UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

AUG 16 2010

ENVIRONMENTAL ASSESSMENT
ON THE EFFECTS OF THE ISSUANCE OF A SCIENTIFIC RESEARCH PERMIT (File No. 14759) TO CONDUCT SCIENTIFIC RESEARCH ON SHORTNOSE STURGEON IN NORTH CAROLINA RIVERS

Lead Agency: USDC, National Oceanic and Atmospheric Administration National Marine Fisheries Service, Office of Protected Resources

Responsible Official: James H. Lecky, Director, Office of Protected Resources

For Further Information Contact: Office of Protected Resources
National Marine Fisheries Service
1315 East West Highway
Silver Spring, MD 20910
(301) 713-2289

Location: North Carolina rivers (Chowan, Roanoke, and Cape Fear) and estuaries (Albemarle Sound)

Abstract: The National Marine Fisheries Service (NMFS) proposes to issue a scientific research permit (File No. 14759) to Joseph Hightower, Ph.D. (North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University, Raleigh, NC 27695), to take shortnose sturgeon (*Acipenser brevirostrum*) in the wild for purposes of scientific research pursuant to the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 *et seq.*).

The applicant is seeking a five-year scientific research permit assessing the presence, abundance, and distribution of shortnose sturgeon within North Carolina river basins (Chowan, Roanoke, and Cape Fear and estuaries) and Albemarle Sound using non-lethal sampling methods. The researcher proposes to combine hydroacoustic surveys (using side-scan and DIDSON sonar) and gill nets, to annually capture, measure, weigh, genetic tissue sample, PIT tag and Floy tag up to 15 shortnose sturgeon annually from the Chowan and Cape Fear River Basins and Albemarle Sound. He also proposes similar activity capturing up to 25 shortnose sturgeon annually from the Roanoke River Basin. A sub-set of up to five sub-adults or adults from each river basin and Albemarle Sound would be anesthetized and implanted with internal sonic transmitters each year. Manual tracking and passive detections of telemetered fish at fixed receiver stations would provide information about movement, seasonal distribution and habitat use.

Printed on Recycled Paper

TABLE OF CONTENTS

CHAPTER 1: PURPOSE AND NEED FOR ACTION **4**

.

1.1 DESCRIPTION OF ACTION 4
1.1.1 *Purpose and Need* 4
1.1.2 *Objectives of the Research* 4
1.2 OTHER EAs INFLUENCING THE SCOPE OF THIS EA **4**
1.3 SCOPING SUMMARY **5**
1.4 APPLICABLE LAWS AND NECESSARY FEDERAL PERMITS, LICENSES, AND ENTITLEMENTS **5**
1.4.1 *National Environmental Policy Act* 5
1.4.2 *Endangered Species Act* 6
1.4.3 *Magnuson-Stevens Fishery Conservation and Management Act* 6

CHAPTER 2: ALTERNATIVES INCLUDING THE PROPOSED ACTION **7**

2.1 ALTERNATIVE No. 1: NO ACTION **7**
2.2 ALTERNATIVE No. 2: PROPOSED ACTION – ISSUANCE OF PERMIT WITH STANDARD CONDITIONS **7**
2.3 DESCRIPTION OF THE PROPOSED ACTION **7**
2.3.1 *Boundaries of Action* 7
2.3.2 *Research Goals and Proposed Activities* 9
2.3.3 *Proposed Take Summary* 9

CHAPTER 3: DESCRIPTION OF THE AFFECTED ENVIRONMENT **13**

3.1 SOCIAL AND ECONOMIC ENVIRONMENT **13**
3.2 PHYSICAL ENVIRONMENT **14**
3.2.1 *Description of the River Systems and Albemarle Sound* 14
3.2.2 *Critical Habitat, National Marine Sanctuaries and EFH* 15
3.3 BIOLOGICAL ENVIRONMENT **16**
3.3.1 *ESA Target Species Under NMFS Jurisdiction* 16
3.3.2 *ESA Non-Target Species Occurring in the Action Area* 17
3.3.3 *Other Species Occurring in the Action Area* 24

CHAPTER 4: ENVIRONMENTAL CONSEQUENSES **25**

4.1 EFFECTS OF ALTERNATIVE 1: NO ACTION **25**
4.2 EFFECTS OF PROPOSED ALTERNATIVE 2: ISSUANCE OF PERMIT WITH STANDARD CONDITIONS **25**
4.2.1 *Effects of Research Activities on the Target Species* 25
4.3 SUMMARY OF COMPLIANCE WITH APPLICABLE LAWS, NECESSARY FEDERAL PERMITS, LICENSES AND ENTITLEMENTS **31**
4.3.1 *Compliance with the Endangered Species Act (ESA)* 31
4.3.2 *Compliance with the Magnuson-Stevens Fishery Conservation & Management Act* 32
4.4 COMPARISONS OF ALTERNATIVES **32**
4.5 MITIGATION MEASURES **32**
4.5.1 *Netting, Holding, and Handling Conditions* 32
4.5.2 *Genetic Tissue Sampling* 34
4.5.3 *Tagging Conditions* 34
4.5.4 *Anesthetization* 35
4.5.5 *Endangered Florida Manatee Interaction* 35
4.5.6 *Sea Turtles* 37
4.5.7 *Bottlenose Dolphin* 37
4.5.8 *Atlantic Sturgeon Interaction* 37

4.5.9 *Aquatic Nuisance Species*……..…… 37
4.5.10 *Incidental Mortality of Shortnose Sturgeon*…..…… 37
4.5.11 *Other Mitigation Measures*……... 38
***4.6 UNAVOIDABLE ADVERSE EFFECTS*..... 38**
***4.7 CUMULATIVE EFFECTS*..... 38**
4.7.1 *Other Shortnose Sturgeon Research Permits*..... 38
4.7.2 *Bycatch and Poaching*…… 39
4.7.3 *Artificial Propagation*……..... 40
4.7.4 *Dams*……..... 40
4.7.5 *Dredging and Blasting*……... 41
4.7.6 *Water Quality and Contaminants*……... 43
4.7.7 *Summary of Cumulative Impacts*…… 46

CHAPTER 5: LIST OF PREPARERS AND AGENCIES CONSULTED..... 47

LITERATURE CITED..... 48

APPENDICES..... 57

CHAPTER 1 PURPOSE AND NEED FOR ACTION

1.1 DESCRIPTION OF ACTION

In response to a request from Joseph Hightower, Ph.D. (North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University**,** Raleigh, NC 27695), the National Marine Fisheries Service Office of Protected Resources (NMFS-PR) proposes to issue a scientific research permit (File No. 14759). The permit would authorize "takes"[1] of shortnose sturgeon (*Acipenser brevirostrum*) in North Carolina rivers pursuant to the Endangered Species Act of 1973 (ESA; 16 U.S.C. 1531 *et seq*.) and the regulations governing the taking, importing, and exporting of endangered and threatened species (50 CFR Parts 222-226).

1.1.1 *Purpose and Need*:

The purpose of the aforementioned scientific research would be to gather information used to help inform conservation management decisions to recover shortnose sturgeon in the wild. Section 10(a)(1)(A) of the ESA allows NMFS to issue permits and permit modifications to take ESA-listed shortnose sturgeon. The applicant requires a permit to conduct the proposed research.

The primary purpose of the permit, therefore, is to provide an exemption from the take prohibitions under the ESA to allow "takes" of shortnose sturgeon for bona fide scientific research. The need for issuance of the permit is related to NMFS's mandates under the ESA. Specifically, NMFS has a responsibility to implement the ESA to protect, conserve, and recover threatened and endangered species under its jurisdiction. The ESA prohibits takes of threatened and endangered species, respectively, with only a few very specific exceptions, including for scientific research and enhancement purposes. Permit issuance criteria require that research activities are consistent with the purposes and policies of these federal laws and will not have a significant adverse impact on the species.

1.1.2 *Objectives of the research*:

The applicant is seeking a five-year scientific research permit to determine the presence, abundance and distribution of shortnose sturgeon in North Carolina rivers (Chowan, Roanoke, and Cape Fear) and estuaries (Albemarle Sound).

1.2 OTHER EAs INFLUENCING THE SCOPE OF THIS EA

A number of EAs have been prepared on the effects of similar research techniques related to shortnose sturgeon. Appendix 1 lists recently issued NMFS permits or permit modifications for shortnose sturgeon for which EAs or SEAs were prepared. Each EA resulted in a Finding of No Significant Impact (FONSI) determination and has not been controversial. If the applicant's current application (File 14759) results in a permit being issued, the permit would be a new action, and would utilize similar methods and take authorizations studying shortnose sturgeon.

---

1 The ESA defines "take" as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." The term "harm" is further defined by regulations (50 CFR §222.102) as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering."

1.3 SCOPING SUMMARY

The purpose of scoping is to identify the issues to be addressed and the significant issues related to the proposed action, as well as identify and eliminate from detailed study the issues not significant or have been covered by prior environmental review. An additional purpose of the scoping process is to identify the concerns of the affected public and Federal agencies, states, and Indian tribes. CEQ regulations implementing the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq.*) do not require a draft EA be made available for public comment as part of the scoping process. A Notice of Receipt of the application was published in the Federal Register announcing the availability of the permit application and related documents for public comment (File No. 14759; March 12, 2010; 75 FR 11862). No comments were received from the public regarding this application.

1.4 APPLICABLE LAWS AND NECESSARY FEDERAL PERMITS, LICENSES, AND ENTITLEMENTS

This section summarizes federal, state, and local permits, licenses, approvals, and consultation requirements necessary to implement the proposed action, as well as who is responsible for obtaining them. Even when it is the applicant's responsibility to obtain such permissions, NMFS is obligated under NEPA to ascertain whether the applicant is seeking other federal, state, or local approvals for their action.

1.4.1 *National Environmental Policy Act*:

The National Environmental Policy Act (NEPA) was enacted in 1969 and is applicable to all "major" federal actions significantly affecting the quality of the human environment. A major federal action is an activity that is fully or partially funded, regulated, conducted, or approved by a federal agency. NMFS issuance of permits for research represents approval and regulation of activities. While NEPA does not dictate substantive requirements for permits, licenses, etc., it requires consideration of environmental issues in federal agency planning and decision making. The procedural provisions outlining federal agency responsibilities under NEPA are provided in the Council on Environmental Quality's implementing regulations (40 CFR Parts 1500-1508).

