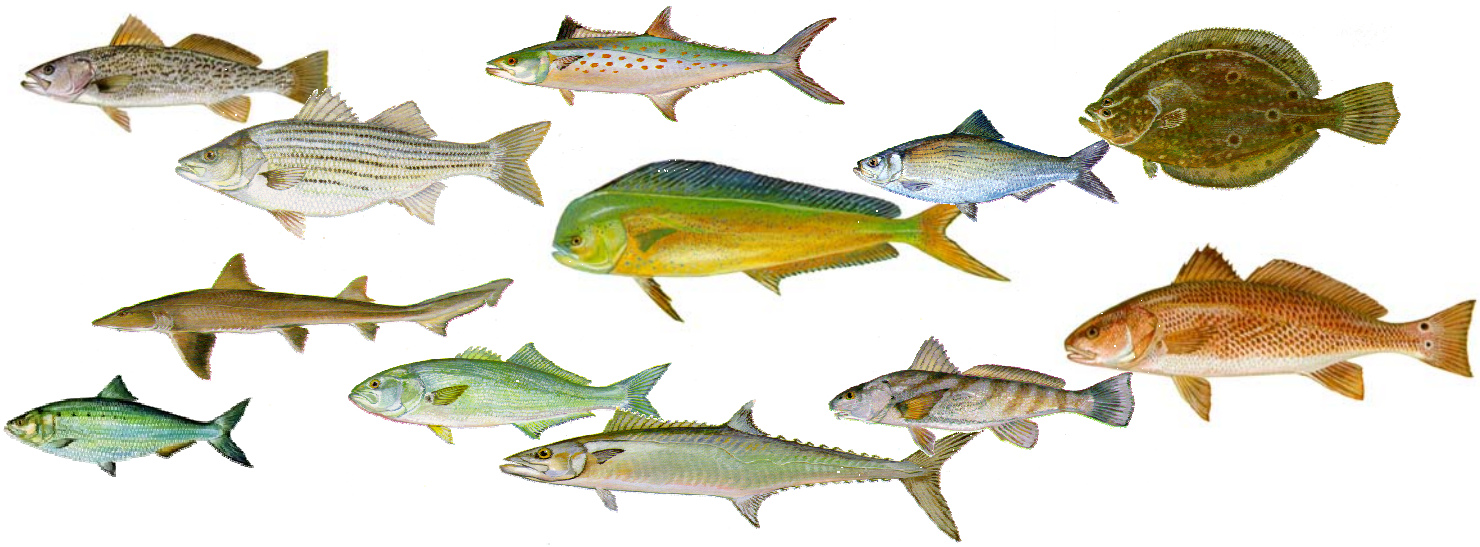
Interstate Fisheries Management Program Implementation for North Carolina

July 2004-July 2005

Changes in Landings, Ex-vessel Value, Effort, and Participation in North Carolina's Commercial Fisheries



North Carolina Department of
Environment and Natural Resources

Division of Marine Fisheries
Morehead City, NC 28557

Interstate Fisheries Management Program Implementation for North Carolina

North Carolina Commercial Statistics System Enhancement

July 2004-July 2005

Changes in Landings, Ex-vessel Value, Effort, and Participation in North Carolina's Commercial Fisheries

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for the

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Abstract

North Carolina's commercial fisheries are extremely diverse and complex allowing participants to operate in a wide variety of inshore and ocean fisheries. The diversity is good for North Carolina's commercial fishermen. However, the diversity also makes fisheries management in North Carolina very difficult. Fisheries managers developing management strategies for a particular fishery must take into account all possible effects those strategies may have on other fisheries and may want to consider ecosystem-based management strategies. However, fisheries management strategies are not the only factors to affect commercial fisheries. Other factors that have impacts on commercial fisheries in North Carolina include environmental variability, market conditions, and changes in infrastructure (ex. loss of seafood processing plants, loss of seafood dealers, etc.). This analysis compares the top ten commercial fisheries by landings, ex-vessel value, effort, and participation in North Carolina in 1994 to those of 2004 to explore what types of impacts these factors may have on the commercial fishing industry. Results indicate that North Carolina's overall seafood production and commercial participation have declined over the years. North Carolina's top ten fisheries experienced a change in production ranging from –88% to 160% from 1994 to 2004.

Introduction

North Carolina's commercial fisheries are extremely diverse and complex allowing participants to operate in a wide variety of inshore and ocean fisheries. Many of North Carolina's commercial fishermen rotate between different fisheries seasonally depending on species abundance and availability. The rotation between fisheries allows participants to harvest a multitude of species, use different gear types, fish in different areas during the year, and operate in commercial fishing activities throughout the year. This diversity is good for North Carolina's commercial fishermen while it also makes fisheries management in North Carolina very difficult. Fisheries managers developing management strategies for a particular fishery must take into account all possible effects those strategies may have on other fisheries and may want to consider ecosystem-based management strategies to account for those impacts (such as fishermen moving from one fishery to another fishery as a result of the management strategy). Fisheries managers must also be aware of other possible factors that can affect a fishery, such as environmental variability, market conditions, and loss of infrastructure (processors, dealers, etc.).

