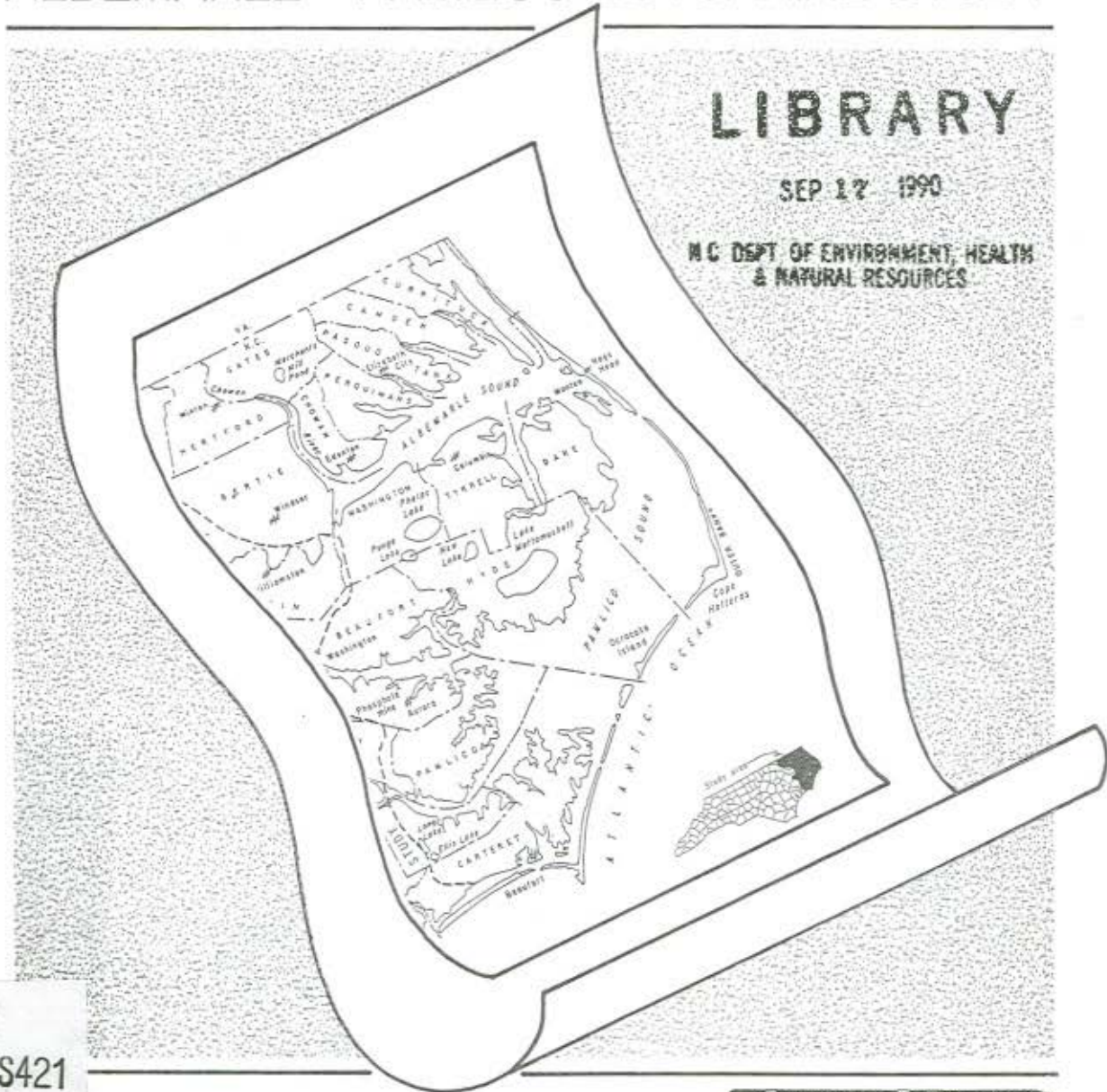


1989

Project No. 89-02

SCOPING STUDY OF DATA REQUIREMENTS FOR FISHERIES STOCK ASSESSMENT IN NORTH CAROLINA

ALBEMARLE - PAMLICO ESTUARINE STUDY



C1
509:S421

Funding Provided By
North Carolina Department of Natural Resources and Community Development
Environmental Protection Agency
National Estuary Program



SCOPING STUDY OF DATA REQUIREMENTS FOR FISHERIES
STOCK ASSESSMENT IN NORTH CAROLINA

By

Michael W. Street and Paul S. Phalen

North Carolina Department of
Environment, Health and Natural Resources

Division of Marine Fisheries
P.O. Box 769
Morehead City, NC 28557

April 1989

"The research on which the report is based was financed, in part by the United States Environmental Protection Agency and the North Carolina Department of Environment, Health and Natural Resources, through the Albemarle-Pamlico Estuarine Study."

"Contents of the publication do not necessarily reflect the views and policies of the United States Environmental Protection Agency, the North Carolina Department of Environment, Health, and Natural Resources, nor does mention of trade names of commercial products constitute their endorsement by the United States or North Carolina Government."

A/P Project 89-02

21
509:5421

900234

ACKNOWLEDGEMENTS

The authors would like to acknowledge all the Division of Marine Fisheries personnel and other individuals who answered surveys and questions concerning information needed for this A/P project. Thanks are also extended to M. Wolff, L. Mercer, D. Spitsbergen, W. Cole, S. Winslow, E. Noble, J. Merriner, K. West, D. Ahrenholz and W. Hogarth for their critical review of this report and to D. Willis and D. Tootle for their typing of this final report. The matching funds were provided by the North Carolina Department of Natural Resources and Community Development, Division of Marine Fisheries.

ABSTRACT

The North Carolina Division of Marine Fisheries' (DMF) mission is to manage the coastal fisheries for the optimum benefit of all of North Carolina's citizens. Management requires the evaluation of the status of stocks under given conditions (stock assessments). Information needed for these assessments includes stock identification, catch (landings, effort, and biological samples), and life history. Available data collected by the DMF come from long term monitoring programs (commercial and recreational statistics, fisheries catch sampling, and surveys) and short term research. Gaps in the available data are identified and species are prioritized based on commercial and recreational landings, jurisdiction, current problems and environmental considerations. Recommendations to fill the data gaps are based on data needs, data availability, and priorities. These recommendations include, but are not limited to: continue monitoring programs to collect landings, effort, age and size composition and year class abundance; conduct stock assessments and update them regularly; allocate the time and resources needed to conduct these analyses; implement mandatory commercial fisheries trip ticket reporting; and initiate biological sampling of hard clams and estuarine gill net fisheries.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	ii
ABSTRACT	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	v
INTRODUCTION	1
MANAGEMENT GOALS	2
NEEDED FISHERY DATA	5
AVAILABLE FISHERY DATA	
Commercial Statistics	9
Recreational Statistics	10
Fishery-Dependent Sampling	10
Fishery-Independent Surveys	10
Tagging Studies	11
Biological Studies	11
Licenses and Permits	12
SPECIES AND DATA PRIORITIES	12
DATA GAPS AND RECOMMENDATIONS	
Stock Assessment Programs	20
Commercial Fisheries Data	20
Recreational Fisheries Data	22
Fishery Independent Data	22
Life History and Stock Identification Data	23
REFERENCES	25
GLOSSARY	26
APPENDIX: Review of DMF Surveys	27

LIST OF TABLES

	Page
1. ASMFC and MFCMA plans which affect North Carolina fisheries	4
2. Management objectives for the principal marine and estuarine species (species groups) of North Carolina	6
3. The availability of the basic data needed for stock assessments for economically important finfish, crustaceans and mollusks in North Carolina	13
4. Criteria for establishing species priorities	18
5. Species priorities for research and monitoring work by the North Carolina Division of Marine Fisheries	19

INTRODUCTION

Over one-half of the U.S. commercial fisheries catch is comprised of estuarine dependent species. The proportion of estuarine dependent species in North Carolina landings exceeds 90% annually (Street and McClees 1981). Total North Carolina commercial landings for 1988 were 192.7 million pounds of finfish and shellfish (crustaceans and mollusks), with a dockside value of \$77.8 million. This value represents the money fishermen received for their catch before any further value is added by packing, freezing, processing, marketing, etc. Comparable estimates of recreational landings and their contribution to North Carolina's economy are not available; however, it has been estimated that recreational fishing in the South Atlantic (North Carolina to Florida) in 1980 resulted in retail sales in excess of \$870 million, not including multiplier effects (Centaur Assoc., Inc. 1985). North Carolina's largest estuary is the Pamlico-Albemarle Sound system. Landings of edible finfish and shellfish and their dockside value in the counties surrounding this system account for approximately two-thirds of the state's edible seafood landings and value.

The North Carolina Division of Marine Fisheries (DMF) is charged with the stewardship of the state's marine and estuarine living resources. The DMF's approach is to gain sufficient knowledge of the fish and fisheries to be able to determine the reasons for trends and changes in abundance and catches, and to use that knowledge to guide and evaluate regulation of the fisheries. In management, the Division seeks to blend biological information with economic and social information to achieve optimal utilization of the resources in the long-term. To be reasonable and successful, management must consider the complexities involved in multi-year, mixed species fisheries which may span several management agencies with varying authorities and management philosophies.

The DMF has developed long-term monitoring and data-collection programs in order to provide biological information needed for management decisions. These data are compiled, entered on the Division's computerized database, and analyzed to provide management recommendations to the North Carolina Marine Fisheries Commission (MFC), which has regulatory authority over the marine and estuarine fisheries.