NMFS, through NOAA Administrative Order (NAO) 216-6, follows agency procedures for complying with NEPA and the implementing regulations issued by the Council on Environmental Quality. NAO 216-6 specifies that issuance of scientific research permits under the MMPA and ESA is among a category of actions that are generally exempted (categorically excluded) from further environmental review, except under extraordinary circumstances. When a proposed action, otherwise categorically excluded, is (1) the subject of public controversy based on potential environmental consequences; (2) has uncertain environmental impacts or unknown risks; (3) establishes a precedent or decision in principle about future proposals, may result in cumulatively significant impacts; or (4) may have an adverse effect upon endangered or threatened species or their habitats, preparation of an Environmental Assessment (EA) or Environmental Impact Statement (EIS) is required.

While issuance of scientific research permits is typically subject to a categorical exclusion, as described in NAO 216-6, NMFS is preparing an EA for this action to provide a more detailed analysis of effects to ESA-listed species. This EA is prepared in accordance with NEPA, its implementing regulations, and NAO 216-6.

1.4.2 *Endangered Species Act*:

Section 9 of the ESA, as amended, and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption such as by a permit. Permits to take ESA-listed species for scientific purposes, or for the purpose of enhancing the propagation or survival of the species, may be granted pursuant to Section 10(a)(1)(A) of the ESA.

NMFS has promulgated regulations to implement the permit provisions of the ESA (50 CFR Part 222) and has produced OMB-approved application instructions prescribing the procedures necessary to apply for permits. All applicants must comply with these regulations and application instructions in addition to the provisions of the ESA.

Section 10(d) of the ESA stipulates for NMFS to issue permits under section 10(a)(1)(A) of the ESA, the Agency must find that the permit: was applied for in good faith; if granted and exercised will not operate to the disadvantage of the species; and will be consistent with the purposes and policy set forth in Section 2 of the ESA.

Section 2 of the ESA sets forth the purposes and policy of the Act. The purposes of the ESA are to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in section 2(a) of the ESA. It is the policy of the ESA that all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of the ESA. In consideration of the ESA's definition of conserve, which indicates an ultimate goal of bringing a species to the point where listing under the ESA is no longer necessary for its continued existence (i.e., the species is recovered), exemption permits issued pursuant to section 10 of the ESA are for activities that are likely to further the conservation of the affected species.

Section 7 of the ESA requires consultation with the appropriate federal agency (either NMFS or the U.S. Fish and Wildlife Service, (USFWS)) for federal actions that "may affect" a listed species (USFWS 2009) or adversely modify critical habitat. NMFS issuance of a permit affecting ESA-listed species or designated critical habitat, directly or indirectly, is a federal action subject to these Section 7 consultation requirements. Section 7 requires federal agencies to use their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of endangered and threatened species. NMFS is further required to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any threatened or endangered species or result in destruction or adverse modification of habitat for such species. Regulations specify the procedural requirements for these consultations (50 Part CFR 402).

1.4.3 *Magnuson-Stevens Fishery Conservation and Management Act*

Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) requires NMFS to complete an Essential Fish Habitat (EFH) consultation for any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by the agency that may adversely affect EFH.

CHAPTER 2: ALTERNATIVES INCLUDING THE PROPOSED ACTION

This chapter describes the range of potential actions (alternatives) determined reasonable with respect to achieving the stated objectives. The expected outputs and any related mitigation of each alternative is also included. Alternative Number 1 is the "No Action" alternative where the proposed permit would not be issued. The No Action alternative is the baseline for the rest of the analyses. Alternative No. 2 is the "Proposed Action" alternative representing the research proposed in the submitted application for a permit, with standard permit terms and conditions specified by NMFS.

2.1 ALTERNATIVE No. 1: NO ACTION

Under this alternative, the No Action alternative, the scientific research permit (File No. 14759) authorizing capturing shortnose sturgeon with gill nets, measuring, weighing, tagging with PIT, Floy and sonic tags, and sampling tissue for genetic analysis, would not be issued at this time.

2.2 ALTERNATIVE No. 2: PROPOSED ACTION –ISSUANCE OF PERMIT WITH STANDARD CONDITIONS

Under this alternative, the Proposed Action alternative, a five-year permit from the date of issuance would be issued for research activities by the applicant, the permit terms and conditions standard to such permits as issued by NMFS. The permit would authorize non-lethal, proposed sampling with anchored gill nets on up to 15 shortnose sturgeon annually from the Chowan and Cape Fear River Basins and Albemarle Sound. Similar activities capturing up to 25 shortnose sturgeon from the Roanoke River Basin each year are also proposed. A sub-set of up to five sub-adults or adults from each river and Albemarle Sound would be anesthetized and implanted with internal sonic transmitters annually. Each would be captured, measured, weighed, sampled for genetic tissue analysis, and PIT tagged. Tracking sturgeon at fixed receiver stations would take place providing information about movement, seasonal distribution and habitat use.

2.3 DESCRIPTION OF THE PROPOSED ACTION

2.3.1 *Boundaries of Action Area*:

The action area is defined in 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The description of the action area therefore includes the areas affected by sampling activities as well as the area transited by project vessels.

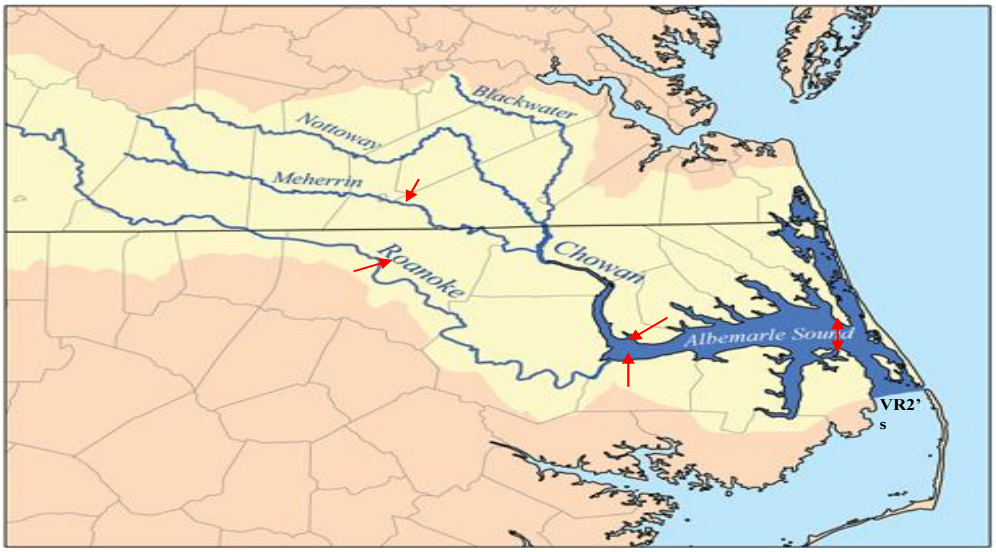
The action area of research is highlighted in Figure 1 below and also illustrated online at: http://maps.google.com/maps/ms?ie=UTF8&hl=en&oe=UTF8&msa=0&msid=110136104058063386946.00048164b43be6240e008.

2.3.1.1 Albemarle Sound:

Two seasonal sampling periods are proposed for shortnose sturgeon in the Albemarle Sound based on areas sampled and temperature regimes to limit impacts on listed sea turtles. Spring sampling efforts would be concentrated in the far western Albemarle Sound (Mar-May) in water temperatures ranging from 12°C - 25°C. Boundaries would be marked by the mouths of the Roanoke and the Chowan Rivers to six kilometers downstream. Fall/Winter sampling (Nov –Feb) would take place in the eastern range of Albemarle Sound in water temperatures ranging between 0°C - 15°. This

sampling area would be bounded to the east by a north-south line crossing Albemarle Sound near Point Harbor, North Carolina (Currituck County), extending to the western sampling area boundary. Additionally VR2 fixed station sonic receivers would be anchored in the Croatan Sound near Oregon inlet marking the southernmost boundary of the research.

Figure 1: Maps of Action Areas



Albemarle Sound, Chowan and Roanoke River Basins. Arrows depicting upper limits of research at first dams located at Emporia, VA, and Roanoke Rapids, NC, lower limits of river research at the mouths of the Chowan and Roanoke Rivers, and the eastern limits of Albemarle Sound.

Cape Fear River Basin. Arrows depicting upper river limits of research at first dam at Riegelwood, NC and lower river boundary near Wilmington, NC

2.3.1.2 Chowan River Basin:

The proposed sampling of the Chowan River Basin extends from the mouth of the river at Albemarle Sound (6 km south of the Hwy 17 Bridge) to the upper reaches of the river basin in Virginia, including the tributaries of the Blackwater, Nottoway and Meherrin Rivers. The first dam preventing sturgeon passage on the system is located at Emporia, Virginia, crossing the Meherrin River near the intersection of Interstate 95.

2.3.1.3 Roanoke River Basin:

The action area requested for sturgeon research on the Roanoke River Basin extends 4 kilometers from the mouth of Roanoke River into Albemarle Sound (including Bachelor Bay) to the base of the first impassible dam located at Roanoke Rapids (rkm 221). Additionally, all branches and tributaries within the Roanoke River Basin would also be potential sampling sites.

2.3.1.4 Cape Fear River Basin:

The Cape Fear River Basin action area would extend from near the city of Wilmington, North Carolina (rkm 45), to the mouth to the first dam, Lock and Dam # 1 (rkm 97) near Riegelwood, North Carolina. Additionally, all branches and tributaries within the Cape Fear River Basin (east of Lock and Dam #1) would be potential sampling sites.

2.3.2 *Research Goals and Proposed Activities*:

A primary goal is to ascertain if using high-frequency side-scan and DIDSON sonars based on body shape and fin positions can assist detecting and sampling shortnose sturgeon in North Carolina rivers. Riverine surveys would be done through a combination of gill-netting and sonar (side-scan sonar and DIDSON) detection in the Chowan, Roanoke, and Cape Fear Rivers of North Carolina. The applicant reported pilot studies in the Roanoke, Cape Fear Rivers in North Carolina, and in the Pee Dee River in South Carolina where he detected Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) using high-frequency side-scan and DIDSON sonars based on body shape and fin positions.

Sampling would focus on capturing adults and juveniles during summer when sturgeon would most likely be congregated in deepwater areas (holes) located near the fresh-saltwater interface. Sampling would also be conducted at likely staging areas between late winter and early spring before the beginning of spring spawning runs. If viable populations of shortnose sturgeon were identified in any of the subject rivers, telemetry tagging of sub-adults or adults would enable monitoring temporal and spatial movement patterns helping identify critical habitat for any discovered populations. Abundance estimates would also be conducted if numbers of captured sturgeon in rivers warranted such estimates.

