7.0 STATUS OF THE FISHERIES

7.1 INTRODUCTION

In North Carolina's coastal sounds and tributary rivers, striped bass are harvested in both commercial and recreational fisheries. Commercial fisheries occur in coastal and joint waters and recreational fisheries occur in coastal, joint, and inland waters. Striped bass harvest in the Atlantic Ocean; both commercial and recreational are managed consistent with coastwide specifications in the Amendment 6 to the ASMFC Interstate FMP for Atlantic Striped Bass (ASMFC 2003).

7.2 COMMERCIAL FISHERIES

7.2.1 A/R Stock

7.2.1.1 Historical

The Albemarle Sound area commercial striped bass fishery has been documented in numerous reports for over 100 years. In 1872, one of the most important striped bass fisheries began to develop through the haul seine fishery in Albemarle Sound. Striped bass were a bonanza to the haul seine fisheries in the Edenton area. Capehart's Avoca haul seine fishery in western Albemarle Sound was considered the best location to capture striped bass. Catches were phenomenal; on May 6, 1876 the first haul of the seine yielded 38,000 pounds and the second haul 13,000 pounds. Many of the fish weighed 80-90 pounds, with one reported at 105 pounds. Virtually all of the fish were iced and shipped to Norfolk, VA and sold to dealers in Washington, DC, Baltimore, MD, Philadelphia, PA and New York, NY (Taylor 1992).

During the early 1880s, a large fishery developed on Roanoke Island catching striped bass in the spring and fall. Gears included haul seines, drag nets, purse seines, fish traps and gill nets. The fish were small, averaging 1 – 2 pounds but the numbers were staggering. In 1886, a typical year, the 215 striped bass fishermen of Roanoke Island caught roughly 380,000 pounds. By the late 1880s, S.G. Worth reported that "The establishment and continuance of the pursuit accounts fully for the decrease or disappearance of the striped bass at the fisheries higher up on the Albemarle Sound" (Taylor 1992).

The huge haul seines, though very efficient, ultimately became victims of their own size. Harvest was high for a period of time and then dropped drastically. In 1869, two Ohio brothers, Captain John and William Hetterick, arrived in Edenton and began fishing with pound nets in Albemarle Sound (Earll 1887). The pound net, a simple device, is a long line of stakes draped with netting extended out into the channel which divert migrating fish into a small, heart-shaped funnel and then into the "pound". One or two men in a small boat used large dip nets to remove the fish from the pound. The use of the pound nets revolutionized fishing in North Carolina, especially in Albemarle Sound (Taylor 1992).

Pound nets had several advantages over the large haul seines: cost was just a few hundred dollars, were tended by only two or three men, and could be set anywhere. The number of pound nets increased from 117 in 1880 to 1,125 by 1896 in Albemarle Sound (Taylor 1992). Chestnut and Davis (1975) reported that 2,767 pound nets were set in North Carolina in 1927. Although the pound nets were set primarily for river herring and shad; striped bass were a considerable portion of the harvest. From the late 1880s through 1954 pound nets accounted for

26-62% of the total striped bass commercial harvest (Section 14, Appendix 1). The fish caught in the pound nets varied in size. Smith (1907) reported several striped bass captured in pound nets at Edenton in 1891 that weighed 125 pounds. By the late 1960's through the early 1970's, pound net contribution to the striped bass harvest had dropped to 4.8 – 7.3% of the total. Gill nets, anchor and drift, have historically been used in the striped bass fishery. Since the development of monofilament webbing, gill nets have been the dominant harvest gear. By the late 1960s to the early 1970s, gill nets were accounting for up to 77% of the striped bass harvest. Striped bass were also harvested by purse seines, fish wheels, hoop and fyke nets and trotlines.

The ASMA and Roanoke River historically supported the largest year-round commercial fishery for striped bass in North Carolina, accounting for up to 95% of the states striped bass harvest from 1930 through 1960. From 1972 to 1987, the Albemarle Sound area produced up to 87% of the striped bass landings from the state's internal waters. Chestnut and Davis (1975) presented a synopsis of striped bass landings by gear for the state (1887-1971), annual landings and value for some years, and landings by county (Section 14, Appendix 1). Annual landings by gear are shown in Table 7.1 for 1978 – 2009 and in Table 4.1 by waterbody for 1972 – 2009.

From 1915 through 1965, various regulations were promulgated for the Albemarle Sound fisheries, some specifically for striped bass, while others affected the harvest of the species though not developed directly for striped bass. The regulations included area closures, yardage restrictions, harvest limits and other restrictions (Section 14, Appendix 2). Appendix 14.3 summarizes rules and regulations enacted since 1979 for striped bass conservation and management.

The commercial fishery for striped bass has principally occurred from November through April in the Albemarle Sound, whereas, Roanoke River commercial effort was concentrated during the spring spawning run. During the summer months, all landings were much lower (Hassler et al. 1981). Anchor and drift gill nets were the most productive gear types in the spring spawning run portion of the Roanoke River fishery. In 1981, anchor gill nets were prohibited in the Roanoke River, and the mesh size of drift gill nets was restricted, resulting in sharply curtailed landings during the spawning run (Hassler 1984). Bow and dip netting was a productive method of harvesting spawning fish in Roanoke River until it was prohibited in 1981. Prior to this rule, fishermen using bow nets in the upper Roanoke River were allowed to retain 25 stripers per day when taken incidentally to shad and river herring fishing. A local law, allowing the commercial sale of striped bass in Halifax and Northampton counties was enacted by the North Carolina General Assembly and created a prominent commercial fishery for striped bass in its principal spawning area (Hassler et al. 1981). This law was repealed in 1981 and commercial fishing for striped bass was totally eliminated in the inland portions of the Roanoke River. Limited commercial fishing seasons were implemented in Albemarle Sound in 1984 (October-May) (Henry et al. 1992). State regulations enacted in 1985 prohibited the sale of hook and line caught striped bass

Table 7.1. North Carolina commercial striped bass landings from internal waters, by gear 1978-2009.

						Haul/Beach							
Year	Anchored Gillnets	Runaround Gillnet	Drift Gillnet	Pound Net	Fyke Net	Seine	Swipe Net	Trawls	Pots	Rod-n-Reel	Trolling	Unknown/other	Grand Total
1978	492,269			36,314		1,164		102		1,513	1,924		533,286
1979	274,940		131	16,844		16,542		180		9,410	56,057		374,104
1980	410,236			13,826		7,276		210		17,332	1,589	200	450,669
1981	336,035			17,645		2,310		124		9,165	504		365,783
1982	195,847			32,048		7,859		42		9,093	548		245,437
1983	286,066	210		11,793		374		189		9,016	581	250	308,479
1984	487,600			7,618		846		2		2,329			498,395
1985	259,746			19,782		16		16			197		279,757
1986	182,853			5,596		500					32		188,981
1987	232,744			29,477									262,221
1988	108,622			7,254									115,876
1989	91,387			9,253				41				57	100,738
1990	95,214			10,055									105,269
1991	113,247			3,341		12		30					116,630
1992	128,592	10		4,626		79							133,307
1993	180,233	6		1,919		4,600		18					186,776
1994	104,837	303	253	12,800	905	2,290	500		292			49	122,228
1995	91,919	120	5	4,277	790	4,592	84	42	242	80		12	102,162
1996	115,257	429	197	4,990	513	1,820	20	17	118			22	123,383
1997	106,710	1,300	120	14,007	440	773	56	206	794	7		230	124,642
1998	130,206	1,493	80	14,735	517	1,890		118	646		20	196	149,900
1999	179,491	274	15	12,820	705	2,100	54		877	252		242	196,829
2000	223,639	476	56	17,590	1,343	369		8	1,227			401	245,110
2001	226,372	1,376		12,761	2,696	538	24		1,189	17		177	245,150
2002	226,705	5,631	3,640	19,790	1,485	1,621	17		180			1,373	260,441
2003	339,056	397	251	17,586	3,480	3,040			867			44	364,721
2004	295,142	221	62	4,689	4,383	1,234		66	298			21	306,115

Table 7.1 continued

						Haul/Beach							
Year	Anchored Gillnets	Runaround Gillnet	Drift Gillnet	Pound Net	Fyke Net	Seine	Swipe Net	Trawls	Pots	Rod-n-Reel	Trolling	Unknown/other	Grand Total
2005	235,708	1,791	982	16,146	2,000	2,931			18			249	259,825
2006	184,266	875	43	17,652	2,338	1,903	6		212			253	207,547
2007	175,205	664	23	17,189	2,111	1,333		3	108			55	196,690
2008	69,879	435	44	12,440	1,639	282			186			136	85,040
2009	101,806	253		16,664	1,409	437			44			28	120,641
Grand Total	6,681,829	16,261	5,901	443,525	26,754	68,731	761	1,414	7,295	58,214	61,452	3,994	7,376,131

7.2.1.2 Current

The ASMA commercial striped bass fishery from 1990 through 1997 operated on a 98,000 pound total allowable catch (TAC). The TAC was split in order to have a spring and fall season. The commercial fishery operated with net yardage restrictions, mesh size restrictions, size limit restrictions and daily landing limits. The A/R stock was declared recovered in 1997 by the ASMFC. In 1998, the commercial TAC was increased to 125,440 pounds and additional increases in poundage occurred in 1999 and 2000. From 2000 through 2002, the commercial TAC remained at 225,000 pounds. The ASMFC Striped Bass Management Board approved a 50,000 pound TAC increase for the ASMA commercial harvest for 2003, for a commercial TAC of 275,000 pounds. Since 2003 the commercial TAC has remained at 275,000 ponds. Since the initial TAC was set in 1990, seasons, yardage, mesh size restrictions and daily landing limits have been used to control harvest and maintain the fishery as a bycatch fishery (Appendix 14.3). A summary of the ASMA commercial seasons, 1991-2009 is presented in Table 7.2.

From 1991 through 2009, the ASMA accounted for 73% – 93% of the internal striped bass landings in North Carolina (Table 4.1). The ASMA averaged approximately 407 fishermen reporting landings of striped bass for 1994 – 2002. From 2003 to 2009 the ASMA averaged 337 fishermen reporting striped bass landings annually. In 2009, 280 fishermen in the ASMA reported striped bass landings. Gill nets continue to account for the highest percentage to the harvest, followed by pound nets. For the period 2000 – 2009 gill nets contributed from 82 to 96% (average 90%) to the striped bass landings in internal state waters. For the same period pound nets contributed from 2 to 15% (average = 8%) (Table 7.1). Fyke net effort has increased in the ASMA since 1994 and is reflected in the striped bass landings (Table 7.1).

Striped bass have been managed as a bycatch of the multi-species fishery in the ASMA since 1991. During 2009, when the striped bass season was open, commercial fishermen were allowed to land from 7 to 15 fish per day, not to exceed 50% by weight of the total catch, with an 18 inch total length minimum size limit. Since 2002 the days of allowable harvest has increased 26%, from 145 to 196 in 2009 (Table 7.2). Finfish dealers who purchase striped bass are required to obtain a striped bass dealer permit from NCDMF. The dealers are required to report their landings daily to NCDMF in order for the quota to be monitored. Dealers are also required to affix striped bass sale tags, provided by NCDMF, to the fish when purchased from the fishermen.

7.2.1.3 A/R Commercial Anchored Gill Net Bycatch Mortality

The ASMA supports a substantial anchored gill net fishery for species such as flounder, striped mullet, white perch, catfish, and American shad. Less substantial catches of other commercially important species include hickory shad (*Alosa mediocris)*, weakfish (Cynoscion regalis), spotted seatrout (Cynoscion nebulosus), spot (Leiostomuus xanthurus), Atlantic croaker (*Micropogonias undulatus*), bluefish (*Pomatomus saltatrix)*, and red drum (*Sciaenops ocellatus)*. Total anchored gill net trips in the ASMA since 1994 have ranged from 13,545 trips per year (2009) to 21,198 trips per year (2001). Total landings for this same period have ranged from 1.86 million pounds (2006) to 2.87 million pounds annually (2002) (Figure 7.1). As a result of the recovery of the A/R stock, the incidental bycatch of striped bass has increased as the stock size has increased. Preventive measures have been implemented to address this issue, which have ranged from the prohibition of certain mesh sizes in gill nets, limiting the amount of yardage that can be fished, area closures, and required net attendance for small mesh gill nets during certain times of the year (Appendix 14.3). The NCMFC allows the multi-species gill net fishery to be pursued as indicated above. Since 1996, NCDMF has worked with commercial fishermen to allow observers on their vessels, on a voluntary basis, in the ASMA while gill net fishing.

Table 7.2. Summary of striped bass commercial seasons in the Albemarle Sound Management Area, North Carolina, 1991 – 2009.

Year	TAC (lbs)	Spring season # Days	Bag limit	Pounds landed	Fall season # Days	Bag limit	Pounds landed	Total pounds landed # Days
2009	275,000	Jan 1 – 31 Feb 1 – Mar 25 Mar 26 – Apr 14 Apr 15 – 30 120 days	7 fish 10 fish 15 fish 10 fish	59,832	Oct 1 – Nov 30 Dec 1 – 15 Pound net ONLY 76 days	10 fish	37,053	96,885 196 days
2008	275,000	Jan 1 – 31 Feb 1 – Apr 9 Apr 10 – 14 Apr 15 – 30 121 days	5 fish 10 fish 15 fish 10 fish	56,922	Oct 1 – Nov 30 61 days	10 fish	17,376	74,298 182 days
2007	275,000	Jan 5 – Feb 28 Mar 1 – Apr 14 Apr 15 – 30 116 days	5 fish 10 fish 5 fish	145,261	Oct 1 – Nov 30 Dec 1 - 14 75 days	10 fish	26,422	171,682 191 days
2006	275,000	Jan 1-Mar 14 Mar 15 – Apr 14 Apr 15 – 30 120 days	5 fish 10 fish 5 fish	151,682	Oct 1 – Nov 30 61 days	10 fish	34,717	186,399 181 days
2005	275,000	Jan 3- Mar 30 Apr 1 – 14 102 days	5 fish 10 fish	182,855	Oct 3 – 27 Oct 28 –Nov 30 58 days	5 fish 10 fish	49,838	232,693 160 days
2004	275,000	Jan 5 – Apr 6 91 days	5 fish	273,636	No Fall Season			273,636 91 days
2003	275,000 (269,998)	Jan 6- Mar 19 Mar 20 – Apr 14 99 days	5 fish 10 fish	190,972	Oct 27 – Dec 31 65 days	5 fish	75,583	266,555* (323,337 total – 56,782 lbs to AO) 164 days
2002	225,000 (215, 514)	Jan7 – Apr14 98 days	5 fish/18”TL	168,562	Nov 4 – Dec20 47 days	5 fish/18”TL	54,294	222,856* 145 days

Table 7.2 continued

Year	TAC (lbs)	Spring season # Days	Bag limit	Pounds landed	Fall season # Days	Bag limit	Pounds landed	Total pounds landed # Days
2001	225,000 (211,348)	Jan5 – Mar25 Mar26 – Apr14 100 days	5 fish/18”TL 10 fish/ 18” TL	185,585	Nov19 – Dec21 33 days	5 fish/18”TL	34,648	220,233* 133 days
2000	225,000 (200,109)	Jan7 – Mar26 Mar27 – Apr14 99 days	5 fish/ 18”TL 10 fish/ 18” TL	162,467	Nov13 – Dec31 49 days	5 fish/ 18”TL	51,562	214,029* 148 days
1999	137,984	Feb9 – Mar28 Mar29 – Apr14 65 days	5 fish/ 18”TL 10 fish/ 18” TL	124,527	Dec1 – Dec12 Dec13 – Dec31 31 days	10 fish/ 18”TL 5 fish/ 18”TL	38,343	162,870 96 days
1998	125,440	Feb16 – Mar6 Mar7 – Apr14 58 days	5 fish/ 18”TL 10 fish/ 18” TL	101,093	Dec1 – Dec31 31 days	10 fish/ 18”TL	22,834	123,927 89 days
1997	98,000	Feb15 – Mar23 Mar24 – Apr14 59 days	3 fish/ 18”TL 7 fish/ 18”TL	73,534	Nov.3 – Dec5 33 days	5 fish/ 18”TL	22,588	96,122 92 days
1996	98,000	Feb16 – Apr7 Apr8 – Apr14 59 days	5 fish/18”TL 3 fish/18”TL	79,678	Nov30 – Dec22 Dec23 – Dec31 32 days	5 fish/18”TL 10 fish/18”TL	10,455	90,133 91 days
1995	98,000	Mar1– Apr4 Apr5– Apr14 45 days	5 fish/18”TL 2 fish/ 18” TL	83,636	Nov22 – Dec31 40 days	2 fish/18”TL	4,200	87,836 85 days
1994	98,000	Feb21 – Mar13 21 days	10 fish/ 18”TL	53,698	Nov21 – Dec23 33 days	5 fish/ 18”TL	48,672	102,370 54 days
1993	98,000	Feb1 – Feb28 Mar1 – Apr5 64 days	5 fish/ 18”TL 3 fish/ 18” TL	109,475	No Season			109,475 64 days

Table 7.2 continued.

Year	TAC (lbs)	Spring season # Days	Bag limit	Pounds landed	Fall season # Days	Bag limit	Pounds landed	Total pounds landed # Days
1992	98,000	Jan11 – Feb2 Feb3 – Mar18 Mar19 – Apr16 97 days	10 fish/ 18”TL 5 fish/ 18” TL 3 fish/18”TL	96,435	Nov9 – Nov20 12 days	3 fish/ 18”TL	4,114	100,549 109 days
1991	98,000	Jan7 – Jan9 Jan18 – Feb12 Feb13 – Feb28 Mar1 – Mar24 Mar25 – Apr5 Apr6 – Apr13 86 days	Monthly quota/14”TL Coastal/16”TL Joint 3 fish/20”TL 5 fish/18”TL 10 fish/18”TL 20 fish/14”TL Coastal/16”TL Joint 5 fish/18”TL	101,219	Nov.1 – Dec20 50 days	3 fish/ 18”TL	7,241	108,460 136 days

*Total allowable catch adjusted to compensate for overages in previous year.

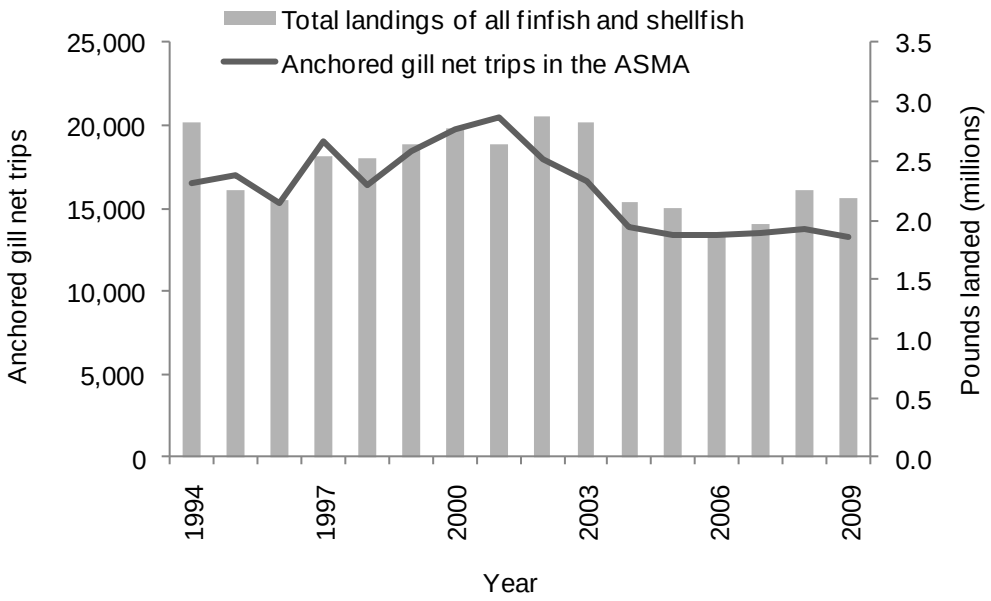


Figure 7.1 Annual gill net trips and total pounds (millions) landed from the Albemarle Sound Management Area 1994-2009.

