SEDAR 44-Red Drum

NC Biological Data

Survey Descriptions and Background Information

NC Red Drum Juvenile Seine Survey
NC Independent Gill Net Survey
NC Red Drum Longline Survey
NC Age and Growth Data
NC Commercial Dependent Sampling

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Program 123: North Carolina Red Drum Juvenile Seine Survey

Objectives: To determine the annual index of juvenile abundance for red drum in North Carolina.

Procedures:

A red drum seine survey was conducted at 21 fixed sampling sites throughout coastal North Carolina (Figure 1) during September through November for each year from 1991 through 2013. Each of these sites was sampled in approximately two week intervals for a total of six samples per site with an 18.3 m (60 ft) x 1.8 m (6 ft) beach seine with 3.2 mm (1/8 in) mesh in the 1.8 m x 1.8 m bag. One "quarter sweep" pull was made at each location. This was done by stationing one end of the net onshore and stretching it perpendicularly as far out as water depth allowed. The deep end was brought ashore in the direction of the tide or current, resulting in the sweep of a quarter circle quadrant. All species were counted and identified; red drum were counted and measured to the nearest mm FL. Salinity (ppt), water temperature (^{o}C), tidal state or water level, and presence of aquatic vegetation were recorded. Locations of fixed stations were determined in 1990 based on previous catch rates and practicality for beach seining (Ross and Stevens 1991). The juvenile index, or CPUE, is the arithmetic mean catch/seine haul of young-of-the-year (YOY) individuals.

Data:

Data for the red drum juvenile seine survey are stored on the ASMFC FTP site as an excel file (**NC_RD_JAI_RAW_DATA.xls**) and a SAS file (pgm123.sas7bdat). A SAS program (**NCJUVRDCPUE_1_28_24.SAS**) has been provided that generates both an arithmetic and geometric CPUE by year, region and month. An output of this program is also provided (NC_RD_JAI.xls).

Results:

The overall statewide arithmetic mean as used in prior assessments is presented in the following table.

Year	N	CPUE	lci	uci	SE	MIN	MAX	SUM	PSE	% Positive
1991	105	15.124	10.85	19.4	2.18179	0	122	1588	14	79
1992	116	3.707	1.48	5.93	1.13497	0	125	430	31	56
1993	117	12.650	8.3	17	2.21725	0	130	1480	18	75
1994	93	8.290	3.56	13.02	2.41167	0	180	771	29	71
1995	119	4.613	3.19	6.03	0.72418	0	44	549	16	63
1996	104	2.625	1.7	3.55	0.47179	0	32	273	18	50
1997	126	13.127	7.1	19.15	3.07395	0	236	1654	23	66
1998	124	8.226	6.03	10.42	1.12098	0	85	1020	14	73
1999	98	1.837	1.02	2.65	0.41452	0	29	180	23	37
2000	123	3.138	2.01	4.27	0.576	0	38	386	18	52
2001	122	0.967	0.6	1.34	0.18766	0	11	118	19	70
2002	120	2.233	1.2	3.27	0.5275	0	39	268	24	40
2003	120	5.008	2.6	7.42	1.2311	0	113	601	25	56
2004	120	8.317	6.1	10.54	1.13259	0	75	998	14	76
2005	120	9.017	6.26	11.77	1.40447	0	80	1082	16	73
2006	120	3.442	2.02	4.86	0.72566	0	63	413	21	52
2007	119	5.462	2.48	8.44	1.52077	0	149	650	28	54
2008	120	1.583	0.99	2.17	0.30116	0	23	190	19	42
2009	120	1.892	0.6	3.19	0.6606	0	74	227	35	34
2010	120	4.692	2.79	6.59	0.96847	0	74	563	21	61
2011	116	10.819	4.4	17.24	3.27573	0	344	1255	30	66
2012	120	2.692	1.3	4.09	0.71192	0	65	323	26	44
2013	120	1.108	0.52	1.7	0.30168	0	23	133	27	26

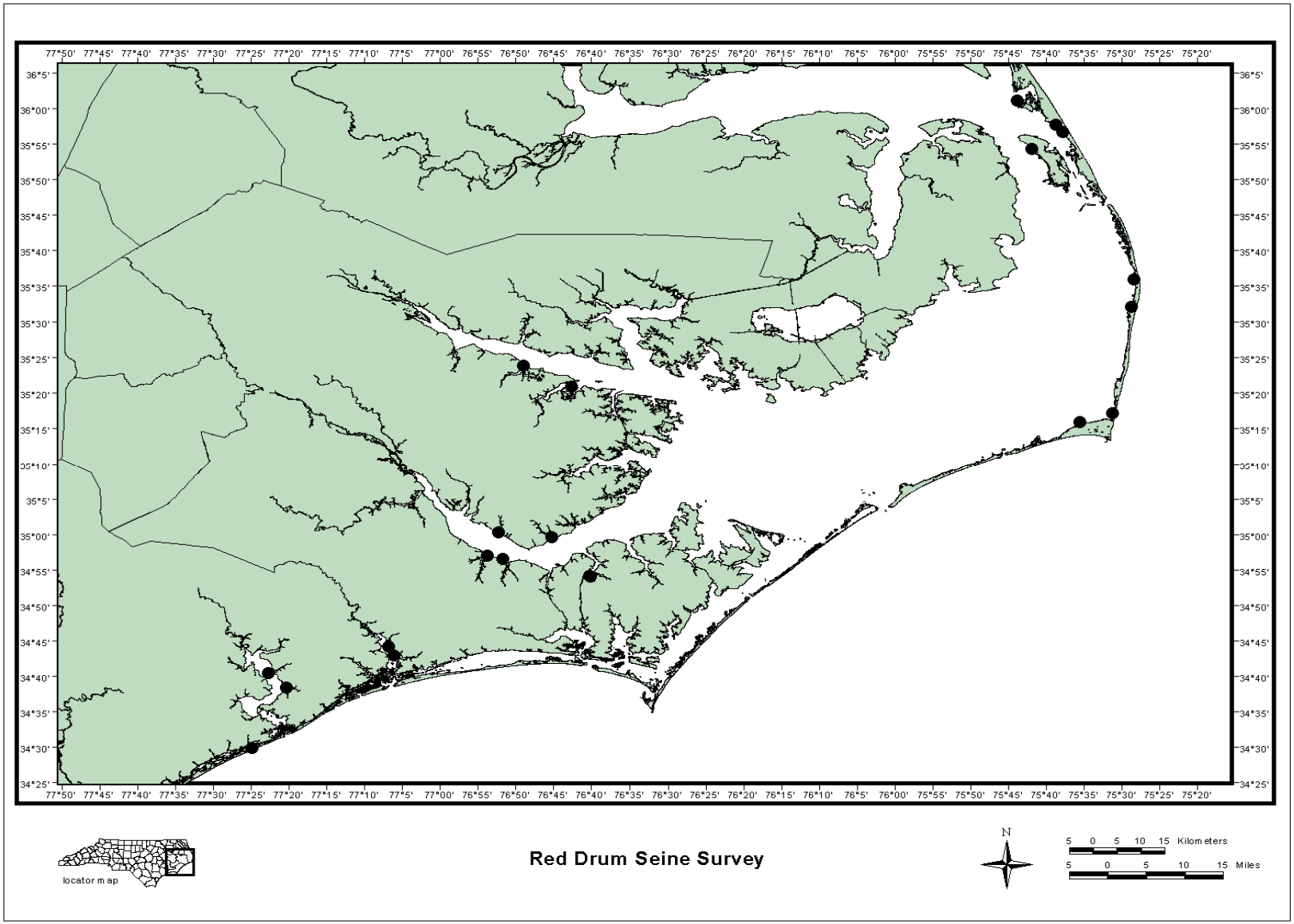


Figure 1. Sampling sites of the juvenile red drum survey in North Carolina.

