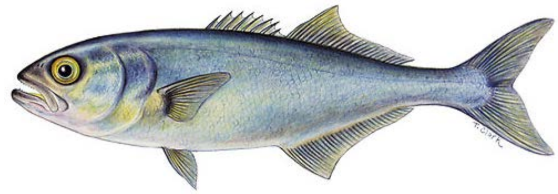
Bluefish

Pomatomus saltatrix



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DESCRIPTION

Bluefish are a coastal, pelagic species of interest to fisheries that are often encountered in South Carolina estuarine and coastal waters.

Taxonomy and Basic Description

Bluefish, *Pomatomus saltatrix* (Linnaeus 1766), is a member of the monotypic family (family represented by single species) Pomatomidae (bluefishes). This family is found within the order Perciformes, the most diversified of all fish orders and largest order of vertebrates (Collette 2002; Nelson 2006). Within the order Perciformes, they are found within the suborder Percoidei (largest suborder of the Perciformes) and superfamily Percoidea (Nelson 2006). The species is similar in appearance to some members of the families Carangidae and Rachycentridae occurring in the western Atlantic (Collette 2002). It differs from the most superficially similar carangid, *Seriola* (amberjacks), because *Seriola* have bands of villiform teeth in jaws (Collette 2002).

Bluefish are a large species (to 1 m or 3 ft.) with a sturdy, compressed body and large head with prominent, sharp, compressed teeth in a single series (Collette 2002). The jaw is terminal, with the lower jaw sometimes slightly projecting (Collette 2002). As is common in most other members of the suborder Percoidei (Nelson 2006), bluefish possess two dorsal fins, the first being short and composed of 7 to 8 weak spines connected by a membrane and the second long, with one spine and 23-28 soft rays (Collette 2002). The pectoral fins are short, not reaching the origin of the soft dorsal fin (Collette 2002). Bluefish possess small scales that cover the head, body, and bases of vertical fins; the lateral line is almost straight (Collette 2002). In color, bluefish possess a greenish-blue back, silvery sides and belly, dorsal and anal fins that are pale green tinged with yellow, pectoral fins that are bluish at the base, and a caudal fin that is dull greenish tinged with yellow (Collette 2002).

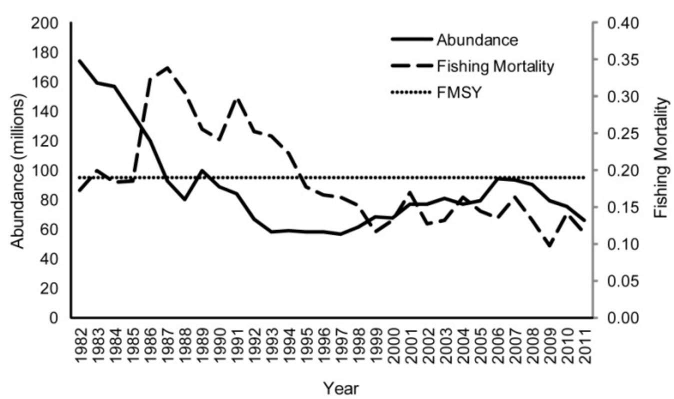

Figure 1: Total bluefish abundance and fishing mortality as estimated in ASAP model. F_{MSY} indicated by dotted horizontal line. (Source: NEFSC 2012).

