Potential Management Options to Reduce Sea Turtle and Atlantic Sturgeon Interactions in the Estuarine Gill Net Fishery
Issue Paper
July 5, 2012

I. Issue

To seek input and consider development of management measures needed to reduce Atlantic sturgeon and sea turtle interactions in the estuarine gill net fisheries

II. Origination

North Carolina Marine Fisheries Commission (NCMFC), May 2012 Business Meeting

III. Background

The Endangered Species Act (ESA) was enacted in 1973, "to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved, (and) to provide a program for the conservation of such endangered species and threatened species." It is unlawful for any person subject to the jurisdiction of the United States to import, export, take within the US or territorial sea of the US, take upon the high seas, possess, sell, deliver, carry, transport, ship, receive, or offer for sale, any endangered species, or to violate any regulation pertaining to such species or to a threatened species under Section 4(d) of the ESA. Under the ESA, "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect. An Incidental Take Permit (ITP) is required to legally interact, or "take", any ESA listed species. ITPs allow for takes of endangered species that occur incidentally to an otherwise lawful activity under limitations specified in each permit. According to the National Marine Fisheries Service (NMFS) rules, the conservation plan in the ITP must emphasize techniques, gear-types, and general practices to avoid, reduce the number of, and to mitigate the impact of takes. Individuals, organizations, or government agencies can apply for an ITP. Individuals, organizations, or government agencies interacting with protected species without an ITP are vulnerable to fines, penalties, and lawsuits.

On February 6, 2012 the NMFS published a final rule to list Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) as an endangered species along most of the Atlantic coast effective April 6, 2012. The petition to list the species as endangered was submitted by the Natural Resources Defense Council. The Atlantic States Marine Fisheries Commission passed a coast wide Atlantic sturgeon fishery management plan (FMP) in November of 1990 and a moratorium on harvest in North Carolina has been in place since 1991. The North Carolina Division of Marine Fisheries (NCDMF) data suggests recovering populations of sturgeon in our waters under existing management measures.

Because of the recent data, NCDMF along with the North Carolina Marine Fisheries Commission (NCMFC) and the North Carolina Wildlife Resources Commission (NCWRC) objected to the Atlantic sturgeon listing as unwarranted. The NCDMF commented on the proposed listing and presented data indicating that positive signs of recovery were being

documented in North Carolina. The U.S. Fish and Wildlife Service, along with all Atlantic coastal states (except Pennsylvania), also objected to the listing.

Despite the State's objection the Carolina Distinct Population Segment (DPS) of Atlantic sturgeon was listed as endangered under the federal ESA on April 6, 2012. The ESA listing has the force of law and fishermen are at risk of lawsuits, federal fines, and penalties if they interact with a listed species. The stated reasons for this decision were based on the following conclusions by NMFS:

- Failure to rebound after the moratorium indicates that impacts and threats from limits on habitat for spawning and development, habitat alteration, and bycatch are responsible for the risk of extinction faced by both DPSs (A major factor in NMFS' decision to list Atlantic sturgeon was the bycatch risk to the species).
- Existing regulatory mechanisms have failed to address and reduce habitat alteration and bycatch.
- Low population numbers of every river population (estimated spawning populations have no more than 300 spawning adults per year).
- None of the populations are large or stable enough to provide any level of certainty for continued existence (NMFS does not state what the threshold is for a population to be deemed "large and stable" and there are no stock assessments of Atlantic sturgeon populations).

The NCDMF submitted a draft General ITP application under Section 10(a)(1)(B) of the ESA on April 5, 2012 to authorize annual Atlantic sturgeon takes in fishery operations in North Carolina internal coastal and Atlantic Ocean waters from April 6, 2012 through April 6, 2013 for the purpose of continued protection for this endangered species. The Atlantic sturgeon ITP application identified several water bodies where sturgeon are often encountered, such as Albemarle Sound and its tributaries, Croatan and Roanoke sounds, and to a lesser extent, the Cape Fear River and its tributaries, Neuse and Pamlico rivers, and Pamlico Sound (NCDMF 2012). The NCDMF is developing a revised Atlantic sturgeon ITP application for North Carolina's estuarine waters.

The NCDMF submitted another ITP application under Section 10(a)(1)(B) of the ESA on August 15, 2011 to authorize the incidental takes of threatened and endangered sea turtles in the estuarine gill net fisheries (NCDMF 2011). The requested takes in the ITP application are divided into management areas and seasons that account for variations in interaction rates and fishing effort (Figure 1). Management areas are delineated on the similarity of fisheries and management, extent of known protected species interactions in commercial gill net fisheries, and NCDMF's ability to monitor fishing effort. The NCDMF has not received the ITP for sea turtles due to revisions and additional information requested by NMFS. NMFS also had concerns regarding the number of authorized takes requested in the ITP application, requested takes for the small mesh gill net fishery without any observer coverage, and proactive management measures that address areas with high sea turtle interactions (hotspots) (Helen Golde and Kristy Long, NMFS Office of Protected Resources, personal communication, May 2012). The hotspot of concern to NMFS was Area D1, which includes southern Core Sound, Back Sound, and North River (Figure 1). The NCMFC voted to annually prohibit the use of unattended gill nets from 4.0 to 6.5 inches stretched mesh in Area D1 from April 1 through November 30 as a proactive measure to address this known sea turtle hotspot. This management measure was implemented by Proclamation M-23-2012(Revised) (http://portal.ncdenr.org/web/mf/proclamation-m-23-2012-revised) on June 10, 2012 and revised

on June 24, 2012 (Proclamation M-28-2012 http://portal.ncdenr.org/web/mf/proclamation-m-28-2012).

In recognition of the documented Atlantic sturgeon interactions, the NCMFC charged the NCDMF at its May 2012 business meeting with developing potential management measures to provide additional protection for Atlantic sturgeon. The NCDMF also is taking this opportunity to consider management measures that could provide additional protection for sea turtles based on revisions to the sea turtle ITP application requested by NMFS, and the concerns NMFS has about the sea turtle ITP application. The NCDMF is dedicated to ensuring sustainable marine and estuarine fisheries and habitats for the benefit and health of the people of North Carolina. The ITP applications submitted by the NCDMF are consistent with this mission statement. Both the Atlantic sturgeon and the sea turtle ITP applications identified unattended estuarine gill nets as gears with relatively high interaction rates (NCDMF 2011, NCDMF 2012). Therefore, this paper will focus on management measures only for the estuarine gill net fishery.

