

COASTAL SURVEY

The SEAMAP - South Atlantic Coastal Survey, funded by the National Marine Fisheries Service (NMFS) and conducted by the South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD), began in 1986. This survey provides long-term, fishery-independent data on the distribution and relative abundance of resident and transient fishes, elasmobranchs, decapod and stomatopod crustaceans, sea turtles, horseshoe crabs, and cephalopods that are accessible by high-rise trawls. Twenty-three finfish, four decapod species, all marine turtles, all coastal shark species, and horseshoe crabs were selected as priority species by the SEAMAP-SA Committee. Additional data recorded for priority species include measurements of length or width for all priority species, sex and individual weights for blue crab, sharks, sea turtles, and horseshoe crabs, and reproductive information on commercially important penaeid shrimp and blue crabs.

Samples are taken by trawl from the coastal zone of the South Atlantic Bight (SAB) between Cape Hatteras, North Carolina, and Cape Canaveral, Florida (Figure 1). Multi-legged cruises are conducted in spring (early April - mid-May), summer (mid-July - early August), and fall (October - mid-November).

Stations are randomly selected from a pool of stations within each stratum. From 1989 through 2000, stations were initially selected using proportional allocation. In 2001, the method of allocation changed to optimal allocation and the number of stations allocated to each stratum was determined annually. From 2001 to 2008, a total of 102 stations are sampled each season (306 stations/year) within twenty-four shallow water strata, representing an increase from 78 stations previously sampled in those strata by the trawl survey (1990-2000). In 2009, the number of stations sampled each season increased to 112 (336 total). Strata are delineated by the 4 m depth contour inshore and the 10 m depth contour offshore. In previous years (1990-2000), stations were sampled in deeper strata with station depths ranging from 10 to 19 m in order to gather data on the reproductive condition of commercial penaeid shrimp. Twenty-seven stations located within ten outer strata in the southern half of the SAB were sampled in spring to collect data on spawning of white shrimp. Sixteen additional stations in the seven outer strata off North Carolina were sampled in fall to gather data on the reproductive condition of brown shrimp. No stations in the outer strata were sampled in summer. Outer strata were abandoned in 2001 in order to intensify sampling in the more shallow depth-zone.

Historical Table

Pilot Phase	1986	<ul style="list-style-type: none"> Participating states sample their respective coastal waters Stratified random sampling design Daylight sampling in November-December with 35' high-rise nets Trawl samples sorted to species with each species weighed and the individuals counted and measured.
	1987 to 1988	<ul style="list-style-type: none"> SCDNR took over all sampling in South Atlantic Bight (Cape Canaveral, FL to Cape Hatteras, NC) Fixed-station sampling design Day/night sampling in monthly cruises of ~ 7 sea days with 75' mongoose-type falcon trawls Priority species sorted, weighed and measured. Non-priority species divided into taxonomic groups and each group weighed.
Full Survey	1989	<ul style="list-style-type: none"> Number of stations proportionally allocated to area of each stratum (2 to 8 per stratum). Stations initially randomly selected, with stations sampled during all cruises Night sampling (Spring); Daylight sampling (Summer and fall) 24 inner (15-30 ft), 24 outer strata (30-60 ft) Contents of each trawl sorted to species. Total biomass and number of individuals recorded for all finfish species, elasmobranchs, decapod and stomatopod crustaceans, and cephalopods. Priority species weighed collectively and individual lengths recorded. Additionally Penaeid shrimp: total length, sex, ovarian development, spermatophore development, and occurrence of mated females; Blue crab: Carapace width, weight, sex, maturity, and presence and developmental stage of eggs; Sharks: weighed, total length and fork length, and sex noted (1994-present); Marine turtle measurements and tagging.
	1990 to 2000	<ul style="list-style-type: none"> Daylight sampling during seasonal cruises (Spring, Summer, Fall) 24 inner strata sampled all cruises. 10 outer strata in southern half of the SAB sampled in spring, and 7 outer strata off North Carolina sampled in fall Stations were sampled in deeper strata with station depths ranging from 10 to 19 m.
	1998 to 2000	<ul style="list-style-type: none"> Additional stations added to all strata to create pool of trawlable sites. Stations chosen randomly from pool in each stratum. Number of stations sampled within each stratum fixed.
	2001 to 2008	<ul style="list-style-type: none"> Outer strata sampling eliminated. Number of stations sampled within each stratum selected annually by optimal allocation. Random selection of stations within each stratum. Total number of stations sampled in inner strata each season increased from 78 to 102 (306 stations/year). Sharks, marine turtles, and horseshoe crabs added to priority species list. Age and growth sampling for selected sciaenid species (suspended in 2007, resumed in 2008). Sampling of stomach contents of weakfish in 2005 and 2006 Sampling of stomach contents of selected sciaenid species in 2008 and continued in subsequent years
	2009	<ul style="list-style-type: none"> Total number of stations sampled in inner strata each season increased from 102 to 112 (336 stations/year). Strata are delineated by the 4 m depth contour inshore and the 10 m depth contour offshore.
	2010	<ul style="list-style-type: none"> Sampling of stomach contents of Atlantic Croaker, Weakfish, and Southern Kingfish discontinued Sampling of diet of Bluefish, King Mackerel, and Spanish Mackerel added.
	2013	<ul style="list-style-type: none"> Sampling of gonad tissues of Atlantic Croaker, Weakfish, and Southern Kingfish discontinued. Diet study discontinued.

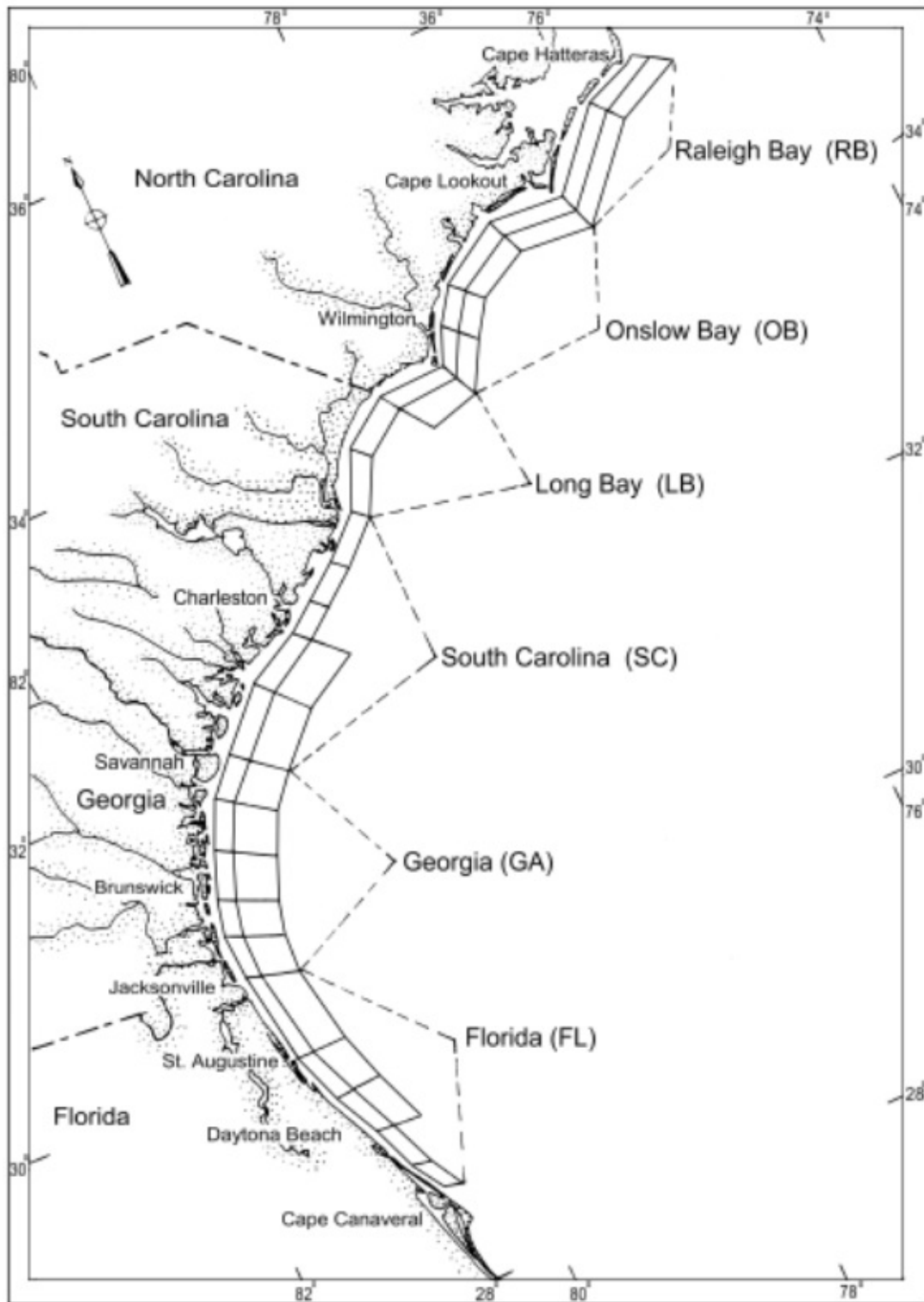


Figure 1. Strata sampled by the SEAMAP-SA Coastal Survey. Inner (shallow) strata sampled during all seasons throughout the survey. Outer (deep) strata were sampled (south in spring, north in fall) from 1990-2000. (Strata are not drawn to scale.)

NORTH CAROLINA RED DRUM LONGLINE SURVEY

DATA ACKNOWLEDGEMENT AND DATA CAVEATS

March 2013

I. ACKNOWLEDGEMENT

The following survey design, protocols, and data caveats are included to assist the data user in acquiring a thorough understanding of the survey before querying the SEAMAP-SA database for North Carolina's Division of Marine Fisheries (NCDMF) Red Drum Longline Survey (NC-LLS) data. The data user is responsible for reading all of the following text and fully comprehending every aspect of the requested data. Each requestor is solely accountable for any further analyses, manipulations, or presentations. It is also the responsibility of the data user to cite and acknowledge SEAMAP and the NC-LLS (see [SEAMAP-SA Intellectual Property protocol](#))

II. BACKGROUND

The NC-LLS is a National Marine Fisheries Service funded fishery-independent longline survey conducted by NCDMF since 2007. The primary objective of the NC-LLS is to develop a state specific sampling protocol that provides a fisheries independent index of abundance for adult red drum. Additional objectives of the NC-LLS include:

- To sample adult red drum and develop information on catch per unit effort (CPUE) and size, to collect migratory and stock identification data on adult red drum.
- To evaluate the age composition of adult red drum.
- To collect additional biological information and samples (otoliths, gonads, muscle, fin clips etc.) from a sub-sample of red drum that can be used to determine size at age, recruitment to adult spawning population, mercury contamination, and genetic composition of the stock.
- To disseminate accomplishments and results to the Atlantic States Marine Fisheries Commission (ASMFC) and National Marine Fisheries Service (NMFS) for inclusion in stock assessment efforts.

This survey will provide North Carolina with the resources necessary to develop a fishery independent index of abundance for adult red drum occurring in state waters that will be used in future stock assessment work. Tagging of red drum captured during the study will allow for additional information on migratory behavior and stock identification. Collection of age structures will provide insight on escapement rates from specific cohorts and provide a means to evaluate the age structure of the adult population.

III. METHODOLOGY

Study Area

This survey employs a stratified-random sampling design based on area and time. Areas chosen for sampling were based on prior North Carolina Division of Marine Fisheries (NCDMF) mark and recapture studies, which indicate the occurrence of adult red drum within Pamlico Sound during the months of July through October. The study area includes the Pamlico Sound in an area ranging from Gull Island to Hatteras and Ocracoke inlets and the adjacent coastal areas near the inlets to the mouth of the Neuse and Bay rivers. This area was overlaid with a one-minute by one-minute grid system (equivalent to one square nautical mile). Grids across the area were selected for inclusion in the sampling universe if they intercepted with the 1.8 m (6 ft) depth contour based on the use of bathymetric data from National Oceanic and Atmospheric Association (NOAA) navigational charts and field observations. Other factors, such as obstructions, accessibility, and logistics, were considered when grids were selected. Finally, the sample area was divided into twelve similarly sized regions (Figure 1).

In order to stratify samples through space and time, two samples were collected from each of the twelve regions during each of three periods from mid-July to mid-October. Sample periods for each year can be seen in Table 1. Sampling begins no sooner than an hour before sunset and continues into the night. An average of four sets is collected per night.

When time allows, additional non-random exploratory samples are made during the study period in Pamlico Sound and also in the nearshore waters of the Atlantic Ocean from Ocracoke to Cape Hatteras.