Data needs for fisheries management are based on why and how the MFC and DMF exercise control over the fisheries. There are a number of reasons why we manage, including: (1) to maintain and enhance stock levels (2) to restore depleted stocks levels, (3) to increase the use of under-utilized resources by the commercial/recreational industry, (4) to provide the opportunity for the commercial and recreational fishing industries to be economically viable, (5) to provide the opportunity for recreational fishermen to enjoy their sport, and (6) to insure optimal levels and variety of seafood to consumers. Knowing why we manage fisheries stocks, we can determine how we manage. Fisheries management involves: (1) establishing goals and objectives for each fishery or species complex, (2) developing a plan with appropriate measures to attain the goals and objectives, (3) implementing the plan through conversion of

measures into appropriate management actions, (4) measuring the effectiveness of management towards achieving the goals and objectives by monitoring and assessing results of the actions, and (5) designing flexibility into the process to accommodate changes from unforeseen factors.

In order to translate the "why's" of management into specific actions, the initial "how" steps must be accomplished; that is, establish goals and objectives and develop procedures. This project was conducted to accomplish these two steps, with four specific objectives:

1. Develop management goals and objectives for North Carolina's coastal fishery resources;
2. Define the fishery data needed for stock assessments;
3. Identify and evaluate existing data; and
4. Recommend appropriate adjustments to existing data collection activities and additional data which need to be collected

Key terms used in this report, such as "management", "research", "development", etc. are defined in the Glossary of the report.

MANAGEMENT GOALS

The general mission of the DMF is to manage the coastal fisheries for the optimum benefit of the citizens of North Carolina. It must be remembered that research, monitoring, assessment, development and enhancement activities can be conducted on the fisheries resources and habitat, but regulation and enforcement can apply only to the people using the resources. The DMF must consider the resource, the habitat, and the various users when making management decisions.

North Carolina General Statutes specifically authorize the Department of Natural Resources and Community Development to "collect such statistics, ... and research data as is necessary or useful to the promotion of sports and commercial fisheries in North Carolina and the conservation of marine and estuarine resources generally; conduct or contract for research programs..." (General Statute 113-181). The DMF is the arm of the Department which carries out this duty. Collection of fisheries statistics is specifically provided by General Statute 113-163. A shellfish management program is authorized by General Statute 113-204. Cooperative agreements with public and private entities "in the overall best interests of the conservation of marine and estuarine resources..." are authorized by General Statute 113-224. Membership in the Atlantic States Marine Fisheries Commission, which provides a medium of interstate coordination, is provided by General Statute 113-252. Participation in the required Fishery Management Council is authorized by Federal law, PL 94-265.

Based on the Division's legal authority and stated mission, six general management goals are given below:

1. To maintain or increase fisheries productivity through conservation of fisheries habitat and stocks
2. To guide wise resource utilization through preparation and implementation of state fishery management plans and improved regulatory and enforcement activities
3. To improve and expedite management decisions by conducting carefully planned research and monitoring of the fisheries resources, habitat, user groups, and harvest methods
4. To promote conservation of the resources and habitat through increased interaction with resource users, including a marine resources education program
5. To improve all aspects of interjurisdictional fisheries management, both intrastate and interstate, by cooperating with other North Carolina agencies and the universities, the marine fisheries management agencies of other Atlantic coast states, the Atlantic States Marine Fisheries Commission (ASMFC), the Atlantic Coast regional Fishery Management Councils, and federal fisheries agencies
6. To provide public access to fisheries resources through development of specific access facilities in cooperation with other governmental entities

Fishery management plans (FMPs) have been prepared for species of importance to North Carolina through two organizational entities: (1) The Interstate Fisheries Management Program of the ASMFC, and (2) the regional Fishery Management Councils under the Magnuson Fishery Conservation and Management Act of 1976 (MFCMA, PL 94-265). The ASMFC program is concerned with species for which the predominant harvest occurs within internal waters of various coastal states and/or the Territorial Sea (the area extending offshore for three nautical miles from the ocean beach). Plans prepared by the Councils concern species harvested predominantly within the Exclusive Economic Zone of the United States (that area between three and two hundred nautical miles offshore). Table 1 lists the FMPs affecting North Carolina fisheries which have been prepared by the ASMFC and the Councils.

A total of 18 different objectives were identified in these nine ASMFC and six MFCMA plans, several of which were specific for a single plan. Four objectives could be considered as generic because they appear in more than half of the plans. These objectives are:

1. Maintain spawning stock(s) sufficient to minimize possible recruitment failure
2. Promote cooperative collection of biological, economic, and social data required to monitor and assess the stocks and plan implementation

Table 1. ASMFC and MFCMA plans which affect North Carolina fisheries.

ASMFC	Year approved	MFCMA	Year approved
Striped bass	1981	Coastal pelagics (king and Spanish mackerel, cobia, and others)	1982
Atlantic menhaden	1982	Reef fish (snappers, groupers porgies, seabass, etc.)	1983
Summer flounder	1982	Sea scallops	1983
Weakfish	1984	Atlantic mackerel, squid, and butterfish	1983
		Atlantic swordfish	1985
American and hickory shad, river herring	1984	Summer flounder	1988
Red drum	1985	Atlantic billfish	1988
Spotted seatrout	1985		
Spot	1987		
Atlantic croaker	1987		

3. Promote research which increases understanding of the species and its fishery
4. Promote harmonious use of the resource among user groups

Another objective (Promote environmental standards necessary to maximize natural production of the species.) was included in seven plans. None of the other objectives were included in more than four plans.

Based on the above review of existing management plan objectives, the following general objectives are established for management of North Carolina's economically important coastal fisheries:

1. Maintain spawning stocks sufficient to minimize possible recruitment failure
2. Collect biological, economic, and social information necessary to monitor the stocks and assess condition of the stocks and fisheries
3. Promote research necessary to fill identified gaps in knowledge needed to make decisions concerning the stocks and fisheries
4. Promote environmental standards necessary to maintain the stocks and their dependent fisheries
5. Promote harmonious use of the fisheries resources among the various user groups
6. Conduct research, promulgate and enforce regulations, and take other steps (such as stocking) to promote rebuilding of depressed stocks
7. Promote actions, such as habitat modification, which contribute to maintenance and improvement in the status of stressed stocks.

The first five objectives pertain to all economically important species while objectives #6 and #7 only apply to certain species (Table 2).

NEEDED FISHERY DATA

It is critical that adequate fishery-dependent data (data collected from the fisheries harvests), as well as fishery-independent data (data collected by sampling the stock directly), be available to fisheries resource managers. These data are needed so that decision makers can take into account the condition of the fish stocks and the potential effect on these stocks of actions being contemplated. For the purposes of this report, needed data are defined as the data needed to complete stock assessments. For assessment of stocks which reside entirely in North Carolina, the data needed include all the data identified below. For stocks which reside in an area greater than North Carolina, the data needed only includes information relevant to the period in which the stock is in North Carolina. Although important to

Table 2. Management objectives for the principal marine and estuarine species (species groups) of North Carolina.

Species	Objectives*						
	Spawning stock	Monitor	Research	Environment	Harmony	Stock recovery	Enhancement
Bluefish	x	x	x	x	x		
Catfish	x	x	x	x	x		
Croaker	x	x	x	x	x		
Red drum	x	x	x	x	x		
American eel	x	x	x	x	x		
Summer flounder	x	x	x	x	x	x	
Southern flounder	x	x	x	x	x		
Harvest/butterfish	x	x	x	x	x		
Hickory shad	x	x	x	x	x		
King mackerel	x	x	x	x	x		
Kingfish	x	x	x	x	x		
Menhaden	x	x	x	x	x		
Mulletts	x	x	x	x	x		
Porgies	x	x	x	x	x		
River herring	x	x	x	x	x		
Black seabass	x	x	x	x	x		
Weakfish	x	x	x	x	x		
Spotted seatrout	x	x	x	x	x		
American shad	x	x	x	x	x	x	
Sharks	x	x	x	x	x		
Snapper/grouper	x	x	x	x	x		
Spanish mackerel	x	x	x	x	x		
Spot	x	x	x	x	x		
Striped bass	x	x	x	x	x	x	
Tilefish	x	x	x	x	x		
Tunas	x	x	x	x	x		
White perch	x	x	x	x	x		
Blue crabs	x	x	x	x	x		
Shrimps	x	x	x	x	x		
Hard clams	x	x	x	x	x		x
Oyster	x	x	x	x	x		x
Bay scallops	x	x	x	x	x	x	
Calico scallops	x	x	x	x	x		

*Spawning stock = Maintain spawning stocks sufficient to minimize possible recruitment failure

Monitor = Collect biological, economical and social information necessary to monitor the stocks and assess condition of the stocks and fisheries

Research = Promote research necessary to fill identified gaps in knowledge needed to make decisions concerning the stocks and fisheries

Environment = Promote environmental standards necessary to maintain the stocks and their dependent fisheries

Harmony = Promote harmonious use of the fisheries resources among the various user groups

Stock recovery = Conduct research, promulgate and enforce regulations, and take other steps (such as stocking) to promote rebuilding of depressed stocks

Enhancement = Promote actions, such as habitat modification, which contribute to maintenance and improvement in the status of stressed stocks

fisheries management, other data needs (socioeconomic, environmental) are beyond the scope of this study. Data needed for stock assessments are well defined (Gulland 1966, 1969, 1983; Ricker 1975, Caddy and Bazigos 1985, Pauly 1984). The data needs vary slightly among species, and specific differences are taken into account when identifying the data availability and gaps later in this report. The basic data needs for stock assessments are identified by the following categories:

- I. Stock Identification
- II. Catch (landings, effort, and biological samples)
 - A. Commercial
 - B. Recreational
 - C. Bycatch
- III. Fishery-Independent Surveys
 - A. Juvenile
 - B. Adult
- IV. Life History
 - A. Mortality (natural, fishing, total)
 - B. Reproductive Parameters (fecundity, age at maturity)
 - C. Age and Growth
 - D. Movements and Migration

Stock Identification - Managers must be able to identify the group of fish that is being affected or which management practices will affect. A common problem is that fisheries data are used to calculate population parameters without considering if the species effectively constitutes a unit stock (Gulland 1983). The assumption of one stock is invalid, if in actuality, a fishery is based on several stocks or only part of a stock.