One way to measure the effects of fishery management strategies, environmental variability, market conditions, and loss of infrastructure is to monitor the commercial landings. The North Carolina Division of Marine Fisheries (NCDMF) monitors commercial fishery landings through the NCDMF Trip Ticket Program (NCTTP). The NCTTP began on 1 January 1994 (Bianchi 2004; Lupton and Phalen 1996). Prior to the implementation of the NCTTP, commercial statistics and harvest data were collected under the National Marine Fisheries Service (NMFS) / North Carolina Cooperative

Statistics Program (Bianchi 2004; Lupton and Phalen 1996). The NCTTP was initiated due to a decrease in cooperation in reporting under the voluntary NMFS/North Carolina Cooperative Statistics Program in place prior to 1994, as well as an increase in demand for complete and accurate trip-level commercial harvest statistics by fisheries managers (Bianchi 2004; Lupton and Phalen 1996). The detailed data obtained through the NCTTP allow for the calculation of effort (i.e. trips, licenses, fishermen, vessels) in a given fishery that was not available prior to 1994 and provides a more accurate record of North Carolina's seafood harvest.

Since 1994, North Carolina's commercial fisheries have been subjected to a wide array of fishery management strategies, impacted by weather events, and affected by changes in market conditions and declining infrastructure. These factors have led to changes in North Carolina's commercial fisheries production, effort, and participation over the years. It is not clear how these factors affect specific fisheries over time and which factors are most important.

Objectives

The goal of this study is to describe the overall trends in North Carolina's commercial fisheries from 1994 to 2004 and to determine how these factors have impacted commercial fisheries. This report has three main objectives:

1). Determine the overall trends in North Carolina's commercial seafood production, participation, and effort;

2). Compare the top 10 commercial fisheries of North Carolina in seafood production, participation, and effort from 1994 to 2004; and

3). Determine the potential factors (management strategies, environmental conditions, etc.) that may have led to changes in the top 10 commercial fisheries in seafood production, participation, and effort in North Carolina from 1994 to 2004.

Methods

The NCTTP provided the commercial landings, number of trips, number of dealers (businesses or individuals who purchase seafood) and ex-vessel value. The total participation, number of participants and number of vessels were determined by combining the license information obtained from the NCTTP with the NCDMF license database. The numbers of licenses sold were obtained from the NCDMF license database, while the number of seafood processors (businesses that process seafood, may or may not be a seafood dealer) were obtained from the National Marine Fisheries Service (NMFS).

The design of the NCTTP requires all individuals or businesses that buy seafood from fishermen in the state must have a seafood dealer's license. These dealers are mandated, under North Carolina general statute, to report all fish and shellfish landings per trip to the NCDMF. Each trip is reported on an individual trip ticket supplied to the dealers by NCDMF or submitted to NCDMF electronically through a specialized trip ticket software program, which is supplied to dealers upon request. Each trip ticket includes the amount in units/pounds of each species landed, type of gear(s) fished (up to three can be listed), water body from which the majority of the catch was harvested, start date of the trip, date of landing, number of crew, and license numbers. The county of landing is determined based on the location of the dealer submitting the trip ticket. In

addition to data collected from trip tickets, ex-vessel value (value that seafood dealers pay to commercial fishermen) data are collected from the dealers on a voluntary basis.

Trip tickets for a given month are submitted to the NCDMF by the 10th of the following month. The tickets are screened and double key entered by NCDMF data clerks and uploaded to the NCDMF Fisheries Information Network (FIN). The FIN generates warning reports if an unlikely combination of variables occurs during the data entry process. These tickets are then flagged and edited by NCDMF port agents. The data are uploaded to the state mainframe so they can be accessed by staff biologists for analyses. Edits and verifications are generated against the data to identify other potential errors.

Once on the mainframe, SAS® data management and analysis software was used to access and analyze the data (SAS® 1989). Customized SAS® programs were developed to analyze and export the data as text files from the mainframe. Microsoft Excel© was used to organize and summarize the data and to generate the graphics presented in this report.

Data analysis included a comparison of North Carolina's top 10 commercial fisheries in production, ex-vessel value, effort, and participation (number of dealers, vessels, and commercial fishermen) in 1994 to the top 10 fisheries in 2004. Changes in the top 10 fisheries were noted and the percent change of each fishery was calculated using the following formula:

$$\%CH = ((T_{2004} - T_{1994})/ T_{1994}) * 100$$

where %CH is the percent change, T_{2004} is the landings, ex-vessel value, number of trips, etc. for 2004, and T_{1994} is the landings, ex-vessel value, number of trips, etc. for 1994.

The ex-vessel value for 1994 was adjusted for inflation, using the Consumer Price Index, to match 2004 values by multiplying by a factor of 1.2746. Landings of Atlantic menhaden (*Brevoortia tyrannus*) and Atlantic thread herring (*Opisthonema oglinum*) were excluded from this analysis because their large quantity of landings may skew the data.

Results

Overall Trends

The historical statewide commercial landings for North Carolina have varied widely from 1972 to 2004 (Figure 1 and Table 1). Total landings for the state increased from 1972 to 1980 but have since declined overall with the exception of a small increase in landings from 1992 to 1996. This increase in landings may be due to the implementation of the NCTTP in 1994. The historical ex-vessel value, unadjusted for inflation, for North Carolina's commercial landings has fluctuated widely from 1972 to 2004 (Figure 1 and Table 1). The ex-vessel value increased from 1972 to 1995 but has since declined from 1995 to 2004.

