

6.0 ESSENTIAL FISH HABITAT RESEARCH NEEDS

6.1 Essential Fish Habitat Research and Monitoring Program

The following constitutes the basic structure of the Council's essential fish habitat (EFH) research and monitoring program. This general structure provides recommendations, for research the Council, the National Marine Fisheries Service (NMFS) and other habitat partners in the South Atlantic region view as necessary for carrying out the EFH management mandate. This Section will be refined after public hearing to better identify and support South Atlantic habitat partners research efforts to describe, map, and document use of EFH by managed species. In addition, subsequent drafts of this document will better efforts of habitat partners to define non-fishing and fishing threats and their impacts on EFH.

The Council has determined that the NMFS, in cooperation with other Federal, State and regional habitat partners in the South Atlantic region, will develop the necessary understanding, using basic and applied research and literature syntheses, to help conserve, protect, and restore EFH of living marine resources managed by the Council. Statutes and international conventions and treaties which authorize the NMFS to conserve and restore marine habitat include but are not limited to the Magnuson Fishery Conservation and Management Act, the Endangered Species Act, the Fish and Wildlife Coordination Act, the National Marine Sanctuaries Act, the Clean Water Act, the Comprehensive Environmental Response, Compensation, and Liability Act ("Superfund"), and Oil Pollution Act (OPA).

Additional research is necessary to insure sufficient information is collected to support a higher level of description and identification of EFH (see Appendices O and P). In addition, research is needed to identify and evaluate existing and potential adverse effect on EFH, including but not limited to, direct physical alteration; impaired habitat quality or function; cumulative impacts from fishing; or indirect adverse effects such as sea level rise, global warming and climate shifts; and non-gear related fishery impacts.

The Council recommends NMFS apply their adopted Habitat Research Plan to direct and conduct research and transfer results to management components within NMFS. The Council coordinates with NMFS management components to provide information on permit and policy activities, fishery and EFH information for fishery management plans. The NMFS plan is designed to develop the necessary expertise to accomplish or oversee the restoration, creation, or acquisition of habitat to benefit living marine resources. The plan provides guidance in four areas: ecosystem structure and function, effects of alterations, on habitat development of habitat restoration methods, and development of indicators of impact and recovery of habitat. A fifth area is the need for synthesis and timely transfer of scientific information to managers.

The Habitat Research Plan of the NMFS (Thayer et al., 1996) serves as a base from which this Section will be revised. After public hearing this Section using this base structure will be revised to further define needs by individual EFH type or EFH-HAPC, as well as by species or species complex. The Council will work with NMFS and other NOAA programs, including the Office of Ocean and Coastal Resource Management, Coastal Ocean Program, Coastal Services Center (Charleston, SC), and National Sea Grant Program, to meet the goals of NOAA. NMFS will work closely with other federal agencies to increase cooperation and partnerships, maximize research information, and reduce potential duplication of research efforts. The Council has adopted the same general structure for the research and monitoring program. In addition, the following draft lists of research needs for habitat or managed species are included for comment.

6.1.1 Ecosystem Structure and Function

Understanding the structure and function of natural ecosystems, their linkages to one another, and the role they play in supporting and sustaining living marine resources, their abundance, distribution, and health -- is critical. Knowing when and how systems are affected, assessing the cause and degree of impact, and providing the basis for restoring and maintaining these systems are integral to this research area, and must be evaluated in terms of landscape ecology. Research on ecosystem structure and function will provide the necessary foundation for linking all areas to provide the basis for making fundamentally sound management decisions. Thus, assessment of habitat impacts, development of restoration methods and evaluation of restoration effectiveness, development of indicators of impact and recovery, and synthesis and transfer of information for the development of management policy and regulations all are dependent on a comprehensive understanding of ecosystem structure and functioning.

Research in this area will include studies on the relationship between habitat and yield of living marine resources including seasonality and annual variabilities and the influence of chemical and physical fluxes on these relationships. These research efforts will be dependent upon knowledge of basic life histories, habitat structural integrity and limiting factors, and must be evaluated within the context of habitat mosaics or habitat heterogeneity. Therefore, data on habitat location are integral to this research area. Information on essential fish habitat, variability in yield of fishery resources as a function of material fluxes, habitat type, location and scale should be generated. This research area provides the foundation for understanding cause and effect relationships and development and evaluation of protection and restoration strategies.