Many times a combination of data sources are needed to identify a stock adequately. Methods to examine possible stock separation include (Gulland 1983):

- 1. Distribution of fishing
- 2. Spawning areas
- 3. Values of population parameters

4. Morphological and physiological characteristics
5. Mark/recapture studies
6. Biochemical techniques

The method that can give the clearest evidence of stock separation is mark/recapture studies (Gulland 1983). The ideal method is to tag in two areas simultaneously with potential return rates equal throughout the area of interest. Tagging studies can also determine migration patterns, and when and at which age fish occur in different fisheries that may be exploiting the same unit stock. Frequently, tagging projects are expensive and return rates are low, so combinations of other available data are used to help delineate separate stocks.

Catch Data - Data for the determination of trends, stock status, and fishery models come primarily from commercial fisheries, with additional data from recreational fisheries and fishery-independent surveys. Fishery-dependent data provide the greatest amount of data at the lowest cost to management agencies. These data are extremely important, but caution must be taken during data collection because it relies on subsampling and input from the non-scientific community, sometimes leading to inaccurate data. Types of data used by stock assessments collected from commercial and recreational fisheries include total catch, effort, and biological data.

Catch data must be a reliable estimate of the quantity harvested. All removals from a stock, including bycatch from other fisheries, need to be identified. Many times discards are ignored, leaving the full impact of fishing unknown (Gulland 1983). Although landings data are important, alone they can only indicate major changes in abundance, since the amount of fishing in many fisheries is greatly influenced by weather and market conditions.

The amount of fishing (effort) is a measure of the cost of fishing and of the fishing mortality coefficient. As with total catch, all effort on a stock needs to be identified. It is often difficult and impractical to derive total effort on a fishery, so effort is usually estimated from data on part of the fishery (Gulland 1983). Data needed to identify effort include craft specifications, areas fished, depth caught, gear type, and time fished (Caddy and Bazigos 1985). When effort data are available and the unit of effort for which the catchability coefficient is most nearly constant, it is possible to calculate on average catch-per-unit-of-effort (CPUE). This is one of the most vital population parameters, especially when fishery-independent data are not available. The CPUE can be used in a variety of analyses, including estimating changes in stock abundance (Ricker 1975). In most assessments some effort data will have to be used in the analyses.

Biological data from commercial and recreational fisheries are important to stock assessments by providing indicators of stock condition and in analyses and population modelling. These data include age, size (length and weight), sex, and others (Ricker 1975, Gulland 1983). Biological data are needed for each fishery affecting a stock. These data can be used to develop

age-length keys and length-weight relationships, and to provide information needed to calculate the total number of each age caught, which is needed for cohort analysis, a modelling technique. Growth rates, age at maturity, natural mortality rates, reproductive rates, and time and location of spawning are examples of other data that can also be obtained or calculated from catch data.

Fishery-Independent Data - The final source of fisheries data is through fishery-independent surveys. These include monitoring surveys to produce indices at regular intervals of juvenile and/or adult relative abundance and surveys to produce estimates of absolute or relative abundance. The surveys are extremely beneficial because they supply indices of abundance (CPUE) relatively free of changes in the catchability coefficient and the problems surrounding the collection of fishery-dependent data. Surveys are also a good source of biological data and can provide data pertaining to habitat use, and abiotic and/or biotic factors affecting stock distribution and abundance.

Life-History Data - Data on mortality, reproductive parameters, age, growth, and movements are important to stock assessments. Most of these data can be obtained in concert with collecting stock identification, fishery-dependent, and fishery-independent data. These data are also collected through special short term research projects.

The data described above can be used for stock assessments by calculating population parameters and/or developing population models. Parameters estimated include growth, abundance, mortality (fishing, natural, and total), fecundity, recruitment, and rate of reproduction as it relates to stock density. These population parameters can be used to develop population models calculating such outputs as yield-per-recruit, maximum sustainable yields, and others (Ricker 1975, Gulland 1983).

AVAILABLE FISHERY DATA

Fishery-dependent and fishery-independent data on major North Carolina fisheries are available from a variety of sources, including the North Carolina Division of Marine Fisheries, National Marine Fisheries Service (NMFS), North Carolina Wildlife Resource Commission (NCWRC), and others. Information includes short-term research, such as fecundity and food habit studies, and long-term monitoring programs which collect data on annual relative abundance, age structure, and other population parameters. The DMF is the major source of these data which have been collected by a wide variety of projects (Appendix I). The major groups of data collected by the DMF are summarized below.

Commercial Statistics

Commercial fisheries statistics are collected by state and federal port agents on a voluntary basis from seafood dealers and processors under a cooperative state/federal program. Data collected include landings by species (pounds and value), type of gear, waterbody of capture, distance from shore,

weekly shrimp catch and effort, and monthly estimates of the number of trips (nominal effort) for major North Carolina fisheries.

Recreational Statistics

Recreational catch statistics are available from the NMFS Marine Recreational Fisheries Statistics Survey, which was standardized in its present form in 1979. Its main purpose has been to provide reliable regional (Gulf, South Atlantic) estimates of catch, effort, and participation. This survey also collects limited biological and socioeconomic data. Beginning in 1987, the DMF expanded the sampling program to obtain statistically valid recreational catch estimates for North Carolina using the same survey design. The survey consists of telephone interviews and intercept interviews which, when combined, produce estimates of recreational catch by species, fishing effort, and participation by mode (party/charter boat, private/rental boat, shore/pier). In addition, data on area of fishing are obtained through the intercept interviews, but estimates of catches by area are not statistically valid.

Fishery-Dependent Sampling

The DMF conducts several coastwide biological sampling programs of the major commercial fisheries. The objectives of these programs are to obtain relative abundance, distribution, species and age compositions and size distribution on an annual basis to aid in the development of management plans and regulations. Sampling includes the following fisheries:

1. Long haul seine fishery
2. Winter trawl fishery
3. Sciaenid pound net fishery
4. Ocean sink net fishery
5. Reef fish and coastal pelagics fisheries
6. Albemarle Sound area shad and river herring fisheries
7. Albemarle Sound area striped bass fisheries
8. Mechanical clam fishery (CPUE estimates only)

Fishery-Independent Surveys

The DMF conducts several fishery-independent surveys within North Carolina waters. The objectives of these programs are to provide an index of relative abundance for important species, age and growth data, and distribution. These surveys provide information on year class strength and/or biological data on species not adequately sampled from the commercial or recreational fisheries. These programs include:

1. Shrimp monitoring
2. Bay scallop monitoring
3. Wild oyster survey
4. Oyster spatfall sampling
5. Juvenile nursery area survey
6. Striped bass juvenile survey
7. Red drum juvenile survey
8. River herring and shad juvenile survey
9. Pamlico/Albemarle sounds survey
10. Nearshore ocean survey conducted by the South Carolina Wildlife and Marine Resources Department from Cape Hatteras to Cape Canaveral (under a cooperative state/federal program called SEAMAP)

In addition, the National Marine Fisheries Services conducts a standardized trawl survey from the Gulf of Maine to the Cape Hatteras-Cape Lookout area.

Tagging Studies

Tagging studies conducted in North Carolina are used to increase the knowledge of migration patterns, distribution, stock identification, exploitation rates, mortality, and growth rates. These studies depend on cooperation from fishermen to return the tags and from other states' fisheries agencies and the NMFS which conducts some region-wide tagging programs. The current DMF tagging projects include:

1. American shad (ocean)
2. Striped bass (Phase II and adult)
3. Summer flounder
4. Spanish and king mackerel
5. Red drum

Biological Studies

As needed, the DMF conducts biological studies to answer specific questions. These studies include stock identification, age and growth, sexual maturity, fecundity, and others. Species presently being studied include red drum, weakfish, king and Spanish mackerel, summer flounder, blue crab, and striped bass.

Licenses and Permits

License and permit data come from commercial fishing vessel license applications and applications for specific fishing activities requiring free DMF permits, such as pound nets and mechanical clamming. License data include vessel descriptions (required) and information on gear used on the licensed vessel (often incomplete). Permit data include area and equipment information. Such data are useful when examining issues concerned with fishing effort.

Species-specific data availability was established by a preliminary survey of fishery workers followed by a review of literature, fishery management plans, ongoing programs, and consultation with biologists knowledgeable about specific species and fisheries. Data from other sources, state, federal, and university organizations, which collect fisheries related data were considered. The availability of data takes into account the quantity, quality (consistency, sampling design) and the region in which the stock occurs (interstate or intrastate). The amount of data available for each economically important species is estimated in Table 3.

SPECIES AND DATA PRIORITIES

Previous sections of this report have considered types of data needed for management decisions, ongoing Division of Marine Fisheries data collection activities (and some other agencies' work), and gaps in the available data. Existing data and data gaps must be matched with the needs for information for decisions by management authorities. Priorities can then be established relative to species and data.

To establish priorities, economically important species (or species groups) were evaluated according to the set of criteria shown in Table 4. These criteria acknowledge the self-interest of the State of North Carolina; that is, species over which the state has greatest jurisdiction are of greatest interest to management because state actions can potentially have the most significant impact. The evaluation process assumed that high landings (commercial and recreational) indicate species of interest to a greater portion of the public than species with a low harvest. Priorities were determined by project personnel using available recreational and commercial landings data, information from council and interstate fishery management plans, experience with regulatory issues considered by the North Carolina Marine Fisheries Commission, and two surveys: one including all DMF biological and administrative personnel, MFC members, and knowledgeable non-DMF personnel, and the other including senior DMF personnel alone. Based in the above analysis, species priorities are shown in Table 5.