A recent analysis of the North Carolina red drum seine survey is provided as a reference document:

Bacheler N.M., Paramore L.M., Buckel J.A., Scharf F.S. (2008b) Recruitment of juvenile red drum in North Carolina: spatiotemporal patterns of year-class strength and validation of a seine survey. N Am J Fish Manag 28:1086-1098.

For results of the preliminary data used to establish the current sampling methods and stations see (no electronic version available, will have hard copy at workshop):

Ross, J. L., and T. M. Stevens. 1992. Life history and population dynamics of red drum (*Sciaenops ocellatus*) in North Carolina waters. NC Division of Marine Fisheries, Marine Fisheries Research Completion Report Project F-29. 130 p.

METADATA

Documented changes in sampling and other notes of concern

DATES	Sampling Procedures
1987-1990	Preliminary sampling to establish productive and accessible stations and establish most appropriate gear type.
1991-present	Set stations and gear – time frame used for current CPUE index for red drum.
1996	Hurricanes during this year caused extreme high and low water conditions and may have altered survey results.

Program 915 – North Carolina Independent Gill Net Survey

Objectives:

- To provide an independent relative index of abundance for key species occurring in the estuarine waters of Pamlico Sound and its tributaries.
- To characterize habitat use in Pamlico Sound

Background:

The Divisions independent gill net study (Program 915) started as the presence and absence of disease sampling in 1998 on the Neuse, Pamlico and Pungo River systems (River Independent Gill Net Survey (RIGNS). Sampling in Pamlico Sound (The Pamlico Sound Independent Gill Net Survey (PSIGNS)) was initiated in May of 2001. Sampling in the RIGNS was dropped after 2000 and resumed in 2003 to present. The PSIGNS has sampled continuously since 2001. A primary objective of both the PSIGNS and the RIGNS is to provide independent relative abundance indices for key estuarine species including red drum.

Sampling locations for the IGNS were selected using a stratified random sampling design based on area and water depth (Figure 2). The Sound was divided into eight areas: Hyde County 1 – 4 and Dare County 1 – 4. The Neuse River was divided into four areas (Upper, Upper-Middle, Middle-Lower, Lower) and the Pamlico River was divided into four areas (Upper, Middle, Lower and Pungo River). A one minute by one minute grid (i.e., one square nautical mile) was overlaid over all areas and each grid was classified as either shallow (< 6 ft), deep (≥ 6ft) or both based on bathymetric maps.

Each area was sampled twice a month. For each random grid selected, both a shallow and deep sample were collected. Each sample (both shallow and deep) consisted of eight 30 yard segments of 3, 3½, 4, 4½, 5, 5½, 6, 6½ inch stretched mesh gill net, for a total of 240 yards per sample. Nets were typically deployed within an hour of sunset and retrieved the next morning, so all soak times were approximately 12 h. This sampling design results in a total of approximately 64 gill net samples (32 deep and 32 shallow samples) being collected per month across both the Rivers and Sound.

Physical and environmental conditions, including surface and bottom water temperature (^{o}C), salinity (ppt), dissolved oxygen (mg/L), bottom composition, as well as, a qualitative assessment of sediment size, were recorded upon retrieval of the nets on each sampling trip. All attached submerged aquatic vegetation (SAV) in the immediate sample area was identified to species and density of coverage was estimated visually when possible. Additional habitat data recorded included distance from shore, presence or absence of sea grass or shell, and substrate type.

Each collection of fish per mesh size (30-yard net) was sorted into individual species groups. All species groups were enumerated and an aggregate weight (nearest 0.01 kilogram (kg)) was obtained for most species, including damaged (partially eaten or decayed) fish. The condition of each individual was recorded as live, dead, spoiled, or parts. Individuals were measured to the nearest millimeter for either fork or total length according to the morphology of the species.

Data:

Data for the North Carolina Independent Gill Net Survey are stored on the ASMFC FTP site as both an excel file (NC_RD_IGNS_raw_data**.xlsx**) and a SAS file (**RDIGNSRAWDATA.txt**). A SAS program (**allrdrum.SAS**) and SAS code can be provided to generate CPUE's by length, age and overall.

Prior Analysis:
For the reason that the time series in the rivers is inconsistent with the Pamlico Sound, results have typically been analyzed for two areas: 1) Hyde and Dare counties (PSIGNS) only, beginning 2001, and 2) Rivers (Pamlico, Pungo and Neuse; RIGNS), beginning 2003. The CPUE represents the number of red drum captured per sample and can be expressed overall or for a given age. A sample was one array of nets (shallow and deep combined) fished for 12 hours. Due to disproportionate sizes of each stratum and region, the final CPUE estimate is weighted. The total area of each region by stratum was quantified using the one-minute by one-minute grid system and then used to weight the observed catches for calculating the abundance indices. CPUE data can be calculated by size, age (with ALK conversion) or overall.

The prior assessment used the PSIGN portion of the survey as an Age-1 and Age-2 index. Catches of older ages were less frequent and PSE's were considered too high to provide any meaningful trends. Ages were assigned based on length cutoffs derived seasonal ALK's (6-month: Jan-Jun, Jul-Dec). With a longer overall time series for both the rivers and Pamlico Sound, consideration should be given to using a combined index from both regions. The PSIGN began in 2001 and the RIGN began in 2003. Sampling methods are consistent between the two regions.

Results based on an overall CPUE calculation and calculations by region (for comparison) are provided below (Tables 1-3).

Sample areas included in the PSIGNS and RIGNS surveys are provided in Figure 3. The graph provides details of the sample coverage from 2001-2006.

The abundance of both age-1 and age-2 is variable from year to year with no strong trend. Figure 1 shows a similar age-1 index between regions while the age-2 index is consistently higher in the PSIGNS region versus the RIGNS. This is likely due to a shift to higher salinity habitat with the increase in age. The combined index (PSIGNS +RIGNS) shows a strong correlation between age specific CPUE's among cohorts for age-1 and age-2 (Figure 3).

Table 1. PSIGN (Pamlico Sound only) catch of age-1 and age-2 red drum by year including weighted CPUE.

