FISHERY MANAGEMENT PLAN UPDATE
KINGFISHES
AUGUST 2019

STATUS OF THE FISHERY MANAGEMENT PLAN

Fishery Management Plan History

Original FMP Adoption:	November 2007
Amendments:	None
Revisions:	None
Supplements:	None
Information Updates:	November 2015
Recommended Schedule Change:	None
Next MFC Scheduled Review:	July 2020

The original 2007 Kingfish Fishery Management Plan (FMP) developed management strategies that ensure a long-term sustainable harvest for recreational and commercial fisheries of North Carolina. The plan established the use of trend analysis and management triggers to monitor the viability of the stock. The N.C. Marine Fisheries Commission (NCMFC) also approved a rule which included proclamation authority for the North Carolina Division of Marine Fisheries (NCDMF) director the flexibility to impose restrictions on season, areas, quantity, means and methods, or size of kingfish (NCMFC Rule 15A NCAC 03M .0518), if needed. An Information Update was completed for the Kingfish FMP in November of 2015. The best available data and techniques used for the trend analysis and management triggers were refined and modified to better assess population trends as part of this FMP Information Update.

Management Unit

The North Carolina Kingfish FMP includes the three species of kingfishes (southern *Menticirrhus americanus*, Gulf *M. littoralis*, and northern *M. saxiatlis*) in all coastal fishing waters of North Carolina. Southern kingfish is designated as the indicator species for this assemblage. The management unit identified in this plan does not encompass the entire unit stock range for any of the three species of kingfishes inhabiting North Carolina. This is the primary reason that a quantified state-specific stock assessment could not be conducted and further, why a regional stock assessment approach is recommended as the most appropriate mechanism for determining the stock status and the long-term viability of this stock (NCDMF 2007).

Goal and Objectives

The goal of the 2007 Kingfish Fishery Management Plan is to determine the health of the stock and ensure the long-term sustainability for the kingfishes stock in North Carolina (NCDMF 2007). To achieve this goal, it is recommended that the following objectives be met:

1. Develop an objective management program that provides conservation of the resource and sustainable harvest in the fishery.
2. Ensure that the spawning stock is of sufficient capacity to prevent recruitment overfishing.
3. Address socio-economic concerns of all user groups.
4. Restore, improve, and protect critical habitats that affect growth, survival, and reproduction of the North Carolina stock of kingfishes.
5. Evaluate, enhance, and initiate studies to increase our understanding of kingfishes' biology and population dynamics in North Carolina.
6. Promote public awareness regarding the status and management of the North Carolina kingfishes stock.

STATUS OF THE STOCK

Life History

Three species of kingfishes occur in North Carolina: southern (*Menticirrhus americanus*), Gulf (*M. littoralis*), and northern kingfishes (*M. saxatilis*). Kingfish refers to a single species while kingfishes refers to multiple species. Kingfishes are demersal (live near and feed on the bottom) members of the drum family. Southern kingfish is the most abundant kingfish species from North Carolina to the east coast of Florida and Gulf of Mexico with a range extending as far as Cape May, New Jersey southward to Buenos Aires, Argentina. Northern kingfish is the most abundant kingfish species from Massachusetts to North Carolina, with a range extending from the Gulf of Maine into the Gulf of Mexico. Gulf kingfish is the most abundant kingfish species in the surf zone south of Cape Hatteras, North Carolina, and has a range extending from Virginia to Rio Grande, Brazil. The northern and southern kingfishes prefer mud or sand-mud bottom types while Gulf kingfish prefer the sandy bottoms of the surf zone. Kingfishes move from estuarine and nearshore ocean waters to deeper offshore waters as water temperature cools. Spawning takes place in the ocean from April to October. The kingfishes have several regional names including sea mullet, king whiting, king croaker, sea mink, roundhead, hard head, whiting, hake, Carolina whiting, and Virginia mullet.

Stock Status

The stock of kingfish is unassessed, thus overfishing/overfished status cannot be determined. However, results from the trend analysis suggests there are no concerns with the stock and no need for management at this time. A coast-wide stock assessment is a high research priority that needs to be addressed before biological reference points relative to overfished and overfishing can be determined.

Stock Assessment

The 2007 Kingfish FMP selected the use of trend analysis with management triggers as the management strategy to monitor the viability of the kingfish stock in North Carolina (NCDMF 2007). During the review of the 2007 Kingfish FMP as part of the 2015 FMP Information Update, best available data and techniques used for the trend analysis and management triggers were refined and modified to better assess population trends. The trend analysis incorporates management triggers to alert NCDMF and NCMFC to the potential need for management action based on stock conditions. The activation of any two management triggers (regardless of trigger category) two years in a row warrants further evaluation of the data and potential management action. The analysis is updated each year and all trends relative to management triggers are provided as part of this annual update. Current management triggers are based on fishery independent indices of abundance for Young-of-Year (YOY), adult fish, the proportion of catch greater than size at 50% maturity (L_{50}) and a relative fishing mortality index. YOY fish includes new fish that enter the population that year. L_{50} is the length at which 50% of the adult population is sexually mature and ready to spawn.

A formal quantitative stock assessment is not available for kingfish in North Carolina; therefore, no determination can be made relative to an overfishing or overfished status. Prior attempts at a stock assessment during the 2007 FMP development were not successful, primarily due to limited data. From these prior attempts, all reviewers noted a lack of migration (mixing) data to determine the movement patterns of kingfishes along North Carolina and the entire Atlantic coast. A regional (multi-state) stock assessment approach is likely needed to best determine the stock status for kingfish along the Atlantic coast including North Carolina. In 2008 and 2014, Atlantic States Marine Fisheries Commission (ASMFC) South Atlantic Board met to consider regional management by reviewing data on kingfishes. However, due to no major concerns with kingfish stocks, it was decided no further action was necessary. As a result, kingfish management in North Carolina continues to fall solely within the framework of the state FMP process.

STATUS OF THE FISHERY

Current Regulations

For shrimp or crab trawls, there is a three-hundred-pound trip limit for kingfishes south of Bogue Inlet from December 1 through March 31 (NCMFC Rule 15A NCAC 03J .0202 (5)). No other harvest limits are in place specific to kingfish in any other fisheries.

Commercial Landings

Commercial landings for kingfishes include southern, northern, and Gulf kingfishes combined. Landings have fluctuated historically, but have been on an increasing trend since 2011. However, the 2018 landings decreased 58% from 2017 (Figure 1). The vast majority of kingfishes landed are from the ocean gill net fishery. The average landings from 2009 to 2018 were 721,930 pounds. Harvest of kingfishes is seasonal with peak landings in April and November. Peaks in landings coincide with seasonal movements of kingfishes along the Atlantic coast.

Recreational Landings

Recreational fishing activity is monitored through the Marine Recreational Information Program. In this report, estimates across all years have been updated and are now based on the MRIP new Fishing Effort Survey-based calibrated estimates. For more information on MRIP methodology changes see https://www.fisheries.noaa.gov/topic/recreational-fishing-data.

Recreational landings for kingfish include southern, northern, and Gulf kingfishes. Total recreational landings had been on an increasing trend from 1983 – 2014. In 2015, 2016 and 2017, recreational landings declined, with 2017 having the lowest landings since 1999. In 2018 recreational landings increased 80% from 2017 (Figure 1). Most kingfishes are landed from the ocean and the majority of the fish are caught from man-made structures, such as piers, jetties, or bridges, or from beaches. A smaller portion of kingfishes are caught in estuarine waters of the state and the majority of those fish are harvested by anglers fishing from private vessels. Recreational harvest of kingfishes is also seasonal with the majority of fish harvested during the spring and the fall, and lowest during the summer. Most of the recreational catch consists of kingfish from 8 to 12 inches (Figure 12).

