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Stock Assessment of the North Carolina Blue Crab (*Callinectes sapidus*)

2011

Prepared by

North Carolina Division of Marine Fisheries
Blue Crab Plan Development Team

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Final Report to the North Carolina Marine Fisheries Commission

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EXECUTIVE SUMMARY

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1 INTRODUCTION

1.1 The Resource

Blue crabs (*Callinectes sapidus*) are present from Nova Scotia to the northern coast of Brazil (Hay 1905; Guillory et al. 2001), supporting commercial and recreational fisheries along the Atlantic and Gulf coasts of the United States. The blue crab resource supports North Carolina's most valuable commercial fishery. Blue crabs are also commonly harvested by recreational fishermen in North Carolina.

Before 1995, the North Carolina Division of Marine Fisheries (NCDMF) did not have a sampling program dedicated to blue crabs, although limited information (landings statistics, juvenile abundance) was collected through other programs. Realizing the increasing importance of the blue crab fishery to the coastal economy, crabbers petitioned the North Carolina General Assembly in 1994 to allocate funding specifically for a blue crab assessment project. The resulting program focused on the establishment of fishery-dependent and -independent databases coast-wide. Section 5.5 of the Fishery Reform Act of 1997 specifically required that the North Carolina Marine Fisheries Commission adopt a Fishery Management Plan (FMP) for the blue crab fishery by January 1, 1999. The plan was adopted by the Marine Fisheries Commission on December 11, 1998. All of North Carolina's state Fishery Management Plans are reviewed and updated every five years. If the FMP includes a stock assessment, the assessment is reviewed and updated at the same time as the FMP. The Blue Crab FMP was first amended December 3, 2004. Amendment 2 to the Blue Crab FMP is currently in development.

The North Carolina blue crab stock was last assessed for management purposes in 2004 as part of the review and amendment of the Blue Crab FMP (Eggleston et al. 2004). Concerns regarding the uncertainty of estimates of maximum sustainable yield (MSY) as well as data and modeling limitations led the NCDMF to conclude that the status of the blue crab stock could not be accurately assessed at the time (NCDMF 2004). The results of the 2004 assessment were not used for management. The management tool that was adopted at the time was the implementation of restrictions to protect the blue crab spawning stock when the defined spawning stock biomass trigger is activated. In addition, an overfished[1] definition for blue crabs was adopted and is defined based on commercial landings trends. The blue crab resource is considered overfished when annual commercial landings decline for five consecutive years. No overfishing[2] definition was developed.

According to the above definition, North Carolina's blue crab stock is currently not overfished, but the stock is currently listed as one of "concern" due to reduced commercial landings of hard blue crabs during 2000 through 2002 and 2005 through 2007 following record-high commercial landings observed during 1996 through 1999 (NCDMF 2011). Commercial blue crab landings in 2010 were the fifth lowest on record

[1] The North Carolina General Statutes define overfished as "The condition of a fishery that occurs when the spawning stock biomass of the fishery is below the level that is adequate for the recruitment class of a fishery to replace the spawning class of the fishery" (N.C. Gen. Stat. § 113−129)

[2] The North Carolina General Statutes define overfishing as "Fishing that causes a level of mortality that prevents a fishery from producing a sustainable harvest" (N.C. Gen. Stat. § 113−129)

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during the 10-year period of 2001 through 2010. Harvest from the Pamlico and Core sounds and tributaries has increased but continues to remain significantly less than historical levels.

The current stock assessment was developed as part of Amendment 2 to the Blue Crab FMP.

1.2 Life History

1.2.1 Stock Definitions

Although blue crab larvae mix when in the larval stages on the continental shelf, the interchange of larvae from North Carolina and other states is assumed to be negligible.

Available tagging data suggest that there is limited migration of adult females across state boundaries (NCDMF 2008; L. Henry, NCDMF, pers. comm.). Based on landings trends and tagging data, there is some evidence that the southern area of the state may be a separate population from the rest of the state (NCDMF 2008). In addition, adult female blue crabs do not migrate from the Pamlico Sound region to Albemarle Sound. However, mature females from Albemarle Sound do migrate to northern Pamlico Sound and towards the ocean inlets (NCDMF 2008; Bridges 2009). Juvenile blue crabs disperse and recruit into the Albemarle area from the northern Pamlico Sound settlement areas.

1.2.2 Movements & Migration

The first larval stage (zoea) occurs offshore for several weeks where it undergoes several developmental stages before metamorphosing into megalopae (Van Engel 1958; Epifanio 1995). Megalopae are then transported into Pamlico Sound, North Carolina via onshore wind events and nighttime incoming spring tides (Forward et al. 2004), which may be overshadowed by tropical storm forcing, depending on frequency and wind direction (Eggleston et al. 2010). Megalopae then settle in seagrass beds in the seaward portion of the sounds before exhibiting density-dependent secondary dispersal resulting in juveniles being widely distributed throughout the estuaries of North Carolina (Etherington and Eggleston 2000). Salinity and the presence of bottom structure influence settlement after this secondary migration. After growth and maturation, females migrate to spawn in the high-salinity waters near the oceanic inlets (Whitaker 2006). Other studies have also shown that the migratory behavior of mature female blue crabs continues between clutches, and spawning females are continually moving seaward through the spawning season (Hench et al. 2004; Forward et al. 2005; Darnell et al. 2009). Males do not migrate regularly as adults.

A tagging study conducted in North Carolina during 2002 through 2005 demonstrated that most mature female blue crabs were recaptured shortly after release near the release site (NCDMF 2008). However, dispersal was greater and long distance returns were more prevalent in 2003 from the north to the south. Additionally, releases in the upper and mid-estuaries of the Albemarle-Pamlico systems and Cape Fear River show a general pattern of summer to fall movement towards the lower estuary areas and coastal inlets.

Mature female blue crabs tagged in the southern coastal area (i.e., Bogue Sound and south) have a southward pattern of movement (NCDMF 2008). A similar trend was noted in mature female crabs released in the Atlantic Ocean south of the Cape Fear River

during February to April 2005 and 2006 and suggested the warming of the estuarine waters was a cue to female blue crab movement (Logothetis et al. 2007). A significant portion of mature females in the southern area overwinter in the ocean near the coastal inlets and move back into the estuaries the following spring to forage and potentially spawn multiple times (NCDMF 2008).

1.2.3 Age & Size

Fischler (1965) reported an average life span of three years for blue crabs and a maximum size of around 217 mm. Estimates of maximum age have ranged between five and eight years.

Ageing crustaceans is notoriously difficult. Crustaceans do not have persistent hard parts usually used to track and count rapid- and slow-growing periods to determine age. Recent advances in quantifying and calibrating oxidation products (lipofuscins) in nerve tissue have been promising as an alternative to the traditional carapace width estimators used to calibrate carapace width with age estimates; however, lipofuscin extraction is a new and costly technique that has not been widely used in ageing laboratories (Puckett et al. 2008).

1.2.4 Growth

Traditional growth models used for finfish are impractical to apply to crustaceans in general because the models assume growth is continuous (von Bertalanffy 1938; Schnute 1981). For blue crabs and other crustaceans, growth is discontinuous as size increases via shedding their exoskeleton (molt). However, the von Bertalanffy growth function returned similar results to crustacean-specific growth models that accounted for the unique growth characteristics of the blue crab (Eggleston et al. 2004; Johnson 2004). The similarity of the two growth models is likely due to the increasing time between molts that occurs as the crabs grow larger, mirroring the decreasing rate of growth with size evident in the von Bertalanffy growth function.

1.2.5 Reproduction

Blue crabs mature at between one and two years of age in North Carolina (Johnson 2004). Mating occurs during the spring or summer in brackish estuarine waters as females molt into maturity (Forward et al. 2003; Whitaker 2006). Spawning typically occurs within two months after mating; however, females can retain sperm through winter for spawning the following spring (Hill et al. 1989; Forward et al. 2003). Spawning is initiated after migration to the high-salinity inlets. In the Chesapeake Bay, Prager et al. (1990) found that fecundity was significantly related to carapace width and estimated that average fecundity was 3,200,000 eggs. Females may spawn once or several times a season. Spawning has two peak pulses, April–June and August–September, in North Carolina (Darnell et al. 2009).

For the current assessment, length at maturity for female blue crabs was determined by fitting a logistic model to the available maturity data. Pooled maturity data collected in Programs 100, 120, 195, and 436 were included in the model. Programs 100, 120, and 195 are described in more detail in section 2.2 of this report. Program 436 is described in

more detail in section 2.1.1.3 of this report. Otto et al. (1990, cited by Hjelset et al. 2009) recommended pooling data from different sampling methods to reduce bias in estimates of size at maturity. Length at maturity was estimated by year for 1987 through 2009 to derive annual estimates of length at 50% maturity (L_{50}). Annual estimates were needed for use as an indicator in the assessment method (see section 3.2.4, this report).

Estimates of L_{50} for female blue crabs ranged from a low of 97.2 mm in 1999 to a high of 125 mm in 2007 (Figure 1.1).

1.2.6 Mortality

Natural mortality rate (*M*) is a key parameter in stock assessments but often one of the most uncertain. Johnson (2004) estimated natural mortality of blue crabs in North Carolina using Hoenig's method (1983), which relates *M* to the maximum age in the population. Assuming a maximum age of 5 years, Johnson (2004) estimated *M* to equal 0.87. This value of *M* was also assumed in the 2004 stock assessment of North Carolina blue crabs (Eggleston et al. 2004).

Hewitt et al. (2007) estimated *M* for blue crabs in the Chesapeake Bay using a variety of methods and concluded that *M* values ranging between 0.7 and 1.1 per year were reasonable for that stock. Wong (2010) assumed $M = 0.80$ in the 2010 assessment of the Delaware Bay blue crab stock.

Total mortality (*Z*) is the sum of natural, fishing, and any other sources of mortality. Johnson (2004) and Eggleston et al. (2004) estimated *Z* using length-based methods based on data collected during June by NCDMF Program 195 (see section 2.2.3, this report). The length-based *Z* estimates ranged from 0.91 to 1.22 between 1987 and 2003 and averaged 1.03 per year during that time period. Estimates of *Z* for blue crabs in the Chesapeake Bay in the 1990s ranged from 1.0 to 1.5 (Rugolo et al. 1997). Estimates of Z derived from the results of a catch-survey analysis applied to the Delaware Bay blue crab stock ranged from 0.50 to 2.69 and averaged 1.51 per year during 1978 to 2009 (Wong 2010).

Fishing mortality rates (*F*) can be estimated directly (e.g., tagging studies) or indirectly. The results of a catch-survey analysis applied to the North Carolina blue crab stock were used to derive estimates of *F*, which ranged from 0.13 to 2.03 between 1987 and 2003 when *M* was assumed equal to 0.87 (Eggleston et al. 2004; Johnson 2004). Wong (2010) applied a catch-survey analysis to the Delaware Bay blue crab stock and the results were used to estimate upper bound *F* (see reference for details). Estimates of upper bound *F* ranged between 0.22 and 1.74 during 1978 to 2009 and averaged 0.75 per year.

Fishing mortality rates are difficult to estimate, especially when losses to the fishery are unknown. For example, reporting of discards and bycatch is not always required; if these quantities are significant and associated mortality is high, estimating *F* is made increasingly difficult. For blue crabs, the mortality associated with shedding operations may be substantial, with estimated losses of 10 to 30% daily (Chaves and Eggleston 2003).

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1.2.7 Food & Feeding Habits

Blue crabs consume a wide variety of food, fulfilling roles as predators and detritivores. They are large consumers of annelids, polychaetes, crustaceans, live or dead fish, and vegetation and feed heavily on oyster spat and juvenile clams (Williams 1984). They are also cannibalistic, and larger crabs are capable of exhibiting a check on population growth by consuming large amounts of small crabs and juveniles.

1.3 Habitat

1.3.1 Overview

The blue crab life cycle consists of an offshore phase and an estuarine phase and uses a wide range of habitats based on its life stage, sex, maturity, and associated salinity preferences. The blue crab is common to all North Carolina coastal waters.

1.3.2 Spawning Habitat

Blue crabs spawn weeks after mating in late spring to early fall (Whitaker 2006). After mating, inseminated female blue crabs migrate from their usual brackish areas to high-salinity waters near ocean inlets. Females rely on high-salinity cues to ensure eggs are released for their development on the continental shelf.

1.3.3 Nursery & Juvenile Habitat

The first larval stage (zoeae) is carried offshore by ocean currents (Costlow and Bookhout 1959; Costlow et al. 1959; Epifanio 1995). Zoeae larvae are restricted to high salinity areas because of their intolerance of low salinity water (Costlow and Bookhout 1959). Their intolerance of low salinity water continues into the megalopal stages, when they return to the estuary.

Once within the estuary, megalopae settle in beds of submerged aquatic vegetation and other complex habitats (i.e., salt marsh, detritus, and oyster shell) where they undergo further metamorphosis to become juveniles (Heck and Thoman 1981; Orth and van Montfrans 1987; Hill et al. 1989; Pardieck et al. 1999; Posey et al. 1999; Etherington and Eggleston 2000; Ruiz et al. 2003). Seagrass beds are an important nursery habitat that provide refuge from predators but are not available in all coastal waters of North Carolina to support juvenile blue crab development (Posey et al. 2005). Lower salinity regions in the river-dominated estuaries may provide important nursery areas for the blue crab population. After their metamorphosis, juveniles undergo a secondary migration to shallow, less-saline waters in the upper estuaries and rivers (Etherington and Eggleston 2000).

1.3.4 Adult Habitat

Adult blue crabs have differential habitat distribution by sex and salinity. Since females undergo a spawning migration and are observed migrating even when not gravid (Darnell et al. 2009), they are more likely to be found in higher-salinity waters near the oceanic inlets than in areas with relatively freshwater.

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1.3.5 Habitat Issues & Concerns

Blue crabs use five of the six habitats identified by the North Carolina Coastal Habitat Protection Plan including water column, wetlands, submerged aquatic vegetation, soft bottom, and shell bottom. These habitats may be impaired by physical degradation by dredges, watercraft, and fishing practices or through poor water quality caused by freshwater drainage, land use changes, eutrophication (excessive nutrients), high organic loading, and chemical pollution (Steele and Perry 1990). Sea level rise, subsidence, invasive species, storms, disease, and erosion are natural processes—perhaps exacerbated by human activities—but also responsible for loss of critical habitat.

Although indirect, blue crabs are affected by natural disturbances of their environment. In particular, tropical cyclones can affect crab harvest in the short term by concentrating crabs in areas where they are vulnerable to fishing gear (Eggleston et al. 2004). These effects can have long-term effects as well. Since the relocation of crabs induces a change in localized abundance, harvest could be affected. Not all the effects of tropical cyclones are detrimental. For example, peaks in post-larval blue crab settlement coincided with tropical cyclone tracks that came from a southwesterly direction (Eggleston et al. 2010). The massive ingress of post-larval crabs could make a significant contribution to the blue crab population. The caveat is that storm forces must be moderate. Excessive freshwater input can alter the salinity of large bodies of water, increasing megalopae and juvenile crab mortality, and thereby negating the benefits of increased settlement.

1.4 Description of Fisheries

1.4.1 Commercial Fishery

The blue crab resource supports North Carolina's most valuable commercial fishery. During 1950 through 2009, commercial landings of blue crabs have ranged from a low of 6.29 million pounds per year to a high of 67.1 million pounds per year (Figure 1.2). During the last decade (2000–2009), an average of 32.2 million pounds per year has been landed by the commercial fishery. The ex-vessel value of commercial blue crab landings was highest during 1994 through 2003, averaging 47.9 million dollars (2009 USD)[3] per year (Figure 1.3). Before 1994, the average ex-vessel value of North Carolina's commercial blue crab landings was 10.1 million dollars (2009 USD) per year (1950–1993 average). During 2004 through 2009, the ex-vessel value of commercial blue crab landings averaged 24.2 million dollars (2009 USD) per year.

Commercial fishermen have harvested blue crabs with a variety of different gears over time, including dredges, trotlines, pots, and trawls (Figure 1.4). The majority of blue crabs (81.5%) landed from 1950 to 2009 was harvested by pots. Pots have accounted for 96.8% of North Carolina's commercial blue crab landings during the last decade (2000–2009).

Peeler and soft crabs have been a relatively small portion of the commercial fishery for blue crabs, comprising less than 2% of the total blue crab landings reported from 1950 to 2009 (Figure 1.5). Peeler crabs are a value-added harvest that is captured via peeler pots

[3] All values converted to 2009 U.S. dollars (USD) based on the annual average consumer price index values (U.S. Bureau of Labor Statistics, pers. comm.)

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and trawling for hard crabs and shrimp, mainly during the spring, as well as peeler trawls that target the peeler crabs. The peelers are then held in shedding systems until they molt and are sold as soft crabs, either shipped live or cleaned and frozen. Despite being a small portion of the overall blue crab commercial fishery, the impact of the peeler crab fishery may be underestimated due to unreported mortality in the shedding operations.

The commercial fishery for blue crab primarily occurs during late spring through the fall (Figure 1.6). Reported landings are highest in July and August, and this pattern has persisted for at least the last three decades.

The number of commercial fishermen that have reported landings of blue crabs and the associated number of trips have generally decreased during 1994 through 2009 (Table 1.1). The number of commercial fishermen that have reported landings of blue crabs has ranged between 914 and 2,288 during that time period. The number of trips in which blue crabs were landed in North Carolina ranged from a low of 52.6 thousand and a high of 143 thousand over the same period.

1.4.2 Recreational Fishery

Recreational fishermen in North Carolina harvest blue crabs with a variety of gears, including pots (collapsible and rigid), gill nets, trawls, hand lines, and dip nets. A separate license category, the Recreational Commercial Gear License (RCGL), allows recreational fishermen to use limited amounts of certain commercial gear to harvest seafood for their personal consumption (see section 1.5.4.2, this report). Estimates of the RCGL blue crab harvest are available from NCDMF surveys conducted from 2002 to 2008. During 2002 through 2008, an estimated average of 26,402 RCGL recreational fishing trips per year was directed at blue crabs (Table 1.3). In that same time period, RCGL-licensed recreational fishermen harvested from 94.5 thousand pounds to 157 thousand pounds of blue crabs per year (Figure 1.7). In terms of number of blue crabs, recreational harvest by RCGL licensees has averaged 321 thousand blue crabs per year between 2002 and 2008 (Table 1.4). The amount of blue crabs discarded by recreational fishermen has been approximately half the recreational harvest during this time period.

1.5 Fisheries Management

1.5.1 Management Authority

The NCDMF is responsible for the management of estuarine and marine resources occurring in all state coastal fishing waters extending to three miles offshore.

1.5.2 Management Unit Definition

The management unit includes the blue crab and its fisheries in all of North Carolina's coastal fishing waters.

1.5.3 Regulatory History

1.5.3.1 Commercial Fishery

There are no federal or interstate FMPs that apply specifically to the blue crab fishery in North Carolina. In December 1998, a state FMP for blue crabs was approved for North Carolina. The Blue Crab FMP is reviewed and updated every five years. The most recent

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amendment was performed in 2004 (NCDMF 2004). Annual licenses are issued for commercial fishermen who harvest and sell fish, shrimp, or crab: the Standard Commercial Fishing License (SCFL) or a Retired Standard Commercial Fishing License. The number of SCFL licenses is currently capped at 8,896. A Commercial Fishing Vessel Registration is also required for fishermen who use boats to harvest seafood.

1.5.3.2 Recreational Fishery

Prior to 1999, no recreational fishing license was required unless a vessel was used. After July 1, 1999, the RCGL was required when using certain allowable commercial gear. No license is required for the following non-commercial equipment: collapsible crab traps, cast nets, dip nets, and seines less than 30 feet.

1.5.4 Current Regulations

In addition to the regulations described below, the 2004 amendment to the Blue Crab FMP adopted a spawning stock trigger to protect the blue crab spawning stock (NCDMF 2004). The trigger is based on data collected during September by Program 195 (see section 2.2.3, this report) and is defined as the sum of the carapace widths of mature female blue crabs divided by the total number of tows. The trigger is activated when this index falls below the lower 90% confidence limit of the reference baseline average for two consecutive years. In the 2004 amendment, the reference baseline was 1987 through 2003. The amendment states that the reference baseline will be updated every five years as part of the FMP review. However, if the trigger is active at the time of the review, the reference baseline update will be delayed until the trigger is no longer active.

When the trigger is activated, the NCDMF has the proclamation authority to implement spawning stock protection measures. These measures include a 6 ¾-inch maximum size limit on mature female blue crabs and a 5 ¼-inch maximum size limit on female peeler crabs from September through April for all fisheries. In addition, a culling tolerance of not more than five percent by number in any container shall be allowed in the commercial fisheries.

The spawning stock trigger has been activated every year since 2006, and the associated measures have been implemented.

1.5.4.1 Commercial Fishery

There is no regulatory season for harvesting crabs with the exception of a restriction on crab dredge usage from January 1 to March 1 and a cleanup period for lost and abandoned pots between January 15 and February 7.

Current commercial fishery regulations include a carapace width size limit of 5 inches for male and immature female hard blue crabs and a 10% tolerance based on the number of blue crabs in any container. Mature females, soft and peeler crabs, and male crabs for use as peeler bait are exempt from this size limit; however, a maximum size limit of 6 ¾-inch carapace width is currently in place for mature females. The maximum size limit is effective September through April when the trigger to protect blue crab spawning stock has been activated. If pots are used, they must contain two unobstructed escape rings no less than 2 5/16-inches in inside diameter. Peeler pots with a mesh size less than 1 ½ inches are exempt from the escape ring requirement. For trawls, a 4-inch stretch tailbag

mesh is required west of a line dividing Pamlico Sound down the middle and a 3-inch stretch tailbag mesh is required to the east of this line.

It is unlawful to use trawls, pots, and mechanical methods for oysters or clams or take blue crabs with the use of commercial fishing equipment from crab spawning sanctuaries from March 1 through August 31. During the remainder of the year the Director may, by proclamation, close these areas and may impose any or all of the following restrictions: number of days, areas, means and methods which may be employed in the taking, time period, and limit the quantity.

Detailed information regarding North Carolina's current commercial fishery regulations is available on the NCDMF website (http://portal.ncdenr.org/web/mf/home).

1.5.4.2 Recreational Fishery

Current regulations for recreationally-harvested blue crabs include a 5-inch minimum carapace width limit for males and immature females and a 6 ¾-inch maximum carapace width limit. The maximum size limit applies to mature females only and is effective September through April when the trigger to protect blue crab spawning stock has been activated. Otherwise, mature female crabs are exempt from the minimum size limit. A RCGL is required to use commercial gear to harvest finfish and crustaceans for personal consumption. Recreational crabbers are prohibited by law from selling their catch, even if in possession of a RCGL. A maximum of five pots of any type (peeler pots are disallowed) is allowed and must be fished at least every five days; pots cannot be fished at night. Pots must be removed from the water during January 15 through February 7. The current possession limit for the recreational fishery is 50 blue crabs per person per day not to exceed 100 blue crabs per vessel per day. One pot per person may be used to fish from privately owned land or a privately owned pier with no license. Detailed information regarding North Carolina's current recreational fishery regulations is available on the NCDMF website (http://portal.ncdenr.org/web/mf/home).

1.5.5 Management Performance

Since the adoption of the Blue Crab FMP in 1998, commercial landings of blue crabs have decreased (Table 1.2). Based on data collected from the NCDMF Trip Ticket Program (see section 2.1.1, this report), commercial landings of blue crabs during 1994 through 1997 averaged 55.8 million pounds per year. During 1998 through 2009, commercial fishermen landed an average of 36.8 million pounds of blue crabs per year. This decrease in commercial landings is due, at least partly, to the shutting down of crab processing plants, which reduced the amount of crabs that seafood dealers could move, thereby reducing demand and ultimately reducing harvest.

1.6 Assessment History

1.6.1 Review of Previous Methods & Results

The previous assessment of blue crab in North Carolina waters for management purposes was performed by Eggleston et al. (2004). The assessment applied surplus production modeling and catch-survey analysis to estimate population size and fishing mortality rates. Yield-per-recruit and spawning stock biomass-per-recruit analyses were used to

estimate appropriate reference points. The results of the assessment suggested that the stock was overfished and fishing mortality was at or higher than sustainable levels.

The primary author of the assessment (D. Eggleston, NCSU, pers. comm.) and the NCDMF (NCDMF 2004) expressed concerns about the reliability of the estimates of MSY, primarily due to data and modeling limitations. The NCDMF felt that the estimated MSY was not valid due to the following factors:

- Fishery-independent datasets do not allow tracking of the various life history stages and harvest data
- Harvest and fishery-independent data between and within areas are extremely variable, both, temporally and spatially
- Fishery-independent survey data from the Pamlico Sound complex may not be a reliable indicator of population trends in other coastal systems
- Environmental conditions appear to play a significant role in population variability

The results of the 2004 stock assessment were not used by management. Instead, management adopted a spawning stock trigger to protect the blue crab spawning stock (see section 1.5.4, this report). Additionally, the overfished definition for blue crabs in North Carolina was defined based on commercial landings trends. The blue crab resource is considered overfished when annual commercial landings decline for five consecutive years. There is currently no overfishing definition.

1.6.2 Previous Research Recommendations

The 2004 amendment to the Blue Crab FMP listed insufficient assessment data as one of the principal issues identified during the development of the amendment (NCDMF 2004). The 2004 amendment stated that "Necessary data needed to accurately assess the status of the blue crab stock are currently not available." The 2004 amendment went on to recommend that the North Carolina Marine Fisheries Commission and the NCDMF prioritize research needs and implement actions to accomplish the identified research and data needs. Neither of these recommendations has been addressed to date.

The research needs specific to the issue of insufficient assessment data listed in the 2004 amendment to the Blue Crab FMP (NCDMF 2004) were borrowed from a list of research needs identified at a November 2003 meeting of blue crab managers from the Atlantic coast (ASMFC 2004).

2 DATA

2.1 Fisheries-Dependent

2.1.1 Commercial Fishery Monitoring

Prior to 1978, North Carolina's commercial landings data were collected by the National Marine Fisheries Service (NMFS). In 1978, the NCDMF entered into a cooperative program with the NMFS to maintain and expand the monthly surveys of North Carolina's major commercial seafood dealers. Beginning in 1994, the NCDMF instituted a trip-ticket system to track commercial landings.

2.1.1.1 Survey Design & Methods

On January 1, 1994, the NCDMF initiated a Trip Ticket Program (TTP) to obtain more complete and accurate trip-level commercial landings statistics by fisheries managers (Lupton and Phalen 1996). Trip ticket forms are used by state-licensed fish dealers to document all transfers of fish sold from coastal waters from the fishermen to the dealer. The data reported on these forms include transaction date, area fished, gear used, and landed species as well as fishermen and dealer information.

The majority of trips reported to the NCDMF TTP only record one gear per trip; however, as many as three gears can be reported on a trip ticket and are entered by the program's data clerks in no particular order. When multiple gears are listed on a trip ticket, the first gear may not be the gear used to catch a specific species if multiple species were listed on the same ticket but caught with different gears. In 2004, electronic reporting of trip tickets became available to commercial dealers and made it possible to associate a specific gear for each species reported. This increased the accuracy of reporting by documenting the correct relationship between gear and species.

2.1.1.2 Sampling Intensity

North Carolina dealers are required to record the transaction at the time of the transactions and report trip-level data to NCDMF on a monthly basis.

2.1.1.3 Biological Sampling

Program 436 (P436) was initiated in April 1995 to collect fisheries-dependent data at fish houses from North Carolina's commercial blue crab fishery. Initially, sampling was limited to the northeast and Pamlico Sound regions of North Carolina. Statewide sampling was initiated in 1998. Subsamples of culled and unculled catches are taken and biological information is recorded. All blue crabs in a subsample are measured and sexed, and maturity of females is recorded. Program 436 only samples voluntarily cooperative fish houses, and sampling distribution may not reflect landing patterns.

2.1.1.4 Biases

Because trip tickets are only submitted when fish are transferred from fishermen to dealers, records of unsuccessful fishing trips are not available. As such, there is no direct information regarding trips where a species was targeted but not caught. Information on these unsuccessful trips is necessary for calculating a reliable index of relative abundance for use in stock assessments.

Another potential bias relates to the reporting of multiple gears on a single trip ticket. This bias is considered minimal for blue crab landings because the commercial blue crab fishery uses gears specific to crabbing (e.g., crab pots, crab trawls, trotlines). Therefore, it is often easy to identify the gear used to catch blue crabs on a trip ticket that lists multiple gears and species.

2.1.1.5 Development of Estimates

Total landings (pounds) of blue crabs were calculated by year and region for 1994 to 2009. Catch per unit effort (CPUE) was calculated using a simple ratio estimator in which the total pounds landed were divided by the number of pots fished. The number of

pots fished was not reported on trip tickets prior to 1996 and the numbers reported in that year are considered inaccurate[4]; therefore, commercial fishery CPUE was only calculated for 1997 through 2009. Only records in which crab or peeler pots were listed as the first gear on the trip ticket were used in the landings and CPUE calculations. Records of trips for which fewer than two pots were reported or for which no crabs were caught were excluded. Only records of trips by fishermen that have had at least 15 years of experience were included to provide a more stable index. A total of 220 fishermen met this criterion. The commercial landings and CPUE indices included all blue crab types (hard, soft, and peeler crabs) and were calculated by area.

The length-frequency distribution of blue crabs in North Carolina's commercial landings was calculated using the biological sampling data (Program 436). The length data were pooled over the available time series (1995–2009).

2.1.1.6 Estimates

Among the Albemarle, Pamlico, and Southern regions, the majority of blue crabs landed by commercial fishermen during 1997 through 2009 were harvested from the Pamlico region (Figure 2.1). Commercial landings of blue crabs harvested from the Albemarle region have been variable, and there has been a general increase since 2005. Commercial landings of blue crabs harvested from the Pamlico region generally decreased from 2003 to 2009. Commercial landings of blue crabs harvested from the Southern region slightly declined between 2006 and 2009.

Commercial fishery CPUE in all regions show little variation and no trend over the available time series (Figure 2.2). The CPUE indices ranged from a low of 0.332 pounds per pot to a high of 1.39 pounds per pot over all regions during the available time series. Commercial fishery CPUE index values were highest in the Southern region in almost all years. The Albemarle and Pamlico commercial CPUE indices had similar values through 2005; after 2005, commercial CPUE values in the Albemarle region were higher than in the Pamlico region.

Blue crabs sampled from North Carolina's commercial landings ranged from 31.0 mm carapace width to 232 mm carapace width during 1995 to 2009 and averaged 145 mm carapace width per year (Figure 2.3).

2.1.2 Recreational Fishery Monitoring

2.1.2.1 Survey Design & Methods

During 2001 through 2002, a telephone survey of RCGL holders was conducted to determine the 2001 recreational harvest of blue crabs (Nobles et al. 2002). Phone surveys of 388 RCGL holders were conducted between September 2001 and March 2002 to determine use of the RCGL, type of equipment, location of harvest, number of days harvesting, and daily and seasonal harvest estimates.

A mail survey of coastal and estuarine landowners was conducted in North Carolina between May 1, 2002 and April 30, 2003 (Vogelsong et al. 2003). The survey requested

[4] In the first year that required the reporting of the number of pots fished in the trip ticket program (1996), a number of old tickets that did not have a field for the number of pots fished were still in circulation

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information on property characteristics, crabbing effort, and harvest. A total of 382 surveys was returned.

The NCDMF conducted monthly surveys of RCGL holders from 2002 to 2008 to collect information on recreational fishing. Participants were randomly selected and were asked about the number of trips taken and the type and number of gears used during the survey month. Participants were also asked to provide estimates for the numbers and pounds of each species caught and retained as well as the numbers of each species discarded.

From 2007 to 2010, the NCDMF surveyed approximately 20% of Coastal Recreational Fishing License (CRFL) holders regarding their participation in saltwater fishing activities including gigging, use of a cast net, shellfish collection, and crabbing.

2.1.2.2 Biological Sampling

There are currently no programs that collect biological samples of blue crabs from North Carolina's recreational fishery.

2.1.2.3 Biases

The Nobles et al. (2002) survey and NCDMF survey of RCGL holders were limited to fishermen in possession of a RCGL, thereby omitting non-licensed recreational fishermen that harvested blue crabs. The NCDMF survey of CRFL holders also omitted non-licensed recreational fishermen that harvested blue crabs. Estimates of recreational harvest by non-licensed fishermen are unknown. While initiating an estuarine landowner survey filled some of this gap, including many recreational crabbers who are exempt from RCGL and CRFL licensing, it does not take into account harvest from renters or that of fishermen legally harvesting blue crabs without a license.

2.1.2.4 Development of Estimates

2.1.2.5 Estimates

Fifty percent of all blue crabs were harvested along the Intracoastal Waterway, between Pamlico Sound and the Cape Fear River (Nobles et al. 2002). The total estimated blue crab harvest from RCGL holders in 2001 was 118,051 pounds. In this survey, 23.5% of the surveyed RCGL holders indicated that they targeted blue crabs.

The NCDMF survey of RCGL holders estimated that RCGL licensees took an average of 26,402 blue crab directed trips per year between 2002 and 2008 (Table 1.3). During this time period, RCGL holders harvested an average of 116,797 pounds per year, which amounted to 20% of the total estimated RCGL harvest (Figure 1.7).

Estimated blue crab harvest by RCGL holders was less than 0.40% of total blue crab commercial landings for 2001 through 2008. While the harvest of exempted shore- and pier-based pots and other non-commercial gear are unknown, it is unlikely that recreational harvest of blue crabs is significant in North Carolina.

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2.2 Fisheries-Independent

2.2.1 Estuarine Trawl Survey (Program 120)

2.2.1.1 Survey Design & Methods

In 1971, the DMF initiated a statewide estuarine trawl survey, also known as Program 120 (P120). The initial objectives of the survey were to identify the primary nursery areas and produce annual recruitment indices for economically important species. Other objectives included monitoring species distribution by season and by area and providing data for evaluation of environmental impact projects.

The survey samples shallow-water areas south of the Albemarle Sound system (Figure 2.4). Major gear changes and standardization in sampling occurred in 1978 and 1989. In 1978, tow times were set at one minute during the daylight hours. In 1989, an analysis was conducted to determine a more efficient sampling time frame for developing juvenile abundance indices with acceptable precision levels for the target species. A fixed set of 105 core stations was identified and sampling was to be conducted in May and June only, except for July sampling for weakfish (dropped in 1998, Program 195 deemed adequate), and only the 10.5-ft headrope, ¼-inch bar mesh trawl would be used.

The current gear is a 3.2-m otter trawl with 6.4-mm bar mesh body netting of 210/6 size twine and a tailbag mesh of 3.2-mm Delta-style knotless nylon with a 150-mesh circumference and 450-mesh length. The gear is towed for one minute during daylight hours during similar tidal stages and covers 75 yards.

Environmental data are recorded, including temperature, salinity, dissolved oxygen, wind speed, and direction. Additional habitat fields were added in 2008.

2.2.1.2 Sampling Intensity

Prior to 1989, sampling was seasonal. From 1989 to 2003, a fixed set of 105 core stations was identified and sampling was conducted in May and June only. Since 2004, additional July sampling of a subset of the core stations has been conducted.

2.2.1.3 Biological Sampling

All blue crabs caught are counted. The catch of blue crabs is subsampled if there are more than 30 individuals that are less than 20 mm carapace width (CW). These crabs (<20 mm CW) are measured but not sexed. Larger blue crabs (>=20 mm CW) are sexed and measured.

2.2.1.4 Biases

Mature female blue crabs are present throughout the waterways of North Carolina. When it is time to spawn, mature females migrate to the oceanic inlets. Depending on the timing of sampling, the migration could artificially inflate the perceived abundance of mature females in Pamlico Sound by including transient, not resident, mature female crabs. Adult blue crabs are more commonly found in deeper water and are therefore less likely to be encountered by the gear in the locations sampled by Program 120.

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2.2.1.5 Development of Estimates

Spatially, Program 120 samples shallow-water areas in most of the estuarine areas in North Carolina. It almost completely omits Albemarle Sound, deeper areas of Pamlico Sound, and samples the sound side of the Outer Banks lightly. For this reason, data collected from locations in Albemarle Sound were not included in the development of estimates. Additionally, only data collected during May and June were used in the development of estimates.