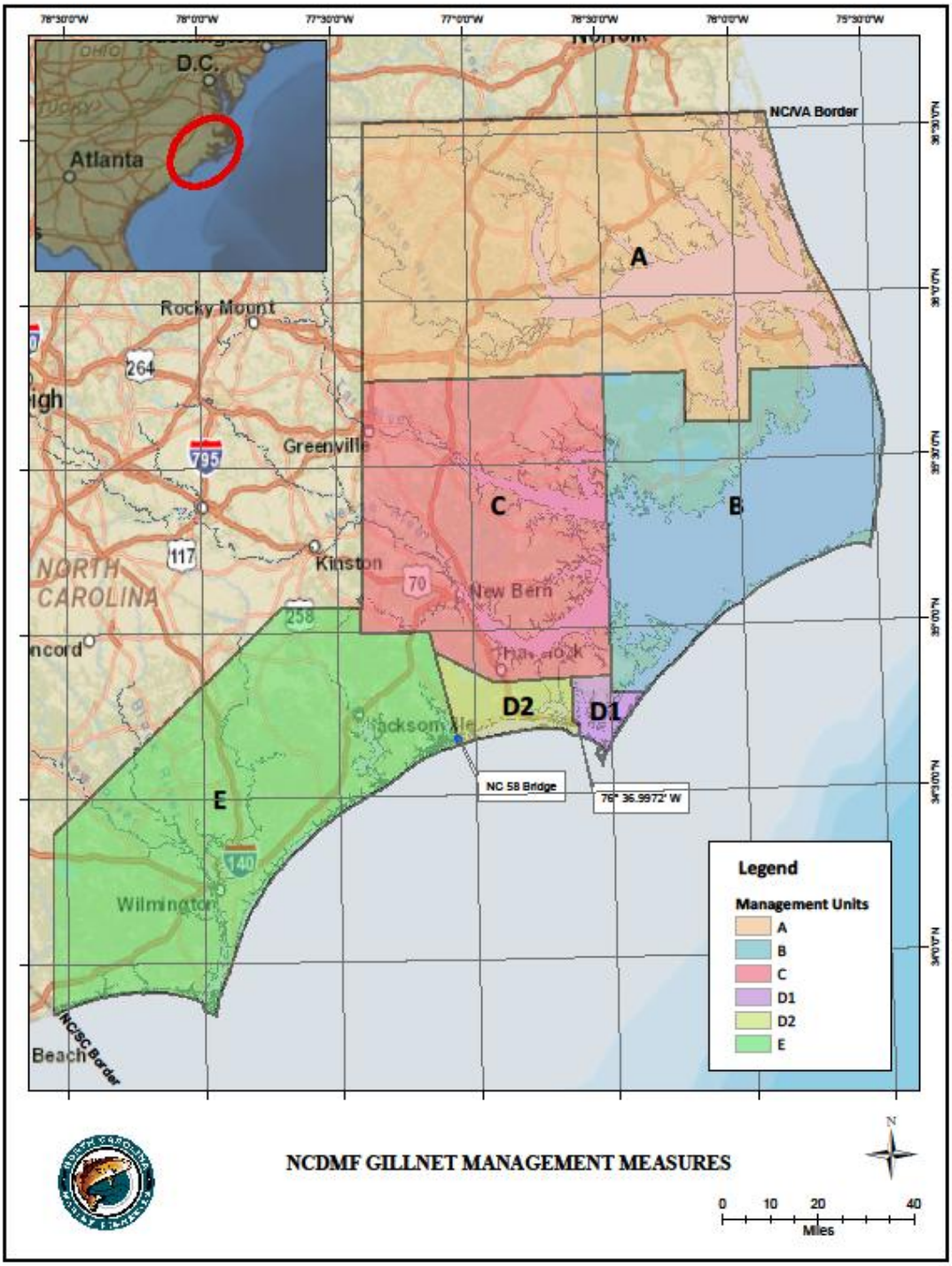

Figure 1. Map of sea turtle management areas for North Carolina's estuarine gill net fisheries.

IV. Discussion

There are several management options that could be implemented individually or in conjunction with one another to minimize sea turtle and Atlantic sturgeon interactions. These management measures could be implemented proactively while the revised ITP applications for Atlantic sturgeon and sea turtles are being developed, or they could be incorporated into the revised ITP applications and become effective if the NCDMF receives the ITPs. Advantages of implementing these measures proactively are to minimize interactions with these protected species as soon as possible to reduce the fishermen's risk of lawsuits, federal fines and penalties if they interact with a listed species under the ESA, and these measures could be modified (relaxed or increased restrictions) based on future data collection before they are incorporated into an ITP. Additional functions of these potential management measures are to prevent early season and area closures under an ITP due to meeting the allowable takes for any given area and season and to possibly reduce the number of takes requested in the ITP applications.

Both the draft Atlantic sturgeon and the sea turtle ITP applications divide requested takes by season and area based on commercial gill net fishing effort and observed takes. Preventing early season and area closures allows more fishing opportunities for the commercial estuarine gill net fishery and reducing the number of requested takes increases the chances of receiving the ITPs from NMFS. These management measures detailed below provide ways to accomplish these objectives and can be applied statewide or to specific areas.

Status Quo

This management option would continue management measures that are already in place, and measures outlined in the ITP applications, but no additional management measures will be considered. Management measures already in place include the Sea Turtle Lawsuit Settlement Agreement management measures, and the closure of Area D1 to unattended gill nets $\geq$4 inches stretched mesh from April 1 through November 30. The Atlantic sturgeon draft ITP application provides protection for Atlantic sturgeon by a variety of measures: increased public outreach by NCDMF to help fishermen avoid, minimize and mitigate incidental takes of Atlantic sturgeon, increased monitoring of its fisheries to further develop information about Atlantic sturgeon bycatch, and data gathered from monitoring (observers) to identify further practicable measures to protect Atlantic sturgeon (NCDMF 2012).

The draft ITP application for Atlantic sturgeon does not include requested takes, but the revised application will. Additional management options to reduce Atlantic sturgeon interactions might be necessary, especially in areas of high abundance (Figure 2), to ensure the actual takes do not exceed the allowed takes in the ITP. This option also does not prevent early season and area closures under an ITP due to meeting the allowable takes for any given area and season; the consideration of additional management measures provides more options for managing the estuarine gill net fishery. This option does not consider proactive management measures while the revised ITP applications for Atlantic sturgeon and sea turtles are being developed, which increases the fishermen's vulnerability to lawsuits, federal fines and penalties if they interact with a listed species under the ESA.