MONITORING PROGRAM DATA

Fishery-Dependent Monitoring

Kingfishes are sampled from a variety of commercial fishery surveys, including the estuarine long haul, ocean trawl, pound net, ocean gill net, estuarine gill net and ocean beach seine fisheries in N.C. A total of 30,939 kingfishes were measured from 2009 to 2018 (25,855 southern, 2,747 northern and 2,337 Gulf; Table 1; Figure 9). Mean length for southern kingfish ranged from 11.4 to 12.1 inches, with a minimum of 6.5 inches and a maximum of 22.0 inches. Mean length for northern kingfish ranged from 12.4 to 13.4 inches, with a minimum of 6.9 inches and a maximum of 17.7 inches. Mean length for Gulf kingfish ranged from 12.2 to 13.2 inches with a minimum of 6.1 inches and a maximum of 18.3 inches.

Recreational lengths are collected as part of Marine Recreational Informational Program (MRIP) by recreational port agents. A total of 7,493 kingfishes were measured from 2009 to 2018 (5,331 southern, 231 northern and 1,931 Gulf; Table 2). Mean length for southern kingfish ranged from 10.4 to 11.7 inches, with a minimum of 6.1 inches and a maximum of 19.9 inches. Mean length for northern kingfish ranged from 9.2 to 13.2 inches, with a minimum of 6.2 inches and a maximum of 16.0 inches. Mean length for Gulf kingfish ranged from 10.2 to 12.1 inches, with a minimum of 5.9 inches and a maximum of 18.2 inches. The length composition and modal length of kingfish caught in the commercial fishery has been stable from 1989 to 2018 (Figure 11).

Fishery-Independent Monitoring

Fishery-independent data are collected through the NCDMF Pamlico Sound Survey (Program 195), the Southeast Area Monitoring and Assessment Program – South Atlantic (SEAMAP-SA) Coastal Survey and the NCDMF Independent Gill Net Survey (Program 915). The Pamlico

Sound Survey catches the most kingfishes of any of the NCDMF fishery independent sampling programs, and the majority of those are southern kingfishes. This survey has been running uninterrupted since 1987. From 1991 to present, the Pamlico Sound Survey has been conducted during the middle two weeks in June and September. The stations sampled are randomly selected from strata based upon depth and geographic location. Tow duration is 20 minutes at 2.5 knots using the R/V Carolina Coast pulling double rigged demersal mongoose trawls. The sample area covers all of Pamlico Sound and its bays, as well as Croatan Sound up to the Highway 64 Bridge, the Pamlico River up to Blounts Bay, the Pungo River up to Smith Creek, and the Neuse River up to Upper Broad Creek. However, most kingfish are caught in Pamlico Sound proper, and very few from the Neuse, Pamlico, and Pungo rivers. The September portion of the Pamlico Sound Survey is used to calculate a YOY index of relative abundance because there are more southern kingfish collected in the fall, and more YOY are present in the catch at this time. The relative index derived from Programs 195 survey was calculated using a stratified generalized linear model (GLM) approach. The Program 195 YOY relative abundance index peaked in 2009, but has been on a decreasing trend since 2013, and remained low in 2018 (Figure 2; Table 4).

The Southeast Area Monitoring and Assessment Program-South Atlantic (SEAMAP-SA) Coastal Survey is conducted by the South Carolina Department of Natural Resources-Marine Resources Division, and provides long-term fishery independent data on the distribution and relative abundance of coastal species (Cowen and Zimney 2016). Stations are randomly selected from a pool of stations in each stratum, and sampled using paired mongoose-type Falcon trawls with tow times of 20 minutes. SEAMAP-SA Coastal Survey cruises are conducted each year in spring (mid-April to the end of May), summer (mid-July to mid-August), and fall (the first of October to mid-November). The summer portion of SEAMAP-SA Coastal Survey is used to calculate an adult index of abundance and the fall portion of SEAMAP-SA Coastal Survey is used as a young of year index of abundance. The indices derived from the SEAMAP-SA Coastal Survey were computed using standard (non-stratified) GLMs. After a peak in 2012, the SEAMAP-SA Coastal Survey adult index of relative abundance has been on a declining trend, which continued in 2018 (Figure 3; Table 4). The YOY index of relative abundance increased to well above the average in 2015 and has since returned to approximately the average in 2018 (Figure 4; Table 4).

The Independent Gill Net Survey is designed to characterize the size and age distribution for key estuarine species in Pamlico Sound and its major river tributaries. Sampling began in Pamlico Sound in 2001 and was expanded to the current sampling area (including tributaries) in 2003. Each array of nets consists of floating gill nets in 30-yard segments of 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, and 6.5-inch stretched mesh, for a total of 240 yards of nets. Catches from an array of gill nets comprise a single sample; two samples (one shallow, one deep) totaling 480 yards of gill net are completed each trip. Gill nets are typically deployed within an hour of sunset and fished the following morning. Efforts are made to keep all soak times within 12 hours. Gill net sets are determined using a random stratified survey design, based on area and water depth. The L_{50} management trigger is based on a conservative proportion of adults in the population. This is the length at which 50% of the population is mature. For southern kingfish, this is 8.25 inches (210 mm) in length. One of the data sources for this management trigger comes from the Independent Gill Net Survey and has been stable over the time series (Figure 5).

Table 3 summarizes the age data for kingfishes (southern, northern, and Gulf), collected from 2009 through 2018. The majority of kingfish age samples came from Independent Gill Net Survey (Program 915), followed by the commercial ocean gill net fishery. Southern kingfish ages ranged from 0 to 7 years old. Northern kingfish ages ranges from 0 to 4 years old. Gulf kingfish ages ranged from 0 to 6 years old. The modal ages ranged from 1 to 3 years for southern and Gulf kingfishes, and northern kingfish.

MANAGEMENT STRATEGY

The 2007 Kingfish FMP selected the use of trend analysis and management triggers as the management strategy to monitor the viability of the kingfish stock in North Carolina (NCDMF 2007). A second management strategy promotes work to enhance public information and education. The trend analysis and management triggers are updated annually and results are presented to the NCMFC as part of the annual FMP Update. The trend analysis incorporates triggers to alert managers to the potential need for management action based on stock conditions. The activation of any two management triggers two years in a row (regardless of category) warrants further data evaluation and potential management action. The NCMFC will be notified should this criterion be met. The Pamlico Sound Survey, the Independent Gill Net Survey and the SEAMAP-SA Coastal Survey data are currently used for management triggers for kingfishes in North Carolina.

The L_{50} management trigger is based on a conservative proportion of adults in the population. This is the length at which 50% of the population is mature. For southern kingfish, this is 8.25 inches (210 mm) in length. Data sources for this management trigger come from three fisheries-independent surveys; the summer component of the SEAMAP-SA Coastal Survey, the July-September component of independent gill net survey, and the June component of the Pamlico Sound Survey.

Relative *F* is a simple method for estimating trends in *F* (Sinclair 1998). It is estimated as catch (commercial landings plus recreational harvest) divided by a fisheries-independent index of relative abundance. Here, catch (commercial landings plus recreational harvest) was divided by the SEAMAP-SA Coastal Survey spring index (Onslow, Raleigh, and Long bays, inner—shallow—strata) of relative abundance, given that the majority of catch occurs in the spring.