AGE-1

Year	N	Age-1 CPUE	SE	PSE	% Positive
1*	237	1.03	0.29	28	18
2	320	2.63	0.42	16	27
3	320	0.27	0.07	26	9
4	320	1.85	0.29	16	25
5	304	1.37	0.29	21	19
6	320	1.64	0.25	15	28
7	320	0.53	0.09	17	14
8	320	1.61	0.29	18	36
9	320	0.66	0.11	17	19
10	320	1.49	0.27	18	28
11	300	0.15	0.04	27	6
12	308	3.03	0.59	19	25
13	308	1.24	0.3	24	19

AGE-2

Year	N	Age-2 CPUE	SE	PSE	% Positive
1*	237	0.44	0.1	23	14
2	320	0.55	0.12	22	16
3	320	0.97	0.2	21	18
4	320	0.06	0.02	33	3
5	304	1.36	0.24	18	25
6	320	1.21	0.22	18	23
7	320	2.54	0.99	39	22
8	320	0.61	0.15	25	15
9	320	3.26	1.17	36	31
10	320	0.64	0.12	19	20
11	300	0.24	0.05	21	11
12	308	0.01	0.01	100	1
13	308	5.3	1.03	19	38

* partial year (May-Dec)

Table 2. RIGN (Rivers only) catch of age-1 and age-2 red drum by year including weighted CPUE.

AGE-1

Year	N	Age-1 CPUE	SE	PSE	% Positive
3*	156	0.97	0.34	35	22
4	320	2.75	0.45	16	25
5	304	1.84	0.31	17	22
6	320	1.12	0.19	17	24
7	320	0.75	0.16	21	15
8	321	1.3	0.2	15	21
9	321	0.89	0.14	16	18
10	320	1.34	0.26	19	19
11	320	0.12	0.03	25	6
12	320	2.92	0.41	14	25
13	320	0.56	0.11	20	16

AGE-2

Year	N	Age-2 CPUE	SE	PSE	% Positive
3*	156	0.06	0.02	33	4
4	320	0.02	0.01	50	1
5	304	1.14	0.16	14	25
6	320	0.83	0.12	14	21
7	320	1.35	0.23	17	25
8	321	0.42	0.1	24	14
9	321	0.87	0.15	17	20
10	320	0.67	0.11	16	19
11	320	0.36	0.08	22	12
12	320	0.02	0.01	50	2
13	320	1.49	0.22	15	27

*Partial Year

Table 3. Combined IGNS (PSIGN and RIGN) catch of age-1 and age-2 red drum by year including weighted CPUE.

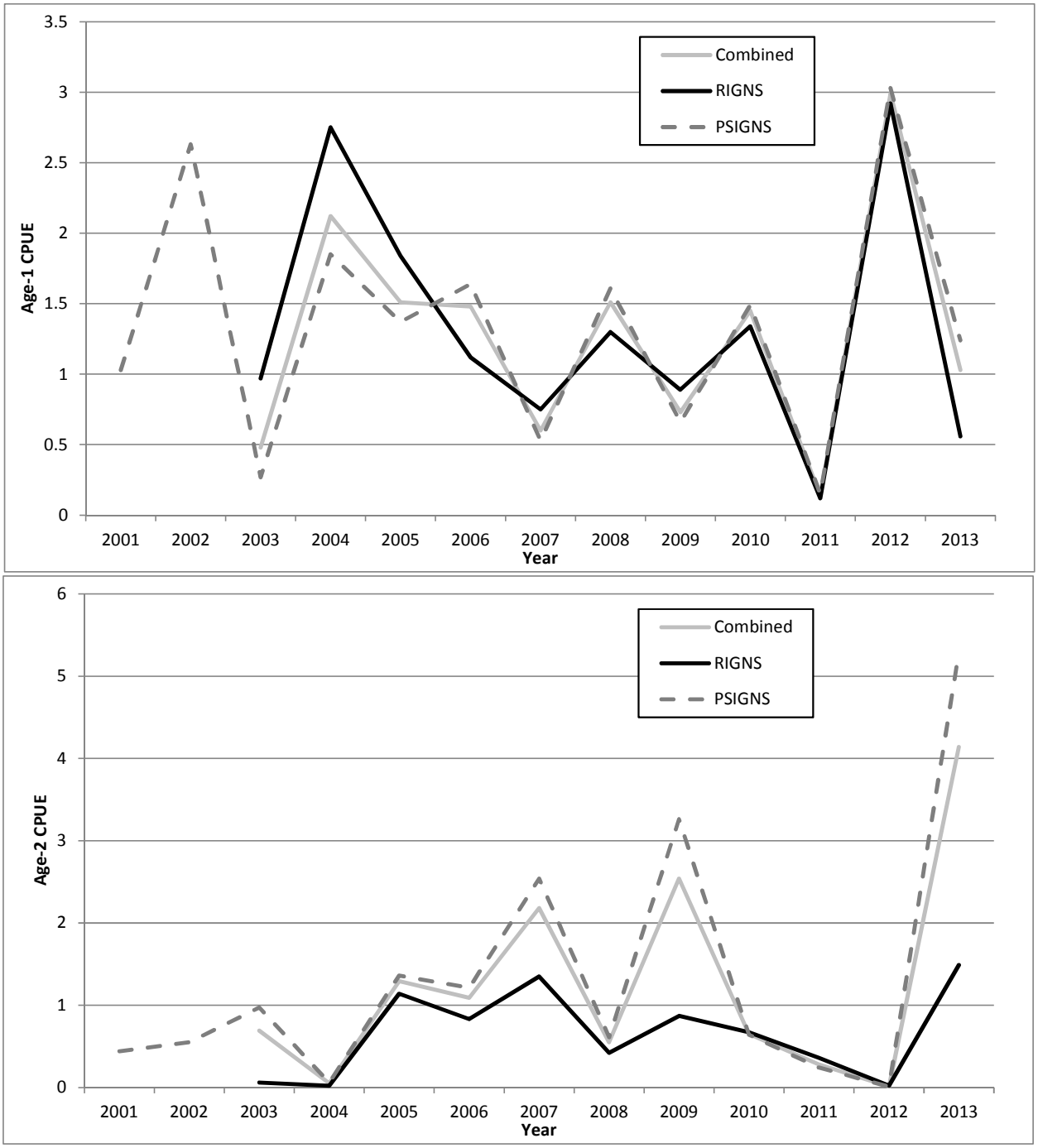
AGE-1

Year	N	STCPUE	Age-1 CPUE	PSE	% Positive
3*	476	0.48	0.11	23	14
4	640	2.12	0.24	11	25
5	608	1.51	0.22	15	21
6	640	1.48	0.18	12	26
7	640	0.6	0.08	13	14
8	641	1.51	0.21	14	23
9	641	0.73	0.09	12	19
10	640	1.45	0.21	14	23
11	620	0.14	0.03	21	6
12	628	2.99	0.43	14	25
13	628	1.03	0.21	20	17

AGE-2

Year	N	STCPUE	Age-2 CPUE	PSE	% Positive
3*	476	0.69	0.14	20	13
4	640	0.05	0.02	40	2
5	608	1.29	0.18	14	25
6	640	1.09	0.16	15	22
7	640	2.18	0.7	32	23
8	641	0.55	0.11	20	14
9	641	2.54	0.82	32	25
10	640	0.65	0.09	14	19
11	620	0.28	0.04	14	12
12	628	0.01	0.01	100	1
13	628	4.14	0.72	17	32

*Partial year for RIGN portion



Figures 1. CPUE for age-1 and age-2 red drum from the Pamlico Sound (PSIGNS) and rivers (RIGNS) gill net surveys, along with an overall combined CPUE across both areas.