6.1.2 Effect of Habitat Alterations

Knowledge of the causes of damage to ecosystems is critical to restoring past losses and preventing future degradation and loss of habitats essential for maintaining and enhancing living marine resources. Therefore, quantification of the response of habitats and living marine resources to natural and anthropogenic alterations is not only a prerequisite to determining the degree of impact, predicting the rate of recovery, and recommending the most effective restoration procedures, but it also is a requisite to establishing effective protective measures.

The basis for determining cause and effect relationships depends on an understanding of the natural structure and function of an ecosystem. Individual living marine resource requirements and population characteristics. The Council is interested in both maintaining sustainable living marine resource populations and protecting the essential fish habitat they depend upon. Habitat partners should conduct research to relate non-fishing impacts observed at the individual level to effects at the population level which would link habitat impacts ultimately to living marine resource populations.

Studies should include cause and effect research designed to evaluate responses of living marine resource and habitats to physical and chemical modifications of coastal and estuarine systems. Research is encouraged that considers downstream responses to upland modification, the role of buffers zones, as well as living marine resource and habitat responses to physical and waterflow alterations and water quality modifications. Information should be generated on responses to both individual and cumulative impacts so as to provide the basis for policy statements, guidelines, and regulations to protect habitats. These cause and effect databases will furnish information pertinent not only to permit-related activities and other consultations, but also to NMFS mandated responsibilities in restoration planning and implementation.

6.1.3 Habitat Restoration Methods

While methods for restoring certain habitats (e.g., salt marshes and seagrass meadows) exist, most have not been rigorously tested under experimental conditions throughout wide geographic areas and at different scales. Additionally, for other habitats (e.g., coral reefs, intertidal and subtidal substrates, riparian habitat) only limited methodology exists and little emphasis has been placed on rapidly restoring biodiversity and monitoring for success and persistence. (As a consequence, a significant proportion of restoration actions has been viewed with skepticism relative to their success and concerns for rates of habitat recovery or development.) Current methods to cleanup, restore or create productive living marine resource habitats must be improved, and new, innovative techniques must be developed and evaluated using statistically rigorous approaches.

Research topics and areas of concern include analyses of the success of contaminant sequestration; assessment of bioremediation techniques; development and evaluation of new habitat restoration techniques; experiments on transplant species culture techniques; and evaluation of the role and size of buffers and the importance of habitat heterogeneity in the restoration process. Research on restoration will lead to scientific information on trajectories of recovery and stability of created and restored systems including physical, chemical and biological components and processes. Assessments of new techniques and evaluation of current techniques over geographic regions and scales will provide bases for success evaluation. Most importantly, guidelines for improved best management practices and improved restoration planning will be generated.

6.1.4 Indicators of Habitat and Living Marine Resources Impacts and Recovery

Increasing and extensive exploitation of coastal resources demands that indicators be used to simplify the process of determining whether an ecosystem, habitat, or living marine resource is healthy, degraded, or is recovering. The development of indicators of habitat/living marine resource impacts and recovery is critical for managers judging the status of essential fish habitat or fishery resources, and determining the need for corrective actions.

The development of habitat or resource indicators must be based on information derived from comparative research on the structure and function of disturbed, natural, and/or restored habitats of different ages and geographical locations for a suite of biological, chemical, and physical parameters; time-dependent biotic population analyses; and contaminant level follow-up evaluations for sediment, biota, and water. This type of research will help managers identify essential fish habitat status; standardize indicators for specific habitats through comparisons across geographic gradients and scales; and develop recommendations on chemical "cleanup" techniques and most appropriate measures to assess success. The Council encourages NMFS, in cooperation with the other habitat partners in the Southeast, to utilize such guideposts to develop and improve best management practice approaches.