Status

Currently, the bluefish population occurring off the East Coast of the United States is managed as a single stock (NEFSC 1997; Fahay et al. 1999) under the joint management authority of the Atlantic States Marine Fisheries Commission (ASMFC) and Mid-Atlantic Fisheries Management Council (MAFMC). As of the most recent assessment of stock status in 2012, the stock is not overfished or experiencing overfishing (NEFSC 2012). Fishing mortality (F) was below F_{MSY} (biological reference point) in the terminal year, with data suggesting F had been below F_{MSY} since the mid-1990s (Figure 1). The time series of F suggested an increasing period in the early 1980s, peaking in 1984, followed by a steady decline in F through the late 1990s. Since 2000, F has remained relatively steady, averaging 0.138. Based on the trajectory, bluefish were experiencing overfishing during the mid-1980s and early 1990s. Recent total stock biomasses peaked in 1982, before steadily declining to low levels in the early- and mid-1990s (Figure 2). At this point, stock biomass was near ½ B_{MSY}, denoting the stock was nearly overfished. Since the mid-1990s, stock biomass has steadily increased through the end of the time series (Figure 2). The stock remains below B_{MSY} (ASMFC 2012c).

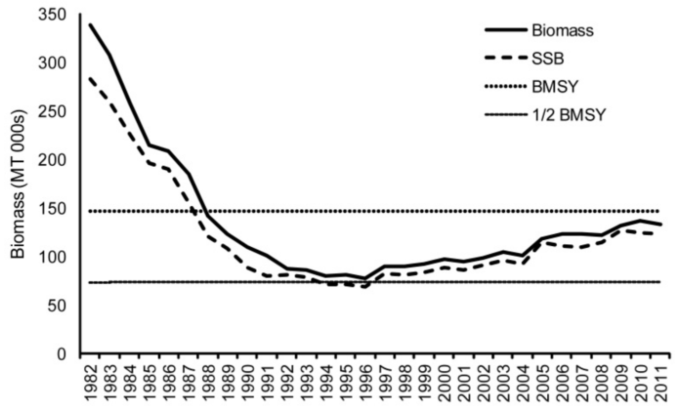

Figure 2: Time series of bluefish total mean biomass (000s mt) and spawning stock biomass (000s mt).

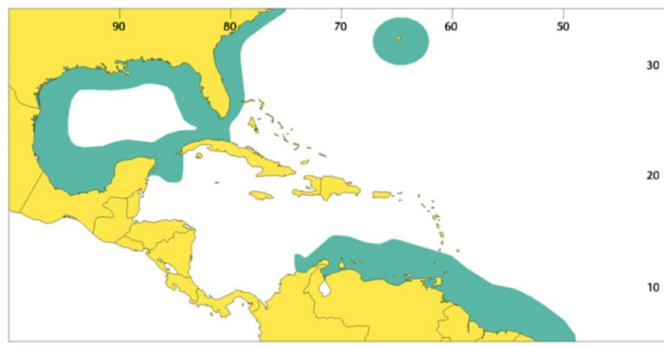

Figure 3: Bluefish native range in the US South Atlantic region through northern South America. (Source: Collette 2002).

POPULATION SIZE AND DISTRIBUTION

Bluefish are found in coastal temperate and subtropical waters of the world but are absent from the eastern Pacific and the Indo-West Pacific north of the equator (Collette 2002). In the western North Atlantic, they range from Nova Scotia along the East Coast of the Americas (including Bermuda) to Argentina, though they are rare between southern Florida and northern South America (Robins et al. 1986; Collette 2002). Bluefish are absent from the Bahamas, West Indies (except for the northern coast of Cuba), and Caribbean coast of Central America (Figure 3; Collette 2002). Throughout this range, bluefish inhabit the open ocean, large embayments, and most estuarine systems (Fahay 1999).

Bluefish tend to travel in schools of like-sized individuals while undertaking seasonal migrations: traveling north along the East Coast of the US during spring, and south or farther offshore during fall (Fahay 1999). This is because they are warm water migrants, with bluefish not being found to occur in waters with temperatures less than 14-16°C (57-61°F)(Bigelow and Schroeder 1953). These seasonal migratory movements results in the movement of bluefish between the US south Atlantic and mid-Atlantic, with individuals traveling as far north as Maine (Shepherd et al. 2006). During summer months, the center of abundance of adults is in New York Bight and southern New England waters while during winter, the center of abundance shifts to South Atlantic Bight (SAB) waters, with individuals traveling as far south as southeastern Florida (Fahay 1999). There is a trend for larger individuals to occur farther north during the summer (Wilk 1977) while some evidence indicates larger adults truncate their southward migration and spend the winter on the outer part of the Continental Shelf of the Mid-Atlantic Bight (MAB) (Fahay 1999). Juveniles have been found in all estuaries of the Mid-Atlantic Bight, though eggs and larvae occur in oceanic waters (Able and Fahay 1998).