The kingfish management triggers are summarized as follows:

<u>Biological Monitoring</u>
Proportion of adults ≥ length at 50% maturity (L_{50}) for NCDMF Program 195 June (Figure 6)
Proportion of adults ≥ L_{50} for NCDMF Program 915 (Figure 5)
Proportion of adults ≥ L_{50} for SEAMAP-SA Coastal Survey summer (Figure 7)
→ If the proportion of adults ≥ L_{50} falls below 2/3 of the average proportion of adults ≥ L_{50} for the time series, then the trigger will be considered tripped.

<u>Fisheries-Independent Surveys—Juvenile and Adult</u>
NCDMF Program 195 September index of YOY relative abundance (Figure 2)
SEAMAP-SA Coastal Survey summer index of adult relative abundance (Figure 3)

SEAMAP-SA Coastal Survey fall index of YOY relative abundance (Figure 4)
→ If a fisheries-independent survey falls below 2/3 of the average abundance for the time series (through 2017), then the trigger will be considered tripped.

Other
Relative fishing mortality rate (*F*) (Figure 8)
→ If relative *F* rises above the average +1/3 of relative *F* for the time series (through 2017), the trigger will be considered tripped.

A summary of the various management triggers by year is provided in Table 4. Bold values indicate years when a particular management trigger was activated. In 2018, one management trigger was activated and only one trigger (the YOY index from the fall portion of SEAMAP Survey) was below the management trigger threshold. No action is required at this time.

RESEARCH NEEDS

The division reviewed and prioritized the research recommendations during the 2015 FMP Information Update (NCDMF 2015). The prioritization of each research recommendation is designated as a high, medium, or low priority. A low ranking does not infer a lack of importance but is either already being addressed by others or provides limited information for aiding in management decisions. A high ranking indicates there is a substantial need, which may be time sensitive in nature, to provide information to help with management decisions. Proper management of the kingfishes resource cannot occur until some of these research needs are met. The research recommendations include:

- Conduct a coast-wide stock assessment of southern kingfish along the Atlantic Coast including estimation of biological reference points for sustainable harvest – HIGH (No action)
- Validate YOY and adult indices used in trend analysis – HIGH (UNCW has conducted seine surveys in the ocean to determine trends for all three species)
- Develop a fisheries-independent survey in the ocean for juvenile and adult kingfishes – HIGH (No action)
- Collect observer data from commercial fishing operations to estimate at-sea species composition of the catch, discard rates, and lengths – HIGH (NCDMF has observers collecting data at sea for the shrimp fishery, flounder gill net fishery and other fisheries)
- Improve recreational data collection, particularly the species composition of discards, discard rates and associated biological data – HIGH (Steps have been taken to improve sampling in recreational fisheries, including a carcass collection program)
- Improve dependent commercial data collection of more sample sizes for life history information – MEDIUM (NCDMF ageing study collects kingfish for life history data)
- Evaluate and potentially expand the NCDMF fishery-independent gill net survey to provide data on species composition, abundance trends, and population age structure by including additional areas of North Carolina's estuarine and nearshore ocean waters – MEDIUM (No action)
- Continue bycatch reduction device studies in the shrimp trawl fishery to decrease bycatch – MEDIUM (Ongoing research through NCDMF and various federal agencies)

- Determine stock structure using genetics of kingfishes along North Carolina and the Atlantic Coast – LOW (Grant approved for UNCW and NCDMF to use genetic markers to delineate the population structure)
- Develop tagging study to estimate natural and fishing mortality, to investigate stock structure, and to understand movement patterns – HIGH (No action)
- Collect histological data to develop maturity schedule with priority to southern kingfish – HIGH (NCDMF currently collecting histology samples in order to validate and update maturity schedules)
- Conduct an age validation study with priority to southern kingfish – HIGH (No action)
- Conduct study to estimate fecundity with priority to southern kingfish – MEDIUM (No action)
- Conduct study to identify spawning areas with priority for southern kingfish – MEDIUM (No action)
- Sample inlets and river plumes to determine the importance of these areas for kingfishes and other estuarine-dependent species – LOW (Sampling in the nearshore ocean through N.C. Adult Fishery Independent Survey was initiated in 2008 but discontinued in 2015. Gill net sampling in Cape Fear, New, Neuse, Pamlico, and Pungo rivers continues)
- Determine the effects of beach re-nourishment on kingfishes and their prey – LOW (Grant approved for UNCW to investigate effects of beach renourishment)
- Conduct a study to investigate how tidal stages and time of day influence feeding in kingfishes – LOW (No action)
- Increase the sample size of surveyed participants in the commercial kingfish fishery to better determine specific business characteristics and the economics of working in the fishery – LOW (NCDMF conducted a study of CRFL holders in 2009/2010)
- Update information on the participants in the recreational kingfish fishery – LOW (Socioeconomic study was conducted by NCDMF on piers)

FISHERY MANAGEMENT PLAN SCHEDULE RECOMMENDATION

The NCDMF recommends maintaining the current schedule for the review to begin in July 2020.

LITERATURE CITED

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Sinclair, A.F. 1998. Estimating trends in fishing mortality at age and length directly from research survey and commercial catch data. Canadian Journal of Fisheries and Aquatic Sciences. 55(5):1248–1263.

TABLES

Table 1. Summary of length data (fork length, inches) sampled from the kingfish commercial fishery, 2009 - 2018.

Southern Kingfish				
Year	Mean Length	Minimum Length	Maximum Length	Total Number Measured
2009	11.5	6.9	16.5	3,909
2010	11.6	6.7	22.0	2,466
2011	11.7	8.1	18.1	2,102
2012	11.5	7.0	17.0	2,947
2013	12.1	6.5	16.1	1,390
2014	11.9	8.3	20.9	2,880
2015	11.9	7.7	15.8	3,286
2016	12.0	7.1	17.2	3,107
2017	11.6	7.9	16.1	2,504
2018	11.4	6.8	16.1	1,264

Northern Kingfish				
Year	Mean Length	Minimum Length	Maximum Length	Total Number Measured
2009	12.4	6.9	15.9	314
2010	12.6	9.0	16.0	189
2011	12.7	8.6	17.0	275
2012	12.8	7.8	17.5	370
2013	13.1	8.6	16.0	815
2014	13.4	9.5	16.7	216
2015	12.7	10.0	16.6	100
2016	12.4	8.8	17.0	227
2017	13.3	9.8	17.4	177
2018	13.9	9.7	17.7	64

Gulf Kingfish				
Year	Mean Length	Minimum Length	Maximum Length	Total Number Measured
2009	12.4	8.4	16.0	305
2010	12.5	10.2	16.2	136
2011	13.2	6.1	17.9	314
2012	12.6	9.2	16.0	151
2013	12.9	8.3	17.4	470
2014	12.2	8.6	15.5	182
2015	12.7	9.2	16.3	168
2016	12.4	8.1	18.3	193
2017	12.3	9.4	16.7	257
2018	12.5	9.0	18.0	161

Table 2. Summary of length data (fork length, inches) sampled from the kingfish recreational fishery, 2009 - 2018.