Abundance: Annual indices of relative abundance were calculated for adults, recruits, and pre-recruits. Adult blue crabs were defined as blue crabs with a carapace width greater than or equal to 100 mm. Recruits were defined as blue crabs less than 100 mm and greater than or equal to 30.0 mm in carapace width. Pre-recruits were defined as blue crabs less than 30.0 mm in carapace width. The lengths used to define life stages were based on examination of length-frequency distributions. The majority of blue crabs collected in Pamlico Sound and Southern region areas are less than 100 mm in carapace width (Figures 2.5, 2.6). Adult and recruit indices were calculated separately for the Pamlico and Southern regions. The pre-recruit index was calculated based on data collected from all sites and is considered a statewide index. The indices were calculated as the geometric average number per tow.

Length: The annual median CW of all blue crabs caught was computed for 1981 through 2009 for the Pamlico and Southern regions.

2.2.1.6 Estimates

<u>Pamlico Region</u>

Recruit Abundance: Relative abundance of blue crab recruits in Pamlico Sound ranged from a low of 1.23 blue crabs per tow in 1978 to a high of 6.47 blue crabs per tow in 1996 over the survey time series (Figure 2.7). The recruit index has been variable over the time series and no overall trend is apparent.

Adult Abundance: Most adult index values during 1978 through 2009 were less than 1 crab per tow, suggesting that adult blue crabs have been encountered less frequently than recruits in the Pamlico Sound sampling area (Figure 2.8). Adult relative abundance ranged from a low of 0.300 blue crabs per tow in 1978 and a high of 1.01 blue crabs per tow in 1999 over the time series. Similar to the recruit index, the index of adult relative abundance varied without trend over the survey time series.

Length: The annual median CW of blue crabs in Pamlico Sound ranged from 23.0 mm to 55.0 mm over the survey time series and averaged 39.2 mm per year (Figure 2.9). Median CW has been variable among years and has shown an overall decrease over the survey time series.

<u>Southern Region</u>

Recruit Abundance: Recruit abundance ranged from a low of 0.175 blue crabs per tow to a high of 1.84 blue crabs per tow over the survey time series (Figure 2.10). The recruit index has been variable but exhibited an overall decline over the 1978 to 2009 time period.

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Adult Abundance: Adult abundance in the Southern region has been variable, ranging from a low of 0.0293 blue crabs per tow to a high of 0.335 blue crabs per tow over the survey time series (Figure 2.11). The adult index demonstrated an overall declining trend over time.

Length: The annual median CW of blue crabs in the Southern region has varied among years, ranging from 18.0 mm to 60.0 mm over the survey time series and averaging 32.9 mm per year (Figure 2.12).

Statewide

Pre-recruit abundance: Relative abundance of pre-recruits has been variable over the time series and no overall trend is apparent (Figure 2.13).

2.2.2 Juvenile Anadromous Trawl Survey (Program 100)

2.2.2.1 Survey Design & Methods

The NCDMF Juvenile Anadromous Trawl Survey, also known as Program 100 (P100), was initiated in 1982 and targets juvenile alosines and striped bass in Albemarle Sound (Figure 2.14). Since its inception, the survey has sampled seven stations (Hassler stations) in western Albemarle Sound. In July 1984, twelve sampling stations were added in the central Albemarle Sound area (Central stations) to monitor juvenile striped bass abundance and to determine if a shift in the striped bass nursery area had occurred.

The survey uses an 18-foot semi-balloon trawl with a body mesh size of 0.75 inch and a 0.25-mesh tailbag. Tow duration is 15 minutes at the Hassler stations and ten minutes at the Central stations. Temperature, salinity, and dissolved oxygen are recorded.

2.2.2.2 Sampling Intensity

Sampling is conducted bi-weekly from mid-July to October.

2.2.2.3 Biological Sampling

The catch of each tow is sorted by species, counted, and measured. The carapace width, sex, and maturity (if female) are recorded for blue crabs. Subsampling methods are used if the catch of blue crabs is excessive.

2.2.2.4 Biases

The Program 100 survey samples only a couple of deepwater areas in Albemarle Sound, and the sampling does not include many of the tributaries or parts of the sound east of the Alligator River. This gap in sampling potentially omits mature females on their spawning migration to the oceanic inlets. Also, the survey trawl cannot sample in shallow waters in Albemarle Sound because of the complex structure, primarily stumps, associated with the shoreline. This potentially omits capture of juvenile blue crabs using the complex, shallow-water habitat as refuge from predators.

2.2.2.5 Development of Estimates

Abundance: The length distribution of blue crabs sampled from Program 100 suggests both recruits and adults have been encountered and there has been no clear modal distinction (Figure 2.15). An index of relative abundance was calculated using all

available data and represents recruits and adults combined. The index was computed as the geometric average number per minute. Computing the index on a per minute basis was done to account for differences in sampling times between the Hassler and Central stations.

Length: The annual median CW of all blue crabs caught was computed for all survey years.

Spawning Stock: Since individual crab weights were not collected during sampling, the sum of the CWs of mature female crabs was used as a proxy for spawning stock biomass (also see section 1.5.4, this report). The spawning stock index was calculated as the sum of CWs per minute based on data collected during September and October. The frequency of occurrence of mature females was also computed and calculated as the proportion of tows in which mature female blue crabs were observed.

2.2.2.6 Estimates

Abundance: Relative abundance varied without trend throughout most of the survey time series (Figure 2.16). The index was less than 0.500 blue crabs per minute in all years through 2007. In 2008, relative abundance increased to 1.26 blue crabs per minute. The 2009 index was the largest for the survey time series at 1.28 blue crabs per minute.

Length: The annual median CW of blue crabs captured in Program 100 averaged 120 mm per year over the survey time series, ranging from 104 mm to 146 mm (Figure 2.17). Median CW was variable among years and no overall trend is apparent.

Spawning Stock: The spawning stock biomass index was at a stable, low level from the beginning of the survey through 1993 (Figure 2.18). Small peaks occurred in 1995, 1999, and 2002, but there is no overall trend. The largest index occurred in 2008 (153 mm/minute). The index decreased in 2009 (88.4 mm/minute) but was still the second largest value on record. The frequency of occurrence of mature females was variable from 1987 through 2004 (Figure 2.19). The frequency of occurrence of mature females generally increased from 2004 through 2009. The 2009 value was the largest observed for the time series.

2.2.3 Pamlico Sound Survey (Program 195)

2.2.3.1 Survey Design & Methods

The Pamlico Sound Survey, also known as Program 195 (P195), was instituted in March 1987 to provide a long-term, fishery-independent database for the waters of the Pamlico Sound, eastern Albemarle Sound, and the lower Neuse and Pamlico rivers. Data collected from the survey have been used to calculate juvenile abundance indices and estimate population parameters for interstate and statewide stock assessments of recreationally and commercially important fish stocks.

The survey samples 52 randomly selected stations based on a grid system (one-minute by one-minute grid system equivalent to one square nautical mile). Sampling is stratified by depth and geographic area. Shallow water is considered water between 6 to 12 feet in depth and deep water is considered water greater than 12 feet in depth. The seven designated strata are: Neuse River; Pamlico River; Pungo River; Pamlico Sound east of

Bluff Shoal, shallow and deep; and Pamlico Sound west of Bluff Shoal, shallow and deep. As of March 1989, the randomly selected stations have been optimally allocated among the strata based upon all the previous sampling in order to provide the most accurate abundance estimates (PSE < 20) for selected species. A minimum of three stations (replicates) are maintained in each strata. A minimum of 104 stations are sampled each year to ensure maximum areal coverage. Sampling now occurs only in the Pamlico Sound and associated rivers and bays (Figure 2.20).

Sampling is conducted aboard the RV *Carolina Coast*, equipped with double-rigged demersal mongoose trawls. The RV *Carolina Coast* is a 44-ft fiberglass hulled double-rigged trawler. The trawl consists of a body made of #9 twine with 47.6-mm stretch mesh, a codend of #30 twine with 38.1-mm stretch mesh, and a 3.05-m tailbag. A 36.6-m three-lead bridle is attached to each of a pair of wooden chain doors that measure 1.22 m by 0.0610 m and a tongue centered on the headrope. A 4.76-mm thick, 9.26-m tickler chain is connected to the door next to the 10.4-m footrope. Tow duration is 20 minutes at 2.5 knots.

2.2.3.2 Sampling Intensity

The sampling season has undergone some changes since the survey's inception. In 1988, the December leg of the cruise was partially extended into January 1989 because of scheduling conflicts and adverse weather conditions. Beginning in 1991, sampling has been performed over a two-week period, usually the second and third weeks of both June and September. In 1999, samples were collected during the month of July and the end of September and October because vessel repairs and hurricanes prevented following the normal schedule. In September 2003, Hurricane Isabel caused a delay and sampling was completed during two days in October.

2.2.3.3 Biological Sampling

All blue crabs are counted and the sum weight of the catch is recorded. Carapace width, sex, maturity stage, and sponge color are recorded for all mature female blue crabs and from all subsampled blue crabs.

Beginning in September 2002, catches of blue crabs that were too large to process efficiently in the field were set aside for processing later. Subsamples were taken if the amount of crabs in the catch consisted of about ¼ of a 50-lb orange basket or more. The subsampling process involved dumping the basket on the culling table and immediately dividing the sample into quarters. The carapace width and sex were recorded and the sum of the crab weights in the subsample was taken. The remaining crabs (the other three quarters) were counted and mature females segregated. The sum weight of mature females was recorded and the carapace width of mature females was taken.

In 2005, the subsampling protocol was modified for situations where the number of blue crabs caught exceeds 100 individuals. In this situation, all mature females are separated, counted, weighed, and measured. The sum weight of all remaining crabs (males and immature females) is recorded before being subdivided into quarters. One quarter of the sample is then processed, recording the same data that are recorded for samples with fewer than 100 crabs. This process is repeated if necessary until a minimum of 100 crabs are measured.

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2.2.3.4 Biases

One shortfall is that this survey, due to the vessel's size, cannot sample shallow water. The survey also cannot sample areas with complex benthic structure, like stumps or other submerged aquatic vegetation. These two limitations could omit important blue crab habitat.

Mature female blue crabs are present throughout the waterways of North Carolina. When it is time to spawn, mature females migrate to the oceanic inlets. Depending on the timing of sampling, the migration could artificially inflate the perceived abundance of mature females in Pamlico Sound by including transient, not resident, mature female crabs.

2.2.3.5 Development of Estimates

Abundance: The length distribution of blue crabs caught by Program 195 differs between fall and summer (Figure 2.21). Distinct modes for recruits and adults are evident in the fall length distribution. The summer length distribution suggests the majority of blue crabs encountered are recruits. Annual indices of relative adult abundance were calculated for the fall only and annual indices of relative recruit abundance were calculated using data collected during summer and fall sampling. Adult blue crabs were defined as blue crabs with a carapace width greater than or equal to 100 mm. Recruits were defined as blue crabs less than 100 mm in carapace width. The indices were calculated as the geometric average number per tow.

Length: The annual median CW of all blue crabs caught was computed for all survey years for fall and summer individually.

Spawning Stock: Since blue crabs grow discontinuously, there is a high amount of variation in weight associated with carapace width. Therefore, the sum of the CWs of mature female crabs was used as a proxy for spawning stock biomass. The spawning stock index was calculated as the sum of CWs per tow based on data collected in September. The frequency of occurrence of mature females was also computed and was calculated as the proportion of tows in which mature female blue crabs were observed.

2.2.3.6 Estimates

Recruit Abundance: The relative abundance of recruits in the fall and summer has varied and has shown a substantial decline over the survey time series (Figure 2.22). The fall recruit index ranged from a high of 8.24 blue crabs per tow in 1996 to a low of 0.505 blue crabs per tow in 2009 over the survey time period. The summer recruit index has ranged from a high of 75.3 blue crabs per tow in 1990 to a low of 2.37 blue crabs per tow in 2009 over the course of the survey.

Adult Abundance: Adult fall abundance was relatively higher in the earlier years (before 2000) of the survey time series relative to later years (Figure 2.23). The two largest index values were observed in 1996 (18.2 blue crabs per tow) and 1998 (11.3 blue crabs per tow). With the exception of the 2004 index value, the adult fall index values have all been less than 2.00 blue crabs per tow since 2000.

Length: The annual median CW of blue crabs has been variable but generally declining over the survey time series in both the fall and summer (Figure 2.24). Median CW in the fall ranged from 72.0 mm to 133 mm and averaged 109 mm per year over the time series.

In the summer, median CW ranged from 53.0 mm to 95.0 mm and averaged 72.6 mm per year over the time series.

Spawning Stock: The spawning stock index demonstrates a general decline over the time series with the exception of two substantial peaks that occurred in 1996 (3,788 mm/tow) and 2003 (2,124 mm/tow; Figure 2.25). The 2009 spawning stock index was 192 mm/tow. The frequency of occurrence of mature females has been variable and generally declining over the time series (Figure 2.26).

2.2.4 Striped Bass Independent Gill-Net Survey (Program 135)

2.2.4.1 Survey Design & Methods

In October 1990, the NCDMF initiated the Striped Bass Independent Gill-Net Survey, also known as Program 135 (P135). The survey was designed to monitor the striped bass population in the Albemarle Sound and Roanoke River.

The survey follows a random stratified design, stratified by geographic area. This survey divides the water bodies comprising the Albemarle region into six sample zones that are further subdivided into one-mile square quadrants with an average of 22 quadrants per zone (Figure 2.27). The survey gear is a multi-mesh monofilament gill net. Four gangs of twelve meshes (2½, 3, 3½, 4, 4½, 5, 5½, 6, 6½, 7, 8, 10 inch stretch) of gill nets are set in each quadrant by the fishing crew, one two-gang set is weighted to fish at the bottom (sink net), and the other is floating unless the area is unsuitable for gill net sampling (marked waterways and areas with excessive submerged obstructions). Alternate zones and quadrants are randomly selected in the event that the primary selection cannot be fished. A fishing day is defined as the two crews fishing the described full complement of nets for that segment for one day. One unit of effort is defined as each 40-yard net fished for 24 hours.

2.2.4.2 Sampling Intensity

The sampling year is divided into three segments: fall-winter, spring, and summer. Summer sampling was discontinued in 1993. The areas fished, sampling frequency, and sampling effort are altered seasonally to sample the various segments of the striped bass population.

2.2.4.3 Biological Sampling

All striped bass are measured and additional parameters are completed while other species collected are counted and subsampled for length, including blue crabs for carapace width.

2.2.4.4 Biases

Program 135 samples the mouths of the tributaries leading into Albemarle Sound and concentrates on the southern coast and western half of Albemarle Sound. It does not sample the middle of the sound or the nearshore portions in the northeast part of the sound. Since blue crabs typically stratify themselves, with larger crabs inhabiting deeper water than the smaller crabs, this sampling regime may omit the relatively large and the relatively small crabs in Albemarle Sound. Additionally, the mid-sound areas are

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classified as the deeper sections of the sound and therefore more likely to undergo hypoxic events than the relatively shallower areas.

Blue crabs are not typically vulnerable to gill nets, and captures are usually a result of getting tangled in the webbing or riding atop finfish that are captured in the netting and functioning as bait. Since the netting is standardized among study sites, the blue crabs that are captured by entanglement are likely to vary with abundance. Blue crabs are also likely to be attracted to the net as a source of food due to the finfish that are caught in the net. The amount of fish caught in the net and functioning as bait would not be similar among sampling sites and dates, introducing a covariate for abundance indices. Additionally, competition for this food source may induce some size selectivity as the larger crabs displace smaller ones.

2.2.4.5 Development of Estimates

An index of relative adult abundance was calculated using data collected from sink gill nets during November sampling. November data were used because November was the most consistently sampled month during the survey time series, and the highest catches of blue crabs have occurred in November. The majority of blue crabs encountered in Program 135 during November sampling have been adults (Figure 2.28). Blue crabs less than 100 mm CW were excluded in the calculation of the index of relative adult abundance. The index was calculated as the geometric average number per net gang.

2.2.4.6 Estimates

The Program 135 relative abundance index fluctuated without trend over the entire survey time series (Figure 2.29). Relative abundance of adults was lowest from 1999 to 2001. After 2000, the adult index demonstrates an overall increasing trend through 2008, when the largest index value was observed (6.26 blue crabs per net gang). In 2009, relative abundance declined to 4.37 blue crabs per net gang.

2.2.5 Fisheries-Independent Gill-Net Survey (Program 915)

2.2.5.1 Survey Design & Methods

The Fisheries-Independent Gill-Net Survey, also known as Program 915 (P915), began on March 1, 2001 and includes Hyde and Dare counties (Figure 2.30). In July 2003, sampling was expanded to include the Neuse, Pamlico, and Pungo rivers (Figures 2.31, Figure 2.32). Additional areas in the Southern District were added in April 2008.

Floating gill nets are used to sample shallow strata while sink gill nets are fished in deep strata. Each net gang consists of 30-yard segments of 3-, 3 ½-, 4-, 4 ½-, 5-, 5 ½-, 6-, and 6 ½-inch stretched mesh, for a total of 240 yards of nets combined. Catches from an array of gill nets comprise a single sample; two samples (one shallow, one deep)—totaling 480 yards of gill net—are completed each trip. Gill nets are typically deployed within an hour of sunset and fished the following morning. Efforts are made to keep all soak times within 12 hours. All gill nets are constructed with a hanging ratio of 2:1. Nets constructed for shallow strata have a vertical height between 6 and 7 feet. Prior to 2005, nets constructed for deep and shallow strata were made with the same configurations. Beginning in 2005, all deepwater nets were constructed with a vertical height of

approximately 10 feet. With this configuration, all gill nets were floating and fished the entire water column.

A stratified random sampling design is used, based on area and water depth. Each region is overlaid with a one-minute by one-minute grid system (equivalent to one square nautical mile) and delineated into shallow (≤6 feet) and deep (>6 feet) strata using bathymetric data from NOAA navigational charts and field observations. Beginning in 2005, deep sets have been made along the 6-ft contour. Sampling is divided into two regions: Region 1, which includes areas of eastern Pamlico Sound adjacent to the Outer Banks from southern Roanoke Island to the northern end of Portsmouth Island; and Region 2, which includes Hyde County bays from Stumpy Point Bay to Abel's Bay and adjacent areas of western Pamlico Sound (Figure 2.30). Each of the two regions is further segregated into four similar sized areas to ensure that samples are evenly distributed throughout each region. These are denoted by either Hyde or Dare and numbers 1 through 4. The Hyde areas are numbered south to north, while the Dare areas are numbered north to south. The rivers are divided into four areas in the Neuse River (Upper, Upper-Middle, Lower-Middle, and Lower; Figure 2.32), three areas in the Pamlico River (Upper, Middle, and Lower; Figure 2.31), and only one area for the Pungo River (Figure 2.31). The upper Neuse area was reduced to avoid damage to gear from obstructions, and the lower Neuse was expanded to increase coverage in the downstream area. The Pungo area was expanded to include a greater number of upstream sites where a more representative catch of striped bass may be acquired.

2.2.5.2 Sampling Intensity

Initially, sampling occurred during all 12 months of the year. In 2002, sampling during December 15 to February 14 was eliminated due to extremely low catches and unsafe working conditions. Each of the sampling areas within each region is sampled twice a month. Within a month, a total of 32 core samples are completed (eight areas × twice a month × two samples) in the river systems.

2.2.5.3 Biological Sampling

The total weight of all blue crabs caught is recorded and the number of individuals is counted. Carapace width, sex, maturity, and sponge color are recorded for each blue crab.

2.2.5.4 Biases

Blue crabs are not typically vulnerable to gill nets, and captures are usually a result of getting tangled in the webbing or riding atop finfish that are captured in the netting and functioning as bait. Since the netting is standardized among study sites, the blue crabs that are captured by entanglement are likely to vary with abundance. Blue crabs are also likely to be attracted to the net as a source of food due to the finfish that are caught in the net. The amount of fish caught in the net and functioning as bait would not be similar among sampling sites and dates, introducing a covariate for abundance indices. Additionally, competition for this food source may induce some size selectivity as the larger crabs displace smaller ones.

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2.2.5.5 Development of Estimates

Abundance: The majority of blue crabs encountered in Program 915 sampling have been adults (Figure 2.33). An index of relative adult abundance was calculated as the geometric average number per haul using all available data. Blue crabs less than 100 mm CW were excluded in the calculation of the index of relative adult abundance.

Length: The annual median CW of all blue crabs caught was computed for all survey years.

2.2.5.6 Estimates

Adult: Relative abundance of adult blue crabs ranged from a low 0.597 blue crabs per haul in 2007 to a high of 1.18 crabs per haul in 2003 between 2001 and 2009 (Figure 2.34). The index has varied with little trend over the short survey time series.

Length: The annual median CW of blue crabs observed in Program 915 averaged 133 mm per year over the time series (Figure 2.35). Median CW has shown a steady increase from the time series low observed in 2006 (126 mm) to the time series high observed in 2009 (145 mm).

2.3 Evaluation of Observed Data

2.3.1 Temporal Trends

The Mann-Kendall test was performed to evaluate trends in the computed indices. The Mann-Kendall test is a non-parametric test for monotonic trend in time-ordered data (Gilbert 1987). The test was applied to the indices of commercial fishery CPUE, relative abundance, spawning stock, median length, and L_{50} described in sections 2.1 and 2.2 of this report. Trends were considered statistically significant at $\alpha = 0.05$.

The Mann-Kendall test was applied to a total of twenty-six indices (Table 2.1). No trends were detected in twelve of the indices. Statistically significant increasing trends were detected in the index of total abundance derived from Program 100 (Figure 2.16), the spawning stock index derived from Program 100 (Figure 2.18), and the frequency of occurrence of mature females derived from Program 100 (Figure 2.19). Statistically significant decreasing trends were detected in eleven indices: Pamlico region commercial fishery CPUE (Figure 2.2); Program 120 recruit and adult indices for the Southern region (Figures 2.10, 2.11); Program 195 fall and summer recruit indices (Figure 2.22); Program 195 fall adult index (Figure 2.23) and spawning stock index (Figure 2.25); frequency of occurrence of mature females during the fall in Program 195 (Figure 2.26); Program 120 median length indices for the Pamlico and Southern regions (Figures 2.9, 2.12); and the Program 195 summer median length index (Figure 2.24).

2.3.2 Consistency of Trends

Commercial CPUE: The commercial CPUE indices among the three regions exhibited minimum variability over the time series (Figure 2.2). The commercial CPUE index for the Albemarle region varied slightly without trend over the time series. In the Southern region, commercial CPUE initially declined and showed no trend during the remainder of the time series. A statistically significant decreasing trend was detected in the Pamlico region commercial CPUE index (Table 2.1).

Recruits: The statewide pre-recruit abundance index derived from Program 120 varied without trend throughout the entire time period (Figure 2.13). The Program 120 recruit index for the Pamlico region also varied without trend over the time series (Figure 2.7). The indices of relative recruit abundance derived from Program 120 samples in the Southern region (Figure 2.10) and from the fall and summer components of the Program 195 survey (Figure 2.22) were variable but demonstrated a statistically significant decrease over time (Table 2.1).

Adults: The Program 120 relative index of adult abundance for the Southern region (Figure 2.11) and the Program 195 (Pamlico region) index of fall adult abundance (Figure 2.23) were both found to have significant declining trends during the survey time periods (Table 2.1). The Program 120 adult abundance index for the Pamlico region was variable and no obvious trend over the time series is evident (Figure 2.8). Most values for this index were less than 1.00 blue crabs per tow. The Program 100 (Albemarle region) relative index of total abundance was low and variable through 2004 and demonstrated a substantial increasing trend during the remainder of the time series (Figure 2.16). The results of the Mann-Kendall test indicated that the Program 100 index significantly increased over time. The Program 135 adult relative index showed a general increase during 2000 to 2009 (Figure 2.29). The adult index derived from Program 915 showed little trend over the short time series (Figure 2.34).

Length: Annual average carapace widths of blue crabs sampled from the Pamlico (Figure 2.9) and Southern (Figure 2.12) regions by Program 120 and sampled during the summer by Program 195 (Figure 2.24) showed statistically significant declines over time (Table 2.1). Blue crab annual average carapace widths derived from Program 100 (Figure 2.17) and fall sampling by Program 195 (Figure 2.24) varied without trend over time. The average carapace widths of blue crabs sampled by Program 915 increased during the last four years of the survey (2006–2009), but no significant trend over the time series was detected (Table 2.1).

Spawning Stock: Significant, opposing trends in spawning stock and frequency of occurrence of mature females were detected between the Albemarle and Pamlico regions. Both the spawning stock index (Figure 2.18) and frequency of occurrence of mature females (Figure 2.19) derived from Program 100 exhibited significant increases over time (Table 2.1). The Program 195 index of spawning stock (Figure 2.25) and frequency of occurrence of mature females (Figure 2.26) showed significant decreases over time (Table 2.1).

Overall: The majority of indices for the Pamlico and Southern regions exhibited significant decreasing trends. Albemarle indices had no trend or an increasing trend.

3 ASSESSMENT

3.1 Overview

3.1.1 Scope

The unit stock for the current assessment is considered all blue crabs occurring within North Carolina coastal fishing waters.

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3.1.2 Current vs. Previous Method

As part of the last FMP review and update, a catch-survey analysis was one of the methods applied to attempt to assess North Carolina's blue crab stock (Eggleston et al. 2004); however, the time series data were extremely variable, there was not much correspondence between the pre-recruits and full recruits, and the data showed a poor fit when compared to the predicted model results (J. Hightower, NCSU, pers. comm.). This previous assessment was included in the 2004 FMP update but was not used for management given its uncertainty (NCDMF 2004). Instead, management adopted a spawning stock trigger to protect the blue crab spawning stock (see section 1.5.4, this report).

The assessment working group considered applying a surplus production model and catch-survey analysis for the current assessment, but the working group concluded that the information needed to conduct a reliable assessment using these methods were limited or unavailable. Uncertainties include unclear boundaries of the unit stock, lack of discard data, limited estimates of recreational harvest, and lack of a reliable statewide index of abundance. Additional factors specifically limiting the use of a catch-survey analysis include highly variable estimates of natural mortality, differing size limits, high coefficients of variation in many indices, and no knowledge of an appropriate scaling factor to relate indices of pre-recruits to indices of full recruits.

Because blue crabs do not retain any hard parts throughout their life cycle (i.e., otoliths, scales, fin spines, or a permanent shell) that are traditionally used to age other finfish and shellfish, ageing blue crabs has been notoriously difficult, making it difficult to employ traditional age-based stock assessment models. Although ageing methodology has been developed using lipofuscin accumulation rates (Ju et al. 1999; Puckett et al. 2008), it has only been recently described and has not been applied to the North Carolina stock. In situations where ageing of an organism is not possible, length-based assessments are sometimes used as a proxy for age-based ones but are often not recommended for producing management advice. Hilborn and Walters (1992) state, "attempts to use length-based analysis to formulate management advice for species that do not exhibit unambiguous modes is misguided and fundamentally hopeless". Blue crabs do not exhibit distinctive modal patterns in length beyond age 0. The inability to adequately determine age and the lack of appropriate tagging data further limits the available assessment options.

North Carolina lacks the appropriate data and information to apply a relatively reliable traditional stock assessment model (e.g., surplus production, VPA, statistical catch at age) to the blue crab population. Although traditional models could be attempted, a large number of assumptions would be required and the results would likely be highly uncertain and ultimately unusable for management. Therefore, the working group decided it would be more appropriate to conduct an index-based assessment.

For the current assessment, the Traffic Light method was applied to synthesize a variety of information to provide a qualitative description of stock condition and propose an overfished definition for the blue crab stock.

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3.2 Traffic Light Method

3.2.1 Definition of Terms

Before the Traffic Light method is described, it may be helpful to define several terms associated with the method. The terms and definitions were modified following Halliday et al. (2001). An **indicator** is a measure of some attribute of the population and is often based on a time series of data. For example, an index of blue crab relative abundance (number per tow) derived from a fisheries-independent survey is an indicator of blue crab stock abundance. Multiple indicators may be available for a single attribute. A **characteristic** is an aggregate of indicators and is used in further analysis or decision making. Halliday et al. (2001) proposed the following system characteristics: Abundance, Production, Fishing Mortality, and Ecosystem/Environment. The process of **scaling** is the assignment of colors, or "traffic lights", to indicators to normalize them before integration. The use of colors is not required; numbers could also be used. In the current assessment, a three-color system is used. **Normalization** is the rescaling of data to a common scale. Here, indicators are normalized to a scale ranging from 0 to 1. Finally, **integration** is the combining of several indicators into a characteristic or into an overall summary indicator.

3.2.2 Description

The Traffic Light method was initially developed to reduce the reliance on data-intensive stock assessment models (Caddy 1999, 2002). Because of the lack of data manipulation necessary, the Traffic Light method can result in more timely fisheries management decisions. Another potential advantage is that fewer assumptions may be necessary for the Traffic Light method when compared to traditional stock assessment models, making them more useful. Additionally, attention can be focused on a variety of information, rather than just the most recent estimates of abundance and fishing mortality as is traditionally done.

The Traffic Light method involves evaluating qualitative and quantitative indicators that provide information on the status of the stock. Relevant information may include fishing mortality, biomass, recruitment, length and age at maturity, and spatial distribution (Halliday et al. 2001). The indicator value in each year is assigned a green, yellow, or red 'signal' based on the state of the indicator as it relates to stock status. Typically the color green is indicative of a positive stock condition, yellow is indicative of an uncertain or transitioning stock condition, and red is indicative of a negative stock condition. Similar indicators are aggregated into characteristics. Characteristics can be further aggregated into a single Traffic Light that represents the overall condition of the stock. The main assumptions of the Traffic Light method are that the indicators reflect the characteristic to which they are assigned and that the characteristics adequately reflect the feature of the stock they are meant to represent.

The resulting set or sets of Traffic Light scores can serve as a stock status index (e.g., Koeller et al. 2000; Ceriola et al. 2007) or provide the basis for a precautionary management framework (e.g., Caddy 2004). It is important to note that management responses to Traffic Light scores should be determined *a priori*.

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3.2.3 Dimensions

The assessment working group decided that the indicators selected for use in the Traffic Light method should cover the same time period in order to avoid the currently controversial issue of combining indicators of different time series length (Halliday et al. 2001). The longest time series of fisheries-independent blue crab data were available from a single survey—Program 120 (1978–2009). The working group was not comfortable relying on a single survey for characterizing the blue crab stock. The next longest time series that could be used was 1987 through 2009. Selection of this time series allowed incorporation of data from a variety of fisheries-independent surveys[5] including Program 120, Program 100, Program 195, and Program 135; however, the earliest year for which fisheries-dependent data are considered reliable is 1994. Further restricting the time series to the 1994 through 2009 period would result in eliminating much of the contrast exhibited by the fisheries-independent surveys. The working group felt the contrast shown in the fisheries-independent surveys provided valuable information and selected the years 1987 through 2009 as the time period for the stock assessment.

Most of the indices considered for use in the Traffic Light were considered to represent one of three regions: Albemarle, Pamlico, or Southern (Figure 3.1). The relative index of pre-recruit abundance derived from Program 120 and the annual estimates of L_{50} for female blue crabs were considered statewide indices. Indices selected for use as indicators were weighted in the integration process (see section 3.2.6, this report) based on regional weights. Regions were weighted based upon the percentage of water surface area within a region relative to all other regions. The regional weights were: Albemarle 27.1%, Pamlico 66.1%, and Southern 6.83%. Statewide indicators were given full (100%) weight.

3.2.4 Indicators

The available data were reviewed to identify appropriate indicators for describing the characteristics of abundance and production. Two abundance characteristics were used—adult and recruit. Abundance indicators characterize the size of the population providing the production, while production indicators reflect the status of the population with respect to growth, survival, maturity, and spawning potential (Halliday et al. 2001).

Four indicators of adult abundance, four indicators of recruit abundance, and eleven indicators of production were selected (Table 3.1). Relative indices of abundance were selected as indicators for adult and recruit abundance. The production indicators include measures of median length (CW), pre-recruit abundance, length at 50% maturity, spawning stock, and frequency of occurrence of mature females.

3.2.5 Scaling

The process of scaling in the Traffic Light context is the assignment of colors to indicators to normalize them to a common scale before integration (Halliday et al. 2001). The Fuzzy Set method of scaling was selected since it allows the representation of

[5] Biological data collected from Program 436 (fisheries-dependent commercial sampling) were included in the estimates of annual lengths at 50% maturity for female blue crabs (see section 1.2.5, this report)

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uncertainty in indicator values and provides a method for expressing conflicting evidence. The Fuzzy Set method also provides an established mathematical method for developing decision rules.

A brief introduction to the Strict scaling method, one of the simplest scaling methods, is provided to facilitate understanding of the Fuzzy Set approach. In the Strict Traffic Light approach, individual indicator values are associated with a single color category. The assignment of color is sensitive to the choice of color boundaries. For example, consider an indicator based on the relative index of adult abundance for the Pamlico region derived from Program 120. Figure 3.2 depicts this indicator using the Strict scaling method in which the boundaries between colors are defined by the upper and lower 95% confidence limits of the time-series average. Indicator values greater than the upper 95% confidence limit are assigned the color green. Indicator values less than the lower 95% confidence limit are assigned the color red. Indicator values that fall between the upper and lower 95% confidence limits are assigned the color yellow.

The sharp transition between colors can result in a loss of information in the integration process. For example, the 1988 indicator value of the Program 120 adult index for the Pamlico region is yellow but near the lower 95% confidence limit (Figure 3.2). The 2002 value is also yellow but close to the upper 95% confidence limit. In the integration process, both of these indicator values would be given equal weight; however, one may be interested in differentiating between a yellow value nearing red and a yellow value nearing green. The Fuzzy Set method provides such an approach by introducing transition zone between colors, allowing indicator values to be associated with more than one color category. The representation of uncertainty with this method is straightforward and the gradual change between colors can improve resolution.

In the current assessment, the transition zones between colors were based on the statistical properties of individual time series. A three-color system was used. For each indicator, the average and upper and lower 95% confidence limits defined the proportion of each color assigned, normalized to a scale of 0 to 1 (Figure 3.3). In this approach, the color boundaries restrict the color assignment within an individual indicator value to a maximum of two co-occurring colors. Continuing with the earlier example, the average and 95% confidence limits of the Pamlico region adult index derived from Program 120 were computed to determine the transition zones for scaling by the Fuzzy Set method (Figure 3.4). The average of the annual values for this index was 0.622 blue crabs per tow. The upper 95% confidence limit was 0.711 blue crabs per tow and the lower 95% confidence limit was 0.533 blue crabs per tow. Consider the 2002 index value, which was 0.690 blue crabs per tow. A vertical black line was drawn in Figure 3.4 where the 2002 value falls on the x-axis. Where the black line intersects with the green and yellow lines indicates the proportion of each of those colors assigned to the 2002 indicator value. In this example, the 2002 indicator is 38% green and 62% yellow.

3.2.6 Integration

Within the Traffic Light context, integration is the combining of indicators into a characteristic or to provide an overall summary index. In the current assessment, indicators were integrated into one of three characteristics: adult abundance, recruit abundance, and production. When individual indicators are integrated to represent a

characteristic, the indicators can be combined by a simple integration of colors because all the indicators within a characteristic are assumed to represent the same thing. Using the Fuzzy Set approach, the simplest method of integration is to sum the proportions of assigned colors over the individual integrators for each year and rescale to 1. Note that, following integration, an individual characteristic value can include up to three colors, the sum of the proportions adding to 1. In the current assessment, indicators were weighted before integration based upon the relative percentage of water surface area within the region represented by the indicator (see section 3.2.3, this report). Statewide indicators were given full (100%) weight. If multiple indicators within a characteristic represented the same region, the spatial weighting was divided by the number of indicators representing a particular region.

The assessment working group also decided to apply additional weighting to the indices of adult abundance for the Pamlico and Southern regions derived from Program 120. The length distribution of blue crabs encountered in the Pamlico (Figure 2.5) and Southern (Figure 2.6) regions suggests adults are encountered much less frequently than recruits. The working group decided to give less weight to these indices and, in addition to the spatial weighting, the weight of both of these indices was reduced by one-third based on the limited availability of adults in the areas sampled by this program.

