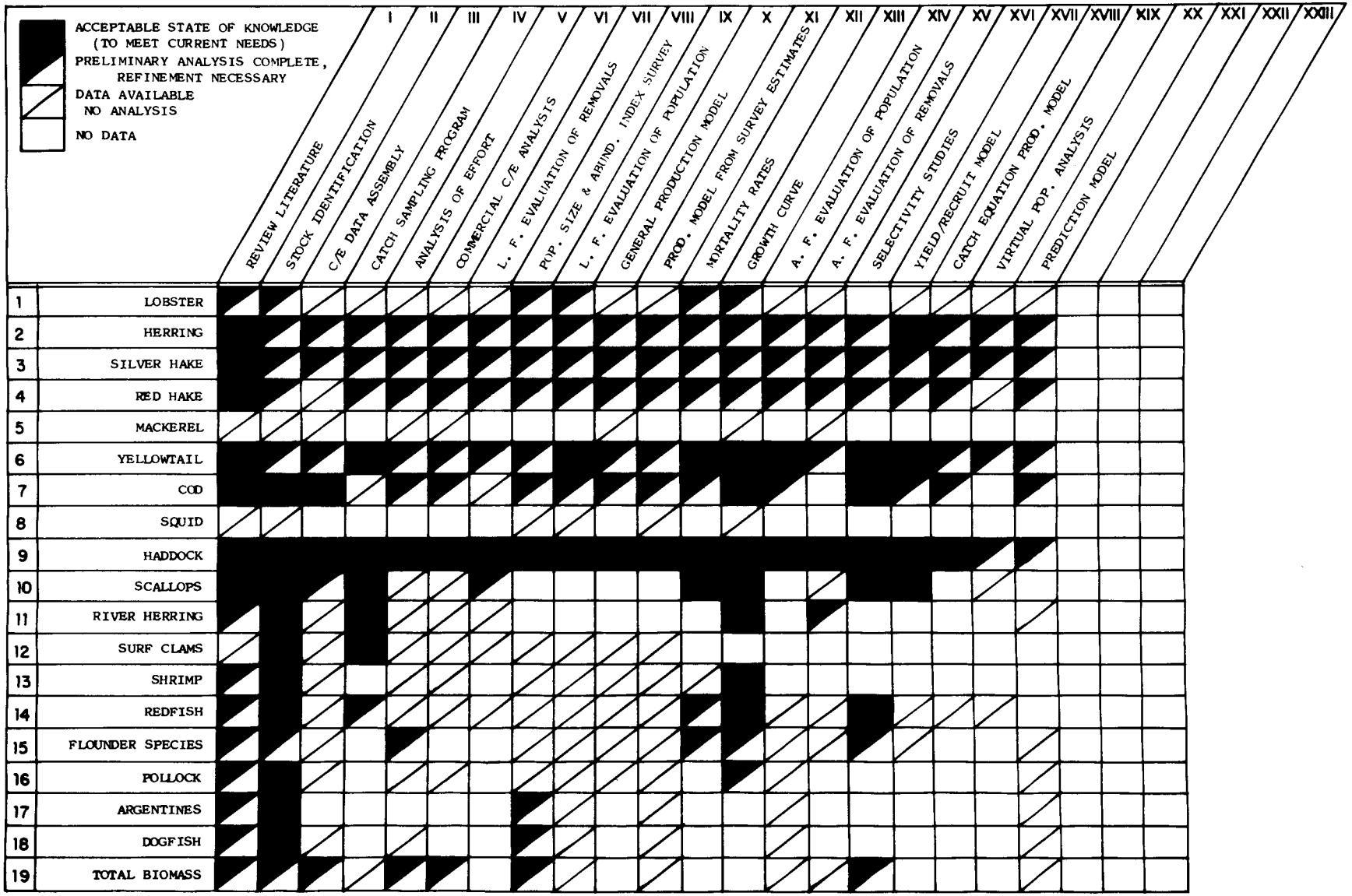
Current plans involve working over the next year on the assessments of cod, haddock, herring, lobster, mackerel, silver and red hake, redfish, and yellowtail flounder.



FISHERY MANAGEMENT BIOLOGY

PRA = Prior Related Activities

STATUS OF KNOWLEDGE FOR FISHERY MANAGEMENT



4.2.2. Resource Ecology Investigation

The goal of this investigation is to acquire a basic understanding of the manner in which natural biotic and abiotic factors control the distribution and abundance of marine organisms. Such an understanding is essential in order to have any reasonable chance of distinguishing between the usually more subtle long-term natural changes and those caused by fishing or pollution, and to improve both short- and long-term predictions of potential yield. The investigation involves the study of the environment in New England waters and the interrelationships among all major biological communities.

Our research strategy has two primary phases. The first involves rather intensive studies of critical biological processes controlling production of marine fishes - recruitment, growth, and natural mortality. Attempts will be made to identify the chief biological and physical mechanisms which control these processes, and to determine how these mechanisms interact in relation to changes in biomass and species composition of the biological communities. Particular emphasis will be placed on factors affecting survival of early life stages of a few selected, representative species, since we must understand this critical stage before we can evaluate the relation between average year class success and spawning stock size. Environmental studies will be closely integrated with the above and special emphasis will be given to understanding the physical oceanographic processes controlling dispersal of eggs and larvae. Results of these studies will be used to formulate mathematical models of the recruitment process, which may be applicable to a wider range of species. Another type of study in this first phase is a quantitative description of the energy requirements and feeding interactions among principal species in the demersal and pelagic communities.

The second phase of research involves analysis of long-term changes in such processes as spawning, growth, and natural mortality of selected species in relation to changes in the total biomass and structure of major biological communities and changes in the physical environment. Results of this phase will provide another basis for estimating the total productive capacity of the marine ecosystem.

All these studies are critical to the assessment of total biomass yields as well as to the long-term assessments of individual fisheries, particularly in relation to the dynamic phase of assessments.

BEGIN GEN FOOD CHAIN STUDIES NEW ENGLAND GROUNDFISH
BEGIN FEEDING STUDIES DEMERSAL PELAGIC FISHES BIOME
FOOD HABITS SHARKS BILLFISHES EAST COAST
FEEDING INTERRELATIONS DEMERSAL NEW ENG FISH COMMUNITIES
MARMAP Invert. Res.
FEEDING STUDIES ZOOPLANKTON BENTHIC COMMUNITIES
BEGIN TIME SERIES FEEDING STUDY SELECTED GROUNDFISH
FEEDING GROWTH JUVENILES HERRING HADDOCK HAKE
ANNUAL SEASONAL VARIATIONS FEEDING GROUNDFISH
ENERGY EXCHANGE TROPHIC LEVELS
Exper Biology
PHYSIOLOGY GROWTH ADULT FISH SELECTED SPECIES
CALORIC LEVELS BIOMASS COMPONENTS
MAJOR FEEDBACK MECHANISMS PREY-PREDATOR COMPETITOR
THEORETICAL PRODUCTION MODELS
POPULATION PROCESSES SELECTED SPECIES, COMMUNITIES
MIGRATION GROWTH REPRODUCTION SELECTED GAMEFISH
GROWTH MORTALITY VS POPULATION DEMERSAL FISH
GEN RECRUITMENT MODEL STOCK-REC IMPLICATIONS
Ichthyoplankton
INITIAL SORT IDENTIFICATION EGGS LARVAE
Manned Undersea
SUBMERSIBLE OBSERVATIONS SELECTED SPAWNING SITES
Exper Biology
LARVAL ENERGY REQ.'S MORTALITY FACTORS
IDENTIFY POTENTIAL MODES ACTION POLLUTANTS
BEGIN INTENSIVE STUDIES RECRUITMENT PROCESS
EXPAND FIELD STUDIES SPAWNING EGGS, LARVAE JUVENILES
BEGIN LARVAL JUVENILE SURVEYS BIOME
VERTICAL GEO DIST HERRING-GADID LARVAE JUVENILES
DISPERSION GROWTH CONDITION FEEDING HERRING LARVAE
COMPREHENSIVE REPORT FECUNDITY SPAWNING HERRING GADIDS
DISPERSION GROWTH CONDITION FEEDING GADID LARVAE
TIMING MECHANISMS LARVAL MORTALITY
FIRST APPROX DYNAMIC MODEL LARVAL SURVIVAL
START RESOURCE ECOLOGY INVESTIGATION
ESTABLISH ENVIRONMENTAL STUDIES GROUP
WHOI Contract
TRANSPONDING BUOY CURRENT MEASURES
COMPARE THEORETICAL EMPIRICAL PRODUCTION MODELS
WORKING PRODUCTION MODEL ECOSYSTEM
PLAN NEW STUDIES CIRCULATION GEORGES GULF MAINE
INTENSIVE CURRENT STUDIES SPRING, FALL SPAWNING SITES
FIRST APPROX MODELS SPRING, FALL CIRCULATION
DYNAMIC MODEL SPRING, FALL CIRCULATION GEORGES
EXPAND PHYSICAL CHEMICAL STUDIES
PROCESSED HISTORICAL HYDROGRAPHIC RECORDS
MARMAP AEG Group
COMPREHENSIVE REVIEW OCEANOGRAPHY EAST COAST
EXPAND SEASONAL MONITORING OCEANOGRAPHY EAST COAST
CIRCULATION NUTRIENT CYCLES COASTAL SLOPE WATERS
MODEL PHYSICAL CHEMICAL OCEANOGRAPHY EAST COAST
Engineering Invert. Res. Alt Res.
FURTHER CALIBRATION TRANS. SURVEY METHODS
BEGIN MORE COMPREHENSIVE ANALYSIS GROUNDFISH COMMUNITIES
STRUCTURE RELATIVE ABUNDANCE GROUNDFISH COMMUNITIES
INITIAL CALIBRATION GROUNDFISH SURVEY METHODS
FIRST APPROXIMATION STANDING CROP GROUNDFISH
COMPARE STRUCTURE YIELD ATLANTIC GRDFSH COMM'S
SECOND APPROX STANDING CROP GROUNDFISH
MARMAP Invert. Res. Alt Res.
FIRST APPROX STANDING CROPS PLANKTON PELAGIC FISH BENTHIC INVERT
RESOURCE ECOLOGY
JAN 73
JAN 74
JAN 75
JAN 76
JAN 77

4.2.3. Fishery Technology and Engineering Investigation

This investigation is staffed primarily by personnel of the Gloucester Exploratory Fishing and Gear Research Base, which was transferred to Woods Hole in September, 1970, and included as part of the Northeast Fisheries Center. Work projects are assigned in three areas: sampling gear development, harvesting system development, and alternate resources assessment.