6.1.5 Synthesis and Information Transfer

The synthesis and timely transfer of information derived from research findings and the existing literature is a key element of the essential fish habitat research and monitoring program. Decisions on permitting, regulation, enforcement, redirection of research efforts, and development and implementation of restoration plans must be made with the best available information. Scientists must step back from their research long enough to provide timely information syntheses to habitat managers. Likewise, it is imperative that State and Federal

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habitat managers recognize that generic information generated by the scientific community does have powerful application to their site-specific problems.

Technology and information transfer will be expedited through the use of all available information sources and the application of "user-friendly" information bases. Geographical Information Systems provide the opportunity to amass and array large quantities of complex data, thereby, providing potential for relational observations by decision-makers; such use is strongly encouraged. Many areas of synthesis and transfer have been indicated in the earlier four research areas and will not be repeated here. Additional examples include information syntheses on essential fish habitat and essential fish habitat-habitat areas of particular concern and modes of protection and restoration, and synthesis of available information on landscape approaches to basinwide management including permitting and restoration. Such collations of current and evolving information bases are important to the Council and those charged with the conservation and management of fishery resources as well as to State and Federal habitat managers concerned about developing and implementing policy. These syntheses could be done within NMFS, through partnerships with other agencies, and by contract. It is important, however, that syntheses be provided in a useable format and even published in outlets available to both scientific and management communities. The scientific community must participate in the synthesis and transfer process.

6.1.6 Implementation

The five interlinked areas provide a framework for the type of research and continuity needed to effectively manage EFH. In some instances this linkage between research areas may be hierarchical. Research on ecosystem structure and function provides the foundation for linking all areas. For example, knowledge of the structure and function of the ecosystem must be known before one can actually determine the effects of habitat alterations, develop restoration methods, or develop indicators of impact and recovery. Continuity of information from each research area is required to develop a comprehensive data base for making important resource decisions. Research founded on this approach will provide State and Federal habitat managers with a broad information base that is scientifically and ecologically credible, and responsive to management needs. The Council will coordinate with and support NMFS Southeast Regional Office and Fisheries Science Centers in their effort to determine habitat research and management priorities. Research conducted to address the EFH mandate in the southeast region should: address regional management and research needs pertinent to the Council, NMFS or other habitat partner responsible for conservation or management of EFH or species which depend on EFH; be consistent with the Council's, NMFS's and other habitat partner's long-term goals or habitat policies; and provide information about the benefit of protecting EFH or living marine resources.

Cooperative efforts between NMFS research and management staffs and with other federal/state agencies, industry, and academia are encouraged. This approach will create greater and improved partnerships, which will be required if we are to meet the Council's, NOAA's, and NMFS's goal to protect, conserve, and restore essential fish habitat through sound habitat research and management. In addition, the Council will support programmatic EFH research proposals when requested from and developed by NMFS SEFSC.

6.2 Research Needs Identified in Fishery Management Plans

6.2.1 Research Needs Identified in SAFMC Fishery Management Plans

Habitat and species specific research needs identified in Council fishery management plans are presented below for the following species or species complexes - penaeid and deepwater shrimp, red drum, spiny lobster, coastal migratory pelagics, coral, coral reefs and live hard bottom habitat, golden crab, the snapper grouper complex, calico scallops and pelagic *Sargassum* habitat.

Shrimp Research Needs:

Rock Shrimp

The following research needs are listed in no particular priority order:

1. Recruitment processes and life history strategy.
2. What are the settlement patterns of juveniles with respect to depth? What are the subsequent development and mortality rates, and how do they vary across depths?
3. Growth rates. Accurate, detailed laboratory experiments to test effects of ecological variables are particularly desirable.
4. Reproductive cycle.
5. Seasonal movements.
6. Habitat preferences. Basic ecological questions concerning physiological ecology, refuges and foraging habits, trophic dynamics, and community relationships remain largely unanswered.
7. Basic physiology of rock shrimp, biogeography, and systematics.

Additional fishery management related items include:

8. Estimate potential yield.
9. Document economic and social information of fishermen and dealers.
10. Identification of the extent of existing bottom habitat suitable for rock shrimp in the South Atlantic Council's area.
11. Bycatch characterization of the rock shrimp fishery.

