

The Southeast Area Monitoring and Assessment Program (SEAMAP): A State-Federal-University Program for Collection, Management, and Dissemination of Fishery-Independent Data and Information in the Southeastern United States

PETER J. ELDRIDGE

Introduction

The implementation of the Magnuson Fishery Conservation and Management Act of 1976 (MFCMA) substantially changed management practices for marine fisheries in the United States. The Act provided for the creation of eight Regional Fishery Management Councils with the specific responsibility of developing fishery management plans (FMP's) for marine resources within a 197-mile Fishery Conservation Zone (FCZ)—now known as the Exclusive Economic Zone (EEZ)—adjacent to the 3-mile U.S. territorial sea. The plans identify, for each fishery, the optimum yield which can be harvested annually, the allowed U.S. harvest, the total allowable level of foreign fishing, and the

rules and regulations governing foreign and domestic harvesting. National Standard No. Two of the Act requires that conservation and management measures recommended by the regional councils shall be based upon the best scientific information available.

Three of the councils are located in the southeastern United States: Gulf of Mexico, Caribbean, and South Atlantic. Their combined jurisdiction includes the offshore EEZ waters from Texas to North Carolina, and U.S. waters in the Caribbean. A total of thirteen FMP's have been implemented by the councils and about five more are under development. In addition, about ten State-Federal FMP's either have been implemented or are under development in the southeast. The State-Federal plans are

designed to manage species that migrate across state jurisdictions, but remain for the most part within the territorial sea, whereas plans developed by the councils are designed primarily for species that spend most of their life span in the EEZ, although it is acknowledged that many species are located both inside and outside the territorial sea, particularly as juveniles.

All major marine fishery management agencies are represented on the Fishery Management Councils and actively participate in managing EEZ marine resources. In the southeastern United States, these are the state fishery management agencies of Texas, Louisiana, Mississippi, Alabama, Florida, Georgia, South Carolina, and North Carolina, and those of the territories of Puerto Rico and the U.S. Virgin Islands; the Gulf (GSMFC) and Atlantic States Marine Fisheries Commissions (ASMFC); the U.S. Fish and Wildlife Service; the U.S. Coast Guard; and the National Marine Fisheries Service (NMFS). Plans for interstate fisheries within the territorial sea are developed under the auspices of the GSMFC and ASMFC.

A common deficiency encountered during the development of fishery management plans was inadequate or incomplete fishery-dependent (information based on statistics reported by commercial or recreational fishermen) and fishery-independent (information collected

ABSTRACT—*The Southeast Area Monitoring and Assessment Program (SEAMAP) is a state-federal-university program for collection, management, and dissemination of fishery-independent data and information in the southeastern United States. Major activities in the Gulf of Mexico and South Atlantic include shrimp and groundfish surveys, ichthyoplankton surveys, collection of environmental and benthic data, mapping of live and hard bottom areas, investigations of low-oxygen and other environmental perturbations, and the establishment of a regional, user friendly, data management system that can be accessed by all marine management agencies in the southeastern United States.*

Each SEAMAP component is directed by a Scientific Technical Committee under the guidance of their respective Fishery Management Boards in the Gulf of Mexico and Atlantic States Marine Fisheries Commissions. The Committees establish Work Groups to

plan and execute SEAMAP activities and submit annual budgets for program events. Committees are assisted by regional coordinators, a data manager, an ichthyoplankton curator, and numerous scientists recruited from participating agencies and universities. The program has been funded at \$1,000,000 annually.

Recent programmatic events include shrimp surveys from Perdido Bay, Ala., to Brownsville, Tex.; winter surveys to locate trawlable concentrations of coastal herrings (Clupeidae) in the northeastern Gulf; plankton surveys primarily directed toward bluefin tuna, Thunnus thynnus, eggs and larvae; larval red drum, Sciaenops ocellatus, surveys; near-shore trawling surveys in the South Atlantic; live and hard bottom mapping project in the South Atlantic; and the design and initial implementation of the regional SEAMAP information system.

P. J. Eldridge is an Operations Research Analyst with the Southeast Fisheries Center, Charleston Laboratory, National Marine Fisheries Service, NOAA, P.O. Box 12607, Charleston, SC 29412.

without direct reliance on such statistics) information. The State-Federal Regional Fishery Statistics Program in the southeast subsequently was formed by NMFS, the fishery commissions, and the states to address the collection, processing, and dissemination of fishery-dependent data; that program has been underway for 7 years and has markedly improved the collection of such data. A similar effort, SEAMAP, for the past 6 years, has collected, stored, and disseminated fishery-independent data.

SEAMAP Program Development

Shortly after the implementation of the Magnuson Act, it became evident to state and Federal fishery management agencies in the southeast that they would be closely involved in developing and monitoring: 1) Numerous management plans, 2) management measures designed to protect and conserve critical fishery habitat, 3) conservation and management programs for marine mammals and endangered species, and 4) programs to use underutilized fishery stocks more effectively. Agencies dealing with these activities depend on cooperative research and management programs, not only among themselves but also with their counterparts in academia and other governmental agencies directly or indirectly involved with managing living resources in the southeast region.

In June and July 1980, the NMFS Southeast Regional Office (SERO) sponsored a series of state-by-state meetings with state, Sea Grant, and Coastal Zone officials to determine needs for cooperative State-Federal planning. Initially, 174 projects were identified throughout the southeastern region. These projects were reduced to 45 that were concerned either with assessment activities or which would require assessment data. Because state and Federal management agencies recognized and supported the need to coordinate assessment and related activities in the southeast, the NMFS Southeast Fisheries Center (SEFC) implemented a Southeast Area Monitoring and Assessment Program (SEAMAP) with an initial task of construction of a Strategic Plan. The Strategic Plan was completed in 1981. Sub-

sequently, two SEAMAP Operations Plans—one for the Gulf of Mexico and one for the South Atlantic—were completed and implemented. The Gulf of Mexico SEAMAP effort was implemented in 1981 and the South Atlantic program in 1983.

Gulf of Mexico and South Atlantic Resources and Fisheries

Fish and shellfish stocks of the United States are an enormous renewable resource; the total reported U.S. commercial catch of fishery resources in 1986 was 6.0 billion pounds, with an ex-vessel (dockside) value of \$2.8 billion. Living marine resources in the southeastern United States support the largest individual U.S. commercial fisheries in volume (menhaden, *Brevoortia* spp.) and value (penaeid shrimp, *Penaeus* spp.).

In 1986, menhaden yielded 40 percent of the total poundage (2.4 billion pounds) and southeastern shrimp were worth \$623 million.

In 1985, over one-half of all marine angler trips along the Gulf and Atlantic coasts occurred in the South Atlantic and Gulf of Mexico (Anonymous, 1986). Although reliable statistics on sport-fishing value comparable to commercial statistics are not available, it is likely that the value of the recreational fishing sector, including supporting facilities and services, may equal or surpass that of the commercial sector.

The sustained growth in southeastern marine fisheries has generated employment for over 40,000 people in the region. The total economic impact of fisheries on the regional economy is difficult to estimate, but is assumed to be between three and six times the ex-vessel value of the landings, or \$2.8-5.6 billion. Table 1 details southeastern commercial landings, by states, for 1985 and 1986.