All data types discussed in this report are important to stock assessments. Due to constraints (time, personnel, cost) it is impractical to activity collect all data at this time. For this reason we have prioritized data into two groups with the highest priority assigned to monitoring (recreational, commercial and fishery-independent data) data and lower

Table 3. The availability of the basic data needed for stock assessments for economically important finfish and shellfish in North Carolina.*

Data type	Bill-fishes	Blue - fish	Catfish (fresh-water)	Croaker	Red drum	Ameri-can eel	Summer flounder	Southern flounder
Stock Identification	S	A	S	S	S	.	S,P	S
Recreational Fisheries								
Catch	S	S,E	E	S,E	S,E	S,E	S,E	S,E
Effort	S	S,E	E	S,E	S,E	E	S,E	S,E
Biological samples	S	S,E	E	S,E	S,E	E	S,E	S,E
Commercial Fisheries								
Catch	N/A	A	S,E	A	S,E	S,E	A	A
Effort	N/A	S,E	.	S,E	S,E	.	S,E	.
Biological samples	N/A	S,E	.	A	S,E	.	A	S,E
Fishery-Independent Survey								
Juvenile	.	S	S	A	A	S	S,P	A
Adult	.	S	S	S,P
Life History								
Natural mortality	S	S	.	S	S	.	S	.
Reproductive parameters	S	S	.	S	S	S	S	.
Age and growth	S	A	S	A	A	S	A	.
Movement	S	S	S	A	A	.	A	S

* . = no data available and no project directed to obtain these data.
 S = some data available
 E = project needs expansion or modification to obtain needed data
 A = adequate data available
 P = project in place to collect data
 N/A = not applicable

Table 3. (continued)

Data types	Harvest- fish/ butter- fish	Hickory shad	King mackerel	King- fish (Menti cirrus)	Menhaden	Mullet	Porgies	River herring
Stock Identification	.	S	A	S	A	.	.	S
Recreational Fisheries								
Catch	N/A	S,E	S,E	S,E	N/A	S,E	S,E	S
Effort	N/A	S,E	S,E	S,E	N/A	S,E	S,E	.
Biological samples	N/A	S,E	S,E	S,E	N/A	S,E	S,E	S
Commercial Fisheries								
Catch	S	S	S,E	S	A	S	S	A
Effort	S	.	S,E	.	A	.	S,P	A
Biological samples	S	A	S,E	S	A	.	S,P	A
Fishery-Independent Survey								
Juvenile	S	S	S,P	S,P	S,E	S	.	A
Adult	S	.	.	P	.	P	.	S
Life History								
Natural mortality	S	.	S	.	A	.	S	S
Reproductive parameters	.	S	S,E	.	A	.	S	A
Age and growth	S	A	S,P	.	A	.	S	A
Movement	.	S	P	.	A	.	S	A

. = no data available and no project directed to obtain these data.
S = some data available
E = project needs expansion or modification to obtain needed data
A = adequate data available
P = project in place to collect data
N/A = not applicable

Table 3. (continued)

Data types	Black Seabass	Weakfish	Spotted seatrout	American shad	Sharks	Snapper/ Grouper	Spanish mackerel
Stock Identification	.	S,P	S	A	.	.	S
Recreational Fisheries							
Catch	S,E	S,E	S,E	P	S	S,E	S,E
Effort	S,E	S,E	S,E	P	S	S,E	S,E
Biological samples	S,E	S,E	S,E	.	S	S,E	S,E
Commercial Fisheries							
Catch	S,P	A	S	S	S	S,P	S,E
Effort	S,P	S,P	S	E	.	S,P	S,E
Biological samples	S,P	A	S	A	S	S,P	S,E
15 Fishery-Independent Survey							
Juvenile	.	S,P	S	S	.	.	S,P
Adult	.	S	.	.	S	.	.
Life History							
Natural mortality	.	S,P	.	S	.	S	S
Reproductive parameters	.	S	.	A	.	S	.
Age and growth	S,P	A	S	A	.	S	S,P
Movement	.	.	.	P	S	S	P

. = no data available and no project directed to obtain these data.
S = some data available
E = project needs expansion or modification to obtain needed data
A = adequate data available
P = project in place to collect data
N/A = not applicable

Table 3. (continued)

Data types	Spot	Striped bass	Tile-fishes	Tunas	White perch	Blue crab	Shrimp	Hard clam
Stock Identification	S	A	.	.	S	S	S	A
Recreational Fisheries								
Catch	S,E	S,P	S,E	S,E	S,E	.	S	.
Effort	S,E	S,P	S,E	S,E	E	.	.	.
Biological samples	S,E	S,P	S,E	.	E	.	.	.
Commercial Fisheries								
Catch	S,E	S,P	S	S	S	A	A	A
Effort	S,E	.	.	.	S	.	S,E	S,E
Biological samples	A	A	S	.	S	.	.	.
¹⁵ Fishery-Independent Survey								
Juvenile	A	A	.	.	S	S	A	.
Adult	S,P	.	.	.	S	S	S	.
Life History								
Natural mortality	S	S	.	.	.	S	A	S
Reproductive parameters	S	A	.	.	.	A	A	S
Age and growth	A	A	S	.	S	A	A	S
Movement	S	A	.	S	S	S	A	N/A

.

S = some data available

E = project needs expansion or modification to obtain needed data

A = adequate data available

P = project in place to collect data

N/A = not applicable

Table 3. (continued)

Data types	Oyster	Bay scallop	Calico scallop
Stock Identification	A	S	S
Recreational Fisheries			
Catch	.	.	
Effort	.	.	N/A
Biological samples	.	.	N/A
Commercial Fisheries			
Catch	S	S	S
Effort	.	S,E	.
Biological samples	.	.	S,E
17 Fishery-Independent Survey			
Juvenile	S,E	S,E	S,E
Adult	S,E	S,E	S,E
Life History			
Natural mortality	S	S	.
Reproductive parameters	A	A	S
Age and growth	A	A	A
Movement	N/A	N/A	N/A

. = no data available and no project directed to obtain these data.
S = some data available
E = project needs expansion or modification to obtain needed data
A = adequate data available
P = project in place to collect data
N/A = not applicable

Table 4. Criteria for establishing species priorities.

A. <u>Jurisdiction</u>	
Entirely under DMF/MFC	Higher
or	
Interstate management plans	
or	
Council/federal authority	
or	
International management	Lower
B. <u>Commercial Landings</u> (1986-1988)	
Mean > 10×10^6 pounds	Higher
or	
Mean > 10^6 pounds	
or	
Mean < 10^5 pounds	Lower
C. <u>Commercial value</u> (ex-vessel-1986-88)	
Mean > $\$10^5$	Higher
or	
Mean < $\$5 \times 10^5$	Lower
D. <u>Recreational landings</u> (1984-87)	
Mean > 10^6 fish	Higher
or	
Mean < 10^5 fish	Lower
E. <u>Existing FMP recommending</u> <u>action by state of NC</u> Research/monitoring and/or Regulation/enforcement	
F. <u>Problems</u>	
Com'l landings (1986-1988) below 1974-76 level	Equal
and/or	value
Rec landings below 1979-82 level	
and/or	
Significant MFC regulatory activity during 1986-1988	
or	
Perceived social problems	
G. <u>Environmental considerations</u> Pollution/habitat alteration probably affecting stock/fishery	

Table 5. Species priorities for research and monitoring work by the North Carolina Division of Marine Fisheries.

<u>High</u>	Hard clam Summer flounder Southern flounder	Striped bass Blue crab Oyster
<u>Medium-high</u>	Bluefish Atlantic croaker Red drum Spanish mackerel River herring King mackerel	Spot Shrimp Bay scallop Menhaden Weakfish
<u>Medium-low</u>	Spotted seatrout Snapper/Grouper Mullet	American shad White perch Black seabass
<u>Low</u>	Freshwater catfish American eel Harvestfish/ butterfish Hickory shad Kingfish Porgies	Sharks Tilefish Tunas Calico scallop Billfishes

priority assigned to data from short term research or data collection programs (stock identification and life history data). For the species identified as having high and medium-high priority recommendations for all data types are made, while for species of medium-low priority only recommendations for monitoring data are made, and no recommendations are made for low priority species. Although no recommendations are made for the low priority species, many of the proposed recommendations for higher priority species will partially or fully fill many of the data gaps for these species.

DATA GAPS AND RECOMMENDATIONS

Upon evaluation of needed data, available data, and priorities, data gaps have been identified and needed improvements and additions to current DMF programs are identified. Recommendations are made for the DMF stock assessment program and major data types.

Stock Assessment Program

The most important elements needed for stock assessments are a continuous long-term database of landings, effort, age and size composition, and year class abundance data. The DMF has monitoring programs to acquire a good portion of these data. It is critical that these monitoring programs, with modifications and additions described in this report be continued, along with regular analyses and interpretation of resulting data. Analyses are needed to provide up-to-date assessments of fishery stocks' status and to ensure that the goals and objectives of projects are being met efficiently.

In general, data analyses by the DMF are limited to descriptive analyses or are lacking. Because of this lack, evaluation of the data's quality for this report has been limited and frequently impossible. The benefits of efficient projects and up-to-date stock assessments for regulatory decisions would more than compensate for the resources needed to complete these tasks. Also, being able to anticipate and act upon potential crises before they happen will allow the DMF and MFC to better protect the fishery resources with and mitigate some impacts on the resources and users. To ensure the future existence of the long-term DMF database described above and the analyses needed to provide up-to-date stock assessments, as well as to and ensure that projects are being conducted efficiently, the following recommendations are made:

- * Continue the monitoring programs in existence with modifications and additions described in this report
- * Conduct regular analyses and interpretation of data
- * Provide the time and personnel trained in population dynamics needed to conduct these analyses and interpretations.