Shrimp Bycatch Research Needs:

The research needs listed below are specified to bycatch.

1. Characterization of bycatch in the rock and royal red shrimp fisheries.
2. Determine the impact of shrimp trawl bycatch on the habitat and all non-target species of fish and invertebrates (i.e., include impacts on habitat and all incidental species, not just the impact on other "fishery resources").

The following research needs are summarized from recommendations presented in the bycatch characterization report for the South Atlantic region (SEAMAP 1996):

1. Shrimp effort data needs to be collected to provide estimates based on time fished (or number of tows), rather than at the trip level. Future sampling needs to be improved with respect to collection of both shrimp effort and bycatch characterization data.
2. Future characterization effort should be expanded to include important strata for which no observer data is available and strata which have low sample sizes.
3. Bycatch monitoring should be conducted regularly if data are to be used in stock assessments. Conduct characterization for 5 years after implementation of state and federal

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bycatch reduction regulations to determine the effectiveness of the gears used, and to establish new baseline bycatch estimates for stock assessments.

4. Long-term characterization data sets should be funded.

Red Drum Research Needs:

Research priorities include the following list from the stock assessment for Atlantic coast red drum:

1. Direct the improvement in catch, effort and length frequency statistics from the recreational and commercial fisheries.
2. Direct additional effort in intercepting recreational fishermen through the MRFSS who fish nighttime hours.
3. Increased tagging efforts on age 3-5 year old red drum, with directed effort to recapture subadult and adult red drum to determine if disappearance is due in part to offshore emigration.
4. Standardize sampling of the Atlantic coast subadult red drum population to develop a long-term index of recruitment.
5. Develop a more reliable maturity schedule for population level analyses.
6. Determine relationships between annual egg production and female length or weight for Atlantic coast red drum.
7. Develop a more reliable estimate of natural mortality through directed sampling of the adult population.

Other research needs identified in Section 5.7 of the Source Document for the Atlantic coast red drum fishery management plan include:

1. Determine escapement levels of juvenile red drum to the spawning stock by state.
2. Determine natural and fishing mortality rates.
3. Determine stock structure.
4. Determine survival rate of released red drum.
5. Develop a fishery independent index of relative abundance.
6. Determine inshore/offshore, as well as coastwide, migration patterns through enhanced mark-recapture studies, aerial surveys and sonic tagging efforts.
7. Determine spawning areas.
8. Determine the economic value of the Atlantic coast recreational red drum fishery.
9. Assess and modify, as needed, MRFSS procedures to more accurately survey red drum recreational catch and effort.
10. Document and characterize schooling behavior for Atlantic coast red drum.
11. Encourage current efforts to continue collection of socioeconomic data in the MRFSS and to collect socioeconomic data in the commercial fishery, where available.

Red Drum Habitat Research Needs:

1. Identify optimum red drum habitat and environmental conditions.
2. Quantify relationships between red drum production and habitat.
3. Identify the effects of water quality degradation on red drum production.
4. Identify areas of particular concern for red drum.
5. Determine habitat conditions that limit red drum production.
6. Determine methods for restoring red drum habitat and/or improving existing environmental conditions that adversely affect red drum production.

7. Encourage research in developing bio- or photo-degradable plastic products to reduce impact of refuse on the inshore, nearshore, offshore marine environments utilized by red drum at various stages of development.
8. Quantify impacts of acid rain on estuarine systems vital to red drum production.
9. Determine research that could be incorporated into a biological and socioeconomic impact assessment quantifying the effects of oil, gas and mineral exploration, development or transportation on red drum, their essential offshore, nearshore and estuarine habitat and the Atlantic coast red drum fishery.
10. Determine the impacts of dredging nearshore and offshore sand bars for beach renourishment on red drum spawning activity. In addition, the impacts of any type of dredging activity on all life history stages of red drum.