3.2.7 Results & Discussion

The results of integration of the indicators into the characteristics of adult abundance, recruit abundance, and production provide an overall summary of trends across the state. The Traffic Light series for adult abundance suggests conflicting trends in the indicators during the late 1980s through the mid-1990s (Figure 3.5). During the mid- to late 1990s, the adult abundance Traffic Light was indicative of mostly positive trends; however, the majority of Traffic Lights for adult abundance from 2000 to 2009 were red. The recruit abundance Traffic Light series during 2000 through 2009 exhibited a pattern similar to the one demonstrated by adult abundance over that time period (Figure 3.6). The Traffic Light for recruit abundance showed no obvious patterns before 2000. The production Traffic Light in 2000 was largely red (Figure 3.7). Since 2000, the degree of red has decreased while the degree of green has increased. Prior to 2000, the Traffic Light series for production demonstrated nearly equal amounts of green and yellow; red was present to a slightly lesser degree.

The Traffic Light analysis indicated that adult and recruit abundance levels were higher overall before 2000 (Figure 3.8). There is some suggestion of negative trends in recent years, especially in recruit abundance. Production has been variable, but the Traffic Light gives evidence of increasingly positive trends in recent years.

3.3 Management Implementation

The intent of NCDMF stock assessments is to provide a valid scientific basis for management. The assessments are not intended to provide specific management advice. This separation of management and science is made to ensure the science is unbiased. Limited applications of the Traffic Light method to fisheries management currently exist (e.g., Koeller et al. 2000; Ceriola et al. 2007; GADNR 2008), and this is the first time the NCDMF has considered the method for resource management. For the current

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assessment, the working group felt it would be beneficial to provide managers with an example of how the results of the Traffic Light method could be used for management. The management implementation scenario given below is strictly an example and should not be considered a recommendation for specific management. The actual and specific implementation of the Traffic Light method should occur through the NCDMF's normal development process (e.g., Rule Changes, Proclamations, and Supplements).

The Traffic Light method was originally envisioned as an approach for developing limit reference points based on life history characteristics measured by multiple indicators (Caddy 1999). Limit reference points differ from target reference points in that they define an undesirable condition for the stock—a situation management would want to avoid. In contrast, a target reference point represents a desirable condition and management actions are implemented in an attempt to achieve the defined target. It is clear that the implementation of limit reference points provides for a more precautionary management framework.

The results of the Traffic Light could be applied to the North Carolina blue crab stock in the precautionary context; that is, the results could be used to define conditions that are considered undesirable and to identify situations when management action should be considered and implemented. As an example, the amount of red exhibited by a characteristic for three consecutive years could serve as the trigger for management. The proportion of red that a characteristic can exhibit ranges from 0 to 1. This range can be divided in quartiles for which different management strategies can be associated. That is, if a characteristic falls within a particular quartile for three years in a row, the management strategy associated with the given quartile for that characteristic should be pursued.

The assessment working group developed some example management strategies for the adult abundance, recruit abundance, and production characteristics based on the three-year quartile approach. If the proportion of red in the Traffic Light for any of the characteristics is less than the first (<0.25) or second (<0.50) quartile for three consecutive years, no management action may be necessary (i.e., status quo). If the proportion of red exhibited is greater than or equal to the second (>=0.50) quartile and less than the third quartile (<0.75), one or more of several moderate management actions could be taken, depending on the characteristic. For example, moderate management actions for the adult abundance characteristic might include reductions in adult harvest, season or area closures, an increase in minimum size limits, implementation of a maximum size limit, and gear restrictions. Moderate management actions associated with the recruit abundance characteristic might include reductions in recruit harvest, an increase in minimum size limits, restriction of gear that catches a large proportion of juvenile blue crabs, reduction of blue crab bycatch in other fisheries, and reduction in tolerance of sub-legal size blue crabs. The moderate management actions for the production characteristic might include reduction of bycatch of mature female blue crabs in the crab and other fisheries, gear modifications, and implementation of sizes limits on the harvest of mature female blue crabs. Finally, if the proportion of red in the Traffic Light for any of the characteristics is greater than or equal to the third quartile (>=0.75), then strict management measures could be implemented. For example, strict management actions for the adult abundance characteristic might include control of fishing effort

directed at adult blue crabs, area closures, and closure of the fishery. Strict management actions for the recruit abundance characteristic might include an increase in the minimum size of cull rings, area closures, and closure of the fishery. Strict management measures associated with the production characteristic might include limits on the harvest of sponge crabs, limits or elimination of the harvest of mature female blue crabs, season or area closures, and limits in the peeler pot fishery.

The management strategy described above is provided strictly as an example implementation of the Traffic Light method for management and should be used as a starting point for discussion.

4 STATUS DETERMINATION

The General Statutes of North Carolina define overfished as "the condition of a fishery that occurs when the spawning stock biomass of the fishery is below the level that is adequate for the recruitment class of a fishery to replace the spawning class of the fishery" (NCGS § 113-129). The General Statues define overfishing as "fishing that causes a level of mortality that prevents a fishery from producing a sustainable harvest."

The 2004 FMP for blue crab defined the overfished condition for the blue crab stock based on commercial landings trends (NCDMF 2004). The blue crab resource is considered overfished when annual commercial landings decline for five consecutive years. No overfishing definition was developed.

An overfishing definition and status relative to overfishing cannot be determined at this time because available data are considered insufficient for estimating reliable fishing mortality rates. Therefore, the current assessment considers the status of the North Carolina blue crab stock relative to overfishing as unknown.

The current assessment recommends defining the overfished condition based on the blue crab production Traffic Light such that when the proportion of red for the production Traffic Light is greater than or equal to the third quartile (>=0.75) for three consecutive years, the blue crab stock is considered overfished. Based on this definition, the results of this assessment suggest the North Carolina blue crab stock is currently not overfished.

Though the recommended overfished definition is based only on the production Traffic Light, the working group recommends evaluating the adult and recruit Traffic Lights for warning signs that the stock may be approaching an undesirable state. If a series of negative trends is evident in the adult and recruit Traffic Lights, managers and fishermen may want to consider implementation of actions to prevent the stock from becoming overfished.

5 SUITABILITY FOR MANAGEMENT

<summary of external peer review comments; will be developed following external peer review>

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6 RESEARCH RECOMMENDATIONS

One of the principal issues identified in the 2004 amendment to the Blue Crab FMP was the lack of sufficient data to accurately assess the status of the blue crab stock. To address this deficiency, the following recommendations for research and monitoring are offered:

- Continue existing programs that have been used to monitor North Carolina's blue crab stock in order to maintain baseline data
- Conduct a study of the selectivity of the gear used in the Juvenile Anadromous Trawl Survey (Program 100) to evaluate the size at which blue crabs are fully-selected to the survey gear; the results of such a study could help determine whether the survey data could be used to develop a reliable index of blue crab recruitment for the Albemarle region; no such index is currently available
- Expand spatial coverage of the Estuarine Trawl Survey (Program 120) to include shallow-water habitat in Albemarle Sound; sampling in shallow-water habitat is intended to target juvenile blue crabs so that a recruitment index for the Albemarle Sound could be developed
- Expand temporal coverage of the Estuarine Trawl Survey (Program 120) beyond May and June sampling; additional sampling later in the blue crab's growing season would provide more information on within-year changes in growth, mortality, and abundance; at a minimum, recommend addition of September sampling in order to capture the fall settlement peak
- Expand spatial coverage of Pamlico Sound Survey (Program 195) to include deepwater habitat in Albemarle Sound and the Southern Region; expanding the sampling region of adult blue crab habitat would allow for a more spatially-comprehensive adult index; additionally, there would be increased confidence in comparison of adult abundance trends among regions since all would derive from the same sampling methodology
- Implement a statewide survey with the primary goal of monitoring the abundance of blue crabs in the entire state; such a survey would need to be stratified by water depth to ensure capture of all stages of the blue crabs life cycle and standardized among North Carolina waters
- Implementing monitoring of megalopal settlement near the ocean inlets could potentially add a predictive function to the blue crab stock assessments in the future; Forward et al. (2004) detected a positive, linear relationship between megalopal abundance and commercial landings of hard blue crabs for both the local estuarine area and the entire state of North Carolina when a two-year time lag was implemented (Forward et al. 2004); such monitoring is critical to track larval ingress peaks and the effect of natural forces, such as tropical storms and prevailing winds, on ingress
- Continue surveys of recreational harvest and effort to improve characterization of the recreational fishery for blue crabs
- Identify programs outside the NCDMF that collect data of potential use to the stock assessment of North Carolina's blue crabs

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- Perform in-depth analysis of available data; consider standardization techniques to account for year and other effects in development of indices; explore utility of spatial analysis in assessing the blue crab stock
- Investigate assessment methods that can account for environmental factors that significantly impact the blue crab stock

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8 TABLES

Table 1.1. Number of fishermen (excluding crew) that reported landings of blue crabs in North Carolina, associated number of trips, average crew size, and estimated total number of participants (fishermen + crew), 1994–2009.

Year	Number Fishermen	Number Trips	Average Crew Size	Total Participants
1994	2,060	121,833		
1995	2,211	125,974		
1996	2,288	123,900		
1997	2,284	132,493		
1998	2,004	143,063		
1999	1,919	124,378	1.42	2,718
2000	1,756	111,221	1.40	2,463
2001	1,787	113,572	1.42	2,535
2002	1,681	93,620	1.48	2,483
2003	1,578	91,730	1.45	2,289
2004	1,489	80,828	1.47	2,182
2005	1,216	64,029	1.43	1,744
2006	1,010	52,886	1.43	1,442
2007	952	53,833	1.46	1,388
2008	914	52,641	1.53	1,402
2009	990	59,072	1.60	1,582

Table 1.2. Annual commercial fishery landings of blue crabs in North Carolina since the adoption of the Blue Crab Fishery Management Plan in 1998, 1998–2009.

Year	Pounds
1998	62,076,170
1999	57,546,676
2000	40,638,384
2001	32,180,390
2002	37,736,319
2003	42,769,797
2004	34,130,608
2005	25,430,119
2006	25,343,159
2007	21,424,960
2008	32,916,691
2009	29,707,232

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Table 1.3. Estimated number of blue crab directed fishing trips compared to estimated total number of fishing trips, taken by RCGL license holders in North Carolina, 2002–2008.

Year	Number of Trips		Percent of total trips
	Total	Directed	
2002	80,159	28,324	35%
2003	55,787	27,907	50%
2004	53,488	28,021	52%
2005	47,120	26,278	56%
2006	43,384	24,401	56%
2007	41,617	25,153	60%
2008	40,556	24,732	61%

Table 1.4. Estimated number of blue crabs harvested and discarded by RCGL license holders in North Carolina, 2002–2008.

Year	Harvest	Discards
2002	346,550	185,939
2003	354,425	124,196
2004	329,478	138,316
2005	323,531	152,905
2006	297,875	123,787
2007	286,856	102,695
2008	311,690	132,519

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Table 2.1. Results of Mann-Kendall trend analyses applied to the full time period for each index. *P*-value is the one-tailed probability for the trend test. Type indicates whether the program is fisheries-dependent (FD) or fisheries-independent (FI). Trend indicates the direction of the trend if a statistically significant temporal trend was detected (two-tailed test: *P*-value < $\alpha/2$; $\alpha = 0.05$); NS = not significant.

Index	Life Stage	Program	Type	Available Years	*P*-value	Trend
Catch per effort (lb/pot)	All	TTP (Albemarle)	FD	1997–2009	0.335	NS
		TTP (Pamlico)	FD	1997–2009	0.0120	↓
		TTP (Southern)	FD	1997–2009	0.0384	NS
Relative abundance	Pre-recruits	P120 (Statewide)	FI	1978–2009	0.0414	NS
	Recruits	P120 (Pamlico)	FI	1978–2009	0.253	NS
		P120 (Southern)	FI	1978–2009	*P* < 0.001	↓
		P195 (fall)	FI	1987–2009	*P* < 0.001	↓
		P195 (summer)	FI	1987–2009	0.0224	↓
		P915	FI	2001–2009	0.126	NS
	Adults	P120 (Pamlico)	FI	1978–2009	0.253	NS
		P120 (Southern)	FI	1978–2009	*P* < 0.001	↓
		P195 (fall)	FI	1987–2009	0.00109	↓
		P135	FI	1991–2009	0.0918	NS
		P915	FI	2001–2009	0.301	NS
	All	P100	FI	1987–2009	0.0101	↑
Spawning stock	Mature Females	P100	FI	1987–2009	0.00325	↑
		P195	FI	1987–2009	0.00155	↓
Frequency of Occurrence	Mature Females	P100	FI	1987–2009	0.00153	↑
		P195 (fall)	FI	1987–2009	*P* < 0.001	↓
Median length	All	P120 (Pamlico)	FI	1981–2009	0.0155	↓
		P120 (Southern)	FI	1981–2009	0.00301	↓
		P100	FI	1987–2009	0.317	NS
		P195 (fall)	FI	1987–2009	0.500	NS
		P195 (summer)	FI	1987–2009	0.00166	↓
		P915	FI	2001–2009	0.0877	NS
Length at 50% maturity	Females	P436, P120, P100, and P195	FI	1987–2009	0.437	NS

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Table 3.1. Summary of indicators included in the Traffic Light for North Carolina blue crabs, grouped by stock characteristic.

Characteristic	**Indicator**
Adult Abundance	Total Abundance (Albemarle, P100)
	Adult Abundance (Pamlico, P120)
	Adult Abundance (Pamlico, P195, Fall)
	Adult Abundance (Southern, P120)
Recruit Abundance	Recruit Abundance (Pamlico, P120)
	Recruit Abundance (Pamlico, P195, Fall)
	Recruit Abundance (Pamlico, P195, Summer)
	Recruit Abundance (Southern, P120)
Production	Median CW (Albemarle, P100)
	Spawning Stock (Albemarle, P100)
	Freq. Mature Females (Albemarle, P100)
	Median CW (Pamlico, P120)
	Median CW (Pamlico, P195, Fall)
	Median CW (Pamlico, P195, Summer)
	Spawning Stock (Pamlico, P195)
	Freq. Mature Females (Pamlico, P195)
	Median CW (Southern, P120)
	Pre-Recruit Abundance (Statewide, P120)
	Length @ 50% Maturity (Statewide, various)

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9 FIGURES

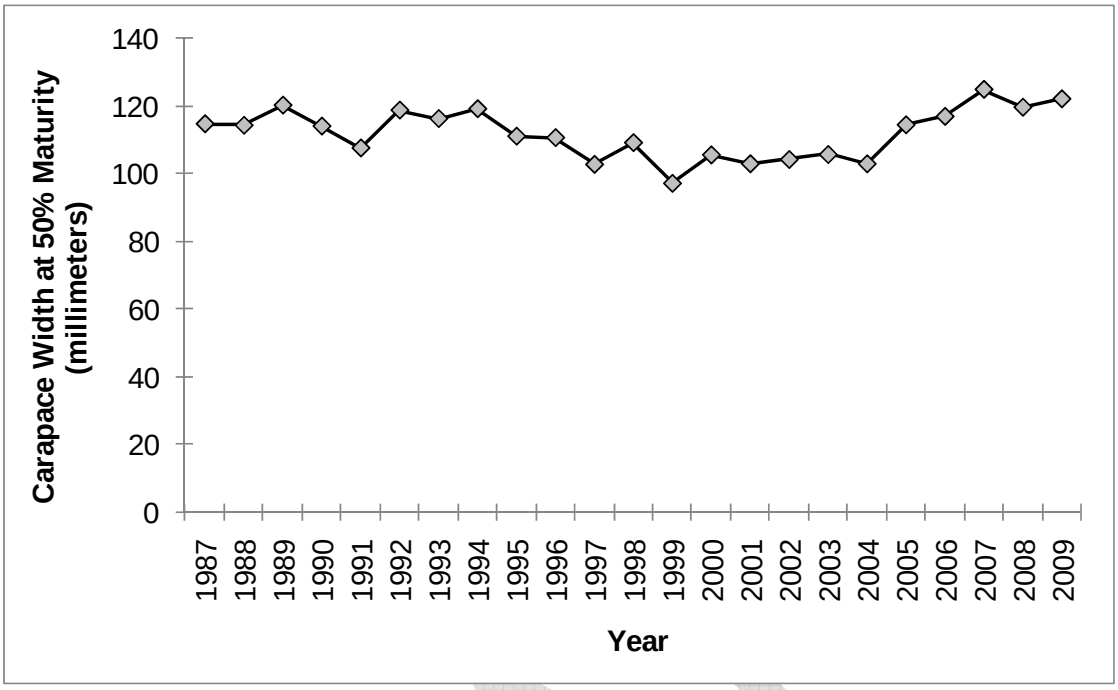

Figure 1.1. Annual carapace width at 50% maturity for blue crabs collected in multiple NCDMF sampling programs (100, 120, 195, 436 and 915) in North Carolina water bodies, 1987–2009.

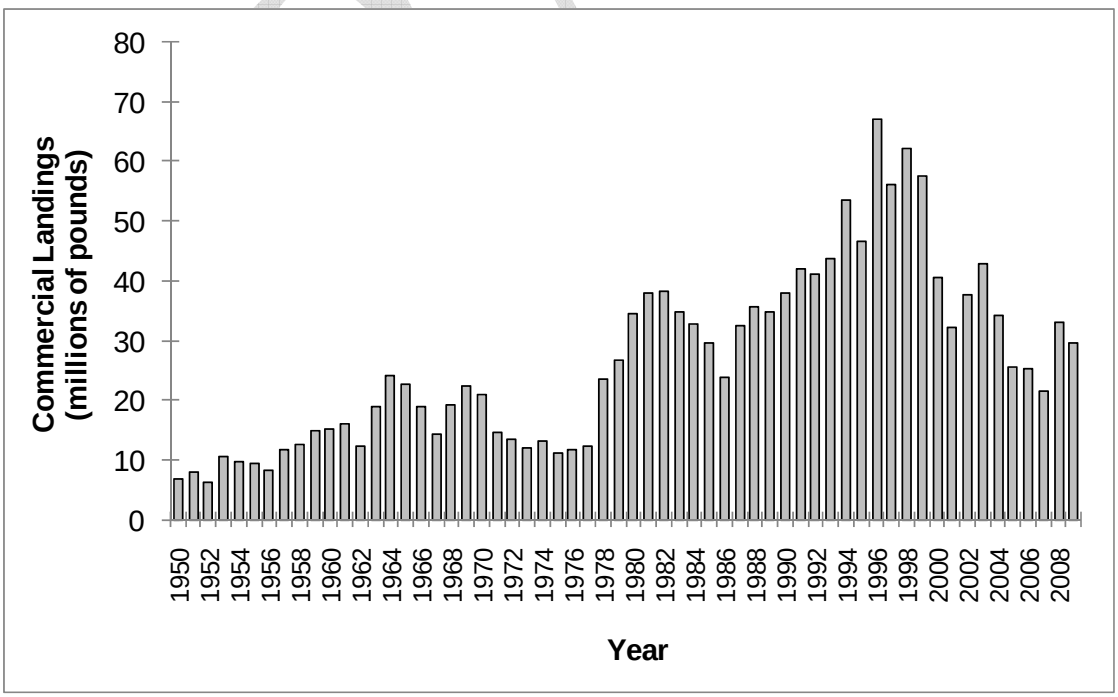

Figure 1.2. Annual commercial fishery landings of blue crabs in North Carolina, 1950–2009.

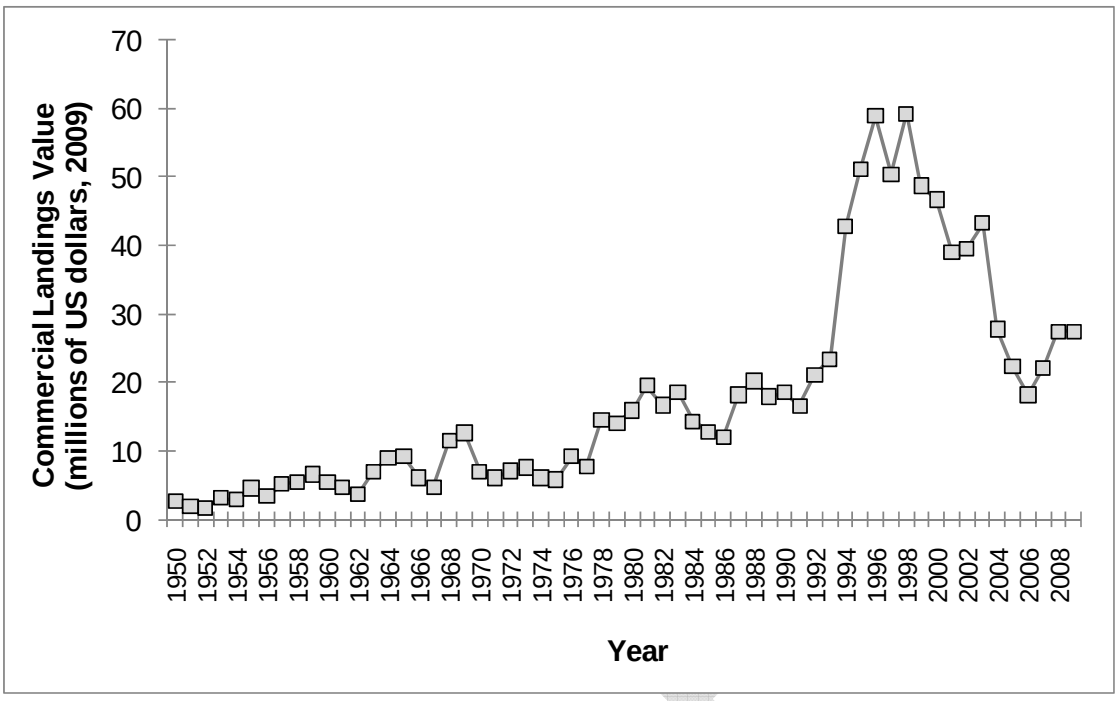

Figure 1.3. Annual ex-vessel values of North Carolina's commercial fishery blue crab landings, 1950–2009. Note that historical values were converted to 2009 dollars.

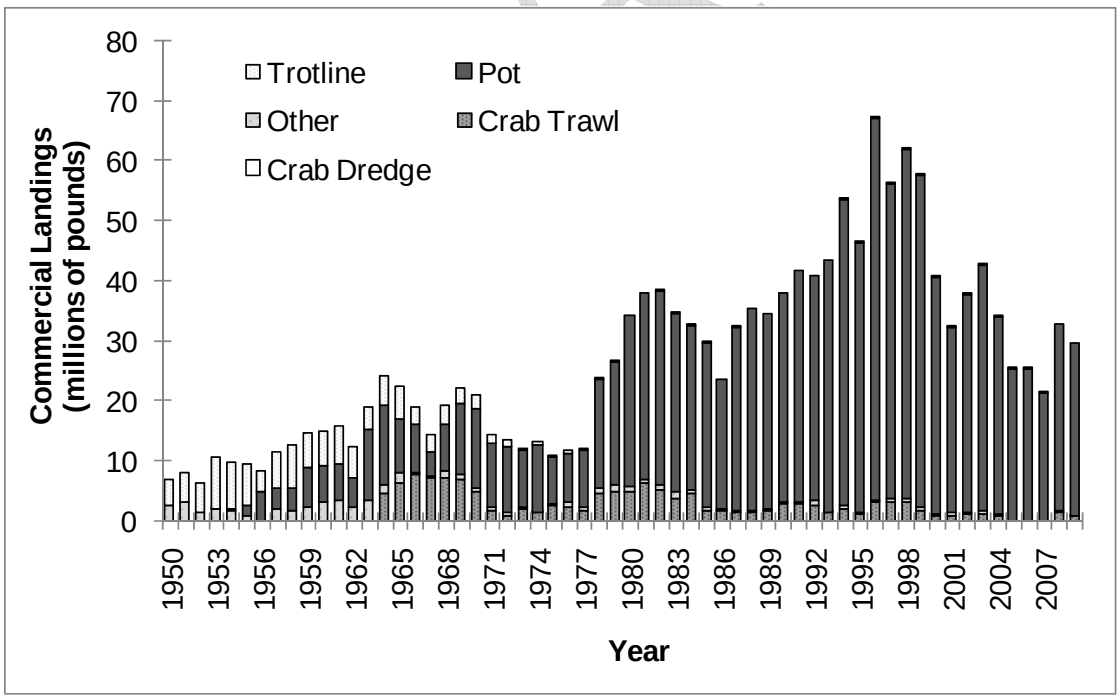

Figure 1.4. Annual commercial fishery landings of blue crabs in North Carolina, by major gear, 1950–2009.

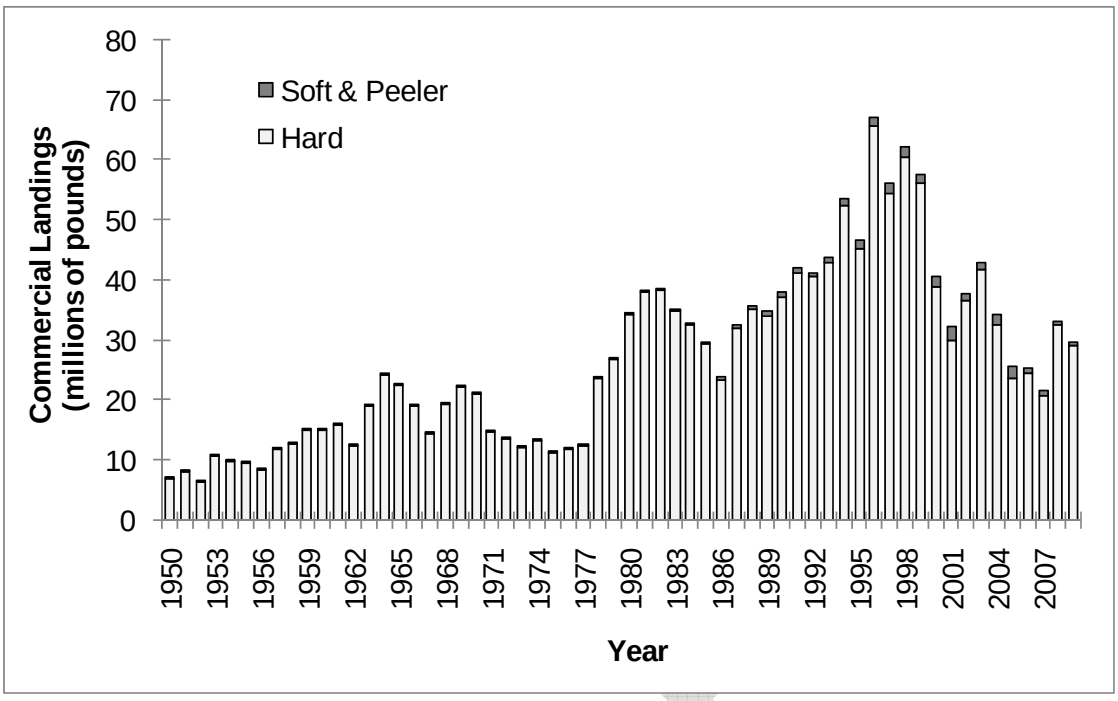

Figure 1.5. Annual commercial fishery landings of blue crabs in North Carolina, by crab type, 1950–2009.

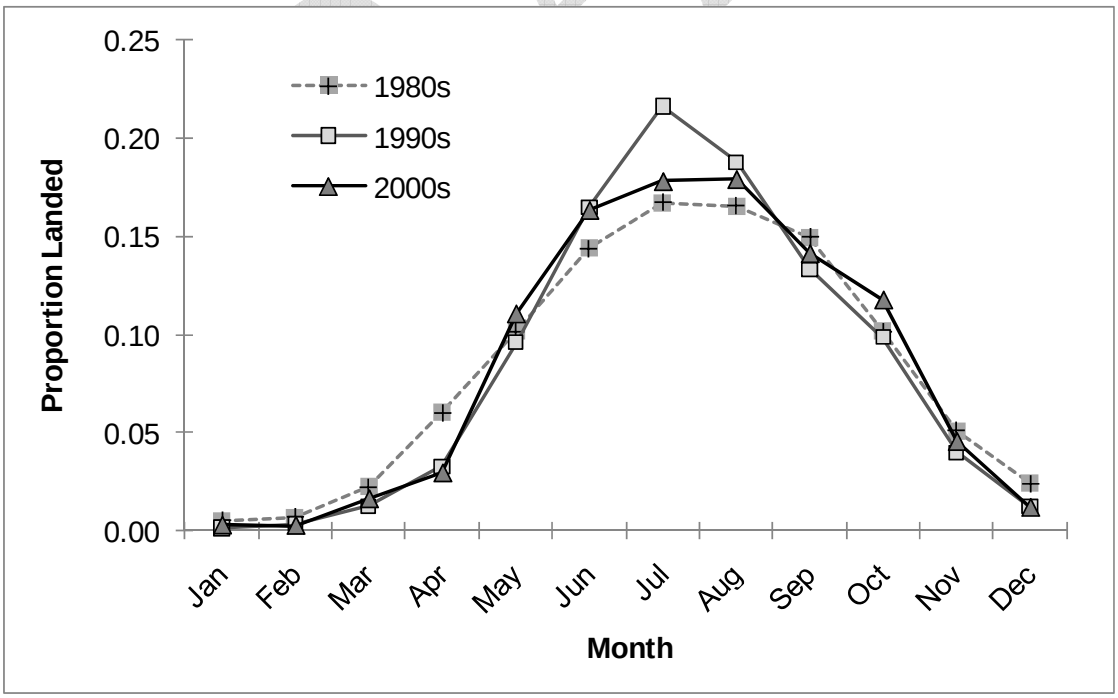

Figure 1.6. Proportion of blue crab commercial landings among months, by decade, 1980–2009.

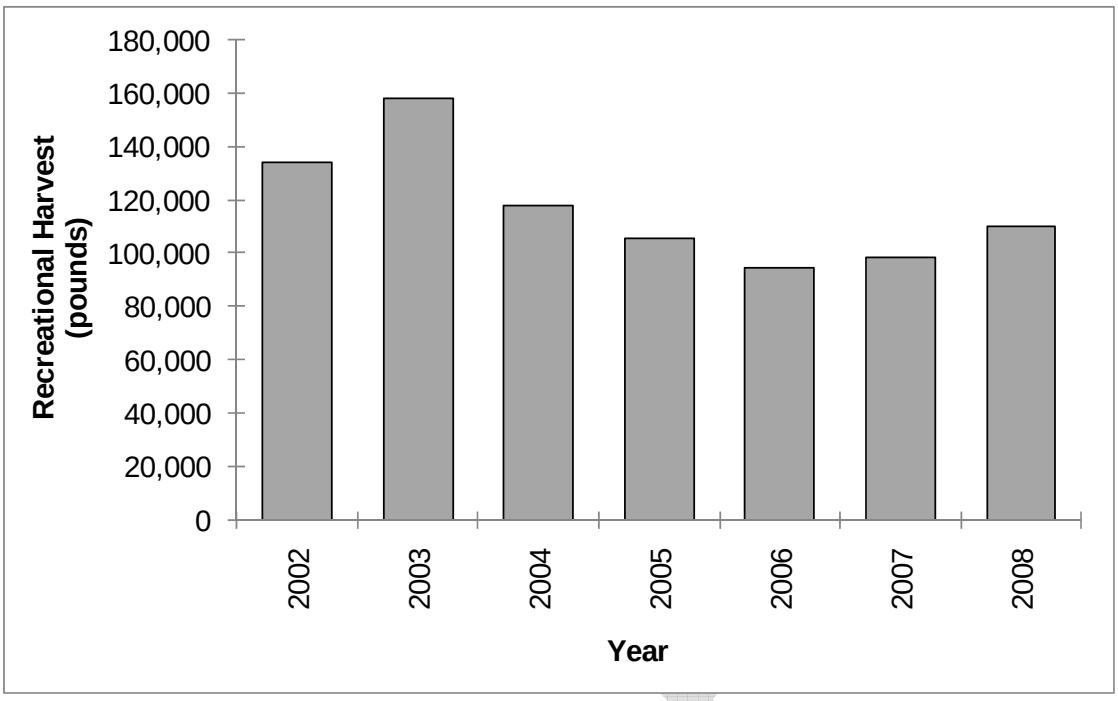

Figure 1.7. Estimated recreational harvest of blue crabs in North Carolina by RCGL license holders, 2002–2008.

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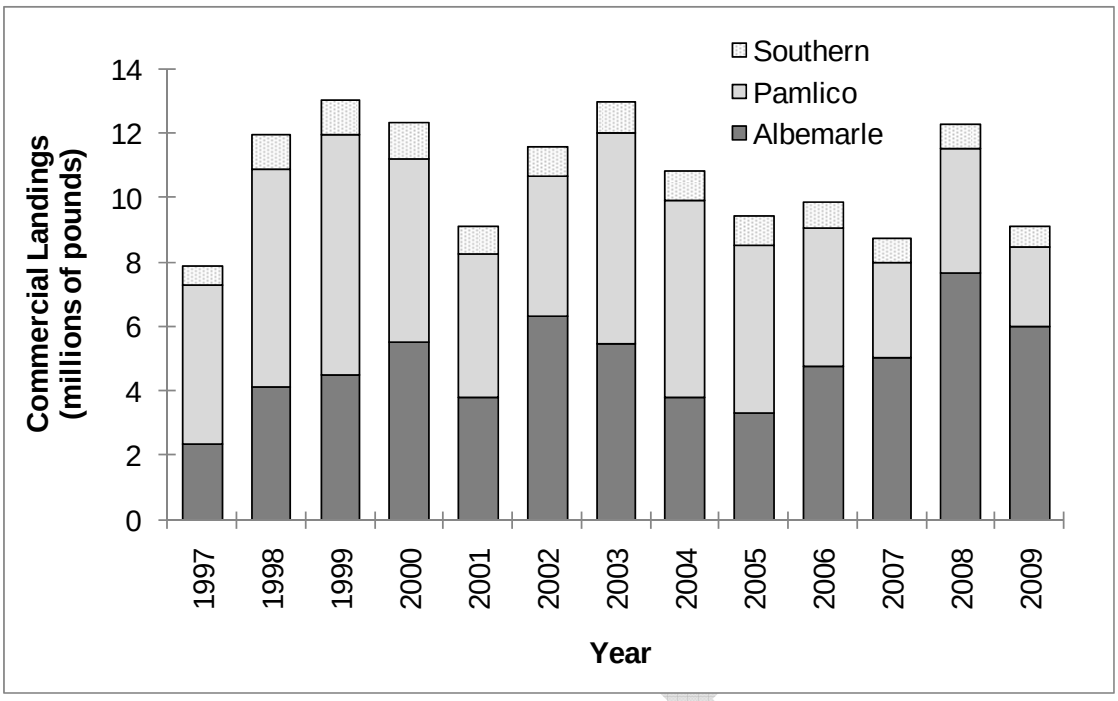

Figure 2.1. North Carolina's annual blue crab pot landings reported by commercial fishermen that have had at least 15 years experience, by harvest area, 1994–2009.

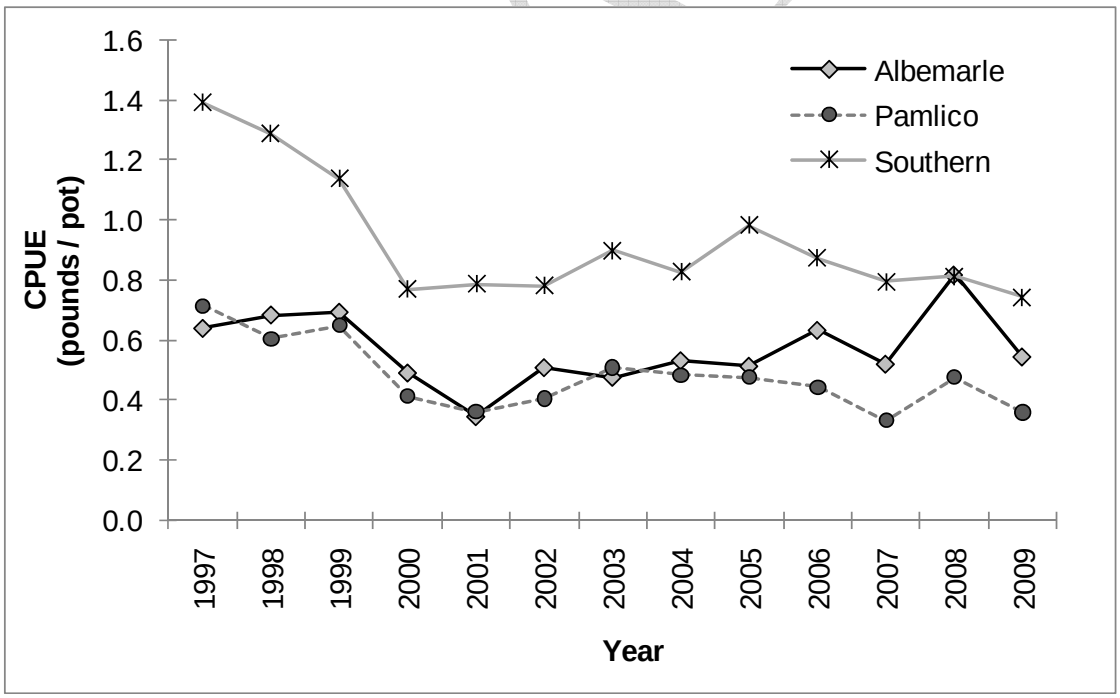

Figure 2.2. Annual index of commercial fishery catch per unit effort (CPUE) for blue crabs landed in North Carolina, by harvest area, 1997–2009. The CPUE indices are based on pot landings reported by fishermen that have had at least 15 years experience.