An Alternate Resources project is to be conducted jointly by several Center investigations. It is proposed to develop rapid and accurate survey and assessment systems and to develop gear to promote economic harvest of unutilized (by U. S. vessels) fish and shellfish populations (see section 4.1.3).

A Lobster Conservation project is underway to devise methods of eliminating the threat posed by the so-called "Ghost Pot" problem. Standard and experimental lobster pots are to be tested with the assistance of the Center diving team at Boothbay Harbor.

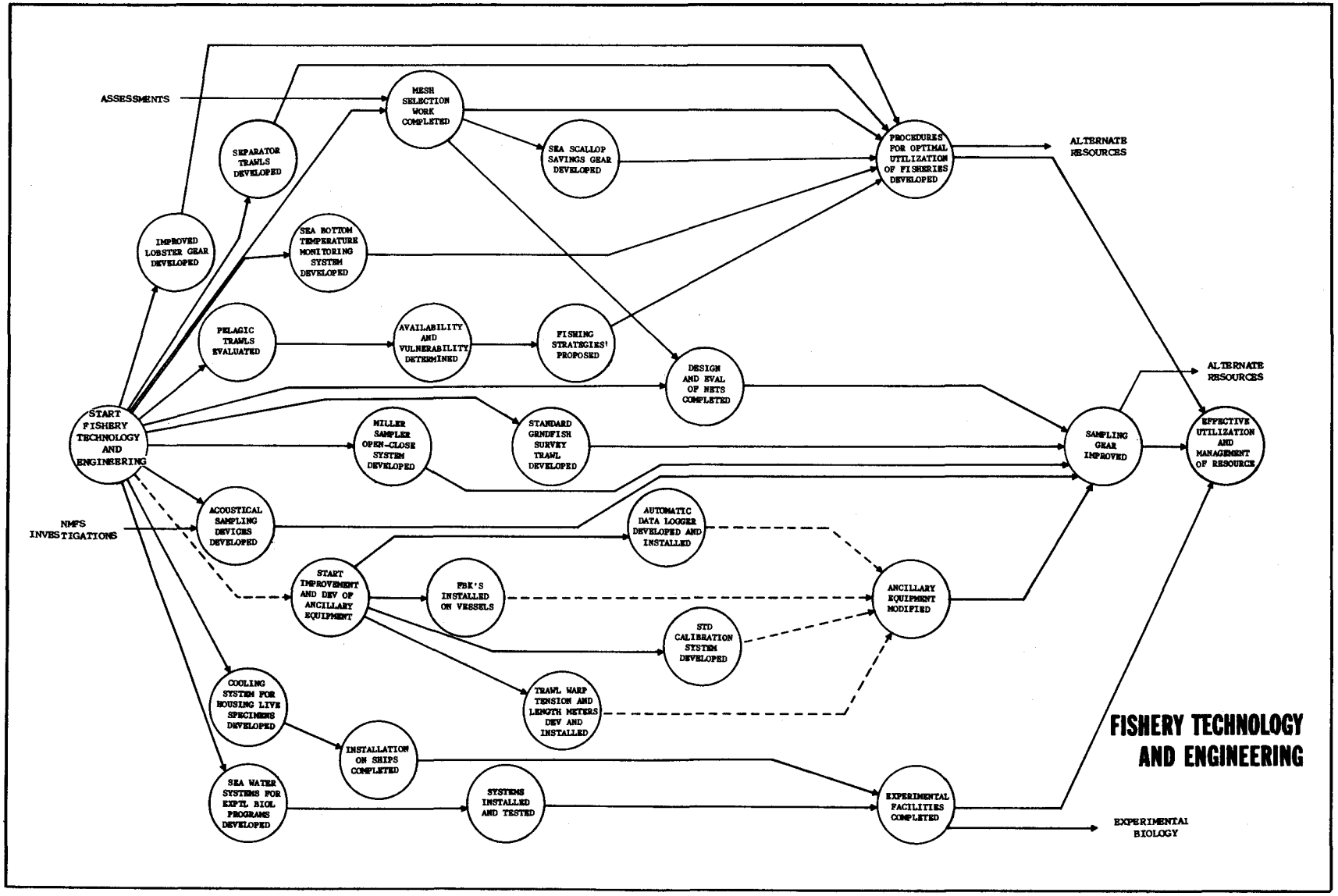
A Fishing Gear-Mesh Selection study is planned to promote conservation of immature fishes and small scallops. The use of separator trawls for the purpose of providing escapement of immature groundfish while harvesting adult smaller fishes will be investigated.

Standard Survey Trawls for groundfish and juvenile fishes are in the process of design, development and testing. These are expected to increase the accuracy and precision of survey and assessment activities.

The Fishnet Bathykymograph, a device that fits in a headrope float-type steel ball and automatically measures the time and depth of trawl tows on commercial fishing vessels, is almost completely developed and in service. An Automatic Data Logger that records (on magnetic tape) course, speed, and position of the vessel, plus 23 other meterological, hydrographic, and biological measurements, was developed to aid in survey cruise data processing.

Fishery Engineering and Electronic Support to the various programs of the Northeast Fisheries Center are the responsibility of this investigation.

Proposed work on alternate resources, mesh selection and improved harvesting systems is dependent upon program approval and funding.


ASSESSMENTS
MESH SELECTION WORK COMPLETED
SEPARATOR TRAWLS DEVELOPED
SEA SCALLOP SAVINGS GEAR DEVELOPED
PROCEDURES FOR OPTIMAL UTILIZATION OF FISHERIES DEVELOPED
ALTERNATE RESOURCES
IMPROVED LOBSTER GEAR DEVELOPED
SEA BOTTOM TEMPERATURE MONITORING SYSTEM DEVELOPED
PELAGIC TRAWLS EVALUATED
AVAILABILITY AND VULNERABILITY DETERMINED
FISHING STRATEGIES! PROPOSED
DESIGN AND EVAL OF NETS COMPLETED
ALTERNATE RESOURCES
START FISHERY TECHNOLOGY AND ENGINEERING
MILLER SAMPLER OPEN-CLOSE SYSTEM DEVELOPED
STANDARD GRNDFISH SURVEY TRAWL DEVELOPED
SAMPLING GEAR IMPROVED
EFFECTIVE UTILIZATION AND MANAGEMENT OF RESOURCE
NMFS INVESTIGATIONS
ACOUSTICAL SAMPLING DEVICES DEVELOPED
AUTOMATIC DATA LOGGER DEVELOPED AND INSTALLED
START IMPROVEMENT AND DEV OF ANCILLARY EQUIPMENT
FBK'S INSTALLED ON VESSELS
ANCILLARY EQUIPMENT MODIFIED
STD CALIBRATION SYSTEM DEVELOPED
COOLING SYSTEM FOR HOUSING LIVE SPECIMENS DEVELOPED
TRAWL WARP TENSION AND LENGTH METERS DEV AND INSTALLED
INSTALLATION ON SHIPS COMPLETED
SEA WATER SYSTEMS FOR EXPTL BIOL PROGRAMS DEVELOPED
SYSTEMS INSTALLED AND TESTED
EXPERIMENTAL FACILITIES COMPLETED
EXPERIMENTAL BIOLOGY
FISHERY TECHNOLOGY AND ENGINEERING

4.2.4. Experimental Biology (Physiology) Investigation

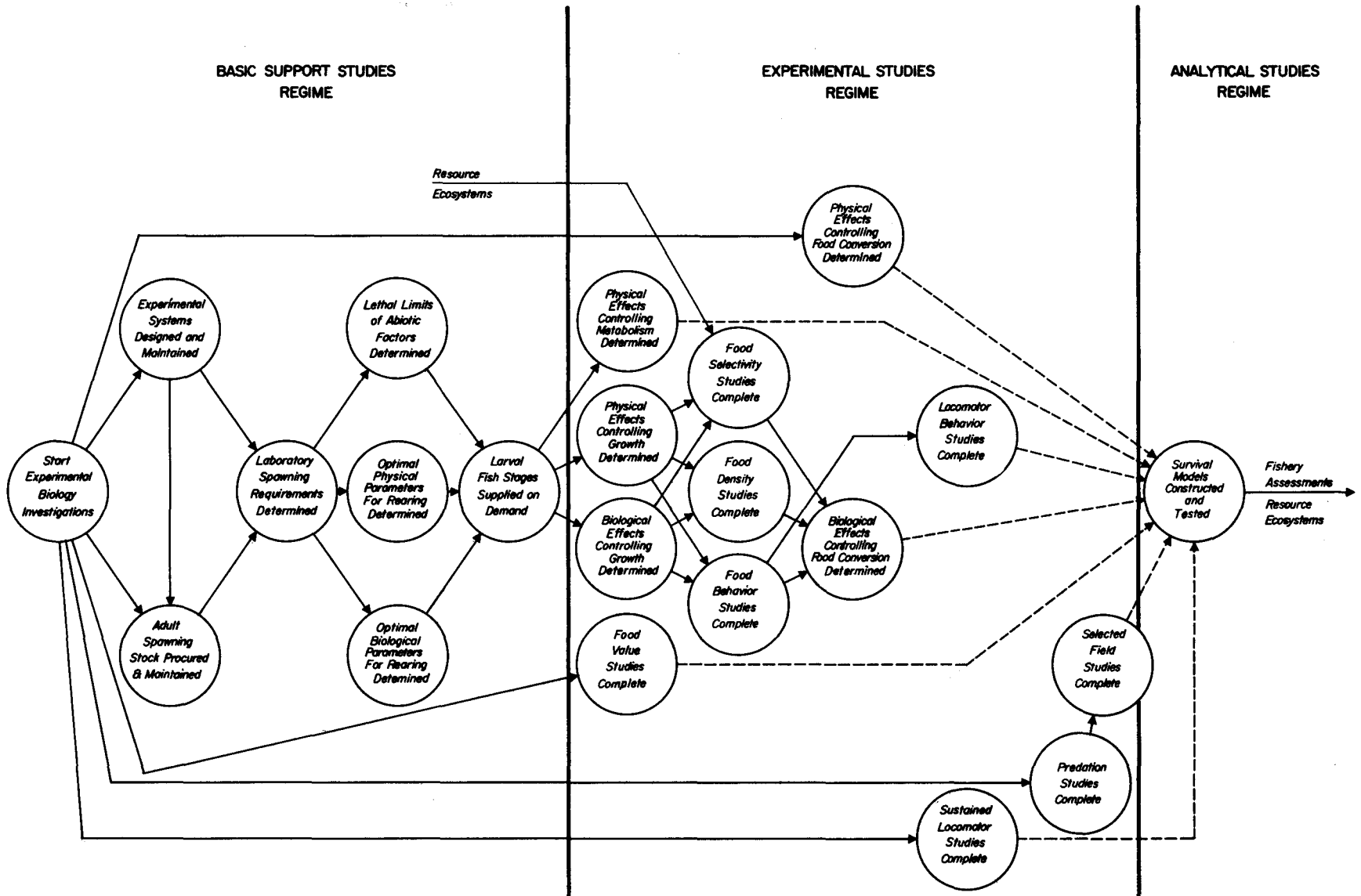
As part of the Center's mission of conserving the living marine resources of the Northwest Atlantic, the Experimental Biology (Physiology) Investigation conducts laboratory studies to aid in the determination of the mechanisms of survival of the early life stages of selected finfishes and invertebrates. It has been established that mortality in these stages is greatest and most variable. Since adult stock abundance is determined in part by successful recruitment of young, there is a critical need for studies of the life processes that determine survival in pre-recruit stages. Once knowledge of the dynamics of these processes is attained, more rational and efficient management schemes can be realized because information on the effects of natural factors on fluctuations of abundance is necessary to complement for regulation of the more controllable factor influencing abundance - man's fishing activity.