2.3.3 *Proposed Take Summary*:

The researcher proposes to capture, measure and weigh, genetic tissue sample, PIT tag and Floy tag up to 15 shortnose sturgeon annually from the Chowan and Cape Fear River Basins and Albemarle Sound. He also proposes similar activities capturing up to 25 shortnose sturgeon from the Roanoke River Basin. A sub-set of up to five sub-adults or adults from each river and the Albemarle Sound would be anesthetized and implanted with internal sonic transmitters. Manual tracking and passive detections of telemetered fish at fixed receiver stations would provide information about movements and habitat use (See Appendix 2 for a summary of proposed take).

2.3.3.1 Capturing:

Using hydroacoustic surveys (side-scan, DIDSON) and/or gill nets, adult and juvenile sturgeon would be captured using a standardized netting protocol (anchored gill nets) approximately 1-3 days per week throughout the duration of the study. All sampling of sturgeon would be conducted following the guidelines established in "A Protocol For the Use of Shortnose and Atlantic Sturgeon" (Moser et al 2000) and as supplemented by newer NMFS guidance. All necessary precautions would be taken to ensure shortnose sturgeons are not harmed during capture and handling.

Gill Netting: Gill nets of 12.7 cm (5-inch) or 15.2 cm (6-inch) stretched mesh monofilament would be used to sample for adult and juvenile shortnose sturgeon. Gill nets would typically be 100 meters long and 1.8 meters deep, although shorter shots of net may sometimes be used. Netting would cease in waters above 28ºC. The maximum net set duration in freshwater areas (< 2ppt salinity) would be 14 hours when water temperature is 15 ºC or below. Above 2ppt salinity (also at 15 ºC or below), nets could be set for 10 hours, while attended and in daylight hours only to avoid marine mammal or sea turtle interactions. At water temperatures between 15 ºC and 25 ºC, net sets would not exceed 4 hours; and at water temperatures between 25 ºC and 28 ºC soak times would not exceed 1 hr. Additionally, gill nets would be set in waters having minimum dissolved oxygen (D.O.) concentrations of 4.5 mg/L for the entire deployment.

Additionally, other seasonal netting conditions based on temperature and location would be applied in the Albemarle Sound to avoid impacts with sea turtles and marine mammals. Specifically, netting in the eastern range of the Albemarle would take place in the fall and winter while netting in the western range would take place in the spring (See Section 2.3.1.1).

Table 1: Summary of General Netting Conditions

Water Temperature (ºC)	Minimum D.O. Level (mg/L)	Maximum Net Set Duration (hr)
< 15	4.5	14[1]
< 15	4.5	10[2]
15 < 25	4.5	4
25 - 28	4.5	1
>28	N/A	Cease netting

1 Net set durations of 14 hours (overnight sets permitted) with < 2ppt salinity & < 15ºC

2 Net set durations of 10 hours (daylight sets only permitted) > 2ppt salinity & < 15ºC

Hydroacoustic Monitoring: The applicant proposes to use two types of sonar devices. Side-scan sonar would be used to provide very high resolution images of bottom structure and topography, covering large areas quickly identifying potential target sturgeon as the boat passes by at about three-knot speed; whereas, DIDSON multi-beam sonar would be used for obtaining short-range video clips, accurately identifying target fish prior to deploying gill nets. This combination of high-resolution sonar approaches with gill netting sampling would allow for more directed sampling for sturgeon over larger areas with the potential for greatly reduced by-catch of non-target species.

The Edgetech 4125P-D side-scan unit (http://www.edgetech.com/edgetech/gallery/item/4125-p-side-scan-sonar-system/category/side-scan-sonar-systems) can be used in either low (400 kHz) or high (1250 kHz) frequency modes, but, for the purposes of this study, the researcher would only propose using the high-frequency mode. In this mode, the sonar beam would extend 20-50 m to either side of the boat's path traveling about 3 knots, resulting in a high-resolution image of the bottom along the transect.

The DIDSON multi-beam sonar (http://www.soundmetrics.com/) would be used in high-frequency mode (1.8 MHz), with a range setting of up to 15 m. It would typically be deployed by lowering the sounder to the bottom from an anchored boat to positively identify sturgeon species. It would also be used in a mobile survey, by fixing the DIDSON to the boat and getting images along transects. The DIDSON sonar is somewhat similar to a fish finder in that both use sound to detect objects in the water. Conventional fish finders use single beam whereas the DIDSON unit uses 96 narrow beams to form composite images showing fish shape and movement). DIDSON files are extremely large so it would only be used in specific situations (typically recording five or ten minute files). (http://www.soundmetrics.com/FM/fm_fisheries.html)

2.3.3.2 General Handling (e.g., Holding, Measuring, and Weighing):

Once captured, sturgeon would be held onboard research vessels in live wells or in temporary in boat-side net pens measuring approximately 200 cm long x 150 cm wide x 200 cm deep. If increased catches (including bycatch) becomes apparent, additional net pens would also be included onboard to accommodate excess holding of sturgeon and bycatch. Handling of fish would be kept to a minimum and fish would not be held for more than two hours after removed from capture gear, typically less than 30 minutes. Once recovered, sturgeon would be transferred to an onboard holding tank, they would be weighed, measured, fin clipped, tagged, photographed and further processed. To minimize handling, sturgeon would be moved and handled by researchers using latex gloves and, when held live wells onboard, sturgeon would be immersed in a continuous stream of water supplied by a pump-hose assembly mounted over the side of the research vessel. Dissolved oxygen would be supplemented with compressed oxygen to ensure D.O. concentrations do not fall below saturation. Sturgeon would be weighed on a platform scale fitted with a small waterproof cushion attached to the surface of weighing platform. Total length of each sturgeon would be measured with a standard measuring board and, by using calipers, mouth width and interorbital width would be measured to confirm species (Moser *et al*. 2000).

The time required to complete routine, non-invasive methods (*i.e.*, handling, PIT and Floy tagging, measuring, weighing, and photographing) would be less than two minutes per fish. The cumulative time required for procedures such as anesthesia induction, telemetry tagging, and genetic tissue sampling would vary, but would typically average less than 15 minutes per fish, not accounting for recovery time from anesthesia. While onboard, all fish would be treated with a slime coat restorative in the onboard live well, and, if anesthetized, or otherwise necessary, placed in a separate net pen to ensure full recovery prior to release.

Any sturgeon not responding readily would be recovered further in the net pen by holding upright and immersed in river water and gently moved in a frontward motion to aid freshwater passage over the gills to stimulate. When showing signs of being able to swim away strongly, the fish would be released and a spotter would watch to make sure it remains down and fully recovered.

2.3.3.3 Genetic Tissue Sampling:

Genetic information would be obtained from tissue samples of sturgeon helping characterize the genetic "uniqueness" and current level of genetic diversity of North Carolina populations. Immediately prior to release, a small (1.0 cm^2) soft tissue sample would be collected from the trailing margin of soft tissue of one of the pectoral fins using sharp sterilized scissors. Tissue samples would be preserved in individually labeled vials containing 95% ethanol. The researcher has agreed to provide genetic tissue samples collected from shortnose sturgeon for archival purposes to NOAA/NOS in Charleston, South Carolina, or to Co-investigators identified in the permit. Proper certification, identity, and chain of custody of samples would be maintained during transfer of tissue samples.

2.3.3.4 PIT Tagging:

Prior to PIT tagging, the entire dorsal surface of captured sturgeon would be scanned using a PIT tag reader to detect PIT tags of previously captured fish. All unmarked shortnose sturgeon (≥300 mm TL) would be tagged using 11.9 mm x 2.1 mm PIT tags injected using a 12 gauge needle at an angle of 60 to 80° in the dorsal musculature (left and just anterior to the dorsal fin). No fish would be double-tagged with PIT tags. The last step after injecting PIT tags would be to verify and record the PIT tag code with a tag reader. During the study, the rate of PIT tag retention would be documented and reported to NMFS in annual reports.

2.3.3.5 Floy (T-bar Anchor) Tagging:

The researcher proposes to tag shortnose sturgeon with Floy (T-bar anchor) tags to incorporate incidental recaptures by commercial or recreational fishermen and other researchers to make possible collection of information useful for the assessment of the sturgeon population. In all captured shortnose sturgeon, Floy tags would be anchored in the dorsal fin musculature base and inserted forwardly and slightly downward from the left side to the right through the dorsal pterygiophores. After removing the injecting needle, the tag would be spun between the fingers and gently tugged to be certain the tag is locked in place. During the study, the rate of Floy tag retention would be documented and reported to NMFS in annual reports.

2.3.3.6 Implanting Acoustic Transmitters:

Annually, a maximum of five shortnose sturgeon would be surgically implanted with VEMCO acoustic tags in each river basin and Albemarle Sound. Adult sturgeon (≥ 600 mm) would be tagged with model V16-5H tags, whereas juveniles would be tagged with either VEMCO V7-4L, V9-6L, or V13-1H tags. The applicant proposes tagging juvenile fish with a fork length of 450 mm and larger, which would result in a minimum 783g weight (See Length/Weight relationship, Huff 1975). Specifications for these transmitters are listed in Table 2 below.

Table 2: Proposed Vemco Acoustic Tag Models and Specifications

Model	Length	Diameter	Weight (H^20)	Weight (O^2)
V7-4L	22.5 mm	7 mm	1.0 g	1.8 g
V9-6L	21.0 mm	9 mm	1.6 g	2.9 g
V13-1H	36.0 mm	13 mm	6.0 g	11.0 g
V16-5H	95.0 mm	16 mm	16.0g	36.0 g

Surgery for Implanting Acoustic Tags: The following 4 to 6 minute transmitter implantation surgery under anesthesia would be used. Just prior to the surgical procedure, fish would be removed from an anesthetic bath (described below) and placed on a moist surgery rack. A tube supplying fresh water over the gills would be placed in the mouth of the fish to maintain respiration. The incision site for implanting the tag (40 to 60 mm anterior to the pelvic fins, although the specific location would vary with fish size) would be disinfected with povidone iodine (10 percent solution). A sterile surgical packet containing all surgical instruments and supplies would be used to make a 10 to 20 mm incision in individual fish selected for surgery. A sterilized sonic transmitter, coated with an inert polymer compound, would be inserted into the surgical openings of sturgeon and the incision closed with interrupted sutures of 3-0 polydioxanone (PDS) and treated with povidone iodine to prevent infection. Post-surgery fish would be held in an aerated holding tank and released into the live well or net pen to recover from anesthesia. The applicant estimated the surgical procedure and total holding time would require no more than 15 minutes (including anesthesia induction, surgery and recovery). Further, internal tags would not be implanted in unhealthy or stressed fish or pre-spawning fish in the spring.