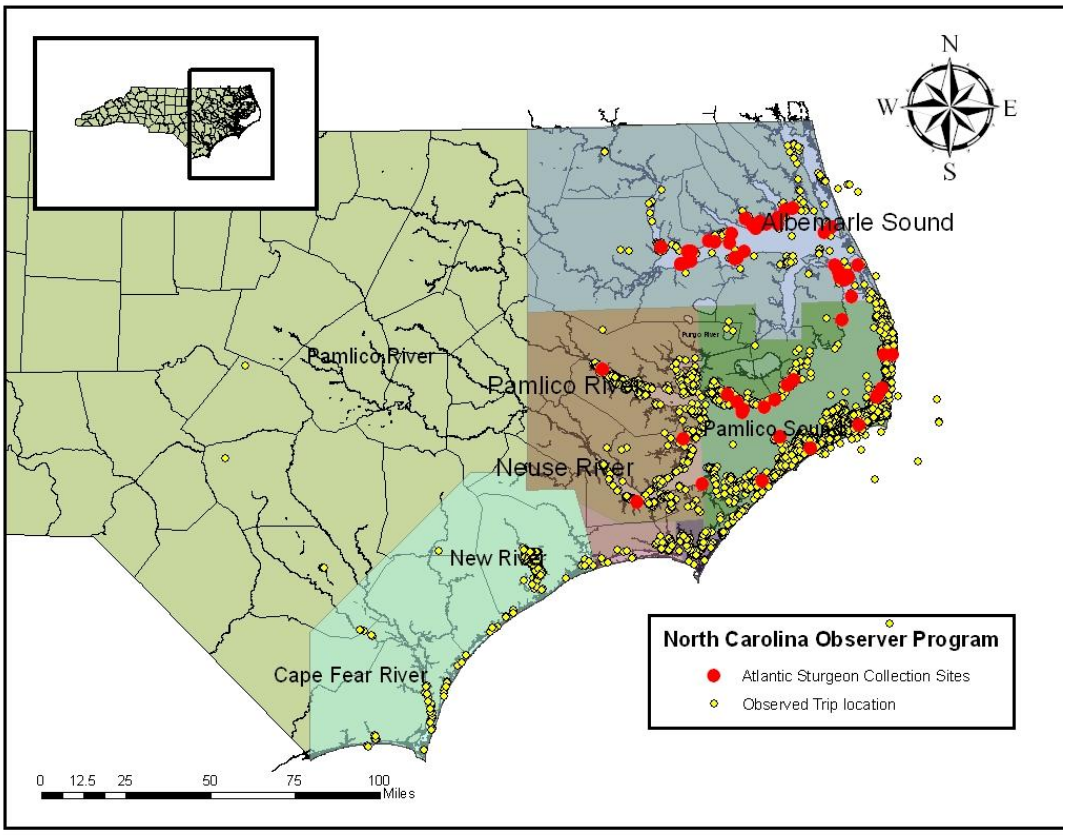

Figure 2. Locations of Observed trips and interactions of Atlantic sturgeon from the North Carolina Gill Net Observer Program, 2001-2010.

Maximum Yardage Limit Reduction for Large Mesh Gill Nets

The NCMFC implemented a statewide 3,000 yard limit per fishing operation for large mesh gill nets (≥5 inches stretched mesh) as per management measures adopted in the 2005 Southern Flounder FMP (NCDMF 2005). The intent of this regulation was to reduce the effort of fishing operations setting more than 3,000 yards and to avoid further expansion of effort in the southern flounder gill net fishery.

The Sea Turtle Lawsuit Settlement Agreement reduced the maximum yardage limit for gill nets ≥4 inches stretched mesh to 2,000 yards per fishing operation from Croatan and Roanoke sounds at the Highway 64/264 bridges to Bogue Sound at the Highway 58 Bridge; the maximum yardage limit from the Highway 58 Bridge to the South Carolina state line is 1,000 yards per fishing operation. With an additional year of observer data, the Pamlico, Pungo, Bay, and Neuse rivers were exempted from provisions of the Sea Turtle Lawsuit Settlement Agreement by Proclamation M-27-2011 on September 12, 2011 due to very few documented sea turtle interactions (Figure 3, http://portal.ncdenr.org/web/mf/proclamation-m-27-2011). Albemarle Sound and its tributaries as well as Croatan and Roanoke sounds north of the Highway 64/264 bridges were also exempt from the provisions of the Sea Turtle Lawsuit Settlement Agreement due to no documented sea turtle interactions. Atlantic sturgeon interactions were reported in

these areas but were much higher in Albemarle and Croatan sounds than in the other exempted water bodies (NCDMF 2012).

The NCDMF Observer Program documented Atlantic sturgeon interactions in the large and small mesh gill net fisheries throughout Albemarle, Croatan, Roanoke, and Currituck sounds and its tributaries (Figure 4) (NCDMF 2012). There were 274 observed trips in these water bodies with 88 observed interactions; 80 of these interactions were in large mesh gill nets (NCDMF 2012). In comparison, there were 1,853 observed trips in Pamlico Sound with only 19 observed interactions; 15 of these interactions were in large mesh gill nets. There were 420 observed trips in the Pamlico, Pungo, Bay, and Neuse rivers with only 4 observed interactions—all from large mesh gill nets (NCDMF 2012).

Lowering the maximum yardage limit for large mesh gill nets in Albemarle, Croatan, Roanoke, and Currituck sounds and its tributaries could provide additional protection to Atlantic sturgeon by reducing the yardage of large mesh gill net in the water at any given time, assuming that effort in the large mesh gill net fishery does not increase. Analysis from Amendment 1 to the North Carolina Southern Flounder FMP found the average amount of large mesh gill net fished per operation in Albemarle Sound from 2000 to 2009 ranged from approximately 1,700 to 2,100 yards per operation and averaged less than 2,000 yards per trip for the Pamlico, Pungo, Bay, and Neuse rivers with few trips fishing greater than 2,000 yards of large mesh gill net (NCDMF 2010). Any reduction in the maximum yardage limit will need to ensure that it will appreciably reduce yardage for a particular water body, which means a uniform yardage reduction for areas exempt from the Sea Turtle Lawsuit Settlement Agreement may not be appropriate. Maximum yardage limits are widely implemented in North Carolina's estuarine waters, but they are difficult to enforce because the Marine Patrol officer must encounter every gill net set by the fishing operation.