Gear

Sampling is conducted using bottom longline gear. Lines are set and retrieved using hydraulic reels. Main lines consist of 500# test monofilament. All random samples are conducted with a 1,500-meter mainline with gangions placed at 15 meter intervals (100hooks/set). Stop sleeves are placed at 30 m intervals in order to prevent gangions from sliding down the ground line and becoming entangled when large species are encountered. Terminal gear is clip-on, monofilament gangions consisting of a 2.5 mm diameter stainless steel longline clip with a 4/0 swivel. Leaders on gangions consist of 200# monofilament with a 15/0 Mustad tuna circle hook. Gangions are placed on ground line at 15 m intervals allowing for a total of 100 hooks to be fished per set. Hooks are baited with readily with the standard being striped mullet and squid when striped mullet are unavailable. Sets are anchored and buoyed at each end. Soak times are kept short (~30 minutes) to minimize bait loss and to ensure that the red drum can be tagged in good condition.

Soak times, bait size, bait type, hook size, number of hooks, gangion length and distance between hooks are standardized as much as possible. One hundred hooks per set is the standard, although in rare instances, damage to lines or limited areas have resulted in shorter sets (i.e., less hooks). As a result, CPUE will be calculated as the number of red drum captured per hook (this assumes same soak times for all sets). Given the deterioration of bait and decreased fishing

power over time) soak times are standardized to be as close to 30 minutes as possible from time the last hook is deployed to the time the first hook is retrieved (work-up time could vary depending on species captured).

IV. RESULTS

Environmental and Habitat Data

Environmental and habitat data are recorded during the haul back of each-main line and include: location, duration/soak time, gear parameters, sediment size, bottom composition, depth, surface and bottom temperature (°C), surface and bottom salinity (ppt), surface and bottom dissolved oxygen (mg/L), weather description, wind direction, wind speed (knots), and location (lat-longs in degrees, minutes seconds) of tagged and released fish. For more details on how parameters were measured and recorded see the [North Carolina Red Drum Longline Survey Parameters and Variables](#) document.

Catch Data

All individuals captured were processed at the species level and were measured to the nearest millimeter for either fork or total length according to the morphology of the species. Hook location and species condition (alive or dead) were also recorded. Red drum and selected shark species were tagged and released. Each red drum was tagged with both an external Hallprint stainless steel dart tag (SSD) and an internal Passive Integrated Transponder (PIT) tag. PIT tags provide a means to monitor tag loss/non-reporting and also provide an internal means to means to monitor recaptures within the study (i.e., the public cannot detect and remove a PIT tag unlike SSD tags). The presence or absence of drumming sounds was noted for all red drum captured. Selected red drum species were retained and taken to the lab where age structures (otoliths) were removed and sex was determined. For sacrificed fish, stomach contents were removed and frozen. Stomachs were later worked up and each prey item in the stomach was identified to the most detailed taxonomic level possible, enumerated and weighed. Genetic material (fin clip) was removed for later processing from all red drum captured. All finclips were sent to SCDNR for further processing and analysis.

Table 1. North Carolina Red Drum Longline Survey (NC-LLS) historical sampling periods.

Sample Year	Sample Period
2007	<ul style="list-style-type: none"> • Period 1 - July 23 to August 8 • Period 2 - August 13 to September 7 • Period 3 - September 10 to October 5
2008	<ul style="list-style-type: none"> • Period 1 - July 14 to August 8 • Period 2 - August 9 to September 6 • Period 3 - September 7 to October 10
2009	<ul style="list-style-type: none"> • Period 1 - July 20 to August 10 • Period 2 - August 11 to September 10 • Period 3 - September 11 to October 1
2010	<ul style="list-style-type: none"> • Period 1 - July 21 to August 10 • Period 2 - August 11 to September 10 • Period 3 - September 11 to October 11
2011	<ul style="list-style-type: none"> • Period 1 - July 21 to August 10 • Period 2 - August 11 to September 9 • Period 3 - September 10 to October 4
2012	<ul style="list-style-type: none"> • Period 1 - July 25 to August 13 • Period 2 - August 21 to September 12 • Period 2 - September 13 to October 3

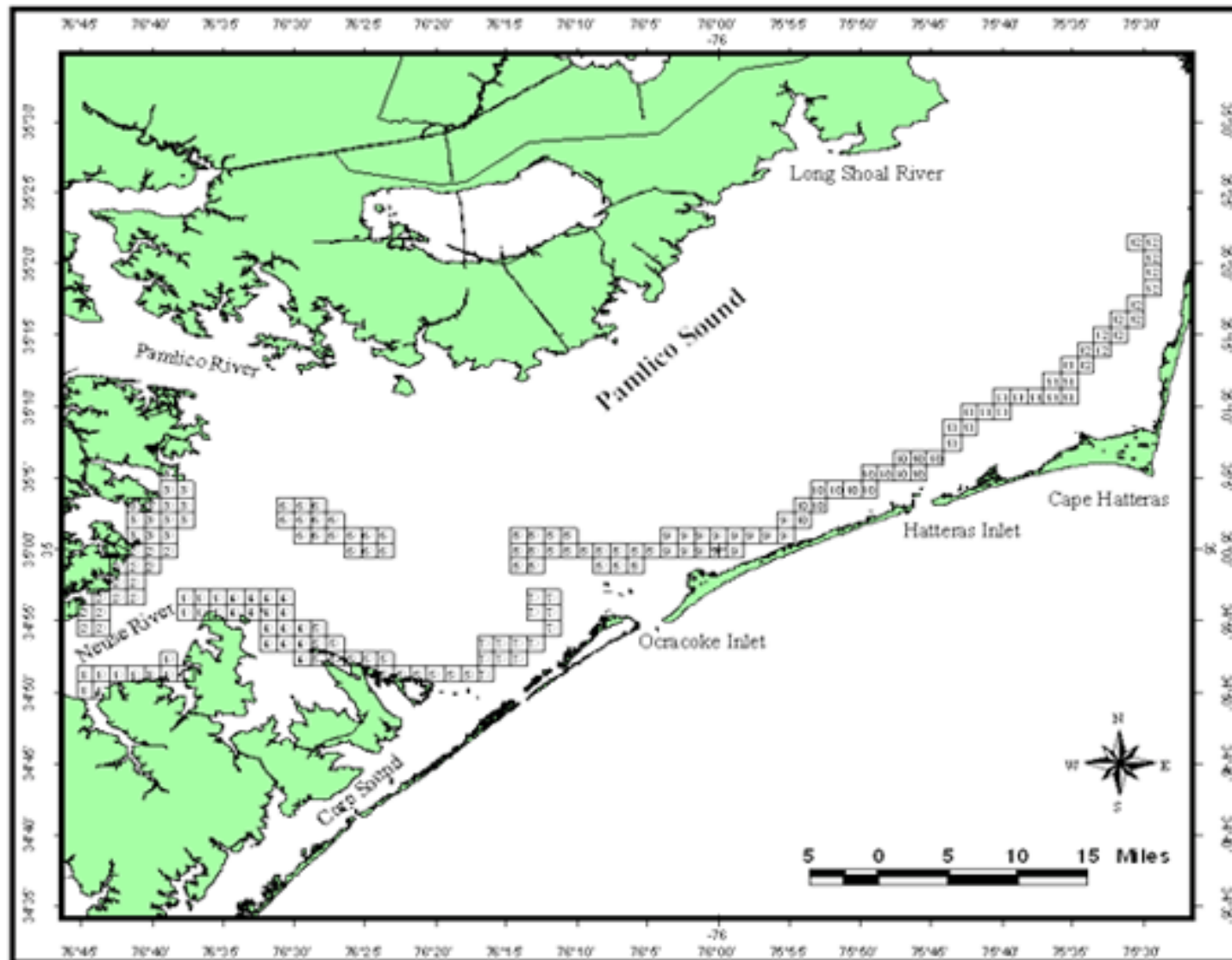


Figure 1. The random grid system and sample regions used in the North Carolina Red Drum Longline Survey.

Reef Fish Survey

DATA ACKNOWLEDGMENT AND DATA CAVEATS

November 2013

I. ACKNOWLEDGMENT

The following survey design, protocols, and data caveats are included to assist the data user in acquiring a thorough understanding of the survey before querying the SEAMAP-SA database for South Carolina Department of Natural Resources – Marine Resources Division (SCDNR-MRD) MARMAP program data. The data user is responsible for reading all of the following text and fully comprehending every aspect of the requested data. Each requestor is solely accountable for any further analyses, manipulations, or presentations. It is also the responsibility of the data user to cite and acknowledge SEAMAP-SA and MARMAP (see [SEAMAP-SA Intellectual Property protocol](#))

II. BACKGROUND

For over 40 years the Marine Resources Research Institute (MRRI), through the Marine Resources Monitoring, Assessment and Prediction (MARMAP) program, has conducted fisheries-independent research on groundfish, reef fish, ichthyoplankton, and coastal pelagic fishes within the region between Cape Lookout, North Carolina, and Cape Canaveral, Florida. The overall mission of the program has been to determine distribution, relative abundance, and critical habitat of economically and ecologically important fishes of the South Atlantic Bight (SAB), and to relate these features to environmental factors and exploitation activities. Research toward fulfilling these goals has included trawl surveys (from 6-350 m depth), ichthyoplankton surveys, location and mapping of reef habitat, sampling of reefs throughout the SAB, life history and population studies of priority species, tagging studies of commercially important species and special studies directed at specific management problems in the region. Survey work has also provided a monitoring framework that has allowed for the standardized sampling of fish populations over time, and development of an historical base for future comparisons of long-term trends in relative abundance and life history parameters. The trend data are critical for use in stock assessments, and greatly enhance the assessment of abundance of many reef species within the region.

Major field and laboratory efforts since 1990 were directed at economically valuable reef fishes. The purpose was to continue monitoring relative abundance of reef fish populations in the SAB using standardized methods, as well as developing monitoring techniques to reduce manpower needed for surveys of these habitats. Reef habitats in depths of 15-200 m support many species of sessile and motile invertebrates, as well as a great diversity of fishes. Reef fishes of economic importance include black sea bass (*Centropristis striata*), gag (*Mycteroperca microlepis*), scamp (*M. phenax*), *Epinephelus* groupers, red snapper (*Lutjanus campechanus*), vermilion snapper (*Rhomboplites aurorubens*), red porgy (*Pagrus pagrus*) and other porgies (*Calamus* spp.), triggerfishes (*Balistes* spp.), white grunt (*Haemulon plumieri*), tilefish (*Lopholatilus chamaeleonticeps*), and blueline tilefish (*Caulolatilus microps*). Also included are species of

potential commercial importance such as tomtate (*Haemulon aurolineatum*), bank sea bass (*Centropristis ocyurus*), and blackbelly rosefish (*Helicolenus dactylopterus*). Many of these species are included in the SAFMC snapper-grouper management complex (SAFMC, 2011).

Over the years, areas of improvement within the MARMAP program have been identified, primarily through the SEDAR process, an integrated stock assessment process that provides a critical review and research recommendations for the data inputs used for stock assessments. The two most frequent recommendations to improve the MARMAP program have been to increase sampling at the northern and southern ends of the sampling area (the MARMAP program is headquartered in Charleston, SC), and to increase sampling in waters less than 90 ft deep. In addition, a need for data to support Ecosystem Based Fisheries Management, in particular diet information, was identified as a priority area. Finally, several stock assessments identified the lack of data on juvenile stages of important reef fishes as a research deficiency for developing indices of abundance for early life stages, in particular those with estuarine dependent early life stages, such as gag grouper.

The primary objectives of the project were to enhance the fishery-independent reef fish data collected by MARMAP by increasing sampling in under-represented regions of the sampled area. In particular, efforts concentrated on:

1. Adding live bottom, reef and deepwater reef sampling areas to the current MARMAP database, and include these sites for sampling and incorporation of the data into the fishery-independent indices of abundance calculated for reef fish species. Particular focus was on supplementing the existing MARMAP reef fish survey with additional samples collected from live bottom habitats in waters less than 90 ft deep, and shelf break and deepwater reefs in the northern and southern portions of the sampling area. In addition, efforts were aimed at obtaining additional life history data from specimens associated with the new locations for incorporation into regional descriptions of the life history of reef fish species.
2. Conducting gut content analyses on reef fish species of interest for incorporation into ecosystem models and ecosystem based fisheries management.
3. Monitoring the ingress of reef fish larvae into estuaries along the Atlantic coast of the southeastern United States. Specifically, investigating the use of estuarine habitats by larval and juvenile reef fish species, and (if appropriate) begin to develop a pre-recruit index of abundance for these species, particularly gag grouper.
4. Management and processing of data aimed at incorporation of additional live bottom sites into a GIS database, procurement and integration of data acquisition software to allow the rapid and accurate measurement of sampled specimens, and incorporating the data into the SEAMAP-SA database.