Anesthesia for Implanting Acoustic Tags: Shortnose sturgeon selected for transmitter implantation, would be netted at temperatures 27 ºC or below and 7 ºC or above. Each sturgeon prepared for surgery would be anaesthetized using a bath solution of up to 150 mg/L of tricaine methane sulfonate (MS-222) buffered to neutral pH with sodium bicarbonate. Upon reaching a sedated anesthesia stage (i.e., slow movement and breathing reduced) animals would be removed from the solution and placed on a surgery rack to implant the tag. The anesthetic's induction and surgery would vary between 3 and 5 minutes, but would be appropriate for shortnose sturgeon under the specific water temperature and oxygen conditions present (Fox *et al*. 2000).

CHAPTER 3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

This EA evaluates the potential impacts to the human environment from issuance of the proposed permit and the potential impacts on the social, economic, physical, and biological environment (*i.e.*, targeted shortnose sturgeon), specifically those that may result from the proposed research activities requested.

3.1 SOCIAL AND ECONOMIC ENVIRONMENT

Although economic and social factors are listed in the definition of effects in the NEPA regulations, the definition of human environment states that "economic and social effects are not intended by themselves to require preparation of an EIS." However, an EIS or EA must include a discussion of a proposed action's economic and social effects when these effects are related to effects on the natural or physical environment. The social and economic effects of the proposed action mainly involve the effects on the people involved in the research, as well as any industries that support the research, such as suppliers of equipment needed to accomplish the research. There are no significant social or economic impacts of the proposed action interrelated with significant natural or physical environmental effects. Thus, the EA does not include any further analysis of social or economic effects of the proposed action.

3.2 PHYSICAL ENVIRONMENT

The following section provides a description of the critical resources within the action area.

3.2.1 *Description of the River Systems and Albemarle Sound*:

3.2.1.1 Albemarle Sound:

Albemarle Sound is the receiving waters of the Chowan, Roanoke and Pasquotank rivers draining over 18,000 square miles of northern North Carolina and southern Virginia (NCDWR 2001). The two western tributaries, the Chowan and Roanoke rivers, provide over half the annual freshwater discharge into the sound (mean annual freshwater inflow value is estimated at 17,000 cfs). The watershed includes 9,300 miles of freshwater rivers and streams. Albemarle Sound covers 500 mi^2 and is a significant portion of the North Carolina coastal ecosystem. Details of the geological origins of Albemarle Sound are presented in Copeland *et al*. (1983) and Stanley *et al* (1992).

Albemarle Sound and tributaries have long been recognized as providing habitat of prime importance for diadromous fish species (Copeland *et al.* 1983, Epperly and Ross 1986, Stanley *et al.*1992, Waite *et al.* 1994). The sound is used by many anadromous fish including Atlantic sturgeon. Juveniles of all the diadromous species use the shallow, protected areas of Albemarle Sound from spring through fall (Epperly and Ross 1986, Armstrong and Hightower 2002) as nursery habitat; migrating out to the Atlantic Ocean by late fall (Epperly and Ross 1986). Historically, Albemarle Sound was considered one of the most important commercial anadromous fisheries on the east coast. Historical trends in abundance of American shad and river herring in Albemarle Sound were documented by Hightower *et al*. (1996), and those for sturgeon by Secor (2002). At their peak, annual Albemarle Sound landings for American shad were three thousand metric tons (mt); those for river herring (alewife and blueback herring combined) exceeded eight thousand mt; and those for sturgeon (presumably both species combined), 118 mt.

3.2.1.2 Chowan River Basin:

The Chowan River Basin is located in the northeastern Coastal Plain of North Carolina and southeastern Virginia occupying approximately 5,415 square miles. The basin is part of the Albemarle-Pamlico National Estuary Program, and there are 782 total stream miles within the basin (NCSU 2008). Approximately 75 percent of the basin (4,061 square miles) is located in the Virginia portion of the watershed (Basinwide Planning Section 2007), and the remaining 1,378 square miles originates in North Carolina (NCDEM 1982, NCSU 2008). The river is formed at the border of North Carolina and Virginia by the confluence of the Nottoway and Blackwater Rivers. The third major tributary, the Meherrin River, joins the Chowan River south of the Virginia border.

3.2.1.3 Roanoke River Basin:

The Roanoke River Basin begins in the Blue Ridge Mountains of northwestern Virginia and flows for more than 400 miles in a generally southeastern direction, emptying into Albemarle Sound in northeastern North Carolina (TNC 2005; Basinwide Planning Section 2006). Upstream from the fall line located near Roanoke Rapids, the drainage area is nearly 8,000 square miles. From Roanoke Rapids to the coast, the river drains another 2,000 square miles. Discharge from Roanoke River is greater than any other NC river (Basinwide Planning Section 2006), with 36% of the watershed located within North Carolina and the remainder in Virginia.

3.2.1.4 Cape Fear River Basin:

The Cape Fear River Basin is the state's largest river basin. The river basin is located entirely within the state's boundaries and flows southeast from the north central piedmont region near Greensboro to the Atlantic Ocean near Wilmington. The Cape Fear River is formed at the confluence of the Haw and Deep Rivers on the border of Chatham and Lee counties, just below the B. Everett Jordan Reservoir dam. From there, the river flows across the coastal plain past Fayetteville through three locks and dams to Wilmington before entering the ocean. The Black and Northeast Cape Fear Rivers are blackwater rivers meeting the Cape Fear River in Brunswick County. The Cape Fear River Estuary is unique in North Carolina because it is the only estuary which opens directly into the Atlantic Ocean (Street *et al.* 2005), and it has the highest tidal range (± 2 m) of any NC estuary. Tidal range attenuates up the estuary and decreases from 1.2 m at rkm 49 to 0.3 m at rkm 96 (Moser and Ross 1995). The estuary is 0.3 km wide at Wilmington, widens to 2.1 km at Snow's Cut in mid-estuary, and 2.0 km at its mouth. The estuarine portion of the Cape Fear River Basin occupies 880 km^2 of the entire system (approximately 6 percent).

3.2.2 *Critical Habitat, National Marine Sanctuaries and EFH*

There are no designated critical habitats located within the area for the proposed activities. Also, there are no protected areas (e.g., National Estuarine Research Reserves or state protected aquatic areas) affected by the research; nor are there eligible historic resources in the project location. However, designated EFH exists for federally managed species within the action area. Specifically, coinciding with the proposed gill netting and boating activities, the tidally mixed areas of the Cape Fear River Basin, as well as the Albemarle Sound, have designated EFH. A description of specific designated EFH for species within the action area can be found at: http://www.nmfs.noaa.gov/habitat/habitatprotection/profile/southatlanticcouncil.htm, and http://www.nmfs.noaa.gov/habitat/habitatprotection/efh/GIS_inven.htm.

NMFS PR concluded minimal potential impacts to EFH of managed species would be caused by the proposed boating and gill netting activities. Specifically, while the researcher's boats would pass through and over the water column of the action area, NMFS PR considers this portion of the research would not adversely impact the physical environment, including any portion that is considered EFH. Likewise NMFS PR considered netting activities would have no substantial impact on the bottom substrate of rivers and Albemarle Sound consisting of shallow mud bottoms, to coarse textured sand substrates and some rocky substrates. Because there would be very little bottom drag by anchored nets on the bottom substrate and benthic organisms, impacts from netting to EFH would be short-term and result in minimal disturbance with no adverse effects.

Additionally, because anadromous fish (striped bass, American shad, herring etc) use sections of the action area coinciding with EFH for spawning, nursery, and migratory pathway, and because juvenile anadromous fish are a food source for the managed bluefish species, any adverse impact to these species would also be considered an adverse effect on EFH based upon the EFH rules.[2.] However, because netting protocols for sturgeon sampling would be conditioned to be checked at short intervals—

2 The EFH final rule at 50 CFR Section 600.810 defines an adverse effect on EFH as "any impact which reduces the quality and/or quantity of EFH." The rule further states: "An adverse effect may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from action occurring within EFH or outside EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions."

based on water temperature designed to eliminate stress to fish held in nets—NMFS believes virtually all bycatch would be released alive.

NMFS PR contacted the Southeast Office of Habitat Conservation (Beaufort Lab, Beaufort, NC) by email on May 21, 2010 to ask for concurrence whether the proposed action, as it would be conditioned, would have minimal impacts or not on designated EFH in the Cape Fear River and Albemarle Sound. Results of the informal consultation appear in Section 4.3.2 of this EA.

3.3 BIOLOGICAL ENVIRONMENT

The following is a brief summary of the status and occurrence of targeted shortnose sturgeon range-wide, including the proposed study area. Further descriptions of the status of these species can be found in the Biological Opinion accompanying this document as well as NMFS Recovery Plans and other documents at http://www.nmfs.noaa.gov/pr/publications/.

3.3.1 *ESA Target Species Under NMFS Jurisdiction*:

ESA Endangered: Shortnose sturgeon (*Acipenser brevirostrum*)

3.3.1.1 Range-wide Distribution of Shortnose Sturgeon:

Shortnose sturgeon occur along the east coast of North America in rivers, estuaries and the sea. They were once present in most major rivers systems along the Atlantic coast (Kynard 1997). Their current distribution extends north to the Saint John River, New Brunswick, Canada, which has the only known population in Canada (Scott and Scott 1988). Their southerly distribution historically extended to the Indian River, Florida (Everman and Bean 1898) but the southern limit of their range is currently believed to be in the Saint Johns River, FL (NMFS 1998). They are sympatric with the Atlantic sturgeon throughout much of their range. However, the Atlantic sturgeon spend more of its life cycle in the open ocean. In rivers, shortnose sturgeon and Atlantic sturgeon may share foraging habitat and resources but shortnose sturgeon generally spawn farther upriver and earlier than Atlantic sturgeon (Kynard 1997, Bain 1997). Magnin (1963) theorized the species was primarily found in freshwater on the basis of growth (i.e., if shortnose sturgeons spent more time in the ocean they would grow to larger sizes). In recent years, telemetry data and genetic analyses have demonstrated coastal migrations of shortnose sturgeon between adjacent rivers may be relatively common in some areas (S. Fenandes, T. Squiers-Maine Rivers; & D. Peterson,-S.E. Rivers, *pers. comm.*, 2009).