Snapper Grouper Research Needs:

To understand the causes of fishery declines and better predict the effects of human activities on fishery populations, the following research needs relative to snapper grouper habitat are provided so that state, federal, and private research efforts can focus on those areas that would allow the South Atlantic Fishery Management Council to develop measures to better manage snapper grouper and their habitat:

1. Identify optimum snapper grouper habitat and environmental and habitat conditions that limit snapper grouper production (e.g., what are the critical fisheries habitats for food, cover, spawning, nursery areas, and migration?);
2. Determine the relationship between juvenile snapper grouper and estuarine habitat. If an obligatory relationship is found, determine the distributions, rates of change, and documented causes of loss for estuarine habitat types;
3. Quantify the relationships between snapper grouper production and habitat (e.g., what are the key trophic pathways in the ecosystem, and how does the flux of essential nutrients, carbon compounds, and energy through these systems influence fisheries productivity?);
4. Determine the relative effects of fishing, pollution, and natural mortality on fishery population dynamics. Also determine the effects of cumulative habitat loss on fisheries productivity and economic value;
5. Determine methods for restoring snapper grouper habitat and/or improving existing environmental conditions that adversely affect snapper grouper production. The 29 recommendations for future studies in Bohnsack and Sutherland (1985) are supported here; and
6. Identify essential fish habitat - habitat areas of particular concern for snapper grouper.

King Mackerel Research Needs:

1. Continued refinement of estimates of sustainable yield, condition of the stock, and stock structure. This requires improved estimates of age composition of catches, recruitment, natural mortality, total catch, growth rate, and standing stock.
2. Develop fishery independent methods of assessing stock abundance.
3. Develop and refine estimates of economic value of the recreational and commercial fisheries on the mackerel resources, including effects of regulations on these values.
4. Determine impact of bag limits on the total catch and consider release mortality.
5. Compile king and Spanish mackerel price data by gear type.

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Spanish Mackerel Research Needs:

1. Continuing refinement of estimates of sustainable yield, refinement of subgroups, and condition of stock. This requires improved estimates of age composition of catches, recruitment mortality rates, total catch, growth rate, and standing stock.
2. Develop fishery independent methods of assessing stock abundance.
3. Develop and refine estimates of the economic values of the recreational and commercial fisheries on the Spanish mackerel resource, including effects of regulations on these values.
4. Determine impact of bag limits on the total catch and consider release mortality.

Cobia and Dolphin Research Needs:

1. Increase general life history information.
2. Determine status of stocks.

Spiny Lobster Research Needs:

Biological

1. Determine whether a relationship between the magnitude of postlarval recruitment and subsequent fishery yield exists and, if so, monitor long-term for establishing optimal harvesting strategies.
2. The eggs per recruit ratio in relation to overfishing definition should be defined and monitored.
3. Estimates of growth, mortality (M and F), and better indices of effort.
4. Determination of the relationship between the reproductive cycle characteristics in Florida and in the Caribbean, with postlarval recruitment in Florida.
5. Determination whether a relationship between juvenile habitat quality and abundance and magnitude of harvest exists on fishery-wide scale.
6. Estimate the impact that loss of nursery habitat may have on recruitment to the fishery.

Economic

7. Economic assessment of status of commercial and recreational fisheries including production (cost) and demand considerations.
8. Evaluation of the economic and social impacts of efforts limitation systems for traps.
9. Quantification annually of Florida recreational landings, effort, and CPUE.

Data

10. An evaluation of available catch and effort by geographic area, distance from shore, and number of traps fished per craft is needed.
11. Spanish lobster landings need to be sampled for size frequency and sex ratios.

Golden Crab Research Needs:

The following research needs (Items 1-8 taken from Lindberg and Wenner, 1990) are listed in no particular priority order:

1. Recruitment processes and life history strategy.
2. What are the settlement patterns of juveniles with respect to depth? What are the subsequent development and mortality rates, and how do they vary across depths?

3. Growth rates. Accurate, detailed molt staging should be incorporated into future sampling regimes, while controlled laboratory experiments to test effects of ecological variables are particularly desirable.
4. Reproductive cycle. Age at first reproduction is poorly known. Comparative studies and experimentation are needed to resolve questions of this basic life history trait.
5. Seasonal movements, encounter rates among potential mates and competitors, movement by mated pairs, and takeover attempts all need to be documented to test golden crab mating strategies.
6. Habitat preferences. Basic ecological questions concerning physiological ecology, refuges and foraging habits, trophic dynamics and community relationships remain largely unanswered.
7. Home ranging versus nomadism needs to be examined.
8. Questions of basic physiology of deep-dwelling organisms, biogeography and systematics, or parasitology and symbiosis.