The number of seafood dealers reporting landings increased overall from 1994 to 1999 but declined overall from 1999 to 2004 (Figure 2 and Table 2). However, the number of dealers reporting landings was still greater in 2004 than 1994. A closer look at the data indicates that the increase in the number of dealers reporting landings may be due to an increase in small to medium sized dealers (dealers reporting 100,000 lb. or less) while the number of larger dealers declined (dealers reporting greater than 100,000 lb.)

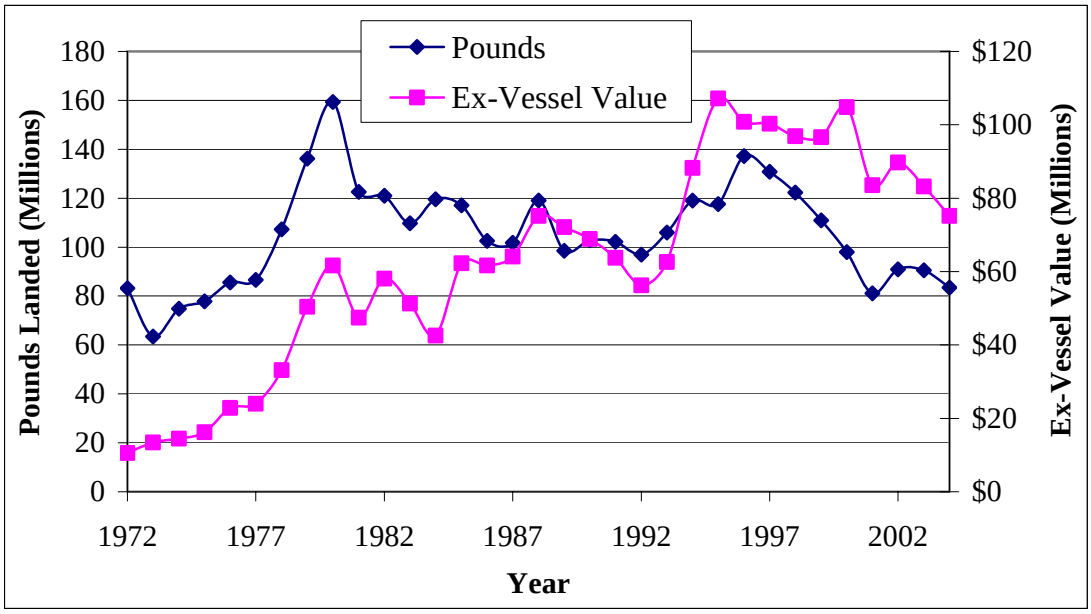

Figure 1. Statewide commercial landings and ex-vessel value for North Carolina from 1972 to 2004 (excluding Atlantic menhaden and Atlantic thread herring).

(Table 3). The same trend is not apparent in the number of seafood dealer licenses issued. Although the number of seafood dealer licenses issued varied widely over the 1994 to 2004 period, the number of seafood dealer licenses declined overall from 1995 to 2001 (Figure 3 and Table 2). However, since 2001, the number of seafood dealer licenses increased overall.

The number of commercial fishermen and the number of vessels landing seafood from 1994 to 2004 declined overall, while the number of licenses issued allowing the sale of seafood increased overall (Figure 2 and Table 2). The increase in the number of commercial licenses issued that allow the sale of catch is due to the following reasons: fishermen may hold more than one license, purchase a commercial license to harvest commercial quantities of seafood for recreational purposes, buy commercial licenses for

Table 1. Statewide commercial landings and ex-vessel value for North Carolina from 1972 to 2004 (excluding Atlantic menhaden and Atlantic thread herring).

Year	Landings (Pounds)	Ex-Vessel Value
1972	83,209,540	$10,579,510
1973	63,509,632	$13,415,028
1974	74,851,562	$14,437,874
1975	77,898,290	$16,193,700
1976	85,574,745	$22,874,930
1977	86,631,255	$24,005,423
1978	107,217,177	$33,110,828
1979	136,142,094	$50,394,493
1980	159,272,436	$61,644,183
1981	122,591,173	$47,481,251
1982	120,952,833	$58,050,810
1983	109,759,390	$51,257,107
1984	119,501,511	$42,517,237
1985	117,135,685	$62,262,805
1986	102,503,694	$61,639,894
1987	101,825,348	$64,082,775
1988	118,977,463	$75,189,922
1989	98,441,191	$72,148,701
1990	102,760,880	$68,871,636
1991	102,112,394	$63,784,877
1992	96,914,109	$56,280,614
1993	105,986,092	$62,649,493
1994	119,080,397	$88,236,839
1995	117,626,856	$107,208,777
1996	137,273,546	$100,838,358
1997	130,852,605	$100,331,845
1998	122,247,392	$96,899,432
1999	110,935,494	$96,624,721
2000	97,949,567	$104,836,825
2001	81,154,273	$83,583,597
2002	90,980,463	$89,696,999
2003	90,488,551	$83,179,541
2004	83,523,697	$75,213,962