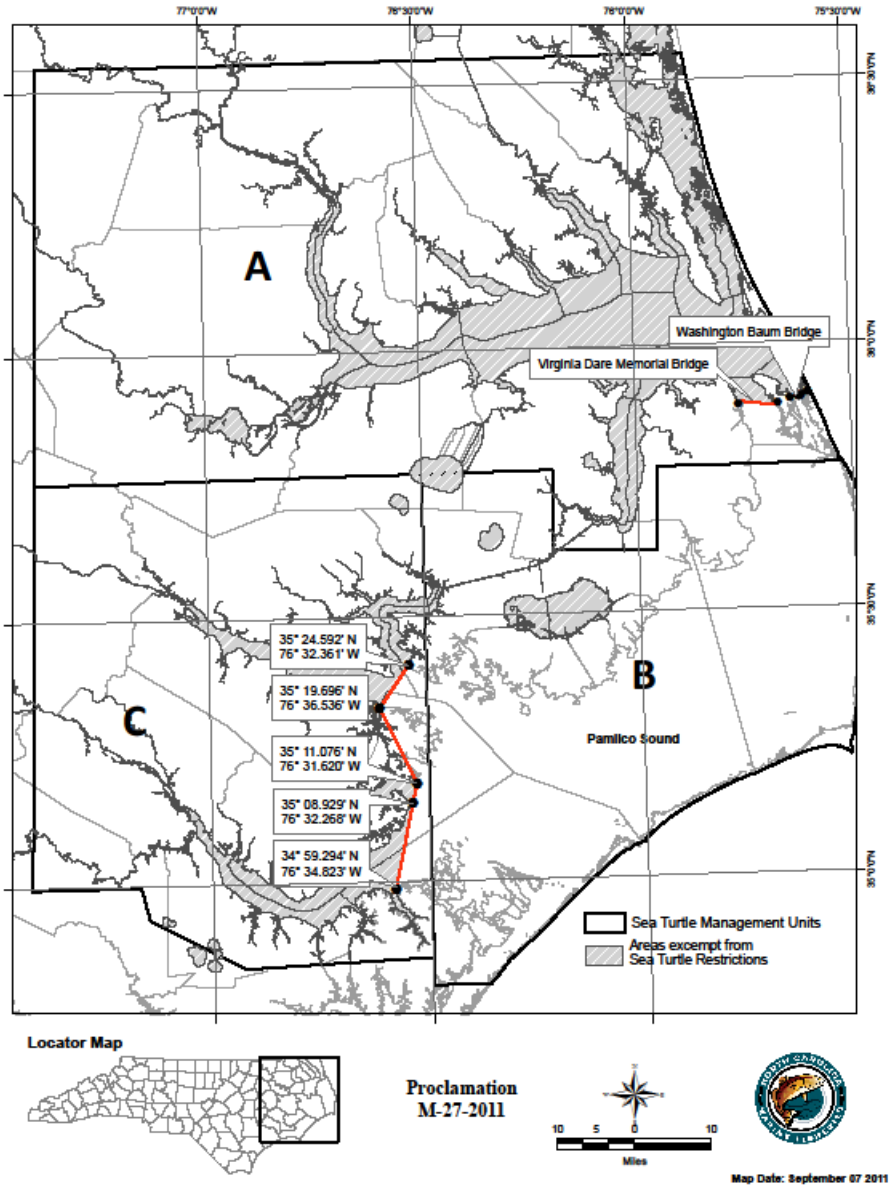

Figure 3. Map showing areas exempted from the Sea Turtle Lawsuit Settlement Agreement management measures. Proclamation M-27-2011, http://portal.ncdenr.org/web/mf/proclamation-m-27-2011.

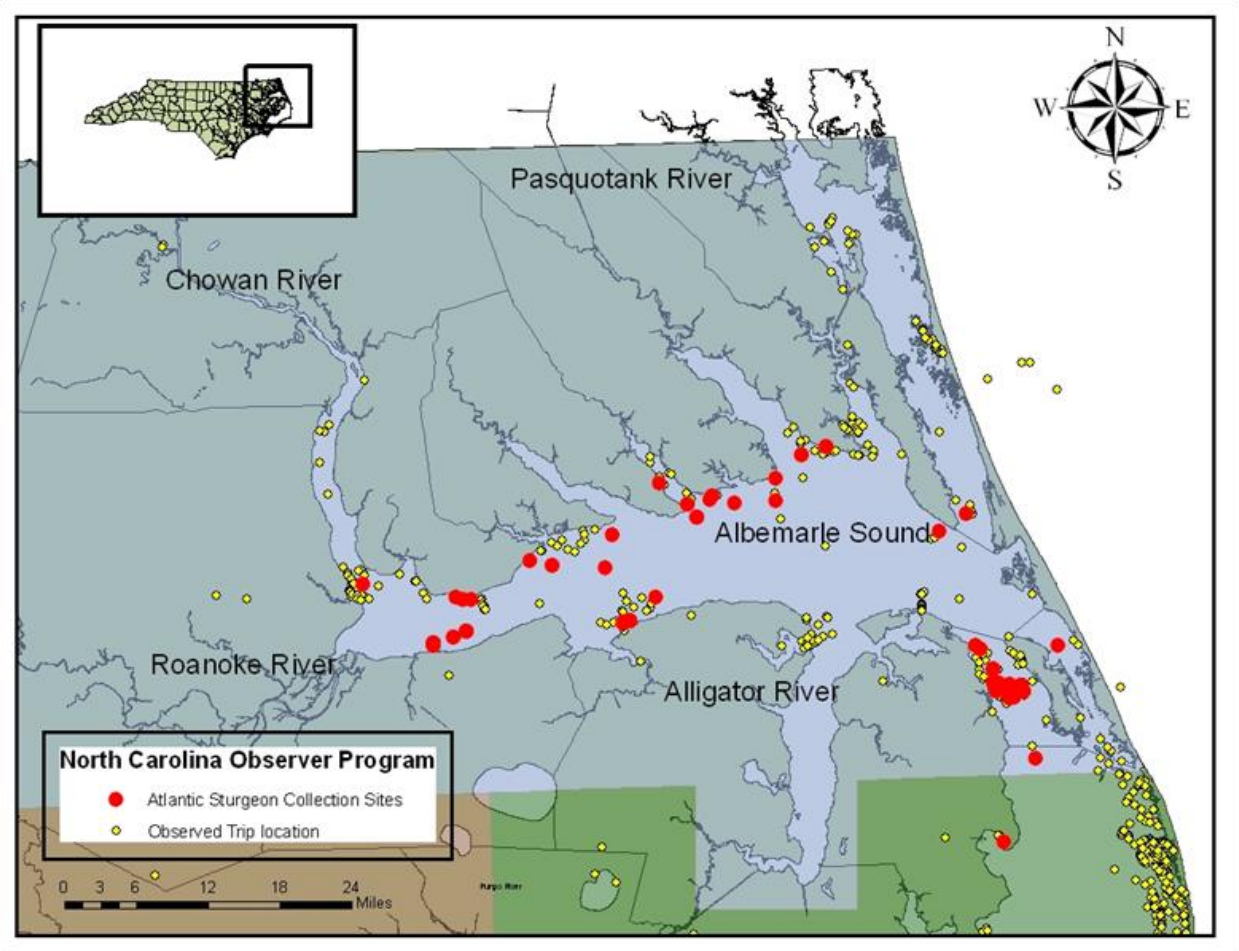

Figure 4. Locations of observed trips and interactions of Atlantic sturgeon from the North Carolina Gill Net Observer Program from Albemarle Sound, 2001-2010 (NCDMF 2012).