The investigation is composed of two elements. The first concerns itself with determining the physical and biological requirements of adult organisms especially regarding reproductive capacity and spawning in the laboratory. It is also concerned with the development of suitable systems for rearing and maintaining the resultant early life stages. This element provides the basic support for the more sophisticated studies of the second element by providing a constant and reliable source of experimental organisms.

The second element of the investigation conducts laboratory studies designed to gain an understanding of survival processes. The experimental approach is mainly physiological and includes research of the influence of biotic and abiotic factors on growth, metabolism, feeding abilities and behavior, trophic energetics, and locomotor abilities and behavior.

Ultimately, the results of these laboratory studies will be coordinated with other field-oriented Center investigations, particularly the Resource Ecology Investigation, to gain a basic and broad knowledge of the biology of young life stages. This, in turn, will lead to an understanding of recruitment processes and the relationship to exploitable biomass, as well as the impact of natural and man-induced environmental changes on the productivity of living marine resources.

Since these studies are, in part, concerned with the solution of basic biological and ecological problems, it will be some years before the resulting information can be integrated with other Center investigations. When this is achieved, this investigation should be a primary contributor to an understanding of the processes involved in the production of, and the interrelationships of, the components of the biomass.



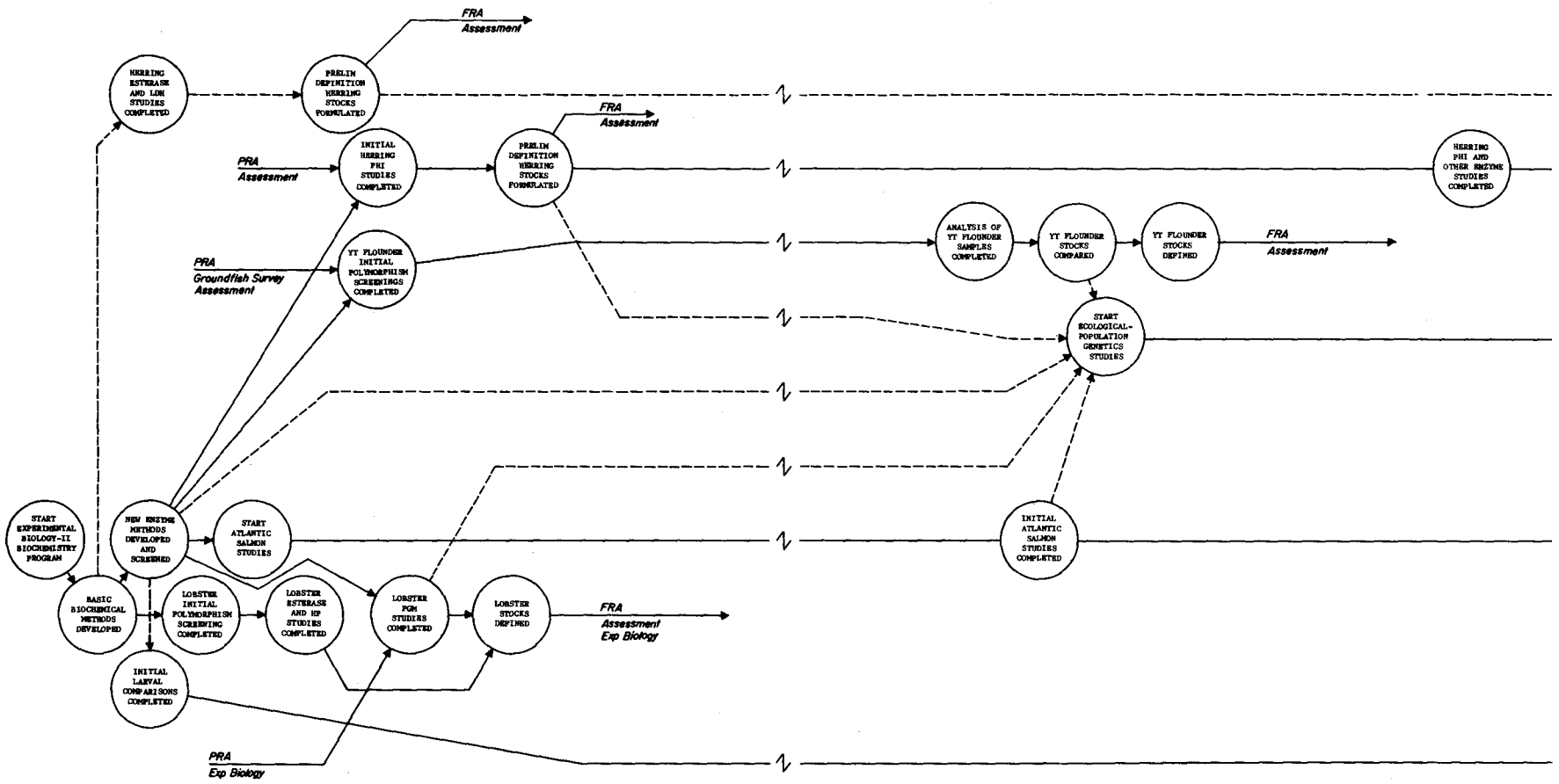
EXPERIMENTAL BIOLOGY I
PHYSIOLOGY

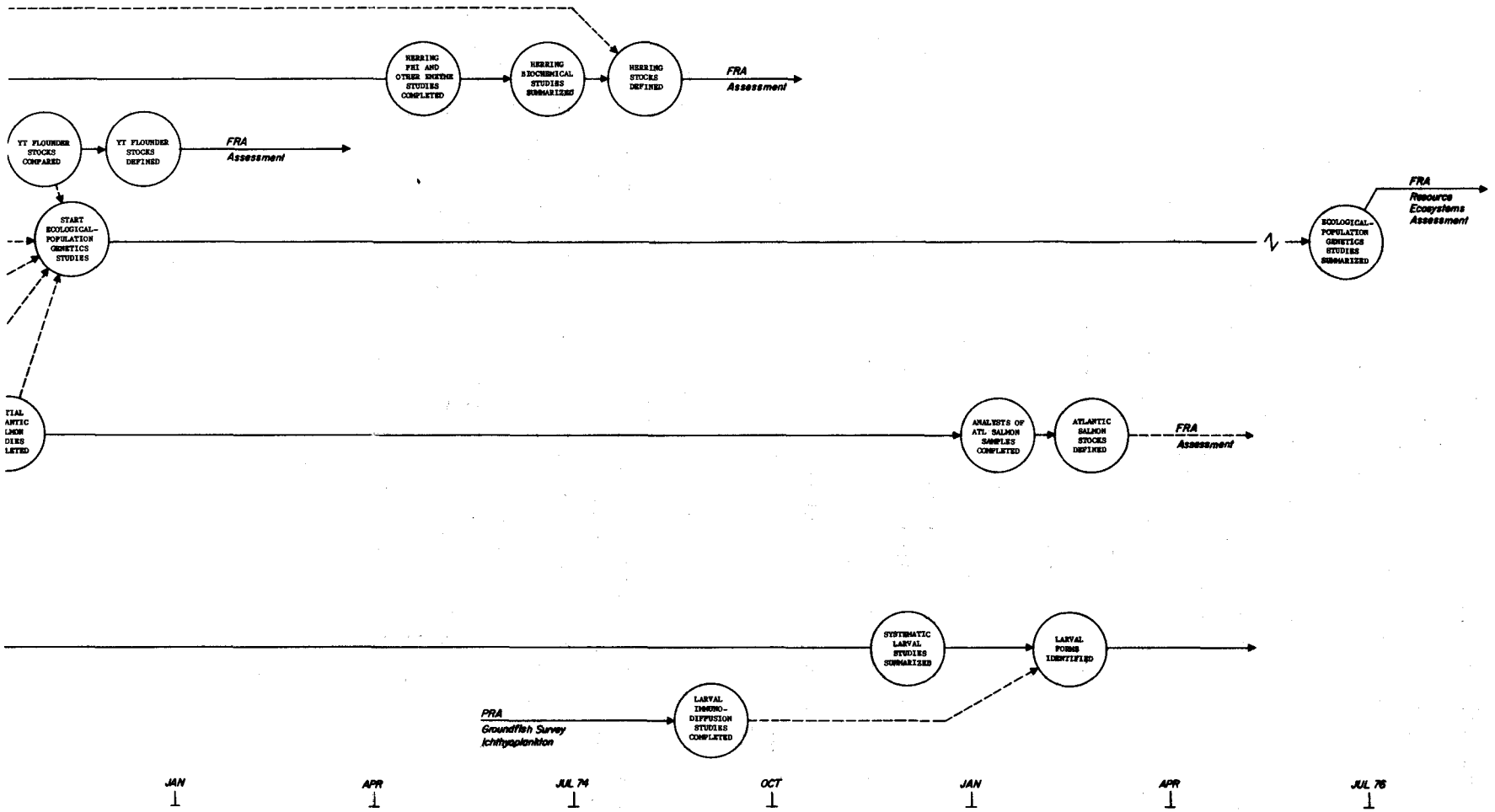
4.2.5. Experimental Biology (Biochemistry) Investigation

All species of fish are separated into a number of discrete geographic races or unit stocks. These stocks spawn in separate places and in some cases at different times or seasons. Nevertheless, several stocks may intermingle during juvenile stages or while undertaking feeding or overwintering migrations. Such unit stocks may differ not only in their distribution patterns but in growth rate, fecundity, year class abundance, and mortality rates. Thus, accurate assessment and management of resource species must be based on a knowledge of their stock structure.