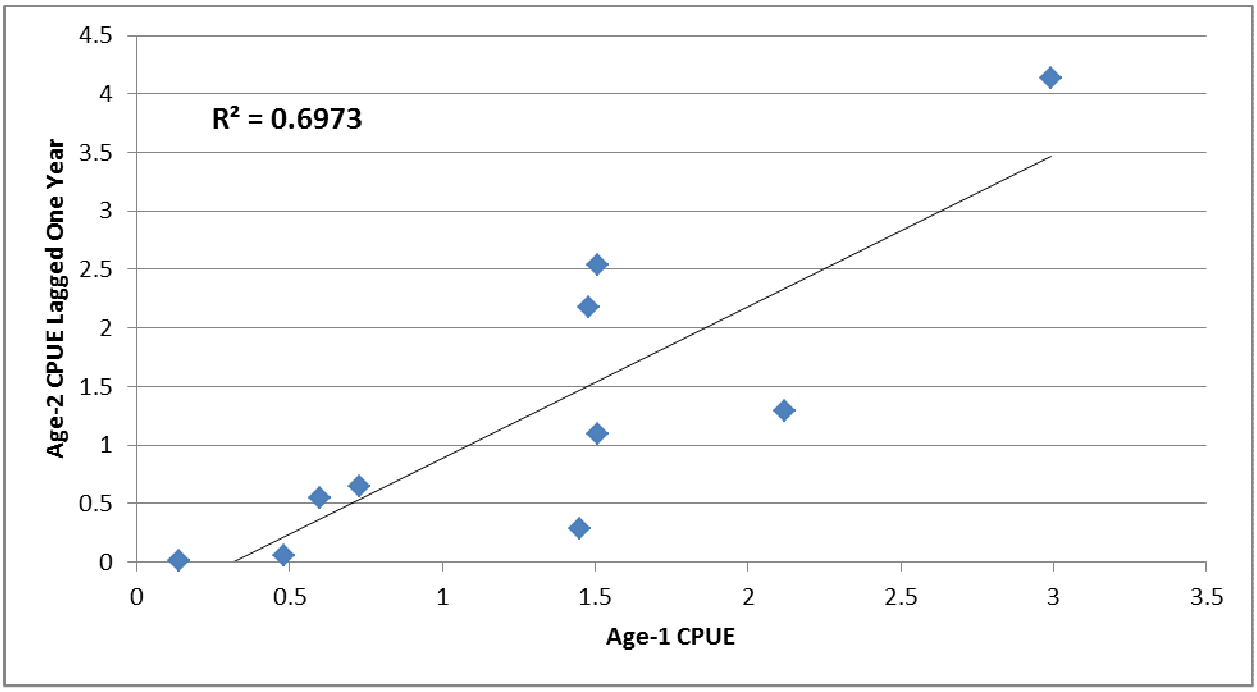


Figure 2. Regression of cohort specific Age-1 and Age-2 red drum from the combined (PSIGN and RIGN) independent gill net survey.

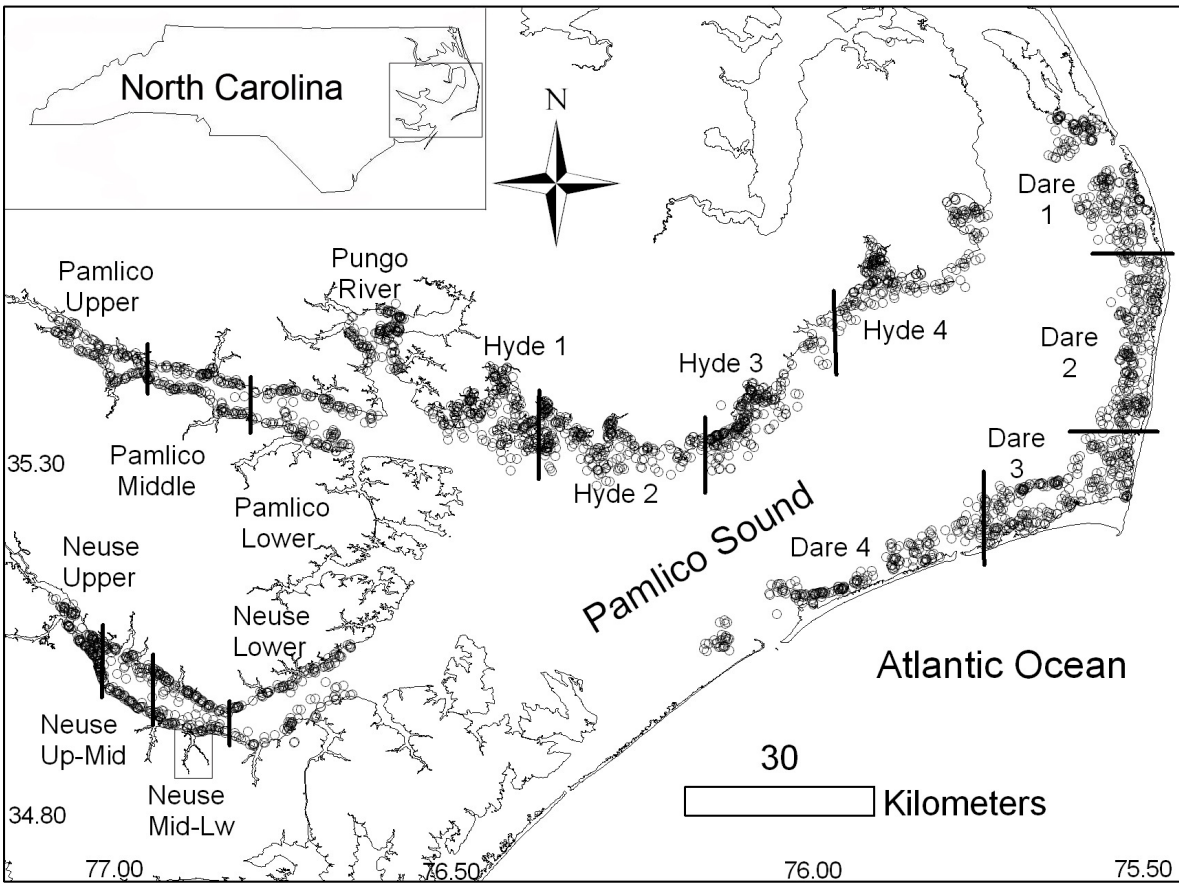


Figure 3. Map of Pamlico Sound and associated rivers showing the sample strata and locations of individual samples taken in the NCDMF independent gill net survey from 2001 to 2006. RIGNS includes Pamlico/Pungo and Neuse rivers. PSIGNS includes Pamlico Sound (Hyde and Dare on map).