In addition to the economic contributions of the commercial fishing industry the demand for thrills, pleasure, and tests of skill has made marine recreational fishing another major source of economic revenue. Recently, statistics have been collected on catch and participation in recreational fisheries, and 1985 estimates (Anonymous, 1986) place the number of sport fishermen in

the southeast at 6.4 million. These fishermen caught over 222 million fish and spent roughly \$3 billion.

SEAMAP Overview

The basic philosophy and approach employed to implement the SEAMAP program is described in the SEAMAP Strategic Plan (Anonymous, 1981). A brief summary is provided here to orient the reader to the description of program accomplishments.

SEAMAP is designed to encompass all fishery-independent data collection activities in the southeast including those pursued by states, territories, and other Federal agencies in the southeastern region. The goal of the program is to maximize the efficiency of data collection and processing in order to provide the best data base possible for management decisions. Also, the program is designed to share and minimize costs among management agencies as well as to pool scientific expertise wherever appropriate. The program utilizes a variety of research platforms including vessels, aircraft, satellites, and observers on commercial fishing vessels. Common activities include trawling, hydrographic and plankton tows, sightings of species of special interests (i.e., turtles and marine mammals), development of regional data bases, and planning for annual field surveys.

SEAMAP projects survey marine and estuarine waters and their living resources within the territorial sea and EEZ contiguous to the southeastern states and territories, from Texas to North Carolina. Where necessary and appropriate, the scope may be expanded

Table 1.—Reported United States commercial landings for southeastern states, 1985-1986¹.

State	Landings, 1985		Landings, 1986	
	Thousand pounds	Thousand dollars	Thousand pounds	Thousand dollars
N.C.	214,871	64,589	168,885	63,435
S.C.	12,827	13,941	16,788	25,064
Ga.	17,241	20,887	15,476	24,501
Fla.	182,577	171,073	166,577	154,501
Ala.	29,559	40,664	36,690	63,988
Miss.	470,648	40,136	418,409	45,581
La.	1,704,498	229,134	1,699,321	321,514
Tex.	102,691	177,147	116,493	246,122

¹Landings are reported in round (live) weight for all items except univalve and bivalve mollusks, such as clams, oysters, and scallops, which are reported in weights of meats (excluding the shell) (Source: USDOC, 1987).

to include geographical areas outside these boundaries such as open ocean areas in the Gulf of Mexico for pelagic egg and larval surveys, and off the coast of Mexico for coastal stock surveys. Fisheries emphasized include those subject to joint State-Federal or council management, as opposed to those which fall exclusively under the jurisdiction of an individual state or other political entity. Also included are fishery-independent survey activities related to endangered species, especially sea turtles and marine mammals, as well as surveys designed to characterize habitats of critical interest to fishery managers, such as reef areas.

Because southeastern fishery management agencies are responsible for assessments of their marine resources, most SEAMAP activities and projects are directed toward assessment efforts. In particular, fishery management agencies are concerned about: 1) Causes of fluctuations of abundance and recruitment of commercially and recreationally important species, 2) improving understanding of the relationships between fisheries and habitat productivity, and 3) documenting impacts of man's activities on habitats and fishery resources.

Table 2 shows relationships between SEAMAP goals and sources of data. It illustrates that assessment activities can be combined into compatible sampling groups. For instance, bottom trawling, plankton sampling and hydrographic data can be taken sequentially on the same station, whereas it is impractical to combine trawling and purse seine operations on the same cruise. Based on prior survey experience in the southeastern United States, SEAMAP chose to concentrate its initial efforts on bottom trawling and benthic sampling. Plankton and environmental data were also selected to be surveyed in conjunction with trawling and benthic activities. Development of a regional SEAMAP data management system was given high priority to make survey information accessible and useful to participants and managers. In addition to surface vessels, submersibles and satellite remote sensing techniques have also been identified as appropriate sampling platforms, particularly for parameters such as temper-

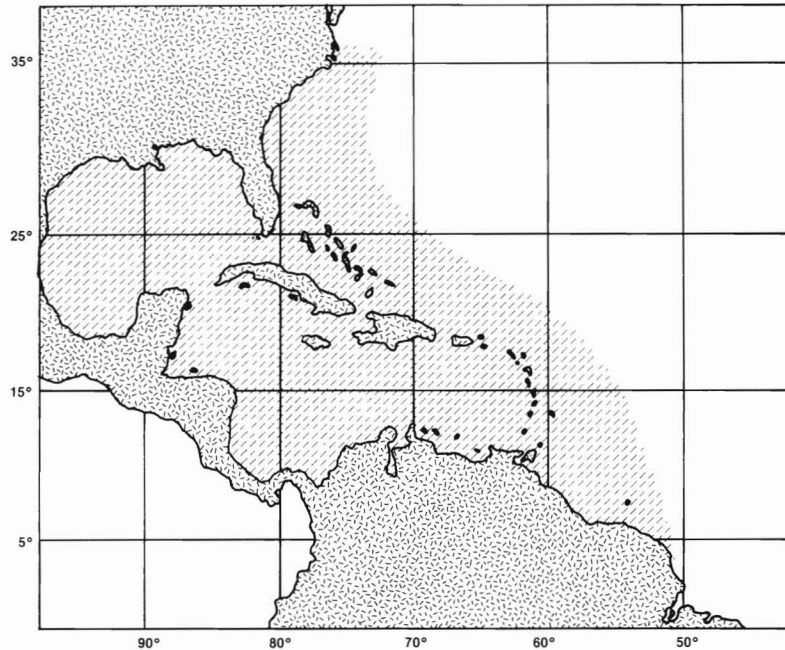


Figure 1.—Overall coverage needed for understanding of the southeastern marine ecosystem.

Table 2.—Primary (P) and secondary (S) sources of data to meet SEAMAP Goals.

Goals	Description	Activity Type															
		O	M	B	U	A	S	F	S	U	U	U	U	U	U	U	
I	Reef fish assessment	S	P		P	P	P	P	P	S							
II	Migratory pelagics assessment	S		S													
III	Oceanic pelagic assessment	S			P	P										S	
IV	Groundfish assessment	S	P			P											
V	Coastal herrings assessment	S	S	P	S	P				P	S	S					
VI	Coastal shrimp assessment	S	P			P											
VII	Spiny lobster and stone crab assessment	P				P	S									S	
VIII	Deepwater stock assessment	S	P		P	S	P	S	S								
IX	Precious coral assessment		S					P									
X	Marine mammals assessment	S								S	P	S					
XI	Marine turtles assessment	S	S	S						S	P	S					
XII	Describe resource environment	P	S	S	S	S	S	S	S							P	
XIII	Ecosystem structure studies	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	
XIV	Resource health monitoring	P	P	P	P	P	P	P	P	S					S	S	
XV	Maintain and disseminate data																P

ature, chlorophyll, and turbidity.