The objective of the Center's biochemistry investigation is to use biochemical and population genetic methods to delineate the unit stock structure of important resource species in the Northwest Atlantic. Work accomplished so far indicates that important resource species have numerous genetically controlled systems of biochemical characteristics that occur in several forms or types. Similar characters are well-known in man, e.g., skin color, eye color, and blood types. Stocks of marine animals vary in their biochemical characteristics and this variation can be used to distinguish among them.

Currently, biochemical studies are being made on the stock structure of herring, lobsters, yellowtail flounder, and salmon. Research is also underway to apply biochemical methods to identification of egg and larval forms taken on ichthyoplankton surveys. The biochemical studies on lobsters are virtually complete. The studies on herring are relatively far advanced but the stock structure of herring is complex and an additional two years work will be required to clarify detailed aspects. Biochemical research on yellowtail flounder has only recently been started but excellent progress has been made in finding useable genetic characters. The West Greenland salmon fishery has created a serious problem of international management, and research has been initiated to determine the relative contribution to Greenland of salmon stocks from Europe and America.


START EXPERIMENTAL BIOLOGY-II BIOCHEMISTRY PROGRAM
BASIC BIOCHEMICAL METHODS DEVELOPED
NEW ENZYME METHODS DEVELOPED AND SCREENED
INITIAL LARVAL COMPARISONS COMPLETED
START ATLANTIC SALMON STUDIES
LOBSTER INITIAL POLYMORPHISM SCREENING COMPLETED
LOBSTER ESTERASE AND HP STUDIES COMPLETED
LOBSTER PGM STUDIES COMPLETED
LOBSTER STOCKS DEFINED
HERRING ESTERASE AND LDH STUDIES COMPLETED
PRELIM DEFINITION HERRING STOCKS FORMULATED
INITIAL HERRING PHI STUDIES COMPLETED
PRELIM DEFINITION HERRING STOCKS FORMULATED
YT FLOUNDER INITIAL POLYMORPHISM SCREENINGS COMPLETED
ANALYSIS OF YT FLOUNDER SAMPLES COMPLETED
YT FLOUNDER STOCKS COMPARED
YT FLOUNDER STOCKS DEFINED
HERRING PHI AND OTHER ENZYME STUDIES COMPLETED
START ECOLOGICAL-POPULATION GENETICS STUDIES
INITIAL ATLANTIC SALMON STUDIES COMPLETED
FRA Assessment
FRA Assessment
FRA Assessment
FRA Groundfish Survey Assessment
FRA Assessment
FRA Assessment Exp Biology
FRA Exp Biology
EXPERIMENTAL BIOLOGY II BIOCHEMISTRY
JUL 72
OCT
JAN
APR JUL 73
OCT
JAN
APR

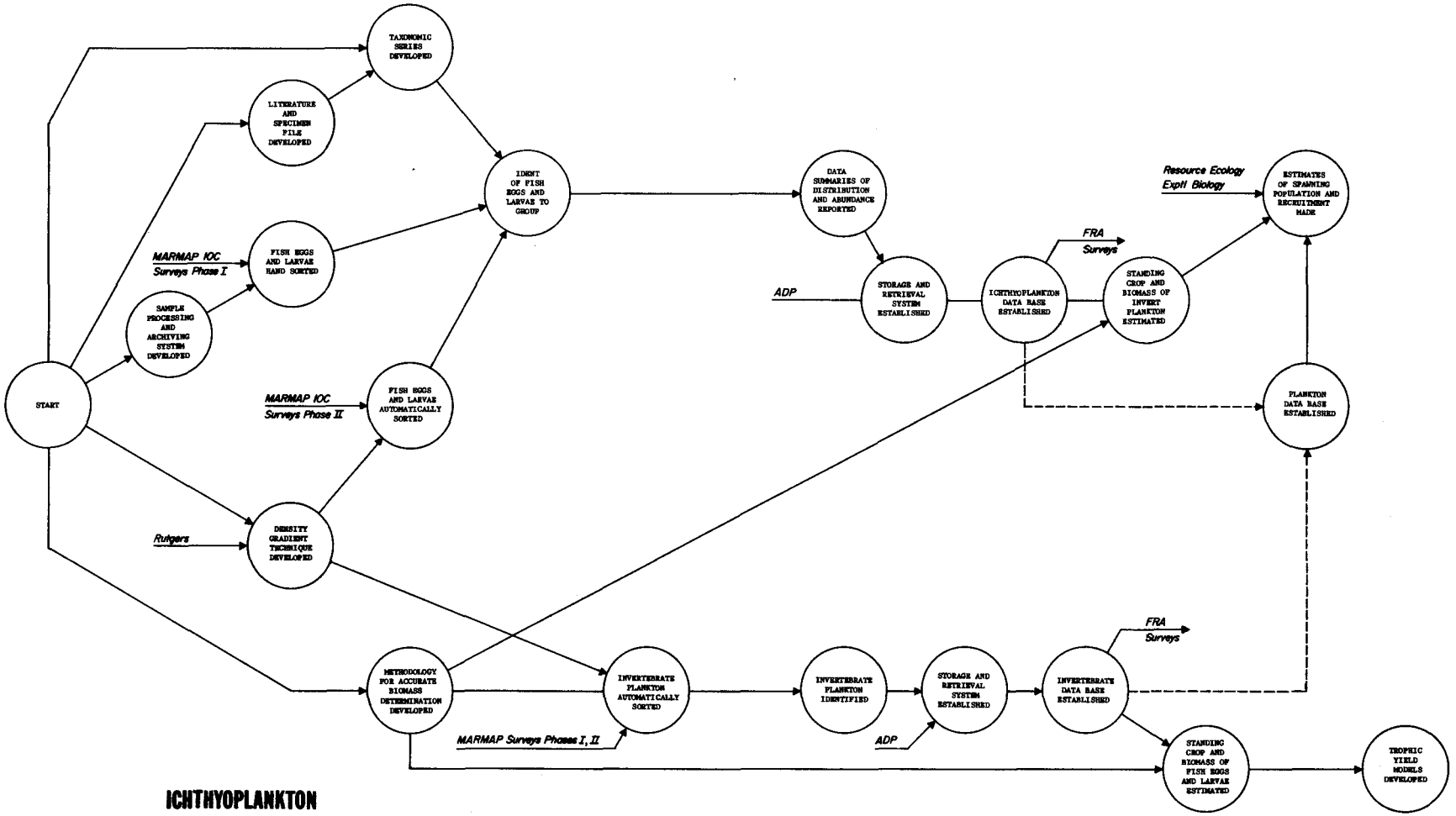

HERRING FRI AND OTHER ENZYME STUDIES COMPLETED
HERRING BIOCHEMICAL STUDIES SUMMARIZED
HERRING STOCKS DEFINED
FRA Assessment
YT FLOUNDER STOCKS COMPARED
YT FLOUNDER STOCKS DEFINED
FRA Assessment
START ECOLOGICAL-POPULATION GENETICS STUDIES
ECOLOGICAL-POPULATION GENETICS STUDIES SUMMARIZED
FRA Resource Ecosystems Assessment
ANALYSIS OF ATL. SALMON SAMPLES COMPLETED
ATLANTIC SALMON STOCKS DEFINED
FRA Assessment
SYSTEMATIC LARVAL STUDIES SUMMARIZED
LARVAL FORMS IDENTIFIED
FRA Groundfish Survey Ichthyoplankton
LARVAL IMMUNO-DIFFUSION STUDIES COMPLETED
JAN
APR
JUL 74
OCT
JAN
APR
JUL 75

4.2.6. Ichthyoplankton Investigation

This program is responsible for the routine shoreside handling of plankton samples collected on MARMAP and Northeast Fisheries Center cruises in coastal and offshore waters between Nova Scotia and Cape Hatteras. The immediate program objectives are: (1) receive, catalog, process, store, and disseminate ichthyoplankton samples and data; (2) sort, identify, measure, and enumerate fish eggs and larvae, and determine zooplankton biomass; (3) conduct studies of the systematics of previously undescribed Northwest Atlantic larvae fishes; (4) develop new techniques to more effectively and efficiently sort, measure, and enumerate fish eggs and larvae; and (5) prepare and publish tabular, graphic, and descriptive summaries of the distribution, abundance, taxonomy, and early life history stages of fish eggs and larvae.

These objectives relate primarily to the functional aspect of the investigation. They result in providing part of the data base which is required for completing the objectives in Management Biology and Resource Ecology Investigations. The initial activities will be concentrated on fish eggs and larvae to furnish the basis for estimating future recruits and adults. However, a measure of the total plankton biomass will ultimately be obtained to permit an independent assessment of yield potential of the fish biomass.

Significant progress has been made in the automation of the sorting of fish eggs and automation larvae from invertebrate zooplankton. In a cooperative study with Rutgers University, it has been demonstrated that fish eggs and larvae can be separated by iso-pycnic sedimentation in density gradients of different materials. Of the various gradient materials tested, Ludox AM (an osmotically inactive inorganic silica colloid) has proven most effective. Gradient fraction recovery techniques are now being perfected and it is expected that a completely operational system will soon be available. It is estimated that this system will reduce sorting time by a factor of ten.