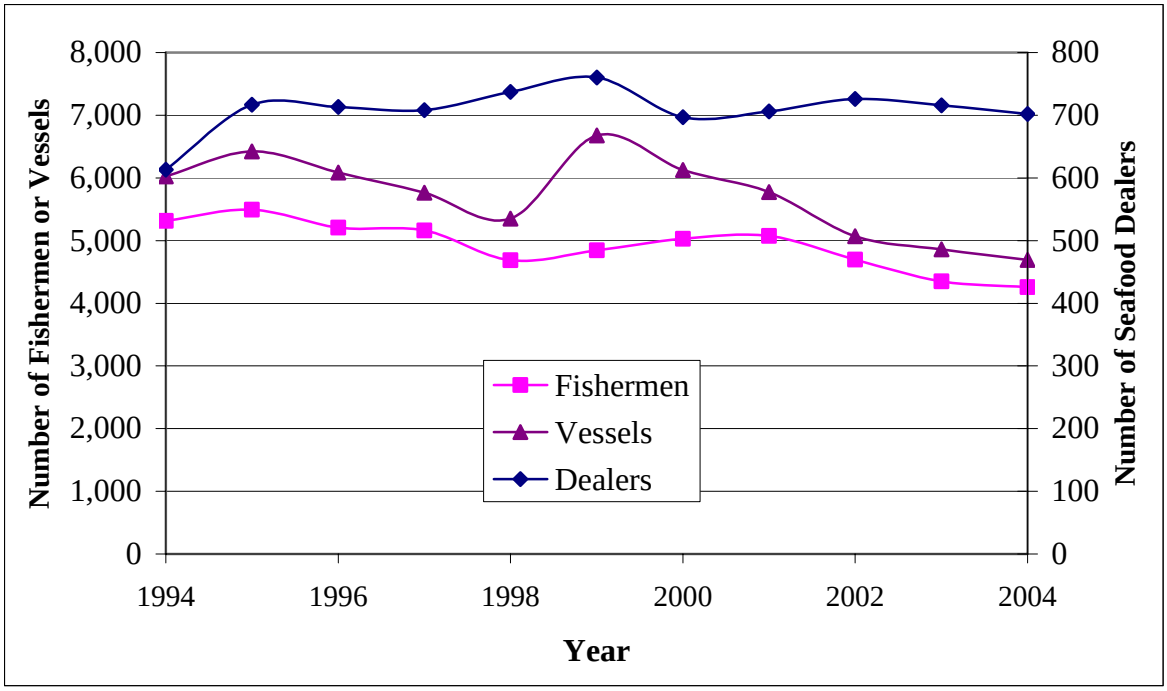

Figure 2. Total number of seafood dealers, commercial fishermen, and vessels reporting landings from 1994 to 2004 in North Carolina.

Table 2. Total number of seafood dealers, active commercial fishermen, vessels, trips, dealer licenses issued[1], commercial licenses issued[1], and seafood processors[2] in North Carolina from 1994 to 2004.

Year	Dealers	Fishermen	Vessels	Trips	Deal Lics	Comm Lics	Processors
1994	613	5,317	6,025	274,186	846	6,779	79
1995	717	5,494	6,420	286,096	849	7,534	52
1996	713	5,207	6,084	261,954	918	7,801	47
1997	708	5,160	5,765	282,844	851	8,177	52
1998	737	4,688	5,349	272,969	876	8,669	47
1999	760	4,845	6,679	252,869	868	8,440	41
2000	697	5,031	6,128	252,683	856	9,663	40
2001	706	5,077	5,775	255,288	841	9,642	36
2002	726	4,695	5,071	224,499	851	9,669	32
2003	716	4,352	4,862	207,788	882	9,454	***
2004	702	4,256	4,691	194,559	880	9,096	***

1. The number of licenses issued is based on license year (July-June). The number of commercial licenses includes the following licenses that allow the sale of seafood: ETS (1994-1999), SCFL, RSCFL, Shellfish w/out a SCFL, and Land or Sell.