METADATA

Documented changes in sampling and other notes of concern

DATES	Sampling Procedures
2005 to current	A portion of deep water sample grids were dropped from Pamlico Sound portion of IGNS. No reduction in sampling activity. Grids were dropped to reduce potential for sea turtle mortality.
2011 to current	Area 1 of Region 1 (eastern Pamlico Sound) is not sampled from June to August due to prior sea turtle interactions. Sampling reduction had minimal impact on overall CPUE for red drum.

Program 365: North Carolina Red Drum Longline Survey

Objectives

1) To develop a state specific sampling protocol that provides a fisheries independent index of abundance for adult red drum.
2) To sample adult red drum and develop information on catch per unit effort (CPUE) and size.
3) To collect migratory and stock identification data on adult red drum.
4) To evaluate the age composition of adult red drum.
5) 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.
6) 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.

Background

In order to begin developing a long-term index of abundance for red drum, this study 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 (Bacheler et al., 2009a; Burdick et al., 2007). The sample 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 3). 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.

A standardized sampling protocol that is replicated each year has been consistently utilized in the survey since 2007. All sampling was conducted using bottom longline gear. Lines were set and retrieved using a hydraulic reel. Ground lines consisted of 227 kg (500 lb) test monofilament. Samples were conducted with a 1,500-meter mainline with gangions placed at 15 meter intervals (100 hooks/set). Stop sleeves were placed at 30 m intervals in order to aid in accurate hook

spacing and to prevent gangions from sliding down the ground line and becoming entangled when large species were encountered. Terminal gear was clip-on, monofilament gangions consisting of a 2.5 mm diameter stainless steel longline clip with a 4/0 swivel. Leaders on gangions were 0.7 m in length and consisted of 91 kg (200 lb) monofilament rigged with a 15/0 Mustad tuna circle hook. Hooks were baited with readily available baitfish (striped mullet is the primary bait and longline squid is the first alternative). Sets were anchored and buoyed at each end. Anchors consisted of a 3.3 kg window sash weight. Multiple sash weights were used in high current areas. All soak times were standardized and kept as close to 30 minutes as logistically possible. Soak times were measured from the last hook set to the first hook retrieved. Short soak times were designed to minimize bait loss, ensure that the red drum were tagged in good condition, and to minimize negative impacts to any endangered species interactions. The SAS procedure PLAN was used to randomly select a sampling grid within each region (SAS Institute, 1985). Each of the two samples taken originated from a selected grid. In order to maintain consistency, all samples were made in the vicinity of the 1.8 m depth contour with sample depths typically ranging from 1.2 to 4.6 m in depth. All random sampling occurred during nighttime hours starting at sunset. On average, a total of four sets were made per night. Physical and environmental conditions, including surface and bottom water temperature (^{o}C), salinity (ppt) and dissolved oxygen (mg/L), were recorded for each longline sample. Bottom composition and sediment size were recorded in the instances where they could be ascertained. Location of each sample was noted by recording the beginning and ending latitude and longitude.

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. Live 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 can not 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.

Catch rates were calculated annually and expressed as an overall catch per unit effort (CPUE), along with corresponding length class distributions. The overall CPUE provides a relative index of abundance showing availability of red drum to the study. The overall CPUE was defined as the number of red drum captured per sample. Longline sets, unless otherwise noted, were standardized to 100 hooks set at 15 m intervals for 30 minutes (measured as time elapsed from last hook set to first hook fished).

Data

Data for the North Carolina Independent Red Drum Longline Survey are stored on the ASMFC FTP site as an excel file (NC_longlinerdrum_8_12_14**.xlsx**).

Results

Summary statistic and the annual CPUE for the NC Red Drum longline survey are provided in the table and figures below.

Table 1. NC red drum longline survey results for 2007-2013 based on random sets.

	2007	2008	2009	2010	2011	2012	2013	2007-13
% Positive Sets	67.61%	61.11%	62.86%	56.94%	61.11%	69.44%	68.06%	63.87%
# red drum	403	273	418	400	406	376	356	2632
CPUE	5.68	3.79	5.97	5.56	5.64	5.22	4.94	5.25
	2007	2008	2009	2010	2011	2012	2013	
Mean per set (CPUE)	5.676056338	3.791667	5.971429	5.555556	5.638889	5.222222	4.944444	
Standard Error	0.924901354	0.67713	1.081937	1.141905	1.000255	0.929692	0.777191	
PSE	16.29	17.86	18.12	20.55	17.74	17.80	15.72	
Median	4	1	2	1.5	2	2	3	
Mode	0	0	0	0	0	0	0	
Standard Deviation	7.7934	5.7456	9.0521	9.6894	8.4874	7.8887	6.5947	
Sample Variance	60.7364	33.0123	81.9412	93.8842	72.0368	62.2316	43.4898	
Kurtosis	6.3438	4.1389	2.8028	8.0455	2.4490	8.7268	3.0370	
Skewness	2.2521	1.9851	1.8613	2.5914	1.8220	2.6227	1.8106	
Range	42	28	36	53	35	44	29	
minimum in a set (100 hooks)	0	0	0	0	0	0	0	
maximum in a set (100 hooks)	42	28	36	53	35	44	29	
# red drum captured	403	273	418	400	406	376	356	
# sets made	71	72	70	72	72	72	72	
PSE=(ROUND(SE/CPUE))*100								
calculated 95% CI	1.812773343	1.32715	2.120558	2.238093	1.960464	1.822164	1.523266	

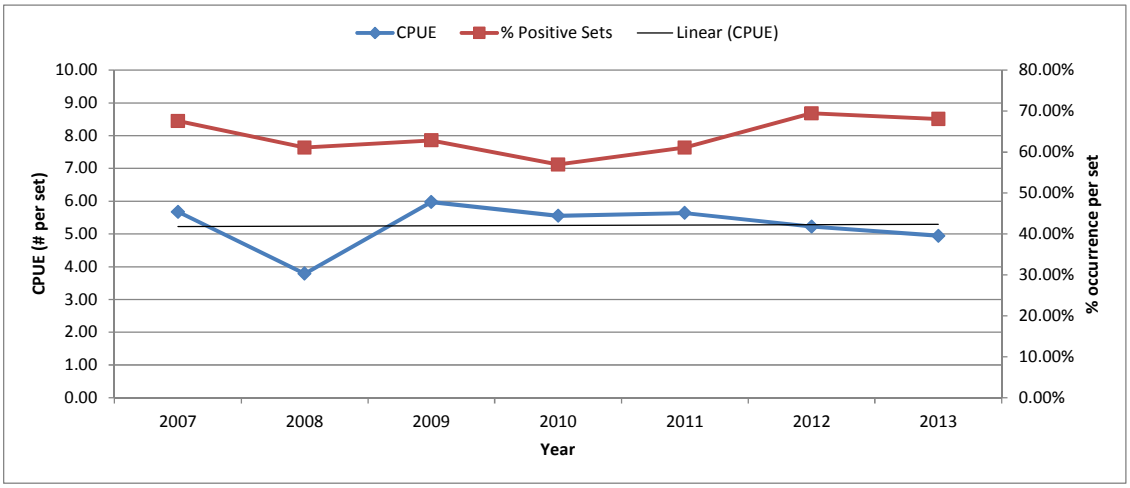


Figure 1. NC red drum longline survey CPUE and % occurrence from random sets made from 2007-2013.