ICHTHYOPLANKTON

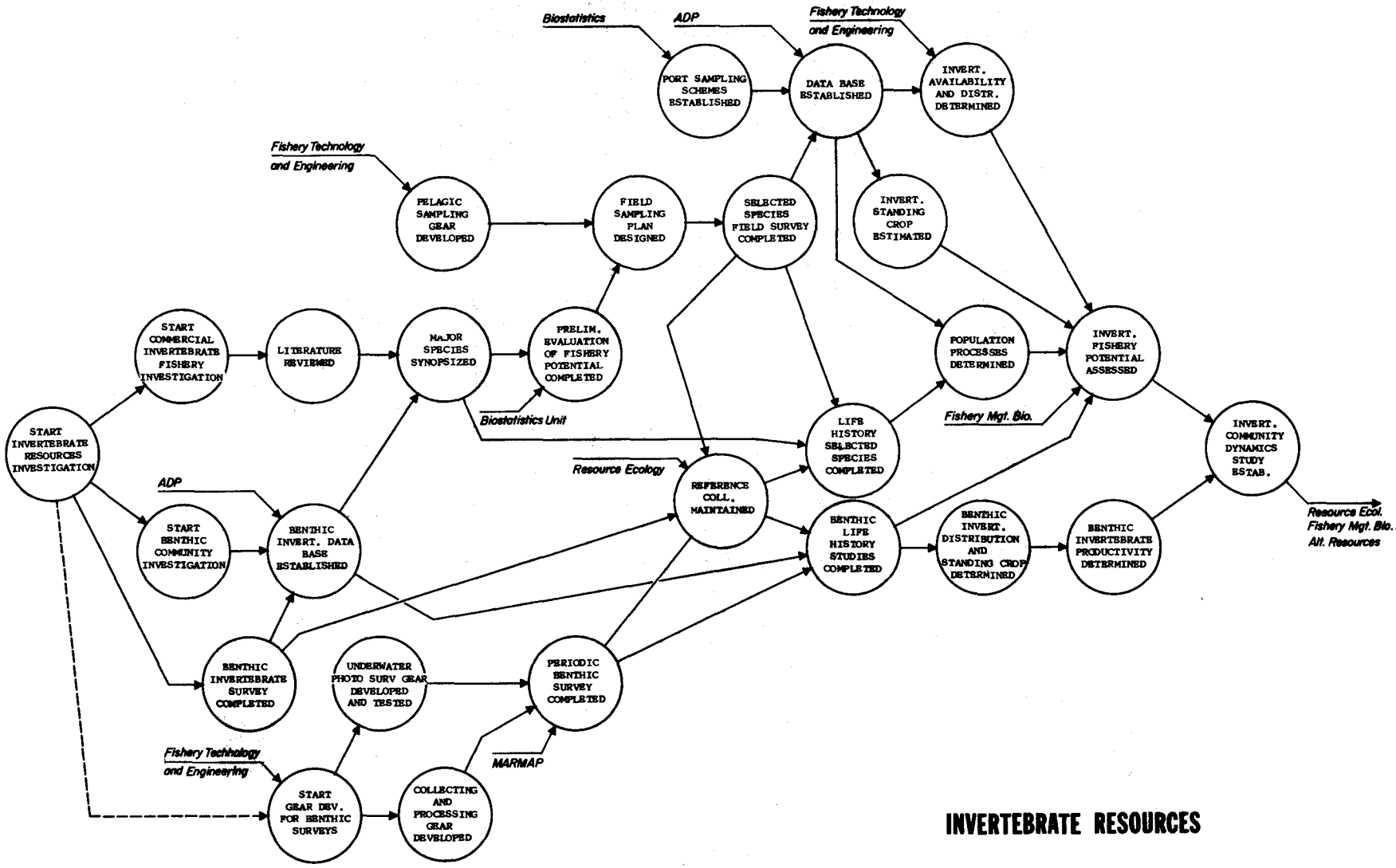
4.2.7. Invertebrate Resources Investigation

The principal goals of this investigation are to determine the distribution, abundance, and -- for selected species -- life history of bottom-living invertebrate animals. This includes large and abundant species, such as the northern shrimp, rock crab, sea scallop, as well as the multitude of small organisms that serve as food for other invertebrates and fishes. Part of the alternate resource task is included in this activity.

Knowledge of the different kinds of invertebrates that inhabit our offshore waters, their interrelationships with one another, and their dependence upon the various environmental characteristics are necessary to understand the productive potential of the area. Because of the prime importance of food supplies in the production of fish, our objective is to ascertain the kinds or organisms inhabiting the various fishing grounds, particularly the more productive areas, and ultimately to determine the quantities of major fish foods produced each year. This knowledge together with estimates of plankton production provides a basis for estimating fish production.

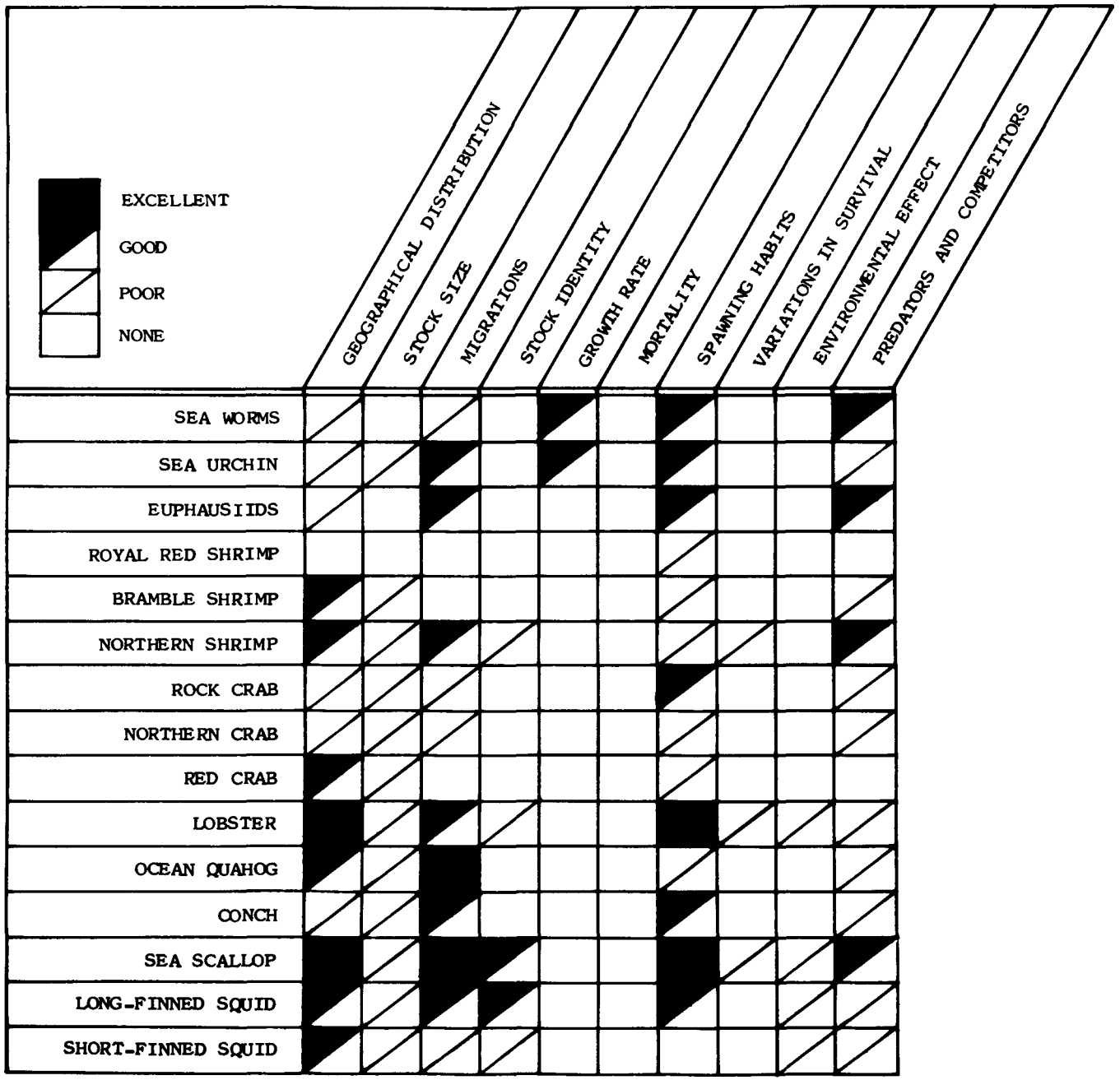
Invertebrates presently constitute a major share (54 percent of the total value) of all fishery products landed in New England. To allow for expanding utilization of invertebrates, we are emphazing study of two species of squid -- the long-finned squid and the short-finned squid; both species occur in large quantities off New England. Information about cancer crabs and deepwater shrimp is also being developed. These activities will be coordinated with direct sampling (c.f., fishery technology) to ascertain potentials.

Materials for invertebrate studies are collected on groundfish survey cruises, cooperating institutional cruises (U. S. Geological Survey, Woods Hole Oceanographic Institution, etc.), and special cruises of NMFS vessels. The sampling is coordinated under Phase II of MARMAP. Biological information to supplement and calibrate surface-collected samples is obtained from photographs and visual observations of the sea bottom using research submarines and SCUBA-equipped divers.