2. The number of seafood processors were obtained from NMFS. Data for 2003 and 2004 are not yet available.

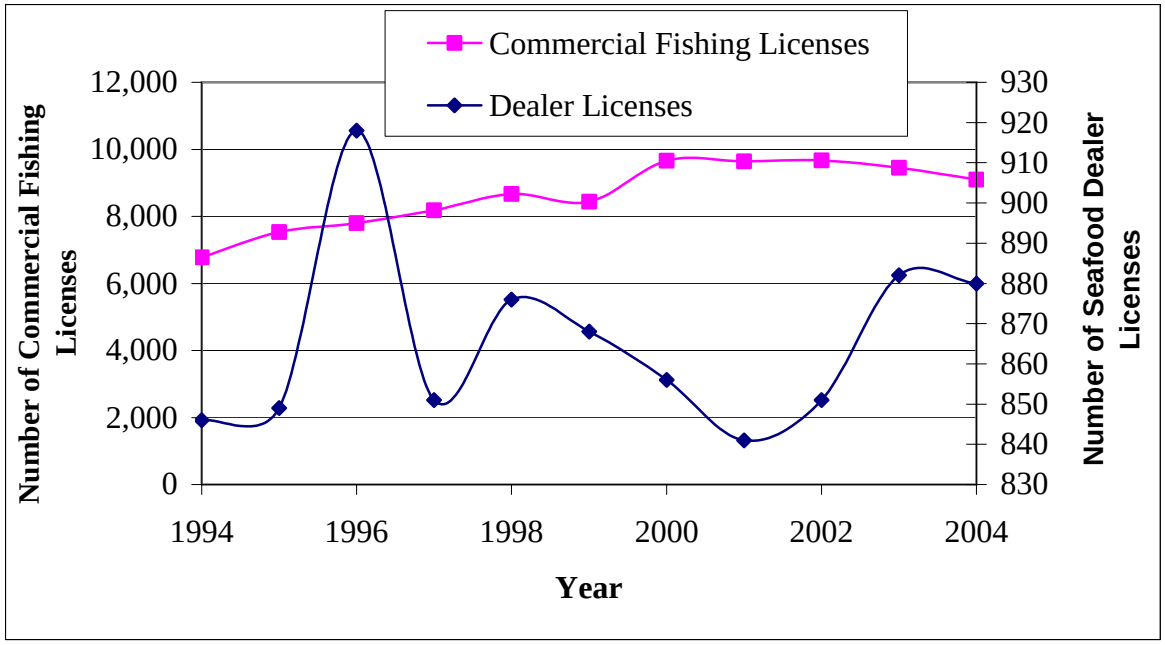

Figure 3. Total number of seafood dealer and commercial licenses issued from 1994 to 2004 (commercial licenses include the ETS, SCFL, RSCFL, Shellfish w/out a SCFL, and Land or Sell).

Table 3. Number of seafood dealers and percent by landing category for 1994 and 2004.

Range	94 Dealers	94 Percent	04 Dealers	04 Percent
<= 500 Pounds	110	18%	97	14%
501 - 1,000 Pounds	49	8%	51	7%
1,001 - 2,000 Pounds	55	9%	55	8%
2,001 - 5,000 Pounds	68	11%	105	15%
5,001 - 7,500 Pounds	31	5%	43	6%
7,501 - 10,000 Pounds	9	1%	34	5%
10,001 - 15,000 Pounds	28	5%	47	7%
15,001 - 25,000 Pounds	38	6%	49	7%
25,001 - 50,000 Pounds	39	6%	52	7%
50,001 - 100,000 Pounds	38	6%	52	7%
100,001 - 150,000 Pounds	23	4%	20	3%
150,001 - 200,000 Pounds	14	2%	14	2%
200,001 - 250,000 Pounds	11	2%	9	1%
250,001 - 300,000 Pounds	4	1%	11	2%
300,001 - 500,000 Pounds	29	5%	20	3%
500,001 - 1,000,000 Pounds	35	6%	25	4%
>= 1,000,001 Pounds	32	5%	18	3%
Total	613	100%	702	100%

use as investments, purchase licenses for tax breaks, or purchase licenses to pass on to someone else.

The number of trips conducted in North Carolina has also decreased from 1994 to 2004, following the same trend as the number of fishermen and vessels (Table 2). Trips peaked in 1995 at 286,096, but declined to 194,559 by 2004. Similarly, the number of seafood processors in North Carolina declined from 1994 to 2002 according to data obtained by NMFS (Table 2). The total number of processing plants ranged from a maximum of 79 in 1994 to minimum of 32 in 2002.

Comparisons between 1994 and 2004

The top 10 commercial fisheries in pounds landed for 1994 and 2004 are listed in Table 4. There were two species that ranked in the top 10 commercial fisheries in 1994 that did not rank in 2004, weakfish (*Cynoscion regalis*) and sharks (Orders Hexanchiformes and Lamniformes). These species were replaced by striped mullet (*Mugil cephalus*) and tunas (*Sarda sarda*, *Euthynnus alletteratus*, *Thunnus* spp. and *Katsuwonus pelamis*).

Although the fisheries that ranked in the top 10 did not differ much from 1994 to 2004, the order of the top 10 fisheries did change over time. Besides weakfish and sharks, the largest changes were seen in Atlantic croaker (*Micropogonias undulatus*), dogfish sharks (*Squalus acanthias* and *Mustelus canis*), and bluefish (*Pomatomus saltatrix*). Atlantic croaker was ranked fifth in 1994 and moved to second in 2004 with a percent change in production of almost 160% (Table 5). Atlantic croaker composed only five percent of the landings for the top 10 fisheries in 1994, but by 2004, this species accounted for 18% (Table 4). Bluefish moved from being ranked 10th in

Table 4. Top 10 commercial fisheries in pounds landed for North Carolina in 1994 and 2004 and the percent composition for each species.

Year	Species	Pounds	Percent Composition	Year	Species	Pounds	Percent Composition
1994	Hard blue crab	52,260,168	56%	2004	Hard blue crab	32,591,115	49%
1994	Dogfish sharks	9,877,661	11%	2004	Atlantic croaker	11,992,803	18%
1994	Shrimp	7,286,347	8%	2004	Shrimp	4,880,816	7%
1994	Southern flounder	4,897,459	5%	2004	Summer flounder	4,844,126	7%
1994	Atlantic croaker	4,615,754	5%	2004	Bluefish	3,762,944	6%
1994	Summer flounder	3,573,774	4%	2004	Southern flounder	2,453,381	4%
1994	Weakfish	3,489,950	4%	2004	Spot	2,316,982	3%
1994	Sharks	3,147,453	3%	2004	Striped mullet	1,593,795	2%
1994	Spot	2,937,311	3%	2004	Tunas	1,436,789	2%
1994	Bluefish	1,782,299	2%	2004	Dogfish sharks	1,146,251	2%

Table 5. Percent change in the top 10 commercial fisheries in pounds landed for North Carolina from 1994 to 2004.