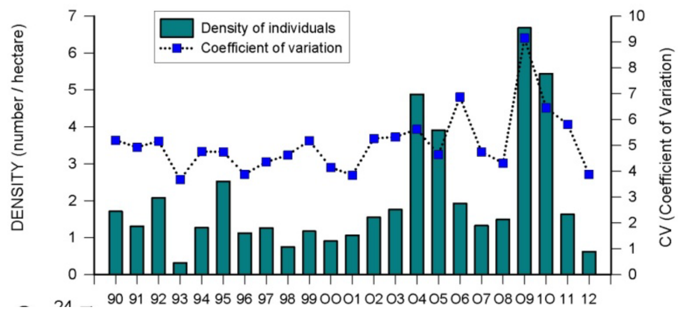

Figure 4: Annual relative abundance of bluefish, *Pomatomus saltatrix*, in U.S. South Atlantic waters based on SEAMAP-SA coastal trawl survey catches. (Source: Jeanne Boylan, SCDNR, unpublished data).

In South Carolina, juvenile and adult bluefish are present in estuarine and coastal ocean waters. Unfortunately, a time series of their absolute abundance in South Carolina waters is not available. However, they are encountered in some SCDNR fishery-independent surveys, most notably the SEAMAP-SA coastal trawl survey and the SCDNR trammel net survey. From these it is possible to construct a relative abundance index of bluefish in SAB coastal waters and South Carolina estuaries, respectively (Figure 4 and Figure 5). From the SEAMAP-SA coastal trawl data (Figure 4), it is apparent that the abundance of bluefish in the SAB has been somewhat variable, with at times large annual changes in abundance. Given that larger adults are generally found in more northern latitudes, this may be more indicative of recruitment variability than changes in adult abundance. The SCDNR trammel net survey, while still exhibiting a high degree of annual variability, exhibits a more consistent trend of increasing relative abundance throughout the time series (Figure 5). Of particular note are the two periods of high relative abundance in South Carolina estuaries,

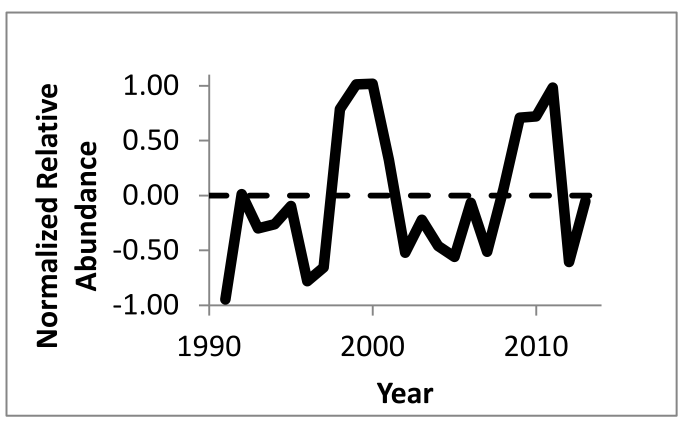

Figure 5: Annual normalized relative abundance of bluefish, *Pomatomus saltatrix*, in South Carolina estuaries based on SCDNR trammel net survey catches. (Source: Steve Arnott, SCDNR, unpublished data)

1998-2000 and 2009-2011. While the first does not coincide with high abundances in the SEAMAP-SA coastal trawl survey, the second period does (Figure 4).