3.3.1.2 Status of Shortnose Sturgeon in the Action Area:

Shortnose sturgeon are federally listed as an ESA-endangered species. The lack of records from most North Carolina rivers (Kynard 1997) may be due to their low abundance or the lack of directed survey effort. Shortnose sturgeon were thought to be extirpated from North Carolina until 1987, when Ross et al. (1988) obtained a shortnose sturgeon from the Brunswick River. Much additional gill net sampling from 1990 to 1993 established shortnose sturgeon were present but rare within the lower Cape Fear River (Moser and Ross 1995). A shortnose sturgeon was captured in western Albemarle Sound in 1998 by the NC Division of Marine Fisheries (Armstrong and Hightower 1999). No sturgeon were collected in a survey of the Neuse River conducted in 2001-2002 (Oakley and Hightower 2007). Netting surveys for shortnose sturgeon have not been conducted in the Chowan or Roanoke rivers.

3.3.2 *ESA Non-Target Species Occurring in the Action Area*:

In addition to the target species, the subject of the permit, a wide variety of non-target species can be found within separate sections of the action area, including marine mammals, sea turtles, invertebrates, teleost and elasmobranch fish, and sea birds. However, merely being present within the action area does not necessarily mean the organism will be affected by the proposed action. Thus, the following discussion focuses on the distribution and abundance of only those species potentially affected by the proposed research activities.

Highlighted in Table 3 below is a summary of the non-target ESA threatened or endangered species managed under either NMFS or USFWS jurisdiction occurring in the Chowan, Roanoke and Cape Fear River Basins and Albemarle Sound.

Table 3: Summary of Non-target ESA Species Potentially Affected by the Proposed Action.

Species	Location	Occurrence & Potential Interaction	Federal ESA Status/ Agency
Chowan River Basin (NC/VA)			
Roanoke logperch (*Percina rex*)	Meherrin & Nottoway (VA)	Extremely rare/ Low	Endangered/FWS
American alligator (*Alligator mississippiensis*)	Isolated brackish/freshwater	Rare, but increasing/Low	Threatened(SA*)/FWS
Roanoke River Basin			
American alligator (*Alligator mississippiensis*)	Isolated brackish/freshwater	Rare, but increasing/Low	Threatened(SA*)/FWS
Cape Fear River Basin			
American alligator (*Alligator mississippiensis*)	Isolated brackish/freshwater	Rare, but increasing/Low	Threatened(SA*)(FWS)
West Indian manatee (*Trichechus manatus*)	Estuary and freshwater inlets	Extremely rare / Low	Endangered (FWS)
Wood stork (*Mycteria americana)*	Isolated brackish/ freshwater	Rare but increasing/ Low	Endangered (FWS)
Green sea turtle (*Chelonia mydas*)	Brackish waters of lower CFR	Low/ Low	Threatened (NMFS)
Kemp's ridley sea turtle (*Lepidochelys kempii*)	Brackish waters of lower CFR	Low/ Low	Endangered (NMFS)
Leatherback sea turtle (*Dermochelys coriacea*)	Off-shore ocean waters	Very Low/ Very Low	Endangered (NMFS)
Loggerhead sea turtle (*Caretta caretta*)	Brackish waters of lower CFR	Low/ Low	Threatened (NMFS)
Albemarle Sound (AS)			
American alligator (*Alligator mississippiensis*)	Isolated brackish/freshwater	Rare but increasing/ Low	Threatened(SA*)(FWS)
West Indian manatee (*Trichechus manatus*)	Isolated brackish fresh water areas of Albemarle Sound	Extremely rare / Low	Endangered (FWS)
Hawksbill sea turtle (*Eretmochelys imbricata*)	Off-shore ocean waters	Very Low/ Very Low	Endangered (NMFS)
Green sea turtle (*Chelonia mydas*)	Brackish waters of AS	Low/ Low	Threatened (NMFS)
Kemp's ridley sea turtle (*Lepidochelys kempii*)	Brackish waters of AS	Low/ Low	Endangered (NMFS)
Leatherback sea turtle (*Dermochelys coriacea*)	Off-shore ocean waters	Very Low/ Very Low	Endangered (NMFS)
Loggerhead sea turtle (*Caretta caretta*)	Brackish waters of AS	Low/ Low	Threatened (NMFS)

*Listed threatened by similarity of appearance (SA) by the USFWS

3.3.2.1 ESA Non-target Species Under USFWS Jurisdiction:

Roanoke logperch: The Roanoke logperch is a rare member of the Percidae family growing up to 14 cm. Its primary and reproductive range has been recorded in upper watershed pools and riffles of the Nottoway and Meherrin River in Virginia, upstream of the applicant's proposed netting areas; however, during different phases of life history and season, the downstream habitats within these rivers has been reported to be used by the logperch (Burkhead 1983). The proposed research activity could therefore affect the species when the species is present in downstream locations of the Meherrin and Nottaway River systems during winter months. However, the researcher indicated he would not anticipate affecting logperch as he is proposing to use five and six inch gill netting gear which would not effectively target logperch.

American alligator: The American alligator is listed as "threatened by similarity of appearance (SA)" throughout North Carolina because of its likeness to other protected crocodilians worldwide. The species occurs mostly in freshwater inland rivers and wetland areas in coastal counties in of North Carolina. Although alligators have been reported in isolated areas of the entire proposed range of research, interactions by the researcher have been limited to occasional sightings while boating in the Cape Fear River Basin; none have been captured and only rarely have they been disturbed when passing.

Wood stork: Endangered wood stork favor cypress trees in marshes, tidal and freshwater swamps, and other coastal wetlands of North Carolina; and they primarily occur as wandering juveniles after fledging from populations further south. However, there is a small population and rookery established in southeastern North Carolina (Sunset Beach, Brunswick County). The researcher has incidentally sighted wood stork in the Cape Fear Basin, primarily birds on foraging flights over the Cape Fear River. Thus, NMFS considers potential disturbance of feeding or resting wood storks would be possible in Dr. Hightower's research activities. The researcher indicated he would not anticipate much opportunity from his research to adversely impact wood stork, but he would agree to avoid wood storks if he encountered them resting or feeding.

West Indies manatee: The West Indies manatee is listed as endangered under the ESA and is protected under the MMPA. They inhabit both marine and fresh water of sufficient depth (1.5 meters to usually less than 6 meters) throughout their range of the southeastern U.S., occurring in low numbers in North Carolina waters as intermittent, seasonal inhabitants. Typically they are reported from June through October when water temperatures are above $21^{O}C$. Manatees spend much of their time underwater or partly submerged, making them difficult to detect even in shallow water. Therefore there is potential for interaction with manatee within the research area. Researchers do not expect to interact with manatees in this study and there have been no interactions with manatees reported in past studies. However he is aware of their documented presence in North Carolina waters and would agree to follow the proposed mitigation measures (See Section 4.5.5)

Summary: NMFS PR concluded impacts were possible on non-target listed species under USFWS jurisdiction, but they would not likely be adversely affected. Informal consultations were therefore conducted by email with the USFWS (sent 5/17/2010) asking for concurrence that Dr. Hightower's research encountering these animals would not adversely impact them. Results of this informal consultation follow in Section 4.3.1.2 of this EA.

3.3.2.2 ESA Non-target Species Under NMFS Jurisdiction:

Sea turtles:
As highlighted in Table 3, five species of sea turtles under NMFS jurisdiction have been documented in North Carolina waters. However, occurrences of the hawksbill sea turtle are very rare within the action area of the Albemarle Sound or Cape Fear River due to their preferred feeding habits on sponges and corals (not abundant in North Carolina waters). Also, although leatherback sea turtles have been documented in the lower Cape Fear River, they occur almost exclusively in open ocean waters in relation to the outer banks, (J. McNeill, *pers. comm*. email 5/21/10). Because green turtles, Kemp's ridley and loggerheads are more specialized, grazing on sea grasses and algae, they are thus more abundant in the both the sounds and in the lower Cape Fear River. Therefore, ranked in order of occurrence, juvenile loggerheads, green and Kemp's ridley sea turtles are considered in this EA as more common having potential impact in the Albemarle Sound and the Cape Fear River (Epperly *et al.* 1995, McClellan 2009).

***Green sea turtle*:** The green sea turtle was listed as threatened in 1978, except for the Florida and Pacific coast of Mexico breeding populations, listed as endangered. Critical habitat for the green sea turtle has been designated for the waters surrounding Isla Culebra, Puerto Rico, and its associated keys from the mean high water line seaward to 3 nautical miles (5.6 km). These waters include Culebra's outlying Keys including Cayo Norte, Cayo Ballena, Cayos Geniqui, Isla Culebrita, Arrecife Culebrita, Cayo de Luis Pena, Las Hermanas, El Mono, Cayo Lobo, Cayo Lobito, Cayo Botijuela, Alcarraza, Los Gemelos, and Piedra Steven. Key physical or biological features essential for the conservation of the green sea turtle found in this designated critical habitat include important food resources and developmental habitat, water quality, and shelter.

Green sea turtles are distributed around the world, mainly in waters between the northern and southern 20° C isotherms (Hirth 1997). The complete nesting range of the green sea turtle within the southeastern U.S. includes sandy beaches of mainland shores, barrier islands, coral islands, and volcanic islands between Texas and North Carolina and at the U.S. Virgin Islands (USVI) and Puerto Rico (NMFS and USFWS 1991). Principal U.S. nesting areas for green turtles are in eastern Florida, predominantly Brevard through Broward counties. Regular green sea turtle nesting also occurs on the U.S. Virgin Islands and Puerto Rico.

***Kemp's ridley sea turtle*:** The Kemp's ridley has declined to its lowest population level since listing in 1970. As of yet, there is no designated critical habitat established. This species has a very restricted range relative to other sea turtle species. Kemp's ridleys nest in daytime aggregations known as arribadas, primarily at Rancho Nuevo, a stretch of beach in Mexico. Most of the population of adult females nests in this single locality (Pritchard 1969). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963). By the early 1970s, the world population estimate of mature female Kemp's ridleys had been reduced to 2,500-5,000 individuals. The growing trend in total number of nests suggests that the adult nesting female population is about 7,400 individuals.

Although it appears that adult Kemp's ridley sea turtles are restricted somewhat to the Gulf of Mexico in shallow near shore waters, adult-sized individuals sometimes are found on the eastern seaboard of the United States and in North Carolina waters. Atlantic juveniles/subadults travel

northward with vernal warming to feed in the productive, coastal waters of Georgia through New England, returning southward with the onset of winter to escape the cold (Lutcavage and Musick 1985; Henwood and Ogren 1987; Ogren 1989).