Commercial Fisheries Data - Gaps within commercial fisheries catch data are related to the quality (accuracy and/or precision) of the landings estimates and effort data. Statewide catch estimates are adequate at this time. For

species in which a more defined catch estimate, in terms of area, is needed, the data quality is not known and may be insufficient. These data gaps are due to the DMF/NMFS Commercial Fisheries Statistics Program's inability to control or measure the data's quality because it depends on a voluntary reporting program by dealers whose current view of the DMF varies widely affecting the degree of cooperation received by DMF in data collection. Effort data are lacking or limiting for species, except for menhaden and river herring, due to limited information on trips. To improve the landings estimates and increase the amount of effort data, the sampling program needs to be modified by implementation of mandatory trip ticket reporting with spot inspections to identify under-reporting.

A group of biologists, the DMF statistician, and other fishery workers need to study other states' reporting methods and design an implementation plan to adopt mandatory trip ticket reporting. This study must be done with extreme caution to prevent the mandatory information from being unreliable. These modifications would provide the catch estimates for species needing data on a regional basis and increase the amount and quality of effort data needed for stock assessments. This modification would also allow the DMF to drop special surveys of effort such as the mechanical clam telephone survey and the aerial survey for mechanical clamming and bay scallop dredging effort. Spot inspections can be integrated into the biological sampling of the commercial catch. The oyster and hard clam hand gear fisheries do not lend themselves to trip ticket reporting. An additional survey will have to be implemented to obtain effort. A recommendation would be to conduct a telephone survey of hand oyster fishermen and hard clambers to assess CPUE and total effort.

The data gaps in the commercial catch sampling program are due to the lack of age composition data and limited or no sampling of some fisheries. No sampling is currently done on the clam, oyster, shrimp bycatch, and most types of estuarine gill net fisheries.

Initiation of a clam house survey modelled after the other DMF commercial fisheries sampling programs would supply continual age and size data needed for hard clam stock assessments. Oyster biological sampling would be better done within the scope of a proposed fishery independent survey (wild oyster survey). Shrimp bycatch for which data are lacking, comprises an unknown part of juvenile mortality for many important finfish and needs to be included for in stock assessments. Field sampling is impractical due to the manpower and expense of data collection. Recommendations are to incorporate sampling into future gear development studies involved with finfish and/or turtle excluder devices. Also recommended to fill commercial catch sampling data gaps is modification of adult finfish sampling program to include the estuarine gillnet fisheries.

Age composition data for specific species, fisheries, and seasons are not consistently available for most species due to limited reading of hardparts and/or the lack of a consistent sampling program to collect these data. The DMF biological staff is now attempting to age the backlog of data. Once this task is completed the data need to be evaluated to determine if the sampling

intensity is correct and if samples are adequate within specific size classes for each species, season, and/or fishery. A sampling program should provide data sufficient to generate age-length keys for each species, season, and the major fishery or group of fisheries in which differences or not age-dependent.

The following specific recommendations are made:

- * Initiate mandatory trip ticket reporting combined with spot inspections to identify under-reporting.
- * Initiate a telephone survey of hand clammers and oyster fishermen
- * Initiate a clam house survey
- * Incorporate the collection of shrimp bycatch data into future finfish and turtle excluder gear tests
- * Initiate biological sampling of estuarine the gill net fisheries
- * Age the backlog of data, evaluate data, and ensure that correct sampling programs exist to provide specific age-length keys

Recreational Fisheries Data

The gaps in data for catch and effort for most species are related to problems in obtaining accurate data from the telephone survey and a need for catch estimates on less than a statewide basis. Initiation of a sportfishing license would provide a sampling frame for the telephone survey, as well as other needed surveys. The DMF lacks authority to start such a program. Expansions of the recreational fisheries data program are needed to obtain catch, and biological data on a more local (water body) basis for species such as striped bass, white perch, croaker, spot, and weakfish. Also recreational catch sampling of blue crabs, oyster, clams, bay scallops and shrimp needs to be incorporated into this program. Specific recommendations are given below:

- * Initiate a sport fishing license for finfish and shellfish
- * Expand the current survey to include data for clams, blue crabs, oysters, bay scallops, and shrimp
- * Expand the current survey to supply waterbody catch data for striped bass and other species

Fishery-Independent Data

The data gaps in fishery-independent data are a result of not knowing the adequacy of a program due to its short-term database (DMF sounds survey, SEAMAP nearshore survey), lack of analyses, or no directed sampling for a species. Recommendation for most species depend on the results of ongoing analysis and new data. Recommendations would most likely include the expansion of the sounds survey, modification of other surveys, and/or the re-

design of the juvenile survey program. All new and revised programs should have a statistically sound design, such as the stratified random sampling design. Good design will allow the DMF to evaluate the project and determine if the objectives are being met in an efficient manner.

Species for which new surveys are needed and can be identified without any further data or analyses include hard clams and wild oysters. Recommendations are to implement a standard hard clam adult/recruit survey and a wild oyster survey. These surveys would provide data on recruitment, survival, age, growth, and other needs to complete stock assessments.

Specific recommendations are:

- * Evaluate the juvenile surveys and other ongoing programs as the data become available to determine needed modifications to current surveys
- * Design and implement a hard clam adult/recruit survey
- * Design and implement a standard method for a coast-wide wild oyster survey

Life History and Stock Identification Data

Gaps in life history data and stock identification for medium-high and high priority species not filled by recommendations already made exist. Reproductive data for bluefish, Atlantic croaker, southern flounder, Spanish and king mackerel, spot, summer flounder, red drum, weakfish and hard clams are lacking. The collection of these data can be incorporated into ongoing catch-sampling and fishery-dependent programs. Also, cooperation with the university of North Carolina Institute of Marine Science to determine population parameters of hard clams must be continued.

Stock identification and/or movement data are limited for Atlantic croaker, spot, weakfish, summer and southern flounder, red drum, shrimp, and blue crabs. A stock identification program for Atlantic croaker and southern flounder needs to be implemented in cooperation with other states by developing tagging programs, using biochemical techniques, and/or other methods. Existing shrimp and blue crab data needs to be evaluated to determine population parameters, information on stock identification, and movements. If needed, new tagging studies will have to be conducted.

Specific recommendations are:

- * Incorporate the collection of maturity and/or fecundity data into catch sampling programs for bluefish, Atlantic croaker, summer and southern flounder, spot, red drum, weakfish, king and Spanish mackerel, and hard clams
- * Develop a stock identification study for Atlantic croaker and southern flounder

- * Analyze existing shrimp and blue crab tagging data and make appropriate recommendations

The above recommendations will provide the data needed to fill the specified gaps. As data are collected and analyzed, additional gaps will be identified and adjustments to data collecting programs made. This scoping study is only the beginning and needs to be followed up by annual evaluations of data availability needs, and priorities.

As stated earlier in this report, the biological sampling programs of DMF are conducted ultimately to provide bases for making and evaluating regulatory decisions by the MFC and DMF. The results of the various programs must be evaluated regularly, and recommendations provided to the DMF Director and the MFC. In order to focus biological sampling, analyses, and reporting into a coherent system, preparation of state fishery management plans is strongly recommended.

REFERENCES

- Caddy, J.F., and G.P. Bazigos. "Practical Guidelines for Statistical Monitoring of Fisheries in Manpower Limited Situations," FAO Fish. Tech. Paper No. 257, 86 pp., 1985.
- Centaur Assoc., Inc. "Economic Activity Associated with Marine Recreational Fishing in 1980," Sport Fishing Institute, S/K Contract No. NA 82AA-H-00054, 169 pp., 1985.
- Gulland, J.A. "Manual of Sampling and Statistical Methods for Fisheries Biology, Part 1," Sampling Methods, FAO/Whitefriars Press Ltd., London. 87 pp., 1966.
- "Manual of Methods for Fish Stock Assessment, Part 1," Fish Population Analysis, FAO/St. Paul's Press Ltd., Malta. 154 pp., 1969.
- Fish Stock Assessment, A Manual of Basic Methods, Wiley, New York. 223 pp., 1983.
- Pauly, D. "Fish Population Dynamics in Tropical Waters: A Manual for Use with Programmable Calculators," ICLARM Studies and Reviews, 8, 325 pp., 1984.
- Ricker, W.E. "Computation and Interpretation of Biological Statistics of Fish Populations," Bull. Fish. Res. Bd. of Canada, 191, 382 pp., 1975.
- Street, W.M., and J.D. McClees. "North Carolina's Coastal Fishing Industry and the Influence of Coastal Alterations," p. 238-251. In Richardson, C.J. (Ed) Pocosin Wetlands, An Integrated Analysis of Coastal Plain Freshwater Bogs in North Carolina. Hutchinson Ross Publ. Co., Stroudsburg, PA. 364 pp., 1981.

GLOSSARY

The meaning of certain key terms must be clearly understood in order to utilize this report. Seven terms are defined below:

- Management - all activities concerned with maintenance or enhancement of fisheries resources and utilization of those resources, including the habitat producing the resources
- Research - systematic study undertaken to determine factual information and to test hypotheses
- Monitoring - systematic collection of specified data over a long term
- Assessment - evaluation of the status of a situation or stock under given conditions
- Development - to increase utilization of a resource by taking specific actions
- Enhancement - to increase or improve the status of a resource by taking specific actions
- Conservation - wise use

A P P E N D I X

Review of North Carolina Division of Marine Fisheries (DMF) Surveys.