Maximum Yardage Limit Reduction for Small Mesh Gill Nets

Although the estuarine gill net fishery is extensively managed, there is no maximum yardage limit for gill nets <4 inches stretched mesh for most of North Carolina's estuarine waters. Unattended small mesh gill nets in the Albemarle Sound Management Area (ASMA—Albemarle, Currituck, Croatan, Roanoke sounds and its tributaries) are limited to 800 yards per operation, and the allowable mesh sizes <4 inches stretched mesh are limited. Amendment 1 to the North Carolina Red Drum FMP analyzed small mesh gill net yardage used in the commercial fishery for a variety of target species (NCDMF 2008). From 2001 to 2006, average gill net yardage fished ranged from approximately 700 yards per trip in the white perch fishery to over 1,300 yards per trip for the weakfish fishery. Small mesh gill net yardage fished per trips ranged from 100 yards per trip to 4,000 yards per trip.

There are only two documented sea turtle interactions in small mesh gill nets (Jacob Boyd, NCDMF, personal communication, June 2012), but NMFS is still concerned about these interactions (Helen Golde and Kristy Long, NMFS Office of Protected Resources, personal communication). Atlantic sturgeon are more commonly caught in commercial small mesh gill

nets than sea turtles (NCDMF 2012). NCDMF's independent gill net surveys encounter Atlantic sturgeon in small mesh gill nets (Tables 1-3) (NCDMF 2012). Implementing a maximum yardage limit for small mesh gill nets could provide additional protection to Atlantic sturgeon and sea turtles by reducing the yardage of small mesh gill net in the water at any given time, assuming that fishing effort does not increase. Any reduction in the maximum yardage limit will need to ensure that it will appreciably reduce yardage for a particular water body, which means a uniform yardage limit for gill nets <4 inches stretched mesh in all water bodies might not be appropriate. As in the large mesh gill net fishery, maximum yardage limits for small mesh gill nets would be difficult to enforce because the Marine Patrol officer must encounter every gill net set by the fishing operation.

Table 1. Atlantic sturgeon CPUE and at net mortality by mesh size from the Albemarle Sound Independent Gill Net Survey, NC, 1990-2010 (NCDMF 2012).

Albemarle Sound						
Mesh Size	Effort	CPUE	CPUE per yard	Atlantic Sturgeon (N)	Mortality (N)	Mortality (%)
2.5	7,483	0.02245	0.00056	168	5	3
3	7,486	0.02378	0.00059	178	5	3
3.5	7,509	0.02743	0.00069	206	5	2
4	7,446	0.02780	0.00070	207	10	5
4.5	7,564	0.02565	0.00064	194	5	3
5	7,518	0.01676	0.00042	126	3	2
5.5	7,001	0.00743	0.00019	52	1	2
6	7,057	0.00524	0.00013	37	0	0
6.5	6,991	0.00358	0.00009	25	2	8
7	7,027	0.00313	0.00008	22	0	0
8	7,664	0.00091	0.00002	7	0	0
10	6,945	0.00014	0.00000	1	1	100
Total	87,691	0.01395	0.00035	1,223	37	3

Table 2. Atlantic sturgeon CPUE and at net mortality by mesh size from the Pamlico Sound Independent Gill Net Survey, NC, 2001-2010 (NCDMF 2012).

	Pamlico Sound					
Mesh Size	Effort	CPUE	CPUE per yard	Atlantic Sturgeon (N)	Mortality (N)	Mortality (%)
2.5						
3.0	3,101	0.00161	0.00005	5	1	20
3.5	3,101	0.00194	0.00006	6	1	17
4.0	3,101	0.00258	0.00009	8	1	13
4.5	3,101	0.00226	0.00008	7	0	0
5.0	3,101	0.00258	0.00009	8	0	0
5.5	3,101	0.00323	0.00011	10	1	10
6.0	3,101	0.00129	0.00004	4	0	0
6.5	3,101	0.00161	0.00005	5	1	20
Total	24,808	0.00214	0.00007	53	5	9

Table 3. Atlantic sturgeon CPUE and at net mortality by mesh size from the Pamlico, Pungo, and Neuse rivers Independent Gill Net Survey, NC, 2003-2010 (NCDMF 2012).

	Pamlico, Pungo, Neuse Rivers					
Mesh Size	Effort	CPUE	CPUE per yard	Atlantic Sturgeon (N)	Mortality (N)	Mortality (%)
2.5						
3.0	2,380	0.00546	0.00018	13	2	15
3.5	2,380	0.00504	0.00017	12	0	0
4.0	2,380	0.00294	0.00010	7	2	29
4.5	2,380	0.00210	0.00007	5	1	20
5.0	2,380	0.00126	0.00004	3	0	0
5.5	2,380	0.00126	0.00004	3	1	33
6.0	2,380	0.00084	0.00003	2	0	0
6.5	2,380	0.00042	0.00001	1	0	0
Total	19,040	0.00242	0.00008	46	6	13

Limitations on How Gill Nets can be Set

Management measures that limit the length of an individual gill net and establish a minimum distance between gill net sets could reduce interactions with Atlantic Sturgeon and sea turtles by reducing the amount of gill net set in any given area. Proclamation M-15-2008 (http://www.ncfisheries.net/procs/procs2k8/M-15-2008.html) implemented a maximum gill net length of 200 yards for an individual gill net set in the Pamlico Sound Gill Net Restricted Area

(PSGNRA) to minimize sea turtle interactions in the large mesh gill net fishery. The Sea Turtle Lawsuit Settlement Agreement requires a maximum large mesh gill net length of 100 yards for an individual gill net set with a minimum of 25 yards between each gill net set (NCDMF 2011). These requirements do not apply in areas exempted from the Sea Turtle Lawsuit Settlement Agreement. There are no maximum gill net set lengths or spacing requirements for gill nets <4 inches stretched mesh in North Carolina's estuarine waters. Establishing these measures for unattended gill nets <4 inches stretched mesh and for gill nets ≥4 inches stretched mesh in the areas exempted from the Sea Turtle Lawsuit Settlement Agreement has the potential to minimize Atlantic Sturgeon and sea turtle interactions. Enforcing these management measures is easier than a maximum gill net yardage limit per operation because every gill net set by a given fishing operation does not need to be observed by the Marine Patrol officer.