III. METHODOLOGY

Overview

The MARMAP fishery-independent reef fish survey is an annual fishery-independent survey of reef fish in the South Atlantic Bight (SAB), with particular emphasis on species included in the South Atlantic Fisheries Management Council's Snapper-Grouper Fishery Management Plan. MARMAP has been conducting the Survey along the continental shelf and shelf edge to provide necessary information for reliable stock assessments and evaluation of management plans. For each gear used, data include information regarding sampling (i.e. latitude, longitude, time of gear deployment, etc.) and information regarding the fish collected in each deployment or collection. The database currently contains data through the 2009 sampling year. Data from more recent years will be added to the database in the near future and can be obtained by contacting MARMAP (see information ****).

Standardized Gears Deployed:

Biology:

[Chevron trap](#) (1990-2009; code 324)

[Short-bottom longline](#) (previously called vertical longline; 1996-2009; code 061)

[Long-bottom longline](#) (previously called horizontal longline; 1996-2009; code 087)

[Florida Antillean trap](#) (1980-1989; code 074)

[Blackfish trap](#) (1977-1989; code 053)

Data Collected by Species:

Biomass, Abundance, and Length Frequency by species for all species collected (for each deployment)

Age/Growth and Reproductive Parameters for individual fish of selected species.

How Data Is Provided:

Project codes denote sampling performed by the MARMAP (P05).

Catch codes denote the purpose and results of sampling:

Code	Purpose	Result
0	Monitoring	No catch
1	Monitoring	Catch of finfish
2	Monitoring	Catch without finfish.
3	Monitoring	Gear lost or damaged – no catch
4	Monitoring	Catch inadvertently mixed or lost
6	Monitoring	Gear damaged or moved – catch questionable
7	Monitoring	CTD deployment
8	Monitoring	Finfish sub-sampled
9	Reconnaissance	Catch result denoted by second digit when available
90, 91, 92,...,98	Reconnaissance (denoted by 1 st digit)	Catch denoted by 2 nd digit, as above

Individual gear deployments can be tracked by their unique Event code, which is a concatenation of the project code, collection number, and gear code.

Abundance, biomass, and length frequency can be linked to collection information through the unique Event and a species ID.

Age/Growth and reproductive parameter data can be linked to collection information, abundance, biomass, and length frequency through the unique Event, species ID, and specimen number (PCGSS).

GEORGIA RED DRUM LONGLINE SURVEY

DATA ACKNOWLEDGEMENT AND DATA CAVEATS

January 2014

I. ACKNOWLEDGEMENT

The following survey design, protocols, and data caveats are included to assist the data user in acquiring a thorough understanding of the survey before querying the SEAMAP-SA database for Georgia Department of Natural Resources' Coastal Resources Division (GADNR CRD) Red Drum Longline Survey (GA-LLS) data. The data user is responsible for reading all of the following text and fully comprehending every aspect of the requested data. Each requestor is solely accountable for any further analysis, manipulations, or presentations. It is also the responsibility of the data user to cite and acknowledge SEAMAP and the GA-LLS (see [SEAMAP-SA Intellectual Property protocol](#))

II. BACKGROUND

The GA-LLS is a National Marine Fisheries Service funded fishery independent longline survey conducted by GADNR CRD since 2006. The primary objective of the GA-LLS is to develop a state specific sampling protocol that provides a fisheries independent index of abundance for adult red drum. Additional objectives of the GA-LLS include:

- To sample adult red drum and develop information on catch per unit effort (CPUE) and size, to collect migratory and stock identification data on adult red drum.
- To evaluate the age composition of adult red drum.
- To collect additional biological information and samples (otoliths, gonads, muscle, fin clips etc.) from a sub-sample of red drum that can be used to determine size at age, recruitment to adult spawning population, mercury contamination, and genetic composition of the stock.
- To disseminate accomplishments and results to the Atlantic States Marine Fisheries Commission (ASMFC) and National Marine Fisheries Service (NMFS) for inclusion in stock assessment efforts.

This survey will provide Georgia with the resources necessary to develop a fishery-independent index of abundance for adult red drum occurring in state waters that will be used in future stock assessment work. Tagging of red drum captured during the study will allow for additional information on migratory behavior and stock identification. Collection of age structures will provide insight on escapement rates from specific cohorts and provide a means to evaluate the age structure of the adult population.

III. METHODOLOGY

Study Area

The nearshore red drum survey design encompasses state and federal waters off the coast of Georgia and northeast Florida, generally bounded by 32° 05' N latitude to the north, 29° 20' N latitude to the south, 80° 30' W longitude to the east, and the coastline to the west. Current sampling occurs in a smaller area in waters off the Altamaha River drainage in Georgia to the St. Johns River drainage in Florida (Figure 1).

Sampling will be conducted monthly from April through December. From April through August, 25 stations will be sampled each month in waters off southeast Georgia. From September through November, 35 stations will be sampled each month, 10 of which will be in waters off northeast Florida. Stations are randomly chosen from a subset of sites identified as areas with high encounter probabilities for April through August sampling events. From September through December, three strata are delineated off Georgia (inshore behind the ColReg lines; near shore <3nm from the beach; offshore <12 nm) and sampling efforts are proportionally allocated, to match the emigration pattern of adult reds. Stations sampled off Florida are randomly sampled from sites with high encounter probabilities. Maximum number of sampling days per month range from 5 (during months with 25 stations) to 6 (during months with 35 stations). All stations are sampled during daylight hours. Stations are generally located in water depths between 4 and 20 meters.

Gear

Bottom longline gear consisted of a 926 m mainline of 2.5 mm diameter monofilament nylon line anchored at both ends with weights of up to 50 lbs. Large orange surface floats labeled with agency identification information will be attached to each end of the mainline to enable pickup and retrieval of the longline. Up to 60 branch lines or gangions will be clipped to the bottom section of the longline at 15 m intervals. Stop sleeves are placed at 30 m intervals in order to prevent gangions from sliding down the mainline and becoming entangled when large species are encountered. Each gangion will consist of 0.7 m of 1.6 mm diameter monofilament nylon line terminated with either one 15/0 or one 12/0 circle hook. Hooks will have depressed barbs with no offset and be baited with squid. Only one longline will be deployed at any time. Soak times will be 30 minutes in duration, measured from second anchor deployed to first anchor retrieved. Soak times, bait size, bait type, hook size, number of hooks, gangion length and distance between hooks are standardized as much as possible.

Changes in Sampling Methodology

The GADNR CRD red drum longline survey has had some notable changes since its pilot study years during 2006 and 2007. These changes have included bait type, hook size and the inclusion of adaptive sampling. The timeline of changes made are outlined in in Table 1.

IV. RESULTS

Environmental and Habitat Data

Environmental and location data are recorded during when the line is being set. Variables measured include: start and end locations, duration/soak time, depth, surface temperature (°C), surface salinity (ppt), surface dissolved oxygen (mg/L), weather conditions, wind direction, wind speed (knots), and air temperature (°C).

Catch Data

All individuals captured were processed at the species level and were measured to the nearest millimeter for fork and total length. Hook size and species condition (alive or dead) were also recorded. Red drum and selected shark species were tagged and released. Each red drum was tagged with both an external Hallprint stainless steel dart tag (SSD) and an internal Passive Integrated Transponder (PIT) tag. PIT tags provide a means to monitor tag loss/non-reporting and also provide an internal means to means to monitor recaptures within the study (i.e. the public cannot detect and remove a PIT tag unlike SSD tags). The presence or absence of drumming sounds was noted for all red drum captured. Selected red drum species were retained and taken to the lab where age structures (otoliths) were removed and sex was determined. Genetic material (fin clip) was removed for later processing from all red drum captured. All finclips were sent to SCDNR for further processing and analysis.

Table 1. GA DNR Longline Survey Changes in Sampling Methodology. November 2006 – December 2011.

Bait Type	
Nov-Dec 2006:	Mackerel
Apr-Dec 2007:	50% of hooks mackerel, 50% squid
Apr 2008 – Present:	Squid
Hook Size	
Nov 2006 – Dec 2007:	15/0
Apr 2008 – present:	Equal split of 15/0 and 12/0
Sample Design	Random stratified based on Region (SGA and NFL) and Zone (Estuary, 0-3nm, 3-12nm, > 12nm). Grids ½ x ½ nm.
Nov 2006 – Dec 2008:	Adaptive. If 2 or more red drum captured, the adjacent site would also be sampled.
Sep-Dec 2009 – Present: (Fall only)	Adaptive
Sep-Dec 2007 – Present: (Fall only)	Allocation shift. Monthly station allocation shifts from inshore to offshore as the season progresses.

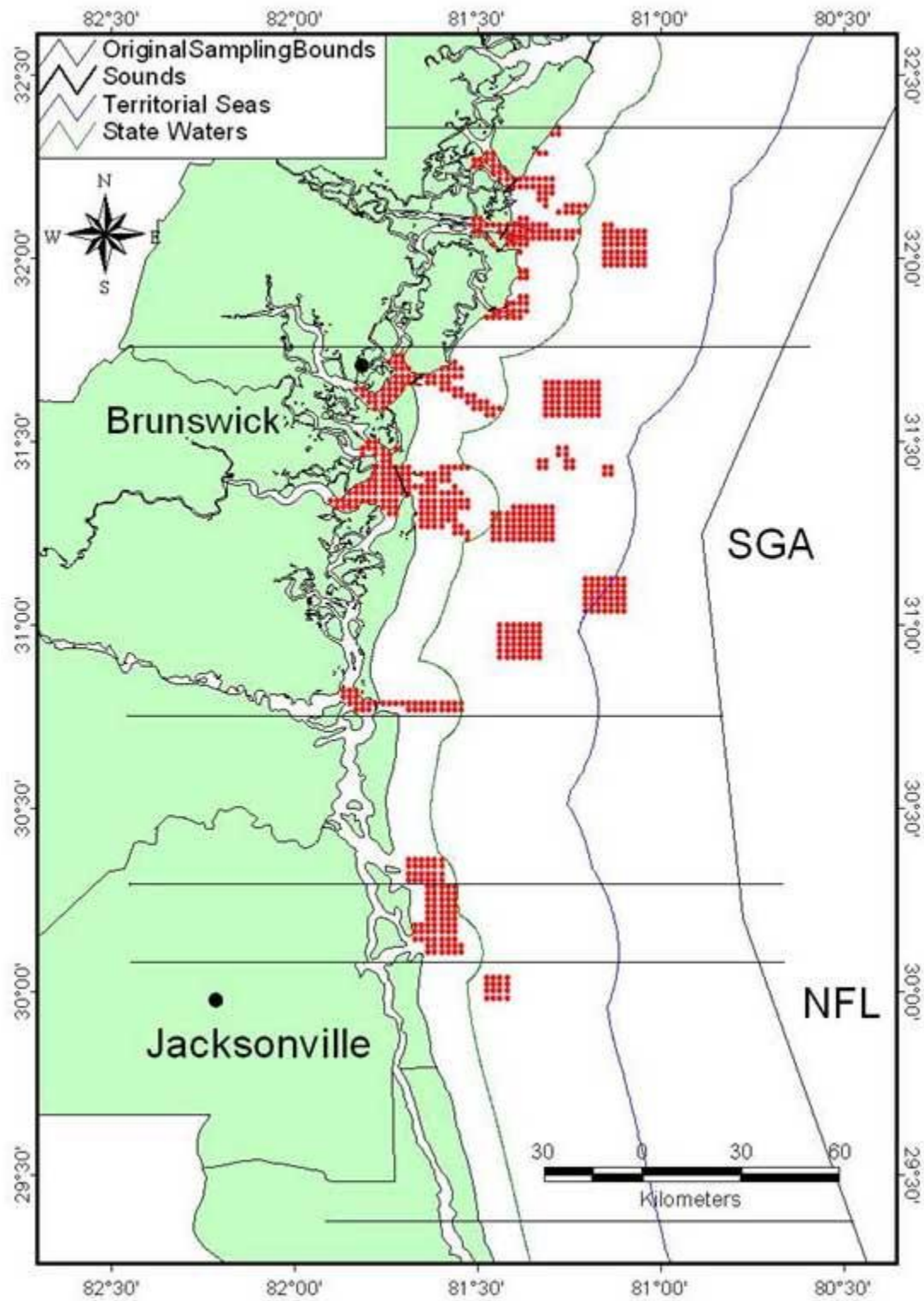


Figure 1. Georgia Longline Survey potential stations.