Southern Kingfish				
Year	Mean Length	Minimum Length	Maximum Length	Total Number Measured
2009	10.9	6.3	18.1	689
2010	11.2	6.3	16.3	968
2011	11.0	7.2	16.5	583
2012	10.9	6.1	16.1	828
2013	10.4	6.1	15.8	370
2014	11.7	7.8	19.9	383
2015	10.7	6.4	18.7	258
2016	11.2	7.8	16.5	490
2017	11.0	7.8	15.4	472
2018	11.5	7.8	15.2	290

Northern Kingfish				
Year	Mean Length	Minimum Length	Maximum Length	Total Number Measured
2009	10.6	8.6	15.1	19
2010	11.1	8.7	15.4	20
2011	12.2	7.1	16.0	70
2012	11.3	8.3	15.1	58
2013	10.9	6.2	14.8	26
2014	11.2	9.3	13.5	2
2015	10.9	8.5	14.1	7
2016	10.8	7.9	11.8	3
2017	13.2	9.8	14.4	24
2018	9.2	6.4	13.1	2

Gulf Kingfish				
Year	Mean Length	Minimum Length	Maximum Length	Total Number Measured
2009	10.2	7.2	16.9	203
2010	10.8	5.9	18.2	363
2011	11.9	7.5	16.9	223
2012	10.4	6.4	17.2	406
2013	10.4	6.0	17.2	180
2014	11.5	6.5	17.2	203
2015	11.3	8.5	16.0	63
2016	10.7	6.9	14.1	81
2017	12.1	7.5	15.8	126
2018	11.6	6.5	17.0	83

Table 3. Kingfish age data collected from all sources (commercial and recreational fisheries and fishery independent sampling programs) combined, 2009 - 2018.

Southern Kingfish				
Year	Modal Age	Minimum Age	Maximum Age	Total Number Aged
2009	2	2	5	15
2010	2	1	5	163
2011	2	0	6	243
2012	1	1	6	228
2013	2	1	5	298
2014	3	0	5	269
2015	2	0	5	353
2016	1	0	7	530
2017	2	0	6	413
2018	1	0	7	308

Northern Kingfish				
Year	Modal Age	Minimum Age	Maximum Age	Total Number Aged
2009	1	1	3	14
2010	2	1	3	4
2011	2	0	4	115
2012	1	0	3	17
2013	2	1	3	26
2014	2	2	2	1
2015	2	0	2	40
2016	1	1	4	49
2017	2	1	3	13
2018	3	3	3	1

Gulf Kingfish				
Year	Modal Age	Minimum Age	Maximum Age	Total Number Aged
2009	-	-	-	0
2010	3	3	3	1
2011	2	1	6	28
2012	1	0	4	98
2013	1	1	4	44
2014	2	1	4	38
2015	2	0	4	78
2016	1	0	5	116
2017	2	0	5	167
2018	2	0	6	95

Table 4. Summary of management trigger organized by category. Bold indicates values that activate a trigger.

	BIOLOGICAL MONITORING			FISHERIES-INDEPENDENT SURVEYS			OTHER
	Proportion of Adults >= L50			YOY Indices		Adult Index	Relative *F*
Year	Program 195 June	Program 915 July-September	SEAMAP Summer	Program 195 September	SEAMAP Fall	SEAMAP Summer	Relative *F*
1987	0.611			**0.86**			
1988	0.450			**0.22**			
1989	**0.300**		0.585	**1.32**	6.30	**3.41**	67,901
1990	0.563		0.488	**1.35**	6.60	17.70	**305,648**
1991	0.667		0.863	**1.90**	**4.70**	18.30	107,162
1992	0.429		0.663	**0.75**	**1.78**	6.80	109,121
1993	0.543		**0.354**	**0.23**	**1.92**	**6.70**	**268,584**
1994	0.794		0.815	**0.65**	5.70	**1.78**	**450,576**
1995	0.440		0.444	**1.80**	**1.44**	**4.67**	149,528
1996	0.872		0.697	**0.24**	5.60	**2.46**	**172,560**
1997	0.589		**0.367**	**0.24**	**1.10**	**5.99**	83,659
1998	1.000		0.732	**0.19**	6.1	**2.47**	54,363
1999	0.920		0.569	**1.11**	7.20	13.20	124,682
2000	0.733		0.918	3.68	**3.40**	**4.90**	**324,589**
2001	0.660	0.983	**0.303**	2.60	**2.72**	11.60	117,159
2002	0.704	0.978	0.922	**1.84**	5.80	**5.81**	110,959
2003	0.872	0.978	0.693	5.40	**2.60**	10.20	30,979
2004	0.513	0.971	**0.300**	2.37	6.10	19.40	34,545
2005	0.594	0.971	0.552	**1.68**	**3.80**	9.40	39,849
2006	0.541	0.980	0.392	7.82	**3.10**	11.60	57,803
2007	**0.343**	0.976	0.468	4.70	**4.40**	**3.72**	**174,234**
2008	0.488	0.978	0.611	9.94	**4.60**	**1.89**	133,516
2009	0.586	1.000	**0.357**	4.49	**1.43**	8.20	**178,712**
2010	0.529	0.983	0.641	**1.73**	**4.30**	**6.19**	91,015
2011	0.432	1.000	**0.372**	7.38	15.80	10.30	127,485
2012	0.511	1.000	**0.283**	3.34	**3.90**	29.20	34,803
2013	0.659	0.947	0.528	9.79	5.30	18.60	32,764
2014	0.422	0.982	0.502	5.87	**4.90**	19.10	108,961
2015	0.534	0.981	0.527	4.52	93.00	17.50	46,684
2016	**0.358**	0.950	**0.349**	2.82	9.50	14.50	14,224
2017	0.503	0.958	0.661	2.43	6.81	10.26	7,145
2018	0.639	1.000	0.448	3.09	**2.48**	9.33	27,767
Threshold	<0.392	<0.652	<0.385	<2.0	<5.2	<6.8	>159,421
Total Years	32	18	30	32	30	30	30
Years Trigger Activated	3	0	8	16	16	12	7

Table 5. Summary of the N.C. Marine Fisheries Commission management strategies and their implementation status for the 2007 Kingfish Fishery Management Plan.

Management Strategy	**Implementation Status**
Fisheries Management	
The proposed management strategy for kingfishes in North Carolina is to 1) maintain a sustainable harvest of kingfishes over the long-term and 2) promote public education. The first strategy will be accomplished by developing management triggers based on the biology of kingfishes, landings of kingfishes, independent surveys, and requesting a stock assessment of kingfishes be conducted by Atlantic States Marine Fisheries Commission (ASMFC). The second strategy will be accomplished by the NCDMF working to enhance public information and education.	Accomplished
Recommend ASMFC conduct a coast-wide stock assessment on sea mullet.	ASMFC determined a stock assessment for the kingfishes was not necessary due to the positive trends in SEAMAP southern kingfish CPUE.
Endorse additional research to reduce bycatch in the shrimp trawl fishery, primarily shrimp trawl characterization studies involving at-sea observers and investigations into fish excluder devices with a higher success rate for reducing the harvest and retention of kingfish in shrimp trawls.	Ongoing
Implement rule giving NCDMF director proclamation authority to manage kingfish.	Accomplished. Rule 15A NCAC 3M .0518 in effect since October 1, 2008
Habitat and Water Quality	
The NCDCM should continue promoting the use of shoreline stabilization alternatives that maintain or enhance fish habitat. That includes using oyster cultch or limestone marl in constructing the sills (granite sills do not attract oyster larvae).	Endorsed through the Coastal Habitat Protection Plan (CHPP)
To ensure protection of kingfish nursery areas, fish-friendly alternatives to vertical stabilization should be required around primary and secondary nursery areas.	Endorsed through the CHPP
The location and designation of nursery habitats should be continued and expanded by the NCDMF.	Endorsed through the CHPP
No trawl areas and mechanical harvest prohibited areas should be expanded to include recovery/restoration areas for subtidal oyster beds and SAV.	Endorsed through the CHPP
Expansion and coordination of habitat monitoring efforts is needed to acquire data for modeling the location of potential recovery/restoration sites for oysters and SAV.	Endorsed through the CHPP
Any proposed stabilization project threatening the passage of kingfish larvae through coastal inlets should be avoided.	Endorsed through the CHPP
All coastal-draining river basins should be considered for NSW classification because they all deliver excess nutrients to coastal waters, regardless of flushing rate.	Endorsed through the CHPP
Efforts to implement phase II stormwater rules must be continued.	Endorsed through the CHPP
The EEP process should be extended to other development projects.	Endorsed through the CHPP
Reduce sediment and nutrient loading by addressing multiple sources, including: • improvement and continuation of urban and agricultural BMPs, • more stringent sediment controls on construction projects, and • implementation of additional buffers along coastal waters.	Endorsed through the CHPP