Loggerhead sea turtle: The loggerhead was listed as a threatened species in 1978 and critical habitat has not been designated. The latest loggerhead status review (Conant *et al*. 2009) concluded there are nine loggerhead distinct population segments (DPSs). These include the North Pacific Ocean DPS; the South Pacific DPS; the North Indian Ocean DPS; the Southeast Indo-Pacific Ocean DPS; the Southwest Indian Ocean DPS; the Northwest Atlantic Ocean DPS; the Northeast Atlantic Ocean DPS; the Mediterranean Sea DPS; and the South Atlantic Ocean DPS. On March 16, 2010 NMFS published a Notice of a Proposed Rule (75 FR 12598) to formally designate the loggerhead with these nine DPS' worldwide. The notice also stated that NMFS plans to reclassify both DPS' within the United States as endangered (N. Pacific DPS and Northwest Atlantic Ocean DPS). The public has until June 14, 2010 to comment on the proposed rule.

Loggerheads occur throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans and inhabit continental shelves and estuarine environments. Developmental habitat for small juveniles includes the pelagic waters of the North Atlantic Ocean and the Mediterranean Sea. Adults have been reported throughout the range of this species in the U.S. and throughout the Caribbean Sea. Non-nesting, adult female loggerheads are reported throughout the U.S. and Caribbean Sea; however, little is known about the distribution of adult males who are seasonally abundant near nesting beaches during the nesting season. Aerial surveys (TEWG 1998) suggest that loggerheads (benthic immatures and adults) in U.S. waters are distributed in the following proportions:

- 54% in the southeast U.S. Atlantic
- 29% in the northeast U.S. Atlantic
- 12% in the eastern Gulf of Mexico
- 5% in the western Gulf of Mexico

NMFS PR identified potential sea turtle interaction from proposed boating and netting activity for shortnose sturgeon would occur primarily in the Albemarle Sound, the action area described as between the mouth of the Alligator River, west to the mouths of the Chowan and Roanoke Rivers. Freshwater areas where sampling would take place, such as riverine waters of the Roanoke, Chowan, and Cape Fear Rivers, would not be considered areas where turtles would be taken.

Movement of Sea Turtles in North Carolina Sounds and Cape Fear River:
An understanding of sea turtle seasonal occurrence and movement patterns of turtles in the proposed action area is important for assessing the potential for seasonal overlap with fishing operations and developing appropriate mitigations strategies for reducing interactions. During spring, as temperatures begin to rise, sea turtles migrate up the coast and into estuarine waters of the lower Cape Fear River, Pamlico and Albemarle Sounds (Braun-McNeill *et al*. 2004). In the fall, many sea turtles migrate southward out of the temperate latitudes to warmer waters (C. McClellan, 2009). This general pattern is reversed the following spring as they again migrate estuarine and northward along the coast, repopulating estuarine waters and temperate latitudes. Since 1988, researchers with NMFS in Beaufort began monitoring distribution of sea turtles in North Carolina sounds and near-shore

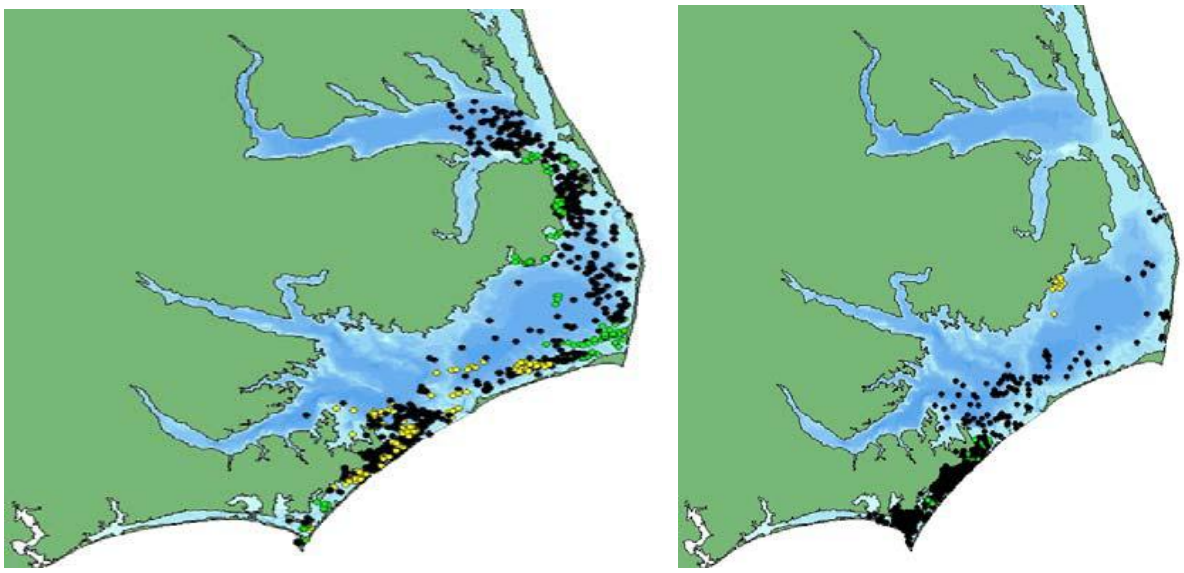
waters, employing three methods assessing turtle distributions: aerial surveys, public sightings and mark-recapture studies (NCDMF 2006). A distinct seasonal pattern of sea turtle distribution in the sounds and near-shore waters was discerned where in April, as coastal waters warm, sea turtles enter the sounds through five main inlets. During summer, turtles may be found from Albemarle Sound to Cape Fear and as far west as the lower reaches of the Neuse River estuary. The greatest densities occur in Core Sound (located just south of Pamilco Sound) and along the eastern shore of Pamlico Sound. In the fall, turtles leave the sounds as water temperatures cool and are rarely seen inside barrier islands from January to March. Sea turtles are observed offshore throughout the year.

Results of turtle tracking: While mark-recapture programs and sightings data offer indirect evidence of the movements of sea turtles, satellite telemetry on turtles in North Carolina waters from Albamarle Sound to the Cape Fear River has provided more detailed, direct data by tracking individual sea turtles continuously over a long period of time (NCDMF 2006, Snoddy 2009).

Beginning in 2002, satellite telemetry was employed to track the movements of loggerhead, green, and Kemp's ridley sea turtles examining their interactions with flounder gill nets in Pamlico Sound, (NCDMF 2006). Figure 2 below depicts cumulative location data for satellite tagged sea turtles between 2002 and 2003. Although other turtles were tagged in later years, results were similar (McClellan 2009).

Figure 2: Map of estuarine locations of sea turtles displaying cumulative satellite tracking data in the North Carolina Sounds between 2002 and 2003 (NCDMF 2006; McClellan 2009).

2002 2003



Species Key: Loggerhead sea turtle
Green sea turtle
Kemp's ridley sea turtle

Results of tracking turtle movement in the Albemarle Sound indicate sea turtles extend their range westward (typically during the summer) approximately to the mouth of Alligator River — the eastern most range of proposed sampling— and leave the area beginning in late summer and early

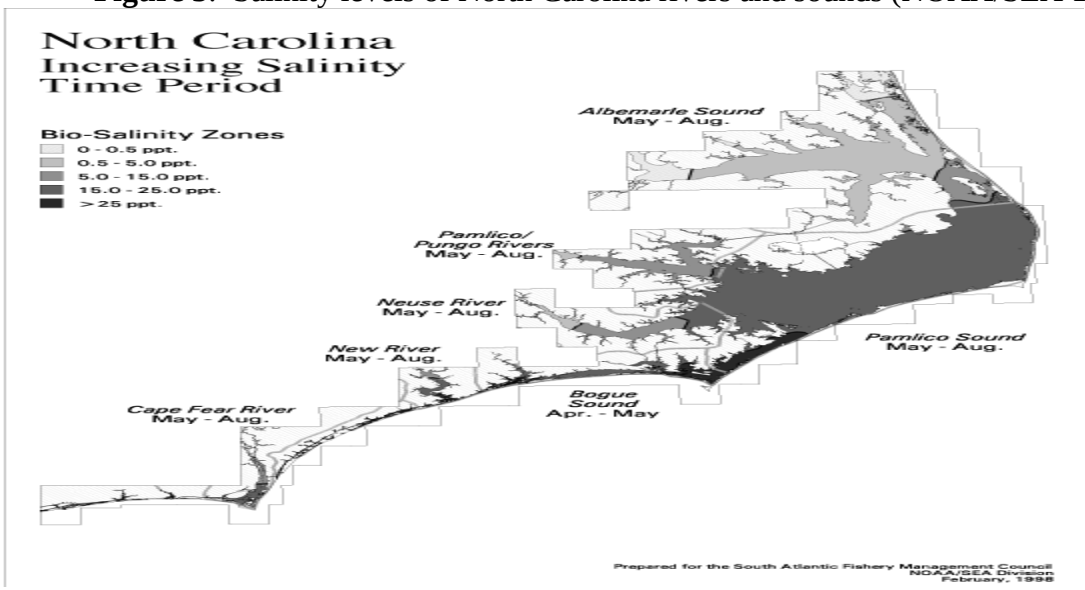
fall as temperature declines. Most turtles moving into the sounds are found concentrated in the northern and southern Pamlico, and also found in high concentrations in Bogue and Core Sounds (Carteret County). Turtles migrate out of the sounds between September and December, most leaving in November (McClellan 2009). Based on five years of tracking, Dr. McClellan (*pers. comm*., email 4/24/2010) suggested it would be rare for turtles to venture far into the Alligator River, or further west in Albemarle Sound. To exit the sounds, turtles use inlets from Oregon Inlet to Beaufort Inlet, but most exit through Barden Inlet at Cape Lookout. After leaving, turtles migrate to three general over-wintering areas: Florida, offshore North Carolina, and the North Atlantic via the Gulf Stream (NCDMF 2006).

In the Cape Fear River, juvenile sea turtles use the estuary as seasonal foraging habitat, present in the summer. Snoddy (2009) documented seasonal movements of green and kemps ridley sea turtles in the Cape Fear River estuary with satellite telemetry. However, turtle movement was limited to the lower river areas having 32 – 39ppt salinity, to rkm 25 (downstream of Wilmington, North Carolina rkm 45). Joanne McNeil (NMFS SEFSC) also confirmed juvenile loggerhead sea turtles use the lower Cape Fear river estuary during summer months (pers. comm.).