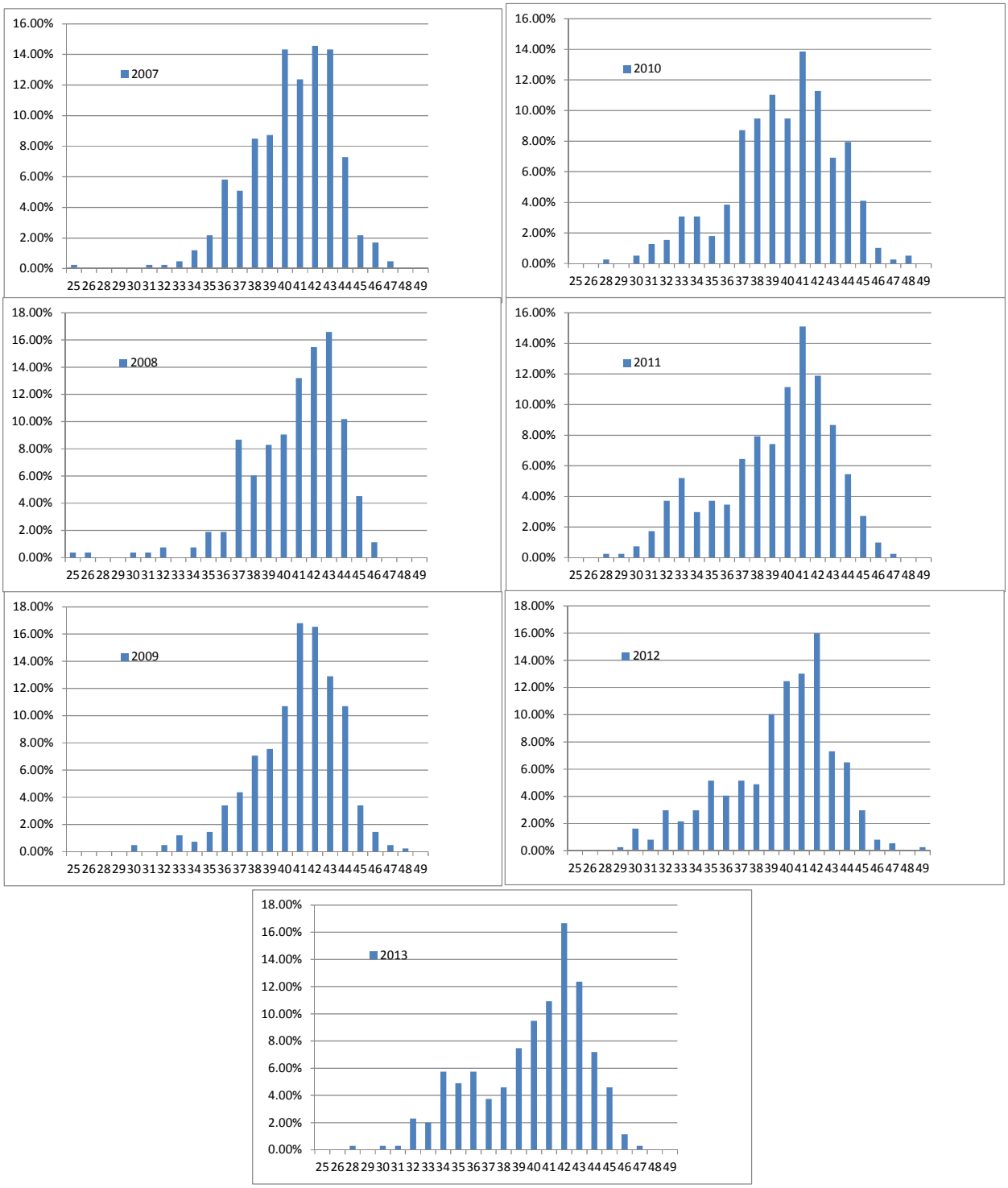


Figure 2. Length frequency distribution (FL, inches) from the NC red drum longline survey random sets from 2007-2013.