HABITAT AND NATURAL COMMUNITY REQUIREMENTS

The habitat used by bluefish tends to vary by size and cohort. The following is a description of the habitat used by bluefish at various life stages.

Eggs

Bluefish eggs are found in the open ocean at temperatures between 18 and 22^{o}C (64-90°F) and salinities >31.0 ppt (Fahay 1999). For the spring-spawned cohort, spawning occurs near the edge of the Continental Shelf in the SAB (Fahay 1999). For the summer-spawned cohort, eggs have been collected in MAB waters from May to August, being most abundant in July (Fahay 1999). Bluefish egg distribution varies by month, with eggs being distributed near Cape Hatteras in May and then rapidly expanding further northward during the summer (Fahay 1999). By July, eggs are distributed as far north as southern New England waters with a center of abundance off Delaware Bay and New Jersey (Berrien and Sibunka 1999). Most eggs are collected over depths of 30 to 70 m (98-230 ft.) (Norcross et al. 1974).

Larvae and Pelagic-Juveniles

Larvae occur in open oceanic waters near the edge of the Continental Shelf in the southern Mid-Atlantic Bight and over mid-shelf depths farther north (Norcross et al. 1974; Kendall and Walford 1979). Most larvae occur in temperatures of 18-24^{o}C (64-75°F) and salinities of 30-32 ppt. As larvae, bluefish migrate vertically in the water column, occurring near the surface at night but centered at about 4 m (12 ft.) during daylight (Kendall and Naplin 1981). If spawned in the SAB (spring-spawned bluefish cohort), larvae are advected north via the Gulf Stream (Hare and Cowen 1996; Kendall and Walford 1979), but some recruit successfully to estuaries in the SAB (Collins and Stender 1987; McBride et al. 1993).

Many pelagic-juveniles are found in the vicinity of Cape Hatteras as early as April (Fahay 1999). In May, several have been collected on the shelf of the SAB (Fahay 1975; Kendall and Walford 1979). By June, pelagic-juveniles occur in the MAB between the shore and the shelf/slope front, actively crossing the shelf (Hare and Cowen 1996). In both the SAB and MAB, there is a strong negative correlation between fish size and depth, indicating an offshore origin and onshore migration with growth (Fahay 1999).

Juveniles

The following description of juvenile habitats derives from the works of Lund and Maltezos (1970), Olla et al. (1975), Milstein et al. (1977), Nyman and Conover (1988), Rountree and Able (1992), McBride et al. (1995), Able et al. (1996), and Buckel and Conover (1997).

Juvenile bluefish occur in estuaries, bays, and the coastal ocean of the MAB and SAB where they are less common. Such juveniles are found in many habitats, though they do not use the marsh surface. Juveniles begin to depart MAB estuaries in October and migrate south to spend the winter months south of Cape Hatteras. Juveniles arrive in estuaries, bays, and coastal ocean waters once water temperature exceeds 20^{o}C (68°F) and subsequently remain in these waters throughout the summer until water temperature declines to 15^{o}C (59°F). There is a thermal minimum and maximum for juveniles, with data suggesting they cannot survive at temperatures less than 10^{o}C (50°F) or above 34^{o}C (93°F). As they do occur in estuaries, juveniles can tolerate a wide range of salinities (as low as 3.0 ppt), though they are generally found in salinities of 23.0-33.0 ppt.

Adults

Adults are generally oceanic, being distributed in nearshore to well offshore over the Continental Shelf, preferring waters warmer than 14-16^{o}C (57-61°F) (Bigelow and Schroeder 1953; Olla and Studholme 1971). Bluefish can tolerate water temperatures between 11.8 and 30.4^{o}C (53.2-86.7°F), though there is physiological stress at either extreme (Fahay 1999). Being oceanic in nature, adults are generally found in waters of oceanic salinity (Bigelow and Schroeder 1953; Olla and Studholme 1971). Adults are not uncommon in bays, larger estuaries, and coastal waters (Bigelow and Schroeder 1953; Olla and Studholme 1971) and have been found in most estuarine systems within their range (Fahay 1999).