The geographic area that must eventually be surveyed to gain a complete

understanding of the dynamics of the southeastern marine ecosystem is vast (Fig. 1). Much of this region is outside

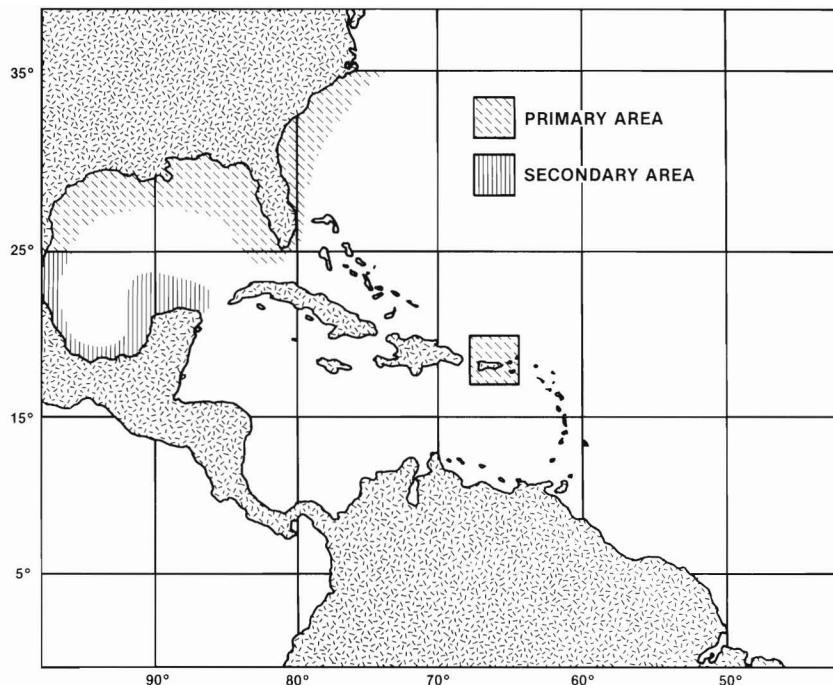


Figure 2.—Basic standardized surveys areas.

the sphere of U.S. jurisdiction and will have to be satisfied through cooperative agreement and coordination with foreign governments and international bodies or commissions. Conversely, most of the short-term specific requirements of the councils, and particularly of the states and commissions, can be met by assessment activities in areas contiguous to the southeastern United States and Caribbean territories. Survey activities in this region (Fig. 2) will provide much of the information necessary for process-oriented and dynamics studies, particularly those dealing with estuarine and coastal interactions.

Initially, SEAMAP concentrated its efforts on the U.S. territorial sea and contiguous zones. Many of these activities arose from research and management needs derived directly from council and State-Federal fishery management plans. For example, the "Texas Closure" in the Gulf Shrimp Plan led directly to a series of SEAMAP groundfish and shrimp cruises designed to evaluate the economic impacts of the closure as well as to help determine starting and ending dates of the closure.

Gulf SEAMAP Program Development

Chronology

Because of an impending need to obtain fishery-independent data upon which to base an evaluation of a major fishery management measure (the Texas Closure), the Gulf of Mexico was selected as the "test" area for SEAMAP. The Gulf of SEAMAP program was implemented in December 1981, under guidelines formulated by the Technical Coordinating Committee (TCC) of the GSMFC. Initial operations were to test the coordination, standardized collection, management, and dissemination of data from three classes of surveys—plankton, bottom trawl (shrimp/groundfish), and environmental.

Results of the initial SEAMAP operations were most encouraging. The shrimp/groundfish survey yielded data on offshore shrimp movements, which were used by Texas and the Gulf of Mexico Fishery Management Council in a cooperative seasonal closure of Texas territorial waters and the EEZ and, subsequently, evaluation of its

benefits to the fishery.

The initial ichthyoplankton survey, conducted cooperatively with Mexico, produced the most comprehensive regional collection of fish eggs and larvae ever acquired. Environmental data, collected in association with the ichthyoplankton surveys, produced a Gulf-wide data base that is being used to describe the distribution and abundance of the region's resources. Survey activities were summarized in 1982 and 1983 Environmental and Biological Atlases, 1982 and 1983 SEAMAP Ichthyoplankton Atlases, and numerous reports and other publications.

Other key activities of the program's first year included:

- 1) Establishment of scientific advisory work groups to assist in planning and coordinating surveys and data reports.
- 2) Distribution of quick-report (real-time) shrimp and groundfish data—a system designed to return weekly computer plots and data listings to managers, researchers, and fishing industry.
- 3) Implementation of programs to compile data for an annual SEAMAP Marine Directory, a regional listing of fishery research facilities and survey plans in the Gulf, and SEAMAP Atlases.
- 4) Development of requirements for a 5-year SEAMAP Operations Plan.
- 5) Preliminary design of SEAMAP information system.

Second year operations extended the scope of SEAMAP activities further, and included:

- 1) Expansion of spring-summer survey activities for plankton, shrimp/groundfish, and environmental data, including quick-report information on low bottom oxygen (hypoxia) areas in the Gulf;
- 2) Generation of the 5-year Operations Plan;
- 3) Publication of the 1982 Marine Directory;
- 4) Sponsorship of Shrimp/Groundfish Trawling Gear Assessment workshop;
- 5) Partial implementation of the SEAMAP Information System.

Potential Yields

Fisheries resources of the Gulf are generally believed to have a strong potential for substantially greater contributions to the region's economy by devel-

Table 3.—Current and estimated potential value of Gulf fisheries by major species/fishery groups (values in millions of dollars ex-vessel)¹.

Fishery	Current value	Potential increase ²	Total potential value
Shrimp	422.4	20.0	442.4
Menhaden	72.7	96.8	169.5
Coastal pelagics	10.2	1.5	11.7
Reef fish	23.7	2.4	26.1
Coastal herrings	0.6	439.4	440.0
Oceanic pelagics	3.0	0.3	3.3
Groundfish	8.6	110.0	118.6
Oysters and scallops	23.9	6.0	29.9
Crabs and crustaceans	26.7	3.0	29.7
TOTALS	591.8	679.4	1,271.2

¹All values in 1982 dollars.