Soak Time Limitations for Gill Nets

The Sea Turtle Lawsuit Settlement Agreement limits soak times for unattended gill nets ≥4 inches stretched mesh from one hour before sunset to one hour after sunrise to remove unattended gill nets from the water when sea turtles are more active (NCDMF 2011). Seminoff and Jones (2006) found that green sea turtles moved during the day and night but covered more distance during daylight hours. Ogden et al. (1983) reported feeding events by green sea turtles occurred most often during the day. However, activity patterns of other sea turtles in their natural environment are not as well documented. At a minimum, this regulation reduces the chance for a sea turtle to interact with an unattended gill net. The soak time limitation does not apply in the exempted areas where sea turtles are not commonly found and does not apply to gill nets <4 inches stretched mesh. Atlantic sturgeon discard mortality from ocean gill nets from Maine to North Carolina averaged approximately 14%, but the mortality rates were higher in gill nets with soak times greater than 12 hours; this was particularly the case for gill nets targeting monkfish (ASMFC 2007). Atlantic sturgeon gill net mortalities from the NCDMF Observer Program averaged 6% overall (NCDMF 2012). The Albemarle Sound Independent Gill Net Survey, which commonly encounters Atlantic sturgeon, had an overall mortality rate of 3% under a 24-hour soak time (Table 1) (NCDMF 2012). The Pamlico Sound Independent Gill Net Survey, which does not encounter Atlantic sturgeon as often, had an overall mortality rate of 9% under a 12-hour soak time (Table 2). The Pamlico, Pungo, and Neuse rivers Independent Gill Net Survey had an overall mortality rate of 13% under a 12-hour soak time (Table 3). The discrepancy in mortality rates and soak times between the independent gill net surveys could be a result of water temperatures. The Albemarle Sound Independent Gill Net Survey takes place from November to May and the Pamlico Sound and the Pamlico, Pungo, and Neuse rivers independent gill net surveys take place from mid February through mid December.

Limiting soak times in areas where Atlantic sturgeon are commonly found when water temperatures are warmer should reduce overall interactions and mortalities. Minimizing discard mortality for Atlantic sturgeon is particularly important because they are long-lived, late maturing animals. To remain stable or grow, populations of Atlantic sturgeon can sustain only very low anthropogenic sources of mortality (<4% per year) due to their long-lived and late maturing life history strategy (ASMFC 2007).

Limiting the soak times for unattended gill nets will also make fishing gill nets more challenging. Fuel costs are higher due to the extra trip required to reset the gear the following evening. Gill net fishermen that have a substantial transit time from their home port to the fishing grounds have a difficult time removing their gear from the water in the specified time frame. In areas affected by the Sea Turtle Lawsuit Settlement Agreement, this has resulted in some areas

becoming inaccessible to gill netters because of the long transit time. In areas with higher tidal amplitudes, low tides at sunset and sunrise could prevent gill netters from setting and retrieving their gear within the specified time frame. This management measure could also result in safety hazards for the gill net fishermen due to fishing in low light conditions, during times of cold water temperatures, and inclement weather.

Small Mesh Gill Net Attendance

Required attendance of small mesh (<5 inches stretched mesh) gill nets in North Carolina's estuarine waters is a management measure designed to minimize bycatch of undersized finfish. Small mesh gill net attendance is required from mid-May through mid-November in the ASMA, and small mesh gill nets in the upper reaches of Pamlico, Pungo, Neuse and Trent rivers are required to have year-round attendance to minimize bycatch of undersized striped bass (NCDMF 2004). The North Carolina Red Drum FMP implemented attendance requirements for small mesh gill nets from May 1 through October 31 in areas known to be critical for juvenile red drum. These critical areas were defined as all primary and secondary nursery areas, areas within 200 yards of any shoreline, and the extensive shallow grass flats located behind the Outer Banks. An exemption to this rule lifts the attendance requirement for the region from Core Sound to the South Carolina state line in October to allow for the fall spot fishery (NCDMF 2008).

Amendment 1 to the North Carolina Red Drum FMP expanded on the small mesh gill net attendance requirements. Specifically, it extended the year round attendance within 200 yards of shore to include the area of the lower Neuse River out to the mouth of the river, and extended the seasonal attendance requirements to include the period of May 1 through November 30 in the following areas: all primary and permanent secondary nursery areas and all modified no-trawl areas (shallow grass beds in eastern Pamlico and Core sounds); within 200 yards of any shoreline for the areas of Pamlico, Pungo, Neuse, and Bay rivers; and within 50 yards of any shoreline in areas of Pamlico and Core sounds and in all coastal waters south to the South Carolina state line (NCDMF 2008). However, the area from Core Sound to South Carolina state line was excluded from the shoreline attendance requirement during October and November.

Small mesh gill net attendance requirements designed to minimize undersized red drum bycatch also occur in areas and times where sea turtles are most commonly found. Few sea turtle interactions have been documented in small mesh gill nets. The attendance requirements may be the reason for the few interactions or it could be the result of reduced effort stemming from the attendance requirements. Extending the attendance requirement through November 30 from Core Sound to South Carolina state line could potentially provide more protection for sea turtles, but this is also a time of year when sea turtles are migrating out of the estuaries in advance of colder water temperatures and are not as abundant (Epperly et al. 1995; Avens and Lohmann 2004, STAC 2006).

Extending the small mesh gill net attendance areas year-round could minimize bycatch of Atlantic sturgeon in this gear, but Atlantic sturgeon are common in some of North Carolina's estuaries and rare in others. The NCDMF Observer Program only observed three Atlantic sturgeon out of 215 trips in small mesh gill nets in Pamlico Sound, zero out of 52 trips in the Pamlico, Pungo, Bay, and Neuse rivers, and zero out of 34 trips in the estuarine waters south of Pamlico Sound (NCDMF 2012). However, the NCDMF independent gill net surveys in Pamlico Sound and in the Pamlico, Pungo, and Neuse rivers caught Atlantic sturgeon in small mesh gill net sets (Tables 2 and 3) (NCDMF 2012). The small number of observed small mesh gill net

trips may partly explain the lack of Atlantic sturgeon observed in this fishery. Therefore, extending the small mesh gill net attendance requirements for areas where Atlantic sturgeon are most commonly found could be an effective management measure without implementing additional regulations in places where bycatch of sturgeon is rare.

Large Mesh Gill Net Attendance

Required attendance of large mesh (≥5 inches stretched mesh) gill nets is not a commonly used management measure in North Carolina's estuarine waters due to lower rates of bycatch than in unattended small mesh gill nets. Amendment 1 to the North Carolina Red Drum FMP required the setting of unattended large mesh gill nets at least 10 feet from any shoreline from June through October (NCDMF 2008). The purpose of this regulation was to move large mesh gill nets away from shore to minimize the discards of undersized and oversized red drum as well as to minimize discards of red drum above the daily commercial trip limit.

In response to the high abundance of sea turtles in the lower Cape Fear River and associated takes in gill nets, NCDMF required attendance of large mesh gill nets in 2005 from June 20 to August 31 (NCDMF 2012). In 2009, attendance of all gill nets in this region was required from May 23 to November 11. The seasonal attendance requirement resulted in much less large mesh gill net fishing effort in the lower Cape Fear River (NCDMF 2012).

Requiring large mesh gill net attendance in estuarine waters would likely reduce mortalities of sea turtles and sturgeon by minimizing the time the animals are entangled. Additional reductions of interactions and mortalities would likely result from reduced effort in terms of both number of trips made and yards of gill net fished and from fishermen choosing not to fish.