These observer trips have mainly focused on the flounder gill net fishery, during the summer and early fall, when personnel have been available. Some observer trips have been made in the shad and small mesh gill net fisheries as well, but insufficient data have been gathered to make estimates of striped bass discard mortality in all fisheries based on observer coverage alone.

In 2003 the NCDMF initiated an observer program in the Pamlico Sound directed at more accurately estimating interactions with sea turtles in the fall/winter large mesh flounder gill net fishery. However, at sea observer trips were also made in the ASMA small mesh fisheries and large mesh flounder fisheries. From 2003 to 2008 over 250 trips observing ~225,000 yards of gill net were made in the ASMA. These observer trips have allowed the NCDMF to more accurately estimate variables such as: average yards per trip for various fisheries, at net striped bass gill net mortality rates for various fisheries, and striped bass catch rates in various fisheries.

The estimation of striped bass bycatch in the ASMA gill net fisheries has been a point of compliance with the ASMFC Striped Bass Interstate Fishery Management Plan since 1994. An annual estimate of striped bass discards in the ASMA anchored gill net fisheries has occurred since 1994. The methods used and the estimates derived are discussed in the following sections.

7.2.1.3.1 Bycatch Estimation Methods

In order to calculate an annual anchored gill net discard mortality estimate for the ASMA, total annual gill net trips and the average yards set per trip was estimated. Also needed was an estimate of rates of striped bass catch and mortality. Because observer coverage was limited, assumptions concerning average yards set per trip and striped bass catch rates had to be substituted where observations could not be made. Also, when adequate observer coverage was available all necessary estimates were calculated monthly. When inadequate observer

coverage is available certain estimates may be pooled across several months. The total number of annual fishing trips also needed to be further broken down into major fishery categories. The total number of trips was obtained from the NCDMF Trip Ticket Program (TTP). Each time fish are sold to a licensed seafood dealer in North Carolina a trip ticket must be completed. Information included on each ticket includes the weight in pounds for each species sold, the gear type used (i.e., trawl, gill net, pound net, etc.), and the primary area fished. Total yards of gill net fished is not recorded on trip tickets. While the total number of gill net fishing trips was easily obtainable, assumptions were required to determine the mesh size used in each trip. First, three trip categories were established: 1) flounder, 2) shad, and 3) small mesh (also termed "other").

Next, predominant allowable mesh sizes were estimated for each category. Based on at sea observer data and fishery research, the predominant mesh size used in the perch, mullet, and catfish fisheries is 3 ¼ inch stretched mesh, while 5 ½ inch stretched mesh (ISM) is used in the flounder and shad fisheries. Third, assuming that size selectivity of small mesh nets would not result in substantial catches of flounder or shad, and that flounder and shad trips could be categorized based on catch characteristics, each trip was examined for species composition and assigned to one of the three categories based on the primary species landed. A catch that consisted of 10% or greater of flounder, and flounder landings greater than shad, was considered a flounder trip. This procedure worked well when determining the number of flounder trips, largely because regulations require flounder nets to be tied down and set so as to fish on the bottom not to exceed a vertical height of 48 inches. The 5 ½ ISM or larger flounder net is more effective in the capture of flounder than any other species, and usually other gill net types are not fished simultaneously with the flounder net, so the trip would not be incorrectly assigned to another type of fishery. The minimum mesh size allowed for flounder nets is 5 ½ ISM, and from January through April no meshes greater than 6 ISM are allowed. This is not the case when estimates of trips were made for the shad and the small mesh category in the spring. These fisheries occur simultaneously and fishermen typically employ both shad nets and small mesh nets in a single trip. Although several mesh sizes were likely used in any given trip, trips were either counted as shad or small mesh trips depending on the catch composition. Shad trips were defined as shad landings greater than flounder or greater than 30 pounds of shad. Trips that did not meet the criteria for the flounder or shad trips were considered small mesh trips (Table 7.3).

Table 7.3 The number of anchored gill net trips broken down into trip category, 1994-2009, ASMA.

Year	Small mesh trips (attended and unattended)	Flounder trips	Shad trips	Totals
1994	5,559	10,059	832	16,450
1995	5,461	10,356	1,430	17,247
1996	5,014	8,338	1,836	15,188
1997	4,681	12,866	1,527	19,074
1998	5,137	10,311	2,252	17,700
1999	8,291	8,425	2,288	19,004
2000	8,077	9,326	2,546	19,949
2001	8,526	10,099	2,573	21,198
2002	8,299	7,630	2,029	17,958
2003	8,964	5,655	2,651	17,270
2004	6,394	5,903	2,096	14,393

Table 7.3. (Continued).

Year	Small mesh trips (attended and unattended)	Flounder trips	Shad trips	Totals
2005	6,467	5,189	1,989	13,645
2006	5,087	6,653	1,896	13,636
2007	4,633	7,110	1,922	13,665
2008	4,974	8,586	1,178	14,738
2009	4,171	8,031	1,343	13,545
Totals	99,735	134,537	30,388	264,660

Once the total number of trips for each category for a given year was estimated, trips were further broken down by month. Mortality estimates were calculated monthly because of the significant impact water temperature has on mortality. Mortality increases as water temperature increases. For some years the amount of gear used per trip was estimated for the flounder nets and small mesh nets by using the average yardage from observer data compiled by NCDMF staff. Currently the average yards per flounder trip used in discard calculations varies from 1,317 to 1,688 depending on the month. The average yards per trip used for small mesh trips for the 2009 estimate was 650. There is currently insufficient observer data available in the shad fisheries, so the maximum allowed yardage per trip (1,000 yards) must be used in discard calculations.

Catch per unit of effort was defined as the catch of striped bass per yard of gill net set for 24 hours. Catch per unit effort is one variable in the equation that must be developed annually for each trip category because CPUE is directly related to individual year class strength. Also, due to the way they are constructed, flounder nets capture far less striped bass than shad nets. So even though both nets may employ the same mesh size it is not reasonable to expect them to have the same striped bass CPUE. So over the years CPUE has come from NCDMF observer data, Fishery Resource Grants (FRG), or the IGNS (Table 7.4).

Table 7.4 Origination of variables used in annual mortality estimates for the ASMA anchored gill net fisheries. IGNS=Independent Gill Net Survey; FRG=Fisheries Resource Grant.

Year	Fishery Category	Yards Per Trip	Striped bass catch rates (# striped bass per yard)	Percent At Net Mortality
2009				
	Flounder	Observer Trips	IGNS	Observer Trips
	Shad	Maximum Assumed	IGNS	Observer Trips
	Attended small mesh	Observer Trips	IGNS	FRG 1997
	Unattended small mesh	Observer Trips	IGNS	Observer Trips
2008				
	Flounder	Observer Data	IGNS	Observer Data
	Shad	Maximum Assumed	IGNS	Observer Data
	Attended small mesh	Observer Data	IGNS	FRG 1997
	Unattended small mesh	Observer Data	IGNS	Observer Data
2007				
	Flounder	Observer Data	Observer Data	Observer Data
	Shad	Maximum Assumed	IGNS	Observer Data
	Attended small mesh	Observer Data	IGNS	FRG 1997
	Unattended small mesh	Observer Data	IGNS	Observer Data

Table 7.4 (Continued).

Year	Fishery Category	Yards Per Trip	Striped bass catch rates (# striped bass per yard)	Percent At Net Mortality
2006				
	Flounder	Observer Data	Observer Data	Observer Data
	Shad	Maximum Assumed	IGNS	Observer Data
	Attended small mesh	Observer Data	IGNS	FRG 1997
	Unattended small mesh	Observer Data	IGNS	Observer Data
2005				
	Flounder	Observer Data	Observer Data	Observer Data
	Shad	Maximum Assumed	IGNS	Observer Data
	Attended small mesh	Observer Data	Observer Data	FRG 1997
	Unattended small mesh	Observer Data	Observer Data	Observer Data
2004				
	Flounder	Observer Data	Observer Data	Observer Data
	Shad	Maximum Assumed	Observer Data	Observer Data
	Attended small mesh	Observer Data	Observer Data	FRG 1997
	Unattended small mesh	Observer Data	Observer Data	Observer Data
2003				
	Flounder	Observer Data	Observer Data	IGNS & Observer Data
	Shad	Maximum Assumed	Observer Data	IGNS
	Attended small mesh	Maximum Assumed	FRG 1997, 1998	FRG 1997
	Unattended small mesh	Maximum Assumed	Observer Data	IGNS
2002				
	Flounder	Observer Data	Observer Data	IGNS & Observer Data
	Shad	Maximum Assumed	Observer Data	
	Attended small mesh	Maximum Assumed	FRG 1997, 1998	FRG 1997
	Unattended small mesh	Maximum Assumed	Observer Data	IGNS
2001				
	Flounder	Observer Data	Observer Data	IGNS & Observer Data
	Shad	Maximum Assumed	Observer Data	Observer Data
	Attended small mesh	Maximum Assumed	FRG 1997, 1998	FRG 1997
	Unattended small mesh	Maximum Assumed	Observer Data	IGNS
2000				
	Flounder	Observer Data	Observer Data	IGNS & Observer Data
	Shad	Maximum Assumed	Observer Data	Observer Data
	Attended small mesh	Maximum Assumed	FRG 1997, 1998	FRG 1997
	Unattended small mesh	Maximum Assumed	Observer Data	IGNS
1999				
	Flounder	Observer Data	Observer Data	IGNS & Observer Data
	Shad	Maximum Assumed	IGNS	IGNS
	Attended small mesh	Maximum Assumed	FRG 1997, 1998	FRG 1997
	Unattended small mesh	Maximum Assumed	Observer Data	IGNS
1998				
	Flounder	Observer Data	Observer Data	IGNS & Observer Data
	Shad	Maximum Assumed	IGNS	IGNS
	Attended small mesh	Maximum Assumed	FRG 1997, 1998	FRG 1997
	Unattended small mesh	Maximum Assumed	Observer Data/FRG (1995)	IGNS/Observer data/FRG (1997)

Table 7.4 (Continued).

Year	Fishery Category	Yards Per Trip	Striped bass catch rates (# striped bass per yard)	Percent At Net Mortality
1997				
	Flounder	Observer Data	Observer Data	IGNS & Observer Data
	Shad	Maximum Assumed	IGNS	IGNS
	Attended small mesh	Maximum Assumed	FRG 1997, 1998	FRG 1997
	Unattended small mesh	Maximum Assumed	Observer Data/FRG (1995)	IGNS
1996				
	Flounder	Observer Data	Observer Data	IGNS & Observer Data
	Shad	Maximum Assumed	IGNS/observer data	IGNS/observer data
	Attended small mesh	Maximum Assumed	IGNS/observer data	IGNS/observer data
	Unattended small mesh	Maximum Assumed	IGNS/observer data/FRG (1995)	IGNS/observer data
1995				
	Flounder	Observer Data	Observer Data	IGNS & Observer Data
	Shad	Maximum Assumed	IGNS	IGNS
	Attended small mesh	Maximum Assumed	IGNS	IGNS
	Unattended small mesh	Maximum Assumed	IGNS/FRG (1995)	IGNS
1994				
	Flounder	Observer Data	Observer Data	IGNS & Observer Data
	Shad	Maximum Assumed	IGNS	IGNS
	Attended small mesh	Maximum Assumed	IGNS	IGNS
	Unattended small mesh	Maximum Assumed	IGNS	IGNS

Mortality rates were calculated by dividing the number of dead striped bass observed at the time the net was fished by the total number of striped bass captured. At net mortality rates would not be expected to change from year to year, only monthly with changing water temperature. There is enough observer coverage over several years so that an at net mortality rate can be used from the observer data source in the small mesh and flounder fisheries. Furthermore, small mesh nets in the ASMA must be attended from late spring through early fall. There have been several FRGs conducted using small mesh nets during this period of required attendance, so at net mortality rates for attended small mesh nets was calculated using data from these FRGs. At net mortality rates for shad fisheries were obtained from the IGNS during those same months in which the shad fishery operated. Additionally, it is known that some percentage of striped bass released alive from gill nets will suffer delayed mortality. Without adequate studies on delayed mortality in the various fishery categories in the ASMA, a range of delayed mortality estimates of 25%, 50%, and 75% were also made.

Once all necessary variables were obtained, the total numbers of striped bass captured in each fishery category was determined monthly by multiplying the average yards per trip, trips per month, and striped bass CPUE. Examining the estimate from the flounder fishery for 2009, the number of striped bass overall discard mortalities was obtained by applying the at net mortality rate to the striped bass encountered (N=3,037; Table 7.5a). The number of dead striped bass then needs to be converted into pounds of striped bass by age (Table 7.5b). Numbers of discards were proportioned into age groups based on the composition of striped bass age classes in the 5 ½ ISM from the IGNS. The numbers were then converted into pounds based on mean weight at age (11,576 lbs; Table 7.5 b). Once we have the estimate of dead discards encountered in the fishery category for the year we subtract actual commercial harvest from that fishery category. The difference is reported as dead discard mortality. In this particular example the estimated striped bass discard mortality in the flounder fishery (11,576 lbs) was less than the actual commercial harvest in the flounder fishery (17,659 lbs), so no striped bass discard mortality was attributed to the flounder fishery in 2009.

Table 7.5 An example of bycatch calculation procedures used in the 2009 flounder net category striped bass discard mortality estimate.

a.

Year	Month	Average yards per trip	Trips	Total yards	Striped bass CPUE	Striped Bass Encountered	Percent At Net Mortality	Number of dead striped bass
2009	1	1,317	16	21,072	0.00536	113	0.37143	42
2009	2	1,317	17	22,389	0.00000	0	0.37143	0
2009	3	1,317	40	52,680	0.00156	82	0.37143	31
2009	4	1,317	390	513,630	0.00000	0	0.37143	0
2009	5	1,688	609	1,027,992	0.00000	0	0.61538	0
2009	6	1,688	771	1,301,448	0.00023	295	0.61538	181
2009	7	1,688	821	1,385,848	0.00023	314	0.61538	193
2009	8	1,688	796	1,343,648	0.00023	304	0.61538	187
2009	9	1,688	1,507	2,543,816	0.00023	576	0.61538	355
2009	10	1,600	2,074	3,318,400	0.00023	752	0.69565	523
2009	11	1,600	987	1,579,200	0.00139	2,193	0.69565	1,526
			8,028	13,110,123		4,629		3,038

b.

From 5.5 ISM 2009 IGNS					flounder						
YC	N	% comp	avg kg per fish	avg lb per fish	YC	% comp	N	lbs/fish	ttl lbs	dis #	dis lbs
2005	2	0.13	1.26	2.78	2005	0.13	380	2.78	1,055	-274	-760
2004	8	0.50	1.64	3.62	2004	0.50	1,519	3.62	5,491	-841	-3,041
2003	5	0.31	1.72	3.79	2003	0.31	949	3.79	3,599	-501	-1,901
2002	0	0.00	0.00	0.00	2002	0.00	0	0.00	0	0	0
2001	1	0.06	3.42	7.54	2001	0.06	190	7.54	1,431	-50	-380
	Number of dead striped bass						3,038				
						estimated bycatch lbs			11,576		-6,083
						commercial lbs landed			17,659		
						discard estimate lbs			-6,083		

7.2.1.3.1 Bycatch Estimation Results and Discussion

Total striped bass discard mortality estimates for the ASMA anchored gill net fisheries have ranged from 32,495 lbs in 2009 to 227,900 lbs in 1997 (Table 7.6). The small mesh category has routinely accounted for the majority of the estimated striped bass discard mortality in the ASMA anchored gill net fisheries. At net mortality estimates have ranged from 32,495 pounds in 2009 to 145,826 pounds in 1995. The catch composition in small mesh nets is characterized by striped bass that are less than the 18 inch minimum TL size limit, the majority of which are two to three years old. Years with very high discard estimates can be traced back to years with very high JAIs. Years with high discard estimates in the small mesh category included: 1995, 1997, 2002, 2003, and 2008. Each of these high discard estimates is lagged two and three years behind strong year classes, which included the 1993, 1994, 2000, and 2005 year classes. With the exception of 2008, estimated discards in this category have steadily declined since 2003 (Figure 7.2). This is due in part to lower than average striped bass recruitment for the years 2003-2009 when compared to 1993-2002. Also, the reduction in striped bass discard estimates in the small mesh category was helped through adoption and implementation of the management measures in the North Carolina River Herring FMP, Amendment 1 (2007). Since 1994, the small mesh category has comprised approximately 66% of the total estimated discards by pounds.

The shad and flounder gill net categories have ranged from highs of 74,775 pounds and 51,585 pounds in 1998 and 1997 respectively, to lows of zero estimated discard mortalities in 2009 (Figure 7.2). This low estimate for 2009 seems reasonable intuitively, considering the low striped bass catch rates in flounder and shad nets as reflected in the overall low commercial harvest in 2009 (96,154 lbs). During sampling trips to fish houses in 2009 NCDMF personnel also noted that very few commercial fishermen had captured their maximum possession of striped bass per day, which was either 10 or 15 fish. This is the first time since 1994 that zero discard mortality has been attributed to a fishery category in an annual discard estimate. Both the flounder and shad gill net fishery categories have seen a steady overall decline in estimated discard mortality since 2003. Probably the largest contributing factor in this decline was the last increase in the TAC for the commercial fishery which occurred in 2003. Until 1998, the TAC for the commercial fishery of striped bass was held at 98,000 lb. With the growth of the population and the static TAC, discards of striped bass increased. In October 1997, the A/R stock was declared recovered by the ASMFC after showing substantial growth in the population. Since 1997, the TAC has increased four times to the current harvest level of 275,000 pounds for the commercial fishery. This increase in harvest has had the effect of lowering the number of discards in the flounder and shad fisheries. More of these fish that would have been discarded in previous years are now making it to market. Still, from 1994 through 2004 the number of estimated discards combined with commercial harvest exceeded the TAC during each year (Figure 7.4). In years prior to the poundage increases, the poundage of discards have been equivalent to or as much as two times the allowed harvest for that year. Since 2005 the discard mortalities combined with the harvest has been below the TAC.

Table 7.6 Estimates of initial and delayed striped bass discard mortality for the anchored gill net fisheries in the Albemarle Sound Management Area 1994-2009.

2009

			Combined Initial and Delayed Mortality					
	Initial Mortality		25%		50%		75%	
NET TYPE	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB
Flounder	0	0	0	0	0	0	0	0
Shad	0	0	0	0	0	0	0	0
Un. Sm Mesh	15,667	16,946	19,584	21,183	23,501	25,419	27,417	29,656
Att. Sm Mesh	14,376	15,549	17,970	19,436	21,564	23,324	25,158	27,211
TOTAL	**30,043**	**32,495**	**37,554**	**40,619**	**45,065**	**48,743**	**52,575**	**56,866**

2008

			Combined Initial and Delayed Mortality					
	At Net Mortality		25%		50%		75%	
NET TYPE	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB
Flounder	2,457	10,728	3,071	13,410	3,686	16,092	4,300	18,774
Shad	679	2,962	849	3,703	1,019	4,443	1,188	5,184
Un. Sm Mesh	60,523	81,979	75,654	102,474	90,785	122,969	105,915	143,463
Att. Sm Mesh	9,234	12,508	11,543	15,635	13,851	18,762	16,160	21,889
TOTAL	**72,893**	**108,177**	**91,116**	**135,221**	**109,340**	**162,266**	**127,563**	**189,310**

2007

			Combined Initial and Delayed Mortality					
	At Net Mortality		25%		50%		75%	
NET TYPE	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB
Flounder	1,158	3,994	1,448	4,993	1,737	5,991	2,027	6,990
Shad	1,563	5,054	1,954	6,318	2,345	7,581	2,735	8,845
Un. Sm Mesh	26,503	24,983	33,129	31,229	39,755	37,475	46,380	43,720
Att. Sm Mesh	10,019	9,445	12,524	11,806	15,029	14,168	17,533	16,529
TOTAL	**39,243**	**43,476**	**49,054**	**54,345**	**58,865**	**65,214**	**68,675**	**76,083**

2006

			Combined Initial and Delayed Mortality					
	At Net Mortality		25%		50%		75%	
NET TYPE	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB
Flounder	1,176	4,129	1,470	5,161	1,764	6,194	2,058	7,226
Shad	3,566	14,059	4,458	17,574	5,349	21,089	6,241	24,603
Un. Sm Mesh	11,052	23,097	13,815	28,871	16,578	34,646	19,341	40,420
Att. Sm Mesh	7,985	16,689	9,981	20,861	11,978	25,034	13,974	29,206
TOTAL	**23,779**	**57,974**	**29,724**	**72,468**	**35,669**	**86,961**	**41,613**	**101,455**

Table 7.6 (continued).