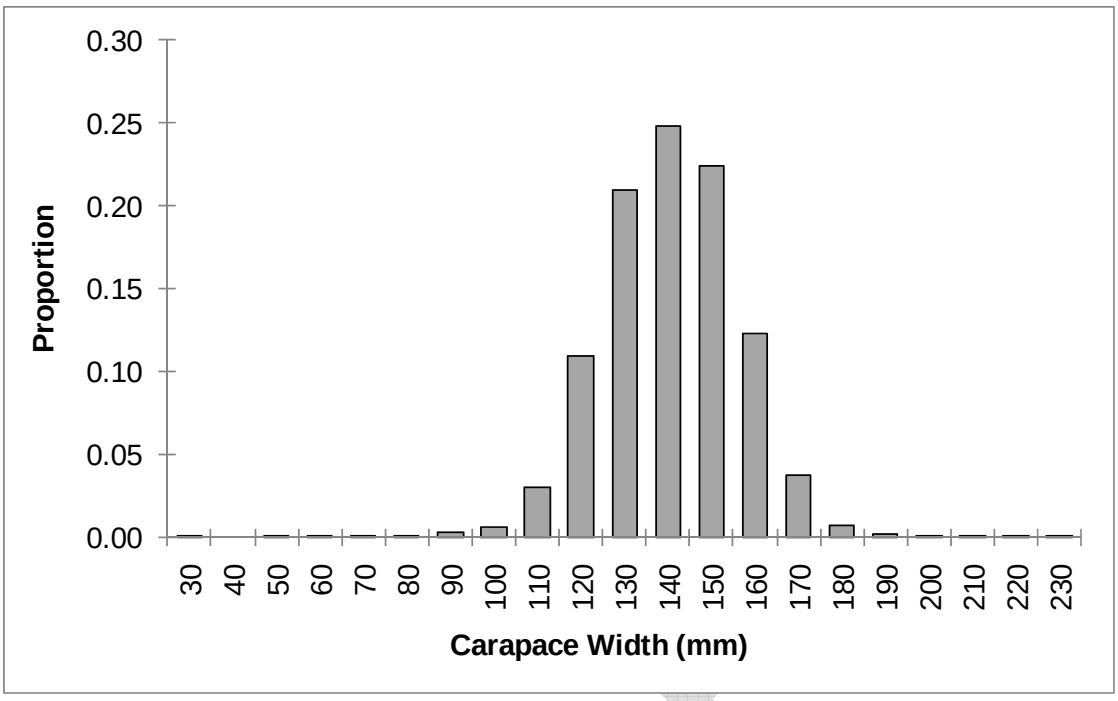

Figure 2.3. Length-frequency distribution of blue crabs landed by commercial fisheries in North Carolina, 1995–2009.

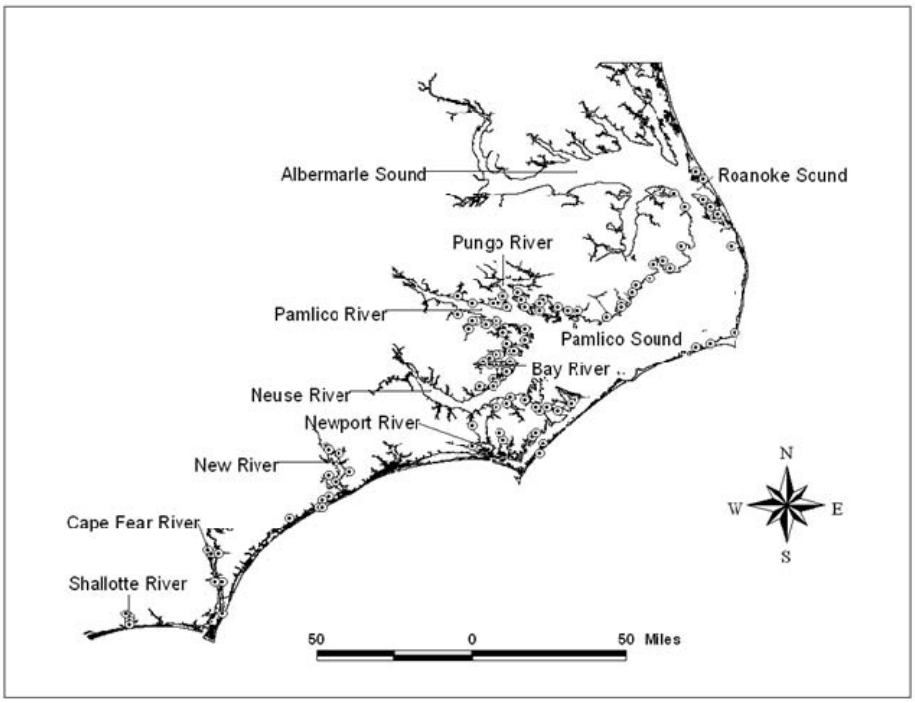

Figure 2.4. Locations of core stations sampled by NCDMF Program 120.

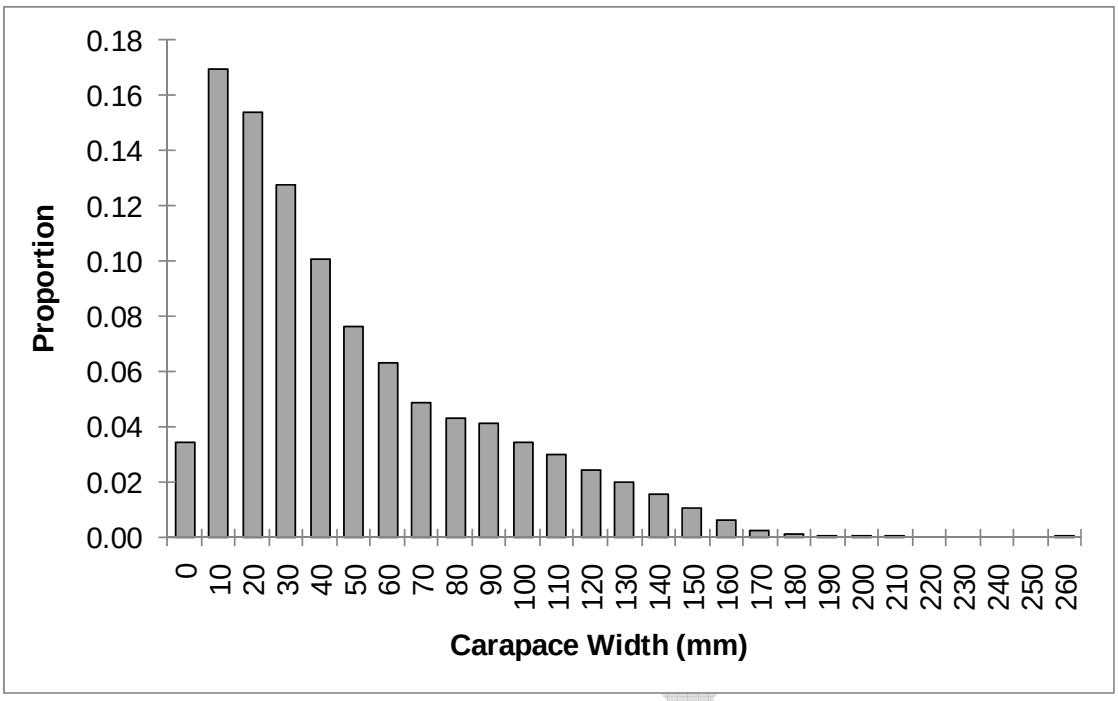

Figure 2.5. Length-frequency distribution of blue crabs collected from Pamlico Sound by NCDMF Program 120, 1978–2009.

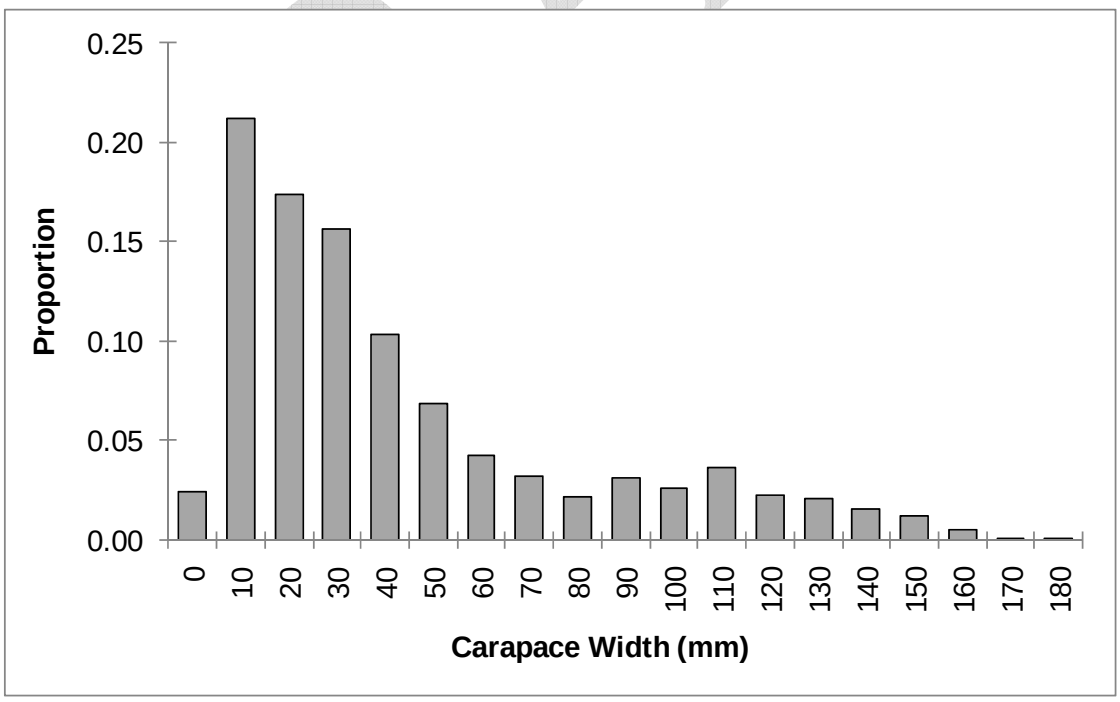

Figure 2.6. Length-frequency distribution of blue crabs collected from the Southern Region by NCDMF Program 120, 1978–2009.

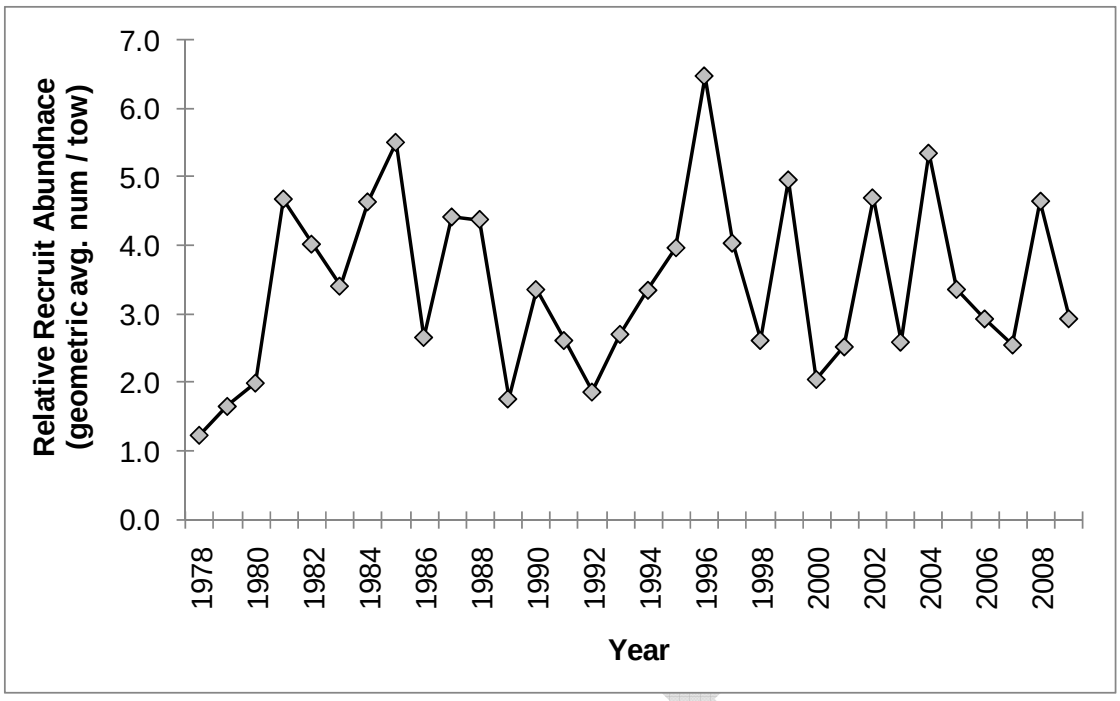

Figure 2.7. Annual index of relative recruit abundance for blue crabs collected from Pamlico Sound by NCDMF Program 120, 1978–2009.

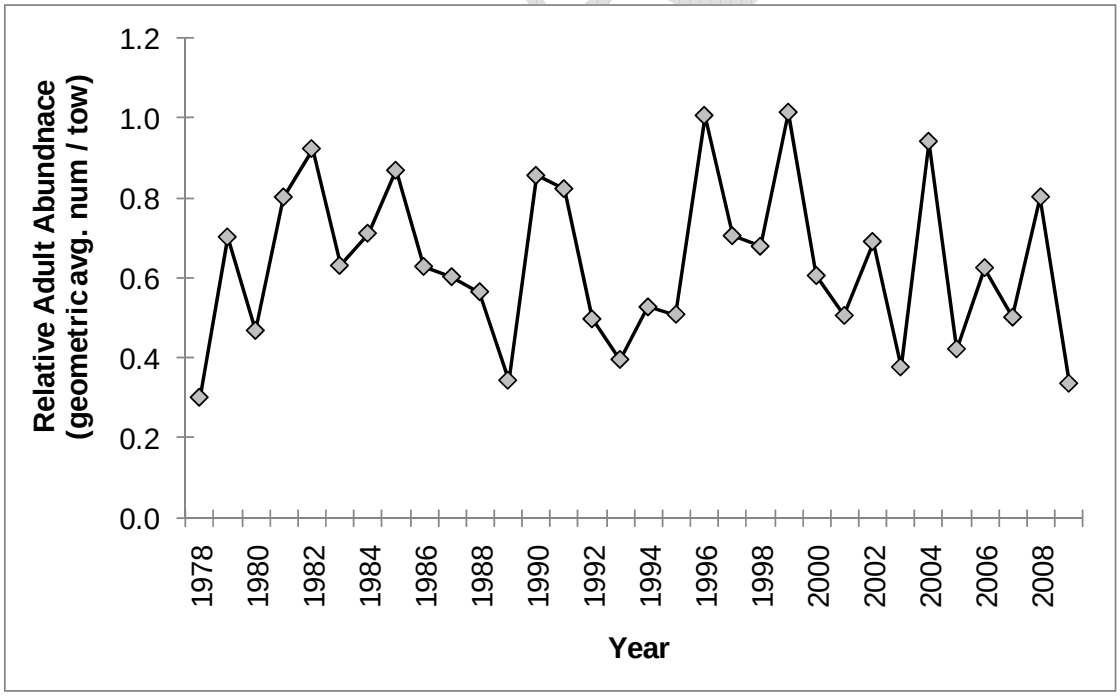

Figure 2.8. Annual index of relative adult abundance for blue crabs collected from Pamlico Sound by NCDMF Program 120, 1978–2009.

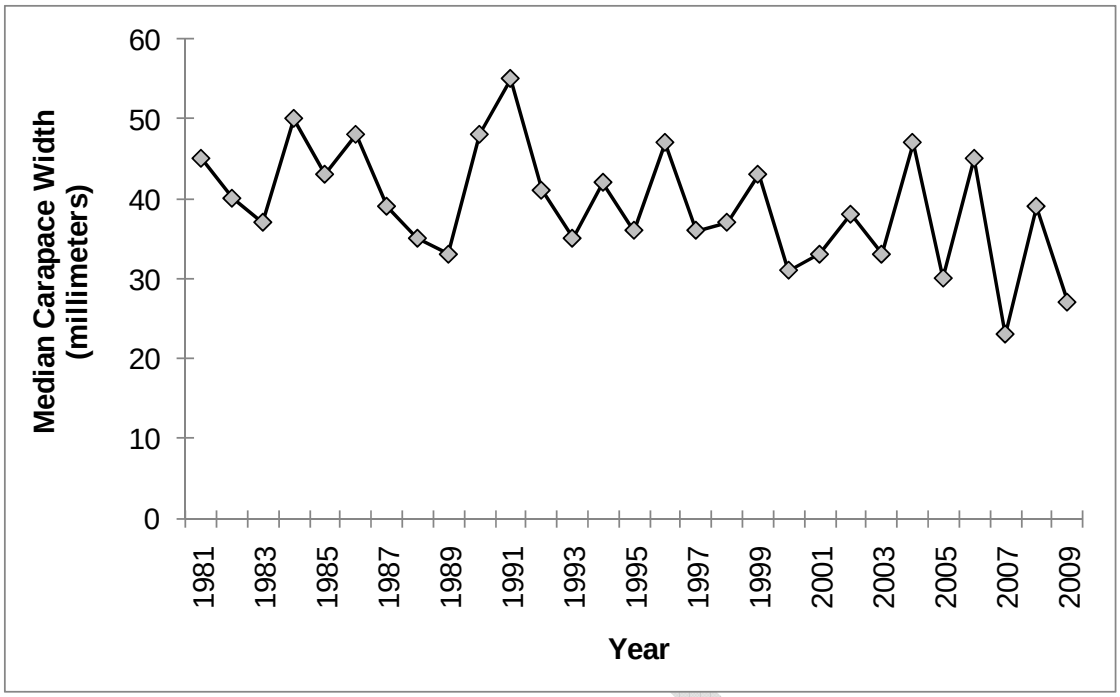

Figure 2.9. Annual median carapace widths of blue crabs collected from Pamlico Sound by NCDMF Program 120, 1981–2009.

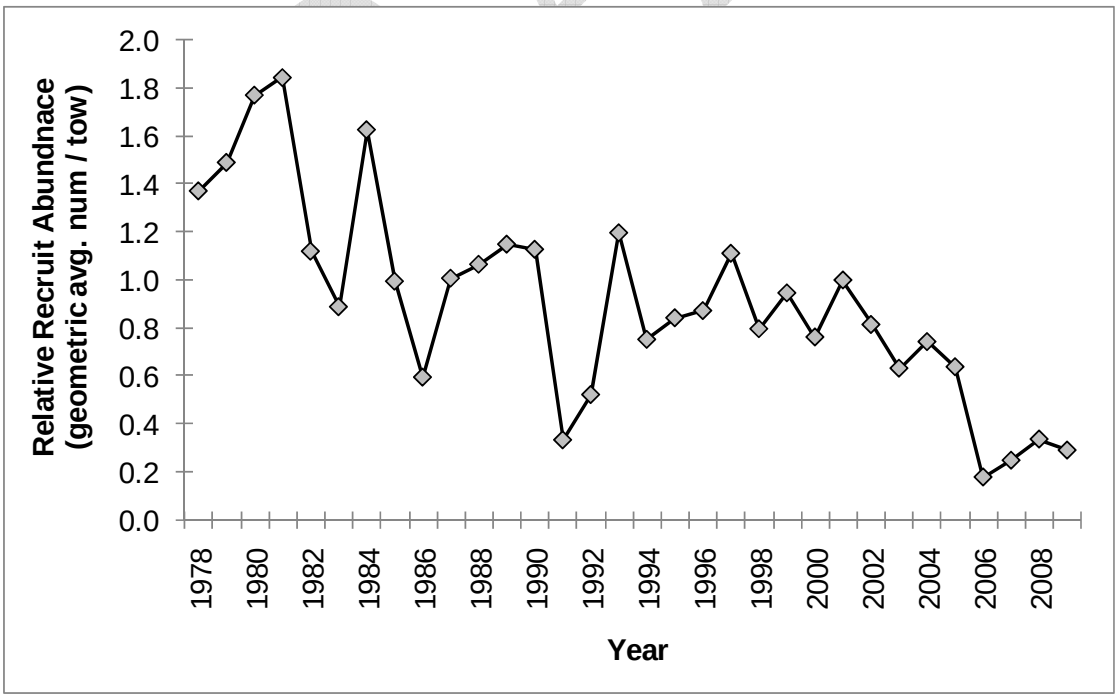

Figure 2.10. Annual index of relative recruit abundance for blue crabs collected from the Southern Region by NCDMF Program 120, 1978–2009.

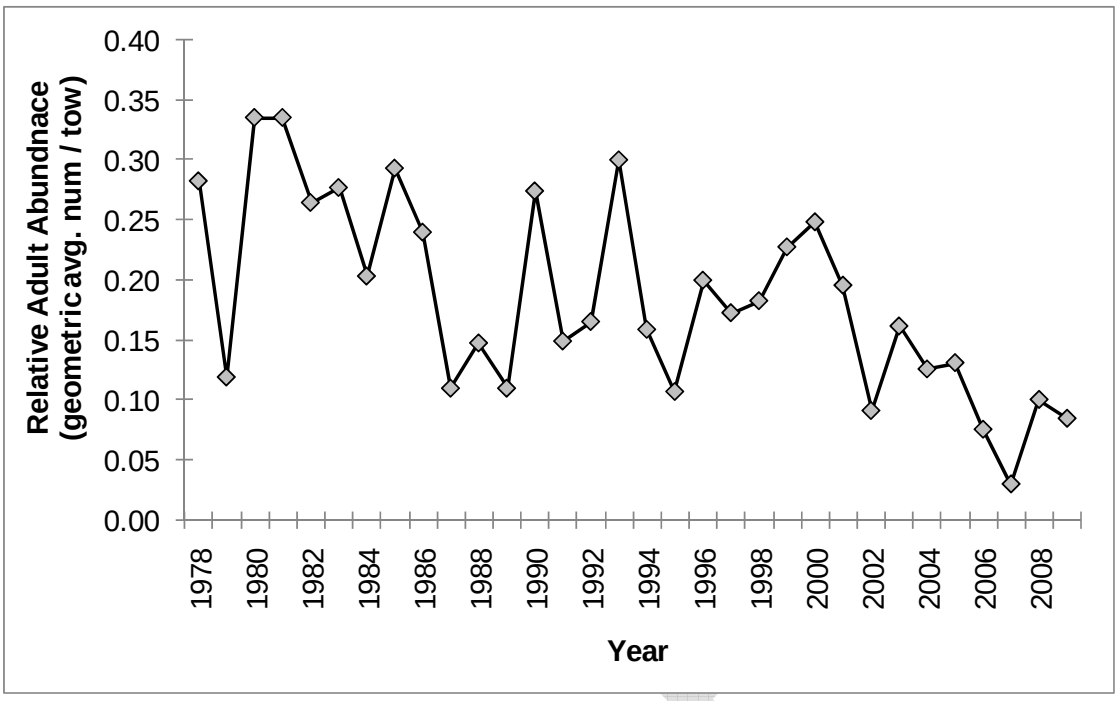

Figure 2.11. Annual index of relative adult abundance for blue crabs collected from the Southern Region by NCDMF Program 120, 1978–2009.

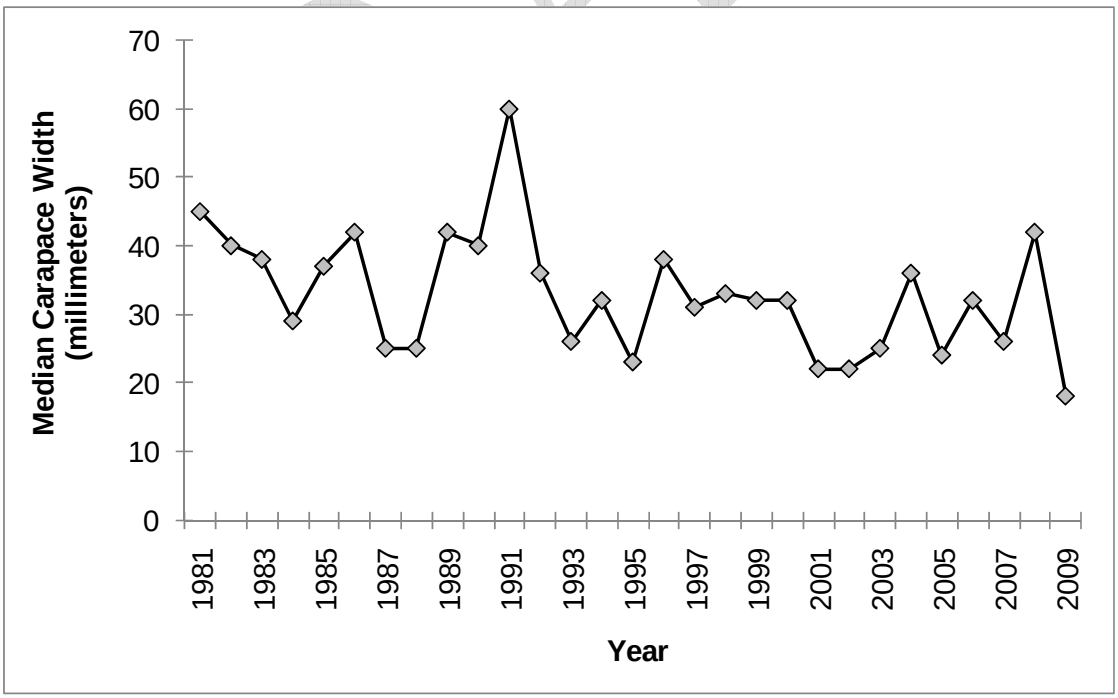

Figure 2.12. Annual median carapace widths of blue crabs collected from the Southern Region by NCDMF Program 120, 1981–2009.

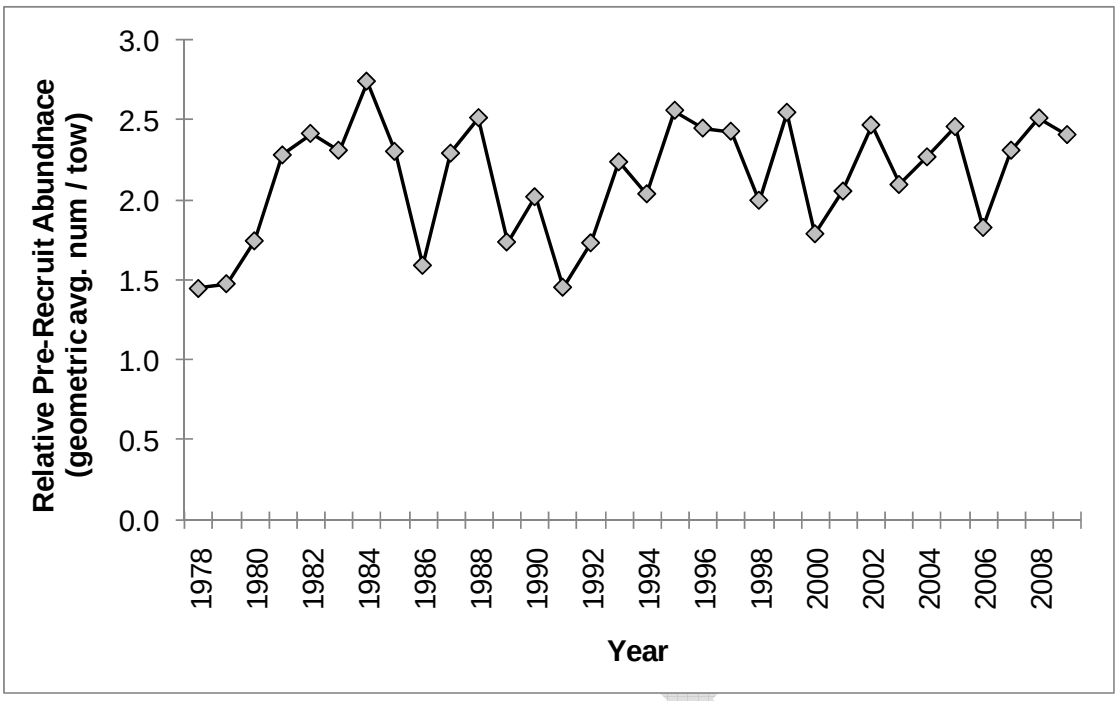

Figure 2.13. Annual index of relative pre-recruit (<30 mm CW) abundance for blue crabs collected from all areas by NCDMF Program 120, 1978–2009.

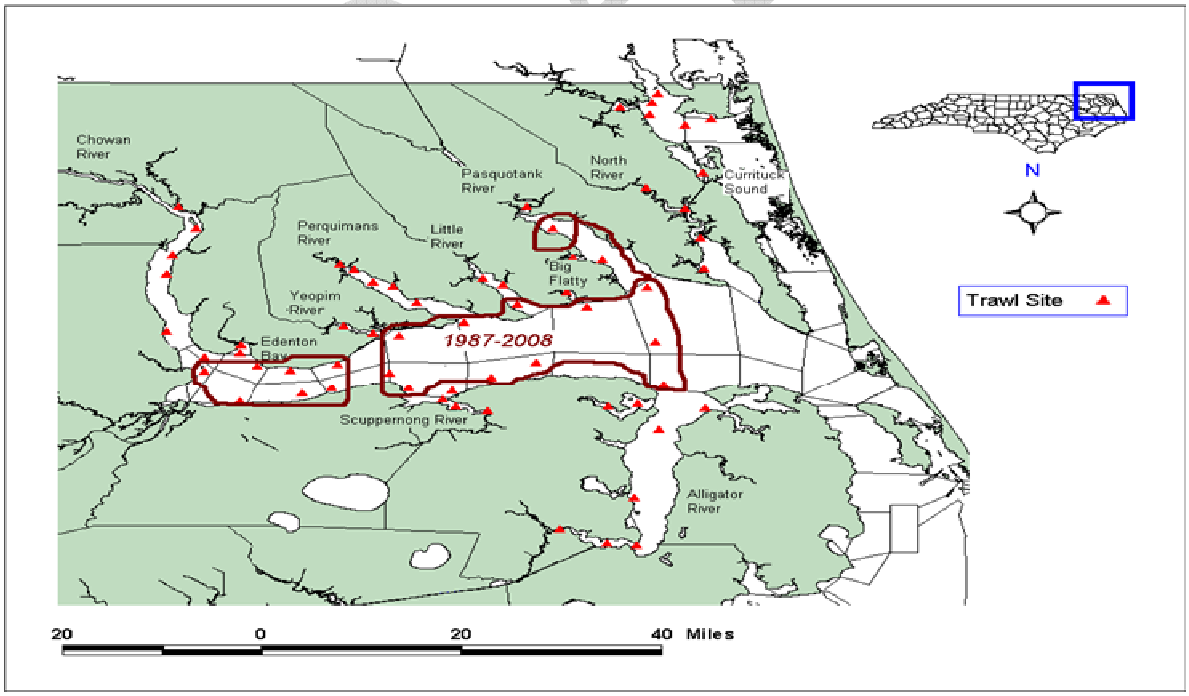

Figure 2.14. Locations of sites in Albemarle Sound sampled by NCDMF Program 100. The seven Hassler stations in the western part of the sound are denoted by the western-most circle. The twelve Central stations are denoted by the eastern-most circles.

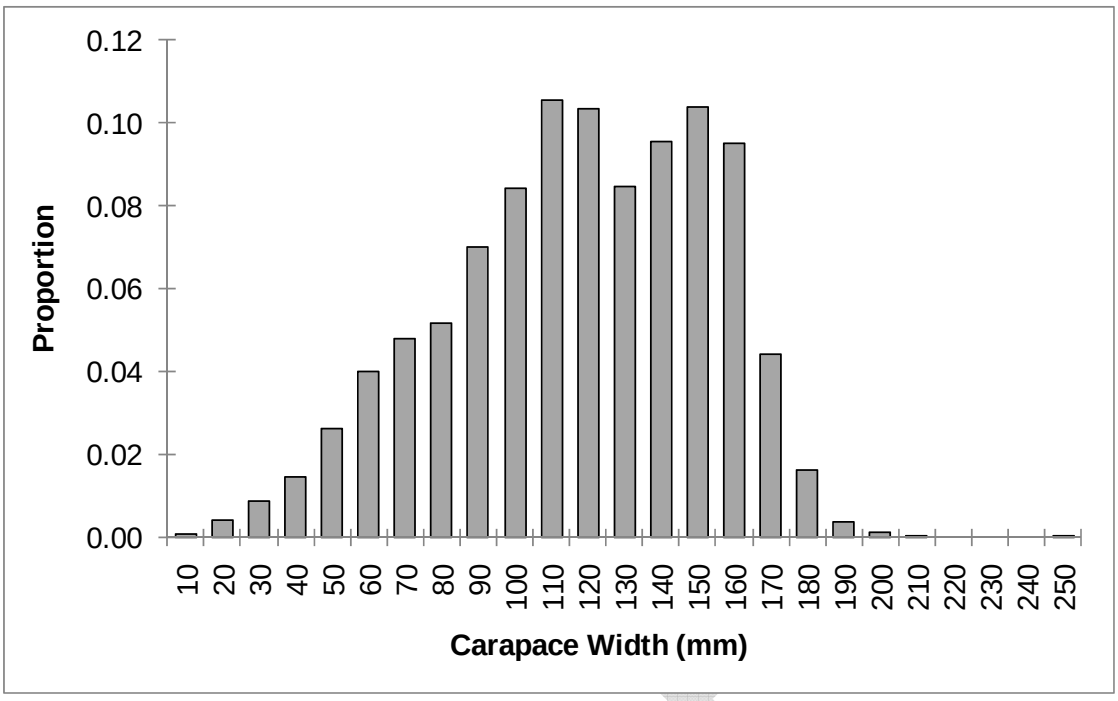

Figure 2.15. Length-frequency distribution of blue crabs collected by NCDMF Program 100, 1987–2009.

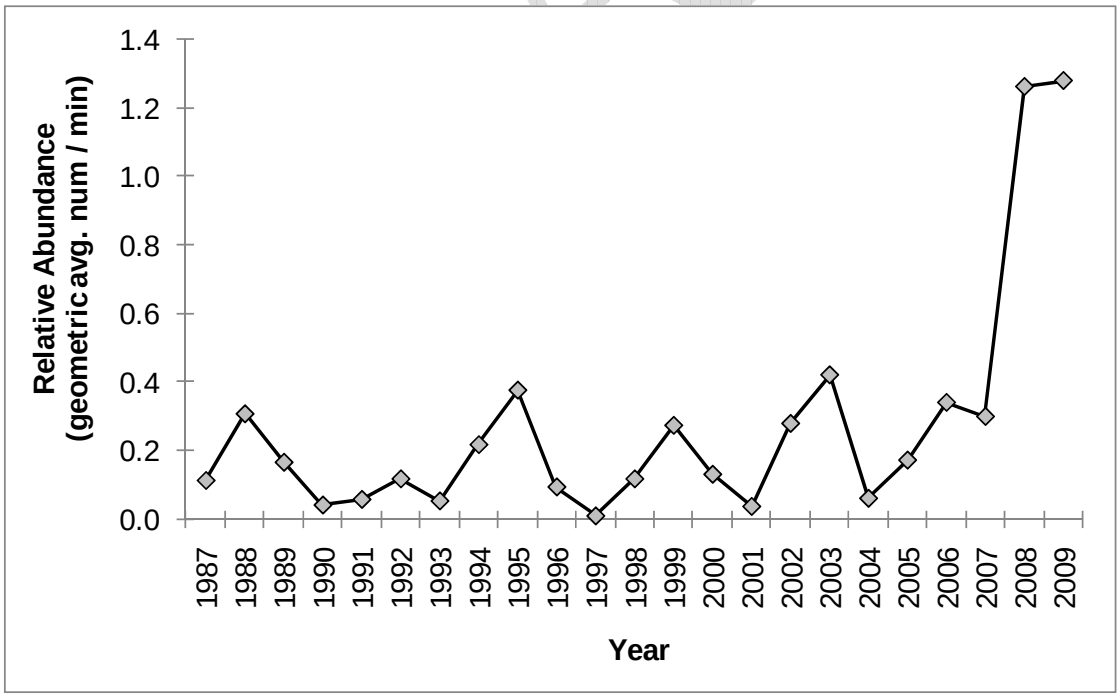

Figure 2.16. Annual index of relative abundance for blue crabs (all sizes) collected from Albemarle Sound by NCDMF Program 100, 1987–2009.