²Potential increase resulting from added yield to the fishery (expansion) or new products (value added to the fishery from utilization of landings in a more valuable form (e.g., menhaden used as human food at 20¢/pound vs. animal food at 7¢/pound) (McIlwain, 1983).

oping presently underutilized resources and converting currently harvested species to a more valuable form. Thus, the Gulf of Mexico appears to be a prime area for fishery expansion (Table 3), but extensive research will be required to reach this goal. Some of the Gulf's fisheries resources, such as shrimp, *Penaeus* spp., and Gulf menhaden, *Brevoortia patronus*, generate very large commercial returns; others are presently important to both recreational and commercial fisheries (mackerel, *Scomberomorus* spp., and red drum, *Sciaenops ocellatus*). Still others offer a potential for future development (herrings (Clupeidae); Gulf butterflyfish, *Peprilus burti*; sharks). The resources of greatest general interest to the region, and corresponding priority research objectives, include:

- 1) Shrimp—Distribution and abundance of all stages, spawning areas, environmental parameters, status of stocks;
- 2) Coastal pelagics—Distribution and abundance, migration, spawning areas, environmental parameters, status of stocks;
- 3) Estuarine pelagics—Distribution and abundance, life histories, predator-prey relationships, food habits, migrations, status of stocks;
- 4) Reef fish, snapper and grouper—Life histories, stock identification, MSY, offshore forage, spawning sites, environmental parameters;
- 5) Menhaden—Spawning areas, larval transport, age structure, distribution, schooling behavior, status of stocks, en-

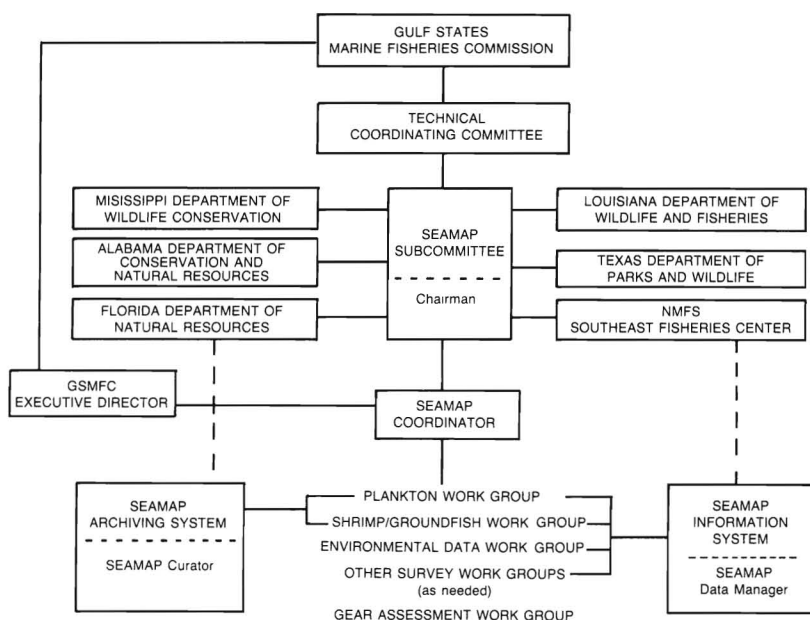


Figure 3.—SEAMAP Gulf program organization.

vironmental parameters;

6) Sharks, tunas, billfish—Abundance, stock recruitment, life histories, environmental parameters; and

7) Squid and butterflyfish—Abundance and distribution, status of stocks.

Program Organization and Operations

The SEAMAP Subcommittee of the GSMFC's TCC controls the SEAMAP program in the Gulf, subject to policies of participating states, the commission and NMFS (Fig. 3). Membership of the Subcommittee consists of one representative from each of the five Gulf States, Gulf of Mexico Fishery Management Council, and NMFS. Daily functions of the program are managed by the SEAMAP Coordinator under the direction of the Subcommittee Chairman, with administrative supervision from the GSMFC's Executive Director. Planning and execution of SEAMAP activities are provided by scientific work groups appointed by the Subcommittee.

A 5-year operations plan for SEAMAP-Gulf provides organizational guidelines and policies, identifies duties and responsibilities, and presents a proposed series of scheduled surveys and activities for the program (Anonymous, 1984a). The latter includes:

1) Shrimp/groundfish. Brown shrimp, *Penaeus aztecus*; white shrimp, *P. setiferus*; and pink shrimp, *P. duorarum*, in the Gulf of Mexico support the most valuable U.S. fishery. In addition to the landed catch, the shrimp fishery annually discards in excess of 1 billion pounds of groundfish. This discard is composed of over 170 different species, with Atlantic croaker, *Micropogonias undulatus*; spot, *Leiostomus xanthurus*; sand seatrout, *Cynoscion arenarius*; Atlantic cutlassfish, *Trichiurus lepturus*; sea catfish (Ariidae), and silver seatrout, *Cynoscion nothus*, comprising the dominant species.

2) Plankton. Spawning success and the early life history of fishery stocks can be evaluated from collections of fish eggs and larvae. Survey emphasis is placed on species such as bluefin tuna, *Thunnus thynnus*; billfishes (Istiophoridae), mackerels, *Scomberomorus* spp., and other coastal pelagics, coastal herrings (Clupeidae), and drums and croakers (Sciaenidae).

3) Environmental Data. Measurements of critical environmental parameters, such as temperature, salinity and oxygen will be collected to determine how the distribution, abundance, and general health of fishery resources are affected by these parameters.

4) Pelagic Fish. Coastal herrings,

mackerel, jacks (Carangidae), billfishes, and tuna will be sampled by midwater trawl/acoustic surveys, surface longline surveys, and visual surveys of surface-occurring species.

5) Special Programs. Special survey programs will include activities such as mark and recapture experiments, satellite and aircraft surveys, low oxygen and sudden environmental perturbation studies, and sediment mapping.

6) Satellite and Aircraft. SEAMAP visual surveys of surface-occurring fishes, porpoises, and sea turtles may be performed by observers aboard aircraft to provide valuable assessment data on seasonal and geographic distribution of these organisms.

7) Low-Oxygen and Sudden Environmental Perturbation. Often, extreme, rather than normal, environmental conditions result in habitat alteration and species succession. For example, movement of cold, oxygen deficient (hypoxic) waters from the Gulf's floor onto the continental shelf may result in the death of much of the resident benthic community and cause mobile species to leave an area.

8) Sediment. The distribution and abundance of many ecologically important species are associated with sediment particle-size, not only for such deposit feeders as shrimp and some groundfish, but also for their predators. Quantitative relationships, however, have not been determined and must be established if management is to assess the impact on fishery resources of activities such as dredge spoil disposal, bulkheading, and toxic substances.

Program Entities and Duties

SEAMAP Coordinator

The Coordinator's primary responsibility is to assist the Subcommittee in ensuring that the operational system functions efficiently and satisfies user requirements. The Operations Plan and associated Event Logic Diagram, schedule of events, survey plans, and GSMFC and TCC directives constitute the basic documents by which the Coordinator monitors program status, coordinates Subcommittee meetings and operations, anticipates potential problems,

and initiates corrective action. Because SEAMAP involves several agencies, the Coordinator must be diplomatic as well as aggressive.

Data Manager

The SEAMAP Data Manager has the overall responsibility for ensuring that verified digital data collected during SEAMAP survey activities are processed, archived, and made available to participants, cooperators, investigators, and others in a manner consistent with approved SEAMAP and applicable NOAA data management policies and procedures. Funding and administration for this position are provided by the SEFC.

SEAMAP Curator

The SEAMAP Curator has responsibility for maintaining collections of ichthyoplankton and other selected organisms collected during SEAMAP survey operations. This position, as well as associated curatorial expenses and support, is funded by SEAMAP and housed at the Florida Department of Natural Resources, Bureau of Marine Research, St. Petersburg, Fla.

Program Facilities

The SEAMAP Program is administered by the GSMFC which provides office space for the SEAMAP Coordinator at the Gulf Coast Research Laboratory (GCRL), Ocean Springs, Miss. Clerical, accounting, and printing services are provided by the commission. Subcommittee and work group meetings are held at the site of GSMFC semi-annual meetings or at other sites selected for their central location.