INVERTEBRATE RESOURCES

STATUS OF KNOWLEDGE FOR OFFSHORE INVERTEBRATES



4.2.8. Manned Undersea Research and Technology Investigation

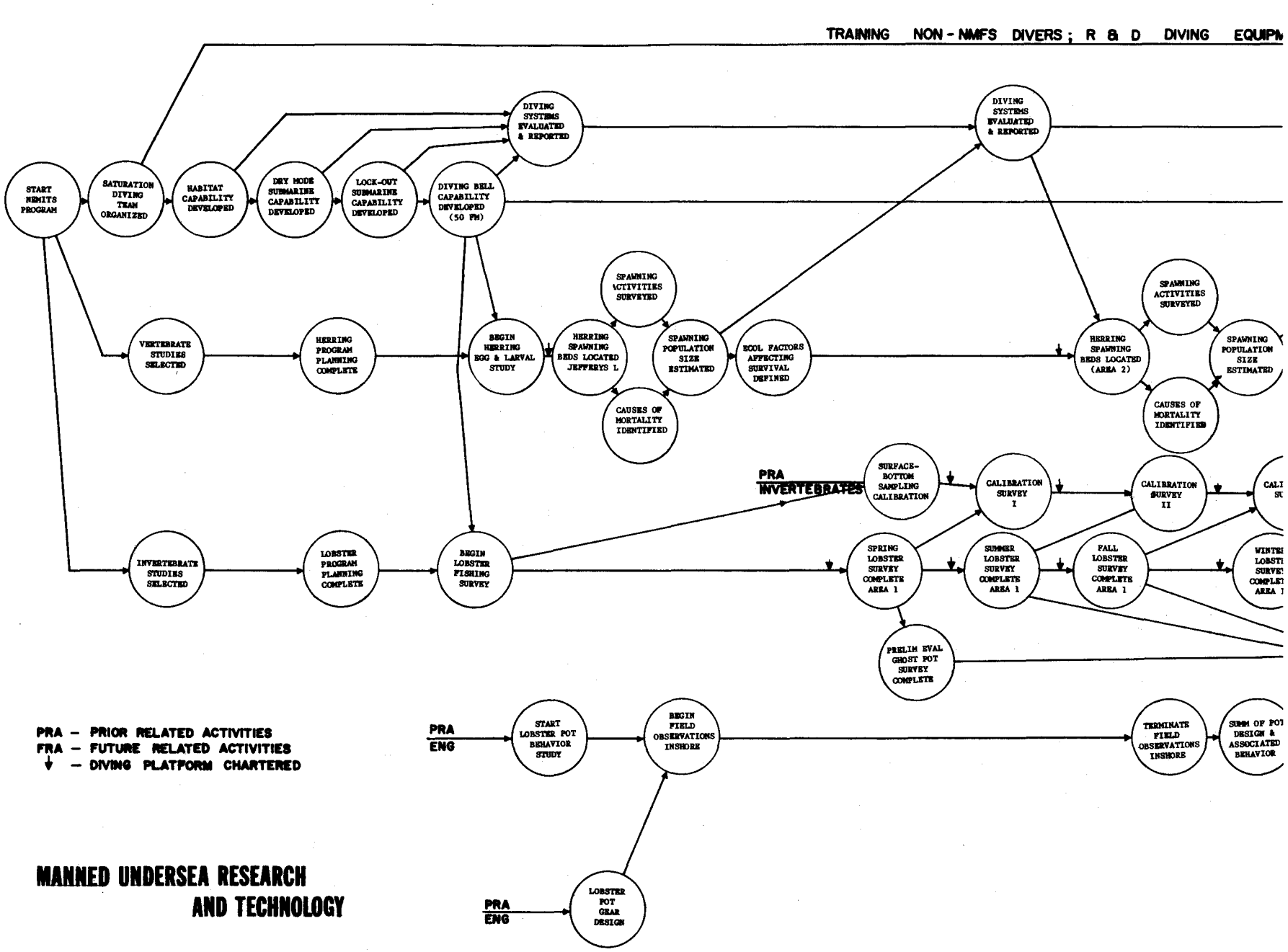
The Northeast Fisheries Research Center initiated a research diving program in the winter of 1972 to solve sampling problems that have been difficult or impossible to address using conventional surface techniques. Major goals of the Investigation are (1) development of efficient research diving capability to the edge of the continental shelf - 100 fathoms, (2) description of the early life history of the sea herring, Clupea harengus, and knowledge of the ecological factors that effect their survival, (3) survey of the macro-benthos of the outer continental shelf with special reference to the seasonal distribution and abundance of the lobster.

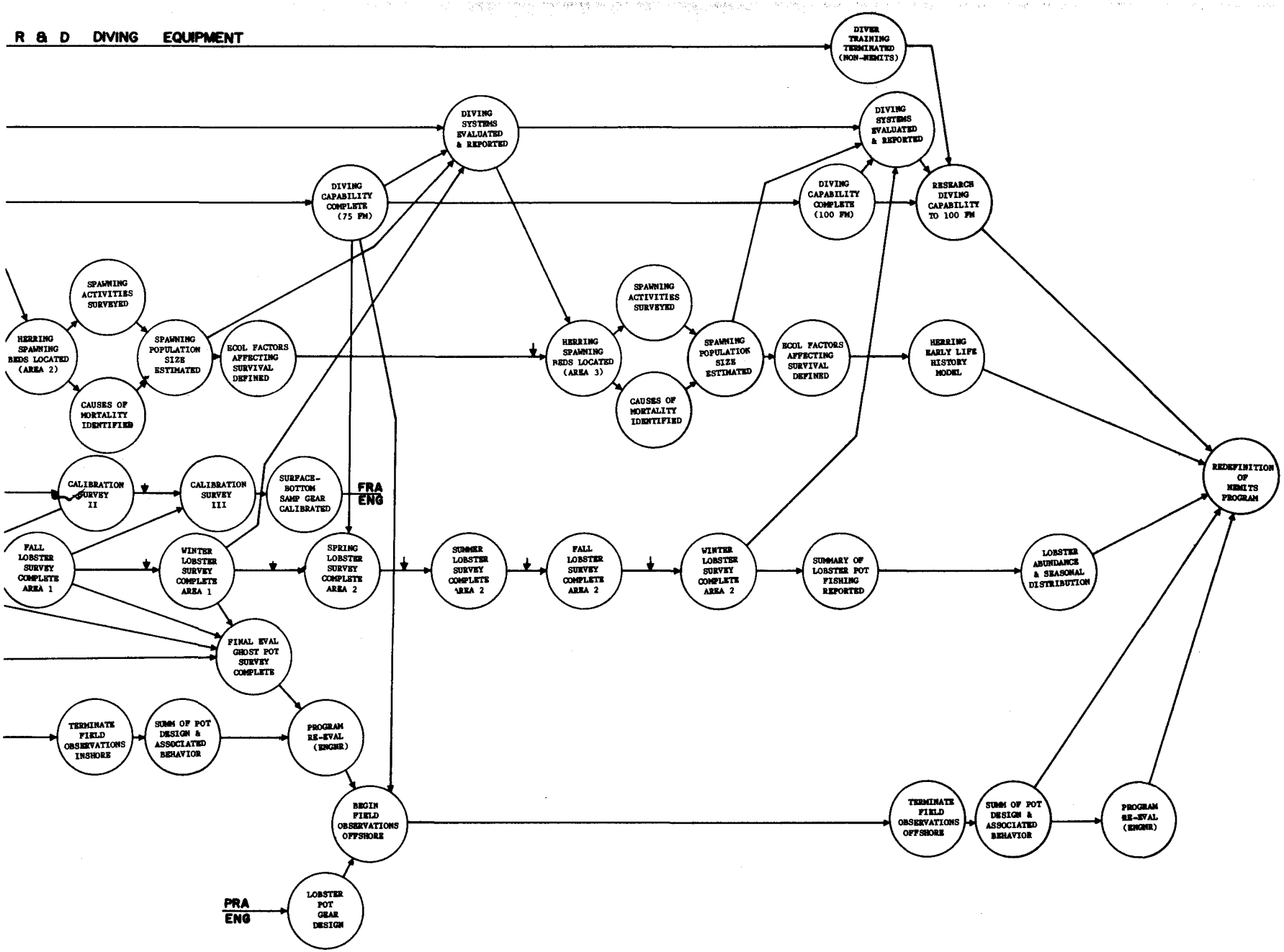
Within the first year of operations, Center team personnel have been trained in research submarine operations and diver lock-out to depths of 300 feet. Saturation diving and bounce diving techniques have been developed, working from fixed habitats on the ocean bottom and stationary platforms at the surface. By 1976 this investigation calls for scientists to be conducting in-situ research at any desired depth of the continental shelf. Scientist/divers from the Fisheries Research Board of Canada, several coastal states of the New England area and other NOAA research activities are also involved.

The first major field study to define the early life history of the sea herring and the ecological factors affecting their survival will take place during September and October, 1972, in the vicinity of Jeffreys Ledge, western Gulf of Maine. This mission will be a prelude to similar studies of herring on Georges Bank in 1973 through 1975.

Seasonal cruises with surface support ship and research submarine will be continued in the offshore fishing grounds between Veatch and Hydrographer Canyons beginning in the spring of 1973. Major emphasis will be placed on defining, calibrating towed optical sampling gear to determine the seasonal distribution, abundance and ecology of the lobster and other commercially important shellfish.

Beginning in mid-fiscal year 1973 a one-year study will begin in inshore Gulf of Maine waters to define trap-related lobster behavior, including effectiveness of escape vents, cannabalism, and catchability of new trap designs. A major part of the data will be gathered by diver/scientists working in cooperation with the lobster conservation project under Fishery Technology and Engineering.


TRAINING NON - NMFS DIVERS ; R & D DIVING EQUIPM
START NEMITS PROGRAM
SATURATION DIVING TEAM ORGANIZED
HABITAT CAPABILITY DEVELOPED
DRY MODE SUBMARINE CAPABILITY DEVELOPED
LOCK-OUT SUBMARINE CAPABILITY DEVELOPED
DIVING BELL CAPABILITY DEVELOPED (50 FM)
DIVING SYSTEMS EVALUATED & REPORTED
DIVING SYSTEMS EVALUATED & REPORTED
VERTEBRATE STUDIES SELECTED
HERRING PROGRAM PLANNING COMPLETE
BEGIN HERRING EGG & LARVAL STUDY
HERRING SPAWNING BEDS LOCATED JEFFERYS L
SPAWNING ACTIVITIES SURVEYED
SPAWNING POPULATION SIZE ESTIMATED
CAUSES OF MORTALITY IDENTIFIED
SCOL FACTORS AFFECTING SURVIVAL DEFINED
HERRING SPAWNING BEDS LOCATED (AREA 2)
SPAWNING ACTIVITIES SURVEYED
SPAWNING POPULATION SIZE ESTIMATED
CAUSES OF MORTALITY IDENTIFIED
PRA
INVERTEBRATES
SURFACE-BOTTOM SAMPLING CALIBRATION
CALIBRATION SURVEY I
CALIBRATION SURVEY II
INVERTEBRATE STUDIES SELECTED
LOBSTER PROGRAM PLANNING COMPLETE
BEGIN LOBSTER FISHING SURVEY
SPRING LOBSTER SURVEY COMPLETE AREA 1
SUMMER LOBSTER SURVEY COMPLETE AREA 1
FALL LOBSTER SURVEY COMPLETE AREA 1
PRELIM EVAL GHOST POT SURVEY COMPLETE
PRA — PRIOR RELATED ACTIVITIES
FRA — FUTURE RELATED ACTIVITIES
↓ — DIVING PLATFORM CHARTERED
PRA
ENG
START LOBSTER POT BEHAVIOR STUDY
BEGIN FIELD OBSERVATIONS INSHORE
TERMINATE FIELD OBSERVATIONS INSHORE
PRA
ENG
LOBSTER POT GEAR DESIGN
MANNED UNDERSEA RESEARCH AND TECHNOLOGY
FY - 72
FY - 73
FY - 74