CHALLENGES

As bluefish of different life stages use a diverse array of habitats, almost all of the estuarine and nearshore waters along the Atlantic Coast from Florida to Nova Scotia serve as an important habitat for some life stage. Pollution and habitat degradation of any estuarine and nearshore habitat could be expected to threaten the coastal bluefish population. Such habitat degradation concerns are especially acute in estuarine waters, due to the residency of juveniles in these habitats. As coastal development increases, estuarine water quality is expected to further deteriorate unless steps are taken to ameliorate their effect on the environment (Cross et al. 1985). Estuarine and coastal habitats have been significantly affected by dredging, filling, coastal construction, energy plant development, pollution, waste disposal, and other human-related activities. Other potential threats in coastal waters include the offshore dumping of sewage.

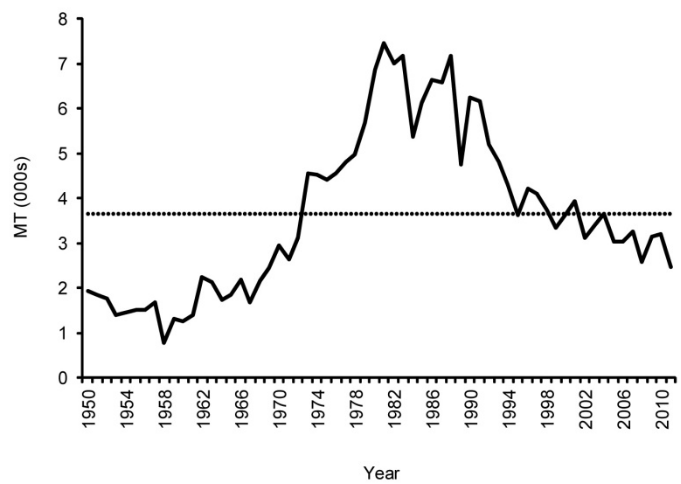

Figure 6: Time series of bluefish commercial landings (mt) along the Atlantic coast from 1950 to 2011. (Source: NEFSC 2012)

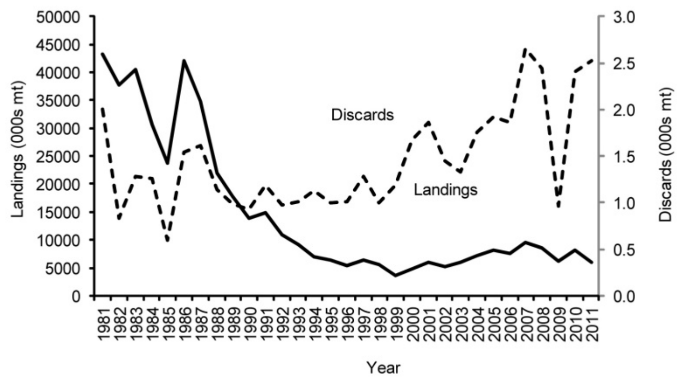

Figure 7: Time series of bluefish recreational landings (mt) and recreational discard losses (MRIP B2 estimates*0.15) from Maine to Florida, 1981 to 2011.

An additional challenge to the bluefish population is the large-scale fisheries that operate on the population. At present, both a large commercial and recreational fishery operates on bluefish along the East Coast of the United States (Figures 6 and 7; NEFSC 2012). Landings for the commercial fishery rose from the 1950s until they peaked at greater than 7,000 mt in 1981. Since the peak, commercial landings have steadily declined through 2011. For the recreational fishery, landings data are available via MRFSS/MRIP since 1981 (Figure 7). Landings in this fishery were highest in the early- to mid-1980s (similar to the peak of the commercial fisheries) with a rapid decrease to low levels by the late-1990s. Since the late-1990s, landings have slightly increased for the recreational fishery, averaging between 5,000,000 and 10,000,000 mt annually. The impact of the fisheries is complicated by the highly migratory nature of the population. This necessitates the need for coordinated management of the bluefish stock on a regional basis as landings external to a given state can have a drastic impact on future abundance within that state's waters in future years.