SOUTH CAROLINA RED DRUM/COASTAL SHARK LOGLINE SURVEY

DATA ACKNOWLEDGEMENT AND DATA CAVEATS

January 2014

I. ACKNOWLEDGEMENT

The following survey design, protocols, and data caveats are included to assist the data user in acquiring a thorough understanding of the survey before querying the SEAMAP-SA database for South Carolina's Department of Natural Resources (SCDNR) Red Drum/Coastal Shark Longline Survey (SC-LLS) data. The data user is responsible for reading all of the following text and fully comprehending every aspect of the requested data. Each requestor is solely accountable for any further analysis, manipulations, or presentations. It is also the responsibility of the data user to cite and acknowledge SEAMAP and the SC-LSS (see [SEAMAP-SA Intellectual Property protocol](#))

II. BACKGROUND

The SC-LLS is a National Marine Fisheries Service funded fishery independent longline survey conducted by SCDNR since 2007. The primary objective of the SC-LLS is to develop a sampling protocol that provides a fisheries independent index of abundance for adult red drum and various species of coastal sharks. Additional objectives of the SC-LLS include:

- To conduct fishery independent longline sampling on adult red drum to develop information on catch per unit effort (CPUE).
- To collect biological information (size, sex, etc.) and samples (otoliths, gonads, fin clips etc.) from subsamples of the red drum catch in order to determine size at age, recruitment to the spawning population, and genetic composition of the stock.
- To tag adult red drum for the collection of migratory and stock identification data.
- To tag and measure small coastal and large coastal sharks, caught incidentally to red drum sampling, for inclusion in the COASTSPAN (Cooperative Atlantic States Shark Pupping and Nursery Survey) database.
- To disseminate accomplishments and results to the Atlantic States Marine Fisheries Commission (ASMFC) and National Marine Fisheries Service (NMFS) for inclusion in stock assessment efforts.

This survey will provide South Carolina with the resources necessary to develop a fishery-independent index of abundance for adult red drum occurring in estuarine and nearshore waters that will be used in future stock assessment work. Tagging of red drum, otolith ageing, and genetic analysis of tissue will allow for additional information on migratory behavior, stock

identification, and escapement rates from specific cohorts as well as provide a means to evaluate the age structure of the adult population.

III. METHODOLOGY

Study Area

Four major estuaries (Winyah Bay, Charleston Harbor, Saint Helena Sound, and Port Royal Sound) along the coast of South Carolina are sampled with equal effort and frequency (Figure 1). During each time period, 30 locations are selected at random from a pool of predetermined locations. Locations within strata were initially identified from previous sampling efforts, suggestions from fishing guides, and from identification of habitat types similar to areas known to be productive. Figure 1 also shows the overlap of SC-LLS sites with two other estuarine sampling projects in SC: an electrofishing survey in brackish water rivers and a trammel net survey in shallow estuarine habitats. The overlap of these surveys allows for individual year classes of red drum to be tracked from the time they are juveniles until they join the adult population.

Beginning in 2007, 30 locations were selected at random from a pool of 54 (Winyah Bay), 40 (Charleston Harbor), 101 (St. Helena Sound) and 88 (Port Royal Sound) possible sites per stratum. Approximately equal sampling effort among the four strata has continued since 2007, the only changes being that some sampling locations have been added or deleted in each stratum as part of our exploration of suitable sampling habitat. And some locations had to be omitted simply on the basis of inaccessibility. Our current locations within site are as follows: 51 (Winyah Bay), 43 (Charleston Harbor), 81 (St. Helena Sound) and 78 (Port Royal Sound).

Since 2007, there have been some changes to the temporal sampling schedule (Table1). In 2007, sampling spanned from July through November. In 2008, sampling began in March and ended in December. In 2009, due to vessel problems early in the season, and low catches of red drum and sharks in the spring, the survey began in July. In 2010 and 2011, efforts were focused from late summer through late fall to maximize potential for catches of both red drum and coastal sharks, making most efficient use of funds. Also, time blocks were condensed beginning in 2010 from two months to six weeks (August 1 – September 15, September 16 – October 31, November 1 – December 15). The same number of locations continued to be sampled within each stratum per time period, but with a more focused effort during the time of increased likelihood of encountering both red drum and coastal sharks. While the decision was made to sample in the late summer through late fall, the use of three defined time periods has been implemented. Each of the four strata continues to be sampled equally during each time period (30 stations/stratum/time period).

Gear

The longline survey is conducted with bottom longline gear from the *R/V Silver Crescent*; a 52-foot shallow draft vessel equipped with two, 1-mile longline reels. Groundlines are constructed of 600 # test monofilament and are approximately 536 m long (0.33 mile stations). Stop sleeves are placed on the groundline at 30 m intervals. Terminal gear is clip-on, monofilament gangions spaced at 15 m intervals (120 and 40 hooks per line respectively). Gangions consists of a 2.5mm diameter stainless steel longline clip with 4/0 swivel, 0.5 m of 200# test monofilament and a

15/0, Mustad tuna circle hook. Approximately 10 – 14, 40-hook longline sets are made per day at a depth of 7–22 m during daylight hours. Hooks are baited with Atlantic mackerel (*Scomber scombrus*) or striped mullet (*Mugil cephalus*). The sets are anchored and buoyed at each end. Since the primary emphasis is on obtaining red drum and sharks in good condition for tagging, gear soak times are short (30 minutes). In live-bottom coastal waters, the rate of bait loss due to crabs and small fish is quite high and longer soak times would be unlikely to increase catch rates.

IV. RESULTS

Environmental and Habitat Data

For each location, soak time, number of hooks, wind direction, wind speed, and coordinates (lat-longs in degrees, minutes seconds) are recorded. Parameters measured at each location include water depth and air temperature (°C), and a YSI Pro 2030 field meter is used to determine water temperature (°C), salinity (ppt), and dissolved oxygen (mg/L) at a depth of approximately 2-3 meters.

Catch Data

All individuals captured were processed at the species level and were measured to the nearest millimeter (mm) for standard, fork, total length, or disc width (SL, FL, TL or DW), or a combination according to the morphology of the species.

Captured red drum are brought onboard to be measured (CL and TL in mm) and processed. Most fish are released alive. However, a small number are dead on arrival at the boat (DOA), and some fish are collected for brood stock (Charleston Harbor) or sacrificed for biological investigations (age, reproductive status, sex, stomach contents). If a red drum is drumming, it is noted. A fin clip sample is collected from each fish in order to identify stocked fish or recaptured individuals, and to investigate stock structure. Red drum are tagged with a Hallprint nylon dart tag beneath the second dorsal fin and a Passive Integrated Transponder (PIT) tag between the first and second dorsal fins, if they were not already tagged. If a red drum is recaptured, numbers of tags are recorded, and tags are replaced if they have been lost or damaged. If a red drum appears abnormally stressed, those individuals are released without tagging to increase chances for survival. All fish were scanned to detect the presence of a PIT tag in case the external tags had been lost.

Most coastal shark species (with the exception of sharpnose sharks and large nurse sharks) are tagged with external plastic cattle tags in the first dorsal fin, using a leather punch and tag applicator. Sharks that are too large to pull onto the boat are tagged with a stainless steel dart tag using a 6-foot long tagging pole.

Table 1. South Carolina Red Drum Longline Survey (SC-LLS) historical sampling periods.

Sample Year	Sample Period
2007	<ul style="list-style-type: none">• Period 1 - July 10 to August 9• Period 2 - September 13 to October 23• Period 3 - November 4 to November 20
2008	<ul style="list-style-type: none">• Period 1 – March 26 to April 30• Period 2 – May 13 to June 17• Period 3 – July 9 to August 19• Period 4 – September 12 to October 23• Period 5 – November 5 to December 4
2009	<ul style="list-style-type: none">• Period 1 - July 27 to August 14• Period 2 – October 5 to October 29• Period 3 – November 3 to November 20
2010	<ul style="list-style-type: none">• Period 1 – August 3 to September 15• Period 2 – September 29 to October 20• Period 3 - November 1 to December 15
2011	<ul style="list-style-type: none">• Period 1 – August 8 to September 13• Period 2 - September 23 to October 27• Period 3 - November 3 to November 21
2012	<ul style="list-style-type: none">• Period 1 - August 9 to September 12• Period 2 - September 26 to October 31• Period 2 - November 1 to December 3

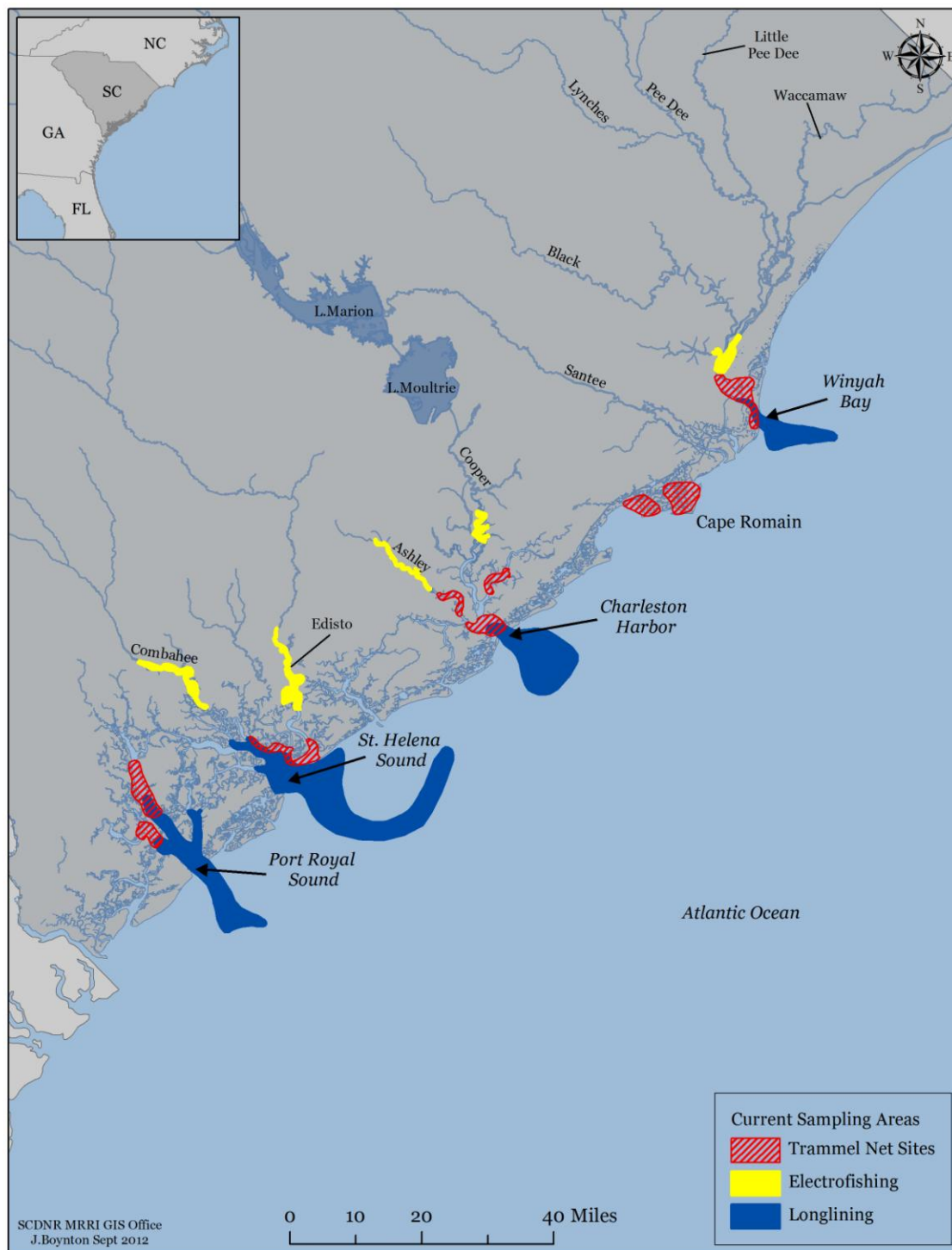


Figure. 1. Map of red drum sampling sites. Trammel net and electrofishing samples target sub-adult red drum, while longline efforts captured adult red drum. Recently trammel net sites were established in Port Royal Sound (southern most estuary); however, for the time frame of this report fish tagged in those efforts have probably not recruited to the adult population yet.