R & D DIVING EQUIPMENT
DIVER TRAINING TERMINATED (NON-PERMITS)
DIVING SYSTEMS EVALUATED & REPORTED
DIVING SYSTEMS EVALUATED & REPORTED
DIVING CAPABILITY COMPLETE (75 FM)
DIVING CAPABILITY COMPLETE (100 FM)
RESEARCH DIVING CAPABILITY TO 100 FM
SPAWNING ACTIVITIES SURVEYED
HERRING SPAWNING BEDS LOCATED (AREA 2)
SPAWNING POPULATION SIZE ESTIMATED
ECOL FACTORS AFFECTING SURVIVAL DEFINED
CAUSES OF MORTALITY IDENTIFIED
HERRING SPAWNING BEDS LOCATED (AREA 3)
SPAWNING ACTIVITIES SURVEYED
CAUSES OF MORTALITY IDENTIFIED
SPAWNING POPULATION SIZE ESTIMATED
ECOL FACTORS AFFECTING SURVIVAL DEFINED
HERRING EARLY LIFE HISTORY MODEL
REDEFINITION OF PERMITS PROGRAM
CALIBRATION SURVEY II
CALIBRATION SURVEY III
SURFACE-BOTTOM SAMP GEAR CALIBRATED
FRA
ENG
FALL LOBSTER SURVEY COMPLETE AREA 1
WINTER LOBSTER SURVEY COMPLETE AREA 1
SPRING LOBSTER SURVEY COMPLETE AREA 2
SUMMER LOBSTER SURVEY COMPLETE AREA 2
FALL LOBSTER SURVEY COMPLETE AREA 2
WINTER LOBSTER SURVEY COMPLETE AREA 2
SUMMARY OF LOBSTER POT FISHING REPORTED
LOBSTER ABUNDANCE & SEASONAL DISTRIBUTION
FINAL EVAL GHOST POT SURVEY COMPLETE
TERMINATE FIELD OBSERVATIONS INSHORE
SUMM OF POT DESIGN & ASSOCIATED BEHAVIOR
PROGRAM RE-EVAL (ENGNR)
BEGIN FIELD OBSERVATIONS OFFSHORE
TERMINATE FIELD OBSERVATIONS OFFSHORE
SUMM OF POT DESIGN & ASSOCIATED BEHAVIOR
PROGRAM RE-EVAL (ENGNR)
PRA
ENG
LOBSTER POT GEAR DESIGN
FY-74
FY-75
FY-76

4.3. Additional Studies

4.3. Additional Activities

The increased use of the ocean for mining, oil extraction, dumping, cooling water, etc., has caused great public concern for the future state of the marine environment. As a consequence, there has been an increasing need for evaluation of the effects of such use; studies are required both before and after the event. The Center provides a focal point of knowledge and expertise and is frequently called upon for data, advice, or assistance in evaluations which are the administrative responsibility of other agencies. We accept this as an important function of the Center. However, the increasing workload imposed by such activity (generally not planned in advance) tends to interfere with planned investigations that are to provide the very basis of the knowledge which is needed.

New England Offshore Mining Evaluation Study (NOMES)

Project NOMES has been designed by NOAA to evaluate the biological, chemical, and physical effects of dredging sand and gravel from marine deposits. It is to be directed by the Environmental Research Laboratories and managed by the Marine Minerals Technology Center. All operations will be conducted by State, university, and private groups through contracts from Sea Grant and NOAA and with some matching funds.

The Center has been directed by NOAA through NMFS, to provide scientific and technical guidance to NOMES on the biological aspects of the project. This consists of reviewing contract proposals, suggesting changes or additions, monitoring progress, reviewing results, and assisting in the final interpretation of the environmental impact of the dredging. Mr. J. A. Posgay and Dr. R. L. Wigley have been detailed to provide these services. Other staff members will assist as a need for their particular expertise develops.

In order to provide a more rational basis for evaluation of this and other uses of the marine area, we have developed and proposed a more comprehensive study - the Biome Study (see section 4.1.2).

Effects of Oil Extraction

At least 2 months of one high-level scientist's time has been expended to review and advise on the effects of possible oil pollution. We can expect increased demands on the Center for information and evaluation studies.

Water Pollution

We have over the last year provided nearly one full man-year to aid in the evaluation of proposals for power plants, dredging, dumping, etc.

Northern Lobster Management

There has been a good deal of pressure lately to come up with a management plan for the northern lobster based on State and Federal cooperation. Biologists of the Center have participated in several planning sessions and meetings with State biologists and administrators. The latest meeting resulted in the formation of a technical committee and a policy committee to consider the matters raised at the meeting; we are providing a biologist to participate in the former.

Direct Aid to Industry (Extension)

The industry is becoming more sophisticated in its planning and development of fisheries. We are frequently requested to supply data and information for a variety of needs. We are trying (and planning) to routinely provide more useful information to the public and private sectors. We do now provide a full man-year to extension activities. However, we cannot predict all the demands for information, and thus, many times we must devote unplanned time and money, to be responsive.

We are involved in many other activities related to our scientific position in the community. We are providing staff to teach courses at the Massachusetts Maritime Academy. We continually evaluate proposals and review results of contract work done by states (P. L. 88-309), universities (Sea Grants), and other national agencies (NSF, EPA, etc.). We also provide facilities and staff time to training of students from the U. S. and other countries.

The accumulated effect of these activities probably accounts for 5-10% of our present activities. It is difficult to get direct support for this - we must develop some slack in the Center program to be properly responsive.

5.0. Staff

5.0. Staff

The following pages list by investigations and administrative units both the present staff and what we consider the optimum staff. The latter is our best judgement of the personnel required to achieve all objectives within the required time-span.

The Center currently employes 128 full-time, permanent people, of which 79 are in the research investigations and 49 in technical support and administration. We are presently allocated 130 full-time permanent positions. We propose an increase of 77 over the next two years.

INVESTIGATION TOTAL

	Proposed No.		Present No.		Increase
Investigation Chiefs GS 13-15	8		8		0
Task Leaders GS 12-14	16		6		10
Research Biologists GS 5-12	48		29		19
Math Statisticians GS 9-12	2		1		1
Engineers (ME) GS 9-12	2		2		0
Technicians GS 2-11	63		33		30
Total -	139	Avg Grade:8.9	79	Avg Grade:9.0	60

ADMINISTRATIVE TOTAL

	Proposed No.		Present No.		Increase
Directors GS 13-16	3		3		0
Special Staff GS 5-14	4		2		2
Task Leaders GS 7-12	3		1		2
Administrative Specialists GS 3-9	19		16		3
Technical Specialists GS 3-12	21		16		5
O & M Specialists WB 2-10	16		11		5
Total -	66	Avg Grade:7.0	49	Avg Grade:6.7	17
CENTER TOTAL -	205	Avg Grade:8.3	128	Avg Grade:8.1	77

These numbers do not include the Port Captain and his Assistant nor the vessel crew of 22. These positions are due for transfer to the NOAA Office of Fleet Operations in January, 1974. In addition, there are 13 temporary or intermittent employees, and 35 students in the cooperative training program and summer assistant category.

NORTHEAST FISHERIES CENTER
TABLE OF ORGANIZATION

Title	Proposed Staff No.	Grade	Present Staff No.	Name (Grade)
FISHERY MANAGEMENT BIOLOGY				
Investigation Chief	1	GS 13-15	1	Brown (12)
		Assessment		
Task Leader	1	GS 12-14		
Research Biologists	6	GS 5-13	4	Anderson (12)
				Heyerdahl (12)
				Anthony (12)
				Vacant (5)
Math. Statistician	1	GS 9-11	1	Brennen (9)
Technicians	2	GS 4-6	2	Callahan (7)
				Lewis (5)
		Biostatistics		
Task Leader	1	GS 12-14	1	Stern (12)
Research Biologists	2	GS 9-11	1	Parrack (9)
Statistician	1	GS 9-11		
Technicians	4	GS 4-9	4	Dryer (9)
				Lozier* (7)
				Morgan (2)
				Went worth* (7)
		Groundfish Survey Unit		
Survey Unit Leader	1	GS 9-11	1	Jensen (9)
Research Biologist	1	GS 9	1	Flescher (9)
Chief Data Technician	1	GS 7-9		
Sea-going Technician	7	GS 4-7	2	Mantzaris (5)
				Poshkus (4)
		Age Unit		
Unit Leader	1	GS 11-13	1	Nichy (11)
Research Biologists	2	GS 5-7	1	Pentilla (5)
Technicians	3	GS 3-5	2	Gifford (3)
				Vacant (4)
Totals -	35	Avg Grade: 8.0	22	Avg Grade: 7.8

*Samples ports in Maine for sardines, and does other work elsewhere performed by OSS. Duties recommended to be transferred.

Title	Proposed Staff No.	Grade	Present Staff No.	Name (Grade)
		RESOURCE ECOLOGY		
Investigation Chief	1	GS 13-15	1	Grosslein (14)
		Recruitment Processes		
Task Leader	1	GS 12-14		
Research Biologists	6	GS 9-13	5	Au (11) Graham (13) Livingstone (11) Honey (11) Davis (11)
Technicians	4	GS 4-11	2	Bickford (5) Dohrmann (4)
		Ecosystem Dynamics		
Leader	1	GS 12-14		
Research Biologists	5	GS 7-12	3	Griswold (11) Lux (12) Morris (7)
Technicians	3	GS 5-7	2	Loners (5) Hersey (7)
		Environmental Studies		
Leader	1	GS 12-14		
Research Biologist	1	GS 9-11		
Technician	1	GS 7-9	1	Nickerson (8)
		Gamefish Studies*		
Leader	1	GS 12-14	1	Casey (12)
Research Biologist	1	GS 9-11	1	Stillwell (9)
Technicians	2	GS 5-9	1	Pratt (5)
Total -	28	Avg Grade: 9.7	17	Avg Grade: 9.2

*Mather (WHOI Cooperator)

Title	Proposed Staff No.	Grade	Present Staff No.	Name (Grade)
FISHERY TECHNOLOGY & ENGINEERING				
Chief	1	GS 13-15	1	Smith (14)
Sampling Gear Development				
Leader	1	GS 12-14		
Research Biologist	1	GS 9-12		
Mechanical Engineer	2	GS 9-12	2	Corbett (11) Blott (9)
Electronics Technician	1	GS 5-12	2	Twohig (12) Carter (9) (to Alb. IV, OFO)*
Engineer Draftsman	1	GS 4-7		
Harvesting Systems				
Leader	1	GS 12-14	1	McRae (13)
Research Biologists	2	GS 7-12	1	Bowman (12)
**(Trawl Master)	3	GS 7-11	1	Handwork (11)
Electronics Technician	1	GS 9-12	1	Crossen (11)
Technicians	2	GS 4-7		
Total -	16	Avg Grade: 9.3	9	Avg Grade:10.7
EXPERIMENTAL BIOLOGY I (PHYSIOLOGY)				
Chief	1	GS 13-15	1	Laurence (12)
Spawning & Rearing				
Leader	1	GS 12-14		
Research Biologists	2	GS 7-12	1	Rogers (7)
Technicians	3	GS 4-9	1	Halavik (4)
Experimental Physiology				
Leader	1	GS 12-14		
Research Biologists	3	GS 9-12	2	Stickney (13) Chenowith (11
Technicians	3	GS 4-9	2	Perkins (9) Smigielsky (7)
Total -	14	Avg Grade: 9.6	7	Avg Grade: 9.0

*This position will be assigned to Office of Fleet Operations when Albatross IV management is transferred to NOAA.
**Fishery Methods and Equipment Specialists.