Information Dissemination

Products resulting from SEAMAP activities may be grouped into two basic categories: Data sets and program information. Data sets include both digital data and specimen collections. Program information is defined here as those communications (reports, bulletins, quick reports, and announcements) that are released to participants, cooperators and investigators, including Sea Grant programs; to the fishing/seafood community; to Federal and regional management agencies; and to the general

public via newspapers and other media.

Program Evaluation

SEAMAP program evaluations are conducted periodically through an internal procedure and submitted to the GSMFC's TCC. External reviews can be conducted at the discretion of the TCC. Also, annual regional SEAMAP reports are provided in October at the respective ASMFC and GSFMC meetings.

Budget Planning

The success of the SEAMAP Program is dependent on coordination of regional activities planned for phased implementation, as well as adequate funding for sampling platforms, sampling systems, and scientific and support personnel. The cost-effective nature of the program resides in the accumulated expertise and cooperative history of its participating agencies, in addition to the sharing of costs.

Although the SEAMAP budget was projected to increase gradually over time, funding has been maintained at \$1 million annually for both the Gulf and South Atlantic components of the program. This has been a substantial achievement given existing fiscal restraints, and has occurred primarily because of the strong Congressional support that state partners have contributed to the program.

South Atlantic SEAMAP Program

Chronology

Since 1982, annual cooperative state-NMFS cruises have occurred in the South Atlantic using the NOAA Ship *Delaware II*. Results of these cruises have been encouraging and a publication describing the deepwater demersal finfish resources off South Carolina utilized SEAMAP-SA data (Low and Ulrich, 1983).

In August 1983, representatives of Florida, Georgia, South Carolina, North Carolina, the South Atlantic Fishery Management Council, and the NMFS met in Charleston, S.C., to determine the feasibility of establishing a SEAMAP-SA Program. That meeting resulted in the formation of the SEAMAP-SA Committee which defined program goals and made recommendations to the South

Atlantic States Regional Marine Fisheries Management Board (Board) concerning program implementation. The Board met in October, selected program goals, and formally established the program under the auspices of the ASMFC. The SEAMAP-SA Committee was given the task of developing an operations plan for the program in 1984.

The Committee met several times during 1984 to develop the SEAMAP South Atlantic Operations Plan 1986-1990. The plan was accepted by the ASMFC at its annual meeting in October 1984. An Executive Summary of the Plan was produced in February 1985 (Anonymous, 1984b).

Program Organization and Operations

The SEAMAP-SA Committee of the ASMFC controls the SEAMAP program in the South Atlantic subject to policy of the commission and NMFS (Fig. 4). Membership of the Committee consists of one representative from each of the four South Atlantic States, the South Atlantic Fishery Management Council, NMFS, and the ASMFC. Daily operations of the program are managed by the SEAMAP-SA Coordinator under the technical direction of the Committee Chairman. Planning and execution of SEAMAP-SA activities are developed by scientific work groups appointed by the Committee.

The system elements of the South Atlantic program are similar to those in the Gulf and will not be described further. Program operations are detailed in the South Atlantic SEAMAP Operations Plan (Anonymous, 1984b). This section will describe only the major points, and refers the reader to the Plan for additional details. Major activities that will be conducted during the life of the plan include:

- 1) Shallow Trawling. White, brown, and pink shrimp constitute the most valuable commercial fishery in the South Atlantic states and also support a substantial, but unquantified recreational fishery. Most juvenile sciaenids, king mackerel, *Scomberomorus cavalla*; and Spanish mackerel, *S. maculatus*; menhaden, mullet, *Mugil* spp.; bluefish, *Pomatomus saltatrix*; blue crabs, *Callinectes sapidus*; herrings, jacks, and numerous

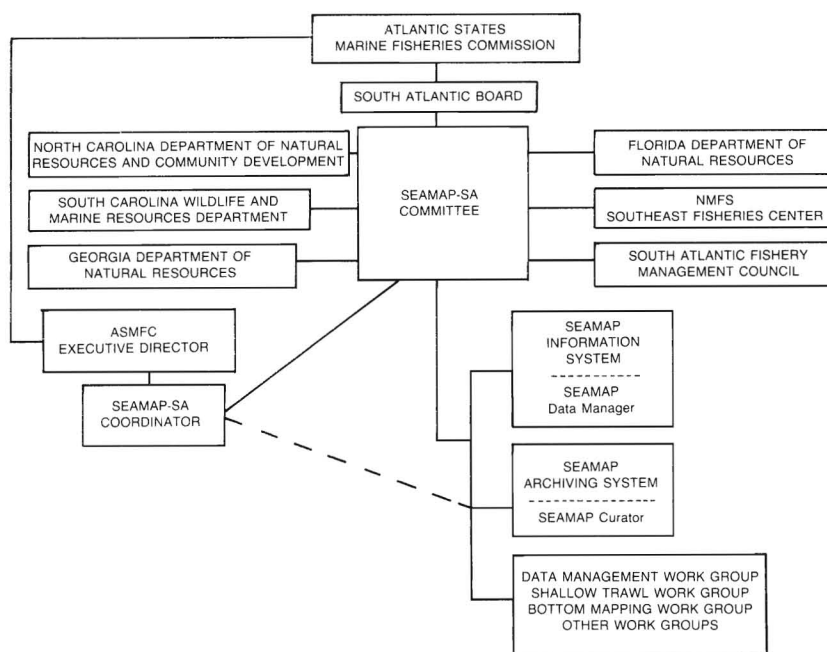


Figure 4.—SEAMAP-SA program organization.

forage species spend part or most of this life stage in shallow trawling grounds. These species have immense commercial and recreational value and form the basis of the inshore South Atlantic fisheries. While current state projects, primarily for shrimp, are sufficient for some basic management needs, the coordinated, standardized SEAMAP-SA surveys are needed to provide supporting ecological data.

- 2) Passive Gear. Passive gear includes traps, hook and line, bottom-tending longline, kali poles and fish sticks, and television. High priority species that will be monitored by one or more of these gears are black sea bass, *Centropristis striata*; snappers, groupers, *Geryon* crabs, and tilefish (Malacanthidae). Numerous lower priority species can also be monitored at the same time. Passive gear surveys will cover waters of the continental shelf and slope throughout the area south of Cape Hatteras and typically will be conducted during summer when sampling is most efficient because of moderate weather.

- 3) Midwater/Highrise Trawling. Although survey techniques have not been fully developed, it is presumed that midwater or highrise trawls will monitor

king and Spanish mackerel, bluefish, shad, *Alosa* spp.; river herring (Clupeidae), squid, and several species of herrings and jacks. Acoustic survey techniques may also be employed in conjunction with trawling.

- 4) Concomitant Activities/Plankton Surveys. Coordinated, area-wide plankton surveys will be undertaken to gain insight into recruitment processes and general productivity.

- 5) Environmental Data. SEAMAP-SA will obtain the data necessary for assessing synoptic patterns of critical environmental driving forces. Vessel activities provide ground truth information for calibrating satellite imagery, while expanding in time and space synoptic patterns of sea surface conditions.