REVISED: 14 November 1988

Program	Project name	Funding source	Period covered	Freq. of collection	Description	Data access-ability	Estimated data on file	Contact person	Comments
A. Statistics For additional info. see DMF reports numbers 28, 29, 76, 84, 85, 91, 95, 98, 118, 122, 128, 137, 145, 160, 175, 188, 190	1. Commercial Landings Bulletin	State, SFFMP	1978-Present	Monthly	Commercial pounds landed and exvessel value by species, county, gear, water, state caught off, and distance from shore	NMFS SEFIN database on Burroughs 7800	24,000 records/year	Paul Phalen	
	2. Detailed Commercial Shrimp Landings	State, SFFMP	1978-Present	Weekly	Commercial pounds landed and exvessel value for shrimp species only by county, gear, water, grading and vessel category. Includes effort - no. of trips, days out of port, days fished	NMFS SEFIN database on Burroughs 7800	9,000 records/year	Paul Phalen	
	3. River Herring	SFFMP	1978-Present	Weekly	Commercial pounds and exvessel value for alewives/blueback by county, gear and water. Includes no. of pound nets fished in Chowan River	DMF-not computerized	-		Sara Winslow
	4. No. of Winter Trawl Trips	State/SFFMP	10/81-Present	Monthly	Estimate of trips by county from expansion of trip count from selected vessels to total vessels in the fishery	DMF-not computerized	50 records/year	Paul Phalen	
	5. Number of Long Haul Trips	State/SFFMP	09/80-Present	Monthly	Estimate of trips by county from expansion of trip count from selected crews to total crews in the fishery	DMF-not computerized	75 records/year	Paul Phalen	
	6. Market News Reports	State/SFFMP	1979-Present	Weekly	Estimate of pounds landed and \$/lb for major species by districts in the state	DMF-not computerized	52 reports/year	Paul Phalen	
	7. General Canvas Operating Units	State/SFFMP	1979-Present	Annual	Number of full-time and part-time commercial fishermen, no. of fishing craft and quantity of gear used. Collected by county	NMFS	350 records/year	Ken Harris (NMFS)	

Review of NC DMF Surveys (Continued).

Program	Project name	Funding source	Period covered	Freq. of collection	Description	Data accessibility	Estimated data on file	Contact person	Comments
A. Continued	8. General Canvas Wholesale and Processing Survey	State/SFFMP	1979-Present	Annual	Survey on the number of plants (name and location) type of products produced and number of persons employed	NMFS	600 records/year	Ken Harris (NMFS)	
	9. Marine Recreational Fishery Statistics Survey (MRFSS)	WB/NMFS	1987-Present	Bi-monthly	Dual Survey methodology of telephone calls (Total effort) and creel interviews (Species CPUE) to estimate total State recreational catch by species for two month time intervals	DMF-MRFSS data file on SIPS IBM mainframe	8,000 intercepts and 10,000 telephone calls/year	Paul Phalen	
	10. Commercial Marine Vessel Licenses	State, SFFMP	1974-Present	Annual	Name and address of commercial vessel license holders and associated vessel and gear characteristics (1982 forward only)	DMF License database on-line SIPS IBM mainframe	24,000 records/year	Mary Jo Roberts	
29	11. Commercial Seafood Dealer Licenses	State	1962-Present	Annual	Name, address, and type of license (crab, shrimp, finfish, etc.) by county	DMF word processor	800 records/year	Mary Jo Roberts	1985 to current on display-writer
	12. Pound Net Registration	State	1985-Present	Annual	Name, address, and location of set, includes Loran readings for inshore and offshore stakes	DMF Pound Net database, online on SIPS IBM mainframe	500 registrations/year	Juanita Gaskill	
	13. Oyster, Scallop, and Clam Licenses	State	1985-Present	Annual	Name, address, type of fishermen and gear used.	DMF Shellfish license database on SIPS IBM mainframe	14,000 license/year	Mary Jo Roberts	

Review of NC DMF Surveys (Continued).

Program	Project name	Funding source	Period covered	Freq. of collection	Description	Data accessibility	Estimated data on file	Contact person	Comments
A. Continued	14. Mechanical Clam Harvest Permits Program 645	State	1985-1987	Annual	Administrative information (name, address, etc.) and a weekly random telephone sample of permit holders to obtain catch/effort	DMF word processor and DMF biological database on SIPS IRMS mainframe	300 permits/year and 1,500 biological records/year	Don Freeman	Not done in 87/88 due to Red Tide 3,225 samples on biological file data
	15. Artificial Reef Catch Survey	WB	1987	Annual	Voluntary mail-in of fishing information (data, location, effort, species numbers and sites) from artificial reefs by recreational fishermen	DMF not computerized		Liz Noble	Discontinued due to lack of response fishermen
	16. Sportfishing Awards	State	1974-Present	Annual	Data on eligible species over a minimum weight, includes length, weight, fishing method, etc. DMF took over the program in 1987.	DMF PC in dBase file	3,000/year	Suzanne Hill	
	17. Pier Licenses	State	1984-Present	Annual	Name, address, location, length, etc. of commercial piers.	DMF word processor	31/year	Mary Jo Roberts	

Review of NC DMF Surveys (Continued).

Program	Project name	Funding source	Period covered	Freq. of collection	Description	Data accessibility	Estimated data on file	Contact person	Comments
B. Anadromous For additional info. see DMF reports numbers 27, 35, 36, 45, 46, 47, 48, 52, 53, 54, 55, 60, 61, 62, 64, 65, 69, 70, 71, 75, 80, 81, 83, 92, 93, 101, 102, 103, 105, 106, 112, 113, 114, 116, 121, 123, 126, 131, 138, 139, 126, 131, 132, 146, 150, 151, 153, 154, 156, 158, 157, 165, 169, 170, 178, 179, 181,	1. Juvenile Anadromous Program 100	PL89-304	1972-Present	Monthly	Seasonal survey to obtain environmental and species data (number, length), catch per effort data	DMF biological database on SIPS IBM mainframe	12,419 samples	Sara Winslow	
	2. Adult Anadromous Program 150	PL89-304	1973-1983, 1987-Present	Daily, Biweekly	Determine spawning areas by presence of ripe adults	DMF biological database on SIPS IBM mainframe	2,882 samples	Sara Winslow	Seasonal-March-May
	3. Egg and Larval Survey Program 160	PL89-304	1973-1984, 1987-Present	Daily, Biweekly	To determine areas of spawning by presence of eggs and larvae	DMF biological database on SIPS IBM mainframe	1,578 samples	Sara Winslow	Seasonal-March-May
	4. Alosid Commercial Harvest Program 400, 410	PL89-304	1972-Present	Weekly Monthly (Striped bass)	Weekly age, sex, and size composition of the commercial anadromous fishery, Albemarle Sound area, February-May only. Include striped bass after 1981. Program 400 is American shad, hickory shad and striped bass (culled). Program 410 is alewife and blue back (unculled).	DMF biological database on SIPS IBM mainframe	1,781 samples	Sara Winslow	Seasonal
	5. Striped Bass Commercial Harvest Program 420	PL89-304	1972-1981	Monthly	Data on age and size and sex frequency of striped bass in the commercial harvest (February-May 1972-1977, year round since July 1977) (AFS-14)	DMF biological database on SIPS IBM mainframe	180 samples	Sara Winslow	1976-1981 on database
	6. Anadromous Inshore Inshore Tagging Program 300	PL89-304	1973-Present	Seasonal	Migration, utilization, and mortality of striped bass, alewife, blueback herring Phase II striped bass stocking began in 1980	DMF biological database on SIPS IBM mainframe	1,032 samples	Sara Winslow	Data estimate only thru '87

Review of NC DMF Surveys (Continued).

Program	Project name	Funding source	Period covered	Freq. of collection	Description	Data accessibility	Estimated data on file	Contact person	Comments
B. Continued	7. Striped Bass Ecology	PL89-304, WRC	1982-1987	Bidaily	Distribution, predators and food analysis for larval striped bass in Albemarle Sound	East Carolina University (ECU) microcomputer	-	Roger (ECU)	Seasonal-Rulifson May-June
	8. Striped Bass CPUE (Logbooks and Boat Count) Program 421, 422	PL89-304	1977-1980	Monthly	Commercial harvest and gill net effort data for striped bass in the Albemarle Sound area	DMF biological database on SIPS IBM mainframe	3,483 samples	Sara Winslow	
	9. Offshore "Dan Moore" Survey Program 700	PL89-304	1968-1981	Monthly	Federal aid work to determine abundance, size distribution, areal distribution, and tagging	Bridge logs on biological database	2,230 samples	Frank Holland	Seasonal-January-May; All data coded, 107 samples on biological file
	10. Gill Net By-Catch Program 928	PL89-304	1984-1986	Monthly	In the Albemarle area various gill net mesh sizes are evaluated to determine their effect on species, size, age, and sex composition. Catch/effort is also obtained. (AFS-23)	DMF biological database on SIPS IBM mainframe	968 samples	Lynn Henry	
	11. Fyke Net Study	NCRI	1988-Present	Seasonal	Various mesh sizes fished to determine feasibility for white perch fishing and release of striped bass.	DMF biological database (planned)	?	Lynn Henry	Seasonal-spring and fall
	12. Ocean Shad Tagging	PL89-304	1989	Seasonal	Tagging of shad in Cape Fear area to determine migration.	To be stored DMF biological database (planned)	?	John Schoolfield	Seasonal January-March

Review of NC DMF Surveys (Continued).