Title	Proposed Staff No.	Grade	Present Staff No.	Name (Grade)
EXPERIMENTAL BIOLOGY II (BIOCHEMISTRY)				
Chief	1	GS 13-15	1	Ridgway (14)
Population Geneticist	1	GS 12-14		
Research Biologists	3	GS 9-12	3	Watson (12) Lewis (11) Perkins (11)
Technicians	4	GS 4-9	3	Sherburne (9) Dogget (3) Marston (3)
Total -	9	Avg Grade: 9.3	7	Avg Grade: 9.0
ICHTHYOPLANKTON				
Chief	1	GS 13-15	1	Colton (13)
Research & Development				
Leader	1	GS 12-14		
Research Biologist	1	GS 9-12		
Technician	1	GS 4-7		
Sorting & Identification				
Leader	1	GS 12-14		
Research Biologists	4	GS 7-12	2	Burns (7) Kinnear (9)
Technicians	2	GS 5-9	1	Stoddard (7)
Sorters	6	GS 2-4	2	Monroe (2) Vacant (2)
Total -	17	Avg Grade: 7.5	6	Avg Grade: 6.7
INVERTEBRATE RESOURCES				
Chief	1	GS 13-15	1	Wigley (14)
Taxonomy & Distribution				
Leader	1	GS 12-14		
Research Biologists	2	GS 7-11	1	Theroux (9)
Technicians	3	GS 4-7	1	Murray (7)
Resource Production				
Leader	1	GS 12-14	1	Rathjen (13)
Research Biologists	2	GS 9-12		
Technicians	2	GS 4-7		
Total -	12	Avg Grade: 9.0	4	Avg Grade: 10.0

Title	Proposed Staff No.	Grade	Present Staff No.	Name (Grade)
MANNED UNDERSEA RESEARCH & TECHNOLOGY				
Chief	1	GS 13-15	1	Cooper (12)
Research Biologists	3	GS 9-13	3	Uzmann (13) Boyer (12) Pecci (5)
Technicians	4	GS 5-9	3	Clifford (7) Newell (7) Orne (5)
Total -	8	Avg Grade: 9.3	7	Avg Grade: 8.9
ADMINISTRATION				
Directorate				
Director	1	GS 16	1	Edwards (16)
Deputy Director	1	GS 15	1	Hennemuth (15)
Executive Officer	1	GS 13-14	1	Skerry (13)
Secretary	3	GS 3-6	2	Crook (4) Vacant (3)
Special Staff Assts	4	GS 5-14	2	Posgay (14) Kelly (13)
Support				
Administrative Officer	1	GS 7-11		
Administrative Assts	3	GS 4-9	3	Swafford (3) Perrigo (7) Cowley (4)
Secretary, Clerk/Typist	9	GS 3-5	7	Addams (5) Foss (4) Wilde (3) Lynch (3) Christie (2) Kelly (4) Rinaldo (3)
Purchasing, Acctg Personnel	4	GS 4-9	4	Kiernan (6) Howe (5) Harkins (4) Burke (3)

Title	Proposed Staff No.	Grade	Present Staff No.	Name (Grade)
		(ADMINISTRATION)		
		Building & Grounds		
Foreman	3	WB 7-10	3	Macaulay (9) Ally (8) Pratt (7)
Maintenance	13	WB 2-9	8	Reese (9) Costa (9) Sandlin (5) Blevins (2) Dolloff (8) Campbell (8) Leeman (2) Larkin (2)
Motorboat Operator	1	WB 5-9	1	Trask (9)
		Public Information & Editing		
Task Leader	1	GS 9-11		
Writer/Editor	1	GS 9-11	1	Eddy (9)
Aquarium Director	2	GS 9-12	2	Wheeler (11) Welch (12)
Aquarium Operator	2	WB 7-11	1	Ruschky (9)
Graphic Arts	6	GS 4-11	5	Brigham (9) Bailey (9) Coffin (9) Rollins (6) Lamont (7)
Librarian	1	GS 5-9	1	Gerrior (5)
		Automatic Data Processing		
Unit Manager	1	GS 11-12	1	Handy (11)
Systems Program	1	GS 9-11		
Computer Technicians	4	GS 3-9	3	Laird (9) Chase (7) Thompson (5)
Card Punch Supervisor	1	GS 4-6	1	Cory (4)
Card Punch Operator	2	GS 3-5	1	Kingsley (3)
Total -	66	Avg Grade: 7.0	49	Avg Grade: 6.8

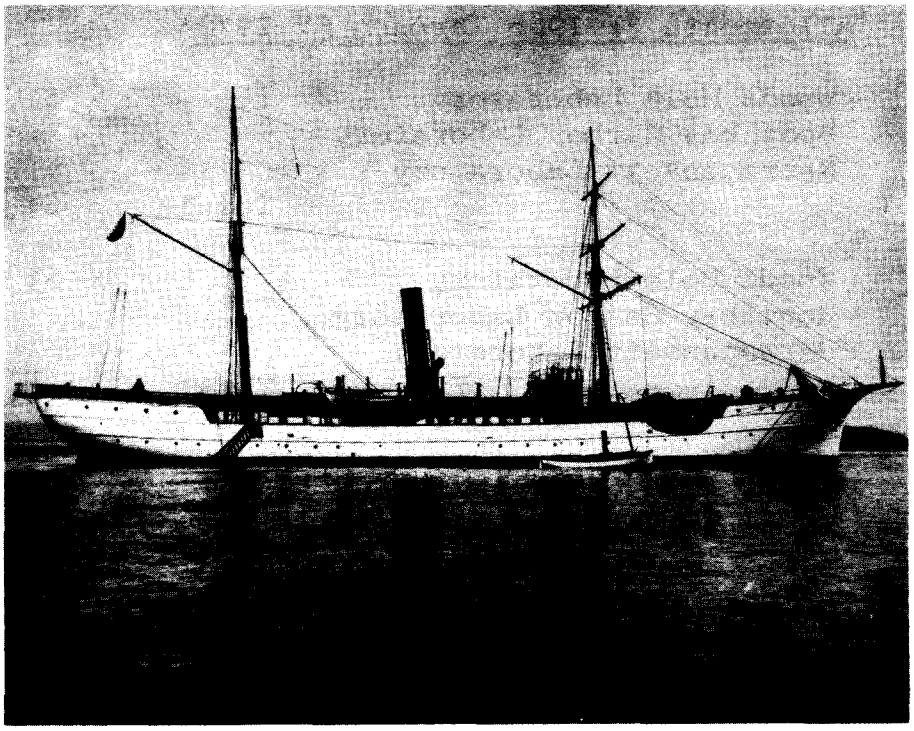
6.0. Funding

Allotments FY 1968 Through FY 1973

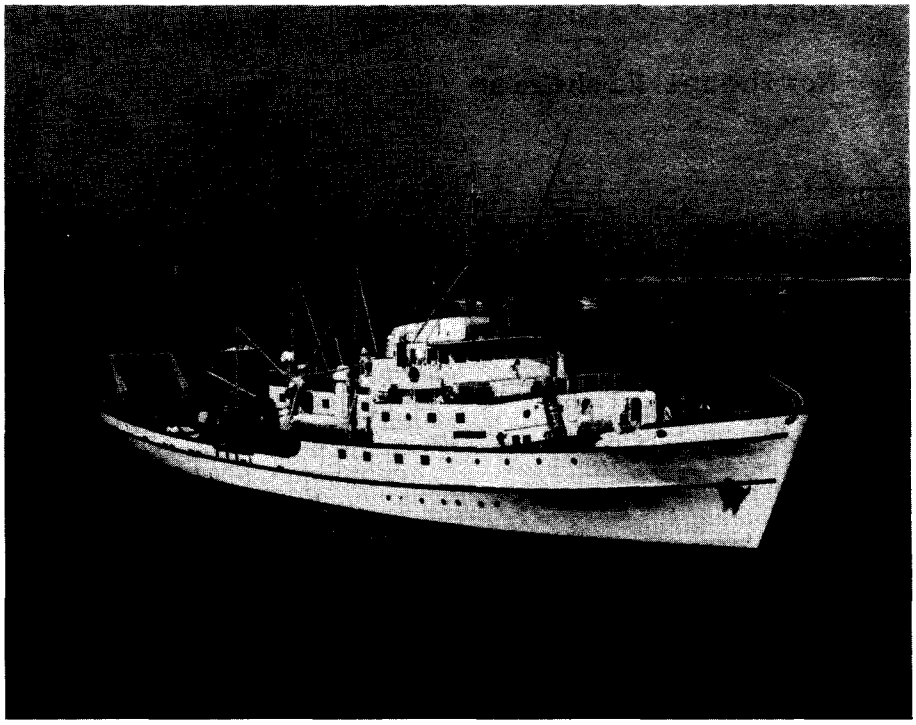
FY 1968	Woods Hole Laboratory		$1,162,000.00
	Boothbay Harbor Laboratory		630,100.00
	Narragansett Laboratory		*
		Total	$1,792,100.00
FY 1969	Woods Hole Laboratory		$1,138,300.00
	Boothbay Harbor Laboratory		549,400.00
	Narragansett Laboratory		*
		Total	$1,687,700.00
FY 1970	Woods Hole Laboratory		$1,216,300.00
	Boothbay Harbor Laboratory		561,200.00
	Narragansett Laboratory		*
		Total	$1,777,500.00
FY 1971	Woods Hole Laboratory		$1,030,600.00
			898,100.00 (transfer with Gear Base)
	Boothbay Harbor Laboratory		599,900.00
	Narragansett Laboratory		222,000.00
		Total	$2,750,600.00
FY 1972	Northeast Fisheries Center		$2,912,300.00
FY 1973	Northeast Fisheries Center		$2,960,700.00

Total Personnel	$2,176,900.00
Permanent Laboratory Personnel	1,586,200.00
ALBATROSS IV	248,000.00
Other Personnel Costs	342,200.00
Other Direct Fixed Costs	592,600.00
Fixed Facility Costs	423,200.00
ALBATROSS IV Operation	169,400.00
Available for Research Costs	191,400.00

*Under Bureau of Sportsfish & Wildlife



The first Albatross, used by Woods Hole Laboratory from 1882-1921.



Albatross IV, present Fisheries research vessel, commissioned in 1962.