CONSERVATION ACCOMPLISHMENTS

Bluefish are currently managed under Amendment 1 to the Interstate Fishery Management Plan (FMP) for bluefish established jointly by the MAFMC and the ASMFC (MAFMC 1998). Amendment 1 to the FMP, which was approved in 1998, allocated fisheries landings between sectors (83% recreational and 17% commercial), established a state-by-state quota system based on historic landings of bluefish, and established a recreational fishery 15 fish bag limit. Addendum 1 to the FMP, approved in 2012, established a coast-wide sampling program to improve the quality of information available for use in future bluefish stock assessments (ASMFC 2012c). The intent of this coast-wide biological sampling program is to address uncertainties existing within the current age-structured assessment model used to assess the status of the bluefish population. Specifically, the goal is to develop aging techniques that can be used to perform a coast-wide age structure analysis of the bluefish stock in an effort to increase the validity of stock assessment results.

Finally, the East Coast bluefish population has played a central role in the development of a multi-species stock assessment model developed by the ASMFC to move fisheries management away from individual species assessments to ecosystem-based fishery management. Members of the ASMFC Multispecies Technical Committee and others have worked to develop a Multi-species Virtual Population Analysis (MSVPA) model to explore important predator-prey interactions among key ASMFC-managed species, including Atlantic menhaden as the primary forage fish and striped bass, bluefish, and weakfish as predators (Garrison et al. 2010). This model was peer reviewed during SARC 42 in 2006 (NEFSC 2006) and has subsequently been updated in 2008, 2009, and 2012 (ASMFC 2012b). While this model has yet to be used to manage the bluefish population directly, the model has been used to produce annual estimates of natural mortality (M) at age for Atlantic menhaden based on varying abundances of bluefish, among other predators. These M at age estimates were subsequently included in the most recent assessments of Atlantic menhaden to help manage that species (ASMFC 2012a), and the ASMFC continues to work on developing ecosystem-based reference points for menhaden that account for predation to provide fisheries managers guidance on how much menhaden biomass is required to meet the forage needs of their primary predators.

CONSERVATION RECOMMENDATIONS

- Continue to evaluate the effects of fishing and management plans on the South Carolina sub-population of bluefish.
- Continue the development of ecosystem-based modeling approaches incorporating bluefish as a primary predator in the coastal waters along the East Coast of the United States.
- Initiate studies to investigate the within-year age composition variability of bluefish in South Carolina coastal waters.
- Explore the trophic assemblages involving bluefish.
- Monitor trends in bluefish young-of-the-year and adult relative abundance by continuing to collect data about this species during ongoing fishery-independent monitoring programs.
- Initiate additional work to understand the local and regional movement patterns of bluefish occurring in South Carolina waters.
- Initiate work to quantify the role that South Atlantic region spawning plays in determining annual recruitment.
- Protect water quality in marine ecosystems by encouraging municipalities to use Best Management Practices (BMPs) to reduce runoff from highways, agricultural fields, and housing developments. Improve BMPs in areas already affected by non-point source pollution.
- Plan development based on sound terrestrial and estuarine ecology that takes into consideration all factors that will affect the long-term health of the estuary ecosystem.
- Identify the origin of non-point source pollution and specific point source pollution, and develop a plan of action to mitigate any negative impacts to the affected aquatic systems.

MEASURES OF SUCCESS

The SCDNR fishery-independent programs that annually monitor the relative abundance and length frequency of inshore fish species are already in place to monitor for changes in size distribution and relative abundance as a result of regional management efforts. The measurement of success will be to see an increasing trend in catch of Atlantic menhaden in these surveys.

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