FIGURES

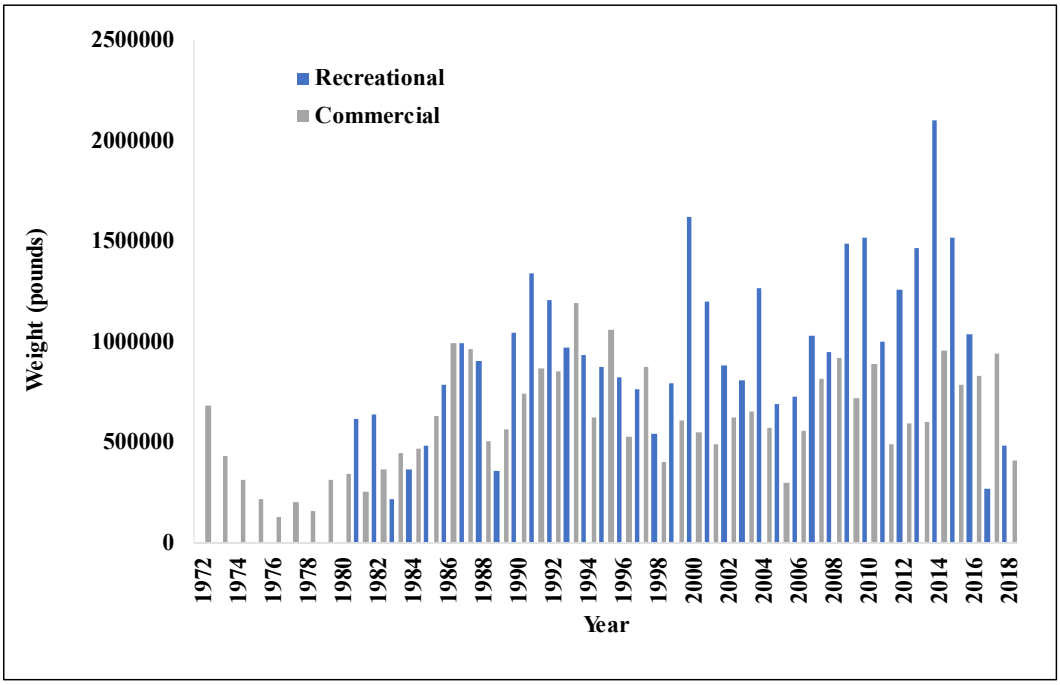

Figure 1. Commercial and recreational landings of kingfishes (southern, northern, and Gulf combined), 1972 - 2018.

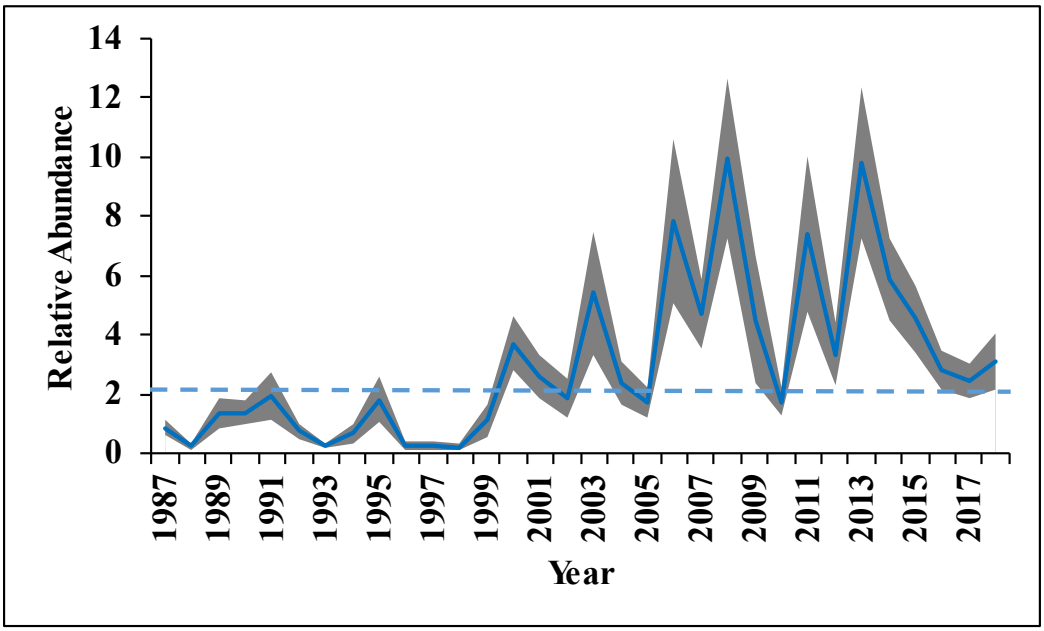

Figure 2. Annual index of relative YOY abundance for southern kingfish derived from the September component of the NCDMF Program 195 survey (excluding strata from the Neuse, Pamlico, and Pungo rivers), 1987–2018. Dotted line represents 2/3 of the average of the time series.

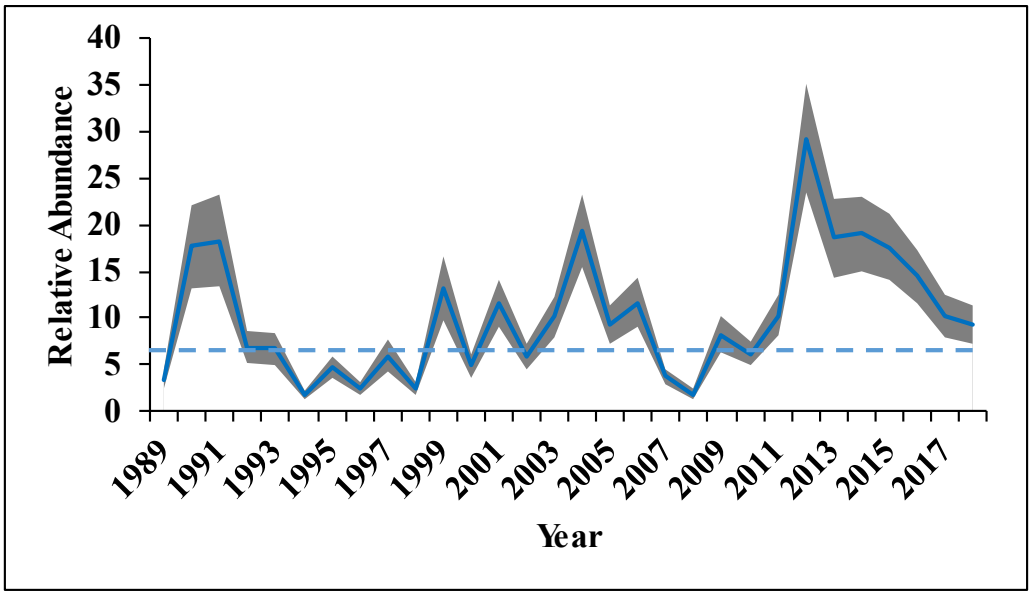

Figure 3. Annual index of relative adult abundance for southern kingfish derived from the summer component of the SEAMAP-SA Coastal Survey (Onslow, Raleigh, and Long bays, inner—shallow—strata), 1989–2018. Dotted line represents 2/3 of the average of the time series.