Additional fishery management related items include:

9. Estimate potential yield.
10. Document economic and social information of fishermen and dealers.
11. Document information on market structure, development, and consumer acceptance of product.
12. Determine whether there is any substitutability with other crustaceans.
13. Identification of existing bottom habitat suitable for golden crabs in the South Atlantic Council's area would be useful.
14. Biodegradable panel research - determine the rate at which specified material degrades and evaluate materials/methods to meet objective of degrading within 14-30 days.
15. Bioprofile sampling - data on size, molt and reproductive status, etc.
16. Gear impacts and refugia.

Pelagic Sargassum Habitat Research Needs:

Additional research is necessary to insure sufficient information is collected to support a higher level of description and identification of pelagic *Sargassum* habitat. In addition, research is needed to identify and evaluate existing and potential adverse effect on pelagic *Sargassum* habitat, including but not limited to, direct physical loss or alteration; impaired habitat quality or function; cumulative impacts from fishing; and non-gear related fishery impacts.

1. What is the areal abundance of pelagic *Sargassum* off the southeast U.S.?
2. Does the abundance change seasonally?
3. Can pelagic *Sargassum* be assessed remotely using aerial or satellite technologies (e.g., Synthetic Aperture Radar)?
4. What is the relative importance of pelagic *Sargassum* weedlines and oceanic fronts for early life stages of managed species?
5. Are there differences in abundance, growth rate, and mortality?
6. What is the age structure of reef fishes (e.g., red porgy, gray triggerfish, and amberjacks) that utilize pelagic *Sargassum* habitat as a nursery and how does it compare to the age structure of recruits to benthic habitats?
7. Is pelagic *Sargassum* mariculture feasible?

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8. What is the species composition and age structure of species associated with pelagic *Sargassum* when it occurs deeper in the water column?
9. Additional research on the dependencies of pelagic *Sargassum* productivity on the marine species using it as habitat.

Calico Scallop Research Needs:

1. Growth and mortality factors need further quantification to refine the critical size estimates.
2. The size frequency of individual calico scallop beds as they are fished, mature, and die is needed to further refine the minimum size specified.
3. There is a lack of information concerning the percentage of calico scallops that can be opened during an at-sea processing operation. The Council supports this research need because it addresses one of the issues and can be completed in a relatively short period of time and at low cost.
4. Survival rate of released calico scallops is required to further evaluate at-sea processing. There is at present only one boat processing at-sea but this could increase in the future. This research need addresses one of the issues and should be undertaken in the very near future given the low cost and short time frame required.
5. Information is needed to address the following areas concerning parasitic nematodes: (1) occurrence of the nematode; (2) survival of the nematode; (3) effect of processing, food handling, reconditioning and associated problems; and (4) consumer perception. Research on the parasitic nematode is aimed at addressing one of the issues and should be supported. Florida Sea Grant and the calico scallop fishing industry have expended some effort in this area.
6. The effect of ocean disposal of at-sea processing waste on the scallop beds should be investigated. Concern has been expressed that this could increase calico scallop losses due to predators. This addresses Issue Number 4 and given the potential increase in at-sea processing more information is needed by the Councils to properly evaluate the situation.
7. The effect of the removal of such a large quantity of hard substrate (shells) that could provide attachment sites for spat settlement should be investigated. This addresses one of the issues and it is recognized that this is a long-term research effort.

6.2.2 Interjurisdictional Prioritized Research Needs

The following habitat and select species specific research needs were identified in Special Report No. 62 published by the Atlantic States Marine Fisheries Commission "Prioritized Research Needs in Support of Interjurisdictional Fisheries Management" (ASMFC 1997).