2005

	Combined Initial and Delayed Mortality							
	At Net Mortality		25%		50%		75%	
NET TYPE	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB
Flounder	486	1,704	608	2,130	729	2,556	851	2,982
Shad	2,615	10,304	3,269	12,880	3,923	15,456	4,576	18,032
Un. Sm Mesh	5,307	11,092	6,634	13,865	7,961	16,638	9,287	19,411
Att. Sm Mesh	10,692	22,345	13,365	27,931	16,038	33,518	18,711	39,104
TOTAL	**19,100**	**45,445**	**23,875**	**56,806**	**28,650**	**68,168**	**33,425**	**79,529**

2004

	Combined Initial and Delayed Mortality							
	At Net Mortality		25%		50%		75%	
NET TYPE	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB
Flounder	2,621	8,725	3,276	10,906	3,932	13,088	4,587	15,269
Shad	476	1,584	595	1,980	714	2,376	833	2,772
Un. Sm Mesh	25,214	38,884	31,518	48,605	37,821	58,326	44,125	68,047
Att. Sm Mesh	26,405	40,679	33,006	50,849	39,608	61,019	46,209	71,188
TOTAL	**54,716**	**89,872**	**68,395**	**112,340**	**82,074**	**134,808**	**95,753**	**157,276**

2003

	Combined Initial and Delayed Mortality							
	At Net Mortality		25%		50%		75%	
NET TYPE	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB
Flounder	6,005	24,576	7,506	30,720	9,008	36,864	10,509	43,008
Shad	1,180	4,826	1,475	6,033	1,770	7,239	2,065	8,446
Un. Sm Mesh	51,280	86,890	64,100	108,613	76,920	130,335	89,740	152,058
Att. Sm Mesh	27,043	45,822	33,804	57,278	40,565	68,733	47,325	80,189
TOTAL	**85,508**	**162,114**	**106,885**	**202,643**	**128,262**	**243,171**	**149,639**	**283,700**

2002

	Combined Initial and Delayed Mortality							
	At Net Mortality		25%		50%		75%	
NET TYPE	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB
Flounder	4,994	21,992	14,722	64,831	20,331	89,531	25,941	114,236
Shad	4,702	20,873	8,912	39,562	13,123	58,255	17,333	76,944
Un. Sm Mesh	46,928	85,790	62,913	115,013	78,899	144,237	94,884	173,459
Att. Sm Mesh	7,818	14,292	12,168	22,245	16,518	30,197	20,868	38,149
TOTAL	**64,442**	**142,947**	**98,715**	**241,651**	**128,871**	**322,220**	**159,026**	**402,788**

Table 7.6 (continued).

2001

	Combined Initial and Delayed Mortality							
	At Net Mortality		25%		50%		75%	
NET TYPE	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB
Flounder	3,416	15,046	5,070	22,331	6,723	29,612	8,377	36,897
Shad	4,295	18,918	7,141	31,454	9,987	43,989	12,833	56,525
Un. Sm Mesh	27,426	58,083	35,570	75,330	43,714	92,578	51,857	109,823
Att. Sm Mesh	5,502	11,652	8,564	18,137	11,625	24,620	14,687	31,104
TOTAL	**40,639**	**103,699**	**56,345**	**147,252**	**72,049**	**190,799**	**87,754**	**234,349**

2000

	Combined Initial and Delayed Mortality							
	At Net Mortality		25%		50%		75%	
NET TYPE	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB
Flounder	4,665	18,328	5,941	23,341	7,216	28,350	8,492	33,364
Shad	7,263	28,535	9,855	38,719	12,446	48,898	15,038	59,082
Un. Sm Mesh	42,545	91,134	52,321	112,075	62,098	133,018	71,874	153,959
Att. Sm Mesh	6,207	13,296	9,661	20,695	13,114	28,091	16,568	35,490
TOTAL	**60,680**	**151,293**	**77,778**	**194,830**	**94,874**	**238,357**	**111,972**	**281,895**

1999

	Combined Initial and Delayed Mortality							
	At Net Mortality		25%		50%		75%	
NET TYPE	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB
Flounder	5,156	20,111	6,806	26,547	8,457	32,987	10,107	39,422
Shad	9,659	37,675	18,980	74,032	28,302	110,392	37,623	146,749
Un. Sm Mesh	41,118	81,257	54,322	107,350	67,526	133,444	80,730	159,538
Att. Sm Mesh	7,099	14,029	11,049	21,835	14,999	29,641	18,949	37,447
TOTAL	**63,032**	**153,072**	**91,157**	**229,764**	**119,284**	**306,464**	**147,409**	**383,156**

1998

	Combined Initial and Delayed Mortality							
	At Net Mortality		25%		50%		75%	
NET TYPE	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB
Flounder	3,875	15,646	8,003	32,314	12,190	49,219	16,348	66,008
Shad	18,519	74,775	31,874	128,699	45,230	182,627	58,585	236,551
Un. Sm Mesh	29,176	45,436	43,062	67,061	56,947	88,684	70,833	110,309
Att. Sm Mesh	7,350	11,446	11,440	17,816	15,530	24,185	19,620	30,554
TOTAL	**58,920**	**147,303**	**94,379**	**245,890**	**129,897**	**344,715**	**165,386**	**443,422**

Table 7.6 (continued).

1997

			Combined Initial and Delayed Mortality					
	At Net Mortality		25%		50%		75%	
NET TYPE	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB
Flounder	10,438	51,585	13,748	67,943	17,058	84,301	20,369	100,664
Shad	11,529	56,976	16,097	79,551	20,664	102,121	25,232	124,696
Un. Sm Mesh	51,908	110,668	85,610	182,521	119,311	254,371	153,013	326,224
Att. Sm Mesh	4,067	8,671	6,330	13,496	8,593	18,320	10,856	23,145
TOTAL	**77,942**	**227,900**	**121,785**	**343,511**	**165,626**	**459,113**	**209,470**	**574,729**

1996

			Combined Initial and Delayed Mortality					
	At Net Mortality		25%		50%		75%	
NET TYPE	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB
Flounder	6,575	28,023	9,421	40,153	12,268	52,287	15,114	64,417
Shad	15,199	64,778	17,533	74,726	19,866	84,669	22,200	94,616
Un. Sm Mesh	18,491	23,502	23,858	30,323	29,226	37,146	34,593	43,968
Att. Sm Mesh	3,636	4,621	5,659	7,193	7,682	9,764	9,705	12,335
TOTAL	**43,901**	**120,924**	**56,471**	**152,395**	**69,042**	**183,866**	**81,612**	**215,336**

1995

			Combined Initial and Delayed Mortality					
	At Net Mortality		25%		50%		75%	
NET TYPE	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB
Flounder	8,581	31,791	12,055	44,662	15,529	57,532	19,002	70,399
Shad	12,026	44,554	14,445	53,516	16,865	62,482	19,284	71,444
Un. Sm Mesh	124,694	143,273	170,233	195,597	215,772	247,921	261,311	300,246
Att. Sm Mesh	2,222	2,553	3,459	3,974	4,695	5,395	5,932	6,816
TOTAL	**147,523**	**222,171**	**200,192**	**297,749**	**252,861**	**373,330**	**305,529**	**448,905**

1994

			Combined Initial and Delayed Mortality					
	At Net Mortality		25%		50%		75%	
NET TYPE	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB	# OF STB	LB OF STB
Flounder	4,133	14,666	5,620	19,943	7,107	25,219	8,593	30,492
Shad	1,861	6,604	2,267	8,045	2,674	9,489	3,080	10,940
Un. Sm Mesh	33,142	82,457	43,255	107,618	53,368	132,779	63,481	157,940
Att. Sm Mesh	6,963	17,324	10,837	26,962	14,712	36,603	18,586	46,242
TOTAL	**46,099**	**121,051**	**61,979**	**162,568**	**77,861**	**204,090**	**93,740**	**245,614**

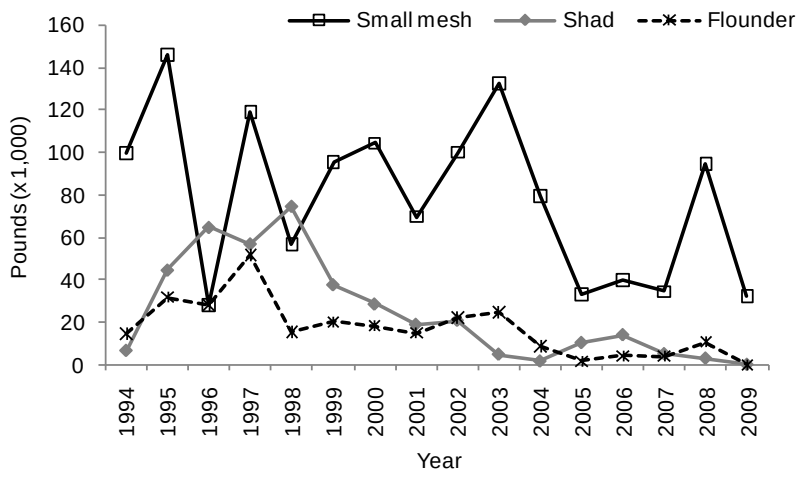


Figure 7.2 Estimated striped bass discards by trip category, 1994-2009, ASMA, NC.

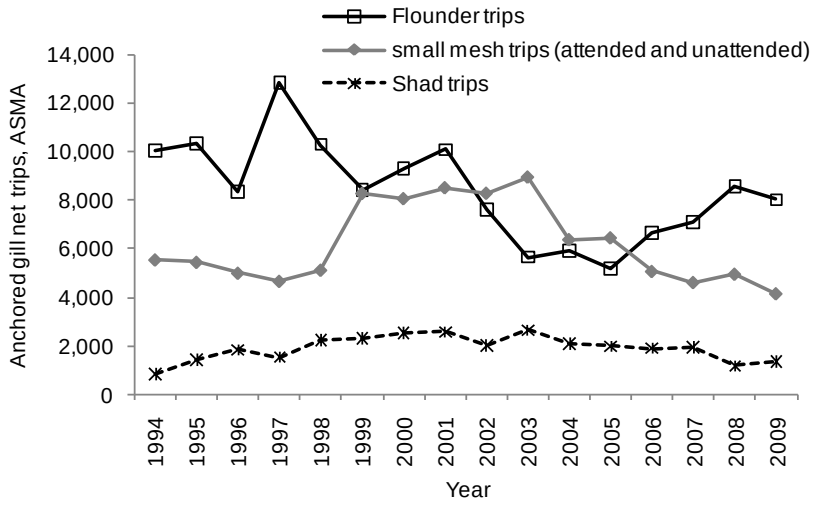


Figure 7.3 Estimated gill net trips by trip category, 1994-2009, ASMA, NC.

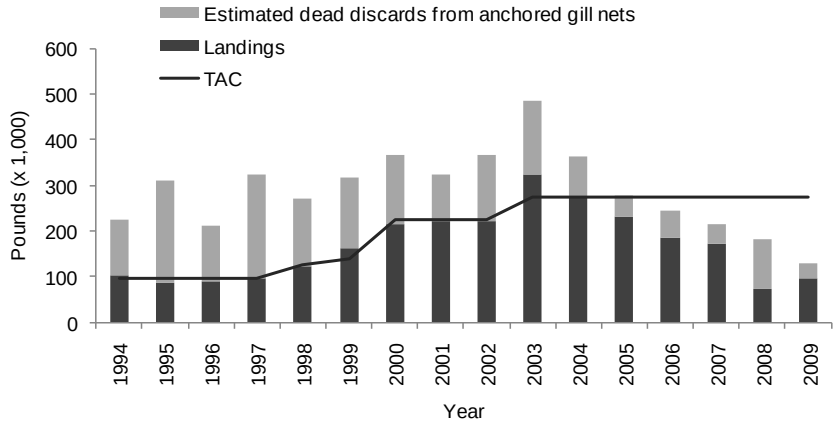


Figure 7.4 Estimated striped bass dead discards, landings, and Total Allowable Catch (TAC) 1994-2009, ASMA, NC.

In examining the discard mortality estimates more closely, it becomes evident how important at sea observer coverage is in accurately estimating striped bass discards. For the time period 2004 – 2009 there is sufficient observer coverage to make improved estimates of the average yards fished per trip for the flounder and small mesh fisheries in each year. In comparing the estimates generated from these years using the maximum allowed yard per trip versus the average yards per trip obtained from observer data, estimates made assuming maximum yardage per trip are nearly twice the estimates made using known values of yard per trip (Figure 7.5). For these six years, the discard mortality estimates totaled 680,256 pounds for assumed maximum yards per trip and 377,439 pounds when at sea observer data was used. If adequate observer information were available for the shad fisheries that indicated the average yards set per trip was less than the currently assumed maximum 1,000 yards, the estimates would be lower still.

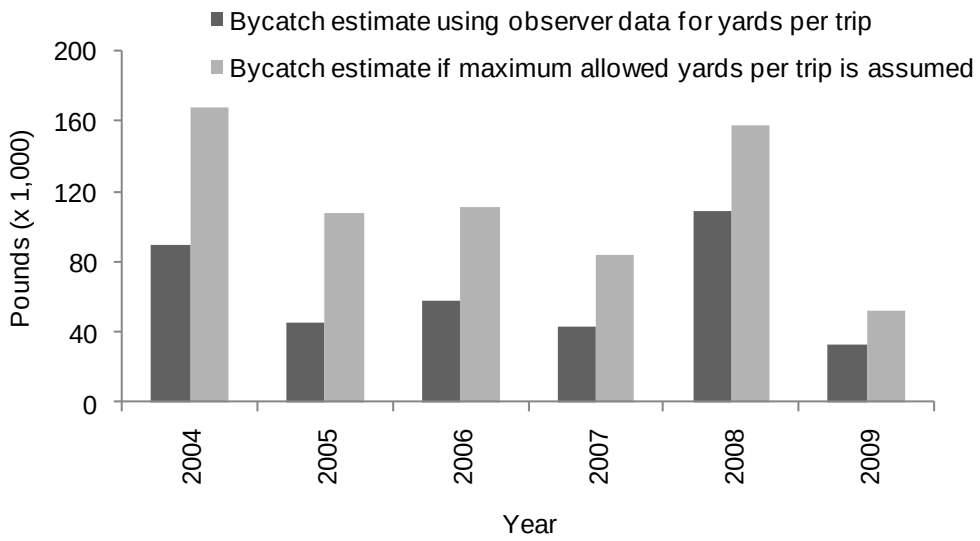


Figure 7.5 Comparison of ASMA anchored gill net striped bass discard mortality estimates using observer information versus assumed maximum values for average yards per trip.

Additional caveats with using IGNS data for the discard estimates are better understood by examining the 2008 discard estimate, the highest estimate since 2003. Two things in particular probably led to a much inflated dead discard estimate in 2008: 1) The strong 2005 year class of striped bass resulted in some of the highest catch rates observed in the IGNS in the entire time series of the survey. However, these high catch rates were observed in the western ASMA only. Zones II and III (western ASMA) accounted for 70% of the total striped bass catch in the 3.0 and 3.5 ISM nets (N=446, CPUE=0.08711), while Zones VI and VII (eastern ASMA) accounted for only 4% of the catch (N=27, CPUE=0.00527). Without an accurate way to distinguish gill net trips made in the western ASMA versus eastern ASMA, these high striped bass catch rates from the IGNS were applied to the total number of commercial gill net trips made in the entire ASMA. The TTP reported 4,974 commercial small mesh gill net trips were made in the ASMA during 2008. Looking at the catch composition from trip tickets it is evident many of these trips were made in the eastern portion of the ASMA. With the low striped bass catch rates observed in the IGNS from this area it is likely very little if any striped bass bycatch was observed in many of these eastern sound trips; 2) The IGNS was designed as a random-stratified-multiple mesh gill net survey to estimate the relative abundance and composition of striped bass residing and overwintering in the ASMA and the relative abundance and composition of the A/R spawning stock. It was not designed to estimate catch rates of any

species observed in commercial fishing operations. This is an important caveat to consider when IGNS striped bass catch rates must be used in estimating bycatch losses attributed to the commercial gill net fisheries. Price (2004) showed that commercial fishermen in the Currituck Sound could use Traditional Ecological Knowledge (TEK) to reduce striped bass bycatch in small mesh white perch fisheries. Striped bass catch rates were significantly lower in nets set by fishermen using TEK compared to nets randomly set. Commercial fishermen will try and set nets so as to encounter as little unwanted bycatch as possible, thus reducing time on the water and fuel consumption. The majority of striped bass captured in the small mesh fisheries are undersized discards, so fishermen use TEK to avoid setting in areas that are likely to produce significant striped bass undersized discards.

There are also many additional regulations since 1990 that would have reduced striped bass discard mortality in the ASMA that may not be reflected when IGNS data have to be used in the annual estimates (Table 7.7). Total harvest and discards by commercial and recreational sectors is shown in Figure 7.6. Table 7.8 is a summary of striped bass commercial seasons in the ASMA.

Acquiring the funding for a state-wide at-sea observer program in all fisheries should be a top priority.

7.2.2 CSMA Stocks: Tar/Pamlico River and Pamlico Sound

7.2.2.1 Historical

Commercial striped bass fisheries have historically occurred throughout Pamlico Sound and its tributaries. However, these fisheries were not of the magnitude of the Albemarle Sound and ran second in total landings for the state. As with the Albemarle Sound, the progression of various gears was the same over time from haul seines, pound nets to gill nets. From the 1930s through the 1960s the Pamlico Sound and Tar/Pamlico River accounted for 3.4 – 5.5% of the total internal striped bass landings in North Carolina. During the 1970s and 1980s this area contributed 7 – 10% of the state's internal striped bass landings. Chestnut and Davis (1975) presented a synopsis of striped bass landings by gear for the state (1887 – 1971), annual landings and value for some years, and landings by county (Section 14, Appendix 1). Annual landings by gear are shown in Table 7.1 from 1978 to 2009 and in Table 4.1 by waterbody for 1972 – 2009.

From 1915 to 1965, various regulations were enacted on the fisheries of the Pamlico system. The regulations included net restrictions and area restrictions (Section 14, Appendix 2). Appendix 14.3 summarizes rules and regulations enacted since 1979 relative to striped bass management.

7.2.2.2 Current

Since 1994, when the initial North Carolina Striped Bass Management Plan was approved, the CSMA (all areas south of the ASMA line) has operated on a 25,000 pound TAC (Table 7.9). The fishery has operated as a low harvest level fishery, using set seasons with size limit restrictions and daily landing limits. The various rules and regulations are shown in Appendix 3.

The Pamlico Sound and Pamlico/Pungo River complex has accounted for 9% of the state's internal striped bass landings since 1994. During 1999 and 2000, these areas exceeded the total 25,000 pound TAC for the entire Central/Southern area of the state (Table 4.1). In the CSMA between 1994 and 2000, there was an average of 211 fishermen reporting landings in a given year. Since 2001, the number of fishermen reporting landings annually has dropped to approximately 168.

Table 7.7 Regulations promulgated since 1990 that would have decreased striped bass discard mortality attributed to anchored gill net fisheries in the ASMA.