- 6) Mapping and Assessment of Hard Bottom Resources. Because the nature of the substrate is a major determinant of faunal composition, a detailed description of surficial geology will be compiled. Features to be included are amount of live bottom, relief, and nature of the surface sediments. Also, SEAMAP-SA will periodically survey live bottom areas to determine whether they are stable, increasing, or diminishing.

- 7) Vessel Visual Surveys. Many eco-

logically and economically important species spend a portion of their time at or near the surface where they are readily visible. Since menhaden, other coastal herrings, mullet, mackerels, turtles, marine mammals, and other pelagic species can frequently be observed from a vessel, visual surveys will be conducted in a "piggy-back" manner to minimize costs. These data will be added to the SEAMAP data base.

8) Support Surveys for Stock Definition and Migration Patterns. Fishery management must take into account the stock structure and migratory patterns of exploited species. However, such information is lacking for some important fishery species, including king and Spanish mackerel, bluefish, and several sciaenids. SEAMAP will provide a coordinating mechanism and the basic logistic support for regional biochemical, morphometric, and tagging studies.

9) Assessment of Hard Bottom Resources (Biotic and Abiotic). After the initial mapping of the south Atlantic has occurred, periodic assessments will be made to monitor the extent and quantity of live and rough bottom and to fill identified data gaps. Television, photography, divers, and bottom dredging should be useful here, as could observers in submersibles. Proposed mining sites are likely areas for special surveys to evaluate potential impacts of developmental projects on living marine resources and associated habitat.

10) Environmental Perturbation Surveys. Short-term environmental perturbations frequently have important biological and socioeconomic effects. Events such as oil spills, hypoxia, and hurricanes, for example, usually affect both marine resources and the users of those resources. Agencies which must respond to or cope with consequences of environmental perturbations need factual information on which to base their actions. They need both advance information which allows them to anticipate what will happen to marine resources and on-site descriptive information during and immediately following the emergency.

11) Pelagic Longlining Surveys. Pelagic longlines are used to capture large fish such as tunas, *Thunnus* spp.; swordfish, *Xiphias gladius*; marlins (*Istiopho-*

ridae), and pelagic sharks living between the surface and mid-depths. Although methods of fishing longlines are well established through extensive commercial experience, an area-wide survey design has not yet been developed.

12) Contaminant Surveys. Some surveys, such as the NOAA National Status and Trends Program, will examine index species for contamination of heavy metals, hydrocarbons, or other toxins. SEAMAP provides a mechanism for the collection of specimens, as well as the sediments upon which their prey organisms feed.

13) Sediment Surveys. The distribution and abundance of many ecologically important species have been qualitatively associated with sediment particle size. This is true not only for detritus and opportunistic feeders such as shrimp and some groundfish, but also for their predators. Quantitative relationships, however, have not been determined and will be required if management is to assess the impact on fishery resources of activities such as disposal of dredge spoil and toxic substances and bulkheading.

14) Calibration of Gear and Standardization of Survey Procedures. Existing survey techniques are not totally adequate for assessing populations of some species, notably those inhabiting live/rough bottom and schooling midwater or pelagic species such as squid, herrings, and jacks. Initially, SEAMAP-SA will attempt to develop survey methods that are both scientifically sound and cost-effective.

15) Data Management Procedures. SEAMAP data management procedures in the South Atlantic are similar to those described for the Gulf.

16) Specimen Archiving. Specimen archiving procedures in the South Atlantic are the same as those in the Gulf.

Program Administration, Entities and Duties

SEAMAP-SA is one of several cooperative State-Federal programs under the aegis of the ASMFC's Interstate Fisheries Management Program (ISFMP). The ISFMP includes several of the Atlantic coast's important fisheries, such as southern shrimp, Atlantic menhaden, *Brevoortia tyrannus*; and striped bass,

Morone saxatilis, as well as the South Atlantic Cooperative Statistics Program. Under the ISFMP, policy and fiscal matters are addressed by an executive group composed of state marine fishery management agency directors and the NMFS Regional Director, while a technical committee is responsible for plan preparation and execution. These roles are filled by the Board and the South Atlantic SEAMAP Committee, respectively for SEAMAP-SA.

In addition to the Board and Committee, ad hoc work groups are established by SEAMAP-SA as needed to address specific issues. Work groups are not standing committees but are formed to accomplish a specified task and are disbanded upon its completion. Members of work groups are drawn from government agencies and institutions, academia, and other sources of appropriate expertise.

South Atlantic SEAMAP Committee

The South Atlantic SEAMAP Committee generally meets on the call of the Chairperson. The Chairperson and Vice Chairperson are elected annually by committee members and may serve an unlimited number of 1-year terms, consecutively or otherwise.

SEAMAP-SA Coordinator, Data Manager, Work Groups, and Information Dissemination

All South Atlantic activities are similar to those in the Gulf of Mexico.

Program Facilities

Office space for the SEAMAP-SA Coordinator is provided by NMFS at the Miami Laboratory, Miami, Fla. Clerical support, telephone facilities, postage, and office supplies are also provided by NMFS.

Program Evaluation

The purpose of program evaluation is to improve SEAMAP's efficiency and its utility to its primary clients, namely, policy makers, fishery managers, industry researchers, and others who need information about living marine resources and their environment. Responsibility for evaluation will reside with the Com-

mittee, which may delegate portions as appropriate to the Coordinator, Work Groups, Data Manager, and Curator. External evaluation can be accommodated at the direction of the Board, Commission, or Committee.

Budget Planning

Funding procedures for the Gulf of Mexico and South Atlantic programs are virtually the same and have been described earlier in this report. Proposed budgets for both SEAMAP components are given in Anonymous (1984a,b).

Present Status of SEAMAP Program

The program presently consists of two operational components, SEAMAP-Gulf of Mexico, which began in 1981, and SEAMAP-South Atlantic, which began in 1983. A third component, SEAMAP-Caribbean, is in the pre-planning phase. Federal programmatic funding for SEAMAP activities and administration was appropriated in fiscal years 1986-1988 (1 October 1985 through 30 September 1988). State and commission funding allocations are through State-Federal cooperative agreements administered by the SEFC. Past budgets have been about \$1,000,000 annually in Federal funds with a lesser contribution by participating states.

Recent Events in Gulf and South Atlantic SEAMAP Program

Shrimp/Groundfish Surveys

In 1985 and 1986, state vessels sampled nearshore waters from Perdido Bay, Ala., to Brownsville, Tex., while a NOAA vessel surveyed offshore waters in the northern Gulf. Catch rates and length-frequencies of penaeid shrimp and finfish, standardized to a 40-foot shrimp trawl, were determined through day and night sampling, on shrimp and groundfish resources. Plankton samples and environmental data were collected at all stations. In addition, a preliminary evaluation of ship vs. laboratory (shore-side) measured weights of selected trawl-caught species was made during the summer to assess the accuracy of shipboard weighing procedures.