American Shad and River Herring:

- Review studies dealing with the effects of acid deposition on anadromous alosids.
- Conduct turbine mortality studies and downstream passage studies.
- Determine the effects of pollution, passage impediments, and other anthropogenic impacts on all other life history stages of shad and river herring.
- Conduct and evaluate historical characterization of socio-economic development (potential pollutant sources and habitat modification) of selected shad rivers along the east coast.
- Identify and quantify potential American shad spawning and rearing habitat not presently utilized and conduct an analysis of the cost of recovery.

Atlantic Menhaden:

- Monitor fish kills along the Atlantic coast and use the NMFS Beaufort Laboratory as a repository for these reports.
- Study the ecological role of menhaden (predator/prey relationship, nutrient enrichment, oxygen depletion, etc.) in major Atlantic coast embayments and estuaries.
- Determine how loss / degradation of critical estuarine and nearshore habitat affects growth, survival and abundance of juvenile Atlantic menhaden.

Atlantic Sea Herring:

- Establish critical spawning habitat areas or special management zones to protect spawning aggregations of herring and/or demersal egg masses.

Atlantic Sturgeon:

- Standardize and obtain baseline data on habitat for important sturgeon rivers. Data should include assessment of spawning and nursery habitat.
- Establish environmental tolerance levels (D.O., pH, temperature, etc.) for different life stages.
- Determine the effects of contaminants on early life stages.

Red Drum:

- Determine habitat preferences, growth rates, and food habits of larval and juvenile red drum.
- Quantify relationships between red drum production and habitat.
- Identify the effects of water quality degradation on red drum production.
- Determine the methods for restoring red drum habitat and/or improving existing environmental conditions that adversely affect red drum production.
- Determine the impacts dredging nearshore and offshore sand bars for beach renourishment on red drum spawning activity. In addition, the impacts of any type of dredging activity on all life history stages of red drum.

Spanish Mackerel:

- Conduct migration studies to determine normal Spanish mackerel migration routes and changes therein, and the climatic or other factors responsible for the changes in the environmental and habitat conditions which may effect the habitat and availability of stocks.

Spotted Seatrout:

- Identify essential habitat requirements.

Red Drum:

1. Conduct standardized fishery independent sampling of subadult red drum on an interstate basis to develop a long term index of recruitment.
Improve catch, effort and length frequency statistics from the recreational and commercial fisheries.
2. Conduct tagging studies to estimate fishing and total mortality, and to determine inshore/offshore migration patterns.
Research efforts on adult red drum should focus on the definition of unit stock for red drum in the South Atlantic using methods such as mark-recapture and genetic discrimination.

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Determine escapement levels of juvenile red drum to the spawning stock by state.

3. Develop a more reliable estimate of natural and fishing mortality and minimum size in managing fisheries.
4. Examine the effectiveness of controlling fishing mortality and minimum size in managing fisheries.
5. Quantify relationships between red drum production and habitat.
6. Increase intercepts of recreational fishermen through the MRFSS who fish nighttime hours.
7. Maintain annual length age keys.
Determine the survival rate of released red drum.
8. Research on stock assessment should focus on genetic implications and cost benefits. The introduction of unmarked fish should be discouraged until present efficacy of such an approach is validated.
 - Determine Habitat preferences, environmental conditions, growth rates and food habits of larval and juvenile red drum.
Identify the effects of water quality degradation on red drum production.
 - Determine the methods for restoring red drum and/or improving existing environmental conditions that adversely affect red drum production.
9. States with significant fisheries should be encouraged to collect socio-economic data on red drum fisheries through ad-ons to the MRFSS or by other means so as to determine the economic value of the Atlantic coast recreational red drum fishery.
10. Assess the effects of environmental factors on stock densities.
11. Document and characterize schooling behavior for Atlantic coast red drum.
 - Determine the impacts of dredging nearshore and offshore sand bars for beach renourishment for red drum spawning activity. In addition, the impacts of any type of dredging activity on all life history stages of red drum.
12. Conduct yield modeling on red drum.
Refine maturity schedules between sampling programs, determine relationships between annual egg production and female length/weight. And determine spawning areas in order to increase accuracy and precision of SSBR estimates.