Year/Area	Large mesh 5 inch and larger	Shad (Feb 1 – Apr 14)	Flounder	Small Mesh (Unattended/Attended)
1990	No restrictions			3 to 4 in – up to 1,600 yards
1991 - 1993	5 ¼ in and greater no restrictions			3 to 3 ½ in – 400 – 1,200 yards
1991 - 1993 Roanoke/Croatan areas	No restrictions			2 ½ in and larger unlimited
1991 – present Batchelor Bay area	Closed to all gill nets Feb 1 – Late Nov			
1994	All gill nets – only set from sunrise Mon – Fri at 4:00 pm	500 yards		3 – 3 ¼ in up to 1,000 yards
1994 - present			Flounder net definition – max 3,000 yards – 5 ¼ and larger	
Roanoke/Croatan areas 1994 – early 1999				2 ½ inch and larger unlimited
1995		500 - 800 yards		3 – 3 ¼ in – 300 -1,000 yards (unattended/attended)
1996 - 2006		1,000 yards		3 – 3 ¼ inch – 400 -800 yards; 3 – 4 inch – 800 yard attended (summer)
Roanoke/Croatan areas Early 1999 - 2001				3 – 3 ¼ inch – 400 – 1,000 yards, seasonal 3 – 4 inch – not exceed 1,200yards
Roanoke/Croatan areas 2002- 2006				3 – 3 ¼ inch – max 800 yards, seasonal 3 – 4 inch not exceed 800 yards total
2007 – present		1,000 yards	Flounder net definition – 5 ½ inch and larger, max 3,000 yards,	Only 3 ¼ inch – max 800 yards – Jan – mid- May, 3 – 4 inch – Max 800 yards – attended – Mid-May – Mid – Nov, 3 and 3 ¼ inch – max 800 yards – unattended - mid-Nov - Dec

Figure 7.6 Total harvest and discards by commercial and recreational sectors 1994-2009, ASMA.

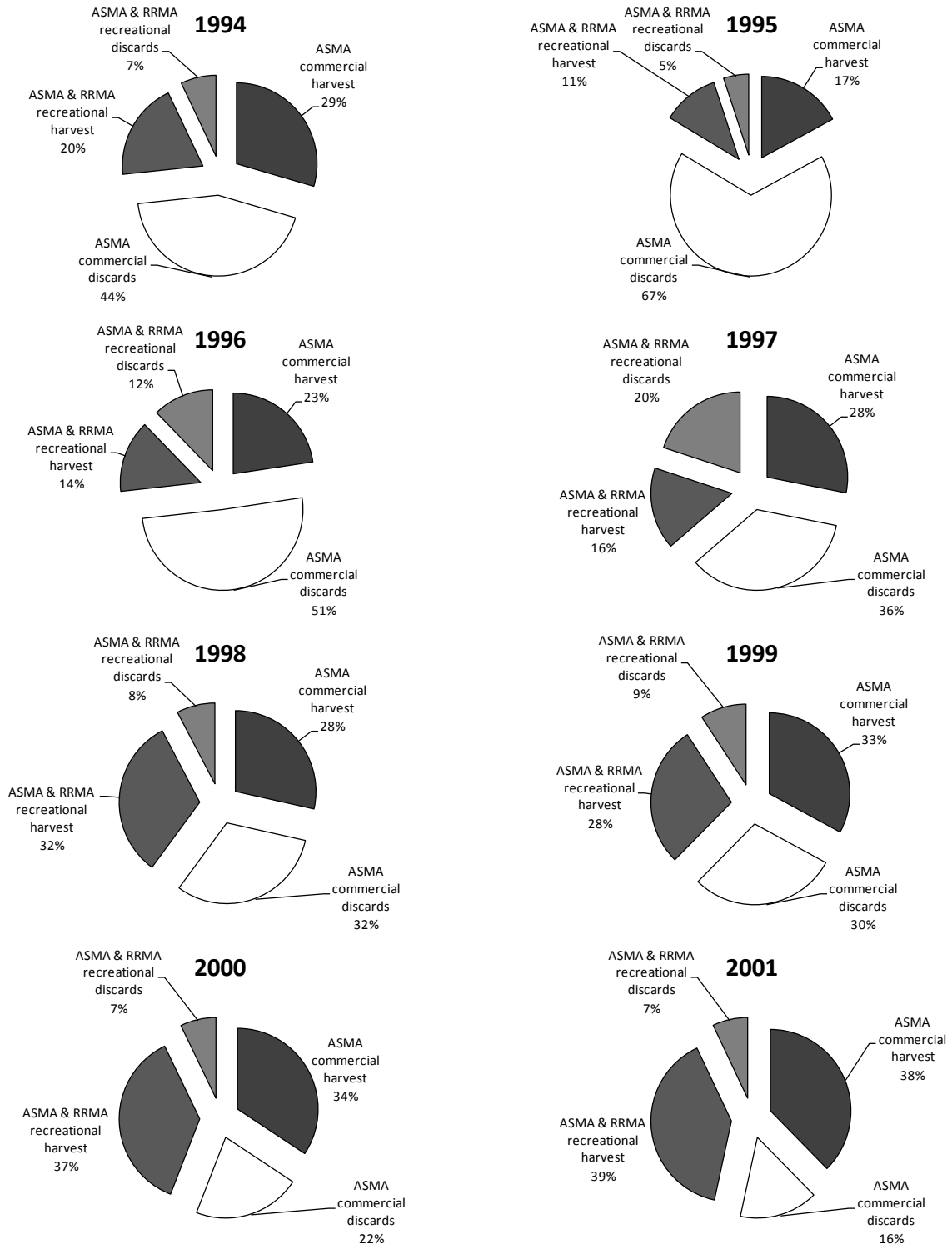
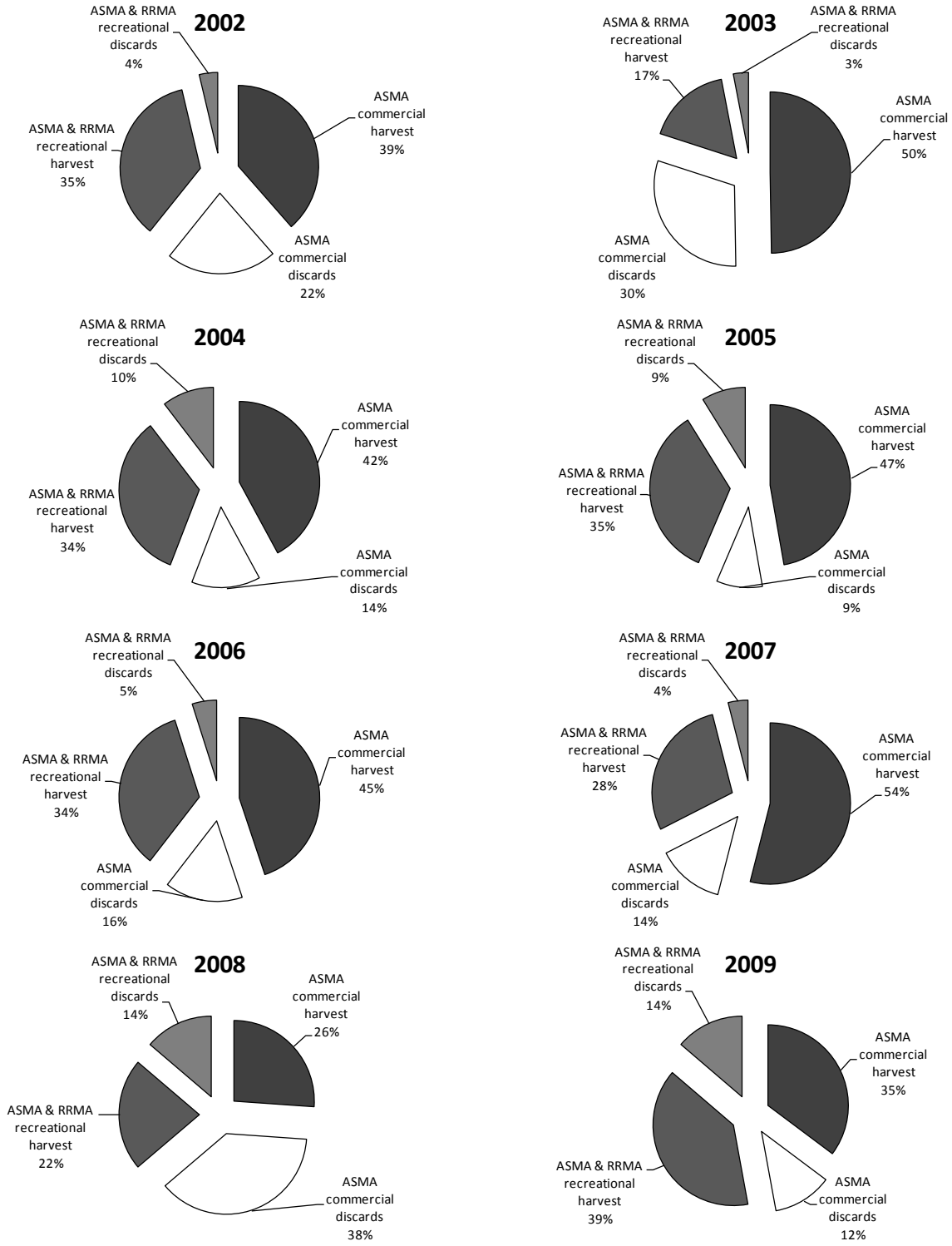


Figure 7.6 (continued).



The majority of these fishermen were from the Pamlico Sound and Pamlico/Pungo river areas. Gill nets account for the highest percentage of the striped bass landings from this area.

For the Neuse and Tar/Pamlico rivers, striped bass discards from large mesh gill nets were identified as the primary source of mortality within the CSMA. To identify ways to reduce discard mortality, NCDMF examined the effectiveness of tie-downs for gill nets to reduce striped bass catch during seasons closed to harvest, and evaluated the effect of prohibiting large mesh gill netting within various distances from shore. To address discards from the commercial large mesh gill net fishery, large mesh gill nets were required to be tied down such that the vertical height did not exceed three feet, with the nets required to be set a minimum distance of 50 yards from shore. This requirement went into effect July 2008.

The striped bass low harvest level fishery occurs only in the spring season. During the open season fishermen are restricted to daily landing limits and minimum size limits. From 2005 to present in Pamlico Sound only, striped bass cannot exceed 50% by weight of the daily commercial catch. Finfish dealers are required to obtain a striped bass permit, with a CSMA validation, report landings daily to NCDMF and affix a sale tag to the striped bass when purchased from the fishermen.

Table 7.8. Summary of striped bass commercial seasons in the Albemarle Sound Management Area, North Carolina, 1991 – 2009.

Year	TAC (lbs)	Spring season # Days	Bag limit	Pounds landed	Fall season # Days	Bag limit	Pounds landed	Total pounds landed # Days
2009	275,000	Jan 1 – 31 Feb 1 – Mar 25 Mar 26 – Apr 14 Apr 15 – 30 120 days	7 fish 10 fish 15 fish 10 fish	59,832	Oct 1 – Nov 30 Dec 1 – 15 Pound net ONLY 76 days	10 fish	37,053	96,885 196 days
2008	275,000	Jan 1 – 31 Feb 1 – Apr 9 Apr 10 – 14 Apr 15 – 30 121 days	5 fish 10 fish 15 fish 10 fish	56,922	Oct 1 – Nov 30 61 days	10 fish	17,376	74,298 182 days
2007	275,000	Jan 5 – Feb 28 Mar 1 – Apr 14 Apr 15 – 30 116 days	5 fish 10 fish 5 fish	145,261	Oct 1 – Nov 30 Dec 1 - 14 75 days	10 fish	26,422	171,682 191 days
2006	275,000	Jan 1-Mar 14 Mar 15 – Apr 14 Apr 15 – 30 120 days	5 fish 10 fish 5 fish	151,682	Oct 1 – Nov 30 61 days	10 fish	34,717	186,399 181 days
2005	275,000	Jan 3- Mar 30 Apr 1 – 14 102 days	5 fish 10 fish	182,855	Oct 3 – 27 Oct 28 –Nov 30 58 days	5 fish 10 fish	49,838	232,693 160 days
2004	275,000	Jan 5 – Apr 6 91 days	5 fish	273,636	No Fall Season			273,636 91 days
2003	275,000 (269,998)	Jan 6- Mar 19 Mar 20 – Apr 14 99 days	5 fish 10 fish	190,972	Oct 27 – Dec 31 65 days	5 fish	75,583	266,555* (323,337 total – 56,782 lbs to AO) 164 days
2002	225,000 (215, 514)	Jan7 – Apr14 98 days	5 fish/18”TL	168,562	Nov 4 – Dec20 47 days	5 fish/18”TL	54,294	222,856* 145 days

Table 7.8 (continued).

Year	TAC (lbs)	Spring season # Days	Bag limit	Pounds landed	Fall season # Days	Bag limit	Pounds landed	Total pounds landed # Days
2001	225,000 (211,348)	Jan5 – Mar25 Mar26 – Apr14 100 days	5 fish/18”TL 10 fish/ 18” TL	185,585	Nov19 – Dec21 33 days	5 fish/18”TL	34,648	220,233* 133 days
2000	225,000 (200,109)	Jan7 – Mar26 Mar27 – Apr14 99 days	5 fish/ 18”TL 10 fish/ 18” TL	162,467	Nov13 – Dec31 49 days	5 fish/ 18”TL	51,562	214,029* 148 days
1999	137,984	Feb9 – Mar28 Mar29 – Apr14 65 days	5 fish/ 18”TL 10 fish/ 18” TL	124,527	Dec1 – Dec12 Dec13 – Dec31 31 days	10 fish/ 18”TL 5 fish/ 18”TL	38,343	162,870 96 days
1998	125,440	Feb16 – Mar6 Mar7 – Apr14 58 days	5 fish/ 18”TL 10 fish/ 18” TL	101,093	Dec1 – Dec31 31 days	10 fish/ 18”TL	22,834	123,927 89 days
1997	98,000	Feb15 – Mar23 Mar24 – Apr14 59 days	3 fish/ 18”TL 7 fish/ 18”TL	73,534	Nov.3 – Dec5 33 days	5 fish/ 18”TL	22,588	96,122 92 days
1996	98,000	Feb16 – Apr7 Apr8 – Apr14 59 days	5 fish/18”TL 3 fish/18”TL	79,678	Nov30 – Dec22 Dec23 – Dec31 32 days	5 fish/18”TL 10 fish/18”TL	10,455	90,133 91 days
1995	98,000	Mar1– Apr4 Apr5– Apr14 45 days	5 fish/18”TL 2 fish/ 18” TL	83,636	Nov22 – Dec31 40 days	2 fish/18”TL	4,200	87,836 85 days
1994	98,000	Feb21 – Mar13 21 days	10 fish/ 18”TL	53,698	Nov21 – Dec23 33 days	5 fish/ 18”TL	48,672	102,370 54 days
1993	98,000	Feb1 – Feb28 Mar1 – Apr5 64 days	5 fish/ 18”TL 3 fish/ 18” TL	109,475	No Season			109,475 64 days

Table 7.8 (continued).

Year	TAC (lbs)	Spring season # Days	Bag limit	Pounds landed	Fall season # Days	Bag limit	Pounds landed	Total pounds landed # Days
1992	98,000	Jan11 – Feb2 Feb3 – Mar18 Mar19 – Apr16 97 days	10 fish/ 18”TL 5 fish/ 18” TL 3 fish/18”TL	96,435	Nov9 – Nov20 12 days	3 fish/ 18”TL	4,114	100,549 109 days
1991	98,000	Jan7 – Jan9 Jan18 – Feb12 Feb13 – Feb28 Mar1 – Mar24 Mar25 – Apr5 Apr6 – Apr13 86 days	Monthly quota/14”TL Coastal/16”TL Joint 3 fish/20”TL 5 fish/18”TL 10 fish/18”TL 20 fish/14”TL Coastal/16”TL Joint 5 fish/18”TL	101,219	Nov.1 – Dec20 50 days	3 fish/ 18”TL	7,241	108,460 136 days

*Total allowable catch adjusted to compensate for overages in previous year.

Table 7.9. Summary of striped bass commercial seasons in the Central Southern Management Area, North Carolina, 1991 – 2009.

Year	TAC (lbs)	Spring season # Days	Bag limit	Pounds landed	Fall season # Days	Bag limit	Pounds landed	Total pounds landed # Days
2009	25,000	Mar 16 – Apr 10 26 days (Cape Fear Closed)	7 fish	24,407	No Fall Season	-	-	24,407 26 days
2008	25,000	Jan 10 – Apr 30 (CF) Mar 3– Apr 30 79 days	5 fish	10,230	No Fall Season	-	-	10,230 79 days
2007	25,000	Jan 10 – Apr 3 (CF) Mar 1 – Apr 3 63 days	5 fish	24,040	No Fall Season	-	-	24,040 63 days
2006	25,000	Jan 1- Apr 3 (CF) Mar 2 Apr 3 60 days	5 fish	20,955	No Fall Season	-	-	20,955 60 days
2005	25,000 (26,932)	Jan 1 – Apr 30 (CF) Feb 28 – Mar 24 58 days	5 fish	26,932	No Fall Season	-	-	26,932 58 days
2004	25,000 (32,480)	Jan 6 –Apr 30 (CF) Mar 8 – Apr 5 116 days	10 fish 5 fish	32,480	No Fall Season	-	-	32,480 99 days
2003	25,000	Jan 9 – Apr 30 (CF) Mar 3 –Apr 1 114 days	10 fish 5 fish	20,327	Dec 1 – Dec 21 21 days	5 fish	4,226	24,472 135 days

Table 7.9 continued.

Year	TAC (lbs)	Spring season # Days	Bag limit	Pounds landed	Fall season # Days	Bag limit	Pounds landed	Total pounds landed # Days
2002	25,000	Jan 7 – Apr 30 (CF) Feb 25 – Mar 16 114 days	10 fish 5 fish	17,752	Dec 2 – Dec 13 12 days	5 fish	1,998	19,810 126 days
2001	25,000	Jan 8 – Apr 30 (CF) Feb 12 – Mar 2 113 days	10 fish 5 fish	20,739	Dec 4 – Dec 14 11 days	5 fish	3,994	24,843 124 days
2000	25,000 (30,832)	Jan 8 – Apr 30 (CF) Feb 11 – Mar 9 113 days	10 fish 5 fish	22,429	Nov 13 – Nov 28 16 days	5 fish	8,383	30,828 129 days
1999	25,000 (31,156)	Jan 7 – Apr 30 (CF) Feb 9 – Apr 30 113 days	10 fish 5 fish	25,214	Dec 1 – Dec 31 31 days	5 fish	5,942	31,156 144 days
1998	25,000	Jan 8 – Apr 30 (CF) Feb 16 – Apr 8 113 days	10 fish 5 fish	21,650	Dec 1 – Dec 31 31 days	5 fish	1,905	23,555 144 days
1997	25,000 (28,859)	Jan 13 – Apr 30 (CF) Feb 15 – Mar 22 102 days	10 fish 3 fish	19,006	Nov 3 – Nov 19 17 days	5 fish	9,853	28,859 119 days
1996	25,000 (32,706)	Jan 29 – Apr 30 (CF) Feb 29 – Apr 15 90 days	10 fish 5 fish	28,568	Dec 12 – Dec 31 19 days	5 fish	4,138	32,706 109 days
1995	25,000	Jan 23 – Apr 30 (CF) Mar 6 – Apr 30 97 days	10 fish 5 fish	7,557	Nov 22 – Dec 31 39 days	10 fish	6,674	14,230 136 days
1994	25,000	Neuse & Cape Fear) Jan 31 – Mar 13 Pam. S. & Pam. R) Feb 21 – Apr 30 41 days	10 fish	12,260	Neuse Nov 24 – Dec 31 38 days	20 fish	7,348	19,808 79 days

7.2.3 Central/Southern Stocks: Neuse River

7.2.3.1 Historical

Striped bass commercial fisheries have occurred in the Neuse River since colonial times. Worth (1903) reported that striped bass were numerous at New Bern and at other points along the Neuse River.

The progression of commercial gears was similar to the other areas of the state. Commercial fisheries on the Neuse River employed drift gill nets with a full range of mesh sizes upstream to Pitch Kettle Creek and stake gill nets and haul seines principally from New Bern downstream (Marshall 1977).