Seasonal Closures

A seasonal closure is a management measure designed to limit fishing effort, and in the case of sea turtles and Atlantic sturgeon, designed to reduce interactions. The Sea Turtle Lawsuit Settlement Agreement included a partial season closure limiting fishing with unattended gill nets ≥4 inches stretched mesh to 4 days per week from Croatan and Roanoke sounds at the Highway 64/264 bridges to Beaufort Inlet and 5 days per week from Beaufort Inlet to the South Carolina state line. Fishing with unattended gill nets ≥4 inches stretched mesh can be fished 7 days per week in areas exempted by the Sea Turtle Lawsuit Settlement Agreement, and Atlantic sturgeon are commonly found in some of these areas. Expanding the 3-day weekly closures to the rest of the State to reduce effort from unattended gill nets ≥4 inches stretched mesh could reduce Atlantic sturgeon interactions as could implementing the 3-day weekly closures to unattended gill nets <4 inches stretched mesh since Atlantic sturgeon interactions in unattended gill nets <4 inches stretched mesh are higher than sea turtles. Both options are dependent on effort not appreciably increasing during days when fishing is allowed. A seasonal closure that occurs when sea turtles and Atlantic sturgeon are present in North Carolina's estuarine waters would provide the most protection. However, either sea turtles or Atlantic sturgeon are present throughout the year, so this would result in no unattended gill nets in estuarine waters. Another possibility would be to limit season closures to areas where Atlantic sturgeon are more common or during months of high water temperatures when discard mortality is higher.

Area Closures

Area closures are a way to address hotspots, or locations with high incidences of protected species interactions compared to other locations confirmed by the NCDMF Observer Program or NCDMF fishery independent surveys. Gill nets >4.25 inches stretched mesh are prohibited in the deep water portions of Pamlico Sound and areas around Oregon, Hatteras, and Ocracoke inlets from September 1 through December 15 to minimize sea turtle interactions (NCDMF 2011). The shallow water portions of Pamlico Sound are open during this time as a result of a Section 10(a)(1)(B) ITP for the PSGNRA; these waters would also be closed without the ITP. Area D1 is currently closed to unattended gill nets >4 inches stretched mesh from April 1 through November 30 due to high sea turtle interactions (Proclamation M-28-2012, http://portal.ncdenr.org/web/mf/proclamation-m-28-2012). Gill nets are prohibited in all inland designated waters managed by the NCWRC. Gill nets in western Albemarle Sound are prohibited from February 1 to mid November in the area southwest of a line from Black Walnut Point 35° 59.3833'N - 76° 41.0060'W; running 138° (M) to a point 35° 56.3333'N - 76° 36.0333'W at the mouth of Mackey's Creek, including Roanoke, Cashie, Middle and Eastmost rivers. The purpose of this rule is to protect striped bass during their migrations into the Roanoke River.

The area closure in western Albemarle Sound is an area where Atlantic sturgeon are commonly caught by the NCDMF's Albemarle Sound Independent Gill Net Survey (Figure 5) (NCDMF 2012). Recent data analysis has shown that Atlantic sturgeon tend to move throughout the western portion of Albemarle Sound between the Highway 32 Bridge and the Highway 17 Bridge, so the potential exists to expand the closed area in Albemarle Sound to reduce interactions (NCDMF 2012). Other hotspots for sea turtles and Atlantic sturgeon may exist in estuarine waters but additional observer coverage is needed to document them. Identifying these hotspots and managing them proactively provides the best chance to minimize interactions and to avoid early season closures in the management areas where these hotspots occur.

Area closures tend to result in fishermen shifting their fishing effort to open areas if it is feasible. If the effort shifts to an area where sea turtles and Atlantic sturgeon are not commonly found, then the area closure will reduce interactions with protected species. However, many of North Carolina's estuarine waters have either sea turtles, Atlantic sturgeon or both present. Shifting fishing effort in other areas could lead to increased protected species interactions in other areas, which could result in more area and season closures.

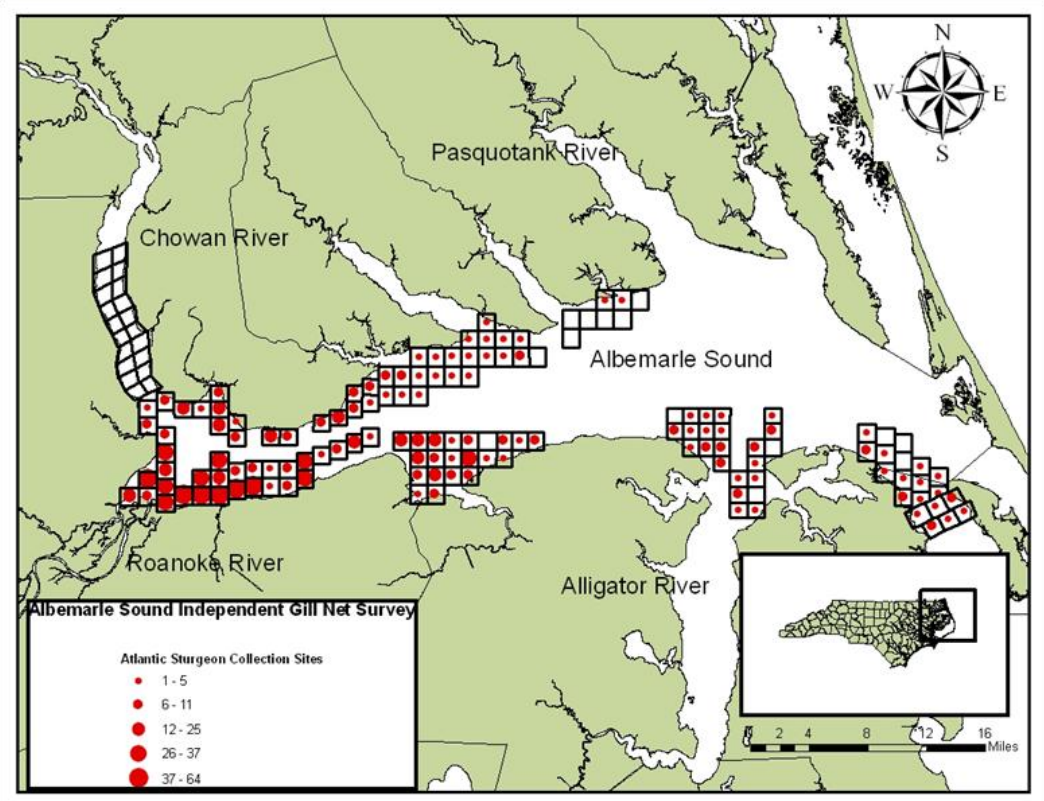

Figure 5. Atlantic sturgeon interactions by sampling zone from the Albemarle Sound Independent Gill Net Survey, NC, 1990-2010 (NCDMF 2012).