Prioritized Research Needs for Spanish Mackerel

High Priority:

- Length, sex, age and CPUE data are needed to improve the stock assessment accuracy. Simulations on CPUE trends should be explored and impacts on VPA and assessment results determined. Data collection is needed for all states, particularly those north of North Carolina.
- Weight and especially length at age for Spanish mackerel needs to be evaluated.
- Develop fishery independent methods of monitoring stock size of Atlantic Spanish mackerel (consider aerial surveys used in south Florida waters).
- More timely reporting of mid-Atlantic catches is needed for quota monitoring.
- Provide better estimates of recruitment , natural mortality rates, fishing mortality rates, and standing stock. Specific information should include an estimate of total amount caught and distribution of catch by area , season and type of gear.
- Methodology for predicting year class strength should be developed, and the relationship between larva abundance and subsequent year class strength should be examined and defined.

Medium Priority:

- Yield per recruit analyses need to be conducted relative to alternative selective fishing patterns.
- Determine the bycatch of Spanish mackerel in the directed shrimp fishery in the Atlantic coastal waters.
- Evaluate the potential bias of the lack of appropriate stratification of the data used to generate age-length keys for Atlantic and Gulf Spanish mackerel.
- Evaluation of CPUE indices related to standardization methods and management history, with emphasis on greater temporal and spatial resolution in estimates of CPUE.
- Encourage the considerations of MRFSS ad-ons or other mechanisms for the collection of socioeconomic data for recreational and commercial fisheries.
- Conduct migration studies to determine normal Spanish mackerel migration routes and changes therein, and the climactic or other changes responsible for changes in the environmental and habitat conditions which may effect the habitat or availability of the stocks.
- Determine if any the migration of prey species (i.e., the engraulids, clupieds, carangids), and the migration patterns of the Spanish mackerel stock.

Low Priority:

- Identification of Spanish mackerel stocks through multiple research techniques needs to be compiled.
- Research needs to be completed on the application of assessment and management models relative to dynamic species such as Spanish mackerel.
- Temporal and spatial sampling to delineate spawning areas and areas of larval abundance should be initiated.

6.2.3 Research on the Effects of Fishing Activities

The effects of fishing are the subject of numerous, mostly site specific and fishery specific, investigations that focus largely on economic and social factors. Most early fisheries management efforts deal with increased yields, gear, and identifying and locating new target species and markets. With the world wide decline of many fish stocks emphasis has shifted, in recent years, to stock management and recovery. This change in management emphasis has gradually led to realization that reductions in the size and quality of fishery habitats have reached critical levels. It has also furthered the view that, in certain situations, fishing itself may be profoundly changing the physical and biological character of fish harvest and life requisite areas.

Trawling and other fishing activities that involve direct contact between fishing gear and the aquatic environment can alter the structural character of fish habitats. When the change is sufficient enough to preclude or limit use by fishery directed or target species, declines in catch abundance and individual fish size may occur. Although a clear cause and effect relationship is evident, determination of the level of effect inducted by physical change may be complex. Relevant factors, in addition to the magnitude of the direct physical change, may include disturbance frequency and duration, seasonality, and other environmental, ecological, and physiological processes that control recovery and recruitment of requisite species of the community. As noted by Auster and Langton (1998) "... mobile fishing gear reduced habitat complexity by (1) directly removing epifauna or damaging epifauna leading to mortality, (2) smoothing sedimentary bedforms and reducing bottom roughness, and (3) removing taxa which produce structure (i.e., taxa which produce burrows and pits)."

6.0 Essential Fish Habitat Research Needs

Primary information is lacking for us to strategically manage fishing impacts on Essential Fish Habitat without invoking precautionary measures. Priority studies should include a number of areas where primary data are lacking, which would allow better monitoring and improved experimentation, ultimately leading to predictive capabilities including:

- The spatial extent of fishing induced disturbance. While many observer programs collect data at the scale of single tows or sets, the fisheries reporting systems often lack this level of spatial resolution. The available data makes it difficult to make observations, along a gradient of fishing effort, in order to assess the effects of fishing effort on habitat, community, and ecosystem processes.
- The effects of specific gear types, along with a gradient of effort on specific habitat types. These data are the first order needs to allow an assessment of how much effort produces a measurable level of change in structural habitat components and the associated communities.