Impacts of Salinity: Because Albemarle Sound begins 20 miles north of the nearest inlet (Oregon Inlet), it is more heavily influenced by runoff from the 9 rivers draining into the Albemarle Basin than tidal influence. According to the NCDMF (M. Loeffler, *pers. comm*., 4/6/2010), differences in the salinity regimes in the Albemarle Sound may be the biggest influence in the lack of any sea turtle interactions the division has experienced while engaged in fishery surveys over the last 15 years. From the mouths of the Chowan and Roanoke Rivers eastward to the mouth of the Alligator River, the proposed sampling area, salinity is documented from 0.0 ppt to a maximum of 5.0 ppt (Figure 3).

The salinity of the Cape Fear River averages 35ppt at the ocean and ranges from 1.0-18.0ppt at Wilmington, NC (rkm 45), and is near 0.0ppt at Lock and Dam #1 (rkm 97). As noted, turtles have only been documented in the lower Cape Fear River estuary upstream to rkm 25. They are thus unlikely encountered in areas proposed for sampling sturgeon at Wilmington and upstream.

Figure 3: Salinity levels of North Carolina rivers and sounds (NOAA/SEA 1998).



Proposed netting and seasonal sampling: To avoid impacts with sea turtles in Albemarle Sound researchers would follow similar seasonal netting practices by the North Carolina Department of Marine Fisheries (NCDMF, M. Loeffler, *pers. comm*., email 4/2010) since 1995 in annual striped bass survey wherewith no turtles have been reported captured. These practices would be amended to include two seasonal sampling periods in the Albemarle Sound to minimize impacts to turtles. Spring sampling would be concentrated in the western Albemarle (Mar-May) in water temperatures ranging from 12°C - 25°C. Western boundaries would include an area 6 km downstream of the mouth of the Roanoke River (including Bachelor Bay) and 6 km downstream of the mouth of the Chowan River (below Hwy 17 Bridge). Fall/Winter sampling (Nov –Feb) would take place in the eastern areas of Albemarle Sound in water temperatures ranging from 0°C - 15°. The eastern boundary for netting extends westward from a north-south line crossing the Albemarle Sound at Point Harbor, NC (Currituck County) to Mashoes, NC (Dare County), near the mouth of the Alligator River, to the previously described western boundary.

Areas of netting proposed in the Cape Fear River where turtles have not been documented, would begin at Wilmington at rkm 45 extending upstream to more freshwater areas. In previous studies by the NCDMF and UNCW for the past eleven years, no interactions have taken place with listed turtles in this area of the river (NCDMF, M. Loeffler, *pers. comm*., email 4/2010).

Conclusions: Researchers have had no record of interactions with sea turtles while surveying striped bass populations in the Albemarle Sound or in freshwater areas of the Cape Fear River since 1995. Additionally, they have agreed to mitigating conditions while sampling for sturgeon, to further limit turtle interactions, specifically: (1) tending nets continually during daylight hours; (2) fishing nets for specific shortened intervals related to water temperature; (3) netting in the western reaches of Albemarle Sound in early spring (Mar – May) (when warmer temperatures would be expected), and in the fall and winter (Nov – Feb) in the eastern sectors (at cooler temperatures when turtles would typically not be present); and (4) fishing in areas on the Cape Fear River not used by sea turtles. Also, gill nets would be removed if a turtle were observed in the area, and, if captured, they would be removed quickly and safely. Further, as a precaution, if a sea turtle were captured, the lead biologists have been trained by Dr. Southwood (UNCW) on handling/resuscitation techniques of sea turtles (See Section 4.5.6 of this EA).

Consequently, NMFS PR does not believe sea turtles would be encountered or adversely affected by research activities.

NMFS PR informally consulted with Joanne McNeill, NMFS Southeast Region Sea Turtle Biologist (Beaufort, NC) by email (5/13/2010) asking for concurrence that sea turtles would not be adversely affected as the permit would be conditioned. Results of this informal consultation follow in Section 4.3.1.3 of this EA.

3.3.3. Other Species Occurring in the Action area:

3.3.3.1 *Marine Mammals Potentially Affected by Proposed Research*:

Bottlenose dolphins (*Tursiops truncatus*): Bottlenose dolphin are marine mammals protected under the MMPA, but are not listed as threatened or endangered under the ESA. They are known to occur periodically in the parts of the action area, including the estuary and upstream tidally influenced portions of the Cape Fear River and occasionally in Albemarle Sound. Bottlenose dolphins could potentially become entangled within the nets; however, the applicant indicated entanglements have not occurred in the inshore waters where the research would be taking place during the last 15 years of the striped bass surveys in North Carolina waters.

Consequently, NMFS PR does not expect adverse impacts with bottlenose dolphins. However, as precautionary measures, the following mitigation conditions would be applied in permits, namely: netting would not be deployed when animals are observed within the vicinity of the research; and animals would be allowed to either leave or pass through the area safely before net setting is initiated. Should any dolphin enter the research area after the nets have been deployed, the lead line would be raised and dropped in an attempt to make marine mammals in the vicinity aware of the net. If marine mammals remain within the vicinity of the research area or approach the set, nets would be removed.

Additionally, in all boating activities — including travel to acoustic receiver arrays outside of the netting area — researchers would be advised to keep a close watch for marine mammals to avoid harassment or interaction and also to review the NMFS Guidelines for Viewing Marine Mammals (http://www.nmfs.noaa.gov/pr/education/regional.htm). See also Section 4.5.7 of this EA for a summary of conditions added to the permit and contact information in case a dolphin were captured.

3.3.3.2 Non-Listed By-catch Species:

The applicant supplied NMFS results of bycatch from the last fifteen years of netting experience on the individual rivers in the action area and the Albemarle Sound. (See Table 1-3, Appendix 3). Nets would typically be checked at short intervals and it is believed virtually all bycatch would be released alive. Additionally, because there is likelihood for Atlantic sturgeon—a NMFS "species of concern"—to appear as bycatch in netting efforts, the following discussion on Atlantic sturgeon is provided.

Atlantic sturgeon: Atlantic sturgeon is currently considered a "candidate species" under NMFS jurisdiction, thought to be co-occurring in the study area with shortnose sturgeon. Thus, there is potential for Atlantic sturgeon to be caught during research activities. Reviewed in 1998, NMFS and USFWS received a petition to list Atlantic sturgeon as endangered. Although a protective ESA status was denied at that time, the species remained a 'species of concern' under NMFS's jurisdiction. In 2007, NMFS completed a second status review for this species and has since accepted a petition evaluating whether the species warrants listing under the ESA. However, currently a proposed rule has not been published, and thus this species does not receive protections under the ESA. Consequently, NMFS considers should a subsequent listing of Atlantic sturgeon occur coinciding with the proposed research activities, the effects of researcher's actions on Atlantic sturgeon would be analyzed at that time. Appropriately, the researcher would monitor gill nets

closely, and if an Atlantic sturgeon were captured prior to its listing, NMFS would request the same netting protocols and standard research conditions protective for shortnose sturgeon be used to ensure Atlantic sturgeon survival (See Section 4.5.8 of this EA).

3.3.3.3 *Aquatic Nuisance Species*:

The U.S. Geological Survey has documented several aquatic nuisance species (USGS 2010) occurring in the North Carolina River watersheds potentially in the action area of researchers including: flathead catfish (*Pylodictis olivaris*); Asian clam (*Corbicula fluminea*); water hyacinth (*Eichhornia crassipes*); hydrilla (*Hydrilla verticillata*); parrot feather (*Myriophyllum aquaticum*); alligatorweed (*Alternanthera philoxeroides*); and Brazilian waterweed (*Egeria densa*). Because the proposed research activities have the potential to spread such aquatic nuisance species to other watersheds, measures proposed by NMFS, outlined in Section 4.5.9 of this EA, were agreed to by the researcher to be implemented as standard research protocol.

For further information on the affected biological environment, please refer to the Biological Opinion written for this proposed action.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

This chapter represents the scientific and analytic basis for comparison of the direct, indirect, and cumulative effects of the alternatives. Regulations for implementing the provisions of NEPA require consideration of both the context and intensity of a proposed action (40 CFR Parts 1500-1508).

4.1 EFFECTS OF ALTERNATIVE 1: NO ACTION

An alternative to the proposed action is no action, i.e., denial of the permit request. This alternative would eliminate any potential risk to all aspects of the environment from the proposed research activities. However, it would also prohibit researchers from gathering information that could help endangered and protected shortnose sturgeon.

4.2 EFFECTS OF PROPOSED ALTERNATIVE 2: ISSUANCE OF PERMIT WITH STANDARD CONDITIONS

Any impacts of the proposed action would be limited primarily to the biological environment, specifically the animals that would be studied or affected by the research. The type of action proposed in the permit request would minimally affect the physical environment and would be unlikely to affect the socioeconomic environment or pose a risk to public health and safety.

4.2.1 *Effects of Research Activities on the Target Species*:

4.2.1.1 *Effects of Capturing*:

The permit would authorize non-lethal, year round sampling with anchored gill nets on up to 15 shortnose sturgeon annually from the Chowan and Cape Fear River Basins and Albemarle Sound. The researcher also proposes similar activities capturing up to 25 shortnose sturgeon from the Roanoke River Basin. Entanglement in nets could result in injury and mortality, reduced fecundity, or delayed or aborted spawning migrations of sturgeon (Moser and Ross 1995, Collins *et al.* 2000, Moser *et al.* 2000). Historically, the majority of shortnose sturgeon mortality during scientific

investigations using gill nets has been related to factors such as water temperature, low D.O concentration, netting duration, meshes size, net composition, and netting experience of the researcher (See Table 5 below).

Table 5: Number and percentage of shortnose sturgeon killed by gill nets associated with scientific research permits prior to 2005

	Permit Number					
	1051	1174	1189	1226	1239	1247
Time Interval	1997, 1999 – 2004	1999–2004	1999, 2001 – 2004	2003–2004	2000 – 2004	1988 – 2004
Sturgeon captured	126	3262	113	134	1206	1068
Sturgeon mortality	1	7	0	0	5	13
Percentage mortality	0.79	0.22	0	0	0.41	1.22

In 2005, NMFS PR began analyzing the results of previous research and updating permit conditions to reduce the chances of stress and mortality to shortnose sturgeon during capture. Since that time, there have been no mortalities caused during their capture (See Table 6 below). The primary causes of mortality identified during a review of permits issued prior to 2005 were high temperatures, low dissolved oxygen, and long net set durations. Despite the permit modifications reducing mortality of sturgeon in nets, there is a chance of delayed mortality occurring without being reported. There is no way to estimate the rate of delayed mortality, however NMFS believes it would be less than one percent based on reports of various species of sturgeon captured and transported to rearing facilities.