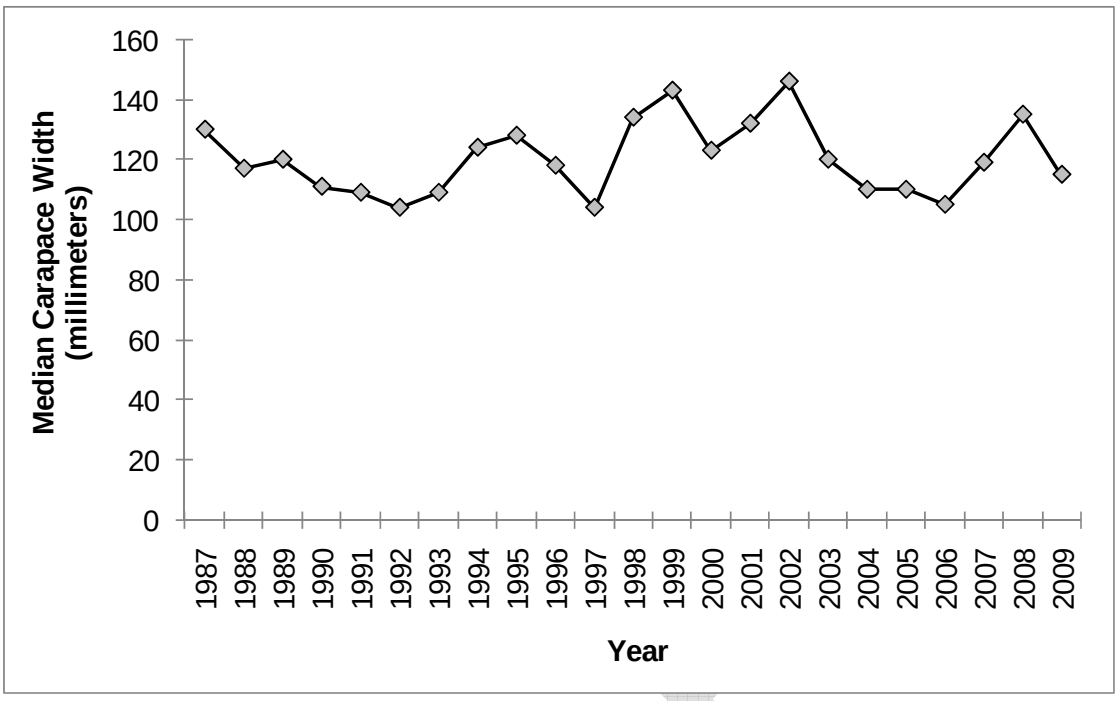

Figure 2.17. Annual median carapace widths of blue crabs collected from Albemarle Sound by NCDMF Program 100, 1987–2009.

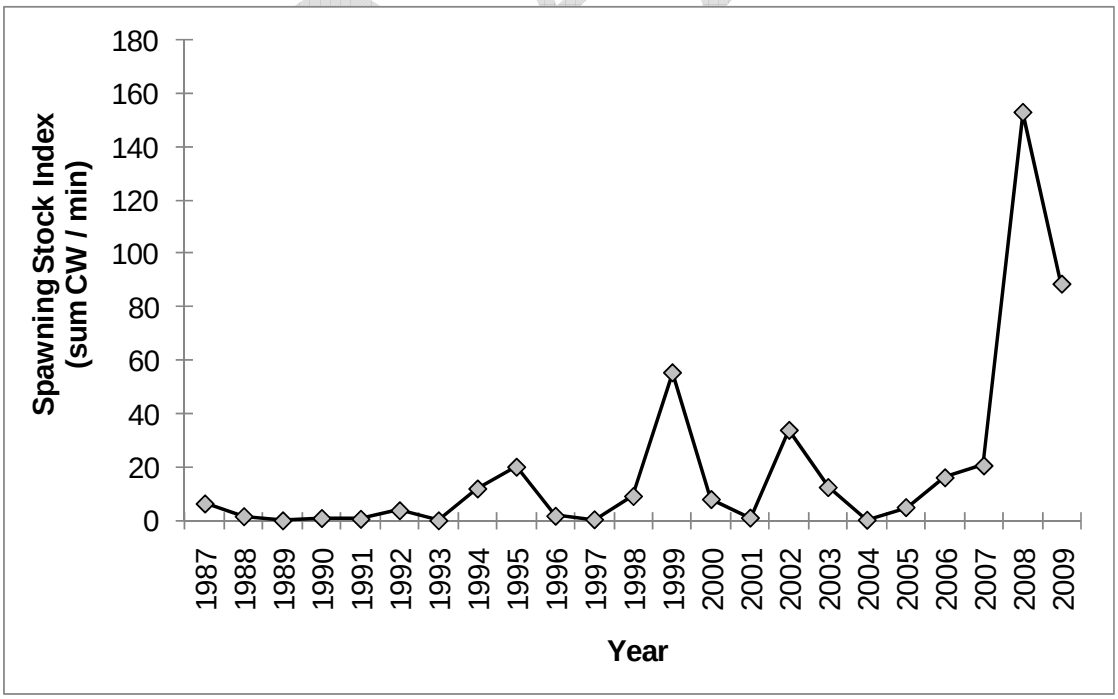

Figure 2.18. Annual spawning stock index for blue crabs collected from Albemarle Sound by NCDMF Program 100, 1987–2009.

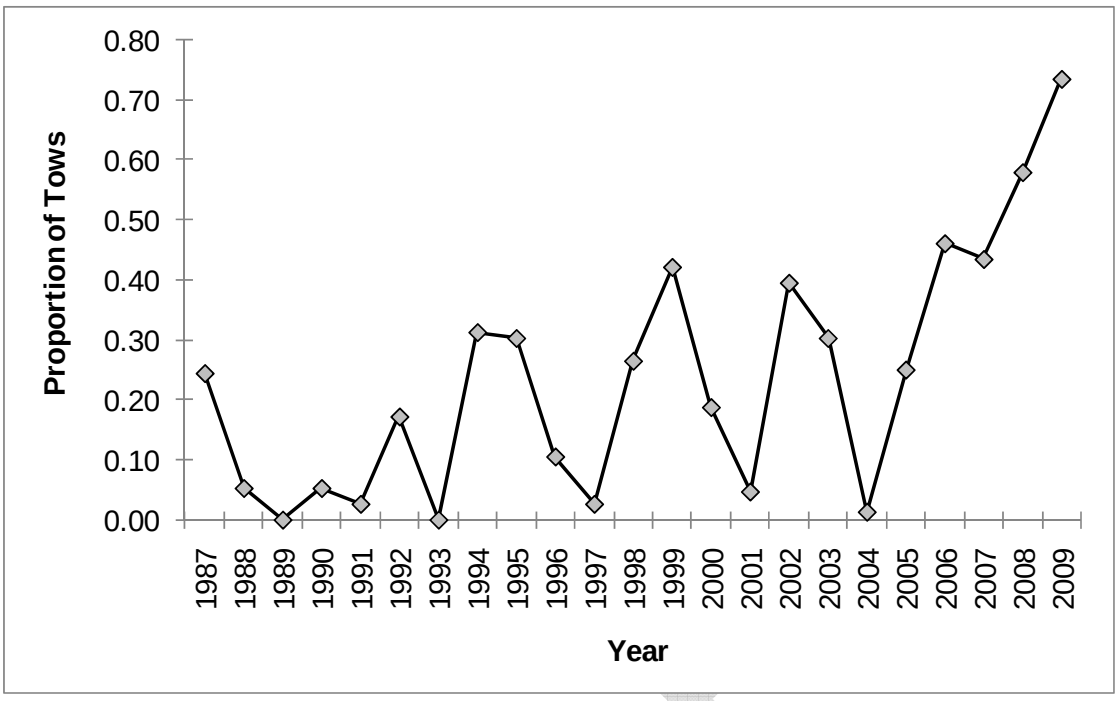

Figure 2.19. Frequency of occurrence of mature female blue crabs collected from Albemarle Sound by NCDMF Program 100, 1987–2009.

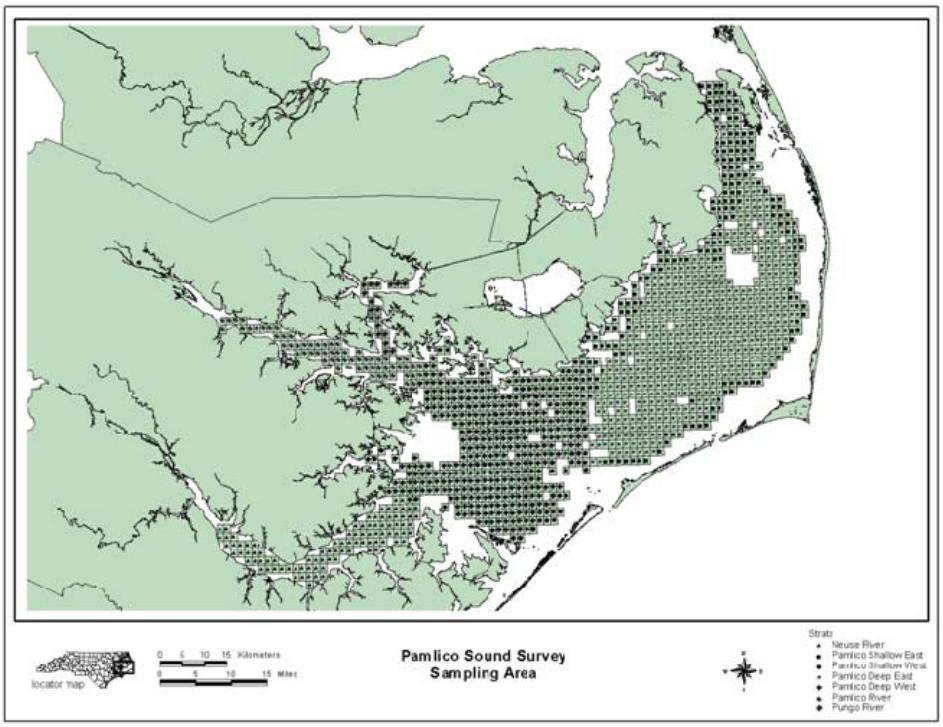

Figure 2.20. Locations of sites in Pamlico Sound sampled by NCDMF Program 195.

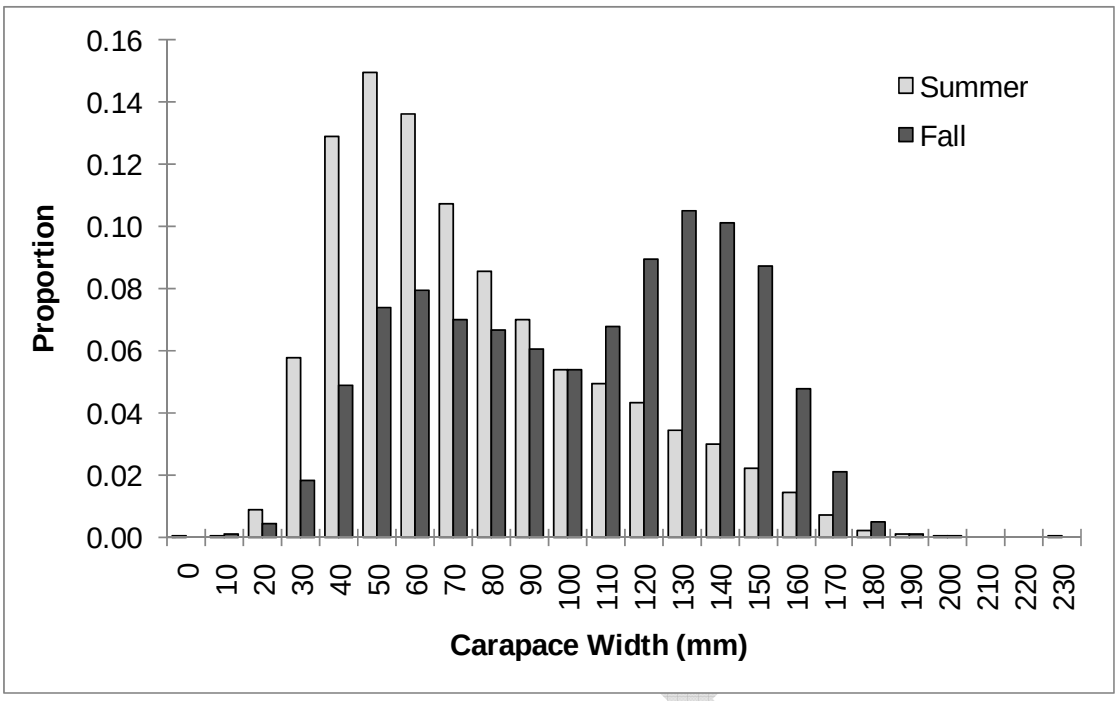

Figure 2.21. Length-frequency distribution of blue crabs collected by NCDMF Program 195, by season, 1987–2009.

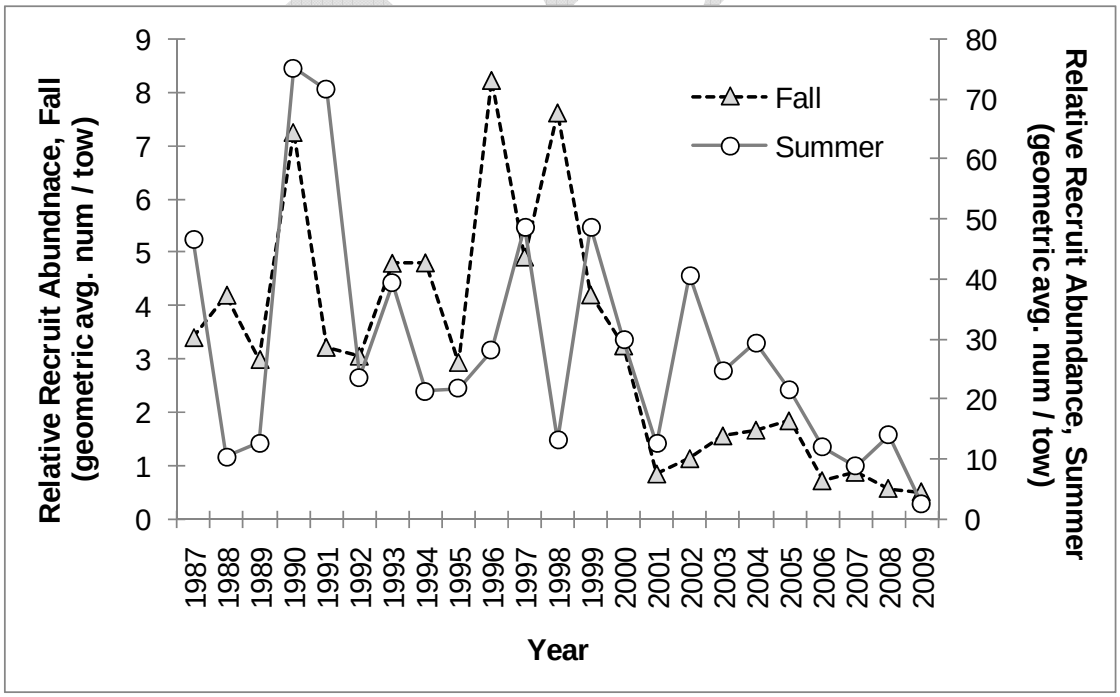

Figure 2.22. Annual index of relative recruit abundance for blue crabs collected from Pamlico Sound by NCDMF Program 195, by season, 1987–2009.

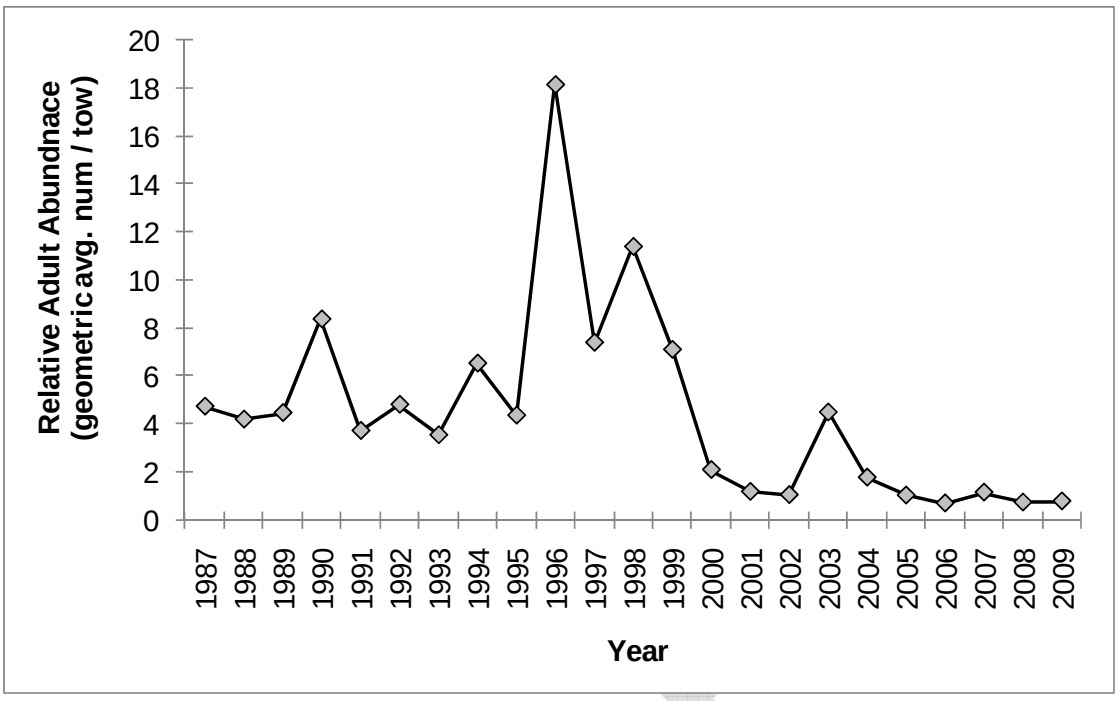

Figure 2.23. Annual index of relative adult abundance for blue crabs collected in the fall from Pamlico Sound by NCDMF Program 195, 1987–2009.

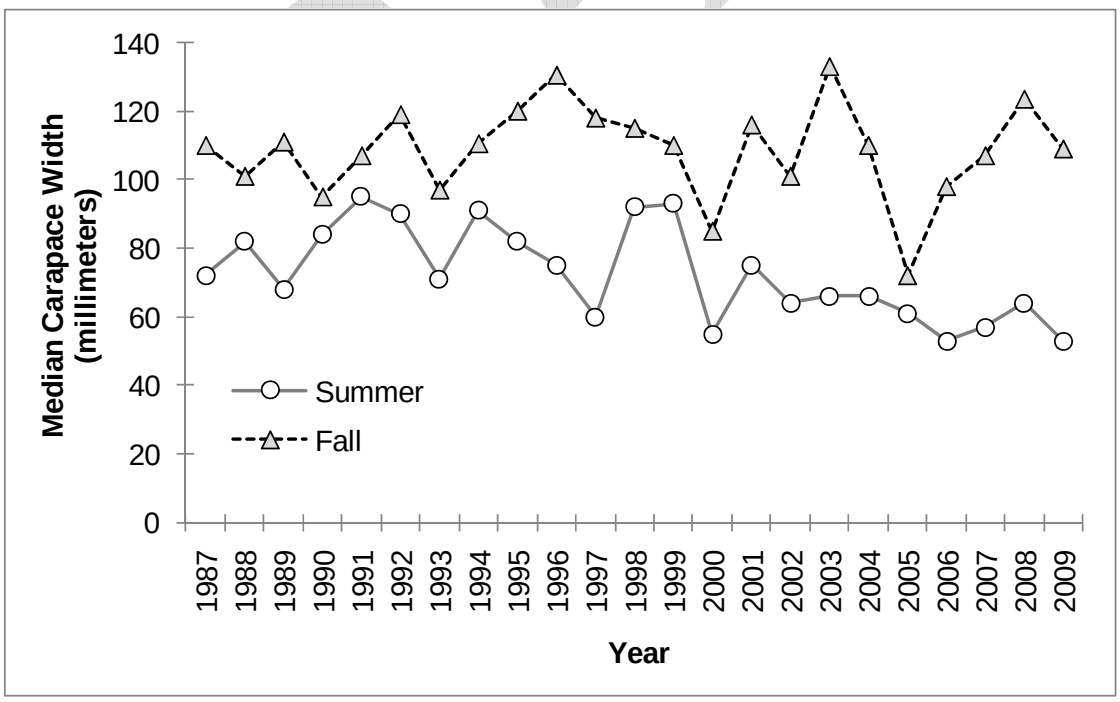

Figure 2.24. Annual median carapace widths of blue crabs collected from Pamlico Sound by NCDMF Program 195, by season, 1987–2009.

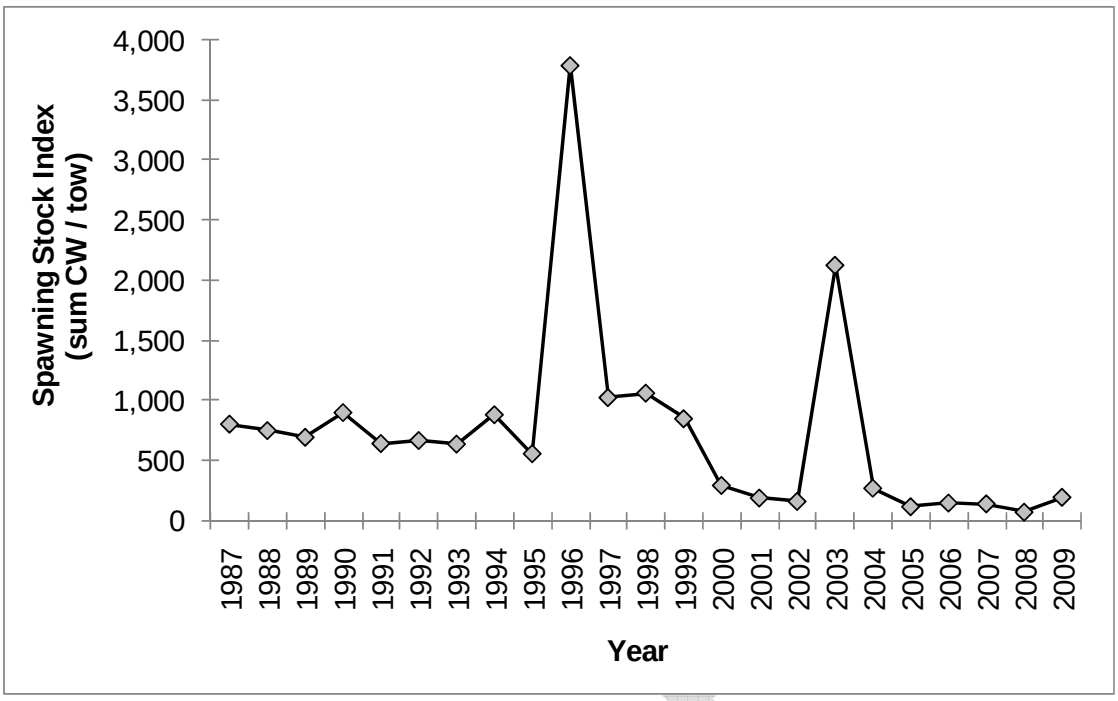

Figure 2.25. Annual spawning stock index for blue crabs collected from Pamlico Sound by NCDMF Program 195, 1987–2009.

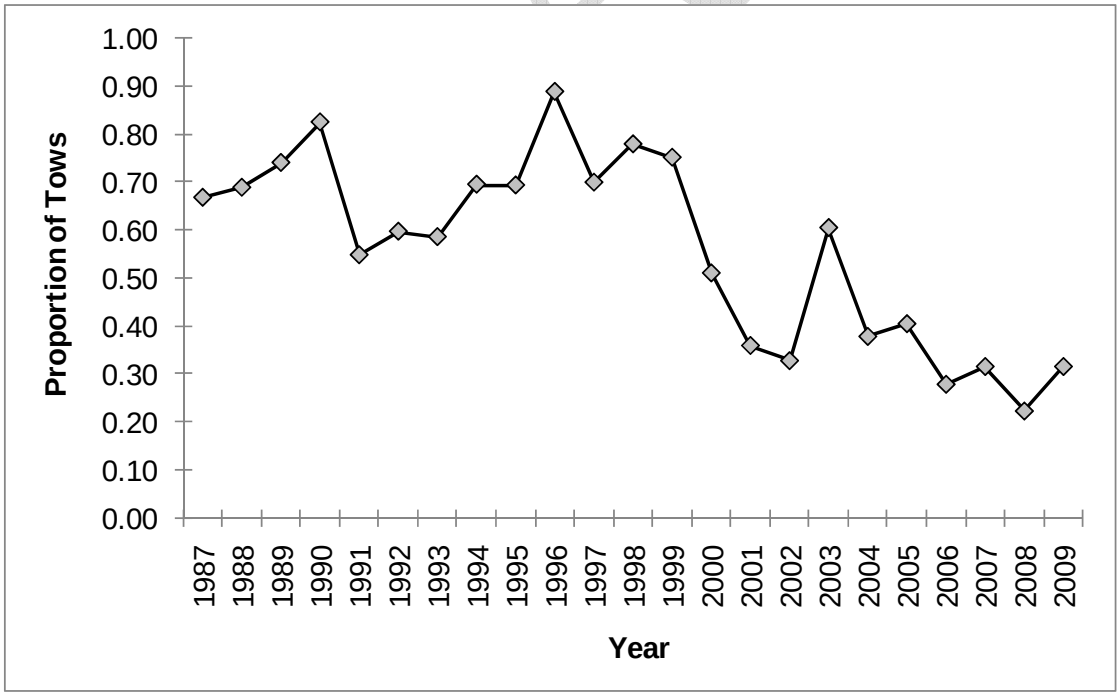

Figure 2.26. Frequency of occurrence of mature female blue crabs collected from Pamlico Sound during the fall by NCDMF Program 195, 1987–2009.

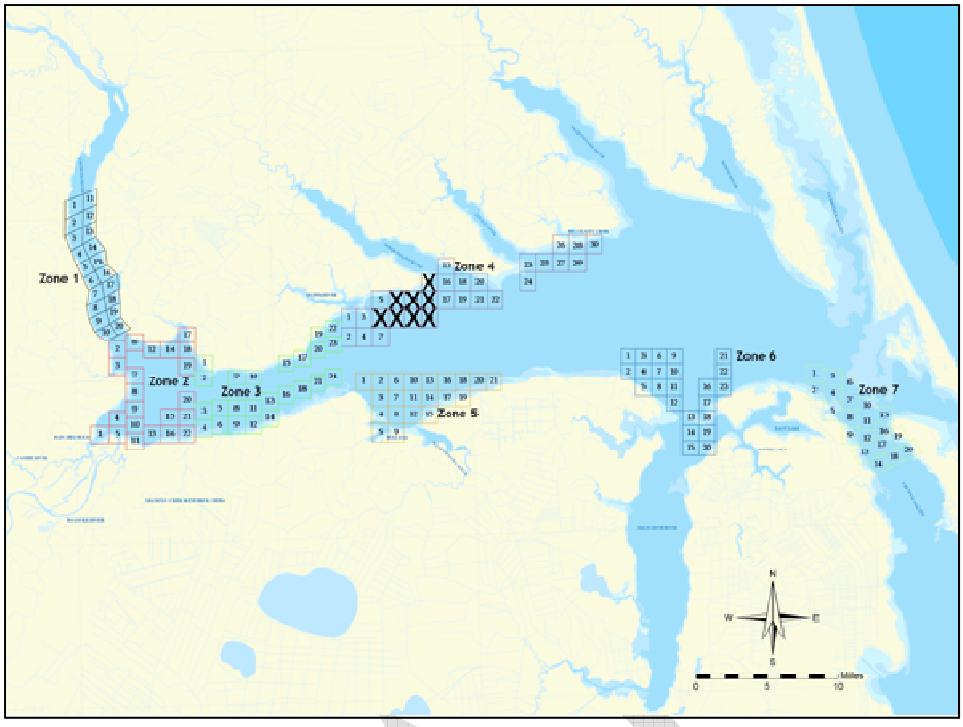

Figure 2.27. Locations of sampling zones and quadrants in Albemarle Sound sampled by NCDMF Program 135.

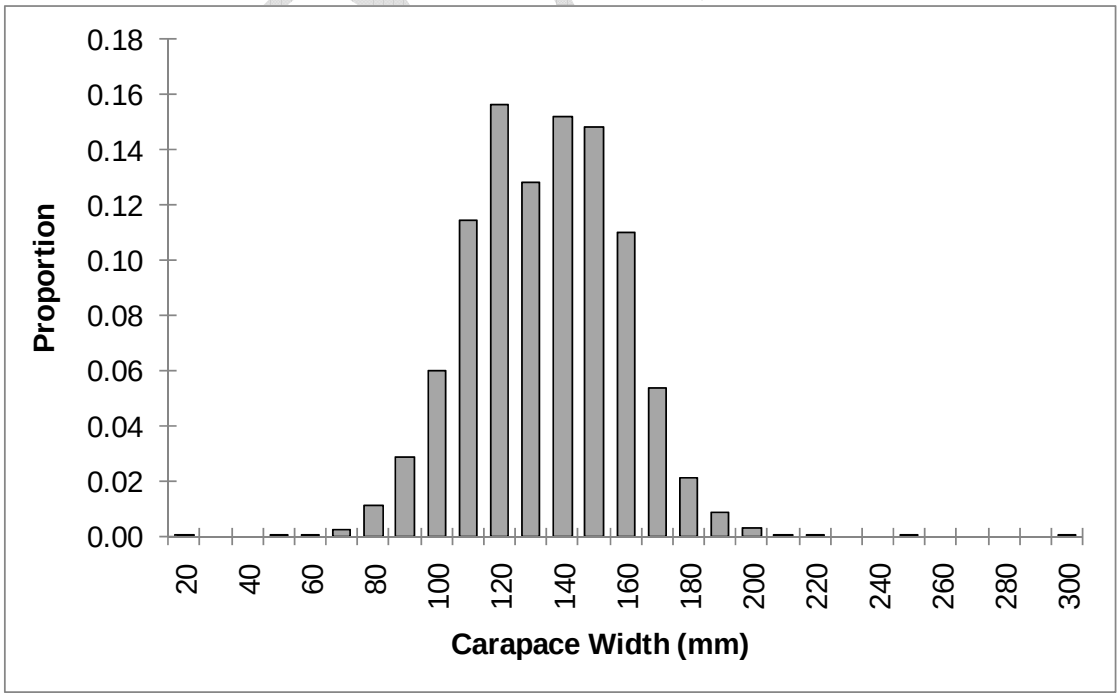

Figure 2.28. Length-frequency distribution of blue crabs collected by NCDMF Program 135, 1991–2008.

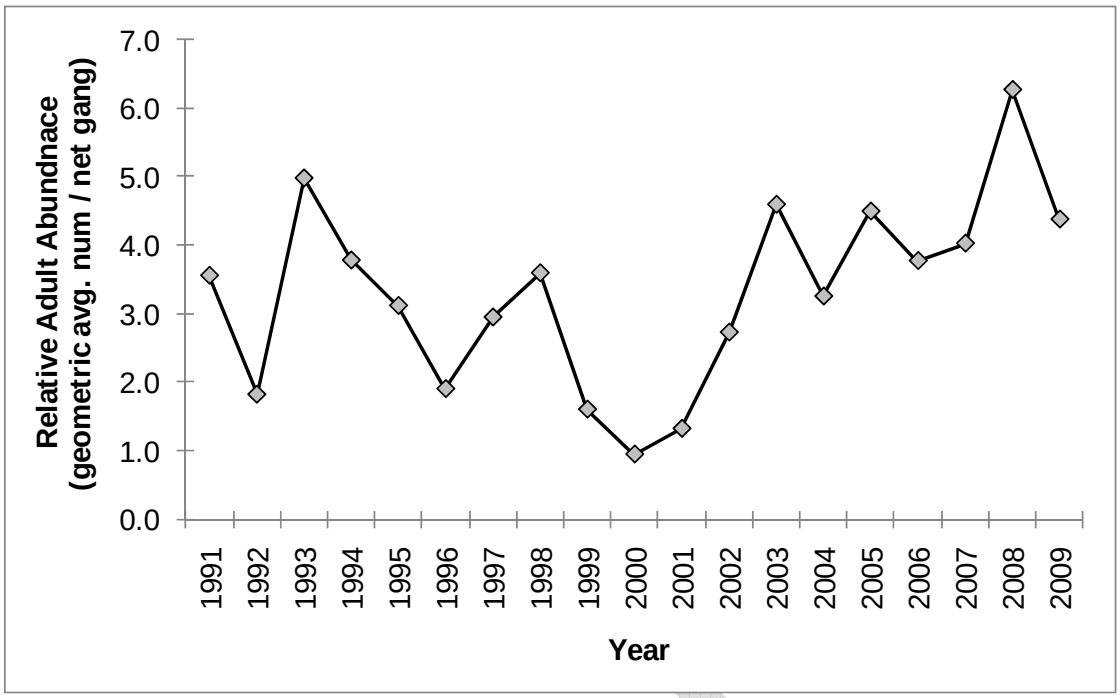

Figure 2.29. Annual index of relative adult abundance for blue crabs collected from Albemarle Sound by NCDMF Program 135, 1991–2009.

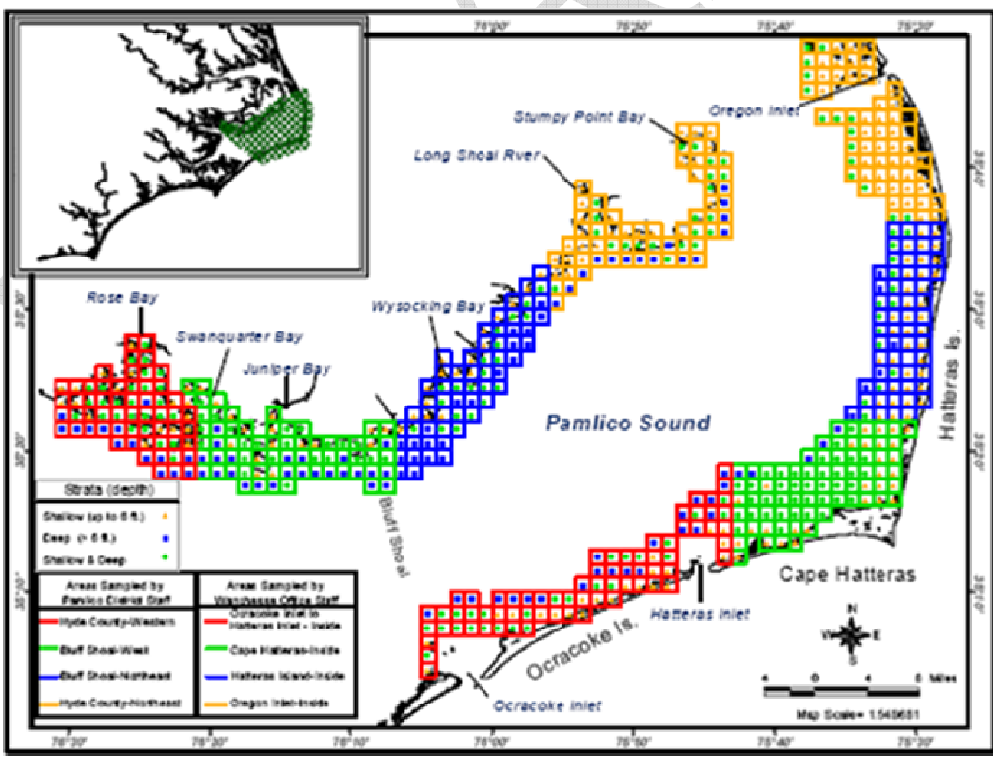

Figure 2.30. The sample regions and grid system for the Pamlico Sound portion of NCDMF Program 915.