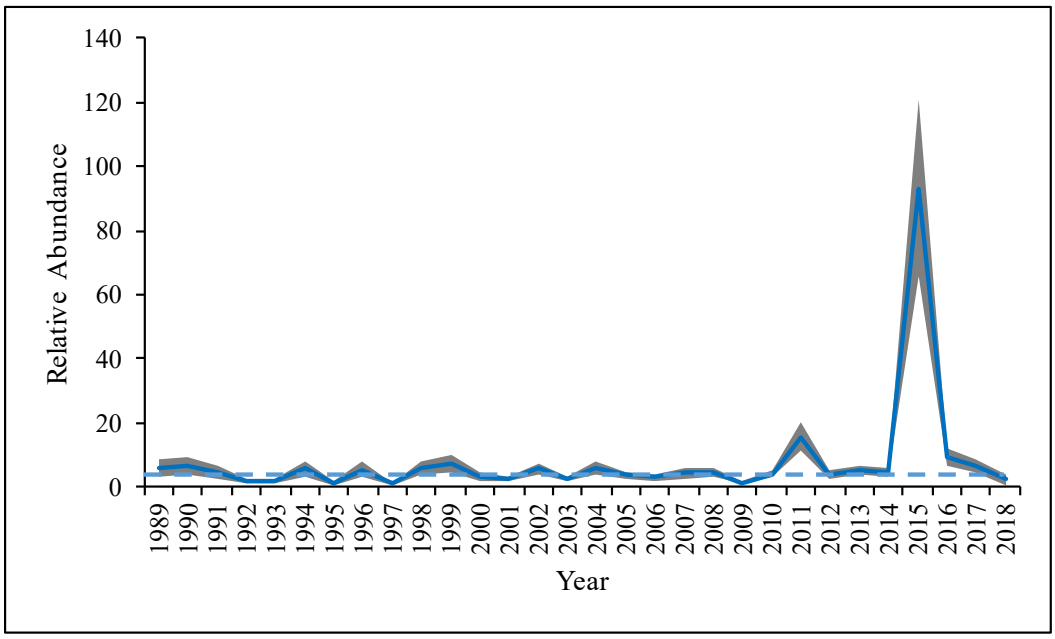

Figure 4. Annual index of relative YOY abundance for southern kingfish derived from the fall component of the SEAMAP-SA Coastal Survey (Onslow, Raleigh, and Long bays, inner—shallow—strata), 1989–2018. Dotted line represents 2/3 of the average of the time series.

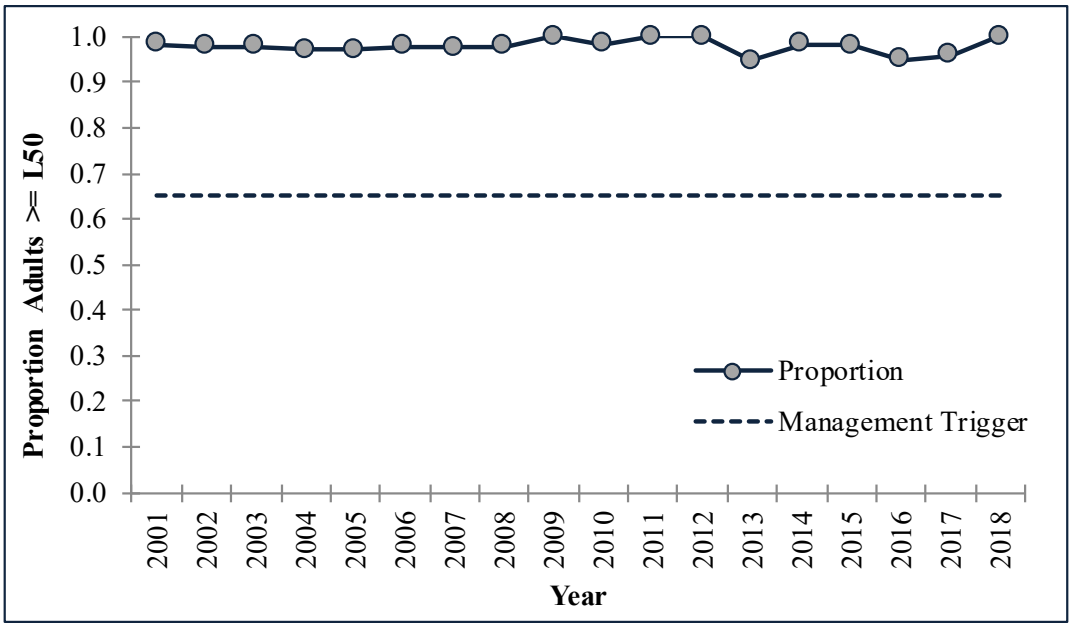

Figure 5. Annual proportions of adults (southern kingfish) greater than or equal to the length at 50% maturity occurring in the July through September component of the NCDMF Program 915 survey (Pamlico Sound, deep strata only), 2001–2018. Dotted line represents 2/3 of the average of the time series.

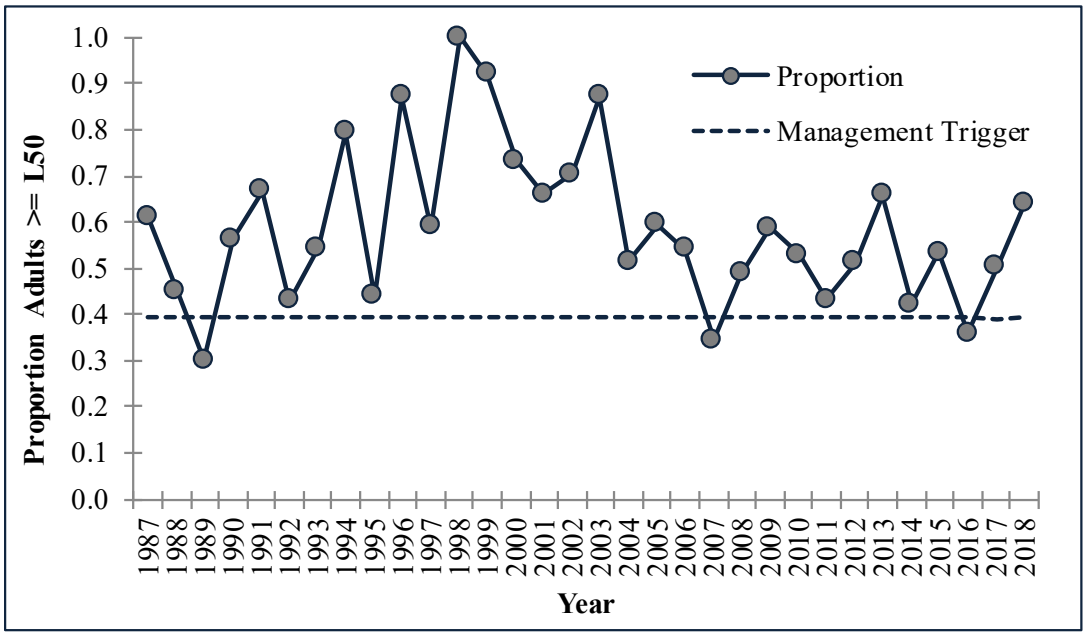

Figure 6. Annual proportions of adults (southern kingfish) greater than or equal to the length at 50% maturity occurring in the June component of the NCDMF Program 195 survey (excluding strata from the Neuse, Pamlico, and Pungo rivers), 1987–2018. Dotted line represents 2/3 of the average of the time series.