Coastal Survey

DATA ACKNOWLEDGEMENT AND DATA CAVEATS

February 2013

I. ACKNOWLEDGEMENT

The following survey design, protocols, and data caveats are included to assist the data user in acquiring a thorough understanding of the survey before querying the SEAMAP-SA database for South Carolina Department of Natural Resources – Marine Resources Division (SCDNR-MRD) Coastal Survey (CS) data. The data user is responsible for reading all of the following text and fully comprehending every aspect of the requested data. Each requestor is solely accountable for any further analyses, manipulations, or presentations. It is also the responsibility of the data user to cite and acknowledge SEAMAP and the CS (see [SEAMAP-SA Intellectual Property protocol](#))

II. BACKGROUND

The primary objective of the Coastal Survey (CS) is to provide long-term, fishery-independent data on the distribution and relative abundance of resident and transient fishes, elasmobranchs, decapod and stomatopod crustaceans, sea turtles, horseshoe crabs, and cephalopods that are accessible by high-rise trawls.

The CS began in 1986 with funding from the National Marine Fisheries Service (NMFS). The pilot phase of the CS was initiated in 1986 and participating states sampled their respective coastal waters. From 1987 to the present, SCDNR-MRD took over all sampling in the coastal zone of the South Atlantic Bight (SAB) between Cape Hatteras, North Carolina, and Cape Canaveral, Florida (Figure 1). The full scale CS began in 1989 (Table 1)

Sampling regimes have changed several times from the pilot phase to the present day CS. The first year of the pilot study, in 1986, daylight sampling was conducted from November to December. From 1987 to 1988, day and night sampling occurred during ~7 day monthly cruises. The first year of the full scale survey, in 1989, night sampling was conducted in the spring and daylight sampling was conducted in the summer and fall. From 1990 to present day, only daylight sampling is conducted during seasonal cruises in spring, summer, and fall (Table 1).

III. METHODOLOGY

Study Area

Initially, during the first year of the pilot phase in 1986, a stratified random sampling design was used. The last two years of the pilot phase, 1987 to 1988, a fixed-station sampling design was implemented. By the time the full scale survey began in 1989, the number of stations was proportionally allocated to the area of each stratum (2 to 8 per stratum) and stations were initially randomly selected with stations sampled during all cruises. From 1990 to 1997, all cruises

samples 24 inner strata (10 outer strata in the southern half of the SAB sampled in the spring, and 7 outer strata off North Carolina were sampled in the fall). From 1998 to 2000 additional stations were added to all strata to create a pool of trawlable sites and stations were chosen randomly from the pool of stations with a fixed number of stations sampled within each stratum. From 2001 to 2008 the total number of stations sampled in the inner strata each season increased from 78 to 102 (306 stations/year) and the outer strata sampling was eliminated in order to intensify sampling in the more shallow depth-zone. The number of stations sampled within each stratum was selected annually by optimal allocation and the random selection of stations within each stratum. In 2009 the total number of stations sampled in the inner strata each season increased to 112 (336 stations/year; Table 1).

From 1990 to present, the strata are delineated by the 4 m depth contour inshore and the 10 m depth contour offshore. In previous years (1990 to 2000), stations were sampled in deeper strata with station depths ranging from 10 to 19 m in order to gather data on the reproductive condition of commercial penaeid shrimp (Table 1).

Trawl Specifications

Tow duration is 20 minutes at 2.5 knots using the R/V *Lady Lisa* pulling a tow parried 75-ft (22.9-m) mongoose-type Falcon trawl nets (manufactured by Beaufort Marine Supply; Beaufort, S.C.) without TEDs. The R/V *Lady Lisa* is a 75-ft (23-m) wooden-hulled, double-rigged, St. Augustine shrimp trawler owned and operated by the South Carolina Department of Natural Resources (SCDNR). The body of the trawl is constructed of #15 twine with 1.875-in (47.6-mm) stretch mesh. The codend of the net is constructed of #30 twine with 1.625-in (41.3-mm) stretch mesh and is protected by chafing gear of #84 twine with 4-in (10-cm) stretch “scallop” mesh. A 300 ft (91.4-m) three-lead bridle is attached to each of a pair of wooden chain doors which measured 10 ft x 40 in (3.0-m x 1.0-m), and to a tongue centered on the head-rope. The 86-ft (26.3-m) head-rope, excluding the tongue, had one large (60-cm) Norwegian “polyball” float attached top center of the net between the end of the tongue and the tongue bridle cable and two 9-in (22.3-cm) PVC foam floats located one-quarter of the distance from each end of the net webbing. A 1-ft chain drop-back is used to attach the 89-ft foot-rope to the trawl door. A 0.25-in (0.6-cm) tickler chain, which is 3.0-ft (0.9-m) shorter than the combined length of the foot-rope and drop-back, is connected to the door alongside the foot-rope.

Each net is processed separately and assigned a unique collection number (port=odd, starboard=even); however, data from the paired trawls are pooled for analysis to form a standard unit of effort (tow), with the port (odd) collection number assigned to the tow.

IV. RESULTS

Environmental and Habitat Data

Environmental and habitat data were recorded during the haul back of each trawl and include: light phase, air, surface and bottom temperature (°C), surface and bottom salinity (ppt), start time, start and end depth (m), pressure (XXX), wind speed (knots), wind direction, wave height, precipitation, start and end latitude, and start and end longitude. For more details on how

parameters were measured and recorded (see the [Coastal Survey Parameters and Variables](#) document).

Catch Data

Twenty-three finfish, four decapod species, all marine turtles, all coastal shark species, and horseshoe crabs were selected as priority species (Table 2) by the SEAMAP-SA Committee. Additional data recorded for priority species include measurements of length or width for all, sex and individual weights for blue crab, sharks, sea turtles, and horseshoe crabs, and reproductive information on commercially important penaeid shrimp and blue crabs.

Contents of each net are sorted separately to species, and total biomass and number of individuals are recorded for all species of finfish, elasmobranchs, decapod and stomatopod crustaceans, cephalopods, sea turtles, xiphosurans, and cannonball jellies. Only total biomass is recorded for all other miscellaneous invertebrates (excluding cannonball jellies) and algae, which are treated as two separate taxonomic groups. Marine turtles are released in good condition according to NMFS permitting guidelines.

Where large numbers of individuals of a species occur in a collection, the entire catch is sorted and all individuals of that species are weighed, but only a random subsample consisting of 30 to 50 individuals is weighed and measured for length and a total number is calculated. For large trawl catches, the contents of each net are weighed prior to sorting and a randomly chosen subsample of the total catch is then sorted and processed. Total number is calculated by multiplying the number measured by the total weight/subsample weight ratio ($\text{Total number} = \text{number measured} \times (\text{total weight} / \text{subsample weight})$). The data from the two nets are combined to represent a tow.

Additional data are collected on individual specimens of penaeid shrimp (total length in mm, sex, female ovarian development, male spermatophore development, occurrence of mated females), blue crabs (carapace width in mm, individual weight, sex, presence and developmental stage of eggs), sharks (total and fork lengths in cm, individual weight, sex), horseshoe crabs (prosoma width and length in mm, individual weight, sex), and sea turtles (curved and straight lengths and widths in cm, individual weight, PIT and flipper tag numbers).

Gonad and otolith specimens from three sciaenid species (*Cynoscion regalis*, *Menticirrhus americanus*, *Micropogonias undulatus*) are also collected during seasonal cruises. A representative sample of specimens from each centimeter size range within each stratum are measured to the nearest mm (TL and SL), weighed to the nearest gram, and assigned a sex and maturity code. Sagittal otoliths and a representative series of gonadal tissue are removed, preserved, and transported to the laboratory at MRRI, where samples are processed. Age and growth sampling was suspended in 2007, due to funding shortfalls, but was resumed in 2008 (Table 1; see the [Coastal Survey Parameters and Variables](#) document).

Table 1. Coastal Survey (CS) Historical data

Pilot Phase	1986	<ul style="list-style-type: none"> • Participating states sample their respective coastal waters • Stratified random sampling design • Daylight sampling in November-December with 35' high-rise nets • Trawl samples sorted to species with each species weighed and the individuals counted and measured.
	1987 to 1988	<ul style="list-style-type: none"> • SCDNR took over all sampling in South Atlantic Bight (Cape Canaveral, FL to Cape Hatteras, NC) • Fixed-station sampling design • Day/night sampling in monthly cruises of ~ 7 sea days with 75' mongoose-type falcon trawls • Priority species sorted, weighed and measured. Non-priority species divided into taxonomic groups and each group weighed.
Full Survey	1989	<ul style="list-style-type: none"> • Number of stations proportionally allocated to area of each stratum (2 to 8 per stratum). Stations initially randomly selected, with stations sampled during all cruises • Night sampling (Spring); Daylight sampling (Summer and fall) • 24 inner (15-30 ft), 24 outer strata (30-60 ft) • Contents of each trawl sorted to species. Total biomass and number of individuals recorded for all finfish species, elasmobranchs, decapod and stomatopod crustaceans, and cephalopods. Priority species weighed collectively and individual lengths recorded. Additionally Penaeid shrimp: total length, sex, ovarian development, spermatophore development, and occurrence of mated females; Blue crab: Carapace width, weight, sex, maturity, and presence and developmental stage of eggs; Sharks: weighed, total length and fork length, and sex noted (1994-present); Marine turtle measurements and tagging. Total biomass recorded for all other miscellaneous invertebrates and algae.
	1990 to 2000	<ul style="list-style-type: none"> • Daylight sampling during seasonal cruises (Spring, Summer, Fall) • 24 inner strata sampled all cruises. 10 outer strata in southern half of the SAB sampled in spring, and 7 outer strata off North Carolina sampled in fall • Stations were sampled in deeper strata with station depths ranging from 10 to 19 m.
	1998 to 2000	<ul style="list-style-type: none"> • Additional stations added to all strata to create pool of trawlable sites. Stations chosen randomly from pool in each stratum. Number of stations sampled within each stratum fixed.
	2001 to 2008	<ul style="list-style-type: none"> • Outer strata sampling eliminated. Number of stations sampled within each stratum selected annually by optimal allocation. Random selection of stations within each stratum. Total number of stations sampled in inner strata each season increased from 78 to 102 (306 stations/year). • Sharks, marine turtles, and horseshoe crabs added to priority species list. Age and growth sampling for selected sciaenid species (suspended in 2007, resumed in 2008).
	2009	<ul style="list-style-type: none"> • Total number of stations sampled in inner strata each season increased from 102 to 112 (336 stations/year). Strata are delineated by the 4 m depth contour inshore and the 10 m depth contour offshore.

Table 2. List of priority species for the Coastal Survey

COMMON NAME	SCIENTIFIC NAMES
Finfish (1986-Present)	
American harvestfish	<i>Peprilus paru</i>
Atlantic croaker	<i>Micropogonias undulatus</i>
Atlantic menhaden	<i>Brevoortia tyrannus</i>
Atlantic spadefish	<i>Chaetodipterus faber</i>
black drum	<i>Pogonias cromis</i>
black sea bass	<i>Centropristis striata</i>
bluefish	<i>Pomatomus saltatrix</i>
butterfish	<i>P. triacanthus</i>
gag	<i>Mycteroperca microlepis</i>
gulf flounder	<i>Paralichthys albigutta</i>
Gulf menhaden	<i>Brevoortia smithi</i>
king mackerel	<i>Scomberomorus cavalla</i>
kingcroaker	<i>M. littoralis</i>
northern kingfish	<i>M. saxatilis</i>
red drum	<i>Sciaenops ocellata</i>
sheepshead	<i>Archosargus probatocephalus</i>
southern flounder	<i>P. lethostigma</i>
southern kingfish	<i>Menticirrhus americanus</i>
Spanish mackerel	<i>S. maculatus</i>
spotted hake	<i>Leiostomus xanthurus</i>
spotted seatrout	<i>Cynoscion nebulosus</i>
summer flounder	<i>P. dentatus</i>
weakfish	<i>Cynoscion regalis</i>
Marine Turtles (1989-Present)	
green sea turtle	<i>Chelonia mydas</i>
Kemp's ridley sea turtle	<i>Lepidochelys kemp</i>
leatherback sea turtle	<i>Dermochelys coriacea</i>
loggerhead Sea Turtle	<i>Caretta caretta</i>
Decapods (1989-Present)	
blue crab	<i>Callinectes sapidus</i>
brown shrimp	<i>Farfantepenaeus aztecus</i>
pink shrimp	<i>F. duorarum</i>
white shrimp	<i>Litopenaeus setiferus</i>
Sharks (1994-Present)	
All species	Elasmobranchs
Xiphosurans (1995-Present)	
Atlantic horseshoe crab	<i>Limulus polyphemus</i>