From the 1930s through the 1980s commercial landings of striped bass in the Neuse River were insignificant compared to the statewide landings. The commercial striped bass fishery may have been important at the turn of the century but has remained at very low levels for the last 50 years. Chestnut and Davis (1975) presented striped bass landings by county for the period 1930 – 1968 (Appendix 1), which shows the small amount of landings for the counties along the Neuse River. Table 4.1 shows the Neuse River landings from 1972 to 2002.

The fisheries of the Neuse were affected by various regulations enacted from 1915 to1965 (Appendix 2). The rules and regulations enacted since 1979 relative to striped bass management are shown in Appendix 3.

7.2.3.2 Current

The harvest of striped bass is from bycatch of other fisheries and the landings are part of the 25,000 pound CSMA commercial TAC. Since 1994, the Neuse River striped bass commercial landings increased from that of the 1970s and 1980s, but still only made up 3% of the states internal striped bass landings. The landings since 2000 have been fairly consistent and averaged 6,158 lbs (Table 4.1). Gill nets account for the majority of the harvest.

7.2.4 CSMA Stocks: Cape Fear River

7.2.4.1 Historical

The striped bass fishery in the Cape Fear River system has typically been small compared to the other systems of the state. In 1923, a law was passed that made it unlawful to catch or take with nets or seines any striped bass in any waters of New Hanover County (North Carolina Fishing Laws- 1923) (Section 14, Appendix 2). This law remained in effect through 1987. The majority of the striped bass landed were taken as incidental bycatch in the American shad fishery. Striped bass landings by county from 1930 to 1968 are presented in Appendix 1. Since 1979, various rules and regulations have been enacted by the state that have affected striped bass harvest (Appendix 3).

7.2.4.2 Current

The Cape Fear River system striped bass fishery has operated under the CSMA TAC since 1994. The fishery has been prosecuted as the other parts of the state with seasons, minimum size limits, daily landings limits and dealer permit requirements. A no harvest regulation (15A

NCAC 03M .0202a) was established for striped bass in the Cape Fear River and its tributaries July 1, 2008. Prior to the closure, the Cape Fear River season was only open to striped bass commercially harvested during the spring (January – April). The striped bass landings primarily occur as bycatch of the American shad fishery. Anchored gill nets accounted for 97% of the landings from 1994 to 2008, while driftnets composed about 3% of the landings. The average annual landings (1994-2008) were approximately 1,300 lbs, which is about 44% less than the average annual landings reported in the 1970s and about 62% less than the early 1980s (Table 4.1).

7.2.5 CSMA Commercial Discard/Bycatch Mortality

The CSMA estuarine gill net fishery is a year round multi-species fishery where netting used and species targeted varies by area and season. Species commonly caught by the gill net fishery include American shad, Atlantic croaker, southern flounder, red drum, spot, spotted seatrout, striped bass, striped mullet and weakfish. Even though a 25,000 lbs TAC, daily landing limits and seasons exist in the CSMA, striped bass is a targeted catch in the bays and mouths of the rivers. Even with the five to ten fish per operation daily landing limit, 7% of the trips in Pamlico Sound and 29% of the river area gill net trips during the open season were dominated by striped bass (striped bass being the highest poundage on the trip ticket).

An estimate of the discarded catch for a gear may be computed by estimating the “total catch” (quantity taken that reaches the deck of vessel) and subtracting from it the “landed catch” (that which is brought ashore). The discarded catch may then be multiplied by a mortality estimate (percent that are dead at the time of harvest) to give an estimate of the quantity of dead discard. The NCDMF data and methods used to calculate a discard (dead) estimate for the set gill net fishery in Pamlico Sound and Pamlico, Pungo, Bay and Neuse rivers can be found in Section 11.7, Discard Mortality of Striped Bass From Commercial Set Gill Nets in the CSMA. Similar data for other areas in the CSMA are not available. Dead discard estimates were based on either observer (fishery dependent data) or the Independent Gillnet Survey (fishery independent data) catch and mortality rates combined with numbers of trips from the Trip Ticket program. For 2004 – 2009 the yearly average dead discard striped bass commercial estimate for these areas was ~5,500 lbs using the observer data and ~16,000 lbs using IGNS data. These estimates for a number of reasons are not precise and are meant to provide a relative basis on which to judge the relative extent of the commercial discards. At-net mortality rate during the cooler water temperatures of the open season averaged 16% whereas the closed season rate was higher at 24%. These are pooled values across the years 2004-2009.

7.3 RECREATIONAL FISHERIES

7.3.1 Introduction

The origins of recreational angling in North Carolina are poorly documented in existing literature, although Worth (1912) provides an interesting anecdotal account of the Neuse and Roanoke Rivers. When Ralph Lane and the first English explorers visited the Croatan, Roanoke, and Albemarle Sound area, they observed the various Native American tribes harvesting fish with weirs. The early colonists may have also taken striped bass with hook and line purely as a matter of subsistence. After the industrial revolution and with the advent of outboard motors, anglers began to seek striped bass with hook and line for both subsistence and recreation. Early in the 20th century, in the Croatan and Roanoke Sound areas of Dare County, charter boat fishing fleets developed, signaling a move towards angling for striped bass, purely as a recreational activity. An increase in disposable income and leisure time during the mid-1900s

gave rise to a great interest in fishing for striped bass in North Carolina's sounds and rivers. As recovery of the A/R stock continued into the late 1990s, a tremendous increase in recreational effort for striped bass occurred.

Keeping striped bass for food has always been an important element of the recreational experience, but because striped bass caught recreationally were allowed to be sold in some areas the distinction between recreational and commercial fisheries has been unclear at times. For example, until the early 1980s, striped bass were caught with recreationally licensed bow nets in the upper reaches of Roanoke River and local legislation allowed these fish to be bought and sold. Striped bass caught on hook and line in the eastern Albemarle Sound charter boat fisheries were also bought and sold. After the near collapse of the A/R striped bass stock in the late 1970s, regulatory agencies recognized the need to remove economic incentives to sell striped bass taken with traditional recreational gear so that commercial harvest could be limited and quantified. Statutes allowing the sale of recreationally caught striped bass were repealed and rules of the NCMFC were changed to implement distinctions between the manner in which commercially saleable striped bass could be taken.

Taking and possession of striped bass using hook and line in coastal North Carolina is regulated by the NCWRC in designated Inland waters, jointly by the NCWRC and NCMFC in designated Joint waters and by the NCMFC in designated Coastal waters. In designated Joint waters, rules governing harvest seasons, creel limits and size limits are jointly enacted by the NCWRC and the NCMFC and are jointly enforced by officers of both agencies.

Techniques for catching striped bass on hook and line include trolling, casting, and jigging with artificial lures and the use of live bait (eels, shiners) and cut bait. Traditionally most preferred live bait or cut bait for striped bass has been river herring. In 2007 the NCDMF instituted a no harvest provision on river herring for commercial and recreational fishermen. Similarly, NCWRC enacted a moratorium (no harvest) on river herring greater than 6 inches. These actions to protect river herring essentially eliminated the use of fresh, live or cut bait river herring for recreational anglers targeting striped bass, especially during the spring harvest season in the RRMA.

The total TAC for the A/R stock is 550,000 lbs annually. This is split evenly between commercial and recreational sectors, with the recreational portion of the TAC (275,000 lbs) further divided between the ASMA and RRMA (137,500 lbs each). The total commercial TAC for the CSMA is 25,000 pounds and there is no CSMA recreational poundage limit or quota.

7.3.2 Roanoke River Management Area

Using a combination of observer tallies and angler post card surveys, Hassler et al. (1981) estimated numbers of striped bass caught on hook and line in the Weldon area of Roanoke River from 1959 through 1980 and in the entire length of the river from 1970 through 1980. Catch (and presumably harvest) in the Weldon area survey ranged from 3,174 striped bass in 1963 to 37,446 in 1971. In the survey of the entire Roanoke River, estimates of striped bass catch were lowest in 1980 (15,239) and highest in 1971 (65,399). Based upon angler reports, Hassler et al. (1981) also estimated numbers of striped bass caught by drift bow nets and fight bow nets for the period 1961 through 1980. Striped bass catches by drift bow net fishermen ranged from 69 fish in 1968 to 8,655 in 1964. Fight bow net catches ranged from 1,051 striped bass in 1978 to 10,393 in 1969.

In 1988, NCWRC began monitoring striped bass harvest in the Roanoke River with creel surveys during spring months. The area surveyed included Roanoke River from Roanoke Rapids Lake dam, downstream to Albemarle Sound, and the Middle, Eastmost, and Cashie rivers. As the agencies recognized that significant harvest restrictions would be necessary to rebuild the A/R stock, NCWRC first closed recreational springtime striped bass harvest in Roanoke River with emergency rules on May 10, 1990. Management of striped bass harvest by TAC began in both the RRMA and ASMA in 1991 and NCWRC closed the RRMA by emergency rules on May 1, 1991. From 1991 until 2001, NCWRC opened and closed the spring striped bass harvest season in the RRMA by proclamation authority of the Executive Director. Season closures were based upon weekly estimates of striped bass harvest as compared to the TAC of striped bass allocated to the RRMA. Because of high angling pressure, NCWRC limited striped bass harvest to three days per week during the spring season with an 18 inch minimum TL size limit with a slot limit (no possession 22-27 inches TL) in inland waters of the RRMA in 1994.

After recovery of the stock in 1997, substantial increases in the TAC were implemented and NCWRC increased the number of days from 3 days to 4 days per week in which striped bass could be possessed. In 2002, after another increase in the TAC to 112,500 lbs, NCWRC decreased the daily creel limit for striped bass from three to two, but set a 46 day season in the lower river (March 1 through April 15) and a 46 day season in the upper river (March 15 through April 30), and allowed striped bass to be possessed seven days per week. From 2000 to 2002, the quota remained at 112,500 lbs yet was exceeded in each of those years. During the spring 2003 season (harvest season ended April 30), NCWRC managed the RRMA with a 112,500 pound allowable harvest although the quota was increased to 137,500 lbs. Despite this difference in TAC management, neither quota would be reached in 2003 when higher flows and cooler water temperatures likely contributed to a decline in angling effort and subsequent harvest.

Since 2004, the TAC for the RRMA has remained at the current level of 137,500 lbs of striped bass and only 1 striped bass of the two fish creel limit could be 27 inches or greater. In 2005 and 2006, season extensions were allowed in the RRMA (both zones in 2005 and the lower zone in 2006). In 2007, a proclamation was set to establish a set season of March 1 to April 30 in the entire river with a subsequent extension for 6 days in the entire river. In 2008, a set season from March 1 through April 30 for the entire river was established by NCWRC rule and continuing through 2009 (Table 7.10). Since 2004, annual harvest estimates have been below the quota , especially in 2008 when mostly sub-legal male striped bass from the strong 2006 cohort were caught but not harvested (Thomas et al. 2009). From the period of 1991 through 2009, estimates of striped bass harvest in the RRMA ranged from 7,471 fish (28,883 lbs) in 1995 to 38,206 fish (120,113 lbs) in 2000 (Table 7.11).

7.3.3 Albemarle Sound Management Area

Recreational striped bass harvest (numbers of fish) in Albemarle Sound and its tributaries as well as Croatan and Roanoke sounds was monitored by Hassler et al. (1981) from 1967 through 1973. Estimates of striped bass harvest were based upon records of marina or landing owners, angler interviews, and angler post card surveys. Striped bass catch was estimated to be 67,172 in 1967 with a peak catch of 96,170 in 1970, and a low catch of 30,783 fish in 1973. Mullis and Guier (1982) used a non-uniform probability, roving/access creel survey to estimate recreational striped bass harvest and effort in Albemarle, Roanoke, and Croatan sounds as well as tributary rivers (excluding Roanoke River) from 1977 through 1980. An average of 118,340 angler hours (54,914 party hours) was exerted each year of the study specifically for striped bass. Estimated

striped bass harvest was 33,202 fish (71,871 lb.) in 1977, 16,599 fish (30,915 lb.) in 1978, and 5,235 fish (12,553 lb.) in 1979.

Table 7.10 Summary of striped bass recreational seasons in the Roanoke River Management Area, North Carolina, 1991 – 2009. Note: For the 2003 spring season, allowable harvest was managed with 112, 500 lbs TAC, although the TAC was subsequently increased to 137,500 lbs.

Year	Allowable Harvest (lbs)	Estimated Harvest (lbs)	Regulations (Bold indicates first year of updated rule)
2009	137,500	69,581	2 fish/18"+ slot + only 1 over 27"; 7 fishing days a week (set season 3/1-4/30 in entire river **by rule**); single barbless hook;
2008	137,500	32,725	2 fish/18"+ slot + only 1 over 27"; 7 fishing days a week (set season 3/1-4/30 in entire river **by rule**); single barbless hook;
2007	137,500	62,492	2 fish/18"+ slot + only 1 over 27"; 7 fishing days a week; **proclamation to set unified season of 3/1-4/30 for entire river**, then proclamation to **extend to 5/6 in entire river**; single barbless hook;
2006	137,500	84,521	2 fish/18"+ slot + only 1 over 27"; 7 fishing days a week (set season 3/1-4/22 in Zone 2, 3/15-4/30 in Zone 1); **7 day extension in lower by proclamation**; single barbless hook;
2005	137,500	107,530	2 fish/18"+ RRMA slot + only 1 over 27"; 7 fishing days a week (set season 3/1-4/27 in Zone 2, 3/15-5/4 in Zone 1); **12 day extension in lower & 4 day extension in upper by proclamation**; single barbless hook;
2004	137,500	90,191	2 fish/18"+ RRMA slot + **only 1 fish over 27"**; 7 fishing days a week (set season 3/1-4/15 in Zone 2, 3/15-4/30 in Zone 1); inland single barbless hook;
2003	112,500	39,170	2 fish/18"+ RRMA slot; 7 fishing days a week (set season 3/1-4/15 in Zone 2, 3/15-4/30 in Zone 1); inland single barbless hook;
2002	112,500	112,698	**2 fish/18"+ RRMA slot; 7 fishing days a week (set season 3/1-4/15 in Zone 2, 3/15-4/30 in Zone 1); first year that slot was in effect for entire season throughout the river;** inland single barbless hook
2001	112,500	112,805	3 fish/18"+ inland slot; 4 fishing days a week (**Tue,Wed,Sat,Sun**); 24 fishing days Zone 2 (3/13-4/22), 28 fishing days Zone 1 (3/13-4/29); slot in lower after 4/1; single barbless hook in upper 4/1-6/30;
2000	112,500	120,091	3 fish/18"+ inland slot; **4 fishing days a week** (**Tue,Wed,Sat,Sun**); 17 fishing days Zone 2 (3/15-4/12), 27 fishing days Zone 1 (3/15-4/30); slot in lower after 4/1; single barbless hook in upper 4/1-6/30;

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Table 7.10 continued.

Year	Allowable Harvest (lbs)	Estimated Harvest (lbs)	Regulations (Bold indicates first year of updated rule)
1999	68,970	72,967	3 fish/18"+ inland slot; 3 fishing days a week (Wed,Sat,Sun); 12 fishing days Zone 2 (3/13-4/7), 21 fishing days Zone 1 (3/13-4/28); slot in lower after 4/1; single barbless hook in upper 4/1-6/30;
1998	62,700	73,541	3 fish/18"+ inland slot; 3/14-4/12 (lower) & 3/14-4/29 (upper); 21 day season; 3 fishing days a week (Wed,Sat,Sun); slot in lower after 4/1; single barbless hook in inland waters 4/1-6/30;
1997	29,400	29,997	3 fish/18"+ inland slot; 3/15-3/23 (5 days lower) & 3/15-4/2 (9 d upper); 3 fishing days a week (Wed,Sat,Sun); upper river re-opened on 4/19 for 6 hours; 9 day upper season; **single barbless hook in inland waters 4/1-6/30;**
1996	29,400	28,178	3 fish/18" + inland slot; 3/16-4/10 (12 d lower) & 3/16-4/17 (15 d upper); 3 fishing days a week (Wed,Sat,Sun); slot in lower after 4/1;
1995	29,400	28,883	3 fish/18"+ inland slot upstream of HWY 258; 3/1-4/9 (18 lower) & 3/1-4/19 (22 upper); 3 fishing days a week (Wed, Sat, Sun); **slot includes lower river (joint waters) from 4/1-5/31;**
1994	29,400	28,089	3 fish/18" + inland slot upstream of HWY 258; 2/19-4/2 (lower) & 2/19-4/21 (upper) 23 day season; **3 fishing days a week** (**Wed,Sat,Sun**);
1993	29,400	45,145	1 fish/18" inland waters from 1/1-3/31 & 3 fish/18" joint waters from 1/1-3/31; 4/1-4/20 3 fish/18"+ inland slot upstream of HWY 258; 2/1-4/25 = 84 day season;
1992	29,400	36,016	**1 fish/18" inland** waters from 1/1-3/31 & **3 fish/18" joint** waters from 1/1-3/31; **4/1-4/20 3 fish/18"+ inland 22"-27" slot upstream of HWY 258;** 1/1-4/20 = 109 day season;
1991	29,400	72,529	3 fish per day; 16" minimum; harvest season **January 1 - May 1** (120 day season); **Roanoke River Management Area established via joint rule with NCDMF on January 1**

Table 7.11. Estimates of striped bass angling effort, harvest, and numbers caught and released from the Roanoke River Striped Bass Management Area, 1988-2009.

	Open Season (Harvest estimates)				Post Harvest Period (Catch and Release Only)			
Year	Number of striped bass	Weight (lbs)	Effort (angler-hours)	Number of trips**	Number of striped bass	Weight (lbs)	Effort (angler-hours)	Number of trips**
1989	8,753	32,107	46,566	9,803	*	*	*	*
1990	15,694	42,204	56,169	11,825	*	*	*	*
1991	26,934	72,529	74,596	15,704	*	*	*	*
1992	13,372	36,016	49,277	10,374	*	*	*	*
1993	14,325	45,145	52,932	11,144	*	*	*	*
1994	8,284	28,089	44,693	9,409	*	*	*	*
1995	7,471	28,883	56,456	11,885	52,698	*	20,639	4,345
1996	8,367	28,178	46,164	9,719	148,222	*	32,743	6,893
1997	9,364	29,997	23,139	4,871	271,328	*	47,001	9,895
1998	23,109	73,541	72,410	15,244	102,299	*	26,367	5,551
1999	22,479	72,967	72,717	15,309	113,394	*	30,633	6,449
2000	38,206	120,091	95,622	20,131	*	*	*	*
2001	35,231	112,805	100,119	21,078	*	*	*	*
2002	36,422	112,698	122,584	25,807	*	*	*	*
2003	11,157	39,170	77,863	16,392	*	*	*	*
2004	26,506	90,191	145,782	30,691	*	*	*	*
2005	34,122	107,530	130,755	27,527	68,147	*	24,146	5,083
2006	25,355	84,521	120,621	25,394	24,719	*	15,235	3,207
2007‡	19,305	62,492	141,874	29,868	11,622	*	9,254	1,948
2008‡	10,541	32,725	110,608	23,286	47,992	*	17,764	3,740
2009	23,248	69,581	120,675	25,405	*	*	*	*

* - No data
** - Number of trips calculated as the dividend of angler effort and an angler trip estimate of 4.75 h
‡ - Post harvest estimates from upper zone of Roanoke River

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In 1991, NCDMF began monitoring the recreational harvest of striped bass in the Albemarle Sound and its tributaries, excluding the Roanoke, Middle, Eastmost, and Cashie rivers. In 1994, the survey was expanded to cover the Currituck, Croatan, and Roanoke sounds to fully encompass the ASMA. Beginning on November 26, 1989, NCDMF opened and closed the spring and fall striped bass harvest seasons in the ASMA by proclamation authority of the Fisheries Director. Management of striped bass harvest through a TAC began in the ASMA on January 1, 1991. Season closures were based upon weekly estimates of striped bass harvest as compared to the TAC of striped bass allocated to the management area. Because of high angling pressure, NCDMF, in 1994, began limiting striped bass harvest to three days per week. In an effort to extend the number of fishing days, from 1995 through 1997, the daily creel limit for the fall season was reduced from three to two fish per person and the minimum size limit was increased to 21 inches TL. In the spring of 1988 the daily creel limit was reduced to two fish per person for both the spring and fall season, with a minimum size limit of 18 inches. TL

Since the A/R stock was declared recovered by the ASMFC in 1997 the overall recreational TAC has increased several times, from 29,400 lbs in 1997 to 137,500 lbs for the ASMA in 2003. The current recreational TAC of 275,000 lbs is split evenly between the ASMA and RRMA. Since the last TAC increase in 2003 harvest peaked in 2004 at 97,097 lbs and dropped to a low of 26,633 lbs in 2007. Since 2007 harvest has risen slowly to 37,313 lbs in 2009. Since 2006, the daily bag limit has been 3 fish at 18 inches TL and seven days per week during the open season. The recreational season in the ASMA has been open the maximum days (October – April) allowed by rule since 2006. A detailed listing of number of days open, daily creel limits, and annual harvest by season is contained in Tables 7.12 and 7.13.