Program	Project name	Funding source	Period covered	Freq. of collection	Description	Data accessibility	Estimated data on file	Contact person	Comments
C. Coastal Finfish For additional info. see DMF reports numbers 4, 5, 7, 8, 15, 17, 24, 26, 32, 37, 41, 50, 67, 68, 74, 76, 78, 84, 85, 86, 95, 96, 97, 100, 104, 107, 108, 117, 120, 121, 122, 125, 127, 129, 130, 133, 134, 140, 141, 142, 143, 144, 149, 152, 161, 167, 168, 182, 184, 192	1. Sciaenid Pound Net Fishery Program 431, 441	PL88-309,IJA	1978-Present	Monthly	Collect species, age, and size composition data on the fishery	DMF biological database on SIPS IBM mainframe	310 samples	Jeff Ross	
	2. Winter Trawl Fishery Program 433, 443	PL88-309,IJA	1979-Present	Monthly	Collect species, age, and size composition data on the fishery	DMF biological database on SIPS IBM mainframe	532 samples	Jeff Ross	
	3. Long Haul Seine Fishery Program 437, 447	State, PL88 309, IJA	1978-Present	Monthly	Collect species, age, and size composition data on the fishery	DMF biological database on SIPS IBM mainframe	841 samples	David Moye	
	4. Sink Net Fishery Program 434, 444	PL88-309,IJA	1982-Present	Monthly	Collect species, age, and size composition data on the fishery. Southern area sampling began in 1987.	DMF biological database on SIPS IBM mainframe	495 samples	Jeff Ross	
	5. Beach Seine Fishery Program 435, 445	PL88-309	1982, 1983, 1986	Monthly	Collect species, age, and size composition data on the fishery	DMF biological database on SIPS IBM mainframe	16 samples	Jeff Ross	
	6. Croaker Tagging Program 350	PL88-309	1982-1985	Monthly	Determine migration, utilization, mortality and stock identification of croaker	DMF biological database on SIPS IBM mainframe	96 samples	Jess Hawkins	
	7. Red Drum Assessment Program 360, 930, and 123	State, WB	1983-Present	Seasonal	Determine migration and utilization of red drum (tagging 1983-present; beginning in 1987 determine nursery areas, begin juvenile monitoring, determine age at maturity, spawning period and fecundity	DMF biological database on SIPS IBM mainframe	(tag only)	399 samples	Jeff Ross

Review of NC DMF Surveys (Continued).

Program	Project name	Funding source	Period covered	Freq. of collection	Description	Data access-ability	Estimated data on file	Contact person	Comments
C. Continued	8. Ageing Samples Program 930	State	Prior to 1982 and after 1984	Monthly	Various ageing data (flounder, croaker, spot, etc.) not stored with the original collection	DMF biological database on SIPS IBM mainframe	326 samples	Rick Monaghan	Data estimate thru '85 only
	9. Flounder Pound Net Fishery Program 432, 442	State	1979-1982	Monthly	Collect species, age, and size composition data on the fishery	DMF biological database on SIPS IBM mainframe	27 samples	Frank Holland	
	10. Inshore Flounder Tagging Program 330	State, WB	1980-1982; 1986-Present	Seasonal	Determine migration and utilization of Paralichthid flounders; WB project for summer flounder only	DMF biological database on SIPS IBM mainframe	361 samples	Rick Monaghan	
	11. Flounder Net Mesh Selectivity	State, PL88-309	1980-1981	Seasonal	Look at the effects of various mesh sizes on the size composition of the flounder fishery	DMF- not computerized	30 samples	Frank Holland	
34	12. DMF Owned Sampling Gear For Adult Finfish Program 170, 180	CZM	1980	Monthly	DMF fished its own long haul seine in an attempt to obtain unbiased samples	DMF-not computerized	4 samples	Paul Phalen	
	13. DMF Eel Pot Sampling Program 175	PL88-309	1979-1980	Monthly	Determine CPUE and obtain otoliths for ageing. Destructive sampling was not allowed in the commercial fishery	DMF-not computerized	-	Sara Winslow	
	14. Albemarle Area Non-Anadromous Adult Finfish Surveys Program 115, 430, 440	PL88-309	1978-1980	Monthly	Determine areas of spawning for white perch, catfish, and eels, species and size composition of commercial harvest, and migration information	DMF-not computerized	-	Sara Winslow	
	15. Finfish Samples From Crab Trawl Fishery Program 470	State	1979-1982	Monthly	Collect finfish data from the crab trawl fishery	DMF-not computerized	6 samples	Jess Hawkins	

Review of NC DMF Surveys (Continued).

Program	Project name	Funding source	Period covered	Freq. of collection	Description	Data accessibility	Estimated data on file	Contact person	Comments
C. Continued	16. Scrapfish Study Program 450	PL88-309	1969-1971	Weekly	Determine finfish by-catch in the shrimp fishery	DMF-not computerized	-	Maury Wolff	
	17. Industrial Fish Survey Program 765	State	1968-1969	Seasonal	"Dan Moore" used in cooperation with NMFS to look at species composition of scrapfish in offshore fisheries	Bridge logs on tape	-	Maury Wolff	43 samples on biological files
	18. Dan Moore Flounder Survey Program 705	State	1968-1981	Monthly	Migration, abundance, species and size composition, and tagging	Bridge logs on tape	540 samples	Frank Holland	34 samples on biological files
	19. Dan Moore Exploratory Fishing Program 720	State	1969-1977	Monthly	Onslow and Raleigh Bays ground fish survey to determine trawlable bottom	Bridge logs on tape	280 samples	Frank Holland	59 samples on biological files
	20. Dan Moore Gear Testing Program 725	State	1968-1979	As Needed	Design and testing of mid-water trawls, etc.	Bridge logs on tape	105 samples	Frank Holland	3 samples on biological files
	21. Dan Moore Diving Survey Program 740	State	06/80	Once	In Onslow Bay to check diving versus trawling to determine reef fish species composition	DMF biological database	2 samples	Frank Holland	
	22. BCF Schoolfish Survey Program 745	Federal	1970	Once	Contract with NMFS to complete mid-water transects from Cape May to Charleston, from beach to 100 miles	Bridge logs on tape	-	Frank Holland	
	23. Demersal Survey Program 755	State	1969	Monthly	Roller rig testing in Onslow and Raleigh Bays	Bridge logs on tape	95 samples	Frank Holland	9 samples on biological files
	24. SEAMAP Gear Testing	SEAMAP/NMFS	1985	Once	Calibration of standard sampling gears between states and NMFS	SC Marine Resources	-	Dianne Stephan	
	25. Bluefish PCB	State/NMFS	1985	As needed	Tissue samples sent to NMFS for PCB analysis	NMFS Sandy Hook	-	Jeff Ross	

Review of NC DMF Surveys (Continued).

Program	Project name	Funding source	Period covered	Freq. of collection	Description	Data accessibility	Estimated data on file	Contact person	Comments
C. Continued	26. Bioprofile sampling of Reef Fish Species 438, 448	SFFMP,IJA	1983-Present	Monthly	Biological samples from fishery taken for species composition, size distribution. Fishermen interviewed for CPUE. Estimate number of trips by port for selected fisheries (Reef Fish and Coastal Pelagic).	DMF-Biological database on SIPS IBM mainframe	1,945 samples	Fritz Rhode	
	27. Coastal Pelagics Program 439, 449, 451, 370, 380	SFFMP/WB	1984-Present	Monthly	Life history data for king and Spanish including fish house and tournament sampling for CPUE and size; tagging for migration; fecundity; ageing	DMF biological database on SIPS IBM mainframe	2,445 samples	Liz Noble	
	28. NCSU Fish Disease	State	1985-Present	Monthly	Field samples from pound nets and trawls are taken to determine prevalence of <i>U. mycosis</i> in Pamlico River. Changed to cast nets in 1988	NCSU	?	Jess Hawkins (Ed Noga NCSU)	
	29. Flynet Mesh Selectivity Study	State	1988	Seasonal	Randomized block design of control versus 5 different codend sizes to determine selectivity factors and 50% retention length for target species (weakfish, spot, croaker, spotted sea trout, kingfish, bottomfish, and bluefish)	To be stored on DMF biological database	-	Rick Monaghan	

Review of NC DMF Surveys (Continued).

Program	Project name	Funding source	Period covered	Freq. of collection	Description	Data accessibility	Estimated data on file	Contact person	Comments
D. Critical Habitat For additional info. see DMF reports numbers 43, 57, 58, 76, 84, 85, 95, 99, 109, 121, 122, 124, 155, 171, 172, 173, 174, 176, 177, 180, 183, 185, 186, 187, 191,	1. Juvenile Stock Assessment Program 120	State, CZM, PL88-309	1970-Present	Monthly	Environmental data and relative abundance of estuarine species, primarily in nursery areas. In 1986 tissue samples taken for baseline data on incidence of fish diseases (Estuarine Fish Health Survey) In 1987 blue crab sampling combined with this program	DMF biological database on SIPS IBM	29,713 samples	Rick Monaghan	
	2. Fish Kills Program 910	State	1964-Present	As Needed	Environmental data, species identification, and estimated numbers of fish killed	DMF-not computerized	-	Ed McCoy	
	3. Freshwater Intrusion Study Program 130	SeaGrant, CZM	1977-1980	Weekly	Comparison of altered and unaltered sites to assess relative productivity	DMF biological database on SIPS IBM mainframe	1,440 samples	Jess Hawkins	3 times per wk. during peak growth period of species
	4. Vandemere Creek Study Program 125	State	1982	Weekly	Short term fluctuation of species abundance in a "nursery area"	DMF biological database on SIPS IBM mainframe	312 samples	Jess Hawkins	Summer Intern Project
	5. Orchard Creek Study Program 126	State	1983	Weekly	Fluctuation of species abundance from day to night	DMF biological database on SIPS IBM mainframe	186 samples	Jess Hawkins	Summer Intern Project
	6. Albemarle-Pamlico Sound Survey Program 195	State	1987-Present	Quarterly	Environmental data distribution, movement and relative abundance of estuarine species, sampling in the sounds, Neuse River and Pamlico River	DMF biological file on SIPS IBM mainframe	208 samples/yr	Dianne Stephan/ David Moya	

Review of NC DMF Surveys (Continued).