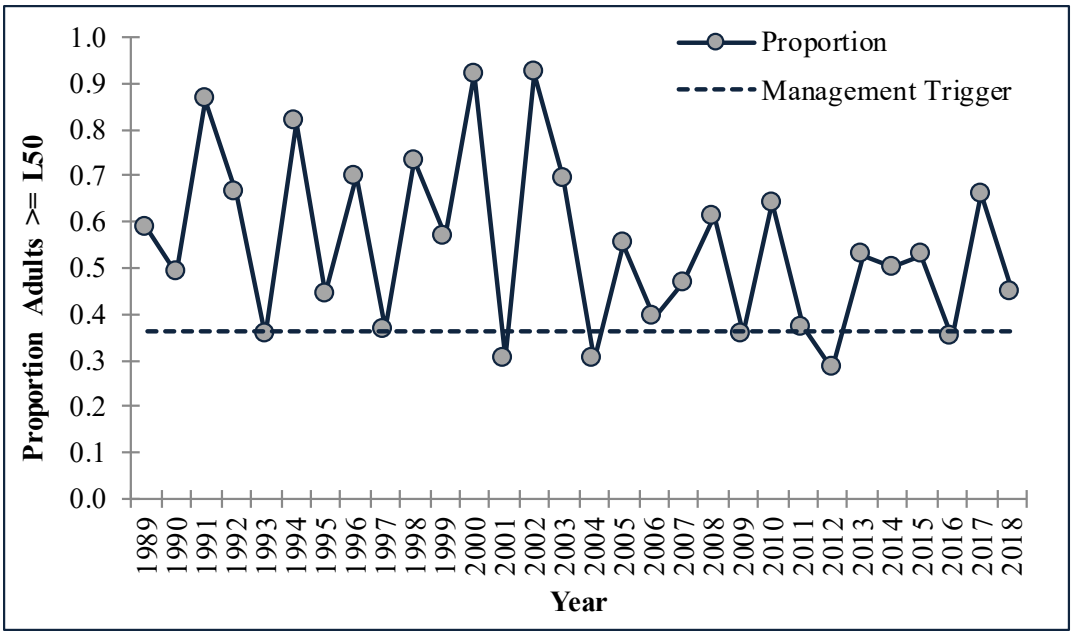

Figure 7. Annual proportions of adults (southern kingfish) greater than or equal to the length at 50% maturity occurring in the summer component of the SEAMAP-SA Coastal Survey (Onslow, Raleigh, and Long bays, inner—shallow—strata), 1989–2018. Dotted line represents 2/3 of the average of the time series.

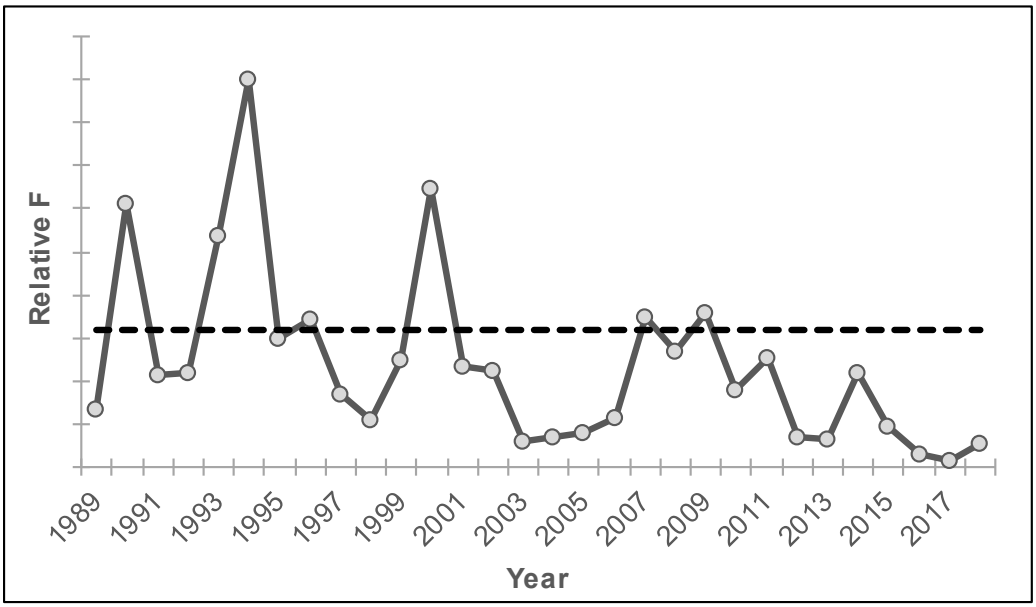

Figure 8. Relative *F*, as estimated as catch (commercial and recreational) divided by the SEAMAP-SA Coastal Survey spring index (Onslow, Raleigh, and Long bays, inner—shallow—strata) of relative abundance, 1989-2018. Dotted line represents 2/3 of the average of the time series.

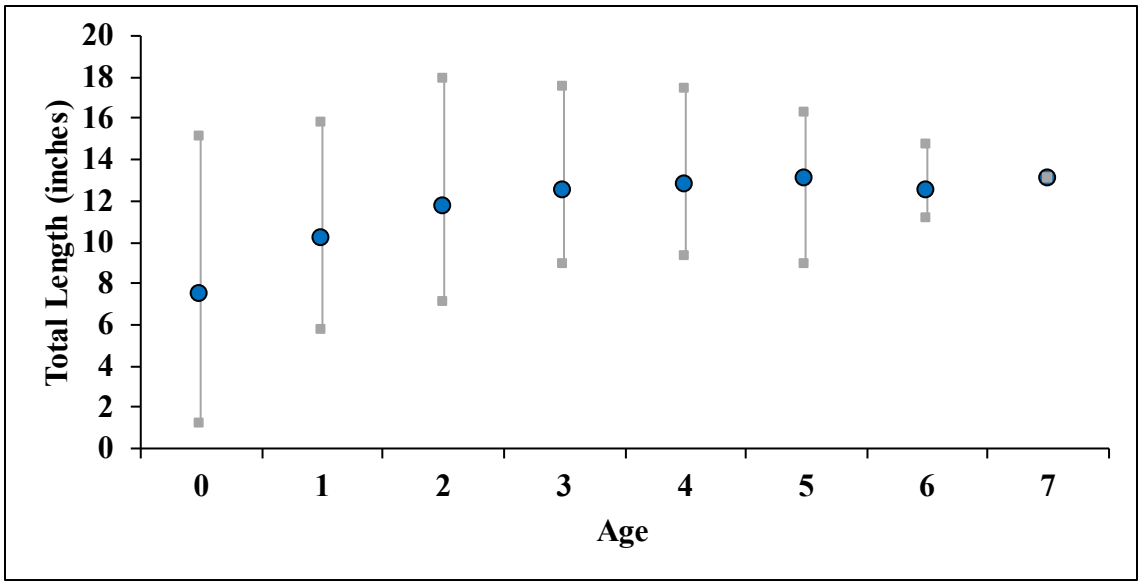

Figure 9. Kingfish length at age based on all samples collected, 1997 - 2018. Blue circles represent the mean size at a given age while the grey squares represent the minimum and maximum observed for each age.