For the fall 2005 season the creel survey design was changed from a non-uniform probability roving-access design to a non-uniform probability stratified access-point design (Pollock 1994). This survey design is the same as is used in the RRMA and CSMA surveys allowing for more statistically valid comparisons of results.

Estimated total effort for striped bass on the Chowan River in 2002 was 24,787 (SE = 3,669) angler hours and peaked during the spring of April 2002 open season in the lower section of the Chowan River (Dockendorf et al. 2004). Total estimated catch of striped bass was 14,024 (SE = 5,183) and an estimated 6,655 (SE = 1,583) striped bass were harvested during the recreational harvest season in spring 2002. Mean trip length for striped bass anglers was 3.7 hours and mean number of striped bass anglers per party was 2.1.

7.3.4 Central Southern Management Area

The 2004 FMP research recommendation for landing statistics for recreational fisheries was met by implementing in 2004 creel surveys in the CSMA. These creel surveys conducted by the NCDMF and NCWRC provided a reliable estimate of the recreational harvest for the CSMA for the first time. The survey area included the Pungo, Tar/Pamlico, and Neuse rivers. A non-uniform probability stratified access-point survey was utilized for site selections as well as effort and catch estimation (Pollock 1994). Returning fishing parties were interviewed to obtain information regarding the trip, catch, and socioeconomic attributes of striped bass anglers. Survey results were expanded to estimate total striped bass catch and effort in the CSMA (NCDMF 2009).

For the NCDMF creel survey, from January 2004 to December 2009, 3,951 survey assignments were conducted resulting in 25,168 intercepts, including 13,711 with fishing activity. A total of 3,260 interviews were anglers targeting striped bass with angling effort estimated over 12,793

fishing hours, resulting in a reported catch of 10,195 striped bass. Total length of observed striped bass ranged from 16.5 inches to 32.3 inches with a mean weight of 3.8 lbs. Expanded data provided an estimated 41,708 striped bass trips over 218,071 angling hours in the CSMA throughout the report period. Estimated striped bass catch was 110,733 fish, comprised of 92,861 discards and 17,873 harvested fish weighing 62,463 lbs. Discarded striped bass were mostly sub-legal sized fish (83%)(Table 7.14). Estimated striped bass catch was 110,733 fish, comprised of 92,861 discards and 17,872 harvested fish weighing 62,463 lbs. Discarded striped bass were mostly sub-legal sized fish (83%) and the total discard to harvest ratio was 5.2:1 (Table 7.14). Estimated catch per unit effort throughout the CSMA from 2004 to 2009 was approximately 0.5 fish per trip.

NCWRC conducted three creel surveys on the three primary rivers of the CSMA between 2002 and 2005 in separate fiscal years. Each creel survey was conducted from July to June and rotated on an annual basis beginning on the Neuse, then Cape Fear and finally, the Tar. Expanded data provided an estimated 66,520 angling hours in these systems during the combined survey period. Estimated striped bass catch was 34,273 striped bass with an estimated 10,017 striped bass harvested. The discard to harvest ratio was 2.4:1.

Following these creel surveys the recreational management regime in the CSMA changed. Prior to July 2008, the recreational fishery in coastal and joint waters the season was open year round with a 3 fish limit per person per day and an 18 inch TL minimum size. Inland waters required the same measures with the addition of a slot limit (22-27 inch TL not allowed) during May and April in upstream inland waters. Significant changes in recreational regulations occurred in 2008, including the establishment of a closed season from 1 May to 30 September. Reduction in the daily creel limit from 3 fish to 2 fish, and a protective slot limit of 22-27 inches TL was enacted throughout the Tar/Pamlico and Neuse river basins in joint and inland waters. The 18 inch TL minimum size limit for the recreational fisheries was maintained in coastal waters. A no harvest provision was implemented in the Cape Fear River and its tributaries. Recreational limits and season apply not only to the hook-and-line fishery but also to any harvest from recreational commercial gear (See Section 7.6).

7.3.5 Tar/Pamlico River

For the Tar/Pamlico River from the NCDMF creel survey, an estimated 12,804 striped bass trips over 64,321 angling hours occurred throughout the report period. Estimated striped bass catch was 38,772 fish, comprised of 36,109 discards and 2,663 harvested fish weighing 9,939 lbs. Discarded striped bass were mostly sub-legal sized fish (95%) (Table 7.14). Estimated catch per unit effort in the Tar/Pamlico River was approximately 0.6 fish per trip.

From the NCWRC creel survey on the Tar/Pamlico River from July 2004 to June 2005, striped bass was the second most popular species sought by anglers and the estimated striped bass angling effort was 14,100 angler-hours (SE = 3,153) (Homan et al. 2006). Effort for striped bass was highest in the lower river during winter (December through February), whereas peak effort in the upper river suggested increased importance of this species during spring (February and June). An estimated 17,177 striped bass (SE = 6,191) were caught with an estimated 188 striped bass (SE = 70) harvested during the creel survey (discard = 16,989; SE =). The estimated discard to harvest ratio was 90:1.

7.3.7 Pungo River

For the Pungo River from the NCDMF creel survey, expanded data provided an estimated 5,565 striped bass trips over 34,045 angling hours occurred throughout the report period. Estimated striped bass catch was 20,159 fish, comprised of 15,170 discards and 4,989 harvested fish weighing 17,230 lbs. Discarded striped bass were mostly sub-legal sized fish (88%) and the total discard to harvest ratio was 3:1 (Table 7.14). Estimated catch per unit effort in the Pungo River was approximately 0.6 fish per trip.

7.3.6 Neuse River

For the Neuse River from the NCDMF creel survey, expanded data provided an estimated 23,338 striped bass trips over 119,705 angling hours occurred throughout the report period. Estimated striped bass catch was 51,802 fish, comprised of 41,581 discards and 10,221 harvested fish weighing 35,292 lbs. Discarded striped bass were mostly sub-legal sized fish (72%) and the discard ratio was 4.1:1 (Table 7.14). Estimated catch per unit effort in the Neuse River was approximately 0.4 fish per trip.

From the NCWRC creel survey on the Neuse River from July 2002 to June 2003, striped bass anglers exerted an estimated total effort of 46,407 angler-hours (SE = 20,249) (Rundle et al. 2004). Striped bass effort peaked during April and June in the upper section of the river and during December and May in the lower section of the river around New Bern. An estimated 15,062 striped bass (SE = 5,438) were caught with an estimated 9,674 striped bass (SE = 5,144) harvested during the creel survey. The estimated harvest to discard ration was 0.5:1. Mean trip length for striped bass anglers was 4.0 hours, with an average of 1.7 anglers per party.

Table 7.12. Estimates of striped bass angling effort, harvest, and numbers caught and released from the Albemarle Sound Striped Bass Management Area, 1991-2009.

Season		Length in days	Angler hours	Number of fish harvested	Average number of fish harvested per day	Average weight of each fish harvested	Total pounds harvested	Average number of pounds harvested per day	Number of fish released	Average number of fish released per day	Number of fish measured by creel clerks
1991	Spring	113		9,978	88	2.5	24,561	217	11,701	104	
	Fall	30		4,417	147	2.4	10,783	359	11,839	395	
1992	Spring	120		8,034	67	2.9	23,582	197	13,167	110	
	Fall	30		2,508	84	2.9	7,176	239	6,814	227	
1993	Spring	77		11,404	148	3.2	36,049	468	13,241	172	
	Fall	No fall season		--	--	--	--	--	--	--	--
1994	Spring	12		4,005	334	3.5	14,087	1,174	no data	no data	495
	Fall	7		4,586	655	3.5	16,130	2,304	no data	no data	684
1995	Spring	9		4,240	471	4.1	17,355	1,928	no data	no data	452
	Fall	15		3,103	207	4.3	13,209	881	no data	no data	502
1996	Spring	8		4,374	547	3.4	14,851	1,856	no data	no data	469
	Fall	14	6,349	3,059	219	4.7	14,335	1,024	no data	no data	487
1997	Spring	5	4,332	4,941	988	3.5	17,315	3,463	6,111	1,222	620
	Fall	21	9,324	1,960	93	4.8	9,409	448	24,660	1,174	468
1998	Spring	18	38,760	9,310	517	3.3	30,709	1,706	25,060	1,392	1,276
	Fall	28	52,060	10,256	366	3.3	34,052	1,216	66,828	2,387	1,963
1999	Spring	37	36,477	10,137	274	3.6	36,970	999	32,742	885	1,722
	Fall	24	27,965	6,830	285	3.6	24,477	1,020	7,579	316	695
2000	Spring	67	53,957	13,993	209	3.7	51,428	768	23,205	346	1,410
	Fall	32	46,468	24,092	753	2.7	64,986	2,031	55,736	1,742	1,746
2001	Spring	53	49,307	17,582	332	2.7	47,448	895	16,737	316	1,783
	Fall	24	60,380	22,545	939	3.2	71,197	2,967	44,681	1,862	2,581
2002	Spring	52	57,549	17,989	346	3.3	59,297	1,140	20,502	394	2,274
	Fall	32	39,931	9,907	310	3.4	33,352	1,042	31,053	970	899
2003	Spring	61	44,588	8,937	147	3.4	30,141	494	14,283	234	724
	Fall	64	42,704	6,187	1,086	3.5	21,653	338	10,998	172	682
2004	Spring	62	53,794	13,728	221	3.5	48,577	784	22,346	360	1,028
	Fall	58	48,711	14,276	246	3.4	48,520	837	18,695	322	1,826
2005	Spring	79	25,397	6,133	78	3.4	21,117	267	4,396	56	826
	Fall *	92	61,546	11,821	128	3.6	42,360	460	16,824	183	809
2006	Spring	120	27,380	3,967	33	3.6	14,354	120	2,482	21	180
	Fall	92	38,377	6,744	73	3.2	21,631	235	6,973	76	558
2007	Spring	126	29,715	4,569	36	3.6	16,410	130	5,537	44	204
	Fall	92	31,964	2,574	28	4.0	10,223	111	8,062	88	226
2008	Spring	121	30,538	3,227	27	3.8	12,140	100	19,375	160	254
	Fall	92	42,135	6,821	74	2.9	19,488	212	17,084	186	379
2009	Spring	120	39,631	8,164	68	2.8	22,904	191	30,896	257	296
	Fall	92	32,390	3,905	42	3.7	14,409	157	9,647	105	253

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Table 7.13 Summary of striped bass recreational seasons in the Albemarle Sound Management Area, North Carolina, 1991 – 2009.

Year	TAC (lbs)	Spring Season # Days	Bag Limit/ Fishing Days Per Week	Pounds Landed	Fall Season # Days	Bag Limit/ Fishing Days Per Week	Pounds Landed	Total Pounds Landed # Days
2009	137,500	Jan 1 – Apr 30 120 days	3 fish/7 days	22,904	Oct 1 – Dec 31 92 days	3 fish/7 days	14,409	37,313 212 days
2008	137,500	Jan 1 – Apr 30 121 days	3 fish/7 days	12,140	Oct 1 – Dec 31 92 days	3 fish/7 days	19,488	31,628 213 days
2007	137,500	Jan 1 – May 6 126 days	3 fish/7 days	16,410	Oct 1 – Dec 31 92 days	3 fish/7days	10,223	26,633 218 days
2006	137,500	Jan 1-Apr 30 120 days	2 fish/7 days	14,355	Oct 1 – Dec 31 92 days	3 fish/7 days	21,642	35,997 (+ ~5,000 lbs RCGL) 212 days
2005	137,500	Jan 5-Apr30 79 days	2 fish/4 days 7 days (Apr 4-30)	21,117	Oct 1-Dec 31 92 days	2 fish/7 days	42,360	63,477 (+ ~3,000 lbs RCGL) 171 days
2004	137,500	Jan 14-Apr 30 62 days	2 fish/4 days	48,577	Oct 11-Dec 31 58 days	2 fish/4 days 7 days (Dec 2-31)	48,520	97,097 (1,306 lbs. RCGL) 120 days
2003	137,500	Jan 15-Apr 30 61 days	2 fish/4 days	30,141	Oct 11-Dec 31 64 days	2 fish/4 days 7 days (Nov 24-Dec 31)	21,653	51,794 (4,986 lbs. RCGL) 125 days
2002	112,500	Jan16 – Apr14 52 days	2 fish/ 4 days	59,297	Nov 6-Dec 29 32 days	2 fish/4 days	33,352	92,649 84 days

Table 7.13 continued

Year	TAC (lbs)	Spring Season # Days	Bag Limit/ Fishing Days Per Week	Pounds Landed	Fall Season # Days	Bag Limit/ Fishing Days Per Week	Pounds Landed	Total Pounds Landed # Days
2001	112,500	Jan17 – Apr18 53 days	2 fish/4 days	47,448	Oct17 – Nov25 24 days	2 fish/4 days.	71,058	118,506 (-9,664 lb overage) 77 days
2000	112,500	Jan1 – Apr26 67 days	2 fish/ 4 days	51,315	Oct. 11 – Nov. 12 Nov. 15 – Dec. 3 32 days	2 fish/ 18”TL Sat.,Sun.,Wed.,Fri. 1 fish/ 18”TL Sat.,Sun.,Wed.,Fri.	64,843	116,158 (-3,658 lb overage) 99 days
1999	68,992	Jan1 – Mar16 Apr 2 – Apr5 37 days	2 fish/ 18”TL Sat.,Sun.,Wed. Fri.,Sat.,Sun.,Mon	36,870	Nov 6 – Dec29 24 days	2 fish/ 18”TL Sat.,Sun.,Wed.	24,468	61,338 61 days
1998	62,720	Mar14 – Apr22 18 days	3 fish/ 18”TL Sat.,Sun.,Wed.	30,671	Oct28 – Dec30 28 days	2 fish/ 18”TL Sat.,Sun.,Wed.	33,909	64,580 46 days
1997	29,400	Mar15 – Mar23 5 days	3 fish/ 18”TL Sat.,Sun.,Wed.	17,257	Nov.15 – Dec31 21 days	2 fish/ 21”TL Sat.,Sun.,Wed.	9,324	26,581 26 days
1996	29,400	Mar16 – Mar31 8 days	3 fish/ 18”TL Sat.,Sun.,Wed.	14,851	Nov22 – Dec23 14 days	2 fish/ 21”TL Sat.,Sun.,Wed.	14,335	29,186 22 days
1995	29,400	Mar1 – Mar19 9 days	3 fish/18”TL Sat.,Sun.,Wed.	17,355	Nov22 – Dec24 15 days	2 fish/21”TL Sat.,Sun.,Wed.	13,209	30,564 24 days
1994	29,400	Feb19 – Mar 16 12 days	3 fish/18”TL Sat.,Sun.,Wed.	14,087	Nov23 – Dec7 7 days	3 fish/18”TL Sat.,Sun.,Wed.	16,130	30,217 19 days

Table 7.13 continued

Year	TAC (lbs)	Spring Season # Days	Bag Limit/ Fishing Days Per Week	Pounds Landed	Fall Season # Days	Bag Limit/ Fishing Days Per Week	Pounds Landed	Total Pounds Landed # Days
1993	29,400	Feb1 – Apr18 77 days	3 fish/18”TL Everyday	36,049	No Season			36,049 77 days
1992	29,400	Jan1 – May1 120 days	3 fish/18”TL Everyday	23,582	Nov1 – Nov30 30 days	1 fish/21”TL Everyday	7,176	30,758 150 days
1991	29,400	Jan1 – Jan31 Feb7 – May1 113 days	3 fish/16”TL Everyday	24,561	Nov 1 – Nov30 30 days	3 fish/18” TL Everyday	10,783	35,344 143 days

Table 7.14 Estimates of striped bass angling effort, harvest, and numbers caught and released from the Central Southern Management Area, 2004-2009.

River	Year	Total Fishing Trips	Striped Bass Fishing Trips	Striped Bass Effort (angler hours)	Number of Allowable Harvest	Pounds of Allowable Harvest	Striped Bass Discard (number over creel)	Striped Bass Discard (number under-sized)	Striped Bass Discard (number legal sized)	Striped Bass Discard (total number)	Discard / Harvest Ratio
Neuse River	2004	26,663	7,445	39,941	3,985	14,845	29	5,720	1,221	6,970	1.7:1
	2005	36,667	5,902	25,425	1,718	6,873	13	6,473	630	7,116	4.1:1
	2006	21,063	3,703	18,901	1,246	4,081	0	7,797	1,980	9,777	7.8:1
	2007	17,908	3,018	16,223	2,618	7,115	140	4,859	1,485	6,484	2.5:1
	2008*	15,770	1,995	10,131	405	1,510	2,838	4,801	2,449	10,088	24.9:1
	2009*	9,440	1,275	9,084	249	868	0	442	704	1,146	4.6:1
	sub-total	127,511	23,338	119,705	10,221	35,292	3,020	30,092	8,469	41,581	4.1:1
Tar/Pamlico River	2004	13,880	3,425	13,666	663	2,887	0	3,463	263	3,726	5.6:1
	2005	10,305	2,554	12,940	572	2,511	0	8,425	294	8,719	15.2:1
	2006	8,064	1,593	8,034	675	1,443	0	2,588	278	2,866	4.2:1
	2007	11,791	2,312	12,995	345	1,656	0	12,392	114	12,506	36.2:1
	2008*	6,408	1,632	8,616	174	648	0	5,137	296	5,433	31.2:1
	2009*	8,463	1,288	8,070	234	794	0	2,348	511	2,859	12.1:1
	sub-total	58,911	12,804	64,321	2,663	9,939	0	34,353	1,756	36,109	13.6:1
Pungo River	2004	5,532	1,909	10,183	1,494	5,227	56	2,543	259	2,858	1.9:1
	2005	3,877	1,152	5,948	1,620	5,915	139	713	76	928	0.6:1
	2006	5,167	758	3,954	562	1,832	33	2,164	56	2,253	4:01
	2007	6,826	991	7,870	637	2,024	7	4,422	108	4,537	7.1:1
	2008*	6,956	304	2,549	263	832	0	1,781	571	2,352	8.9:1
	2009*	6,724	451	3,541	413	1,400	7	1,682	553	2,242	5.4:1
	sub-total	35,082	5,565	34,045	4,989	17,230	242	13,305	1,623	15,170	3:01
All	2004	46,074	12,780	63,791	6,142	22,959	85	11,727	1,743	13,555	2.2:1
	2005	50,849	9,608	44,313	3,909	15,299	152	15,611	1,000	16,763	4.3:1
	2006	34,294	6,055	30,889	2,483	7,355	33	12,550	2,315	14,898	6:01
	2007	36,525	6,321	37,088	3,599	10,796	147	21,673	1,708	23,528	6.5:1
	2008*	29,134	3,931	21,296	842	2,991	2,838	11,719	3,316	17,873	21.2:1
	2009*	24,628	3,013	20,696	896	3,062	7	4,471	1,768	6,246	7:01
Total		221,504	41,708	218,071	17,873	62,463	3,261	77,751	11,849	92,861	5.2:1

*2 fish daily creel limit, Oct 1 - Apr 30 season, harvest moratorium on Cape Fear River and its tributaries-effective July 1, 2008

7.3.8 Pamlico Sound

Although estimates of striped bass harvest specifically from Pamlico Sound are not available, NCWRC and NCDMF personnel believe it to be substantial, especially in northern Pamlico Sound. NCDMF, in cooperation with NMFS, estimates recreational harvest of fish in ocean and estuarine areas of North Carolina through the Marine Recreational Information Program (MRIP). The MRIP estimates categorize catch estimates as having come from offshore, nearshore, or from inside waters. In North Carolina, inside estuarine waters include all southern and central sounds and extreme lower portions of coastal rivers, extending up to and including Croatan and Roanoke sounds. Striped bass harvest in Croatan and Roanoke sounds is therefore included in both the ASMA creel survey and the MRIP estimates, so there is no valid method to attribute harvest in this area to Pamlico Sound.