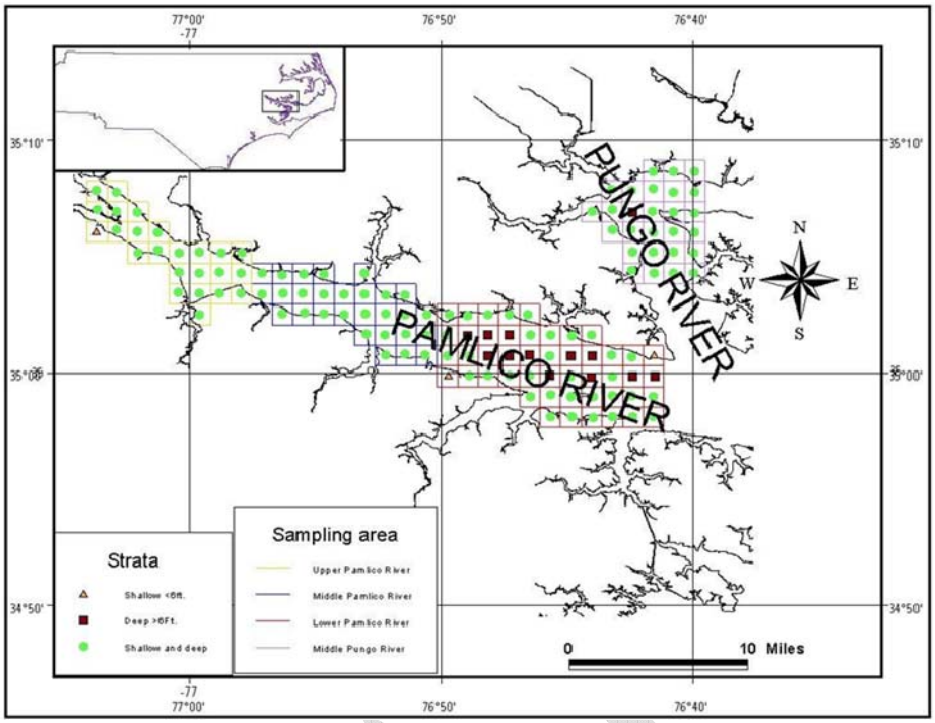

Figure 2.31. The sample regions and grid system for the Pamlico and Pungo river portions of NCDMF Program 915.

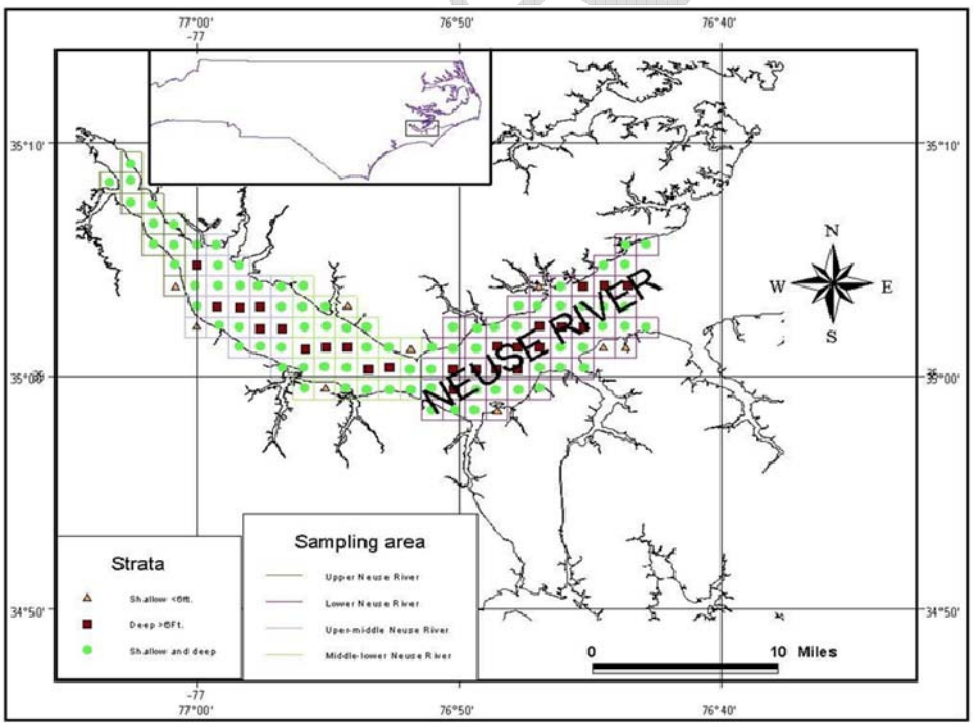

Figure 2.32. The sample regions and grid system for the Neuse River portion of NCDMF Program 915.

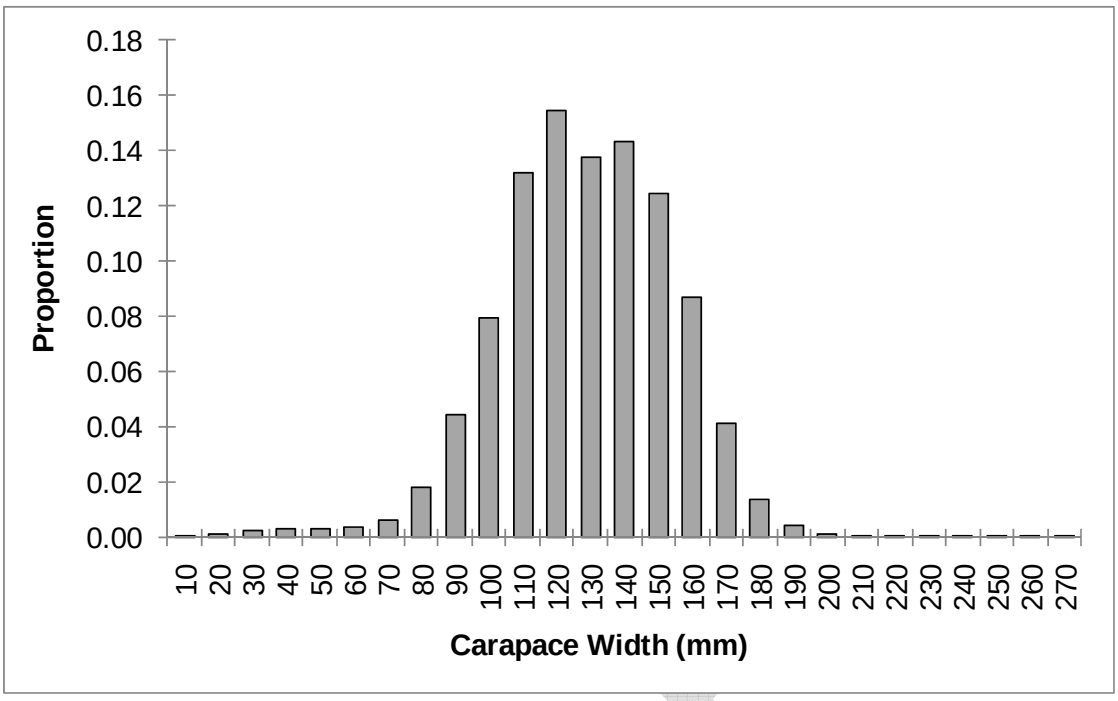

Figure 2.33. Length-frequency distribution of blue crabs collected by NCDMF Program 915, 2001–2009.

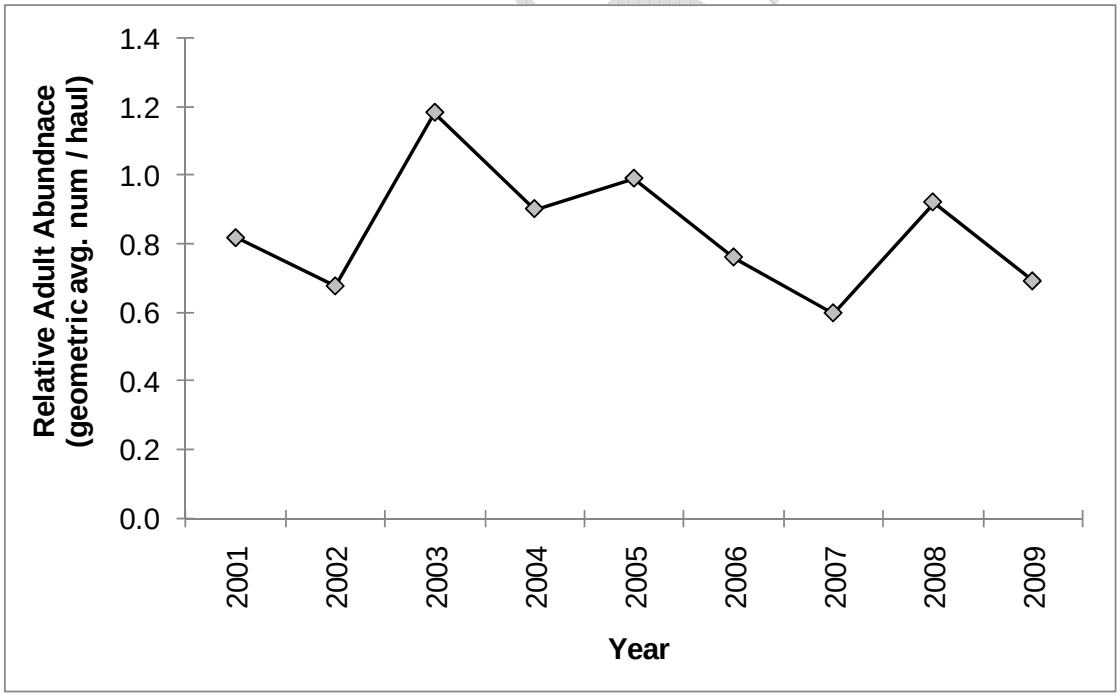

Figure 2.34. Annual index of relative adult abundance for blue crabs collected from Pamlico Sound by NCDMF Program 915, 2001–2009.

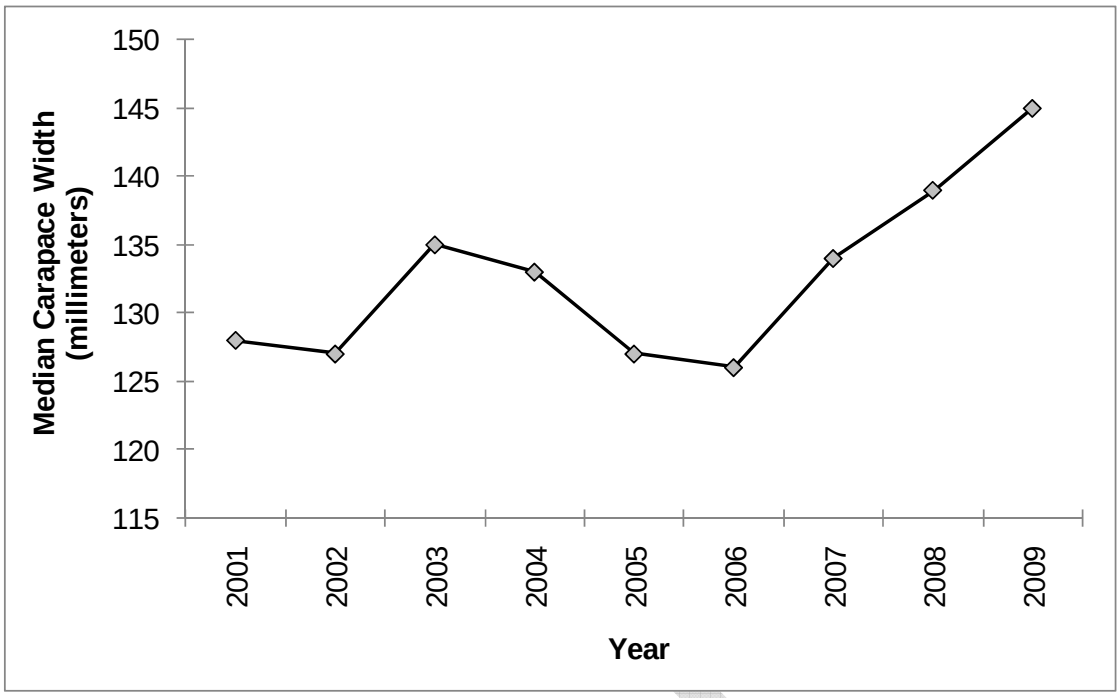

Figure 2.35. Annual median carapace widths of blue crabs collected from Pamlico Sound by NCDMF Program 915, 2001–2009.

DRAFT

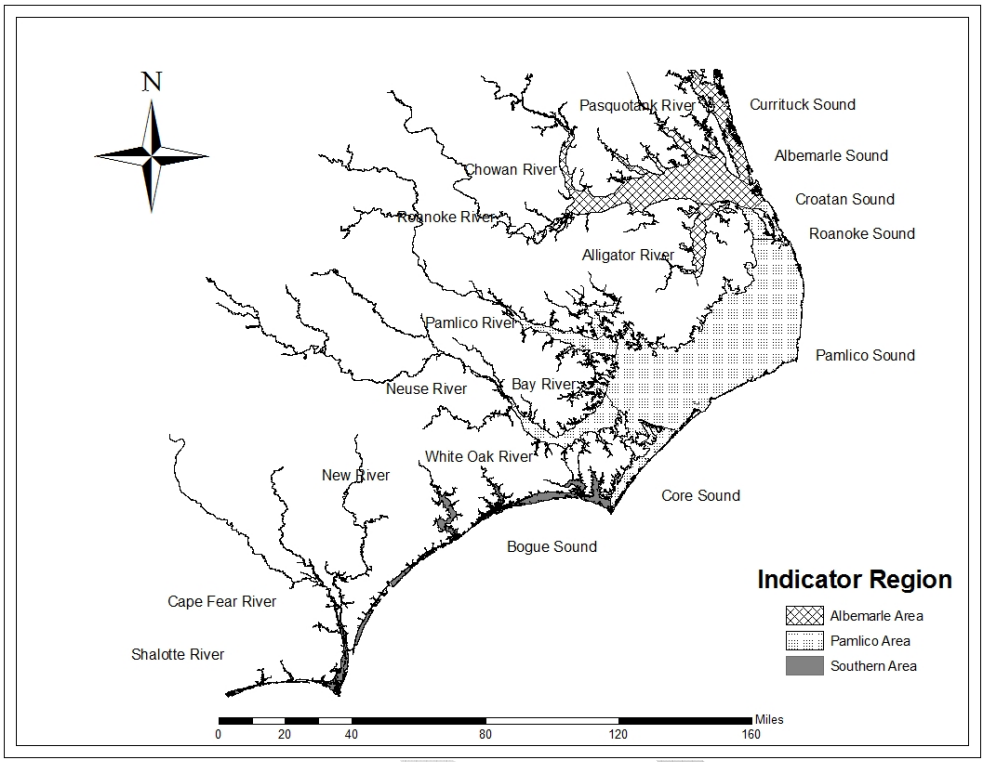

Figure 3.1. Map defining regions that were used to spatially group Traffic Light indicators.

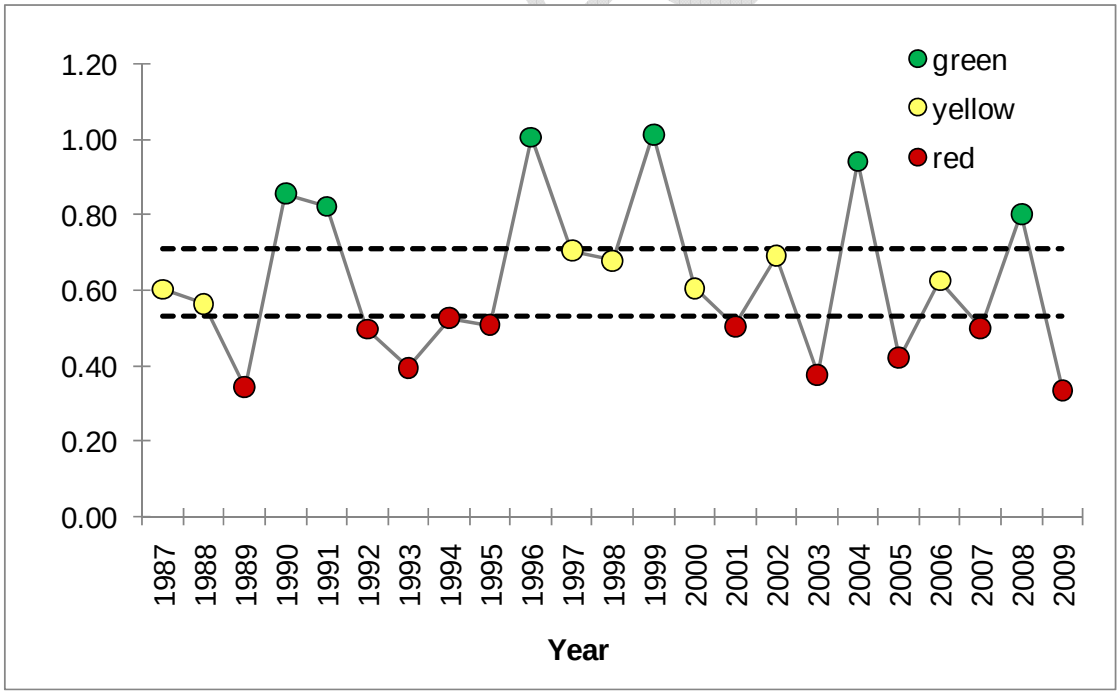

Figure 3.2. Example of the Strict Traffic Light scaling applied to the Program 120 relative index of adult abundance for the Pamlico region. The dotted black lines represent the upper and lower 95% confidence limits of the time-series average.

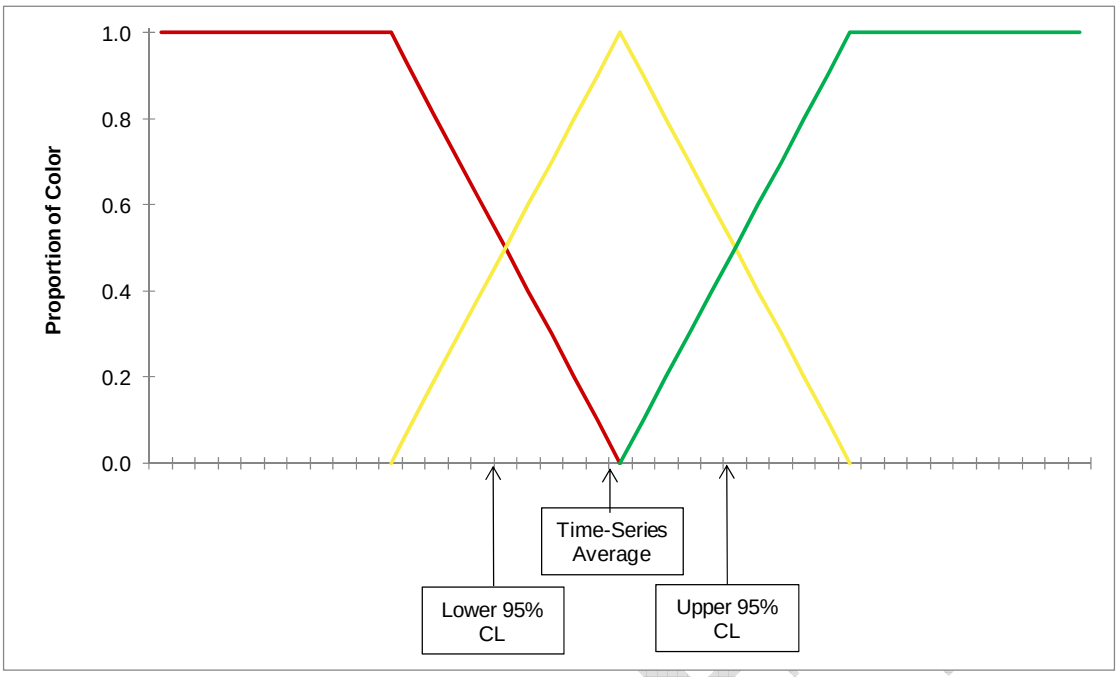

Figure 3.3. Schematic for assignment of Fuzzy Traffic Lights. The x-axis would represent the range of values for the indicator of interest. (Adapted from Halliday et al. 2001)

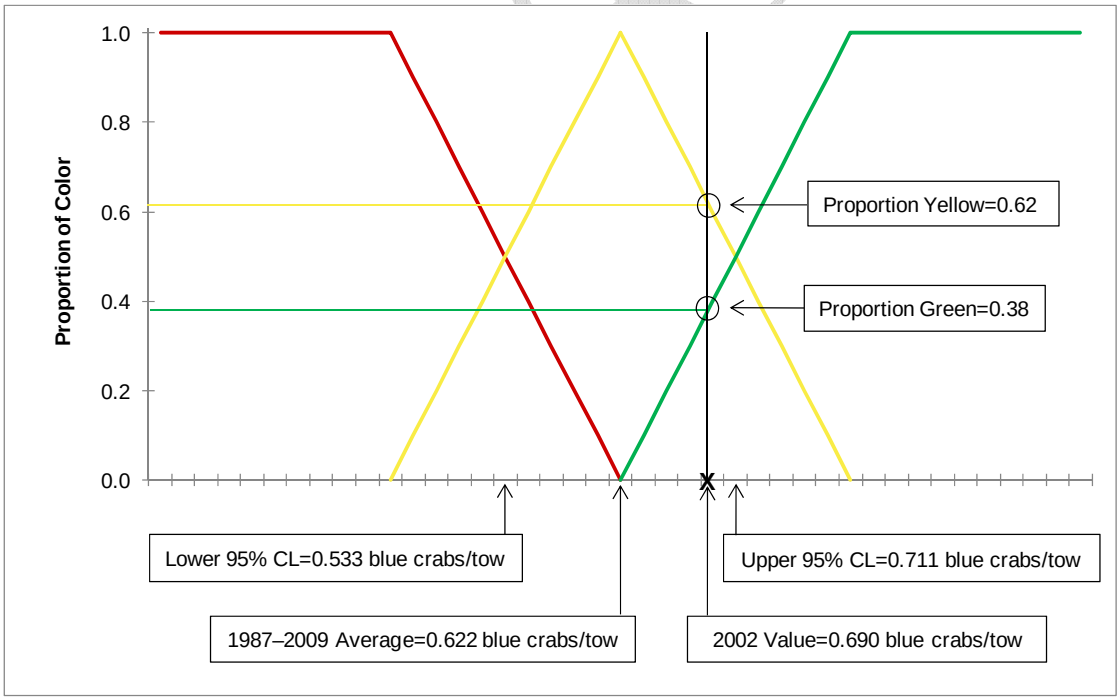

Figure 3.4. Example of Fuzzy Traffic Light scaling applied to the 2002 value of the Program 120 relative index of adult abundance for the Pamlico region. The 2002 value (0.690 blue crabs/tow) is represented by the "X" on the x-axis.

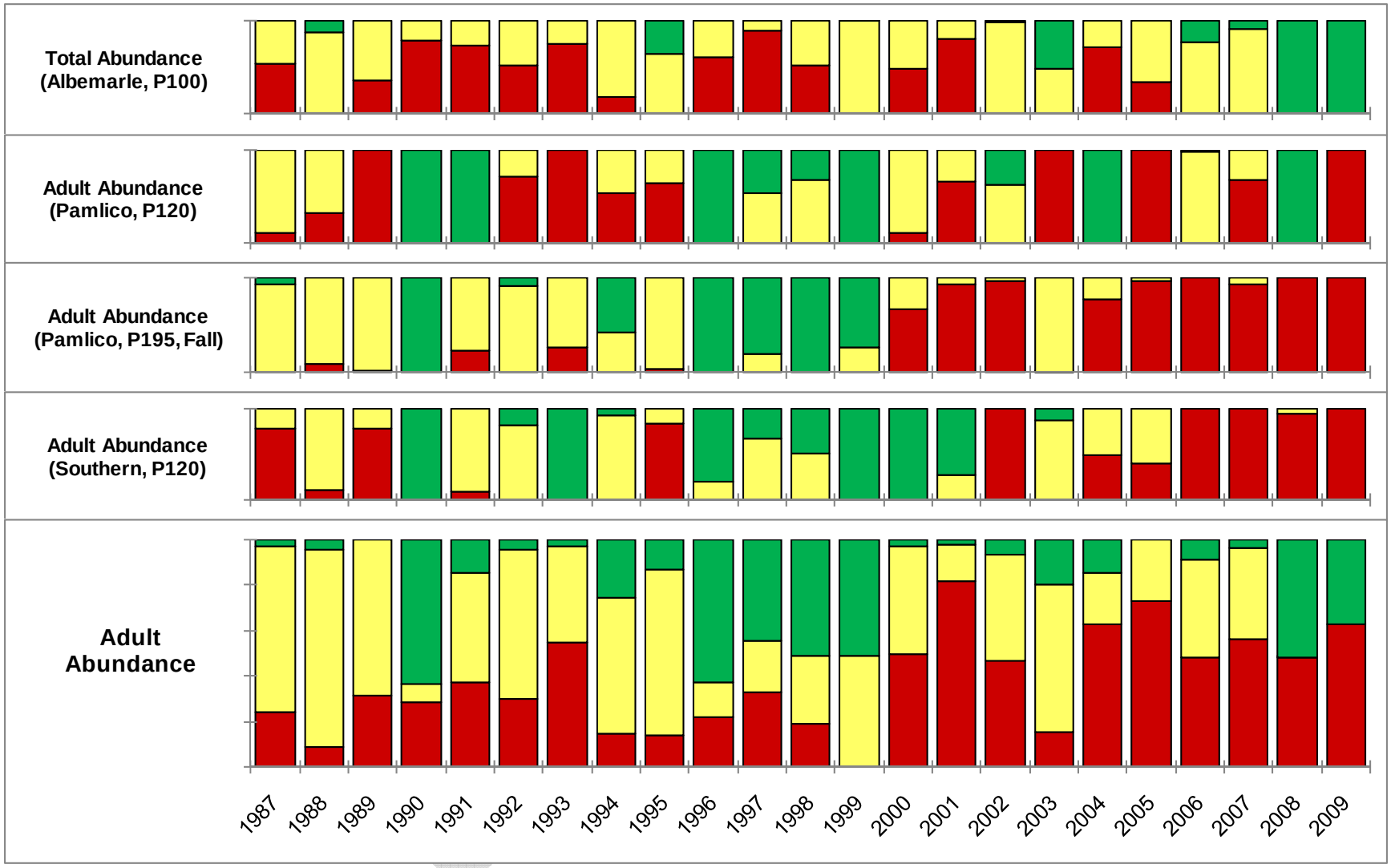

Figure 3.5. Traffic Light representations of individual adult abundance indicators and integrated summary (bottom figure).

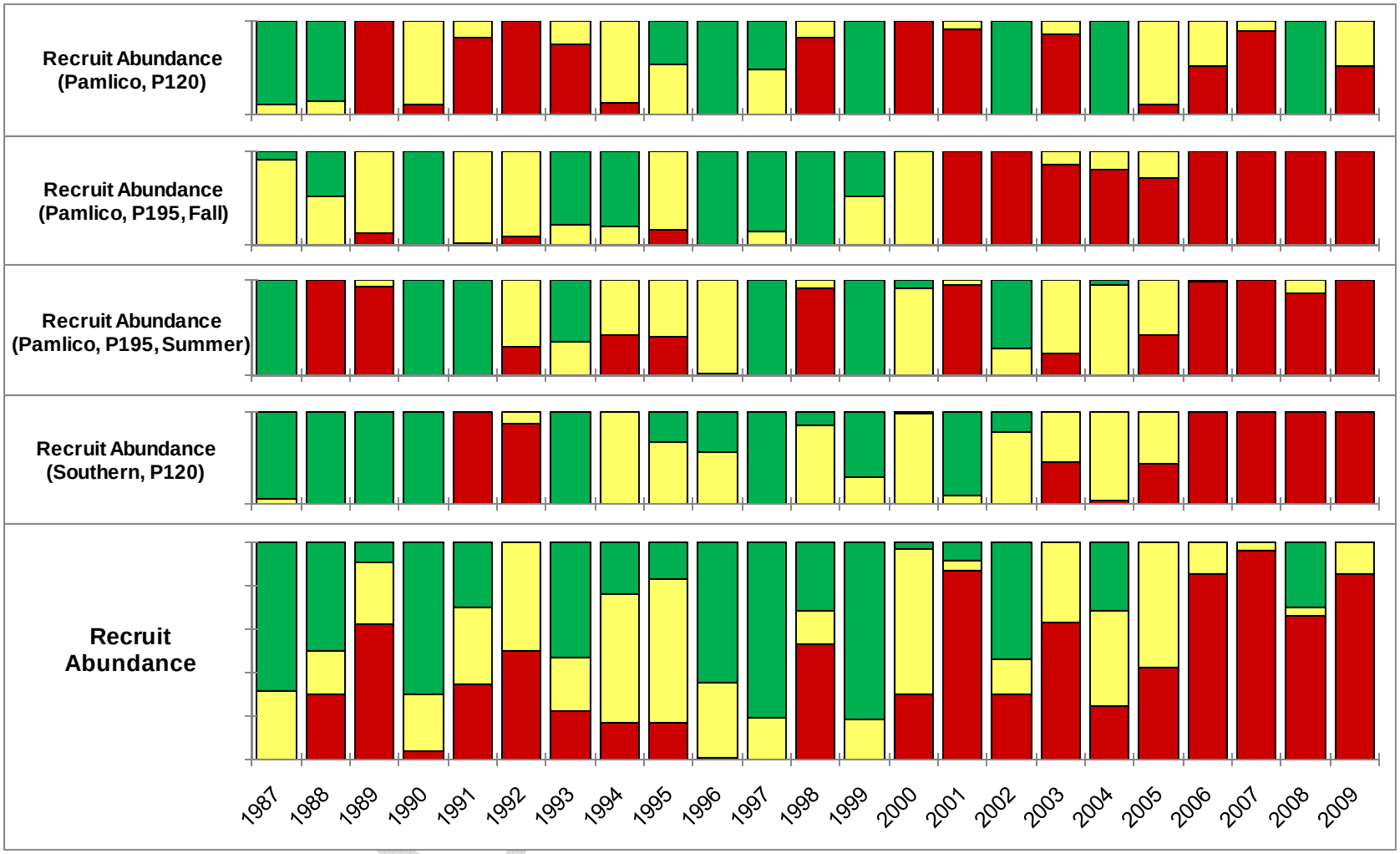

Figure 3.6. Traffic Light representations of individual recruit abundance indicators and integrated summary (bottom figure).

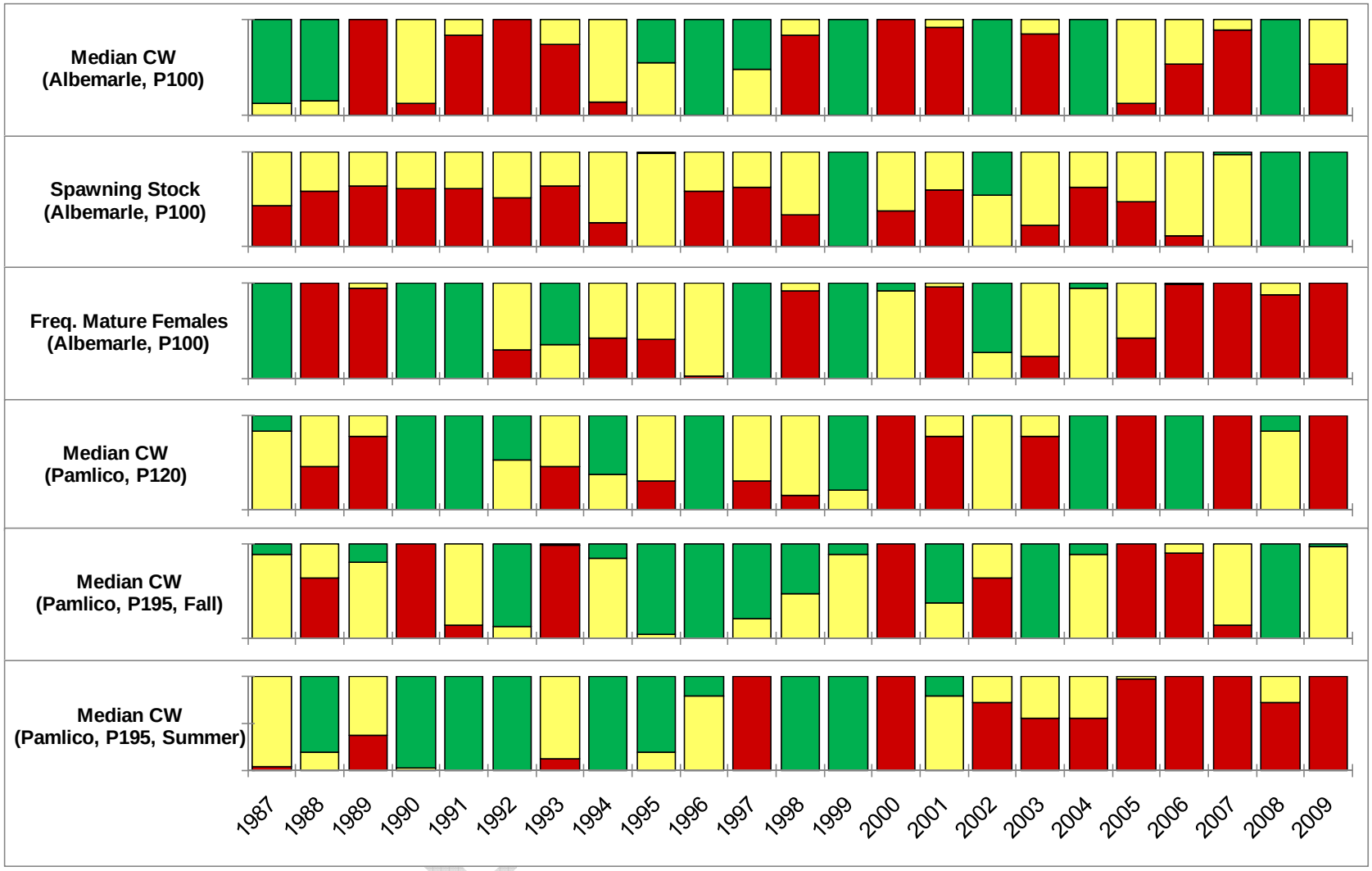

Figure 3.7. Traffic Light representations of individual production indicators and integrated summary (bottom figure—next page).

Figure 3.7 (*cont.*). Traffic Light representations of individual production indicators and integrated summary (bottom figure).

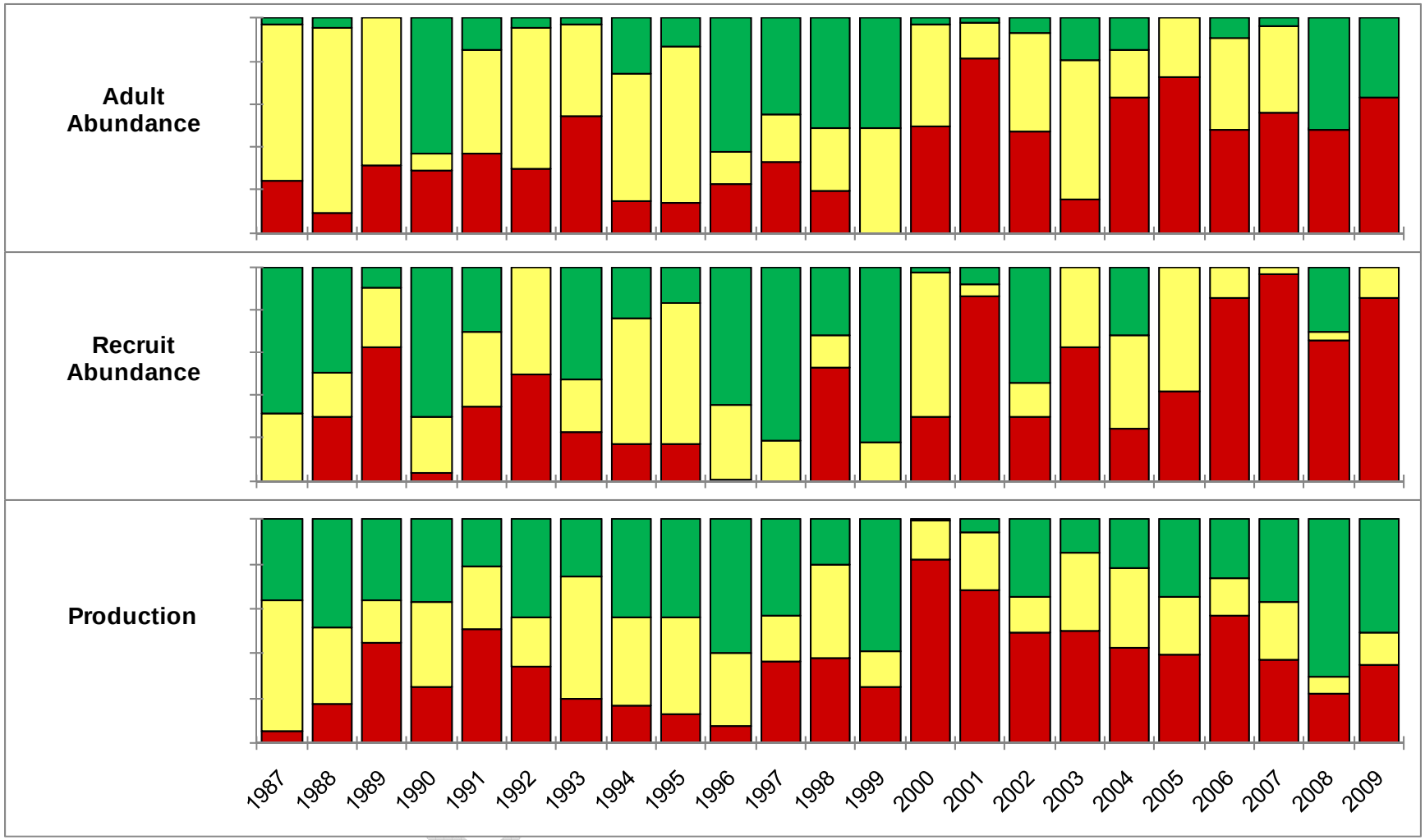

Figure 3.8. Traffic Light representations of adult abundance, recruit abundance, and production characteristics.