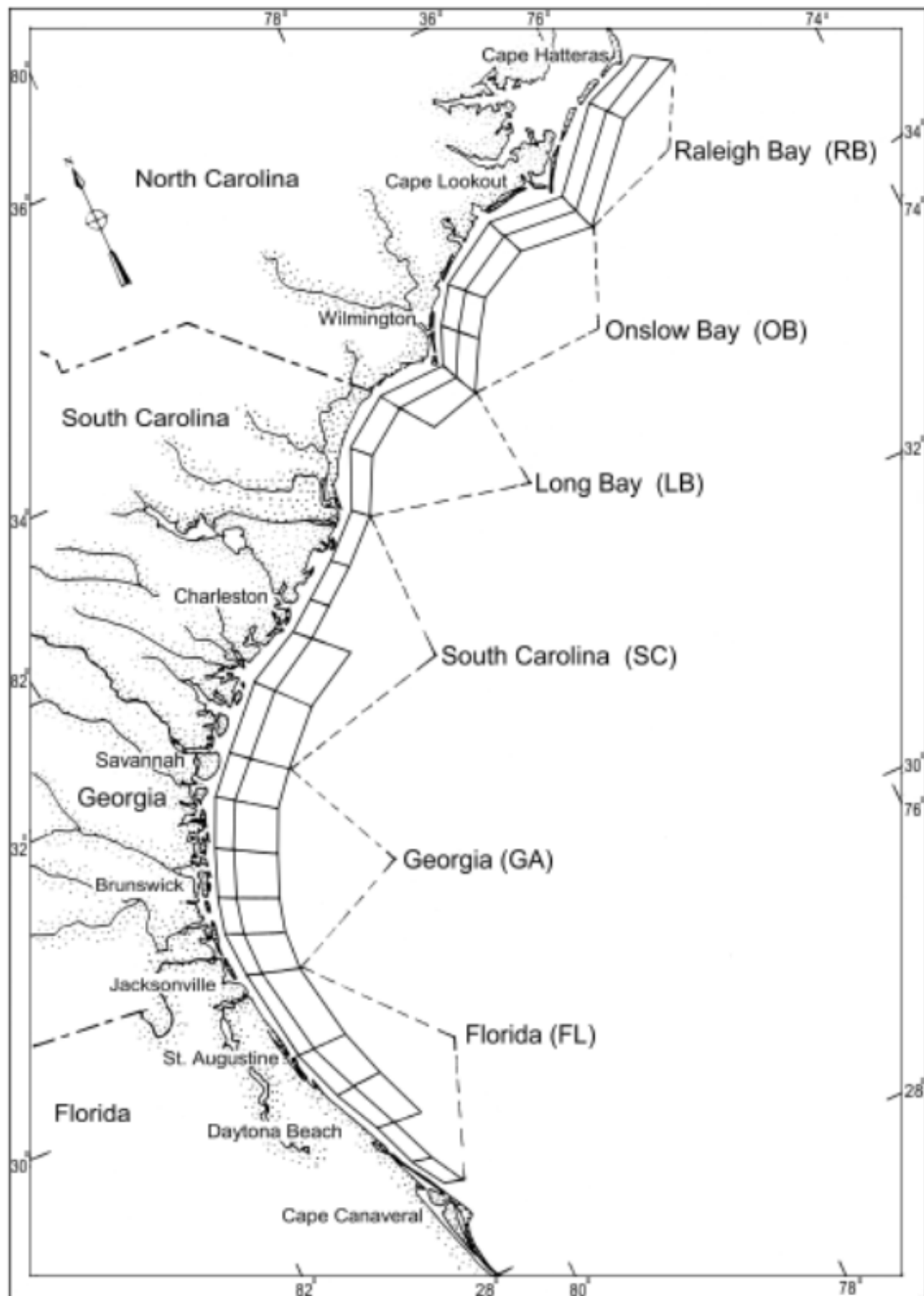


Figure 1. Strata sampled by the SEAMAP-SA Coastal Survey. Inner (shallow) strata sampled during all seasons throughout the survey. Outer (deep) strata were sampled (south in spring, north in fall) from 1990-2000. (Strata are not drawn to scale.)

PAMLICO SOUND SURVEY

DATA ACKNOWLEDGEMENT AND DATA CAVEATS

February 2013

I. ACKNOWLEDGEMENT

The following survey design, protocols, and data caveats are included to assist the data user in acquiring a thorough understanding of the survey before querying the SEAMAP-SA database for North Carolina's Division of Marine Fisheries (NCDMF) Pamlico Sound Survey (PSS) data. The data user is responsible for reading all of the following text and fully comprehending every aspect of the requested data. Each requestor is solely accountable for any further analyses, manipulations, or presentations. It is also the responsibility of the data user to cite and acknowledge SEAMAP and the PSS (see [SEAMAP-SA Intellectual Property protocol](#))

II. BACKGROUND

The primary objective of the Pamlico Sound Survey (PSS) is to produce fishery-independent indices of abundance for important recreational and commercial fisheries in Pamlico Sound.

The PSS began in March 1987 with funding from the North Carolina's Division of Marine Fisheries with additional funds provided by the SM-18 SEAMAP federal program. From 1990-2011, the funding has been provided from a federal Sport Fish Restoration F-42 grant to survey population parameters of marine recreational fishes in North Carolina.

The survey was initially included the Pamlico Sound and its bays, Croatan Sound, Roanoke Sound, Albemarle Sound east of a line from the mouth of Alligator River to the mouth of North River, the Pamlico River up to Bath Creek, and the Neuse River up to Minnesott Beach. In 1990 all Albemarle Sound strata were eliminated and the Pungo River was added. Now sampling occurs only in Pamlico Sound and associated rivers and bays (Figure 1).

All PSS sampling events have been conducted over a two week period. From 1987-1989 sampling was conducted quarterly during the months of March, June, September, and December. In 1990, December sampling was eliminated. From 1991 to the present, the PSS has been conducted during the months of June and September.

There were four years in which the survey did not occur over the same time series; 1988, 1999, 2003, and 2009. In 1988, the December leg of the cruise was partially extended into January 1989 because of scheduling conflicts and adverse weather conditions. In 1999, samples were collected during the month of July and the end of September and into October because vessel repairs and hurricanes prevented following the normal schedule. In September 2003, Hurricane Isabel caused a delay and sampling was completed two days in October. In September 2009, vessel repairs caused sampling to extend into the first week of October. This information as well as changes to environmental sampling, which will be discussed shortly, can be found in Table 1.

North Carolina Division of Marine Fisheries utilizes the PSS to calculate Juvenile Abundance Indices (JAI) for commercial and recreationally important species. The JAI is a critical component to any stock assessment because it provides an index of abundance that is independent of the commercial or recreational fisheries. The juvenile index is the annual geometric mean (weighted by strata) of the number of individuals per tow for young of the year (YOY), length cutoffs vary by month and species. Strata weights are as follows:

Post 1990 Weights for Strata

- Pamlico Sound Shallow East = 206.0;
- Pamlico Sound Shallow West = 135.0;
- Pamlico Sound Deep East = 554.0;
- Neuse River = 93.0;
- Pamlico River = 64.0;
- Pamlico Sound Deep West = 312.0;
- Albemarle Sound Deep = 61.0;
- Albemarle Sound Shallow = 59.0;
- Pungo River = 18.0;

Pre 1990 Weights for Strata

- Pamlico Sound Shallow East = 173.5;
- Pamlico Sound Shallow West = 105.5;
- Pamlico Sound Deep East = 521.5;
- Neuse River = 69.0;
- Pamlico River = 53.0;
- Pamlico Sound Deep West = 282.5;
- Albemarle Sound Deep = 56.0;
- Albemarle Sound Shallow = 54.0;

III. METHODOLOGY

Study Area

Fifty-two randomly selected stations (grids) are sampled during daylight, usually the second and third week of the cruise month. The stations sampled are randomly selected from strata based upon depth and geographic location. The seven designated strata (since 1990) are: Neuse River; Pamlico River; Pungo River; Pamlico Sound east of Bluff Shoal, shallow and deep; and Pamlico Sound west of Bluff Shoal, shallow and deep (Figure 1). Shallow water is considered water depth between 6-12 feet and deep water is considered water greater than 12 feet depth.

Initially stations were originally allocated in proportion to the size of the strata (1987-1988). Beginning in March 1989, the randomly drawn stations are optimally allocated among the strata based upon all the previous sampling in order to provide the most accurate abundance estimates (PSE <20) for selected species. A minimum of three stations (replicates) is maintained in each strata. A minimum of 104 stations is trawled per year.

Trawl Specifications

A similar net design to the SEAMAP Shallow Water Trawl Survey is used. Tow duration is 20 minutes at 2.5 knots using the R/V Carolina Coast pulling double rigged 30 ft (9.14-m) mongoose-type Falcon trawls (manufactured by Beaufort Marine Supply; Beaufort, SC) without TEDs. The R/V Carolina Coast is a 44- ft fiberglass hulled double rigged trawler owned and operated by the North Carolina Division of Marine Fisheries (NCDMF). The body of the trawl is constructed of #9 twine with 1.875-in (47.6-mm) stretch mesh. The codend of the net is constructed of #30 twine with 1.5-in (38.1-mm) stretch mesh. The tailbag is 80 meshes around and 80 meshes long (approximately 10-ft). A 120-ft (36.58-m) three-lead bridle is attached to each of a pair of wooden, chain doors that measure 4 ft by 2 ft (1.22-m X .61-m) and to a tongue centered on the headrope. A 60-cm “polyball” is attached between the end of the tongue and the tongue bridle cable. A 0.1875-in (4.76-mm) tickler chain, that is 3.0-ft (0.9-m) shorter than the 34-ft (10.36-m) footrope, is connected to the door next to the footrope.

IV. RESULTS

Environmental and Habitat Data

Environmental and habitat data were recorded during the haul back of each trawl and include: bottom composition, weather description, light phase, surface and bottom temperature (°C), surface and bottom salinity (ppt), surface and bottom dissolved oxygen (mg/L), start time, start and end depth (m), wind speed (knots), wind direction, precipitation, start and end latitude, and start and end longitude. Adjustments to environmental data collection have occurred over the year of the survey. Recording water quality, taken with a secchi disk, did not begin until 2008 and shoreline data and bottom sediment data, collected by ponar grab sample, did not begin until 2009 (Table 1). For more details on how parameters were measured and recorded see the [Pamlico Sound Survey Parameters and Variables](#) document.

Catch Data

Incidental and/or exotic species (present in low numbers), finfish, and shellfish are separated out. A list of all target species measured is indicated in Table 2. The incidental and/or exotic species are enumerated and their biomass recorded.

For finfish, target species are randomly subsample (1 kg) and enumerated. An additional 30-60 individuals are measured for length and a total biomass is recorded. If not on the target species list, the species is enumerated and a total biomass taken.

For invertebrates, the total biomass of all Penaeid shrimp (brown, white, and pink) and blue crabs is recorded by species. Penaeid shrimp are worked up in the same manner as target finfish species. Blue crabs are worked up individually. Carapace length, sex and maturity are recorded. A subsampling protocol for blue crabs is used when the amount of crabs in the catch consists of about 1/4 of a 50 lb. orange basket or more (started in 2002, modified in 2005). One quarter of the catch comprises the subsample. The carapace width, sex, and maturity of each of the blue crabs as well as the total biomass of the subsample are recorded. The individuals in the remaining three quarters of the basket are counted and the mature females are separated out. The

carapace width of each of the mature females and their aggregate biomass is recorded. For other invertebrates, they are counted and a total biomass is recorded.

Table 1. Pamlico Sound Survey (PSS) historical data.

Year	Activity
1988-1989	<ul style="list-style-type: none">• Area coverage included: Pamlico Sound and its bays, Croatan Sound, Roanoke Sound, Albemarle Sound east of a line from the mouth of Alligator River to the mouth of North River, the Pamlico River up to Bath Creek and the Neuse River up to Minnesott Beach.• Sampling occurred in March, June, September, and December.• December 1988 leg was partially extended into January due to scheduling conflicts and adverse weather conditions.
1989	<ul style="list-style-type: none">• Random sub-sample method used during 6/1989 cruise• Beginning 9/1989 entire catch sorted to species and sub-sampled at the species level if necessary
1990	<ul style="list-style-type: none">• Sampling occurred in March, June, and September only.• The Albemarle Sound strata were eliminated.• The Pungo River Stratum was added.• Stations were expanded upstream along the Neuse and Pamlico River strata.• Begin using grid design for stations and placing station ID in grid field of datasheet.
1991	<ul style="list-style-type: none">• Drop March cruise, only have June and September legs.
1999	<ul style="list-style-type: none">• Both June and September cruises were delayed a month due to equipment malfunction and hurricane events.
2003	<ul style="list-style-type: none">• September cruise extended into two days of October due to hurricane Isabel.
2008	<ul style="list-style-type: none">• Began recording Water Clarity with Secchi disk
2009	<ul style="list-style-type: none">• Shoreline Data and Sediment taken using ponar grab• September cruise extended into October due to boat repairs
2011	<ul style="list-style-type: none">• Hurricane Irene: Category 1, track went through Pamlico Sound on 8/27/2011

For more information regarding the North Carolina Pamlico Sound Survey please contact [Jason Rock](#).