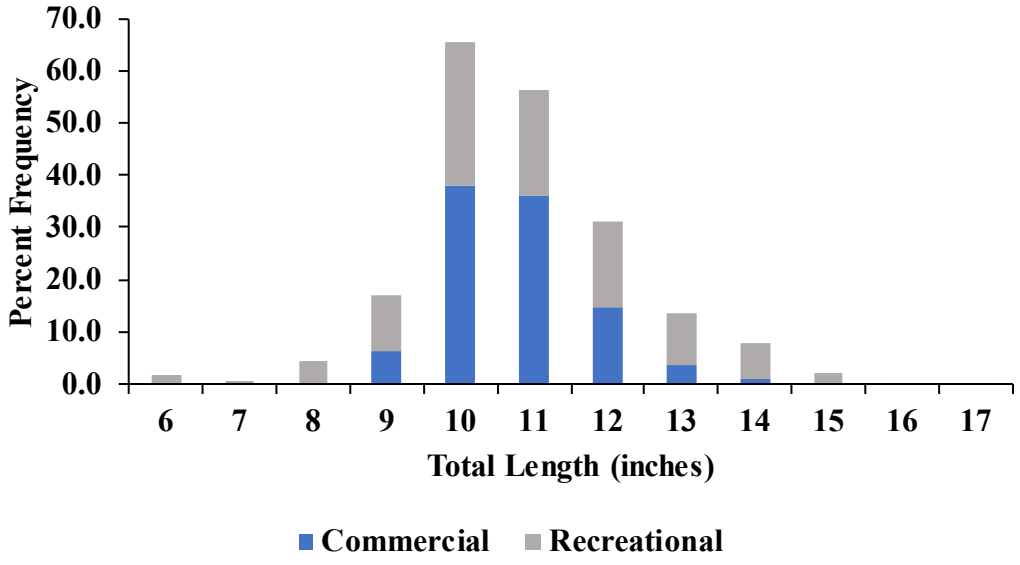

Figure 10. Commercial and recreational length frequency distribution of Kingfish harvested in 2018.

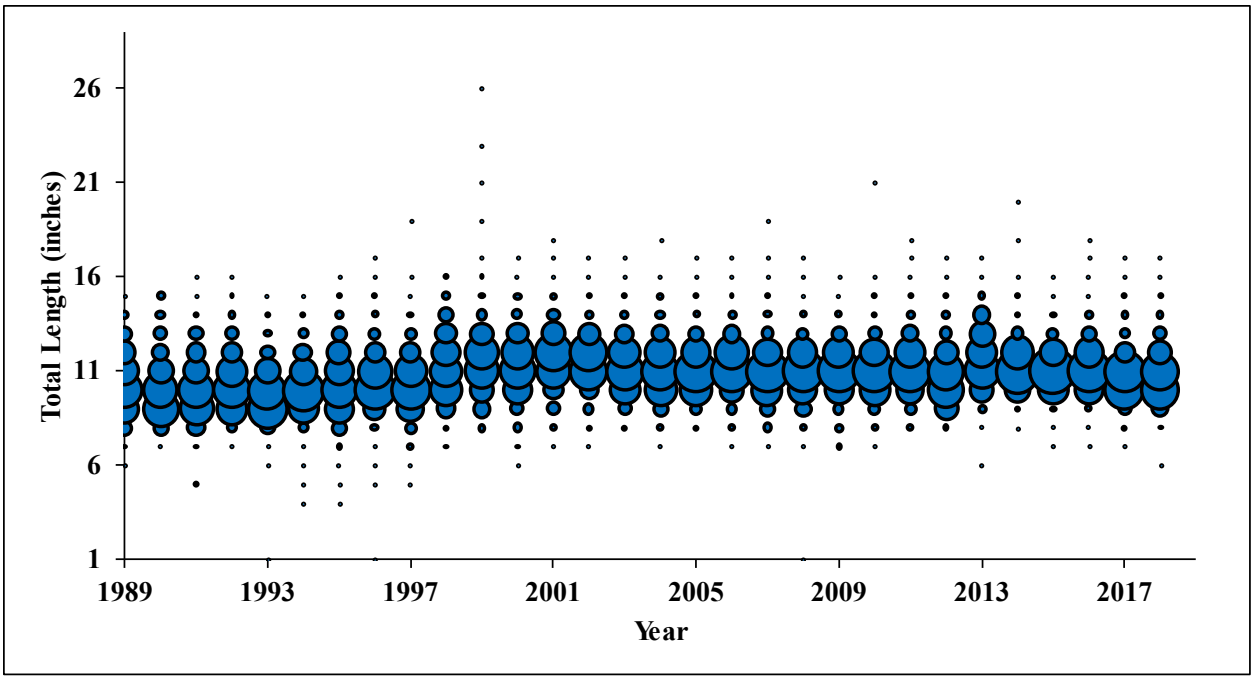

Figure 11. Commercial length frequency of Kingfish harvested, 1989-2018. Bubble represents the proportion of fish at length.

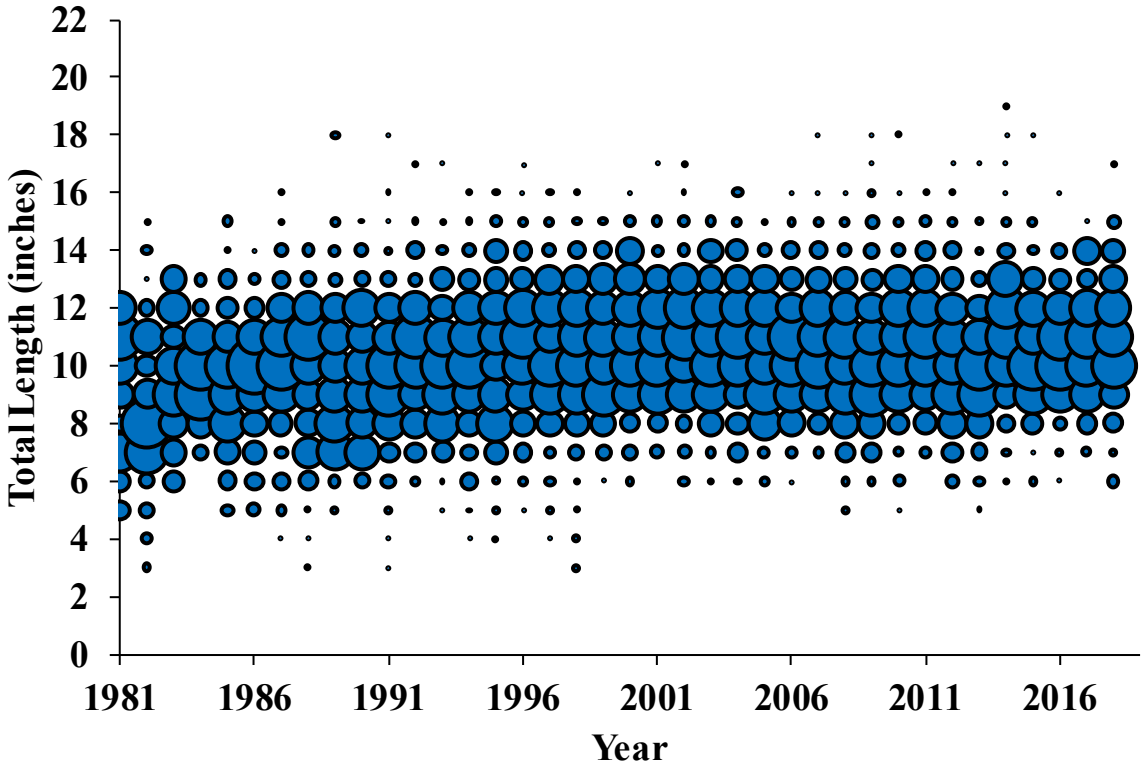

Figure 12. Recreational length frequency of Kingfish harvested, 1981-2018. Bubble represents the proportion of fish at length.