Species	Percent Change
Hard blue crab	-38%
Atlantic croaker	160%
Shrimp	-33%
Summer flounder	36%
Bluefish	111%
Southern flounder	-50%
Spot	-21%
Striped mullet	-8%
Tunas	14%
Dogfish sharks	-88%
Weakfish	-80%

1994 to fifth in 2004 with a percent change in production of 111%. Bluefish composed only two percent of the total landings of the top 10 fisheries in 1994, but by 2004, bluefish composed six percent of the total landings. Dogfish sharks followed an opposite trend compared to Atlantic croaker and bluefish with a decline in ranking from 1994 (ranked second) to 2004 (ranked 10th) with an 88% drop in landings. Dogfish sharks accounted for 11% of the landings for the top 10 fisheries in 1994, but by 2004, that had dropped to two percent.

The top 10 commercial fisheries in ex-vessel value for 1994 and 2004 are listed in Table 6. Three species ranked in the top ten commercial fisheries in 1994 that did not rank in 2004: weakfish, sharks, and groupers (*Epinephelus* spp., *Mycteroperca* spp., *Paranthias furcifer*). These species were replaced by Atlantic croaker, peeler blue crabs (*Callinectes sapidus*), and king mackerel (*Scomberomorous cavalla*).

Besides weakfish and sharks, the largest changes were seen in Atlantic croaker, peeler blue crabs, tunas, shrimp (*Farfantepenaeus aztecus* **,** *F. duorarum, Litopenaeus setiferus*) and southern flounder (*Paralichthys lethostigma*). Atlantic croaker went from being ranked 11th in 1994 to fifth in 2004 with a percent change in value of almost 92% (Table 7). Peeler blue crabs went from being ranked 19th in 1994 to ninth in 2004. Tunas went from their ranking of eighth in 1994 to seventh in 2004. Tunas accounted for only three percent of the total value for the top 10 fisheries in 1994 but by 2004 had increased to 38%. Shrimp and southern flounder exhibited opposite trends, declining in value from 1994 to 2004. Shrimp maintained its ranking in 2004 but there was a 61%

Table 6. Top 10 commercial fisheries in ex-vessel value for North Carolina in 1994 (1994 dollars have been adjusted for inflation to match 2004 dollars) and 2004 and the percent composition for each species.

Year	Species	Value	Percent Composition	Year	Species	Value	Percent Composition
1994	Hard blue crab	$34,282,001	37%	2004	Hard blue crab	$20,188,313	35%
1994	Shrimp	$24,213,854	26%	2004	Shrimp	$9,460,142	17%
1994	Southern flounder	$10,294,724	11%	2004	Summer flounder	$7,612,841	13%
1994	Summer flounder	$7,419,143	8%	2004	Southern flounder	$3,874,491	7%
1994	Hard clams	$4,653,911	5%	2004	Atlantic croaker	$3,550,261	6%
1994	Soft blue crab	$2,462,701	3%	2004	Hard clams	$3,359,308	6%
1994	Weakfish	$2,444,628	3%	2004	Tunas	$3,333,386	6%
1994	Tunas	$2,414,814	3%	2004	Soft blue crab	$2,536,455	4%
1994	Groupers	$2,010,962	2%	2004	Peeler blue crab	$1,664,350	3%
1994	Sharks	$1,901,183	2%	2004	King mackerel	$1,575,433	3%

Table 7. Percent change in the top 10 commercial fisheries in ex-vessel value for North Carolina from 1994 to 2004.

Species	Percent Change
Hard blue crab	-41%
Shrimp	-61%
Southern flounder	-62%
Summer flounder	3%
Atlantic croaker	92%
Hard clams	-28%
Tunas	38%
Soft blue crab	3%
Peeler blue crab	69%
King mackerel	-2%
Weakfish	-80%
Groupers	-31%
Sharks	-69%

reduction in value in 2004 compared to 1994. Southern flounder dropped in ranking in 2004 and had a 62% reduction in value in 2004 compared to 1994.

The top 10 commercial fisheries in the number of seafood dealers reporting landings did not change in composition and there was little change in the ranking order for those fisheries from 1994 to 2004 (Table 8). The largest changes occurred in the hard blue crab, Atlantic croaker, and spotted seatrout (*Cynoscion nebulosus*) fisheries (Table 9). The number of dealers reporting landings of hard blue crabs increased by 15% while the number of dealers reporting landings for Atlantic croaker and spotted seatrout declined by 10% and 13%, respectively.

The top 10 commercial fisheries in the number of fishermen reporting landings in 1994 and 2004 are listed in Table 10. Two fisheries ranked in the top 10 in 1994 that did not rank in the top 10 in 2004: spotted seatrout and shrimp. These fisheries were replaced by striped bass (*Morone saxatilis*) and peeler blue crabs. However, all fisheries

Table 8. Top 10 commercial fisheries in the number of seafood dealers reporting landings for North Carolina in 1994 and 2004.

Year	Species	Dealers	Year	Species	Dealers
1994	Southern flounder	253	2004	Hard blue crab	288
1994	Hard blue crab	250	2004	Southern flounder	259
1994	Spot	233	2004	Shrimp	246
1994	Shrimp	232	2004	Spot	230
1994	Striped mullet	218	2004	Striped mullet	207
1994	Spotted seatrout	198	2004	Weakfish	177
1994	Weakfish	180	2004	Spotted seatrout	173
1994	Atlantic croaker	177	2004	Atlantic croaker	159
1994	Bluefish	159	2004	Bluefish	157
1994	Southern kingfish	150	2004	Southern kingfish	156

Table 9. Percent change in the top 10 commercial fisheries in the number of seafood dealers reporting landings for North Carolina from 1994 to 2004.