Table 2. List of species measured on the Pamlico Sound Survey.*

COMMON NAME	SCIENTIFIC NAME
alewife	<i>Alosa pseudoharengus</i>
American eel	<i>Anguilla rostrata</i>
American shad	<i>Alosa sapidissima</i>
Atlantic croaker	<i>Micropogonias undulatus</i>
Atlantic menhaden	<i>Brevoortia tyrannus</i>
Atlantic spadefish	<i>Chaetodipterus faber</i>
black crappie	<i>Pomoxis nigromaculatus</i>
black drum	<i>Pogonias cromis</i>
black grouper	<i>Mycteroperca bonaci</i>
blueback herring	<i>Alosa aestivalis</i>
bluefish	<i>Pomatomous saltatrix</i>
bluegill	<i>Lepomis macrochirus</i>
brown bullhead	<i>Ictalurus nebulosus</i>
butterfish	<i>Peprilus triacanthus</i>
channel catfish	<i>Ictalurus punctatus</i>
cobia	<i>Rachycentron canadum</i>
crevalle jack	<i>Caranx hippos</i>
gag	<i>Mycteroperca microlepis</i>
gray snapper	<i>Lutjanus griseus</i>
gulf flounder	<i>Paralichthys albigutta</i>
harvestfish	<i>peprilus alepidotus</i>
hickory shad	<i>Alosa mediocris</i>
king mackerel	<i>Scomberomorus cavalla</i>
lane snapper	<i>Lutjanus synagris</i>
largemouth bass	<i>Micropterus salmoides</i>
mutton snapper	<i>Lutjanus falcatus</i>
northern kingfish	<i>Menticirrhus saxatilis</i>
northern puffer	<i>Sphoeroides maculatus</i>
permit	<i>Trachinotus falcatus</i>
pigfish	<i>Orthopristis chrysoptera</i>
pumpkinseed	<i>Lepomis gibbosus</i>
red drum	<i>Sciaenops ocellatus</i>
red grouper	<i>Epinephalus morio</i>
rock sea bass	<i>Centropristis philadelphia</i>
sheepshead	<i>Archosargus probatocephalus</i>
silver perch	<i>Bairdiella chrysoura</i>
southern flounder	<i>Paralichthys lethostigma</i>
southern hake	<i>Urophycis floridanus</i>
southern kingfish	<i>Menticirrhus americanus</i>
Spanish mackerel	<i>Scomberomorus maculatus</i>

spotted hake	<i>Urophycis regius</i>
spotted hake	<i>Leistomus xanthurus</i>
spotted seatrout	<i>Cynoscion nebulosus</i>
striped bass	<i>Morone saxatilis</i>
striped mullet	<i>Mugil cephalus</i>
summer flounder	<i>Paralichthys dentatus</i>
tautog	<i>Tautoga onitis</i>
weakfish	<i>Cynoscion regalis</i>
white catfish	<i>Ictalurus catus</i>
white perch	<i>Morone americana</i>
yellow bullhead	<i>Ictalurus natalis</i>
yellow perch	<i>Perca flavescens</i>
white or greentail shrimp	<i>Litopenaeus setiferus</i>
brown or summer shrimp	<i>Farfantepenaeus aztecus</i>
pink shrimp	<i>Farfantepenaeus duorarum</i>
blue crab	<i>Callinectes sapidus</i>
turtles	

* all other species are counted and each species biomass taken

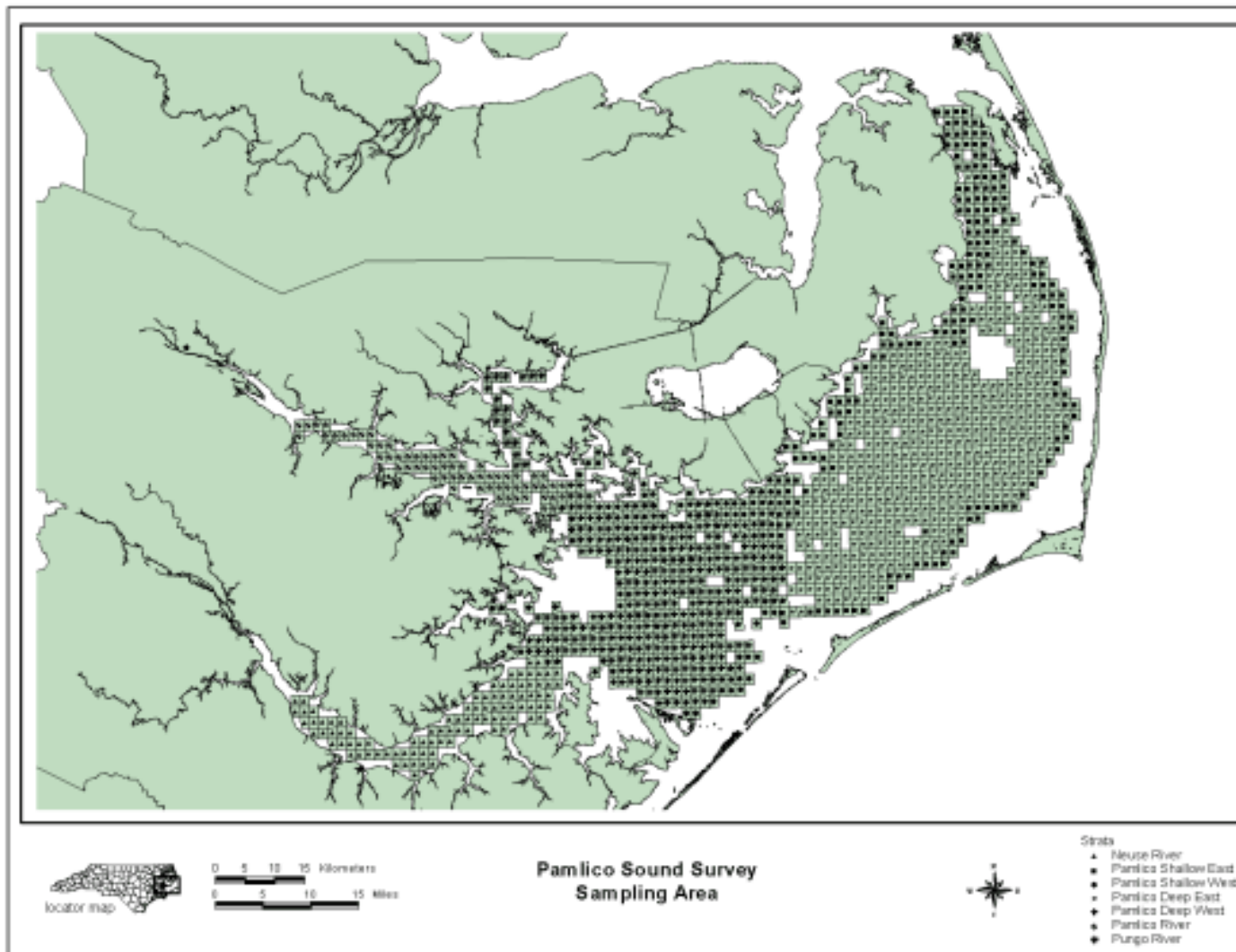


Figure 1. Location and grids of the Pamlico Sound Survey area of eastern North Carolina.

Things to do/check

- Check with Jason about the most updated maps.
- Items highlighted in blue sound be linked document
 - Intellectual Property Right
 - PSS Parameters and Variables – needs to be created from program doc

Type of Data:

Event Information (Tier 1) – For sampling EVENT includes information such as location, collection date, and abiotic factors. A sampling event is the deployment of any gear, whether it collects biotic or abiotic factors.

Abundance and Biomass (Tier 2 & 3) – For COLLECTION and SPECIE(S) includes information pertaining to the gear used and the sampling effort, including any subsampling regime as well as information related to the total catch (e.g. total abundance and total weight) for any species with available data. Output will include “zero catch” collection for query selected species.

Length Frequency (Tier 3) – For a SPECIE(S) includes species-specific length frequency information related to the subsample (relative number measured) and the total (total number collected) within each COLLECTION.

Individual Specimen (Tier 4) – For single individuals of a species, (SPECIMEN) includes unique information (e.g. length, weight, sex, and disease disposition).

Tagging Information (Tier 4) – For single individuals of a species (SPECIMEN) includes specimen tagging related information (e.g. tag number, tag type, capture and release status, and tagging status).

Table. 1. Variable fields included in the output for each “Type of Data” listed above. Linkage variables fields that may be useful to identify a set of related records linking COLLECTION of the output are denoted with an asterisk (*). Note: This does not reflect actual output order and empty rows are space holders to visually display the similarities across queries and will not be displayed in output.

Event Information	Abundance & Biomass	Length Frequency	Individual Specimen	Tagging Information
PROJECTNAME*	PROJECTNAME*	PROJECTNAME*	PROJECTNAME*	PROJECTNAME*
PROJECTAGENCY	PROJECTAGENCY	PROJECTAGENCY	PROJECTAGENCY	PROJECTAGENCY
DATE	DATE	DATE	DATE	DATE
EVENTNAME	EVENTNAME	EVENTNAME	EVENTNAME	EVENTNAME
COLLECTIONNUMBER*	COLLECTIONNUMBER*	COLLECTIONNUMBER*	COLLECTIONNUMBER*	COLLECTIONNUMBER*
VESSELNAME	VESSELNAME	VESSELNAME	VESSELNAME	VESSELNAME
GEARNAME*	GEARNAME*	GEARNAME*	GEARNAME*	GEARNAME*
GEARCODE*	GEARCODE*	GEARCODE*	GEARCODE*	GEARCODE*
TOWTYPE	TOWTYPE	TOWTYPE	TOWTYPE	TOWTYPE
AREACODE	AREACODE	AREACODE	AREACODE	AREACODE
REGION	REGION	REGION	REGION	REGION
DEPTHZONE	DEPTHZONE	DEPTHZONE	DEPTHZONE	DEPTHZONE
STATIONCODE	STATIONCODE	STATIONCODE	STATIONCODE	STATIONCODE
EVENTTYPE	EVENTTYPE	EVENTTYPE	EVENTTYPE	EVENTTYPE
TEMPSURFACE	TEMPSURFACE	TEMPSURFACE	TEMPSURFACE	TEMPSURFACE
TEMPBOTTOM	TEMPBOTTOM	TEMPBOTTOM	TEMPBOTTOM	TEMPBOTTOM
SALINITYSURFACE	SALINITYSURFACE	SALINITYSURFACE	SALINITYSURFACE	SALINITYSURFACE
SALINITYBOTTOM	SALINITYBOTTOM	SALINITYBOTTOM	SALINITYBOTTOM	SALINITYBOTTOM
SDO	SDO	SDO	SDO	SDO
BDO	BDO	BDO	BDO	BDO
LIGHTPHASE				
TIMESTART	TIMESTART			
TIMEZONE				
DURATION	DURATION	DURATION	DURATION	DURATION
DEPTHSTART				
DEPTHEND				
PRESSURE				
WINDSPEED				
WINDDIRECTION				