Coastal Herring Surveys

Two winter surveys to locate trawlable concentrations of coastal herrings (anchovies, sardines, chub mackerel, *Scomber japonicus*; scad, *Decapturus* sp.; butterfish, etc.) were conducted in the northeastern Gulf in 1985 and 1986 in depths from 46 to 455 m. A high-opening bottom trawl and a Shuman trawl were used. The Shuman trawl appeared to be the most efficient with the largest catch 5,029 pounds of fish in a 30-minute tow; of the areas surveyed, that of southwest Florida was most productive.

Spring Plankton Survey

Two surveys were conducted in the spring of 1985 and 1986, primarily directed toward bluefin tuna eggs and larvae in offshore waters. Samples were collected from the Florida Keys to Brownsville, Tex. Specimens were sent to the Plankton Sorting Center at Szczecin, Poland, for identification and will be returned to the SEAMAP Archiving Center in St. Petersburg, Fla.

Summer Squid and Butterfish Survey

The rapid implementation of the Summer Squid/Butterfish Survey illustrates one of the major advantages of the SEAMAP Program; namely, a viable mechanism for coordinating region-wide survey activities. In this case, the newly formed Squid/Butterfish Work Group met in mid-June and recommended a preliminary sampling plan, which was approved by the Subcommittee. Stations were generated, gear purchased and evaluated (special 24 m trawl nets with 1/2-ton steel V-doors) and a data management system established to process quick reports of survey data for distribution to management agencies and others interested in potential new Gulf fisheries. A total of 150 stations was made, at depths from 60 to 530 m in July and August 1985. In May and June 1986, another squid and butterfish survey was conducted. The results of this effort indicated that additional effort was needed to design more efficient sampling strategies for assessment purposes. This was to be initiated in 1987.

Larval Red Drum Surveys

Mississippi conducted fall surveys in 1985 and 1986 to collect larval red drum and analyze patterns of distribution, abundance, and species complexes associated with environmental factors. Samples were sent to the Polish Sorting Center to sort the remaining families.

September 1986 Plankton Survey

The increasing concern for the health of king mackerel stocks in the southeast led to approval of a second SEAMAP survey to assess the abundance and distribution of king mackerel eggs and larvae throughout the region; the first such survey was completed in August 1984. Coverage for the 1986 survey was much broader, extending along the southeast U.S. coast and including almost the entire Gulf of Mexico from the Florida Keys west to Brownsville, Tex., and throughout Mexican Gulf waters. Vessels from the Gulf states of Florida, Alabama, and Mississippi, and from NMFS and the Mexican National Fisheries Institute, surveyed from 2 to 27 September 1986 using the standard bongo array and neuston nets.

Associated Plankton and Environmental Data Surveys

For the fifth year, plankton samples and environmental data were collected routinely during SEAMAP surveys. Samples were taken with a 60 cm bongo array and standard NMFS neuston net. Samples from one side of all bongo tows were shipped to the SEFC Miami Laboratory for transshipment to Poland where they will be sorted to the family level at the Polish Sorting Center; the other sample from each station is retained as a back-up in the event of damage or loss of the specimens sent to Poland.

Several environmental parameters were measured at each SEAMAP station: Temperature, salinity, and oxygen levels from surface, middepth and bottom waters; wind direction and speed. Additional water samples were filtered and sorted onboard the vessels for later laboratory analysis of chlorophyll *a*.

Trawl Calibration Exercise in South Atlantic

Vessels from North Carolina, South Carolina, and Georgia conducted a trawl calibration exercise in Charleston Harbor, S.C., in November 1985 to standardize inshore trawling procedures in the South Atlantic. Results of the work were published in Low and Whitaker (1986).

Nearshore Trawling Project in South Atlantic

Vessels from North Carolina, South Carolina, and Georgia conducted a nearshore trawling project in the fall of 1986 to obtain data for development of a sampling design for shrimp and groundfish resources. A second survey was conducted in the summer and fall of 1987 to refine the sampling design. Results of the 1986 work were analyzed and incorporated into the design for the 1987 work by holding a workshop in June 1987. Principal species of interest included shrimp, sciaenids, menhaden, and juvenile mackerels.

Bottom Mapping Project

A bottom mapping project was completed in the south Atlantic in order to develop procedures to establish a long-term computerized data base to describe bottom types and associated fishery resources. Specific objectives of the study included: 1) Defining user needs of resource management agencies concerned with hard bottom resources, 2) identifying types of physical and biological data needed to satisfy user needs, and 3) developing criteria and procedures to evaluate existing and future data bases.

Geryon Crab Project

SEAMAP is providing funds to augment a research effort cooperatively funded by the Gulf and South Atlantic Fisheries Development Foundation, Inc., the South Carolina Wildlife and Marine Resources Department, the South Carolina Sea Grant Consortium, and the Marquette Foundation to determine the distribution and abundance of *Geryon fenneri* and other decapod species of the continental slope. First-year results indicated that maximum catches occurred in the 458-549 m strata, with catches largest

on bottom sediments of silt-clay and foraminiferan tests. Additional information is given in Wenner and Ulrich (1987).

Stock Identification Project

The newly-formed Stock Identification Work Group was charged by the Committee to begin planning stock identification studies on species important to the south Atlantic states. The specific objectives are to review and evaluate stock identification techniques for applicability to selected species, such as the mackerels and red drum. A plan noting key species and procedures will be prepared and distributed throughout the region, with an emphasis on coordination with the SEAMAP-Gulf efforts to identify stocks of red drum.

System Design Study for SEAMAP Data Management System

During 1986 both SEAMAP components authorized a Contractor to develop a comprehensive system design and implementation plan for a regional SEAMAP data management system. The study was completed in March 1987 and implementation of the system has been initiated. The system will be a decentralized distributive processing system with state sites entering and editing data. Then, information will be forwarded to a central NMFS site for storage and archiving. Local sites using IBM¹ Personal Computers will have extensive analytical and storage capability for their own files. Regional files will be maintained on the NMFS mainframe computer and will be available to all participants. System implementation will take about 3 years. An overview of the SEAMAP information system is illustrated in Figure 5.

Special Studies

Red Drum Stock Identification and Research Plan

In 1986, specimens of young-of-the-year inshore red drum were collected from discrete estuarine systems by all

¹Mention of trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

Gulf States, North and South Carolina, Georgia, and eastern Florida and examined by biochemical means to determine stock structure in the southeastern United States. Also, in response to urgent fishery management needs in the Gulf of Mexico, scientists in that region prepared a State-Federal Cooperative Program for Red Drum Research in the Gulf of Mexico: A Three-Year Plan. Major portions of that plan were implemented in 1986 and 1987.

Status and Trends Benthic Surveillance Study

For the third consecutive year, the SEAMAP Program actively participated in the nationwide sampling for contaminants in coastal fishes and sediments, as part of the NOAA National Status and Trends Program. Both SEAMAP programs supplied personnel from state management agencies to provide guidance in locating concentrations of the target species, Atlantic croaker and spot. Sampling occurred in 14 Gulf and South Atlantic sites from August-October 1986, with a NOAA vessel serving as the primary sampling platform. Analyses of trace metals, organics, chlorinated hydrocarbons and other contaminants as well as histological examinations, are being conducted by the NMFS Beaufort and Charleston Laboratories.