Species	Percent Change
Hard blue crab	15%
Southern flounder	2%
Shrimp	6%
Spot	-1%
Striped mullet	-5%
Weakfish	-2%
Spotted seatrout	-13%
Atlantic croaker	-10%
Bluefish	-1%
Southern kingfish	4%

Table 10. Top 10 commercial fisheries in the number of fishermen reporting landings for North Carolina in 1994 and 2004.

Year	Species	Participants	Year	Species	Participants
1994	Southern flounder	2,196	2004	Hard blue crab	1,425
1994	Hard blue crab	2,008	2004	Southern flounder	1,358
1994	Hard clams	1,686	2004	Hard clams	1,066
1994	Spotted seatrout	1,399	2004	Spot	1,041
1994	Striped mullet	1,366	2004	Striped bass	848
1994	Weakfish	1,355	2004	Atlantic croaker	825
1994	Atlantic croaker	1,287	2004	Striped mullet	793
1994	Spot	1,246	2004	Weakfish	791
1994	Bluefish	1,054	2004	Peeler blue crab	777
1994	Shrimp	989	2004	Bluefish	748

Table 11. Percent change in the top 10 commercial fisheries in the number of fishermen reporting landings for North Carolina from 1994 to 2004.

Species	Percent Change
Hard blue crab	-29%
Southern flounder	-38%
Hard clams	-37%
Spot	-16%
Striped bass	55%
Atlantic croaker	-36%
Striped mullet	-42%
Weakfish	-42%
Peeler blue crab	8%
Bluefish	-29%
Spotted seatrout	-49%
Shrimp	-41%

except for two (striped bass and peeler blue crabs), declined in the number of fishermen reporting landings from 1994 to 2004 (Table 11). Spotted seatrout, striped mullet, weakfish and shrimp all had a percent change near 40% from 1994 to 2004. The number of fishermen harvesting striped bass increased by 55% in 2004 compared to 1994.

The top 10 fisheries in the number of vessels that recorded landings followed a similar trend as the number of fishermen. The top 10 fisheries in the number of vessels that recorded landings for 1994 and 2004 are listed in Table 12. Two fisheries ranked in the top 10 in 1994 that did not rank in the top 10 in 2004, hard clams (*Mercenaria mercenaria*) and shrimp. These fisheries were replaced by striped bass and peeler blue crabs. However, all fisheries except for two (striped bass and peeler blue crabs), declined in the number of vessels reporting landings from 1994 to 2004 (Table 13). Hard clams had a percent change near 50%, while spotted seatrout, shrimp, striped mullet, and weakfish had a percent change near 50% from 1994 to 2004. On the contrary, striped

Table 12. Top 10 commercial fisheries in the number of vessels reporting landings for North Carolina in 1994 and 2004.

Year	Species	Vessels	Year	Species	Vessels
1994	Southern flounder	2,569	2004	Hard blue crab	1,676
1994	Hard blue crab	2,445	2004	Southern flounder	1,585
1994	Hard clams	1,760	2004	Spot	1,160
1994	Spotted seatrout	1,570	2004	Atlantic croaker	920
1994	Striped mullet	1,523	2004	Striped bass	908
1994	Atlantic croaker	1,495	2004	Striped mullet	891
1994	Weakfish	1,491	2004	Weakfish	886
1994	Spot	1,404	2004	Peeler blue crab	871
1994	Shrimp	1,229	2004	Bluefish	821
1994	Bluefish	1,159	2004	Spotted seatrout	787

Table 13. Percent change in the top 10 commercial fisheries in the number of vessels reporting landings for North Carolina from 1994 to 2004.

Species	Percent Change
Hard blue crab	-31%
Southern flounder	-38%
Spot	-17%
Atlantic croaker	-38%
Striped bass	55%
Striped mullet	-41%
Weakfish	-41%
Peeler blue crab	9%
Bluefish	-29%
Spotted seatrout	-50%
Hard clams	-57%
Shrimp	-49%

bass had a percent increase of 55% in 2004.

The top 10 commercial fisheries in the number of trips recording landings varied greatly between 1994 and 2004 (Table 14). There were four species that made the top 10 in the number of trips conducted in 1994 that did not make the top 10 in 2004: catfishes (*Amerius* spp. and *Ictalurus* spp.), Atlantic croaker, spotted seatrout, and striped mullet. These species were replaced by peeler blue crabs, oysters (*Crassostrea virginica*), spot

Table 14. Top 10 commercial fisheries in the number of trips conducted in North Carolina in 1994 and 2004.

Year	Species	Trips	Year	Species	Trips
1994	Hard blue crab	109,603	2004	Hard blue crab	74,160
1994	Hard clams	53,008	2004	Hard clams	30,391
1994	Southern flounder	42,460	2004	Southern flounder	27,050
1994	Shrimp	21,747	2004	Peeler blue crab	12,728
1994	Weakfish	17,414	2004	Shrimp	11,881
1994	Catfishes	16,015	2004	Oysters	11,880
1994	Atlantic croaker	14,349	2004	Spot	10,571
1994	Peeler blue crab	14,181	2004	Striped bass	9,353
1994	Spotted seatrout	13,659	2004	Weakfish	8,553
1994	Striped mullet	13,649	2004	Bluefish	8,011

Table 15. Percent change in the top 10 commercial fisheries in the number of trips conducted in North Carolina from 1994 to 2004.