Summary

These management measures can be implemented individually or in conjunction with one another and can be applied statewide or to specific areas. A combination of management measures may be an effective way to minimize Atlantic sturgeon in one part of the State while another suite of management measures may be an effective way to minimize sea turtles in another part of the State. The potential management options provide the necessary flexibility to implement management measures that are most effective in terms of minimizing protected species interactions and still providing fishing opportunities for the commercial estuarine gill net fishery.

These management measures could be implemented proactively while the revised ITP applications for Atlantic sturgeon and sea turtles are being developed, or they could be incorporated into the revised ITP applications and become effective if the NCDMF receives the ITPs. An advantage of implementing these measures proactively is to minimize interactions with these protected species as soon as possible to reduce the fishermen's risk of lawsuits, federal fines and penalties if they interact with a listed species under the ESA. Another advantage is these measures could be modified (relaxed or increased restrictions) based on future data collection before they are incorporated into an ITP. Additional functions of these potential management measures are to prevent early season and area closures under an ITP due to meeting the allowable takes for any given area and season and to possibly reduce the number of takes requested in the ITP applications.

However, increased observer coverage for the small mesh gill net fishery and in areas with low observer coverage are needed to fully evaluate some of the management options. In addition, more information is needed to identify hotspots.

ITPs under Section 10(a)(1)(B) of the ESA require protected species takes be reduced from prior levels. Estimating the number of protected species interactions from a particular fishery is very uncertain, so it is difficult to quantify the reduction of interactions from any given management option. Regardless, the management measures presented in this issue paper have the potential to reduce interactions. Reductions in interactions resulting from these management measures may not be sufficient to prevent lawsuits and additional management measures. Lawsuits limit management options and flexibility, as is the case with the Sea Turtle Lawsuit Settlement Agreement. This is an important point to consider when selecting preferred management measures.

The historical landings and fishing effort in North Carolina's estuarine gill net fishery will never be achieved again under the current management measures or under an ITP. The NCDMF has objected to the listing of Atlantic sturgeon, pursued ITPs, and increased observer coverage to avoid the closure of the estuarine gill net fishery due to protected species interactions. The intent of these management measures and ITP applications is to ensure the estuarine gill net fishery is in compliance with the ESA and is still able to operate.

V. Current Authority

G.S. 113-189. Protection of sea turtles and porpoises
15A NCAC 03I .0107 ENDANGERED OR THREATENED SPECIES
15A NCAC 03J .0103 GILL NETS, SEINES, IDENTIFICATION, RESTRICTIONS
15A NCAC 03J .0401 FISHING GEAR
15A NCAC 03M .0508 STURGEON

VI. Management Options

(+ potential positive impact of action)
(- potential negative impact of action)

1) Status Quo—no additional management measures
   + Maintains management measures in place to minimize sea turtle interactions
   + Implements management measures outlined in ITPs if they are received
   + No additional burden on commercial fishermen before sea turtle and Atlantic sturgeon ITPs are received, if they are received
   - Does not address Atlantic sturgeon interactions in areas of high abundance
   - Does not implement measures to avoid early season or area closure**s**
   - No measures in place to prevent exceeding allowable takes in an ITP
   - Higher risk of lawsuits, federal fines, and penalties to fishermen if they interact with a listed species under the ESA

2) Maximum Yardage Limit Reduction for Large Mesh Gill Nets in areas exempted from the Sea Turtle Lawsuit Settlement Agreement management measures
   + Reduces maximum yardage limit in areas where Atlantic sturgeon are commonly found

+ Management measure that could reduce Atlantic sturgeon interactions
+ Potential to avoid early season or area closures
- Uniform yardage reduction for large mesh gill nets may not be appropriate in all parts of the state
- Difficult to enforce

3) Maximum Yardage Limit Reduction for Unattended Small Mesh Gill Nets
+ Implements a maximum yardage limit for a gear that does not have one in most of the estuarine waters
+ Management measure that could reduce Atlantic sturgeon and sea turtle interactions
+ Potential to avoid early season or area closures
- Uniform yardage reduction for small mesh gill nets may not be appropriate in all parts of the state
- Difficult to enforce

4) Limitations on How Gill Nets can be Set
+ Management measure that could reduce Atlantic sturgeon and sea turtle interactions in small mesh gill nets and large mesh gill nets in areas exempted from the Sea Turtle Lawsuit Settlement Agreement management measures
+ Potential to avoid early season or area closures
+ Easier to enforce than a maximum yardage limit
- Increased enforcement responsibilities for Marine Patrol
- More buoys and anchors needed to set gill nets

5) Soak Time Limitations for Gill Nets
+ Management measure that could reduce Atlantic sturgeon and sea turtle interactions and mortalities
+ Appears to be an effective management measure for reducing sea turtle interactions
+ Potential to avoid early season or area closures
+ Easier to enforce than a maximum yardage limit
- Increased enforcement responsibilities for Marine Patrol
- Fishing grounds that are a long distance from port might be inaccessible
- Increased fuel cost for gill net fishermen
- Increased safety concerns for large mesh gill net fishermen

6) Small Mesh Gill Net Attendance
+ Management measure that could reduce Atlantic sturgeon and sea turtle interactions and mortalities
+ Potential management measure for areas with high interactions
+ Potential to avoid early season or area closures
- Increased enforcement responsibilities for Marine Patrol
- May not be necessary for areas with small mesh gill net attendance requirements or where Atlantic sturgeon are not commonly found
- Increased safety concerns for small mesh gill net fishermen

7) Large Mesh Gill Net Attendance
+ Management measure that could reduce Atlantic sturgeon and sea turtle interactions and mortalities
+ Potential management measure for areas with high interactions
+ Potential to avoid early season or area closures

- Increased enforcement responsibilities for Marine Patrol
- Other management measures available to address sea turtle and Atlantic sturgeon interactions
- Increased safety concerns for large mesh gill net fishermen

8) Seasonal Closures
+ Management measure that could reduce Atlantic sturgeon and sea turtle interactions and mortalities
+ Potential management measure for areas with high interactions
+ Potential to implement season closures similar to other parts of the State
- Increased enforcement responsibilities for Marine Patrol
- Season closures during the entire time of the year when sea turtles and Atlantic sturgeon are present in estuarine waters would eliminate the use of unattended gill nets

9) Area Closures
+ Management measure that could reduce Atlantic sturgeon and sea turtle interactions and mortalities
+ Potential management measure for areas with high interactions
- Increased enforcement responsibilities for Marine Patrol
- Potential to displace fishing effort to other areas, which could increase sea turtle and Atlantic sturgeon interactions in other areas

VII. Management Recommendations

VIII. Research Needs

- Continued observer coverage of the estuarine gill net fisheries, especially in areas and fisheries with limited coverage
- Document Atlantic sturgeon and sea turtle hotspots
- Identify migration pathways and spawning locations for sturgeon
- Gill net gear avoidance research

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