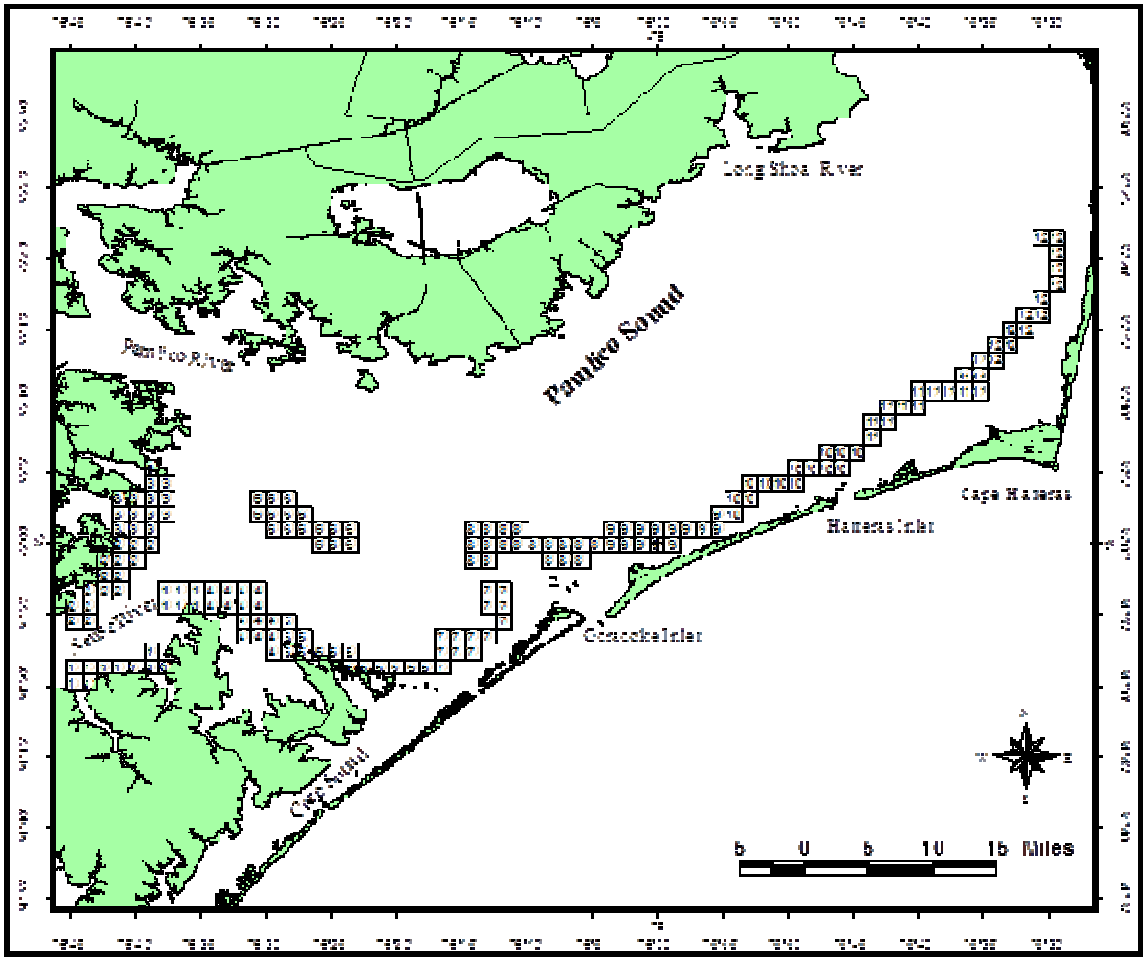


Figure 3. The random grid system and sample regions used in the North Carolina Red Drum Longline Survey used from 2007 to 2013. The numeric value in each grid designates it to one of the twelve regions sampled.

Program 930: North Carolina Age and Growth Data

Procedures:

Red drum (*Sciaenops ocellatus*) otoliths have been collected by NCDMF since 1987. Otoliths are collected monthly from commercial, recreational, and NCDMF fishery independent catches. Otoliths were removed from fish caught throughout state estuarine and coastal waters. The majority of fish sampled come from Pamlico Sound, its tributaries, and the coastal waters of the Outer Banks from Oregon Inlet to Cape Lookout. Fork length (FL) and total length (TL) in millimeters (mm) were recorded for most fish. When possible, whole weight to the nearest 0.1 kilogram (kg) and sex were obtained.

Otoliths (sagittae) were excised from all fish and stored dry. Dorso-ventral sections of the left sagitta were made through the core to the nucleus perpendicular to the anterior-posterior plane with a Hillquist thin-sectioning machine. Sections were mounted on slides with ultra-violet curing glue. All sections were read from a high resolution monitor coupled to a video camera mounted on a microscope. Age determination for red drum was based on the presence of annuli but had to be adjusted because the first annulus is not formed until 19-21 months after the hatching date. Additionally, a September 1 birthdate was used because this is the midpoint of the peak spawning season. Ages were incremented one year on this date. The system was calibrated with an ocular micrometer before each reading session. Validation of this technique is presented in Ross and Stevens (1992). Otolith sections were read independently by two readers. When disagreement occurred, ages were not assigned.

All individual length and weight data for North Carolina are contained within this data set. Maturity data when recorded is typically from macroscopic observation and should be interpreted with caution. Maturity data for North Carolina should be derived from the following reports:

Ross J.L., Stevens T.M. (1992) Life history and population dynamics of red drum (*Sciaenops ocellatus*) in North Carolina waters. Completion Report Project F-29, NC Div Mar Fish, Morehead City, NC.

Ross J.L., Stevens T.M., Vaughan D.S. (1995) Age, growth, mortality, and reproductive biology of red drums in North Carolina waters. Trans Am Fish Soc 124:37-54

Data:

North Carolina age and growth data are stored on the ASMFC FTP site as an excel file (finalncrdage_88-13.xlsx). Ages are reported in the data set for both a September 1 birthdate and for a January 1 birthdate as used in Vaughan and Carmichael (2000) and in SEDAR 18 assessment. A year class variable is also included that gives the year spawned for each fish aged. Table 1 provides a summary of available red drum ages for North Carolina.

Table 1. A summary of all age samples collected for red drum in North Carolina from 1987 to 2013. Ages adjusted to correspond with a January 1birthdate.

	Age										
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10+**	**All**
1987	7	3								1	11
1988	39	26	28	3	1	3		3		29	132
1989	30	64	60	22	1	1	6	3	2	68	257
1990	49	9	62	14	10	3	4	6	5	151	313
1991	98	53		14	8	6				49	228
1992	94	162	21	2	3				2	69	353
1993	45	130	58	1		2			1	43	280
1994	50	64	45	12	2	1	5	1	2	23	205
1995	129	213	34	5	2	1		2		40	426
1996	150	119	19	1	2	3			2	18	314
1997	343	36	8	5	1	1	1			25	420
1998	169	155	6	10	16	9	6	5		38	414
1999	131	138	11					1		2	283
2000	114	102	15	2						2	235
2001	89	67	24	1						0	181
2002	129	72	1							2	204
2003	16	85								0	101
2004	235	11	18							1	265
2005	151	162					1			5	319
2006	214	160	8						1	2	385
2007	46	111	5	8				2	1	84	257
2008	221	108	12	5	2		1	3	1	56	409
2009	121	155	5		1	1			2	32	317
2010	221	72	6	7	10	1	2			16	335
2011	73	28	1		6	7	2	2	1	56	176
2012	489	20		3	1	2	3	2	2	55	577
2013	109	270	1		2	2	2	9	1	52	448

North Carolina Commercial Fisheries Dependent Sampling Program

Procedures:

Commercial length frequency data were obtained by the NCDMF commercial fisheries dependent sampling program. Red drum lengths were collected at local fish houses by gear, market grade (not typical for red drum) and area fished. Individual fish were measured (mm, FL) and total weight (0.1 kg) of all fish measured in aggregate was obtained. Subsequent to sampling a portion of the catch, the total weight of the catch by species and market grade was obtained for each trip, either by using the trip ticket weights or some other reliable estimate. Length frequencies obtained from a sample were then expanded to the total catch using the total weights from the trip ticket. All expanded catches were then combined to describe a given commercial gear for a specified time period. Major commercial gears for North Carolina are gill net, long haul seine, and pound net. Commercial samples were taken throughout the year and from all areas where red drum were landed. Combined, gill nets, long haul seines and pound nets made up over 98% of all NC commercial landings of red drum for the period of 1999-2013. Of these, gill net landings dominated, accounting for >90%.

Dependent length frequency data for red drum in North Carolina began in the early 1980's. Data adequate to describe the major fisheries is available beginning in the late 1980's. A summary of lengths obtained by year and gear is provided in Table 1. A summary of red drum LF by management period used is provided in Figure 1.

Data:

North Carolina commercial dependent data are stored on the ASMFC FTP site as an excel file (**NC_RD Comm LF.xlsx**). The data are summarized by gear and month. The variable ONUM=the number of fish measured for a given size. The variable ENUM=the expanded number of fish in the total catch for a given size. Length frequencies to describe the fisheries should be based on the ENUM variable.

Table 1. Red drum lengths sampled from the commercial fishery in North Carolina and the percent of total harvest that a gear contributed to the overall annual commercial landings. Areas shaded in gray are where less than 20 lengths were acquired in a year. % adequate column represents the percentage of landings that had adequate sampling based on a minimum of 20 lengths by gear and year.