NORTH CAROLINA'S COASTAL HABITAT PROTECTION PLAN

2011 - 2013

BI-ANNUAL IMPLEMENTATION PLAN

FROM

NORTH CAROLINA MARINE FISHERIES COMMISSION,
NORTH CAROLINA COASTAL RESOURCES COMMISSION,
NORTH CAROLINA ENVIRONMENTAL MANAGEMENT COMMISSION, AND
NORTH CAROLINA WILDLIFE RESOURCES COMMISSION
AND
NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

September 2011

Introduction

The legislative goal of the NC Coastal Habitat Protection Plan (CHPP) is the long term enhancement of coastal fisheries associated with coastal habitats. Since 2004, when the CHPP was originally approved, North Carolina's environmental agencies and commissions have been working together to achieve this goal through the development of bi-annual implementation plans that work toward achieving the goals and recommendations of the CHPP.

Agencies involved with CHPP implementation include NC Department of Environment and Natural Resources (DENR) Divisions of Marine Fisheries (DMF), Coastal Management (DCM), Water Quality (DWQ), Ecosystem Enhancement Program (EEP), Environmental Health/Shellfish Sanitation (reorganized in July 2011 as a section under DMF), Forestry (DFR) (reorganized in July 2011 under the NC Department of Agriculture and Consumer Services), Parks and Recreation (DPR), Soil and Water Conservation (DSWC) (also reorganized in July 2011 under the NC Department of Agriculture and Consumer Services), and the Water Resources (DWR). The Wildlife Resource Commission joined the CHPP Steering Committee in 2010. Additional agencies involved in implementation of the CHPP include the Albemarle Pamlico National Estuary Program (APNEP), Duke University, National Estuarine Research Reserve (NERR), NC Sea Grant, National Oceanic and Atmospheric Administration (NOAA), US Army Corps of Engineers (ACE), and the Water Resources Research Institute (WRRI).

The first implementation plan covered the 2005-2007 period. There have been two updates (2007-2009, 2009-2011) to that original implementation plan. This document serves as the third update (2011-2013) to the original CHPP implementation plan.

Each division and commission was charged with developing bi-annual implementation actions that address the goals and recommendations of the CHPP. The CHPP was updated and approved in 2010 (http://portal.ncdenr.org/web/mf/59). The majority of the recommendations in that plan remained similar to the original recommendations, with a few additions and modifications (Appendix 2). The 2011-2013 Implementation Plan contains some ongoing actions from previous plans, new actions for previously existing recommendations, and some new actions for new recommendations contained in the 2010 CHPP.

By working together on complicated, multi-jurisdictional issues, the CHPP Steering Committee (CSC) has played a key role in accomplishing or making substantial progress on several environmental issues over the past six years. This included improving compliance on existing environmental rules, completion or major progress on mapping of shell bottom, SAV, and wetland shorelines, restoration of subtidal oyster reefs, increasing public awareness on environmental issues, supporting research and conducting analyses to identify Strategic Habitat Areas for focused protection, completion of a beach and inlet management plan, and passing of the coastal stormwater rules.

Over the next few years, successful implementation of a number of CHPP initiatives will be more difficult brought about by a reduction in funding and staff needed to work on these initiatives. The Department will realize budget cuts of approximately 28% over the next two years. A number of the reductions involved programs and personnel critical to the implementation of the CHPP and the restoration and protection of important fish habitats. Eastern North Carolina's economy is strongly linked to a healthy environment, including clean waters for swimming and shellfish harvesting and robust fish populations for recreational and commercial fishing. Studies compiled in the CHPP clearly show that degraded habitats and water quality negatively impact fish populations and the economy. With that in mind, the CSC remains committed to moving forward to protect our estuarine resources through execution of the 2011-2013 Implementation Plan.

Implementation of the CHPP will continue in the face of budget cuts, but progress will likely slow down given the reductions in staff and funding seen in each agency. Over the next two years, implementation will focus on:

Outreach to increase awareness of the value of habitat conservation, the effect of human activities on the environment, and voluntary means to reduce nonpoint pollution such as low impact development and proper use and disposal of endocrine disrupting chemicals like certain pesticides and prescription medications.

Monitoring and assessment of habitat conditions through continued mapping and monitoring, support of applicable research, and analysis of Strategic Habitat Areas.

Restoration of fish habitat, with particular focus on improving fish passage through obstruction removal or modification and developing non-traditional compensatory mitigation techniques to restore ecological functions where traditional mitigation is not feasible.

Protecting shallow wetlands and nursery areas by considering modifications of shoreline stabilization rules.

Below is a complete list of implementation actions that each agency has committed to working on in the next two-year cycle:

Division of Marine Fisheries

Goal 1: Improve effectiveness of existing rules and programs protecting coastal fish habitats

Rec	Action
1.2	Develop a data system for monitoring data and mapping the closure of shellfishing waters to enhance the sharing of information among Departmental Divisions.
1.3	Promote habitat conservation by creating informational materials highlighting life history, habitat use, and threats of focal species at festivals; 2) set up fish habitat displays, such as a marsh tank, for longer events; 3) seek funding for additional displays.
1.3	Incorporate CHPP materials into current DMF outreach activities (‘This Week at the Fisheries’ articles, Fish Eye News, Zoo FileZ).
1.3	Encourage CRFL projects related to habitat education.
1.4	Continue to review development issues and address environmental issues as they relate to the CAMA Land Use Planning Program.
1.6	Participate in state and federal efforts to control invasive aquatic species and educate staff and partner agencies.

Goal 2: Identify, designate and protect strategic habitat areas

Rec	Action
2.1a	Facilitate mapping of deep (>15 ft) estuarine bottoms, starting with lower Neuse River.
2.1b	Conduct cooperative DMF/NOAA research on methods for evaluating status and trends in SAV distribution and condition.
2.1b	Continue mapping of all shallow estuarine bottom and bottom types.

2.1b	Investigate SAV and shell bottom monitoring methods for trend assessments.
2.2	Complete SHA evaluation for Region 2.
2.2	Conduct groundtruthing of Region 1 SHA nominations.
2.2	Conduct SHA evaluation for Region 3.
2.2	Integrate resulting criteria and information from SHA committee into DENR Divisions' guidelines, policies, and rulemaking.
2.2	Study the feasibility and benefits of developing an SAV Restoration Program.
2.2	Work with DENR to include SHA priorities within EEP local watershed plans and DENR conservation planning tool.

Goal 3: Enhance habitat and protect it from physical impacts

Rec	Action
3.1a	Continue expanding the oyster sanctuary program.
3.1a	Cooperate with university researchers on oyster larvae distribution and movement investigations.
3.1a	Enhance oyster shell recycling program. Discourage use of shell material for landscaping or other uses besides shellfish cultch.
3.1a	Work with university researchers to monitor fish/invertebrate use of oyster sanctuaries and effect of oysters on local water quality.
3.1b	Make protection and restoration of critical fisheries habitats a priority part of the One North Carolina Naturally initiative, through incorporation of DMF data on habitat and SHAs.
3.1b	Obtain funding to restore designated streams and associated wetlands designated as anadromous fish spawning areas in the Albemarle Sound area as implementation steps for the River Herring Fishery Management Plan.
3.1b	Support efforts to restore SAV.
3.2	Work with the Division of Water Resources to minimize conflicts between Aquatic Weed Control practices and protection of SAV habitat
3.3	Evaluate through the FMP process the need for further restrictions of bottom-disturbing gear.
3.5b	Continue to study the feasibility and benefits of dam and barrier removal in general and for mitigation.
3.5b	Survey previously identified Albemarle Sound river herring spawning areas to estimate current condition and spawning function, and identify stream obstructions on river herring spawning streams.

Goal 4: Enhance and protect water quality

Rec	Action
4.1a	Seek funding to initiate research on impacts of endocrine-disrupting chemicals to blue crabs and oysters.
4.1a	Work with the Department of Agriculture and Consumer Services to develop and implement a drug disposal program for pharmaceuticals.
4.5b	DMF will seek grant funding to reduce stormwater runoff from the HQ property through use of stormwater infiltration, rain gardens, and shoreline marsh plantings.

4.6c	Form workgroup to determine water quality standards necessary to support SAV habitat.

Division of Coastal Management

Goal 1: Improve effectiveness of existing rules and programs protecting coastal fish habitats

Rec	Action
1.3	DCM will incorporate CHPP into their research and education efforts.
1.3	Distribute brochures and posters about fish, fish habitat, and fishing to be available for general distribution by DENR staff.
1.3	Provide information to focus students in K-12 understanding the biodiversity of lakes, streams, and estuaries.
1.4	Continue to review development issues and address environmental issues as they relate to the CAMA Land Use Planning Program.
1.5	Begin analysis of DCM's estuarine shoreline mapping project.

Goal 2: Identify, designate and protect strategic habitat areas

Rec	Action
2.1b	NERR will initiate emergent wetland vegetation monitoring of sentinel sites.
2.1c	Conduct research on the nursery role of SAV, oysters, and wetlands (through NERR in conjunction with UNC-IMS).
2.1c	Conduct research to manage intertidal oyster reefs in a changing climate (through NERR in conjunction with UNC-IMS).

Goal 3: Enhance habitat and protect it from physical impacts

Rec	Action
3.1c	Conduct research to determine if clams can enhance eel grass growth.
3.1c	Support efforts to restore SAV.
3.2	DCM will serve as a clearinghouse for beach nourishment monitoring data and distribute reports to review agencies.
3.2	Develop minimum criteria for monitoring beach nourishment projects.
3.4	Use shoreline mapping to develop methodology to determine estuarine shoreline recession rates.
3.4	Encourage alternatives to vertical shoreline stabilization methods through permit requirements and fees (including but not limited to refining rule 15A NCAC 07H .2700 GP for Marsh Sills).
3.4	Use NOAA grant to delineate estuarine shorelines; apply methods to CAMA counties.
3.7	Develop an interagency policy for marina siting to minimize impacts to ecologically important shallow habitats such as PNAs, AFSAs, and SAV.
3.8	Develop CRC Sea Level Rise Policy.
3.8	Teach the value and function of estuarine habitats, how these habitats may be affected by sea level rise, and alternative methods (other than bulkheads) of estuarine shoreline stabilization.

3.8	Develop a sea level rise education strategy including messages and audiences with CTP and other DCM staff utilizing the information gathered from the DCM's Sea Level Rise Perception Survey, APNEP's Climate Ready Estuary Program, and existing sea level rise educational materials available through the NERRS and other programs.

Goal 4: Enhance and protect water quality

Rec	Action
4.1c	Incorporate power washing BMPs into the Clean Marina Manual.
4.5a	Enhance DCM education efforts such as the N.C. NERR Septic Systems Workshops.
4.5a	Implement Pivers Island stormwater BMP project.
4.5e	Incorporate areas of high aquatic habitat value in addition to high terrestrial habitat value into the NC CELCP.
4.5f	Develop a clean boater initiative
4.7	Improve wastewater/stormwater management at coastal marinas
4.7	Inventory docks and piers in the 20 coastal counties.
4.7	North Carolina's Clean Marina Program and Clean Vessel Act activities will emphasize the threats to fish habitat and benefits of BMPs.
4.7	Seek dedicated funding to staff DCM's Clean Marina Program and effectively implement Best Management Practices as a non-regulatory way to improve water quality in and around marinas and docks.

Division of Water Quality

Goal 1: Improve effectiveness of existing rules and programs protecting coastal fish habitats

Rec	Action
1.3	Conduct outreach to educate citizens about DWQ's Neuse and Tar-Pamlico riparian buffer rules and 401 Water Quality Certification program.
1.3	Provide information to focus students in K-12 understanding the biodiversity of lakes, streams, and estuaries.
1.3	Implement workshops for engineers and consultants on stormwater, buffer, and 401 Water Quality Certifications.
1.4	Continue to review development issues and address environmental issues as they relate to the CAMA Land Use Planning Program.

Goal 2: Identify, designate and protect strategic habitat areas

Rec	Action
2.2	Study the feasibility and benefits of developing an SAV Restoration Program.

Goal 3: Enhance habitat and protect it from physical impacts

Rec	Action
3.1c	Support efforts to restore SAV.
3.5b	Continue to study the feasibility and benefits of dam and barrier removal in general and for mitigation.

Goal 4: Enhance and protect water quality

Rec	Action
4.1a	Work with the Department of Agriculture and Consumer Services to develop and implement a drug disposal program for pharmaceuticals.
4.1c	Incorporate power washing BMPs into the Clean Marina Manual.
4.4	Provide Phase II stormwater educational & technical assistance to local governments through the DENR Runoff Pollution Campaign and through partnerships with the Division of Community Assistance and UNC Institute of Government.
4.6b	Assess impacts of legislative changes to buffers in both the Neuse and Tar-Pamlico river systems.
4.6c	Form workgroup to determine water quality standards necessary to support SAV habitat.
4.7	Improve wastewater/stormwater management at coastal marinas.
4.8a	Support early implementation of environmentally superior alternatives to waste lagoon and spray field systems. Encourage commissions to express their support for early implementation.

<u>Wildlife Resources Commission</u>

Goal 1: Improve effectiveness of existing rules and programs protecting coastal fish habitats

Rec	Action
1.3	Promote habitat conservation through the Wildlife Action Plan (Green Toolbox) and Educational Centers.
1.3	Encourage CRFL projects related to habitat education.
1.4	Continue to review development issues and address environmental issues as they relate to the CAMA Land Use Planning Program.
1.6	Participate in state and federal efforts to control invasive aquatic species and educate staff and partner agencies.

Goal 2: Identify, designate and protect strategic habitat areas

Rec	Action
2.2	Conduct SHA evaluation and designation process for Pamlico Sound and tributaries (Region 2).
2.2	Conduct SHA evaluation and designation process for White Oak basin (Region 3).
2.2	Integrate resulting criteria and information from SHA committee into DENR Divisions'

	guidelines, policies, and rulemaking.
2.2	Study the feasibility and benefits of developing an SAV Restoration Program.

Goal 3: Enhance habitat and protect it from physical impacts

Rec	Action
3.1b	Obtain funding to restore designated streams and associated wetlands designated as anadromous fish spawning areas in the Albemarle Sound area as implementation steps for the River Herring Fishery Management Plan.
3.1b	Continue to study the feasibility and benefits of dam and barrier removal in general and for mitigation.
3.1b	Survey previously identified Albemarle Sound river herring spawning areas to estimate current condition and spawning function, and identify stream obstructions on river herring spawning streams.

Goal 4: Enhance and protect water quality

Rec	Action
4.1c	Work with NC State to develop a GIS-based map of potential sources of endocrine disrupting chemicals statewide.

<u>DENR</u>

Goal 1: Improve effectiveness of existing rules and programs protecting coastal fish habitats

Rec	Action
1.3	Develop and distribute brochures and posters about fish, fish habitat, and fishing to be available for general distribution by DENR staff.
1.3	The Department, through the Public Information Office will coordinate with the Zoo, Aquariums, Museum of Natural Sciences, State Parks, Educational State Forests and Environmental Education Centers to integrate the relevant components of the CHPP into exhibits and programs.

Goal 2: Identify, designate and protect strategic habitat areas

Rec	Action
2.1a	Complete and disseminate photo-interpretation of 2007-08 coast-wide SAV imagery.

Goal 3: Enhance habitat and protect it from physical impacts

Rec	Action
3.1b	DENR review of state agency requests to the Natural Heritage Trust Fund will place a priority on those proposals that would further the protection and restoration of critical fisheries habitats.
3.1b	Make protection and restoration of critical fisheries habitats a priority part of the One North

	Carolina Naturally initiative, such as developing conservation plans for the twenty coastal counties that identify potential conservation focus areas.
3.1b	The Department will assist coastal local governments in identifying navigation and stream restoration projects of particular importance to both fish and fisheries with grants from the State-Local projects program of the Division of Water Resources.
3.6	Provide support for ongoing marine spatial planning efforts (BOEM) task force.

Goal 4: Enhance and protect water quality

Rec	Action
4.4	Provide Phase II stormwater educational & technical assistance to local governments through the DENR Runoff Pollution Campaign and through partnerships with the Division of Community Assistance and UNC Institute of Government.
4.4	Pursue funding for the Community Conservation Assistance Program with emphasis on CHPP stormwater priorities in coastal counties.
4.8a	Support early implementation of environmentally superior alternatives to waste lagoon and spray field systems. Encourage commissions to express their support for early implementation.

Other Agencies

Goal 1: Improve effectiveness of existing rules and programs protecting coastal fish habitats

Rec	Agency	Action
1.1	DFR	Evaluate use of forestry BMPs at logging sites.
1.2	APNEP	The Department, through the APNEP, will develop a comprehensive monitoring plan for the estuarine system.
1.3	APNEP	Conduct outreach to educate citizens about DWQ's Neuse and Tar-Pamlico riparian buffer rules and 401 Water Quality Certification program.
1.3	DPR, APNEP, DSWC	Provide information to focus students in K-12 understanding the biodiversity of lakes, streams, and estuaries.
1.3	DFR	Enhance forestry BMP compliance with education videos, outreach projects, and guide books.
1.3	WRRI	Implement workshops for engineers and consultants on stormwater, buffer, and 401 Water Quality Certifications.
1.4	NC Sea Grant	Continue to review "Inner banks" development issues and address environmental issues
1.4	DFR	The DFR will revise its Memorandum of Agreement (MOA) documents with the NC Division of Land Resources and the NC Division of Water Quality to ensure compliance monitoring and enforcement policies are consistently practiced in a timely and seamless manner. These MOAs primarily address interdivisional communication on the nine forestry performance standards known as the Forest Practice Guidelines Related to

		Water Quality (FPGs) and the Riparian Buffer Rules applicable to NC's river basins.
1.5	DFR	Develop threshold criteria for determining when a noncompliant forestry operation directly contributes to a degradation or loss of in-stream aquatic habitat sufficient to warrant restoration or remediation of the affected water resource.

Goal 2: Identify, designate and protect strategic habitat areas

Rec	Agency	Action
2.1a	APNEP	Complete and disseminate photo-interpretation of 2007-08 coast-wide SAV imagery.
2.1a	APNEP	Conduct cooperative DMF/NOAA research on methods for evaluating status and trends in SAV distribution and condition.
2.2	EEP	Study the feasibility and benefits of developing an SAV Restoration Program.
2.2	EEP	Work with DENR to include SHA priorities within EEP local watershed plans and DENR conservation planning tool.

Goal 3: Enhance habitat and protect it from physical impacts

Rec	Agency	Action
3.1b	DSWC	DSWC encourage local SWCDs to include Strategic Habitat Areas and other CHPP priorities in local priority ranking system for the Agriculture Cost Share Program and the Community Conservation Assistance Program.
3.1b	DSWC	Include Strategic Habitat Areas as a priority area for CREP.
3.1b	DWR	The Department will assist coastal local governments in identifying navigation and stream restoration projects of particular importance to both fish and fisheries with grants from the State-Local projects program of the Division of Water Resources.
3.1b	DFR	The DFR will work with other DENR agencies to start pre-construction water quality and water quantity monitoring of 'The Canal'.
3.1b	EEP	Work with the Corps of Engineers and the Department of Transportation on innovative mitigation projects and an appropriate crediting system for them under the EEP. Such projects may include the protection and restoration of SAV and oyster beds, and the removal of certain dams and other aquatic organism barriers.
3.1b	APNEP, EEP	Obtain funding to restore designated streams and associated wetlands designated as anadromous fish spawning areas in the Albemarle Sound area as implementation steps for the River Herring Fishery Management Plan.
3.5b	EEP, ACE	Continue to study the feasibility and benefits of dam and barrier removal in general and for mitigation.

3.5b	EEP, ACE, DWR	The Department, through the Division of Water Resources and the Ecosystem Enhancement Program will pursue dam removal projects where appropriate.
3.1c	APNEP, EEP	Support efforts to restore SAV.

Goal 4: Enhance and protect water quality

Rec	**Agency**	**Action**
4.4	DSWC	Pursue funding for the Community Conservation Assistance Program with emphasis on CHPP stormwater priorities in coastal counties.
4.5a	Duke, NOAA	Implement Pivers Island stormwater BMP project.
4.5b	DFR	The DFR will begin long-term water quality and water quantity monitoring of Beddingfield Creek during 2007 in anticipation of implementing a 3,000+ acre watershed restoration effort in the Neuse River Basin.

APPENDIX 1. GLOSSARY OF ACRONYMS

ACE	US Army Corps of Engineers
APNEP	Albemarle Pamlico National Estuary Program
CHPP	Coastal Habitat Protection Plan
CSC	CHPP Steering Committee
DCM	Division of Coastal Management
DENR	Department of Environment and Natural Resources
DFR	Division of Forestry Resources
DMF	Division of Marine Fisheries
DSWC	Division of Soil and Water Conservation
DWQ	Division of Water Quality
DWR	Division of Water Resources
EEP	Ecosystem Enhancement Program
NERR	National Estuarine Research Reserve
NOAA	National Oceanic and Atmospheric Administration
SAV	Submerged Aquatic Vegetation
WRRI	Water Resources Research Institute

APPENDIX 2. CHPP GOALS AND RECOMMENDATIONS (DEATON ET AL. 2010)

GOAL 1. IMPROVE EFFECTIVENESS OF EXISTING RULES AND PROGRAMS PROTECTING COASTAL FISH HABITATS

1. Continue to enhance enforcement of, and compliance with, Coastal Resources Commission (CRC), Environmental Management Commission (EMC), Marine Fisheries Commission (MFC), and Wildlife Resources Commission (WRC) rules and permit conditions.
2. Coordinate and enhance water quality, physical habitat, and fisheries resource monitoring (including data management) from headwaters to the nearshore ocean.
3. Enhance and expand educational outreach on the value of fish habitat, threats from land-use and human activities, climate change, and reasons for management measures.
4. Coordinate rulemaking and data collection for enforcement among regulatory commissions and agencies.
5. Develop and enhance assessment and management tools for addressing cumulative impacts.
6. Enhance control of invasive species with existing programs.

GOAL 2. IDENTIFY, DESIGNATE, AND PROTECT STRATEGIC HABITAT AREAS

1. Support Strategic Habitat Area assessments by:
    a. Coordinating, completing, and maintaining baseline habitat mapping (including seagrass, shell bottom, shoreline, and other bottom types) using the most appropriate technology.
    b. Selective monitoring of the status of those habitats, and
    c. Assessing fish-habitat linkages and effects of land use and human activities on those habitats
2. Identify, designate, and protect Strategic Habitat Areas.

GOAL 3. ENHANCE HABITAT AND PROTECT IT FROM PHYSICAL IMPACTS

1. Expand habitat restoration in accordance with ecosystem restoration plans, including:
    a. Creation of subtidal oyster reef no-take sanctuaries.
    b. Re-establishment of riparian wetlands and stream hydrology.
    c. Restoration of SAV habitat and shallow soft bottom nurseries.
    d. Developing compensatory mitigation process to restore lost fish habitat functions.
2. Sustain healthy barrier island systems by maintaining and enhancing ecologically sound policies for ocean and inlet shorelines and implement a comprehensive beach and inlet management plan that provides ecologically based guidelines to protect fish habitat and address socio-economic concerns.
3. Protect habitat from fishing gear effects through improved enforcement, establishment of protective buffers around habitats, modified rules, and further restriction of fishing gears, where necessary.
4. Protect estuarine and public trust shorelines and shallow water habitats by revising shoreline stabilization rules to include consideration of erosion rates and prefer alternatives to vertical shoreline stabilization measures that maintain shallow nursery habitat.
5. Protect and enhance habitat for migratory fishes by:
    a. Incorporating the water quality and quantity needs of fish in water use planning and rule making.
    b. Eliminating or modifying obstructions to fish movements, such as dams and culverts, to improve fish passage.

6. Ensure that energy development and infrastructure is designed and sited in a manner that minimizes negative impacts to fish habitat, avoids new obstructions to fish passage, and where possible provides positive impacts.
7. Protect important fish habitat functions from damage associated with activities such as dredging and filling.
8. Develop coordinated policies including management adaptations and guidelines to increase resiliency of fish habitat to climate change and sea level rise.

GOAL 4. ENHANCE AND PROTECT WATER QUALITY

1. Reduce point source pollution discharge by:
    a. Increasing inspections of discharge treatment facilities, collection infrastructure, and disposal sites.
    b. Providing incentives for upgrading all types of discharge treatment systems.
    c. Develop standards and treatment facilities that minimize the threat of endocrine disrupting chemicals on aquatic life.
2. Adopt or modify rules or statutes to prohibit ocean wastewater discharges.
3. Prevent additional shellfish and swimming closures through targeted water quality restoration and prohibit new or expanded stormwater outfalls to coastal beaches and to coastal shellfishing waters (EMC surface water classifications SA and SB) except during times of emergency (as defined by the Division of Water Quality's Stormwater Flooding Relief Discharge Policy) when public safety and health are threatened, and continue to phase-out existing outfalls by implementing alternative stormwater management strategies.
4. Enhance coordination with, and financial/technical support for, local government actions to better manage stormwater and wastewater.
5. Improve strategies throughout the river basins to reduce non-point pollution and minimize cumulative losses of fish habitats through voluntary actions, assistance, and incentives, including:
    a. Improved methods to reduce pollution from construction sites, agriculture, and forestry.
    b. Increased on-site infiltration of stormwater.
    c. Documentation and monitoring of small but cumulative impacts to fish habitats from approved, un-mitigated activities.
    d. Encouraging and providing incentives for low impact development.
    e. Increased inspections of onsite wastewater treatment facilities.
    f. Increased water re-use and recycling.
6. Improve strategies throughout the river basins to reduce non-point pollution and minimize cumulative losses of fish habitats through rule making, including:
    a. Increased use of effective vegetated buffers.
    b. Implementing and assessing coastal stormwater rules and modify if justified.
    c. Modified water quality standards that are adequate to support SAV habitat.
7. Maintain adequate water quality conducive to the support of present and future aquaculture.
8. Reduce non-point source pollution from large-scale animal operations by the following actions:
    a. Support early implementation of environmentally superior alternatives to the current lagoon and spray field systems as identified under the Smithfield Agreement and continue the moratorium on new/expanded swine operations until alternative waste treatment technology is implemented.
    b. Seek additional funding to phase-out large-scale animal operations in sensitive areas and relocate operations from sensitive areas, where necessary.
    c. Use improved siting criteria to protect fish habitat.

APPENDIX 3. CHPP STEERING COMMITTEE MEMBERS, 2009–2010

Marine Fisheries Commission

Ms. Anna Beckwith	Morehead City	252-671-3474
Dr. B. J. Copeland	Pittsboro	919-837-5024

Environmental Management Commission

Dr. Charles H. Peterson	Morehead City	252-726-6841
Mr. Tom Ellis	Raleigh	919-872-0897

Coastal Resources Commission

Ms. Joan Weld	Currie	910-283-4521
Mr. Bob Emory	New Bern	252-633-7417

Wildlife Resources Commission

Mr. Bobby Purcell	Cary	919-387-0465
Mr. Ray White	Manteo	252-441-4464

Atlantic States Marine Fisheries Commission

2011 Summer Meeting Summary

Working towards healthy, self-sustaining populations of all Atlantic coast fish species or successful restoration well in progress by the year 2015

2011 Summer Meeting
Alexandria, Virginia
August 1-4, 2011

For more information, please contact
the identified individual,
Robert Beal, ISFMP, or
Tina Berger, Public Affairs

703.842.0740

Meeting Summaries, Press Releases and Motions

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AMERICAN LOBSTER MANAGEMENT BOARD (August 1, 2011)

Press Release

ASMFC American Lobster Board Approves Draft Addendum XVII for Public Comment: *Addendum Seeks to Reduce Exploitation on Southern New England Stock by 10%*

Alexandria, VA – The Commission's American Lobster Management Board has approved Draft Addendum XVII for public comment and review. The Draft Addendum presents a suite of management options to reduce fishing exploitation on the Southern New England stock of American lobster by 10% starting in July 2013. The proposed 10% reduction would come from changes in the minimum size limit, maximum size limit, and/or closed seasons. Proposals would be developed for each affected Lobster Conservation Management Area (2, 3, 4, 5, and 6) to meet the 10% reduction as outlined in the Draft Addendum.

In taking this proposed action, the Board indicated that the 10% reduction in exploitation is the first step in responding to Technical Committee advice for significant exploitation reductions over the long-term to initiate Southern New England stock rebuilding.

The Southern New England lobster stock is at low levels of abundance and experiencing persistent low recruitment caused by a combination of environmental factors and continued fishing mortality. It is this low recruitment that is preventing the Southern New England stock from rebuilding. Under the assumptions of poor recruitment and very high natural mortality, the Technical Committee is not certain that the stock would recover to the target level under a total fishery moratorium.

States will be conducting hearings on the Draft Addendum; the details of those hearings will be released when they become available. Fishermen and other interested groups are encouraged to provide input on the Draft Addendum either by attending public hearings or providing written comments. Copies of the Draft Addendum will be available by August 24, 2011 via the Commission's website (www.asmfc.org) under Breaking News or by contacting the Commission at 703.842.0740. Public comment will be accepted until 5:00 PM (EST) on October 14, 2011 and should be forwarded to Toni Kerns, Senior FMP Coordinator, 1050 N. Highland St, Suite A-N, Arlington, VA 22201; 703.842.0741 (FAX) or at tkerns@asmfc.org (Subject line: Draft Addendum XVII). The Board will meet in November at the Commission's Annual Meeting to review public comment and consider final action on the Addendum.

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PR11-25

Motions

Main Motion:

Move to approve Draft Addendum XVII to Amendment 3 for public comment.

Motion made by Mr. White and seconded by Mr. Stockwell. Motion amended.

Motion to Amend:

Move to amend for Section 3 to allow these measures to be implemented by LCMA.

Motion made by Mr. Nowalsky and seconded by Mr. Augustine. Motion substituted.

Motion to Substitute:

Move to substitute that we change the objective to reduce exploitation in the SNE stock by 10% in

each LCMA to initiate rebuilding of the SNE stock and enable each jurisdiction to prepare their fishing industries for more substantive reductions in a subsequent addendum.
Motion made by Mr. Simpson and second by Mr. McElroy. Motion carries (In Favor – MA, RI, CT, NJ, DE; Opposed – ME, NH, MD, NMFS; Abstentions – VA, NC; Null – NY).

Substituted Motion:
Move to amend "that we change the objective to be reduce exploitation in the SNE stock by 10% in each LCMA to initiate rebuilding of the SNE stock and enable each jurisdiction to prepare their fishing industries for more substantive reductions in a subsequent addendum."
Motion amended.

Motion to Amend Substituted Motion:
Move to amend to remove option 1 under issue C (closed season) of option 3 (page 24) the last paragraph.
Motion made by Rep. Peake and seconded by Mr. Simpson. Motion passes (6 in favor, 4 opposed, 2 abstentions).

Amended Substitute Motion:
Move to amend "that we change the objective to be reduce exploitation in the SNE stock by 10% in each LCMA to initiate rebuilding of the SNE stock and enable each jurisdiction to prepare their fishing industries for more substantive reductions in a subsequent addendum and to remove option 1 under issue C (closed season) of option 3 (page 24) the last paragraph.
Motion passes (6 in favor, 2 abstentions).

Main Motion as Amended/Substituted:
Move to approve Draft Addendum XVII to Amendment 3 for public comment as amended to change the objective to "reduce exploitation in the SNE stock by 10% in each LCMA to initiate rebuilding of the SNE stock and enable each jurisdiction to prepare their fishing industries for more substantive reductions in a subsequent addendum" and to remove option 1 under issue C (closed season) of option 3 (page 24) the last paragraph.
Motion passes (7 in favor, 3 opposed, 2 abstentions).

ATLANTIC STRIPED BASS MANAGEMENT BOARD (August 1, 2011)

Meeting Summary
The Atlantic Striped Bass Management Board reviewed Draft Addendum III, which contained management options to reduce fishing mortality up to 40% and provide increased protection for the stock when it is concentrated and vulnerable. The Draft Addendum was initiated due to increased concern over declining catch and abundance, as well as low recruitment. Additionally, there is increasing uncertainty and concern over the prevalence of mycobacteriosis in Chesapeake Bay striped bass. The Board postponed releasing the Draft Addendum for Public Comment, pending the results of the Stock Assessment Update in November. For more information, please contact Kate Taylor, Fishery management Plan Coordinator, at ktaylor@asmfc.org or 703.842.0740.

Motions
Main Motion:
Move to approve the addendum for public comment.
Motion made by Mr. Grout and seconded by Terry Stockwell. Motion substituted.

Motion to Substitute:
Move to substitute to postpone this issue until the November meeting when the Board will receive the stock assessment.
Motion made by Mr. Carpenter and seconded by Mr. Augustine. Motion carries (In Favor – MA, RI, CT, NY, NJ, PA, DE, MD, DC, VA, PRFC, NC, NMFS, USFWS; Opposed – ME, NH).

Main Motion as Substituted:
Move to postpone this issue until the November meeting when the Board will receive the stock assessment.
Motion made by Mr. Carpenter and seconded by Mr. Augustine. Motion carries (14 in favor, 2 opposed).

ATLANTIC HERRING DAYS OUT MEETING (August 1, 2011)

Meeting Summary
Commissioners from the States of Maine, New Hampshire, and the Commonwealth of Massachusetts selected 'days out' effort control measures for the remainder of the 2011 June – September quota period in Area 1A. 'Days out' of the fishery is the primary management measure to prevent early closures and provide herring when demand is greatest.

Updated projections show that consistent with the 2010 fishing season, 2011 catch rates are lower than projected. To ensure that the June – September allocation is fully harvested, Commissioners agreed to set 0 days out (7 landing days) for August 8 – September 30, 2011. Landings will be monitored closely, and Commissioners will quickly convene a 'days out' meeting to reduce landing days if necessary.

Vessels are prohibited from landing more than 2,000 pounds of Atlantic herring on a 'day out' of the fishery. Fixed gear fishermen may remove and land herring from the gear (weirs and stop seines) on the closed days. For more information, please contact Christopher Vonderweidt at cvonderweidt@asmfc.org or 703.842.0740.

Motions
No motions made.

TAUTOG MANAGEMENT BOARD (August 2, 2011)

Meeting Summary
The Tautog Management Board met to review 2010 state compliance and consider state proposals to implement Addendum VI. The Plan Review Team presented findings that all states met or exceeded all Fishery Management Plan (FMP) measures in 2010. Delaware and North Carolina met the requirements for *de minimis* status in the 2011. Following the presentation, the Board accepted the 2010 Tautog FMP Review and *de minimis* status for Delaware and North Carolina in 2011. *De minimis* status allows a state to apply their recreational regulations to their commercial fishery (bag/size limits). States are still required to implement recreational or monitoring measures in the FMP.