7.3.9 Cape Fear River

From the NCWRC creel survey on the Cape Fear River from July 2003 to June 2004, striped bass anglers exerted an estimated 6,013 angler-hours (SE = 784) of total effort (Ashley and Rachels 2005). Striped bass effort peaked during April and June in the upper section of the river and between September and March in the lower section of the river. An estimated 2,034 striped bass (SE = 232) were caught with an estimated 155 striped bass (SE = 33) harvested during the creel survey (discard = 1,879). The discard to harvest ratio was 12.1:1. Mean trip length for striped bass anglers was 4.1 hours, with an average of 1.6 anglers per party.

Despite the recent no harvest regulation for striped bass in the Cape Fear River (15A NCAC 03M .0202a), a recreational catch and release fishery still occurs with many local guide services offering trips targeting striped bass. The release mortality rate that can be attributed to the catch and release fishery in the Cape Fear River is presently unknown. Thus, it is important that the NCDMF and NCWRC educate anglers on proper fishing and handling techniques.

A tag and release striped bass tournament started on the Cape Fear River in 2008 by the Cape Fear River Watch. The tournament raises money for removing the three lock and dams on the river and increases public awareness about anthropogenic factors affecting anadromous fish populations. The tournament selects local charter boat captains trained to tag fish by the NCDMF to guide the tournament fishermen. In December 2008, 21 fishermen participated in the tournament and released 42 striped bass. The next tournament was held in January 2010 with 27 fishermen releasing 25 striped bass. The Cape Fear River Watch continues to organize the Cape Fear Striped Bass Tournament with assistance of the NCDMF and NCWRC.

7.5 GUIDED FISHING FOR STRIPED BASS

In 1984, a North Carolina license requirement for charter boats, headboats or guide boats ("for-hire" vessels) was initiated when North Carolina General Statute 113-152 (Licensing of vessels) was amended to include *"Commercial fishing operations also includes taking people fishing for hire".* After much public debate and with the passage of the Fisheries Reform Act in 1997, "fishing for-hire" was eliminated from the definition of commercial fishing operations, and the license requirement for charter boats and headboats was eliminated, effective July 1, 1999 (NCDMF 2003). In designated joint and inland waters, fishing guides (persons receiving monetary compensation for taking others fishing) are required to purchase an annual guide's license from NCWRC. Since 2008, NCDMF requires for-hire vessels to possess either a For

Hire Blanket Coastal Recreational Fishing License (CRFL) or a Division of Marine Fisheries For Hire Fishing Permit (each customer must have a CRFL).

Since the recovery of the A/R stock and the Atlantic Migratory Stock, striped bass has become one of the major species in the guided recreational fishery. During early 2002, nearly 315 for-hire vessels were identified as operating in North Carolina's coastal waters, representing a 37% increase from the three prior years. Though many of these vessels pursue a variety of species, a growing number target striped bass. In 2002, 96 new vessels entered the for-hire fishery with 48% of these occurring in the northern coastal area of North Carolina. In 2009, 843 vessels entered the for-hire fishery with 35% occurring in the northern region, while 33% and 31% in the central and southern regions. Among the vessels registered in the northern region, 26% were less than 25 feet, 17% were between 26 and 35 feet, and the remaining 57% were greater than 35 feet in length. Among the vessels registered in the central region, 51% were less than 25 feet, 20% were between 26 and 35 feet, and the remaining 29% were greater than 35 feet in length. Among the vessels registered in the southern region, 59% were less than 25 feet, 24% were between 26 and 35 feet, and the remaining 17% were greater than 35 feet in length.

Annual sales of NCWRC guide licenses have increased steadily from 292 in 1987 to 1,213 in 2009 (Figure 7.9). Because the NCWRC guide license is a combination hunting/fishing guide license, the exact proportion of license sales that can be attributed to fishing guides is not possible without separation of the license data or surveys conducted with specific inquiries related to guided striped bass angling trips. Linehan (2008) conducted an angler opinion survey of those who fished the Roanoke River for striped bass in spring 2007. Of the 277 survey respondents, the majority of respondents (90%, N = 252) did not go striped bass fishing with a guide on the Roanoke River in spring 2007. Although fishing guides are a component of the angling parties on the Roanoke River, the actual number of guides or the number of guided trips conducted for striped bass on the Roanoke River are unknown.

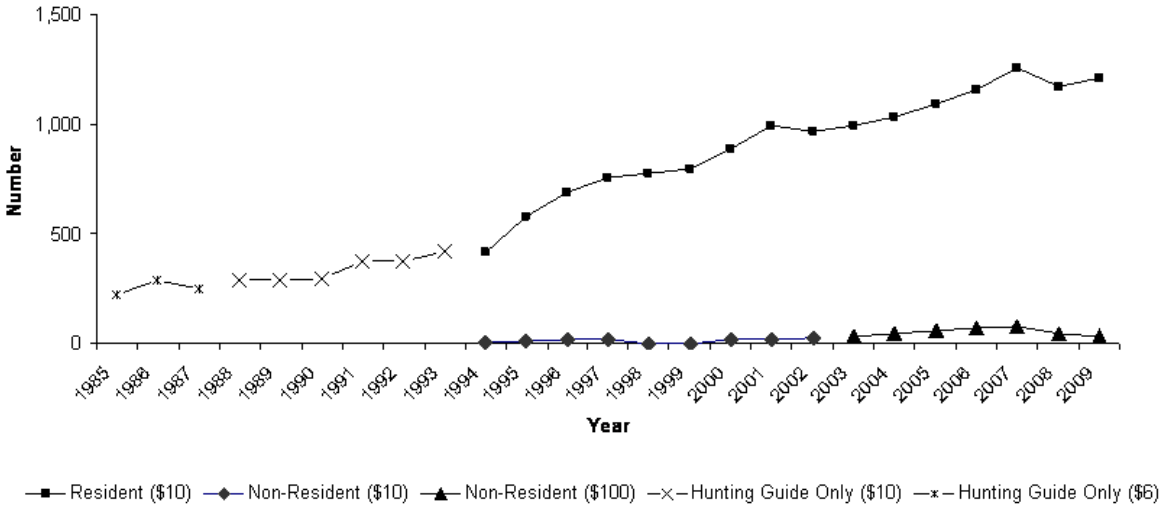


Figure 7.7 NCWRC hunting and fishing guide license sales, 1985-2009

7.6 CATCH AND RELEASE FISHING

Since the early 1990s, conservative striped bass creel limits have been in effect during open harvest seasons in the ASMA and RRMA. As this striped bass population has grown, an extensive catch and release fishery has developed both within and outside of the harvest seasons. During open harvest seasons, many anglers catch and retain their daily creel limit, then continue catching and releasing striped bass with individual catch rates sometimes exceeding 100 fish per day. Anglers often express the opinion that catching and releasing large numbers of striped bass after taking the daily creel limit offsets their desire to harvest more fish. Still, other anglers enjoy catching and releasing striped bass regardless of whether the harvest season is open, expressing no desire to keep any striped bass. The magnitude of the releases was shown for each area previously in Section 7.3.

A proportion of striped bass caught and released in the hook and line fisheries die as a result of injuries or physiological stress. Hooking injuries that cause damage to the gills or puncture the esophagus are often fatal. Striped bass that are bleeding heavily upon capture generally die immediately (referred to as “initial mortality”) but many striped bass that are apparently in good condition upon release die at a later time (referred to as “delayed mortality”). The physical exertion associated with being hooked, fought, dehooked, handled, and released causes the fish’s metabolic rate to increase greatly above normal limits and as a result, large amounts of lactic acid are produced with the muscle tissues. Although this severe condition known as “lactic acidosis” is often fatal, death occurs slowly over a period of several days. Many anglers are under the false impression that if a caught and released striped bass swims away, then it will survive the encounter.

Extensive research has been conducted upon catch and release mortality of striped bass and indicates that hooking location, bait type, and water temperature are the main factors influencing whether a caught and released striped bass will live or die. In an analysis of hooking mortality of 1,275 striped bass in fresh water based on published and unpublished data, Wilde et al. (2000) found that bait type and water temperature were both significant predictors of hooking mortality. Mortality was greater in fish captured on natural baits than artificial lures and increased rapidly for both bait types as water temperatures exceeded 77°F. The predictive model developed in this analysis, suggested that 50% of striped bass captured on natural bait die when water temperatures reach 80.6°F. In controlled tank studies of Roanoke River striped bass caught and released into large holding tanks, mean mortality rates were estimated to be 6.4%, however at water temperatures exceeding 70°F, mortality rates ranged up to 26.7% (Nelson 1998). In Albemarle Sound studies, survival of striped bass caught and released was lowest when water temperatures were high and dissolved oxygen low (Gearhart, 2002). Similar results (less than 10% mortality in cooler waters and up to 40% mortality in warm waters) have been documented in studies in estuarine striped bass populations in Massachusetts, Maryland, and in reservoir striped bass in Texas. In the Hudson River, Millard et al. (2005) found that mortality rates increased when water temperatures were at or above 60.8°F.

Hooking location and its relation to bait type also play a role in catch and release mortality. In studies on Roanoke River, hooking in the esophagus (throat) and gut was much more likely using natural bait than with artificial lures. Striped bass hooked in the esophagus, gut or gills had significantly greater mortality rates than fish hooked in the jaw or mouth. Bartholomew and Bohnsack (2005) also noted that natural bait appeared to increase the risk of deep hooking and that cutting the line on deeply hooked fish significantly increased survivorship. In Albemarle Sound studies (Gearhart, 2002), predictors of mortality included bleeding, fish length, water temperature, hook removal, and dissolved oxygen. Overall, 57.1% of deep hooked striped bass

died compared to 16.7% that were hooked in the mouth or gill and 2.7% for jaw hooked fish. Fish hooks that penetrate the esophagus may penetrate the heart or liver, which lie under the esophagus, causing internal injury and bleeding. Gills damaged by hooks bleed profusely and may result in mortality because they contain major arteries directly from the heart supplying blood flow to the gills for re-oxygenation. Millard et al. (2005) indicated that hook location and occurrence of bleeding were the most important variables in determining the probability of death among striped bass caught and released in Hudson River; noting that the odds of death for a fish that bled around the hooking site was about 15 times greater than a fish with no observable bleeding. In the Neuse River, the short term release mortality was observed for striped bass caught on hook and line using different hook types throughout the year (Brown 2007). Striped bass experiencing no bleeding were 3.4 times more likely to survive than those experiencing minimal bleeding, and striped bass experiencing handling times less than 30 seconds were 3.8 times more likely to survive compared to individuals handled between 30 and 60 seconds. Striped bass caught on treble hooks were 7.4 times more likely to survive then fish caught on circle hooks and 7.8 times more likely to survive when caught on treble hooks compared to individuals caught on J-hooks. Both circle (40.9%) and J-hooks (43.8%) had significantly higher release mortality rates than treble hooks (12.2%). Artificial lures used in the study, typically made up of treble hooks, were thought to be more difficult to swallow, minimizing the adverse hooking location associated with single hooks. Observed mortalities at low salinity trials average 39.2%, and ranged from 0-65.5%, while mortality at high salinity trials averaged 4.3%, ranging from 0-20.0%. Mortality associated with hook type is described in more detail in barbless hook issue paper in section 11.3.

As the popularity of catch and release fishing for striped bass continues to grow, the rate of discards is predicted to rise following the implementation of stricter fishing regulations. The number of discards in the CSMA has fluctuated as a result of the creel limits and seasonal closures set in place as of July 1, 2008 (Table 7.14). In the Neuse River the discard to harvest ratio ranged from 1.7:1 (2004) to 7.8:1 (2006). However in 2008, the discard to harvest ratio increased to 24.9:1, marking the largest increase in discards observed in the CSMA following the restrictions. In the Tar/Pamlico the harvest to discard ratio ranged from 4.2:1 (2006) to 36.2:1 (2007). Nevertheless, in 2008 the discard to harvest ratio (31.2:1) indicated a slight decrease in the number of discards and substantial decrease in the number of directed striped bass fishing trips and effort. In the Pungo River the discard to harvest ratio ranged from a 0.6:1 (2005) to 8.9:1 (2008). Prior to the current CMSA restrictions a slight increase in the number of discards was reported. As a whole, the CSMA discard to harvest ratio ranged from 6.5:1 (2007) to 21.2:1 (2008) following the current restrictions, marking a substantial increase in the number discards. However, the 2009 discard to harvest ratio did not reflect what was observed in 2008 directly following the current CSMA restrictions. Using the post regulation years of 2008 and 2009 and assuming a mortality rate of ten percent, the average dead discard in the hook and line fishery on an annual basis would be 1,206 fish (4,600 lbs if assume average weight=3.8 lbs) in the CSMA, with a dead discard to harvest ratio dropping to 0.4:1.

7.4 RECREATIONAL COMMERCIAL GEAR LICENSE

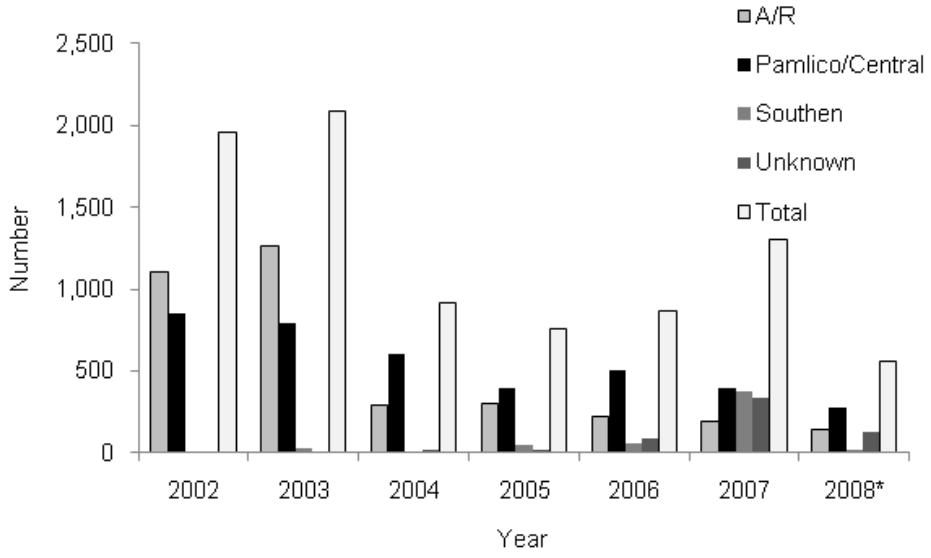
The North Carolina Fisheries Reform Act approved by the North Carolina General Assembly in 1997 established the Recreational Commercial Gear License (RCGL). An individual holding a RCGL is allowed to use limited amounts of specified commercial gear to catch seafood for personal consumption or recreational purposes. The holder of this license cannot sell the catch and the catch must stay within the recreational size and creel limits. This license is not transferable and expires one year from the date of purchase. A monthly mail survey was

initiated in March 2002 to gather catch and effort data from RCGL holders. Questionnaires were mailed to randomly selected individuals from the RCGL population at a sampling rate of 30% of the total population. Approximately 45% of questionnaires distributed were completed and returned to the NCDMF. Types of information collected through the survey include gears and quantity used, number of trips, estimates of the number and poundage of each species harvested, and estimated numbers of each species discarded. Total effort and catch were computed for the subsample and extrapolated to the entire RCGL population. To more easily describe the spatial distribution of RCGL striped bass harvest, the coast was divided into three regions, ASMA, CSMA and unknown if the survey respondent did not provide location information. This survey does not capture individual lengths or weights of fish reported. Due to funding cuts the survey ended in 2008.

7.6.1 RCGL Harvest and Effort Estimates

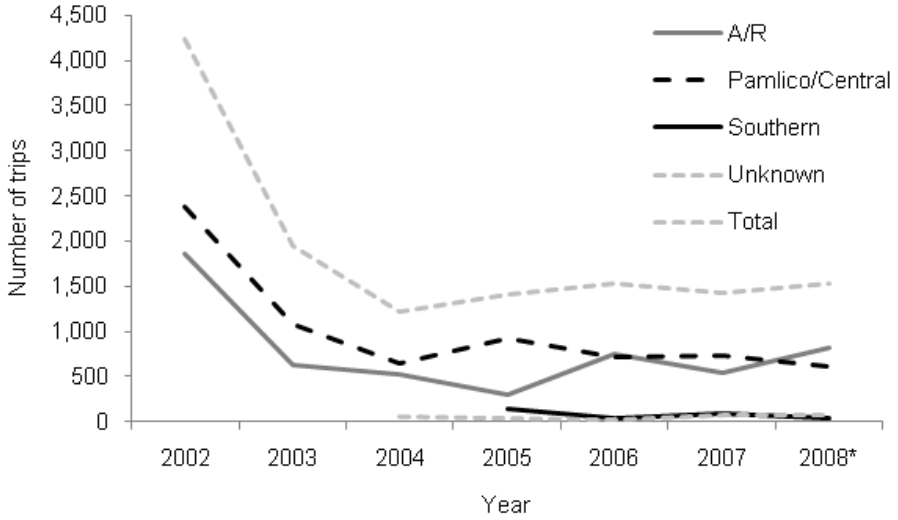
The total contribution of striped bass harvested by RCGL gears was insignificant compared to the harvest by recreational anglers, contributing only 3% by number and weight to the total recreational harvest during the year 2002 through 2008 for inside waters. The RCGL harvest of striped bass exhibited a pattern similar to that observed from the CSMA creel survey with a sharp decline in harvest occurring after 2003 when the largest number of striped bass (2,082) were harvested (Table 7.15). The decline in harvest continued until 2008 when 5,554 striped bass were harvested, with the biggest declines occurring in the A/R and Pamlico/Central management areas (Figure 7.8 and Table 7.15 &.16). Low harvest numbers were observed in the southern region of the CSMA from 2002 to 2006, reaching an all-time high in 2007 when 376 striped bass were harvested. The sharp decline in 2008 was a result of the harvest moratorium enacted in 2008 on the Cape Fear River and its tributaries.

The decline in the RCGL harvest of striped bass can be attributed to the sharp decline in trips occurring after 2003 (Figure 7.9). A total 1,857 trips were reported in the A/R region in 2002; however, an average of 593 trips was reported from 2003 through 2008. In the Pamlico/Central region 2,375 trips were reported in 2002, followed by a yearly average of 784 trips from 2003 through 2008. In the southern region, 2003 marked the highest number of trips reported (233). However, an average of 78 trips was reported from 2005 through 2008.



*2 fish daily creel limit, Oct 1 - Apr 30 season, harvest moratorium on Cape Fear River and its tributaries-effective July 1, 2008

Figure 7.8 North Carolina harvest (number) of striped bass by RCGL holders, 2002-2008.



*2 fish daily creel limit, Oct 1 - Apr 30 season, harvest moratorium on Cape Fear River and its tributaries-effective July 1, 2008

Figure 7.9 Trips targeting striped bass by RCGL holders, 2002-2008.