Program	Project name	Funding source	Period covered	Freq. of collection	Description	Data accessibility	Estimated data on file	Contact person	Comments
D. Continued	7. Carolina Coast Pamlico River Survey Program 190	State	1985-1986	Seasonal	Environmental data and relative abundance of blue crabs and older finfish, monitor tail bag size on catch of estuarine species	DMF biological database on SIPS IBM mainframe	187 samples	Jess Hawkins	
	8. SEAMAP Bottom Mapping	SEAMAP	1985-1986	-	Pilot study to design standards for a regional live bottom database	Duke IBM-PC dBase files	-	Steve Ross NCSU	
	9. Shallow Water Offshore Trawl Survey Program SM-18	SEAMAP	1986	(once)	Environmental data and relative abundance of species between 5 fathom contour and shoreline.	Data stored by SC Wildlife and Marine Resource Department		Dianne Stephan	Cooperative similar surveys performed in SC & GA waters by SC & GA
	10. Inlet/Open Beach Comparison Program SM-18	SEAMAP	1987	Tri-weekly	Environmental data and relative abundance of species between 5 fathom contour and shoreline at inlets and along adjacent open beaches.	Data stored by SC Wildlife and Marine Resource Department		Dianne Stephan	Cooperative similar surveys performed in SC & GA waters by SC & GA
	11. Artificial Reef Descriptions	WB/State	1986-Present	As needed	Administrative data on NC artificial reefs including location, material, cost, dates of construction, buoy maintenance, etc.	DMF PC in dBase files	71 reefs	Steve Murphey	

Review of NC DMF Surveys (Continued).

Program	Project name	Funding source	Period covered	Freq. of collection	Description	Data accessibility	Estimated data on file	Contact person	Comments
E. Shrimp/Lobster	1. Juvenile Shrimp Sampling Program 510	State, PL88-309	1966-Present	As Needed	Size distribution and relative abundance of shrimp in the upper estuarine areas	DMF biological database on SIPS IBM mainframe	11,066 samples	Don Freeman	
For additional info. see DMF reports numbers 3, 12, 14, 15, 18, 21, 31, 33, 34, 39, 40, 42, 51, 63, 73, 87, 90, 147, 164, 166,	2. Shrimp Tagging Program 520	State, PL88-309	1966-1974, 1984-1986	Seasonal	Population dynamics data for pink and brown shrimp	DMF biological database on SIPS IBM mainframe	30 samples	Don Freeman	
	3. Mixed Penaeid Study	SFFMP	1975-1976	Biweekly	RV Raleigh Bay used to trawl for shrimp under a S/F project	DMF-not computerized	-	Dennis Spitsbergen	
	4. Dan Moore Rock Shrimp Survey Program 715	State, PL88-309	1971-1973, 1977-1980	Monthly	Location, relative abundance, and size distribution of rock shrimp	Bridge logs only on tape	170 samples	David Taylor	15 samples on biological files
	5. Dan Moore Lobster Survey Program 730	State, Coastal Plains Regional Commission	1968-1973	Monthly	Distribution, size, migration, sex ratios, etc. for American lobster	Bridge logs only on tape	210 samples	Frank Holland	
	6. TED Testing Program 560	State, p188-309	1985, 1987, 1988	As needed	Testing the effectiveness of a Trawling Efficiency Device at reducing finfish by-catch in the shrimp harvest. Data includes species and size composition of the catch.	DMF- not computerized	30/year	Frank Holland	
	7. Pink Shrimp Program 518	State	1987	Weekly	Night towing of ocean and Core Sound stations to determine differences in relative abundance of pink shrimp as as indicator of migration	To be stored DMF biological database on SIPS IBM mainframe	240 samples	Don Freeman	0 samples on biological file
	8. APES Separator Trawl Testing Program 565	EPA	1987	Seasonal, weekly	Test the effectiveness of a Scottish trawl separator device at reducing finfish by-catch in Pamlico Sound shrimp fishery	DMF biological database on SIPS IBM mainframe	76 samples	David Moye	August-November

Review of NC DMF Surveys (Continued).

Program	Project name	Funding source	Period covered	Freq. of collection	Description	Data accessibility	Estimated data on file	Contact person	Comments
F. Blue crab For additional info. see DMF reports numbers 6, 10, 15, 23, 25, 44, 66, 77, 84, 95, 119, 121, 122, 163	1. DMF Crab Trawl Sampling Program 540	State	1980-1987	Monthly	Determine abundance, distribution and growth of blue crabs in estuarine areas through DMF trawl sampling. In 1987 combined with Program 120.	DMF biological database on SIPS IBM mainframe	2,042 samples	Sean McKenna	
	2. DMF Crab Pot Sampling Program 530	State	1982	Weekly	Cull ring study to determine effectiveness in retention of legal sized crabs, peeler retention, etc.	DMF biological database on SIPS IBM mainframe	154 samples	Sean McKenna	
	3. Crab Tagging Program 550	State, CZM	1980-1982	Seasonal	Determine migration and utilization	DMF biological database on SIPS IBM mainframe	35 samples	Sean McKenna	1981-1982 only on database
	4. Commercial Crab Fishery	State, PL88-309	1976-1977, 1980	Seasonal	Sampled commercial crab pots to obtain size, sex and catch data on blue crabs	DMF-not computerized	-	Sean McKenna	
	5. Blue Crab Morphometric Study Program 532	State	1987-Present	Monthly	Variation of geographic and sexual blue crab morphological features, related to cull rings and peeler crab retention	DMF biological database on SIPS IBM mainframe	320 samples/year	Sean McKenna	
	6. Blue Crab Sentinal Study	State	08/87-10/87	Daily	Pamlico River caging study of blue crabs to examine occurrence of shell disease.	DMF-not computerized. Data contained in DMF report	?	Sean McKenna	

Review of NC DMF Surveys (Continued).

Program	Project name	Funding source	Period covered	Freq. of collection	Description	Data accessibility	Estimated data on file	Contact person	Comments	
41	6. Shellfish	1. Cultch Plantings Program 600	State, CPRC, PL88-309	1970-Present	Seasonal	Environmental and physical data taken to determine cultch sites. Planting done to increase the habitat available to settling oysters	DMF biological database on SIPS IBM mainframe	446 samples	Jeff French	Only data since 1981 on computer
		2. Spatfall Evaluation Program 610, 615	State	1970-Present	Semi-annual	Relative abundance and size of oysters on planted sites	DMF biological database on SIPS IBM mainframe	1,207 samples	Jeff French	Only data since 1981 on computer
		3. Oyster Recruitment Survey	State	1987	Weekly	Spat count on shell strings and French collectors over planted and natural sites. Data includes # of spat, sediment type, fouling organisms, etc., MAY-NOVEMBER	To be stored on DMF biological database	-	Beth Burns	
		4. Oyster Shoal Survey Program 625	State	1987-Present	Seasonal	Oyster bed data on abundance, morphometric measurements, substrate, etc.	To be stored on DMF biological database	-	Sean McKenna	Washington office
		5. Shellfish Relay Evaluation Program 618	State, PL88-309	1970-Present	Seasonal	Relay shellfish from closed polluted waters to open waters	DMF-not computerized	-	Mike Marshall	
		6. Shellfish Survey Program 630	CZM, State	1978-Present	As needed	Locate shellfish resources and estimate standing crop for water systems	DMF-not computerized	95 samples	Mike Marshall	
		7. Shellfish Lease Evaluations Program 660	State	1975-Present	As needed	Sample proposed lease sites to determine if they contain existing shellfish resources	DMF-not computerized	-	Mike Marshall	
		8. Bay Scallop Monitoring Program 697	State, PL88-309	1975-Present	Monthly	Size composition and distribution of bay scallops	DMF-not computerized	670 samples	Don Freeman	Data est. for 1975-1981 only

For additional info. see DMF reports numbers 1, 2, 9, 11, 13, 16, 19, 20, 22, 23, 30, 49, 56, 59, 66, 72, 76, 79, 84, 85, 88, 89, 94, 95, 110, 111, 115, 122, 148, 189

Review of NC DMF Surveys (Continued).

Program	Project name	Funding source	Period covered	Freq. of collection	Description	Data accessibility	Estimated data on file	Contact person	Comments
G. Continued	9. Seed Clam Study Program 620	CZM	1978	Seasonal	Determine effects of cultch covering on seed clam survival	DMF-not computerized	-	Fentress Munden	
	10. Clam Escalator Dredge Program 650	State	1970's-Present	As needed	Catch, effort and size data from commercial dredges in inland waterway	DMF-not computerized	-	Fentress Munden	
	11. Shellfish Bottom Mapping Program 635	State	1988-Present	Daily	Locate and estimate shellfish abundances. Field work in 1988 done in Roanoke Sound, Bogue Sound, and Masonboro Sound. All areas in state ranked qualitatively via shellfish criteria form.	Land Resources Information Sources GIS and DMF biological database of SIPS	612 samples	Mike Marshall	
	12. Clam House Sampling	State	1987	Seasonal	Fish house samples for CPUE, size distribution, location, harvest method, etc.	DMF-not computerized	360 samples/year	Don Freeman	
42	13. Dan Moore Calico Scallop Program 710	State	1969-1981	Annual	Location of beds and estimates of abundance, size distribution	Bridge logs on tape	1,150 samples	David Taylor	364 samples on biological file
	14. Carolina Coast Calico Scallop Program 695	State	1987-1988	Annual	Location of beds and estimates of abundance, size distribution	DMF biological database		24 samples Stephan	Dianne
	15. Dan Moore Clam Survey Program 750	State	1968, 1971	Annual	Exploratory fishing for quahogs using dredges	Bridge logs on tape	-	David Taylor	3 samples on biological file
	16. Dan Moore Squid Program 735	State, CPRC	1968-1973	Monthly	Exploratory fishing for squid	Bridge logs only on tape	50 samples	David Taylor	

Legend: SFFMP = State Federal Fishery Management Program
 SEFIN = Southeast Fisheries Information Network
 CZM = Coastal Zone Management
 EPA = Environmental Protection Agency
 NCRI = National Coastal Resources Institute
 The State Information Processing Service's (SIPS) IBM mainframe is a model 3090A
 NMFS = National Marine Fisheries Service
 CPRC = Coastal Plains Regional Commission
 WB = Wallop-Breaux
 IJA = Interjurisdictional Fisheries Act

Compiled by Katy West