Cooperative King Mackerel Research Program

Because of sharply declining catches of king mackerel in the Gulf of Mexico, scientists utilized the SEAMAP program to coordinate and develop a king mackerel research program. This was accomplished in 1986 and is still serving as guidance for king mackerel research presently being conducted.

The three programs discussed above illustrate one of the major benefits of the SEAMAP program; namely, there is an infrastructure of agencies and scientists available to move quickly toward solution of management and research problems in the southeastern United States. This is true not only for regional problems, but also for national programs, such as the Status and Trends Benthic Surveillance Study, of which the southeastern region is only one component.

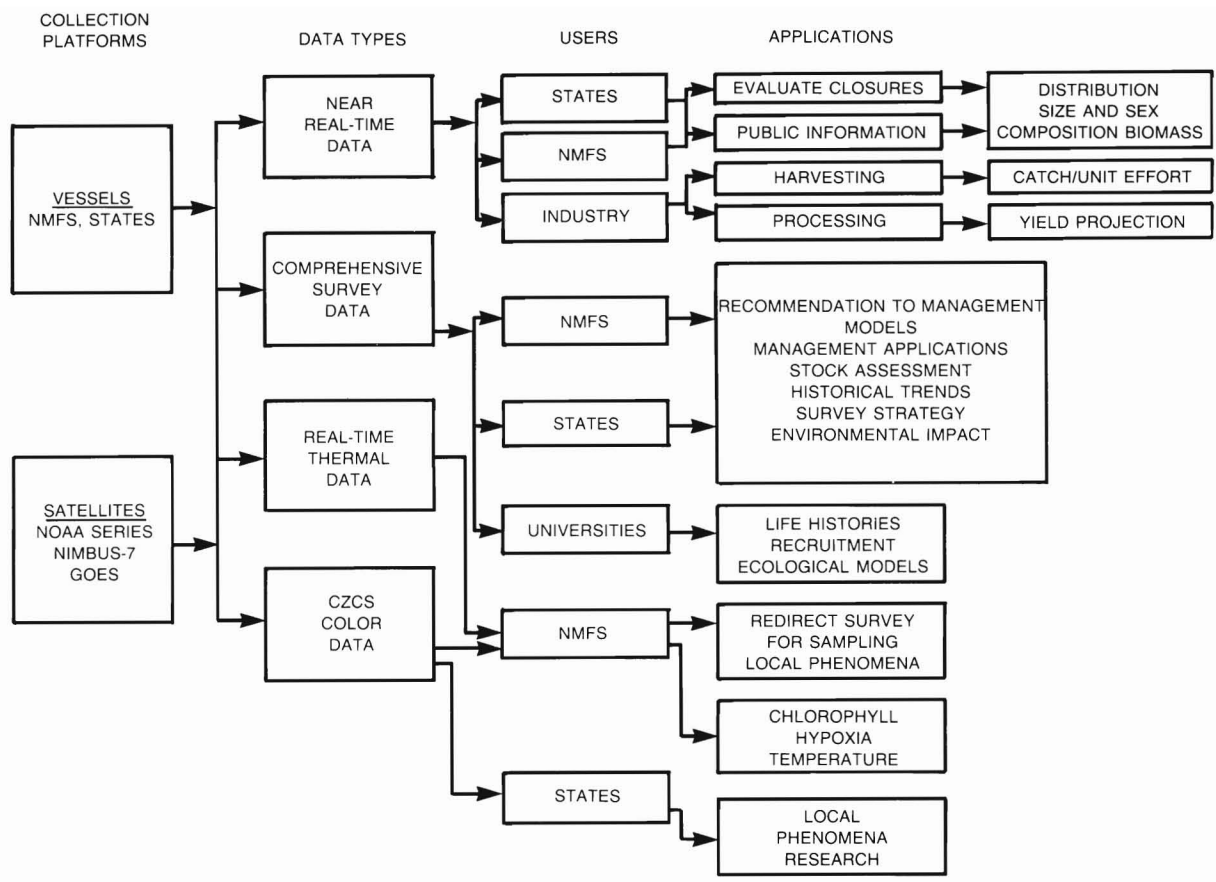


Figure 5.—SEAMAP information system overview.

Summary

The SEAMAP program is the only comprehensive regional program in the United States that involves the collection, analysis, and dissemination of a wide range of fishery-independent information. It has many state, State-Federal, and Federal partners and represents a coherent effort to share financial and scientific resources to collect cooperatively needed fishery-independent data for understanding and maintaining marine fishery resources of the nation at minimal costs. It is a young and dynamic program that is learning as it goes. It has growing pains, but it also has many successes and can serve as a model for other regions that face similar management and research problems.

Acknowledgments

The author is indebted to William Fox,

Andrew Kemmerer, Walter Nelson, Perry Thompson, Warren Stuntz, Ken Savastano, and Nikki Bane, who implemented and guided SEAMAP in its initial years. Thanks are due to the Gulf and Atlantic States Marine Fisheries Commissions that sponsor and administer the program. Special thanks are due to the numerous, dedicated state and Federal personnel, who belong to the committees and Work Groups that actually plan and execute SEAMAP activities and surveys. Also, Andrew Kemmerer, Nikki Bane and Scott Nichols provided valuable suggestions for improvement of the manuscript in their reviews.

Literature Cited

Anonymous. 1981. Southeast Area Monitoring and Assessment Program (SEAMAP) Strategic Plan. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southeast Fish. Cent., Miss. Lab., Rep.

50 p.

- _____. 1984a. SEAMAP Operations Plan: 1985-1990. Gulf States Mar. Fish. Commiss., Ocean Springs, Miss., 118 p.
- _____. 1984b. SEAMAP South Atlantic Operations Plan 1986-1990. Atl. States Mar. Fish. Commiss., Wash., D.C., Spec. Rep. 6, 108 p.
- _____. 1986. Marine Recreational Fishery Statistics Survey, Atlantic and Gulf Coasts, 1985. Current Fish. Statistics No. 8327, NMFS, Washington, D.C., 139 p.
- Low, R. A., and G. F. Ulrich. 1983. Deep-water demersal finfish resources off South Carolina. S.C. Mar. Res. Cent. Tech. Rep. 57, 24 p.
- _____, and J. D. Whitaker. 1986. Seamap comparative shrimp trawling study, 1985. S.C. Mar. Res. Cent. Contrib. 210, 27 p.
- McIlwain, T. D., 1983. Research needs for information leading to full and wise use of fishery resources in the Gulf of Mexico. Discuss. pap. Off. Rep. Trent Lott, Wash., D.C., 20515, 26 p.
- USDOC. 1987. Fisheries of the United States, 1986. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Curr. Fish. Stat. 8385.
- Wenner, E. L., and G. Ulrich. 1987. Exploration for golden crab, *Geryon fenneri*, in the south Atlantic Bight: Distribution, population, structure, and gear assessment. Final rep., 1986-87 Proj. 3209-35650/25000, Gulf S. Atl. Fish. Dev. Found.