	Beach Seine		Gill Nets		Long Haul		Trawls		Pound Net		Rod-n-Reel		Others		
Year	# meas	% Harv	# meas	% Harv	# meas	% Harv	# meas	% Harv	# meas	% Harv	# meas	% Harv	# meas	% Harv	% adequate
1983	1	4%	0	56%	40	10%	0	21%	15	9%	rec A+B1	0%	0	0%	10%
1984	0	6%	14	61%	4	7%	7	23%	26	2%	rec A+B1	0%	0	0%	3%
1985	0	2%	0	57%	2	9%	4	30%	1	2%	rec A+B1	0%	0	0%	0%
1986	0	2%	0	45%	12	29%	5	21%	0	3%	rec A+B1	0%	0	0%	0%
1987	0	2%	0	49%	20	14%	0	8%	2	24%	rec A+B1	2%	0	0%	17%
1988	0	5%	14	60%	29	11%	1	11%	1	11%	rec A+B1	1%	0	0%	12%
1989	0	5%	60	51%	44	20%	8	9%	11	14%	rec A+B1	1%	0	0%	72%
1990	0	15%	398	53%	47	10%	2	8%	69	14%	rec A+B1	0%	0	0%	77%
1991	18	6%	121	71%	10	5%	0	10%	34	8%	rec A+B1	1%	0	0%	79%
1992	6	2%	231	82%	94	5%	1	2%	55	10%	rec A+B1	0%	0	0%	97%
1993	3	4%	546	84%	41	5%	5	3%	8	4%	rec A+B1	1%	0	0%	90%
1994	9	1%	84	81%	42	11%	1	1%	6	4%	rec A+B1	2%	0	0%	94%
1995	0	3%	324	73%	96	15%	1	0%	75	8%	rec A+B1	1%	0	0%	97%
1996	0	4%	31	80%	58	8%	24	1%	7	4%	rec A+B1	2%	0	0%	91%
1997	7	5%	249	70%	7	18%	0	0%	9	3%	rec A+B1	3%	0	0%	73%
1998	0	2%	737	84%	340	12%	0	0%	5	0%	rec A+B1	1%	0	0%	97%
1999	35	1%	903	95%	16	0%	0	0%	54	3%	rec A+B1	1%	0	0%	99%
2000	69	7%	602	89%	23	1%	19	0%	12	2%	rec A+B1	1%	0	0%	98%
2001	1	2%	381	94%	2	0%	2	0%	33	4%	rec A+B1	1%	0	0%	98%
2002	1	1%	393	90%	35	1%	0	0%	38	7%	rec A+B1	0%	0	0%	99%
2003	8	1%	356	95%	18	1%	0	0%	2	3%	rec A+B1	0%	0	0%	95%
2004	57	1%	259	93%	6	2%	0	0%	6	3%	rec A+B1	0%	0	0%	95%
2005	7	1%	730	91%	2	0%	0	0%	72	7%	rec A+B1	0%	0	0%	98%
2006	40	1%	1164	94%	25	1%	0	0%	60	4%	rec A+B1	0%	0	0%	100%
2007	12	0%	1334	95%	22	1%	62	0%	126	4%	rec A+B1	0%	0	0%	100%
2008	8	0%	1124	96%	0	0%	0	0%	79	3%	rec A+B1	0%	0	0%	100%
2009	27	0%	1049	95%	47	1%	0	0%	45	3%	rec A+B1	0%	0	0%	100%
2010	13	0%	1015	96%	10	1%	0	0%	75	3%	rec A+B1	0%	0	0%	100%
2011	6	0%	593	91%	4	2%	0	0%	44	7%	rec A+B1	0%	0	0%	100%
2012	0	0%	329	93%	2	0%	0	0%	28	6%	rec A+B1	0%	0	0%	100%
2013	32	0%	1454	92%	23	1%	0	0%	168	7%	rec A+B1	0%	0	0%	100%

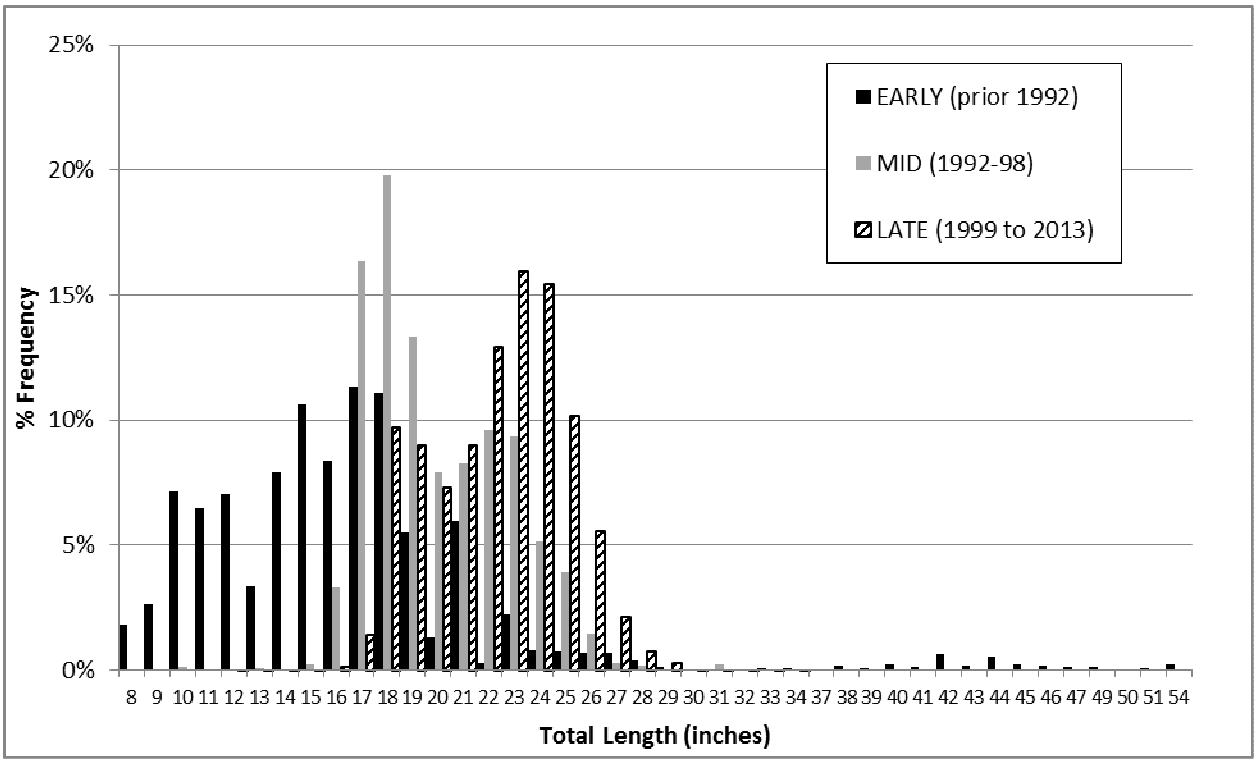


Figure 1. Length frequency of red drum from NCDMF commercial gear sampling by major management periods.