7.6.2 RCGL Seasonality of Harvest and Discard

During the period 2002 through 2008 in the A/R, 72.4% of the total harvest of striped bass by number occurred during the months of March (24.2%), April (16.0%), and October (32.2%). In the A/R, striped bass discards by RCGL holders was highest in October (24.1%) followed by March (14.6%), April (13.9%) and November (10.9%). In the CSMA, 69.2% of the total harvest of striped bass by number occurred during the months of November (21.6%), December (13.0%), May (12.7%), June (11.2%), and March (10.7%) in the CSMA. Striped bass discards by RCGL holders in the CSMA was highest in October (17.0%), followed by December (14.6%), November (13.7%), March (13.0%), and June (11.2%) (Figure 7.10).

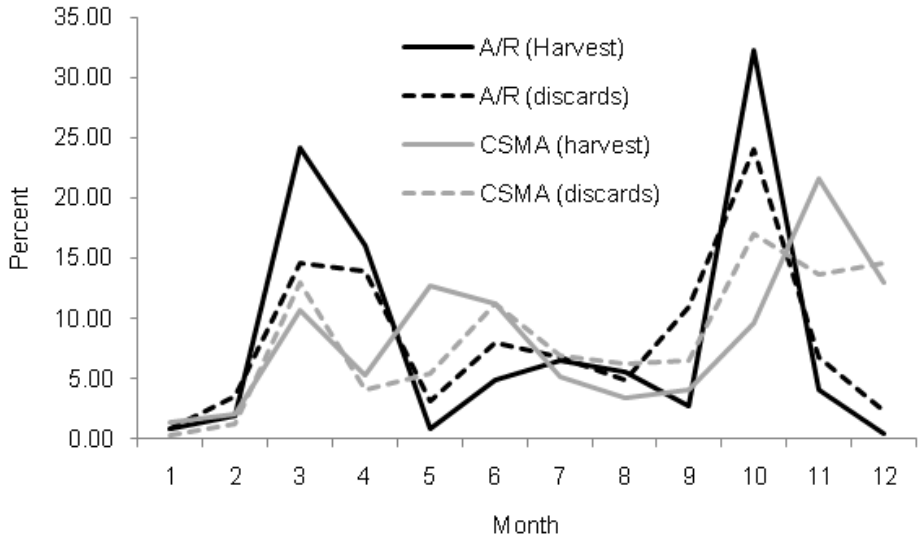


Figure 7.10 Monthly striped bass harvest and discard by RCGL holders during the period 2002 through 2008.

Table 7.15. Striped bass harvested (number, lbs, discard:harvest ratio) by RCGL holders during the period 2002 through 2008.

		Trips (number)				Harvest (number)				Harvest (lbs)				Discard (number)				Discard Harvest Ratio	Discard Harvest Ratio	Discard Harvest Ratio
Year	Gear	A/R	CSMA	Unknown	Total	A/R	CSMA	Unknown	Total	A/R	CSMA	Unknown	Total	A/R	CSMA	Unknown	Total	A/R	CSMA	Total
2002	Large	659	1,607		2,267	428	674		1,101	2,557	3,250		5,807	859	829		1,689	2.0:1	1.2:1	1.5:1
	Small	1,198	767		1,965	675	181		856	2,761	510		3,271	1,124	378		1,502	1.7:1	2.1:1	1.8:1
	All	1,857	2,375		4,232	1,103	855		1,957	5,318	3,760		9,078	1,983	1,208		3,191	1.8:1	1.4:1	1.6:1
2003	Large	59	910		969	109	391		500	496	2,249		2,745	9	244		253	0.1:1	0.6:1	0.5:1
	Small	565	409		973	1,152	430		1,582	5,449	2,005		7,454	1,705	327		2,032	1.5:1	0.8:1	1.3:1
	All	623	1,319	0	1,942	1,261	821	0	2,082	5,945	4,253	0	10,199	1,714	571	0	2,285	1.4:1	0.7:1	1.1:1
2004	Large	103	460	38	602	38	338	0	376	181	1,591	0	1,772	94	180	28	303	2.5:1	0.5:1	0.8:1
	Small	320	181	14	516	255	267	14	537	1,125	711	43	1,879	402	420	0	822	1.6:1	1.6:1	1.5:1
	Other	107			107				0				0	54			54			
	All	531	642	52	1,225	293	606	14	913	1,306	2,302	43	3,651	549	600	28	1,179	1.9:1	1.0:1	1.3:1
2005	Large	30	650	43	723	29	317	14	360	116	1,553	43	1,712	8	238	0	246	0.3:1	0.8:1	0.7:1
	Small	262	416		678	273	125		397	937	408		1,346	464	170		634	1.7:1	1.4:1	1.6:1
	All	292	1,066	43	1,401	302	442	14	757	1,054	1,962	43	3,058	472	408	0	880	1.6:1	0.9:1	1.2:1
2006	Large	554	351		906	112	356		469	564	1,468		2,032	486	775		1,261	4.3:1	2.2:1	2.7:1
	Small	194	410	27	631	107	209	85	402	486	521	342	1,349	295	736	79	1,110	2.8:1	3.5:1	2.8:1
	All	748	762	27	1,537	220	565	85	871	1,050	1,989	342	3,381	781	1,511	79	2,371	3.6:1	2.7:1	2.7:1
2007	Large	332	402	13	747	73	233	0	307	487	1,016	0	1,503	164	209	7	379	2.2:1	0.9:1	1.2:1
	Small	211	420	54	686	118	538	339	995	485	1,013	471	1,969	335	437	13	784	2.8:1	0.8:1	0.8:1
	All	543	822	68	1,433	191	771	339	1,302	972	2,029	471	3,472	498	646	19	1,163	2.6:1	0.8:1	0.9:1
2008*	Large	406	278	43	727	68	124	0	192	706	1,088	0	1,794	172	43	21	237	2.5:1	0.3:1	1.2:1
	Small	395	359	21	774	76	163	124	363	872	958	110	1,940	786	349	14	1,148	10.3:1	2.1:1	3.2:1
	Other	21			21				0		0		0	7			7			
	All	821	637	64	1,522	144	286	124	555	1,578	2,046	110	3,734	965	391	35	1,392	6.7:1	1.4:1	2.5:1
All	Large	2,143	4,659	137	6,941	858	2,433	14	3,305	5,107	12,216	43	17,365	1,792	2,518	57	4,368	2.1:1	1.0:1	1.3:1
	Small	3,144	2,964	116	6,223	2,656	1,913	562	5,132	12,116	6,127	965	19,208	5,110	2,816	106	8,032	1.9:1	1.5:1	1.6:1
	Other	128	0	0	128	0	0	0	0	0	0	0	0	60	0	0	61			
Total		5,415	7,623	253	13,292	3,514	4,346	576	8,437	17,223	18,343	1,008	36,573	6,963	5,334	162	12,459	2.0:1	1.2:1	1.5:1

*2 fish daily creel limit, CSMA restricted to Oct 1 - Apr 30 season, harvest moratorium on Cape Fear River and its tributaries-effective July 1, 2008

7.6.3 RCGL Catch and Discard by Area and Gear

The contributions from each region (North, Central, Pamlico, South, and unknown) to the total poundage of striped bass harvested by weight were 42%, 1%, 44%, 6%, and 7% respectively (Table 7.15). An annual average of 502 striped bass was harvested in the ASMA (North) with an annual average discard of 995 fish during the period of 2002 through 2008. Within the CSMA (Pamlico, Central, and South), an average of 621 striped bass were harvested with an annual average discard of 762 striped bass. The overall discard to harvest ratio was 2.0:1 for the ASMA (North), 1.4:1 for the Pamlico, 0.2:1 in the Central, 0.1:1 in the Cape Fear River (South), and 0.3:1 for unknown locations during 2002 through 2008 (Table 7.15).

Approximately 13,291 trips using small mesh and large mesh gill nets were responsible for landing 36,574 lbs of striped bass during the period from 2002 through 2008. Small mesh gill nets accounted for 53% by lbs of all striped bass harvested by RCGL holders followed by large mesh gill nets (47%) (Table 7.16). Sixty-four percent of all discarded striped bass by RCGL holders were initially captured in small mesh gill nets. The total discard to harvest ratio for small mesh gill nets (1.6:1) was slightly higher than the large mesh gill nets (1.3:1) and slightly higher in the A/R (2.0:1) than the CSMA (1.2:1). The largest discard to harvest ratio (10.3:1) was observed in the small mesh gill nets in the A/R in 2008. In the CSMA there was only a slight increase in the discard to harvest ratio in 2008, during the time when restrictions were set in place limiting creel limit and season as well as harvest moratorium on the Cape Fear River and its tributaries.

Table 7.16 Number of RCGL trips taken, harvested (number or lbs), discarded striped bass by area and discard:harvest ratio, 2002-2008.

		Trips		Harvest				Discard		Discard Harvest
Year	Region	Number	Percent	Number	Percent	Pounds	Percent	Number	Percent	Ratio
2002	North	1,857	44	1,103	56	5,318	59	1,983	62	1.8:1
	Pamlico	2,375	56	855	44	3,760	41	1,208	38	1.4:1
	Central	0	0	0	0	0	0	0	0	
	South	0	0	0	0	0	0	0	0	
	All	4,232	100	1,958	100	9,078	100	3,191	100	1.6:1
2003	North	623	32	1,261	61	5,945	58	1,714	75	1.4:1
	Pamlico	1,077	56	775	37	3,983	39	563	25	0.7:1
	Central	8	0	17	1	117	1	0	0	0.0:1
	South	233	12	29	1	153	2	8	0	0.3:1
	All	1,942	100	2,083	100	10,199	100	2,285	100	1.1:1
2004	North	531	43	293	32	1,306	36	549	47	1.9:1
	Pamlico	642	52	606	66	2,302	63	600	51	1.0:1
	Central	0	0	0	0	0	0	0	0	
	South	0	0	0	0	0	0	0	0	
	Unknown	52	4	14	2	43	1	28	2	2.0:1
	All	1,225	100	913	100	3,651	100	1,178	100	1.3:1

Table 7.16 continued

		Trips		Harvest				Discard		Discard Harvest
Year	Region	Number	Percent	Number	Percent	Pounds	Percent	Number	Percent	Ratio
2005	North	292	21	302	40	1,054	35	472	54	1.6:1
	Pamlico	916	65	396	52	1,828	60	408	46	1.0:1
	Central	0	0	0	0	0	0	0	0	
	South	150	11	46	6	133	4	0	0	0.0:1
	Unknown	43	3	14	2	43	1	0	0	0.0:1
	All	1,401	100	758	100	3,058	100	880	100	1.2:1
2006	North	748	49	220	25	1,050	31	781	33	3.6:1
	Pamlico	612	40	446	51	1,377	41	1,474	62	3.3:1
	Central	111	7	62	7	373	11	14	1	0.2:1
	South	39	3	58	7	239	7	24	1	0.4:1
	Unknown	27	2	85	10	342	10	79	3	0.9:1
	All	1,536	100	870	100	3,381	100	2,371	100	2.7;1
2007	North	543	38	191	15	972	28	498	43	2.6:1
	Pamlico	735	51	395	30	1,721	50	646	56	1.6:1
	Central	0	0	0	0	0	0	0	0	
	South	87	6	376	29	308	9	0	0	0.0:1
	Unknown	68	5	339	26	471	14	19	2	0.1:1
	All	1,433	100	1,301	100	3,472	100	1,163	100	0.9:1
2008*	North	821	54	144	26	1,578	42	965	69	6.7:1
	Pamlico	602	40	272	49	1,973	53	378	27	1.4:1
	Central	0	0	0	0	0	0	0	0	
	South	35	2	15	3	73	2	13	1	0.9:1
	Unknown	64	4	124	22	110	3	35	3	0.3:1
	All	1,522	100	554	100	3,735	100	1,391	100	2.5:1
All	North	5,415	41	3,514	42	17,223	47	6,962	56	2.0:1
	Pamlico	6,959	52	3,745	44	16,944	46	5,277	42	1.4:1
	Central	119	1	79	1	490	1	14	0	0.2:1
	South	544	4	524	6	906	2	45	0	0.1:1
	Unknown	254	2	576	7	1,009	3	161	1	0.3:1
	All	13,291	100	8,437	100	36,574	100	12,459	100	1.5:1

*2 fish daily creel limit, CSMA restricted to Oct 1 - Apr 30 season, harvest moratorium on Cape Fear River and its tributaries-effective July 1, 2008

7.7 HYBRIDS

The NCWRC has documented hybrid striped bass (striped bass X white bass *Morone chrysops*) in the Tar River system, the Neuse River spawning grounds, and the Cape Fear River spawning grounds. These hybrids are the likely result of stockings into upstream impoundments or escapement from aquaculture facilities.

Hybrid striped bass were introduced inadvertently into the Cape Fear River by stocking practices performed in Jordan Lake by the NCWRC, which subsequently escaped into the river (Patrick and Moser, 2001). Stocking of hybrids in Jordan Lake occurred from 1983 to 2001,and during this period hybrid striped bass abundance in the Cape Fear River increased from approximately a 25:75 (hybrid:native) ratio in 1990 to a 50:50 ratio in 2001 (Mallin et at. 2001, Patrick and Moser 2001). Since 2002, however, the number and percentage of hybrid striped bass collected during annual striped bass electrofishing spawning stock survey has steadily declined and is likely related to the discontinuation of stocking hybrid striped bass in Jordan Lake by the NCWRC.

Hybrid striped bass have been collected by the NCWRC from the Neuse River spawning grounds, but are uncommon. Since 2004, only two hybrid striped bass have been collected from the Neuse spawning grounds. Additionally, six hybrid striped bass have been collected from the Tar River spawning grounds since 2004. The number of hybrid striped bass encountered on the Cape Fear spawning grounds has also steadily declined. Hybrid striped bass are infrequently encountered during spawning stock surveys on the Roanoke River. In 2009 the number of hybrid striped bass collected in all the spawning area surveys conducted by the NCWRC totaled less than 2%, and zero hybrid striped bass were collected on CSMA spawning grounds in 2010 (Table 7.17)

During routine field sampling the NCDMF has verified hybrid striped bass in the CSMA. Since 2000, the NCDMF has collected a total of 512 hybrid striped bass compared to 6,132 striped bass. In all years, the Pamlico and Pungo rivers had the highest collected number of hybrid striped bass, but the number of hybrids never exceeded the number of striped bass collected. The highest number of hybrids was collected in 2002 when there were 45 hybrid bass collected compared to 122 striped bass. The Cape Fear River has consistently had the highest percentage of hybrid striped bass, with hybrid striped bass outnumbering striped bass 25 to 23 in 2002. Since 2002, the numbers of hybrid striped bass observed in all systems has steadily dropped. In 2009 there were less than 11 hybrid striped bass captured in all of the NCDMF sampling programs, and zero collected in Pamlico Sound and Cape Fear River (Table 7.18).

Table 7.17 Number and percentage of striped bass and hybrid striped bass collected during annual NCWRC electrofishing spawning stock surveys in the Tar, Neuse, and Caper Fear rivers, NC.

Sample Year	River System	Number of Striped Bass	Number of Hybrid Striped Bass	%Hybrid Striped Bass
2004	Tar	318	1	0.3%
	Neuse	90	0	0.0%
	Cape Fear	104	12	11.5%
2005	Tar	1,419	0	0.0%
	Neuse	127	1	0.8%
	Cape Fear	111	7	6.3%
2006	Tar	530	2	0.4%
	Neuse	62	0	0.0%
	Cape Fear	12	4	33.3%
2007	Tar	317	2	0.6%
	Neuse	173	0	0.0%
	Cape Fear	125	3	2.4%
2008	Tar	505	1	0.2%
	Neuse	142	1	0.7%
	Cape Fear	110	2	1.8%
2009	Tar	347	0	0.0%
	Neuse	374	0	0.0%
	Cape Fear	103	2	1.9%
2010	Tar	392	0	0.0%
	Neuse	158	0	0.0%
	Cape Fear	191	0	0.0%
	Total	5,710	38	0.7%

Table 7.18 Number and percentage of striped bass and hybrid striped bass collected through NCDMF programs 127, 416, and 915, Pamlico Sound area, NC.

Sample Year	River System	Number of Striped Bass	Number of Hybrid Striped Bass	%Hybrid Striped Bass
2000	Pamlico/Pungo	265	2	0.7%
	Neuse/Bay rivers	128	1	0.8%
	Pamlico Sound	11	0	0.0%
2001	Pamlico/Pungo	144	20	12.2%
	Neuse/Bay rivers	13	0	0.0%
	Pamlico Sound	27	3	10.0%
2002	Pamlico/Pungo	112	45	28.7%
	Neuse/Bay rivers	31	0	0.0%
	Pamlico Sound	92	11	10.7%
	Southern Cape Fear	23	25	52.1%
2003	Pamlico/Pungo	321	118	26.9%
	Neuse/Bay rivers	223	1	0.4%
	Pamlico Sound	182	10	5.2%
	Southern Cape Fear	65	40	38.1%
2004	Pamlico/Pungo	318	77	19.5%
	Neuse/Bay rivers	219	1	0.5%
	Pamlico Sound	103	0	0.0%
	Southern Cape Fear	110	40	26.7%
2005	Pamlico/Pungo	527	23	4.2%
	Neuse/Bay rivers	270	2	0.7%
	Pamlico Sound	74	0	0.0%
	Southern Cape Fear	65	3	4.4%
2006	Pamlico/Pungo	499	31	5.8%
	Neuse/Bay rivers	374	6	1.6%
	Pamlico Sound	87	0	0.0%
	Southern Cape Fear	43	2	4.4%

Table 7.18 continued.

Sample Year	River System	Number of Striped Bass	Number of Hybrid Striped Bass	%Hybrid Striped Bass
2007	Pamlico/Pungo	353	20	5.4%
	Neuse/Bay rivers	233	3	1.3%
	Pamlico Sound	49	2	3.9%
	Southern Cape Fear	44	3	6.4%
2008	Pamlico/Pungo	296	11	3.6%
	Neuse/Bay rivers	233	0	0.0%
	Pamlico Sound	27	1	3.6%
	Southern Cape Fear	13	0	0.0%
2009	Pamlico/Pungo	282	8	2.8%
	Neuse/Bay rivers	216	3	1.4%
	Pamlico Sound	57	0	0.0%
	Southern Cape Fear	3	0	0.0%
	Total	6,132	512	8.3%

Hybrid striped bass are also recorded during interviews in NCDMF creel surveys in the CSMA. Since the creel surveys started in 2004 agents have measured 1,238 striped bass and 55 hybrids. The majority are observed in the Tar/Pamlico and Pungo rivers (Table 7.20).

Hybrid striped bass are known to reproduce under hatchery conditions (Forshage et al. 1986; Harrell and Webster, 1997) and in the wild (Ware 1975; Avise and Van Den Avyle 1984; Harrell et al. 1993). However, Smith and Jenkins (1984) reported only a 10% hatching rate in the wild for hybrids.

Sources of these hybrids may be a result of escapement from aquaculture facilities during the floods that resulted from the hurricanes in the late 1990's, especially Hurricane Floyd in 1999. According to the North Carolina Department of Agriculture and Consumer Services website (http://www.ncagr.gov/) , there are 14 active hybrid striped bass facilities in North Carolina. The NCMFC regulations that apply to striped bass also apply to hybrids in coastal and joint waters of the state.

Table 7.19 Number and percentage of striped bass and hybrid striped bass encountered through the NCDMF CSMA striped bass creel survey.

Sample Year	River System	Number of Striped Bass	Number of Hybrid Striped Bass	% Hybrid Striped Bass
2004	Tar/Pamlico/Pungo	280	16	5.4
	Neuse River	152	0	0.0
2005	Tar/Pamlico/Pungo	259	11	4.1
	Neuse River	86	0	0.0
2006	Tar/Pamlico/Pungo	107	6	5.3
	Neuse River	43	1	2.3
2007	Tar/Pamlico/Pungo	87	10	10.3
	Neuse River	67	1	1.5
2008	Tar/Pamlico/Pungo	44	1	2.2
	Neuse River	11	2	15.4
2009	Tar/Pamlico/Pungo	96	5	5.0
	Neuse River	6	2	25.0
	Total	1,238	55	4.3