The next order of business was a Technical Committee (TC) review of state proposals to implement the Addendum VI F_{target} = 0.15. Based on the coastwide assessment ($F_{coastwide}$ = 0.38), states must implement regulations to achieve a 53% reduction in harvest to achieve the F_{target}= 0.15. Addendum VI allows states that can demonstrate a regional F that is lower than the coastwide assessment "at the same level of precision as the coastwide assessment" to only reduce harvest based on their regional F rate. The TC

provided a guidance document to help states calculate reductions on June 19, states submitted proposals for TC review around July 15, and the TC held its meeting to review state proposals on July 25, 2011. Massachusetts and Rhode Island submitted a regional VPA assessment (MA/RI VPA) using identical methodology as the coastwide assessment and demonstrating a regional F below the target. The TC endorsed the MA/RI VPA as at the same level of precision as the coastwide assessment based on a mean square residual (MSR) value of 0.69 compared to MSR = 0.61 for the coastwide assessment. The TC also noted that Rhode Island voluntarily lowered its private recreational bag and vessel limit in 2010, and combined MA/RI harvest was reduced by 25% in 2008 even though these states were only required to reduce harvest by 12%. The Board reviewed and unanimously approved the MA/RI VPA proposal.

Due to a lack of fishery-independent data, several states are unable to run a regional VPA and directly compare precision with a metric in the coastwide VPA. New York, Maryland, and Virginia submitted catch curve analyses demonstrating lower regional F's than the coastwide assessment for TC review. The TC could not determine the precision of the New York or Maryland catch curve analyses and suggested some modifications. The TC did not suggest any modifications to the Virginia catch curve proposal and recommended that the Board consider the analysis. After considering the TC's review, the Board agreed to postpone taking action on all catch curve proposals until the ASMFC Annual Meeting, allowing New York and Maryland to modify their proposals as requested by the TC.

The TC found that regulations in state plans to achieve a 53% reduction are risk neutral for Connecticut, New York, Delaware, Maryland, and Virginia. The Board unanimously approved these states proposals to achieve the 53% reduction based on the TC recommendations. Following the approval of these plans, the Board agreed that states will submit all new and revised proposals by September 15, 2011 to allow for TC review prior to the November ASMFC meeting week. All states will be required to implement regulations to implement Addendum VI by January 1, 2012.

For more information, please contact Christopher Vonderweidt at cvonderweidt@asmfc.org or 703.842.0740.

Motions

Move to accept the FMP Review.
Motion made by Mr. Simpson and seconded by Mr. Gilmore. Motion passes unanimously.

Move to grant *de minimis* status for NC and DE.
Motion made by Mr. Augustine and seconded by Mr. McElroy. Motion passes unanimously.

Move that the Board approve the MA/RI regional VPA and not require that they need to implement Addendum VI reductions.
Motion made by Dr. Pierce and seconded by Mr. McElroy. Motion passes (10 in favor).

Move to approve CT, NY, DE and VA proposals that achieve the required 53% reduction. Motion made by Mr. Travelstead and seconded by Mr. Adler. Motion passes unanimously.

Move that VA catch curve analysis and associated options be approved.
Motion made by Mr. Travelstead and seconded by Dr. Pierce. Motion postponed until Annual Meeting.

Move to postpone to the Annual Meeting.
Motion made by Mr. Himchak and seconded by Mr. Augustine. Motion passes (9 in favor, 1 opposed).

SPINY DOGFISH & COASTAL SHARKS MANAGEMENT BOARD (August 2, 2011)

Meeting Summary

The Spiny Dogfish & Coastal Sharks Management Board met to consider state compliance with the Spiny Dogfish Fishery Management Plan (FMP) during the 2009/2010 fishing season; and review smooth dogfish management measures and landings, state coastal sharks possession limit regulations, the Shark Conservation Act of 2010, and the federal electronic highly migratory species (HMS) dealer proposed rule.

The Spiny Dogfish Plan Review Team (PRT) presented findings that all states met or exceeded all FMP measures in the 2009/2010 fishing and Delaware, South Carolina, Georgia, and Florida met the requirements for *de minimis* status in the 2010/2011 fishing season. The Board accepted the 2009/2010 Spiny Dogfish FMP Review and approved *de minimis* status for Delaware, South Carolina, Georgia, and Florida for the 2010/2011 fishing season. *De minimis* status exempts a state from the commercial biological sampling measures in the FMP.

Staff presented a whitepaper of smooth dogfish management measures, including state and federal measures that apply to smooth dogfish, a discussion of landings, and an example of state shares based on landings from 1998 – 2007. The Board instructed the Spiny Dogfish Plan Development Team (PDT) to draft an addendum with state shares based on landings from 1998 – 2007, 1998 – 2010, and a five-year moving average. The draft addendum will also contain a discussion of how a significant increase in the quota could be allocated equally in the future.

Staff also presented a whitepaper regarding each states timeline to modify their coastal shark possession limits. The Board had requested that staff prepare the whitepaper because NMFS Division of Highly Migratory Species (HMS) indicated that it may use in-season adjustments to possession limits as a quota allocation tool. The presentation addressed the possibility of in-season reductions where the federal possession limit for a species complex is set at zero for a time period or where the possession limit is simply reduced. The Board agreed that staff should treat a zero possession limit in federal waters as a federal waters closure, and state waters should close accordingly based on the FMP measure that state waters must close when adjacent federal waters are closed. Regarding a reduced possession limit, it was noted that adjustments to an already established possession limit (in-season adjustments) can only happen with a 2/3 vote during a Board meeting.

The Board received an update of the Shark Conservation Act of 2010 which prohibits fishermen from removing shark fins at sea (including the head and tail), with the exception of smooth dogfish. The Act contains a savings clause that allows individuals engaged in commercial fishing for smooth dogfish that hold a valid state commercial permit, and are fishing between shore and 50 nautical miles, to remove smooth dogfish fins as long as the fin to carcass ratio does not exceed 12%.

The final order of business before the Board was a review of the proposed rule to implement electronic reporting in federal waters HMS fisheries. The rule proposes to require first receivers of coastal sharks to hold a dealer permit and dealers to report within 24 hours of receiving sharks, and includes a provision that delinquent reports must be submitted before a dealer can receive more sharks. The proposed rule indicates that HMS may reconsider what percentage of harvest would trigger a closure (currently 80%) based on the timeliness of the electronic reports. The Board unanimously approved a motion recommending the Policy Board send a letter in support of the proposed rule. For more information, please contact Christopher Vonderweidt at cvonderweidt@asmfc.org or 703.842.0740.

Motions

Move to approve the *de minimis* requests from DE, GA, SC and FL and accept the FMP review.
Motion made by Mr. Augustine and seconded by Mr. Elroy. Motion passes with objection.

Move to initiate an addendum to the coastal shark FMP to include a state by state allocation for smooth dogfish to be implemented in 2012 or as soon as possible.
Motion made by Mr. Augustine and seconded by Mr. Adler. Motion carries (12 in favor, 4 abstentions).

Move to have the Board recommend to the Policy Board to write a letter supporting the HMS electronic dealer reporting requirements as proposed.
Motion made by Mr. Augustine and seconded by Mr. Bellavance. Motion approved.

ATLANTIC MENHADEN MANAGEMENT BOARD (August 2, 2011)

Press Release

ASMFC Atlantic Menhaden Board Approves Draft Addendum V for Public Comment

Alexandria, VA – The Commission's Atlantic Menhaden Management Board has approved Draft Addendum V to Amendment 1 to the Interstate Fishery Management Plan for Atlantic Menhaden for public comment. The Draft Addendum proposes establishing a new interim fishing mortality threshold and target (based on maximum spawning potential or MSP) with the goal of increasing abundance, spawning stock biomass, and menhaden availability as a forage species.

The Draft Addendum will also initiate the scoping process (comparable to that of a Public Information Document) on the suite of management tools that could be used to implement the new fishing mortality threshold and target levels. As in a PID, it will contain preliminary discussions of biological, environmental, social, and economic information, fishery issues, and potential management options for action through an addendum.

The MSP approach, as recommended by the 2009 peer review panel, identifies the fishing mortality rate necessary to maintain a given level of stock fecundity (number of mature ova) relative to the potential maximum stock fecundity under unfished conditions. The Draft Addendum presents two options for the new interim fishing mortality threshold (status quo based on an MSP of 8% and an MSP of 15%) and four options for the interim fishing mortality target (status quo and F based on MSPs of 20, 30 and 40%). For illustration purposes, a 15% MSP would equate to a fishing mortality rate threshold required to maintain approximately 15% of virgin stock fecundity. The current MSP level is 8%.

Based on the revised 2009 Atlantic menhaden stock assessment, menhaden was not overfished but had experienced overfishing in 2008. Given the current overfishing definition, which sets the fishing mortality rate (F) target at 0.96 and the F threshold at 2.2, this is the first time overfishing has occurred since 1998. Over the time series, overfishing had occurred in 32 of the last 54 years. F in 2008 (the latest year in the assessment) is estimated at 2.28.

States will be conducting hearings on the Draft Addendum; the details of those hearings will be released when they become available. Staff will be finalizing the Draft Addendum over the next couple of weeks. A subsequent announcement will be made once it is available for public comment. The Board will meet in November at the Commission's Annual Meeting to review public comment and consider final action on the Addendum. Having gathered scoping information on management tools to implement Addendum V, the Board

will also consider moving forward on a subsequent addendum to establish associated management measures. The Board's intent is to finalize these management measures for implementation in 2013.

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PR11-28

Motions
Main Motion:
Move to adopt Draft Addendum V for public comment with one change: remove Options 3 through 5 from section 2.3.1.
Motion made by Mr. Grout and seconded by Mr. McElroy. Motion substituted.

Motion to Substitute:
Move to substitute to adopt Draft Addendum V for public comment.
Motion made by Mr. Fote and seconded by Mr. Augustine. Motion passes (In Favor – NH, MA, CT, NY, NJ, DE, MD, NC, SC, GA, FL, NMFS, USFWS: Opposed – ME, RI, VA, Abstention – PRFC).

Main Motion as Substituted:
Move to adopt Draft Addendum V for public comment.
Motion made by Mr. Fote and seconded by Mr. Augustine. Motion carries.

Move to accept the FMP Review and approve the *de minimis* status for South Carolina, Georgia, and Florida.
Motion made by Mr. Adler and seconded by Mr. Augustine. Motion carries unanimously.

Move to add Dr. Amy Schueller to the Menhaden Plan Review Team
Motion made by Mr. Meyers and seconded by Dr. Geiger. Motion carries.

WEAKFISH MANAGEMENT BOARD (August 3, 2011)

Meeting Summary
The Weakfish Management Board reviewed the Technical Committee's (TC) report on the adequacy of North Carolina's conservation equivalency measure of a 10% bycatch allowance with a 1,000 lb trip limit in lieu of the 100 lb commercial trip limit. After North Carolina implemented conservation equivalency in August 2010, 17% of trips were non-compliant resulting in the landing of roughly 19,500 pounds through December 2010. However, from January 2011 through April 2011, North Carolina had better compliance with only 5% non-compliant trips at 1,150 pounds. The Board tasked the TC to provide another update at the November 2011 Board meeting.

The Board also reviewed the TC report on weakfish modeling work completed by Dr. Yan Jiao at Virginia Tech University. The TC recommended using the improved statistical catch at age models with time varying natural mortality in the next weakfish benchmark stock assessment scheduled for 2014.

Motions
No motions made.

SHAD & RIVER HERRING MANAGEMENT BOARD (August 3, 2011)

Meeting Summary

The Shad and River Herring Board was briefed on the timeline for implementation on the New England Fishery Management Council's (NEFMC) Amendment 5 to the Atlantic Herring FMP and the Mid-Atlantic Fishery Management Council's (MAFMC) Amendment 14 to the Squid, Mackerel and Butterfish FMP. Both Amendments are currently being developed to address bycatch of shad and river herring in federal fisheries. The Amendments are expected to be finalized in 2012, with implementation in 2013. Additionally the Management Board responded to a request from the MAFMC to formalize coordination on the reporting of significant issues relating to alosines. The Board also reviewed a motion that was postponed from the March 2011 Board meeting to send a letter to the MAFMC stating its preferred management and monitoring alternatives in Amendment 14, including a statement on the potential for shad and river herring to be added as a "stock in the fishery" to the Squid, Mackerel and Butterfish FMP . The Board was briefed on the alternatives that are being developed by the MAFMC, as well as the implications on a "stock in the fishery" designation. The Board requested additional analysis on the "stock in the fishery" designation for the November meeting.

The Board was updated on the implementation of Amendment 2 (river herring) and 3 (American shad). Four states – Maine, New Hampshire, North Carolina and South Carolina – have submitted River Herring Sustainable Fishery Management Plans (SFMPs), as required under Amendment 2, that have been approved by the Board. New York has informed the Commission that it will also be submitting a SFMP, which will be reviewed by the Board in November. Jurisdictions without an approved plan in place are required to close their commercial and recreational river herring fisheries and prohibit the retention of river herring harvested in state waters by January 1, 2012. Two states – Maryland and South Carolina – have submitted American Shad SFMPs, as required under Amendment 3. Connecticut, North Carolina, Georgia, Florida and the Delaware Basin Cooperative (New Jersey, Pennsylvania, Delaware and New York) have all informed the Commission that they will also be submitting American Shad SFMPs. These SFMPs will all be reviewed by the Board in November. Jurisdictions without an approved plan in place are required to close their commercial and recreational American shad fisheries, with the exception of catch and release fisheries, by January 1, 2013.

For more information, please contact Kate Taylor, Fishery Management Plan Coordinator, at ktaylor@asmfc.org or 703.842.0740.

Motions

Move that we accept the procedures identified in the whitepaper that was developed by staff and the AP recommendations including use of the communication tool of webinars and related devices to access all user groups.

Motion made by Mr. Augustine and second by Mr. Young. Motion passes (19 in favor).

Move that we support section 1 – 8 of the document.

Motion made by Mr. Augustine and seconded by Rep. Peake. Motion passes (18 in favor, 1 abstention).

Move to recommend that the ISFMP Policy Board send a letter to the Mid Atlantic Council stating that the ASMFC does not oppose the removal of Alternative Set 9 from Amendment 14.

Motion made by Mr. Stockwell and second by Mr. Carpenter. Motion postponed until November 2011 meeting.

Motion to postpone until the November 2011 meeting.

Motion made by Dr. Kray and seconded by Mr. Adler. Motion passes (17 in favor).

EXECUTIVE COMMITTEE (August 3 & 4, 2011)

Meeting Summary
The Executive Committee received an update on federal fisheries policy issues from Eric Schwaab, NOAA's Assistant Administrator for Fisheries, as well as discussed issues of mutual concern. In a subsequent session, the Committee received an update on legislative activities and discussed its ongoing legislative strategy. The Committee discussed details related to the planning of the 2011 and 2012 Annual Meetings. For more information, please contact Laura Leach, Director of Finance and Administration, at lleach@asmfc.org or 703.842.0740.

Motions
No motions made.

SOUTH ATLANTIC STATE/FEDERAL FISHERIES MANAGEMENT BOARD (August 4, 2011)

Meeting Summary
Please see press release on the approval of the Omnibus Amendment for Spot, Spotted Seatrout and Spanish Mackerel on page 18.

Motions
Move to accept PRT report.
Motion made by Mr. Cole and seconded by Dr. Rhodes. Motion carries without opposition.

Motion to approve spot option 2 under the stock status.
Motion made by Dr. Laney and seconded by Mr. Cole. Motion carries without opposition.

Move to adopt option 2 under spot recreational measures.
Motion made by Dr. Laney and seconded by Mr. Cole. Motion carries without opposition.

Move to accept option 2 for Spanish mackerel under recreational measures removing the permitted gear specifications and remove the permit requirement.
Motion made by Mr. O'Connell and seconded by Mr. Carpenter. Motion carries without opposition.

Move to accept option 2 for spotted seatrout recreational management measures but move the monitoring and management measures to reach a 20% spawning potential ratio to the recommended management measures section.
Motion by Dr. Duval and seconded by Mr. Woodward. Motion carries.

Move to adopt option 2 of spot commercial management measures.
Motion made by Mr. Cole and seconded by Dr. Rhodes. Motion carries without opposition.

Move to accept option 2 for Spanish mackerel for commercial management measures removing the permitted gear specifications and removing the permit requirement.
Motion made by Mr. O'Connell and seconded by Mr. Cole. Motion carries.

Move to accept option 2 for spotted seatrout commercial management measures but move the monitoring and management measures to reach a 20% spawning potential ratio to the recommended management measures section.
Motion made by Dr. Duval and seconded by Dr. Rhodes. Motion carries without opposition.

Move to adopt option 1 for the *de minimis* criteria for all species.
Motion made by Mr. Cole and seconded by Mr. Woodward. Motion carries without opposition.

Move to allow the exemption of monitoring requirements for *de minimis* states.
Motion made by Mr. Fote and seconded by Mr. Carpenter. Motion carries without opposition.

Motion to submit draft implementation plans for spot and spotted seatrout by October 15, 2011.
Motion made by Mr. Carpenter and seconded by Mr. Cole. Motion carries.

Move that states submit their implementation plans for Spanish mackerel by March 15, 2012.
Motion made by Mr. O'Connell and seconded by Dr. Duval. Motion carries without opposition.

Move to implement the Omnibus Amendment by July 1, 2012.
Motion made by Mr. Woodward and second by Mr. Podey. Motion carries.

Move to recommend to the full Commission to approve the Omnibus Amendment for Spot, Spotted Seatrout, and Spanish Mackerel as amended today.
Motion made by Mr. Cole and seconded by Mr. Frampton. Motion carries without opposition.

Move to approve the *de minimis* status request for DE commercial, SC commercial and recreational, GA com and recreational, and FL commercial.
Motion made by Mr. Carpenter and seconded Mr. Cole. Motion passes.

Move to approve the FMP Review for Atlantic Croaker.
Motion made by Dr Duval and seconded by Dr. Rhodes. Motion passes.

Motion to accept the *de minimis* request for NJ and DE.
Motion made by Dr. Rhodes and seconded by Mr. Cole. Motion carries.

Motion to approve the FMP review for Red Drum.
Motion made by Mr. Cole and seconded by Mr. Woodward. Motion carries.

NORTHERN SHRIMP SECTION (August 4, 2011)

Press Release

Northern Shrimp Amendment 2 Approved for Public Comment

Alexandria, VA – The Commission's Northern Shrimp Section has approved Draft Amendment 2 to the Interstate Fishery Management Plan (FMP) for Northern Shrimp for public comment and review. The Draft Amendment proposes a suite of management options that the Section may use to provide greater flexibility in managing the fishery and maximizing its overall benefits. These include clarification of fishing mortality reference points, timely and comprehensive reporting system, trip limits, trap limits, days out, area management, seasonal quotas, and harvest set asides.

Since the adoption of Amendment 1 in 2004, knowledge of the northern shrimp biology, population dynamics, and fishery has improved. While the management of northern shrimp has resulted in a rebuilt stock and increased fishing opportunity, Amendment 1 only provides two options for managing the fishery – season length and gear limitations. Early season closures occurred in the 2010 and 2011 fishing seasons because landing rates were far greater than anticipated. Furthermore, untimely reporting resulted

in short notice of the season closures and an overharvest of the target total allowable catch by 14% in 2010 and 48 % in 2011. The measures proposed in Draft Amendment 2 are intended to address these issues.

Upon completion of Amendment 2, the Section will initiate consideration of a limited entry program through the adaptive management addendum process. The Public Information Document (PID) for this Amendment initially notified the public of the Section‘s intent to consider development of a limited entry program. Based on public comment received on the PID and the Section’s concern regarding continuing effort increases in this fishery, the Section established a control date of **June 7, 2011**. The intention of the control date is to notify potential new entrants to the fishery that there is a strong possibility they will be treated differently from participants in the fishery prior to the control date. The Section may use historic landings and/or participation criteria for current and past participants as the limited entry system is established.

New England states will be conducting hearings on the Draft Amendment; the details of those hearings will be released when they become available. Fishermen and other interested groups are encouraged to provide input on the Draft Amendment by either attending public hearings or providing written comments. Copies of the Draft Amendment can be obtained via the Commission’s website (www.asmfc.org) under Breaking News or by contacting the Commission at 703.842.0740. Public comment will be accepted until **5:00 PM (EST) on September 30, 2011** and should be forwarded to Michael Waine, Fishery Management Plan Coordinator, 1050 N. Highland St., Suite 200 A-N, Arlington, VA 22201; 703.842.0741 (FAX) or at mwaine@asmfc.org (Subject line: Northern Shrimp Amendment 2).

PR11-29

Motions

Move to nominate Terry Stockwell from Maine as Vice Chair of the Section.
Motion made by Mr. Diodati and seconded by Mr. Balzano. Motion passes by consent.

Move to include trap limits as an option under the annual specification process.
Motion made by Mr. Stockwell and seconded by Mr. Adler. Motion passes (2 in favor).

Motion that we add the new sections 4.1.4, 4.1.5, and 4.1.6 as drafted by staff, to the draft document for public comment.
Motion made by Mr. Stockwell and seconded by Rep. Peake. Motion passes (2 in favor).

Move to approve the document as amended for public hearing.
Motion made by Mr. Adler and seconded by Mr. Balzano. Motion carries (2 in favor).

HORSESHOE CRAB MANAGEMENT BOARD (August 4, 2011)

Press Release

Horseshoe Crab Board Initiates Addendum VII to implement Adaptive Management

New Framework will Incorporate Multispecies Management

Alexandria, VA – The Commission’s Horseshoe Crab Management Board voted to initiate Addendum VII to implement the Adaptive Resource Management framework. The framework, under development

since 2007, will incorporate both shorebird and horseshoe crab abundance levels when considering the optimized horseshoe crab harvest level for the Delaware Bay area. The ARM framework was developed by the Commission, U.S. Fish and Wildlife Service, and U.S. Geological Survey in recognition of the importance of horseshoe crab eggs to shorebirds in the Delaware Bay Region and was peer-reviewed in 2009.

The Draft Addendum will additionally address allocation of the ARM harvest output among the four states of New Jersey, Delaware, Virginia, and Maryland that harvest horseshoe crabs from the Delaware Bay population. The allocation is based upon multiple decision options, including the proportion of horseshoe crabs harvested that originate from Delaware Bay and a potential harvest cap for Virginia and Maryland to protect crabs that do not originate from Delaware Bay. The Board had received input on the allocation options from the Delaware Bay Ecosystem Technical Committee at the March 2011 meeting, and from the Horseshoe Crab and the Shorebird Advisory Panels at today's meeting. All options considered by the committee and panels will be included as options in the Draft Addendum. After review by the Board, the draft Addendum will be available for public comment.

In additional business, the Board approved formation of an ad-hoc working group, made up of technical committee members and biomedical representatives, to develop best management practices to minimize coastwide mortality from the practice of collecting horseshoe crab blood for worldwide biomedical uses. The Board recognizes the important health impacts of the biomedical industry as well as the regional differences that can exist among companies. The working group will report back to the Board on its findings. For more information, please Danielle Brzezinski, Fishery Management Plan Coordinator, at dbrzezinski@asmfc.org or 703.842.0740.

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PR11-31

Motions

Move to initiate Addendum VII to implement the ARM framework, and to direct the Horseshoe Crab Plan Development Team to include 1) the options discussed and reviewed by the Delaware Bay Ecosystem Technical Committee, the Horseshoe Crab and Shorebird Advisory Panels, as options in the draft addendum; 2) a status quo fallback option, should the necessary data for the ARM framework not be available; and 3) an option that would increase the male crab quota in Maryland and Virginia to offset any reductions to the female crab quota due to the DBSA in those states.

Motion made by Mr. Travelstead and seconded by Mr. Himchak. Motion carries (16 in favor).

ISFMP POLICY BOARD (August 2-4, 2011)

Press Release

ASMFC Voices Support for the Marine Recreational Information Program

Alexandria, VA – The Commission's ISFMP Policy Board affirmed its strong support for the direction, pace, and goal of NOAA's Marine Recreational Information Program (MRIP). This support is a direct result of consistent and frequent updates on the program's progress as well as a comprehensive presentation on MRIP's current status and next steps given by MRIP staff at the Commission's Summer Meeting. It is also a reflection of the active participation of the Commission, other interstate commissions, and the coastal states at all levels of MRIP development, including committees and technical working groups.

"MRIP and the data it will provide are essential to the Commission's interstate fisheries management program given the breadth and importance of recreational fisheries managed by the Commission and the 15 Atlantic coastal states," stated Robert H. Boyles, Jr., ASMFC Chair. "The Board applauds the enormous effort NOAA has devoted to improving marine recreational fisheries statistics and appreciates the frank and constructive dialogue NOAA has fostered with the Commission, the states, and the recreational fishing community. The states are committed to continuing to work with NOAA as we transition to using the new survey methodology and catch estimates."

The Board will transmit its support of the program and its efforts to minimize bias in survey methodology, improve precision of catch estimates, and enhance spatial/temporal coverage of survey data in a letter to NOAA Fisheries Service.

MRIP was developed to address the recommendations of the National Research Council following its review of the Marine Recreational Fishery Statistics Survey and other recreational surveys as well as stakeholder concerns about the reliability and credibility of recreational fishing catch and effort estimates. Its goal is to provide accurate, timely, and statistically sound estimates that fisheries managers, stock assessors, and marine scientists need to ensure the sustainability of fisheries resources. The program has made significant advancements over the last several years, including re-estimating catch and effort data from 2004 to present using new estimation methodology (to be released in 2011) and launching the new sampling methodology beginning in 2012. For more information on MRIP, please visit www.CountMyFish.noaa.gov.

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PR11-26

Meeting Summary

The Interstate Fisheries Management Program Policy Board met to address a number of issues that impact the Commission and its interstate fisheries management process.

The Policy Board reviewed the rebuilding progress for each of the species under Commission management. This review was intended to determine if the progress toward each species rebuilding goals was occurring at an appropriate rate. The Board asked staff to focus on the species in the categories of "concern," "depleted," and "unknown" as the 2012 Action Plan is drafted for consideration at the Annual Meeting.

Related to the discussion on rebuilding progress, the Policy Board reviewed a range of options that would increase oversight of species management boards to ensure actions are consistent with the Commission's Vision. The range of options considered was based on the discussion that was held at the Commission's March Meeting. The Policy Board tasked staff with further developing two options for further consideration at the Annual Meeting. These options focus on two options that provide greater oversight for the Policy Board through the review of Plan Development Team tasking and review and approval of addenda.

The Policy Board reviewed the Commission policies regarding appointment and conduct of proxies. The Policy Board agreed that these policies are adequate and have been effective in guiding the use of proxies at the Commission.

The Policy Board reviewed a request from the Northern Shrimp Section to establish a control date to notify new entrants to the shrimp fishery that they may be treated differently as a limited entry program is considered. The Policy Board supported the request and established a control date of June 7, 2011.

The Assessment Science Committee (ASC) reported the results of its meeting that was held earlier this summer. A Subcommittee of the ASC and Management Science Committee developed a summary paper describing the issue of stock assessment capacity in the Atlantic states, based on a survey of state agency scientists and managers. The Policy Board established a working group to provide options to address the reduction of state stock assessment capacity. The working group will be composed of Commissioners and ASC members. The findings of the working group will be presented at the Annual Meeting. The Policy Board approved the Stock Assessment Training Guidance Document based on the recommendation of the ASC. The Policy Board also approved the stock assessment schedule for 2012-2013.

The Policy Board was presented a summary from the Black Drum Working Group on a technical workshop that was held in April. The Working Group provided recommendations on stock assessment tools that can be used to monitor and manage the stock. Based on the available data and a recommendation of the Working Group, the Policy Board agreed to initiate an assessment and interstate fishery management plan for black drum. Resources to initiate this effort will be considered as the 2012 Action Plan is developed.

The Atlantic Coastal Fishery Habitat Partnership (ACFHP) updated the Policy Board on a Science and Data Working Group held in February and a Steering Committee meeting held in May. A summary of the FY11 funding decisions was also provided.

The Policy Board approved a resolution regarding the impacts of non-native species (resolution follows this summary). The Policy Board is concerned about the impacts non-native invasive species may have on Commission managed species. The resolution makes general statements on non-native species and also highlights concern over blue and flathead catfish in the Chesapeake Bay region.

Following the presentation on MRIP progress, the Policy Board discussed the potential impacts of the re-estimated recreational catch numbers from 2004-2010 on assessment and management programs. The Policy Board asked staff to work with the ASC and the Management and Science Committee to explore this issue and report back to the Policy Board.

The Policy Board approved a number of letters to be sent on behalf of the Commission:

- A letter to NMFS supporting proposed changes to the electronic dealer reporting system
- A letter to the Mid-Atlantic Fishery Management Council detailing the Commission position on the Draft Amendment 14 to the Squid, Mackerel, Butterfish FMP.
- A letter to NMFS supporting the status of the Marine Recreational Information Program.

For more information, please contact Robert Beal, ISFMP Director, at rbeal@asmfc.org or 703.842.0740.

Resolution

Atlantic States Marine Fisheries Commission

Approved August 3, 2011

Resolution on Non-Native Invasive Catfish

Whereas, the States along the Atlantic coast from Maine through Florida, including Pennsylvania and the District of Columbia, are concerned about the increasing variety, abundance, range, and ecological impact of invasive species in estuaries, tributaries, and coastal waters; and

Whereas, invasive species negatively impact native species managed by the Atlantic States Marine Fisheries Commission through predation and displacement; and

Whereas, blue and flathead catfish are non-native invasive species that have been introduced and spread to many watersheds along the Atlantic coast; and

Whereas, blue and flathead catfish are large, long-lived fish species exhibiting an opportunistic and non-selective feeding strategy.

Whereas, the spread and high abundance of non-native catfish are causing trophic impacts throughout their range, resulting in unbalanced ecosystems; and

Whereas, predation by blue and flathead catfish is likely having a negative effect on species managed by the Atlantic States Marine Fisheries Commission, most notably, shad, river herring, striped bass, and American eel. Other prey species of concern include white and yellow perch, gizzard shad and freshwater mussels and clams; and

Whereas, the populations and ranges of blue and flathead catfish have become increasingly problematic and both species are expanding significantly in the Chesapeake Bay watershed; and

Whereas, the fishery management jurisdictions in the Chesapeake Bay region are developing policies to address the impacts of invasive catfishes.

Now, Therefore, Be It Resolved,

That the Atlantic States Marine Fisheries Commission does not support the introduction of nor transport of non-native invasive species;

That additional research should be conducted to more fully understand the ecological impacts of non-native catfish on species managed by the Atlantic States Marine Fisheries Commission;

That all practicable efforts should be made to reduce the population levels and ranges of non-native invasive species;

That the Atlantic States Marine Fisheries Commission supports the development of and implementation of a strategy that minimizes the population and ecological impacts of non-native invasive catfish species throughout the Chesapeake Bay watershed.

Motions

Move to adopt option 3 and 4 of the white paper on Policy Board Involvement in Species Management.
Motion made by Mr. Travelstead and seconded by Mr. Goldsborough. Motion postponed until the 2011 ASMFC Annual Meeting.

Move to postpone to the Annual Meeting.
Motion made by Mr. Augustine and seconded by Rep. Martin Motion carries without opposition.

Move to approve the stock assessment schedule as presented.
Motion made by Dr. Kray and seconded by Mr. Grout. Motion carries without objection.

Move that the ISFMP Policy Board approve the stock assessment training guidance document.
Motion made by Mr. Grout and seconded by Mr. Adler. Motion carries without objection.

Move to set June 7, 2011 as the control date to the Northern Shrimp fishery, and future entrants may be treated differently than the current members of this fishery.
Motion made by Mr. Grout on behalf of the Northern Shrimp Section. Motion passes (16 in favor, 0 opposed, 0 null, 2 abstentions)

Move to approve the Resolution on Non-Native Invasive Catfish as presented.
Motion made by Mr. Carpenter and seconded by Mr. Adler. Motion carries (14 in favor, 3 opposed, 0 null, 2 abstentions).

Move that the ASMFC develop an Interstate Fisheries Management Plan for Black Drum.
Motion made by Dr. Duval and seconded by Mr. Fote. Motion carries without opposition.

BUSINESS SESSION (August 3 & 4, 2011)

Press Release

ASMFC Approves Omnibus Amendment for Spot, Spotted Seatrout and Spanish Mackerel

Alexandria, VA – The Atlantic States Marine Fisheries Commission has approved the Omnibus Amendment for Spot, Spotted Seatrout, and Spanish Mackerel. The Amendment updates all three plans with requirements under the Atlantic Coastal Fisheries Cooperative Management Act (1993) and the Interstate Fishery Management Program Charter (1995). All three species represent a large draw for commercial and recreational fishermen in the Mid- and South Atlantic regions with a combined coastwide commercial catch of 12.6 million pounds and a recreational harvest of 14.3 million fish.

The updates to the plans include commercial and recreational management measures and recommendations, adaptive management options, *de minimis* thresholds and exemptions, and monitoring recommendations. The South Atlantic State/Federal Fisheries Management Board adopted these management measures and options after considering public input and technical input from the Plan Development Team. The Omnibus Amendment will be implemented July 1, 2012.

Spanish mackerel is jointly managed by both the Commission and the South Atlantic Fishery Management Council (SAFMC). Due to data limitations, the most recent stock assessment was not

successful in establishing specific values for reference points. The original interstate FMP included a process to review and maintain consistency with federal management, which is essential to maintaining good conservation measures. Over the years, however, both federal and state regulations have changed, while the interstate FMP has remained unchanged. To address this consistency issue, the Omnibus Amendment includes both adaptive management measures as well as a process for Board review and action in response to changes in the federal regulations, which will allow for greater uniformity across the jurisdictions. Currently, the federal FMP has a proposed Amendment 18, which is scheduled for a final vote by the SAFMC at its August meeting. The proposed Amendment 18 changes are included in the current Omnibus Amendment.

The original Spot and the Spotted Seatrout FMPs included no requirements for either management or monitoring. The Omnibus Amendment includes a management trigger for spot, which will help the Board in monitoring the status of the stock until a full coastwide stock assessment can be completed. High levels of spot bycatch present a challenge for managers, in terms of both yearly management and overall assessment of the stock health. For spotted seatrout, the Omnibus Amendment includes recommended measures to protect the spawning stock as well as a required coastwide minimum size. These measures will be essential as increased coastal development presents management challenges to this localized species. Coupled with adaptive management measures, the Omnibus Amendment will provide options for both species to efficiently implement management measures should the Board determine that such measures are needed in the future.

The Omnibus Amendment is available on the Commission's website at www.asmfc.org under Breaking News or can be obtained by contacting the Commission at 703.842.0740. For more information, please contact Danielle Brzezinski, Fishery Management Plan Coordinator, at dbrzezinski@asmfc.org or 703.842.0740.

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PR11-30

Meeting Summary

The Northern Shrimp Section notified the Commission that the due to timing constraints, a fax poll of the Executive Committee may be needed to approve the Amendment 2 to the Interstate FMP later this year.

The Commission also discussed the upcoming meeting between a Special Ad Hoc Committee of Commissioners and the Massachusetts Marine Fisheries Commission. The meeting will be held in November during the Commission's Annual Meeting in Boston, MA. For more information, please contact Robert Beal, ISFMP Director, at rbeal@asmfc.org or 703.842.0740.

Motions

On behalf of the South Atlantic State/Federal Fisheries Management Board, move that the Commission approve the Omnibus Amendment for Spot, Spotted Seatrout, and Spanish Mackerel. Motion made by Mr. Boyles. Motion carries without objection.

Red Drum Landings 2010 - 2011

Landings are complete through May 31, 2011 (the majority of June are in as well)
2011 landings are preliminary

Year	Month	Species	Pounds	Conf	2008-2010 Average
2010	9	Red Drum	28,367		28,844
2010	10	Red Drum	36,521		45,207
2010	11	Red Drum	18,680		16,840
2010	12	Red Drum	3,517		3,546
2011	1	Red Drum	4,183		11,866
2011	2	Red Drum	2,143		16,295
2011	3	Red Drum	1,361		21,742
2011	4	Red Drum	2,101		8,323
2011	5	Red Drum	4,621		15,470
2011	6	Red Drum	4,079*		13,890
2011	7	Red Drum	256*		15,607

Fishing Year (Sept 1, 2010 - Aug 31, 2011) Landings **105,828**

*partial trip ticket landings only
***landings are confidential