Event Information	Abundance & Biomass	Length Frequency	Individual Specimen	Tagging Information
WAVEHEIGHT				
TEMPAIR	TEMPAIR			
PRECIPITATION				
ESTIMATEDLOC				
LATITUDESTART	LATITUDESTART	LATITUDESTART	LATITUDESTART	LATITUDESTART
LATITUDEEND	LATITUDEEND	LATITUDEEND	LATITUDEEND	LATITUDEEND
LONGITUDESTART	LONGITUDESTART	LONGITUDESTART	LONGITUDESTART	LONGITUDESTART
LONGITUDEEND	LONGITUDEEND	LONGITUDEEND	LONGITUDEEND	LONGITUDEEND
SEDSIZE				
BTMCOMP				
WEATHERDESC				
WATERLEVELDESC				
ALTERATION				
ACTIVITY				
NbrRep				
ACCSP GridCODE	ACCSP GridCODE	ACCSP GridCODE	ACCSP GridCODE	ACCSP GridCODE
COMMENTS				
	SPECIESCODE*	SPECIESCODE*	SPECIESCODE*	SPECIESCODE*
	MRR_I_CODE	MRR_I_CODE	MRR_I_CODE	MRR_I_CODE
	SPECIESSCIENTIFICNAME	SPECIESSCIENTIFICNAME	SPECIESSCIENTIFICNAME	SPECIESSCIENTIFICNAME
	SPECIESCOMMONNAME	SPECIESCOMMONNAME	SPECIESCOMMONNAME	SPECIESCOMMONNAME
	SPSTATUS*	SPSTATUS*	SPSTATUS*	SPSTATUS*
	NUMBERTOTAL			
	SPECIESTOTALWEIGHT	SPECIESTOTALWEIGHT	SPECIESTOTALWEIGHT	SPECIESTOTALWEIGHT
	SPECIESSUBWEIGHT			
	SPECIESWTPROCESSED			
	WEIGHTMETHODDESC			
	ORGWTUNITS	ORGWTUNITS	ORGWTUNITS	ORGWTUNITS
	EFFORT	EFFORT	EFFORT	EFFORT
	CATCHSUBSAMPLED			
	CATCHWEIGHT			
	CATCHSUBWEIGHT			
		LENGTHUNITS		
		LENGTHTYPECODE		
		LENGTH		
		NUMMEAS	NUMMEAS	NUMMEAS
		TOTALNUM	TOTALNUM	TOTALNUM
			SPECIMENNUMBER*	SPECIMENNUMBER*
			LEN1	
			LEN1_TYPE	
			LEN2	
			LEN2_TYPE	
			LEN3	
			LEN3_TYPE	
			LEN4	
			LEN4_TYPE	
			ORGLUNITS	
			WEIGHT	
			ESTIMATEDWEIGHT	
			SEXDESCRIPTION	
			MATURITYDESCRIPTION	
			DISEASEDESC	
				FISHCODE
				TAG_1
				TAGTYPEID_1
				TAG_2
				TAGTYPEID_2
				TAG_3
				TAGTYPEID_3
				RECAPOCC
				SEX
				BAITTYPE
				HOOKEDLOC
				DRUMMING
				DISTANCE
				DISTANCECALC
				STATUS

Event Information	Abundance & Biomass	Length Frequency	Individual Specimen	Tagging Information
				DISPOSITION
				TAGGINGSTATUS
				RELEASELATITUDE
				RELEASELONGITUDE
LASTUPDATED	LASTUPDATED	LASTUPDATED	LASTUPDATED	LASTUPDATED

* Primary keyed variables

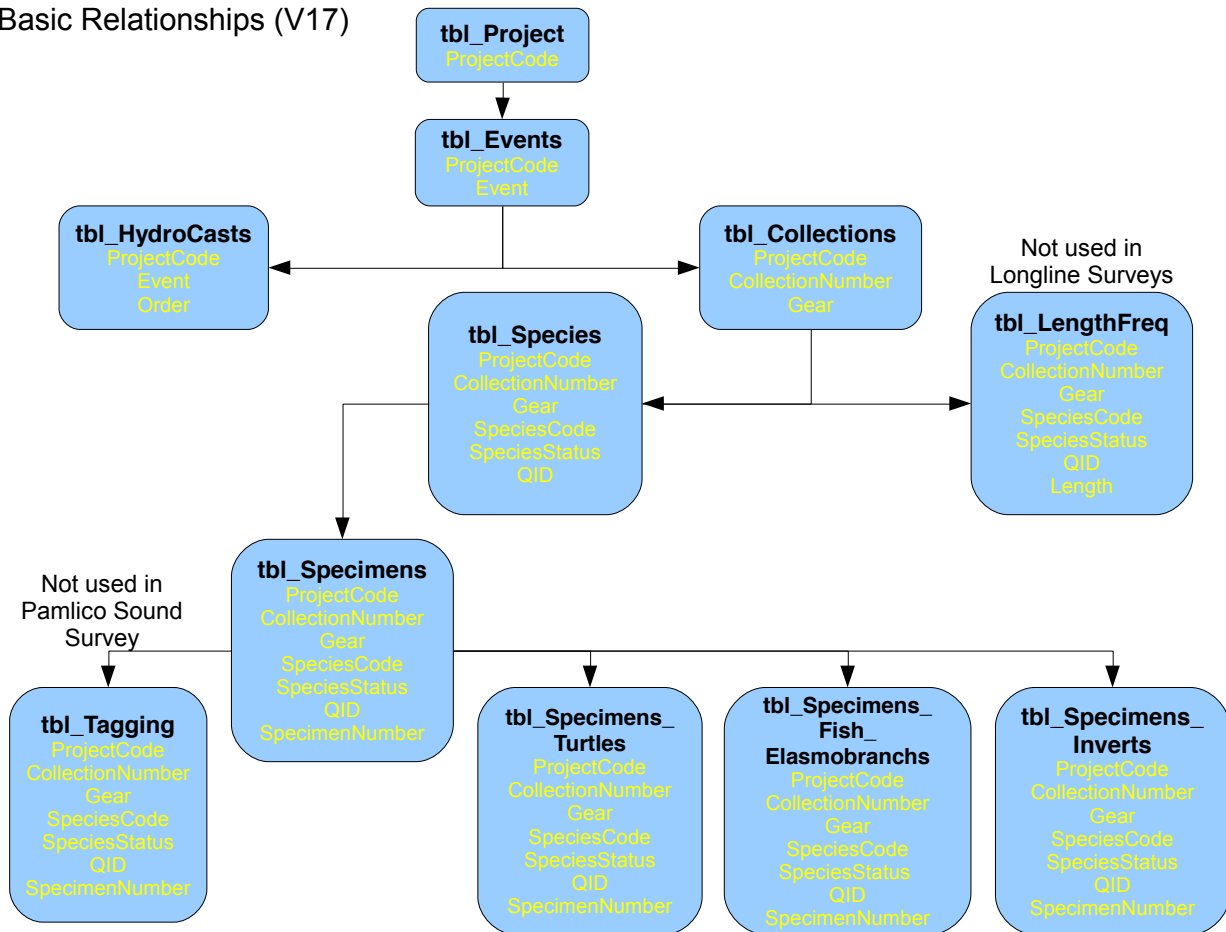
Note: This does not reflect actual output order and empty rows are space holders to visually display the similarities across queries and will not be displayed in output and empty rows are space holders to visually display the similarities across data types and will not be displayed in output.

Table 2. Actual output order for variable fields included in the output for each “Type of Data” listed above. Linkage variables fields that may be useful to identify a set of related records linking COLLECTION of the output are denoted with an asterisk (*).

Event Information	Abundance & Biomass	Length Frequency	Individual Specimen	Tagging Information
PROJECTNAME*	PROJECTNAME*	PROJECTNAME*	PROJECTNAME*	PROJECTNAME*
PROJECTAGENCY	PROJECTAGENCY	PROJECTAGENCY	PROJECTAGENCY	PROJECTAGENCY
DATE	DATE	DATE	DATE	DATE
EVENTNAME	EVENTNAME	EVENTNAME	EVENTNAME	EVENTNAME
COLLECTIONNUMBER*	COLLECTIONNUMBER*	COLLECTIONNUMBER*	COLLECTIONNUMBER*	COLLECTIONNUMBER*
VESSEL NAME	VESSEL NAME	VESSEL NAME	VESSEL NAME	VESSEL NAME
GEARNAME*	GEARNAME*	GEARNAME*	GEARNAME*	GEARNAME*
GEARCODE*	GEARCODE*	GEARCODE*	GEARCODE*	GEARCODE*
TOWTYPE	SPECIESCODE*	SPECIESCODE*	SPECIESCODE*	SPECIESCODE*
AREACODE	MRR I CODE	MRR I CODE	MRR I CODE	MRR I CODE
REGION	SPECIESSCIENTIFICNAME	SPECIESSCIENTIFICNAME	SPECIESSCIENTIFICNAME	SPECIESSCIENTIFICNAME
DEPTHZONE	SPECIESCOMMONNAME	SPECIESCOMMONNAME	SPECIESCOMMONNAME	SPECIESCOMMONNAME
STATIONCODE	NUMBERTOTAL	LENGTHUNITS	SPECIMENNUMBER*	FISHCODE
EVENTTYPEDESCRIPTION	SPECIESTOTALWEIGHT	LENGTHTYPECODE	LEN1	SPECIMENNUMBER*
TEMPSURFACE	SPECIESSUBWEIGHT	LENGTH	LEN1_TYPE	TAG 1
TEMPBOTTOM	SPECIESWTPROCESSED	NUMMEAS	LEN2	TAGTYPEID_1
SALINITYSURFACE	WEIGHTMETHODDESC	TOTALNUM	LEN2_TYPE	TAG 2
SALINITYBOTTOM	ORGWTUNITS	TOWTYPE	LEN3	TAGTYPEID_2
LIGHTPHASE	EFFORT	AREACODE	LEN3_TYPE	TAG 3
TIMESTART	CATCHSUBSAMPLED	REGION	LEN4	TAGTYPEID_3
TIMEZONE	CATCHWEIGHT	DEPTHZONE	LEN4_TYPE	RECAPOCC
DURATION	CATCHSUBWEIGHT	ACCSP GridCODE	ORGLUNITS	SEX
DEPTHSTART	TIMESTART	STATIONCODE	WEIGHT	BAITTYPE
DEPTHEND	DURATION	EVENTTYPEDESCRIPTION	ORGWTUNITS	HOOKEDLOC
PRESSURE	TOWTYPE	TEMPSURFACE	ESTIMATEDWEIGHT	DRUMMING
WINDSPEED	AREACODE	TEMPBOTTOM	SEXDESCRIPTION	DISTANCE
WINDDIRECTION	REGION	SALINITYSURFACE	MATURITYDESCRIPTION	DISTANCECALC
WAVEHEIGHT	DEPTHZONE	SALINITYBOTTOM	DISEASEDESC	STATUS
TEMPAIR	ACCSP GridCODE	SDO	BAITTYPE	DISPOSITION
PRECIPITATION	STATIONCODE	BDO	TOWTYPE	TAGGINGSTATUS
ESTIMATEDLOC	EVENTTYPEDESCRIPTION	SPSTATUS	AREACODE	RELEASELATITUDE
LATITUDESTART	TEMPSURFACE	SPECIESTOTALWEIGHT	REGION	RELEASELONGITUDE
LATITUDEEND	TEMPBOTTOM	ORGWTUNITS	DEPTHZONE	TOWTYPE
LONGITUDESTART	SALINITYSURFACE	EFFORT	ACCSP GridCODE	AREACODE
LONGITUDEEND	SALINITYBOTTOM	DURATION	STATIONCODE	REGION
SDO	SDO	LATITUDESTART	EVENTTYPEDESCRIPTION	DEPTHZONE
BDO	BDO	LATITUDEEND	TEMPSURFACE	ACCSP GridCODE
SEDSIZE	TEMPAIR	LONGITUDESTART	TEMPBOTTOM	STATIONCODE
BTMCOMP	LATITUDESTART	LONGITUDEEND	SALINITYSURFACE	EVENTTYPEDESCRIPTION
WEATHERDESC	LATITUDEEND	SPSTATUS*	SALINITYBOTTOM	TEMPSURFACE
WATERLEVELDESC	LONGITUDESTART	LASTUPDATED	SDO	TEMPBOTTOM
ALTERATION	LONGITUDEEND		BDO	SALINITYSURFACE
ACTIVITY	SPSTATUS*		DURATION	SALINITYBOTTOM
NbrRep	LASTUPDATED		SPSTATUS*	SDO
ACCSP GridCODE			SPECIESTOTALWEIGHT	BDO
COMMENTS			ORGWTUNITS	DURATION
LASTUPDATED			EFFORT	SPSTATUS*
			NUMMEAS	SPECIESTOTALWEIGHT
			TOTALNUM	ORGWTUNITS
			LATITUDESTART	EFFORT
			LATITUDEEND	NUMMEAS
			LONGITUDESTART	TOTALNUM

Event Information	Abundance & Biomass	Length Frequency	Individual Specimen	Tagging Information
			LONGITUDEEND	LATITUDESTART
			LASTUPDATED	LATITUDEEND
				LONGITUDESTART
				LONGITUDEEND
				LASTUPDATED

Basic Relationships (V17)



The bubble diagram shows the relationship of the different tables and variables to one another.

The database operates on the relationship of Event→Collection→Species→Specimen. For query requests, the selection or 'filtering' options [Type of Data](#) are organized in this same relationship, with choices of: Event Information, Abundance and Biomass, Length Frequency, Individual Specimen, or Specimen Tag Information. The output from the request is supplied as a .csv file containing flat records constructed of the limited data variables from applicable data tables. For species included in an Abundance and Biomass query, the output will include the entire set of Events (effort) for the selection parameters in the query, whether or not the species of interest was taken in an Event (i.e. zero catches). This query also contains both the total CatchWeight (all species weights combined) as well as SpeciesTotalWeight (weight for a species in the sample). Additional information on the database schema and variable definitions can be found in SEAMAP-SA Data Management Guidance Plan.