Species	Percent Change
Hard blue crab	-32
Hard clams	-43
Southern flounder	-36
Peeler blue crabs	-10
Shrimp	-45
Oysters	64
Spot	-3
Striped bass	180
Weakfish	-51
Bluefish	-27
Catfishes	-50
Atlantic croaker	-45
Spotted seatrout	-58
Striped mullet	-43

(*Leiostomus xanthurus*), and striped bass. However, almost all fisheries had declined in the number of trips conducted (Table 15). Only striped bass and oysters had a positive percent change from 1994 to 2004. The number of trips that landed striped bass increased by 180% and the number of trips that landed oysters increased by 64%.

Discussion

North Carolina has ranked in the top 11 states in seafood production since 1997 (NMFS 1998, 1999, 2000, 2001, 2002, 2003, and 2004). However, since 1994, total seafood production in North Carolina has declined overall as well as participation and effort. Opposite to these trends, the number of seafood dealers in North Carolina have increased overall during the first part of this time period but then started to decline in the second part of the period. The increase in the number of seafood dealers is primarily due to commercial fishermen buying a seafood dealer's license to sell catch to the public themselves instead of going through another seafood dealer. Seafood dealer licenses are relatively inexpensive, and this practice allows commercial fishermen to get a higher return for their product sold, which has resulted in the increase in the number of smaller seafood dealers.

Although number of seafood dealers was higher in 2004 than in 1994, the number of large dealers has declined overall. Likewise, the number of seafood processors in North Carolina have also declined since 1994. These trends indicate that North Carolina's commercial fishing industry has lost a significant portion of infrastructure. Much of this loss has been due to coastal development, an increase in property values, and increase in taxes on the coast. It is becoming more profitable for a large seafood dealer or seafood processor to sell land to developers than to remain in the industry.

The loss of infrastructure has not been the only factor affecting North Carolina's commercial fisheries. Fisheries management strategies have also significantly affected North Carolina's commercial fishing industry over the past 11 years. The effects of changing management strategies, both direct and indirect, are evident in the dogfish

shark, Atlantic croaker and bluefish fisheries. Spiny dogfish provided a large fishery in the mid-90s, however a large decline in landings occurred following management measures implemented to prevent overfishing (ASMFC 2002, MAFMC and NEFMC 1999). As a result, many fishermen moved to other fisheries, most notably the Atlantic croaker and bluefish fishery, which has increased tremendously over recent years (Daniel 2004).

Management measures were put in place to protect sea turtles in Pamlico Sound during the fall southern flounder gill net fishery starting in 1999 (Price 2005). Many fishermen who historically participated in the deep-water portion of that fishery moved to ocean gill net fisheries to remain in the industry (ASMFC 2005). Others moved to different inshore fisheries, while some left commercial fishing altogether (ASMFC 2005). Not all changes in management strategies resulted in a negative change. Quota increases for both summer flounder and striped bass have resulted in increased landings of both of these species and increased participation for striped bass.

Changes in market conditions contributed to changes in the top 10 commercial fisheries. These effects were most notable in the shrimp and blue crab fisheries. The shrimp fishery has been negatively impacted on the global market by the increase of imports of aquaculture-raised shrimp from foreign countries (NCDMF 2005). The blue crab fishery has been negatively impacted by a lack of demand for processed product and a shift to the live basket market and competition from imported crab (NCDMF 2004). Although both of these fisheries remained in the top 10 in production and value in 2004, both declined considerably from 1994 to 2004, in both production and value.

Natural variations in the environment have also impacted the top 10 commercial fisheries over the period. North Carolina has been directly impacted by six different hurricanes since 1994. The total effect these storms have had on the commercial fishing industry is not yet understood, but it is apparent these storms may have contributed to losses of infrastructure (seafood dealers, processors, gear, boats, equipment, etc.) and changes in the short term and long term production for some of North Carolina's fall fisheries.

Hurricanes are not the only natural variation that has an effect on North Carolina's commercial fisheries. Changes in the stock structure and availability of species can also have a negative or positive effect on the state's top 10 commercial fisheries. Negative changes in the stock have been observed in the weakfish fishery in recent years. This decline is noticeably seen in the commercial landings of weakfish, which dropped significantly in 2004 compared to 1994. However, other species such as oysters have increased in availability over the years, which are observed with the increase in the number of trips conducted for this species in 2004 compared to 1994.

Conclusions

North Carolina's seafood production, ex-vessel value, participation and effort have declined over the 11-year period from 1994 to 2004. Likewise, North Carolina's top 10 fisheries in production, ex-vessel value, participation and effort have changed over the years. These changes have been due to a number of different reasons including: changing management strategies, loss of infrastructure, changes in market conditions, species population changes and environmental variations. These factors have varying effects on North Carolina's commercial fisheries and there may be multiple factors

affecting to a single fishery. It is still unclear whether or not these changes observed in the commercial fishing industry are cyclical in nature or if these changes are stationary. By maintaining funding for the NCTTP, changes like these can be analyzed in the future to determine the nature of the changes in the commercial fishing industry.

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