Table 6: Number of shortnose sturgeon killed during capture under recent scientific research permits

Permit Number	Shortnose sturgeon captured	Shortnose sturgeon mortalities
1420 (2005-2009)	1472	0
1447 (2006-2009)	107	0
1449 (2007-2008)	50	0
1486 (2006-2009)	416	0
1505 (2006-2009)	276	0
1516 (2007-2009)	160	0
1547 (2006-2009)	112	0
1549 (2006-2009)	390	0
1575 (2007-2009)	12	0
1580 (2007-2008)	66	0
1595 (2007-2009)	505	0
10037 (2007-2009)	235	0
10115 (2008-2009)	1	0
Totals	3802	0

The applicant does not anticipate mortality or harmful stress to animals from netting proposed. He has maintained a verifiable record of zero mortalities while engaged in other authorized research on shortnose sturgeon in extirpated rivers of North Carolina (Roanoke River; Permit No.1234; Neuse River; Permit No. 1275, and Albemarle Sound; Permit No. P647) using approved NMFS netting protocols. NMFS PR would not anticipate mortality and/or harmful stress associated with the proposed capture methods, and no mortality is authorized.

Gill Netting: To limit stress and mortality of sturgeon due to capturing with gill nets, the applicant proposes to net in less stressful environmental conditions adopted by NMFS (Table 1; Page 10 of this EA). Namely, in general gill nets would be set in waters having minimum dissolved oxygen (D.O.) concentration of 4.5 mg/L for the entire deployment. Also, the maximum net set duration in freshwater areas (< 2ppt salinity) would be 14 hours when water temperature is 15 ºC or lower. Above this salinity range, and below 15 ºC, nets could be set for 10 hours while attended, but only in daylight hours to avoid potential marine mammal or sea turtle interactions. At water temperatures between 15 ºC and 25 ºC, net sets would not exceed 4 hours; at water temperatures between 25 ºC and 28 ºC soak times would not exceed 1 hr. Finally, netting would cease above 28 ºC.

4.2.1.2 Effects of General Handling (e.g., Holding, Measuring, Weighing):

Sturgeon are a hardy species, but sensitive to handling stress when water temperatures are high or D.O. is low. Handling stress can escalate if sturgeon are held for long periods after capture; and conversely, stress is reduced the sooner fish are returned to their natural environment to recover (D. Peterson, *pers. comm.* November 2008). Signs of handling stress are redness around the neck and fins and soft fleshy areas, excess mucus production on the skin, and a rapid flaring of the gills. Additionally, sturgeon tend to inflate their swim bladder when stressed and when handled in air (Moser *et al.* 2000). If not returned to neutral buoyancy prior to release, sturgeon tend to float and would be susceptible to sunburn and bird attacks. In some cases, if pre-spawning adults are captured and handled, it is possible that they would interrupt or abandon their spawning migrations after being handled (Moser and Ross 1995).

Although sturgeon are sensitive to handling stress, the proposed methods of handling fish described in the application are consistent with the best management practices recommended by Moser *et al*. (2000), and those currently endorsed by NMFS and, as such, should minimize the potential handling stress and minimize indirect effects resulting from handling. Moreover, with conservative permit conditions outlined in Section 4.5.1 of this EA, the likelihood of harm or mortality from handling and restraint would expected to be minimal.

4.2.1.3 Effects of Hydroacoustic Remote Detection:

Remote detection and identification of shortnose sturgeon using a combination of side-scan and DIDSON hydroacoustic/sonar equipment is proposed for the study. Side-scan sonar provides very high resolution images of bottom structure and topography and can cover large areas quickly while mounted to the traveling vessel; the DIDSON technology provides for more positive identification of species while the boat is stationary.

The DIDSON (operating at 1.25 MHz frequency) and side-scan (operating at 1.8 Mhz frequency) sonar equipment are similar to a fish finder in that both use high frequency sounds for detecting objects in the water. NMFS considers the frequencies of sound emitted by the hydroacoustic and

sonar equipment to be outside of the hearing range of sturgeon, (Popper 2005) and thus would be inaudible, causing little, if any, effect on the animal. These frequencies would also be well above those ranges heard by marine mammals and turtles (B. Southall, NOAA; *pers. comm.*; 2009). The combination of high-resolution sonar approaches with netting would allow for more targeted sampling for sturgeon and the potential for greatly reduced by-catch of non-target species such as striped bass, an extremely important fishery in North Carolina which could be impacted during the proposed early spring sturgeon research.

4.2.1.4 Effects of Genetic Tissue Sampling:

The applicant proposes to take small (1 cm^2), non-deleterious tissue samples, clipped with sterile surgical scissors from sections of soft pectoral fin rays of captured sturgeon. Tissue sampling does not appear to impair the sturgeon's ability to swim and is not thought to have any long-term adverse impact (Wydoski and Emery 1983). Many researchers, including the applicant, have reported removing tissue samples with no adverse effects; therefore, NMFS does not anticipate any long-term adverse effects to sturgeon from this activity.

4.2.1.5 Effects of PIT Tagging:

The PIT tags used for permanently marking and identifying individual captured fish will be Destron 12 mm TX1700L tags, nominally 11.5 mm by 2.1 mm, activated at a radio frequency of 125 kHz. The PIT tags would be injected 1 cm into the left dorsal musculature just anterior to the dorsal fin using a syringe equipped with a 12 gauge needle. These biologically inert tags have been shown not to cause problems associated with some other methods of tagging fish such as scarring and damaging tissue or otherwise adversely affecting growth or survival (Brännäs *et al*. 1994). Henne *et al*. (2008) found that both 11.0 and 14.0 mm PIT tags can be safely implanted into juvenile shortnose sturgeon 300 mm or greater total length (TL). However, as fish size decreases below 300 mm TL, factors other than fish length (e.g., fish weight, condition factor) were discovered to affect post implant survival.

As such, the applicant's proposed method of tagging of shortnose sturgeon above 300 mm with 11.0 mm PIT tags is unlikely to have significant impact on the reproduction, numbers, or distribution of shortnose sturgeon. And to avoid duplicate tagging, all sturgeon captured would be scanned with a PIT tag reader prior to the insertion of a PIT tag. Additionally, results of PIT tag retention would be reported to NMFS in annual reports to document PIT tag retention.

4.2.1.6 Effects of Floy (T-bar Anchor) Tagging:

The applicant requested an additional externally identifiable tagging method using Floy tags during the study suggesting the additional information gained from visible tags would be important because any identification of recaptured sturgeon from North Carolina waters should be reported as soon as possible by commercial and recreational fishermen, as well as the scientific community.

Smith *et al.* (1990) compared the effectiveness of dart tags with nylon T-bars, anchor tags, and Carlin tags in shortnose and Atlantic sturgeon. Carlin tags applied at the dorsal fin and anchor tags in the abdomen showed the best retention, and it was noted that anchor tags resulted in lesions and eventual breakdown of the body wall if fish entered brackish water prior to their wounds healing. However, Collins *et al.* (1994) found no significant difference in healing rates (with T-bar tags) between fish tagged in freshwater or brackish water. Clugston (1996) also looked at T-bar anchor

tags placed at the base of the pectoral fins and found that beyond two years, retention rates were about 60%. Collins *et al.* (1994) compared T-bar tags inserted near the dorsal fin, T-anchor tags implanted abdominally, dart tags attached near the dorsal fin, and disk anchor tags implanted abdominally. They found, long-term, T-bar anchor tags were most effective (92%), but also noted minor, slow-healing lesions at the insertion points.

NMFS concludes the use of Floy tags to externally mark shortnose sturgeon is a duplicative means of identifying captured fish which is not encouraged due to potential additional handling stress; however, the practice is not expected to significantly impact sturgeon health. However, to lessen known negative impacts described above using the Floy tag, researchers would use sterile tagging technique and subsequently monitor dorsal fins tag sites of recaptured sturgeon. Additionally, results of tag retention and fish health would be reported to NMFS PR in annual reports and as periodically requested by NMFS. If impacts of the Floy tags are other than insignificant, NMFS would reevaluate their use in the permit.

4.2.1.7 Effects of Implanting Acoustic Transmitters:

In each year of the study, up to five sub-adult or adult shortnose sturgeon from each river basin and Albemarle Sound are proposed to be anesthetized and surgically implanted with an internal acoustic transmitter using the outlined protocol presented in Section 2.2.3.7 of this EA.

The researcher has recorded in annual reports to NMFS surgically implanting acoustic tags in over 175 adult and juvenile shortnose sturgeon with no mortalities or adverse effects directly attributable to such implanting. According to the applicant, the behavior of acoustically tagged shortnose sturgeon in past studies (with some fish tracked for periods greater than two years) suggests the research methods used have had little verifiable negative effects on individual animals. Other precautions would include implanting transmitters only in non-stressed fish of excellent condition, and not attempting the procedure with pre-spawning fish in spring, or when the water temperature exceeds 27° C or when less than 7° C. To verify normal mobility and swimming behavior of sturgeon receiving internal transmitters, the total weight of all transmitters and tags would not exceed 2% of the weight of the fish. Additionally, the applicant proposes to document tag adaptation by individually tracking fish, recording swimming behavior, logging the number of times each fish is detected and the time periods between detection, and the number of unrelocated individuals.

In other research, Dr. Mark Collins (M. Collins, SC DNR; *pers. comm.*, November 2006) tracked radio tagged shortnose sturgeon for two years and documented no mortality from surgical implantation of internal transmitters. Additionally, Kieffer and Kynard (*In press*) reported tag rejection internally was reduced by coating tags with an inert elastomer and by anchoring tags to the body wall with internal sutures. All fish retained tags for their operational life, and in most cases, lasted much longer (mean, 1,370.7 days). However, Devries (2006) reported movements of 8 male and 4 female (≥ 768 mm TL) shortnose sturgeon internally radio-tagged between November 14, 2004 and January 14, 2005, in the Altamaha River, Georgia. Nine of these fish were tracked until the end of 2005. Although no mortality or serious harm was directly documented for these fish, the remaining five individuals not accounted for were censored after movement was not detected, or they were not relocated, after a period of four months.

This later account signals the potential for adverse delayed or indirect effects from such tagging. Thus, while often not verifiable, NMFS believes the surgical implantation of acoustic transmitters does have the potential to injure or kill shortnose sturgeon. Although more invasive surgical procedures are required for internal implantation, this tagging procedure does provide greater retention rates than external attachment. In general, direct effects of the proposed tagging procedure could include pain, handling discomfort, hemorrhage at the site of incision, risk of infection from surgery, affected swimming ability, and/or abandonment of spawning runs. However, use of proper anesthesia, sterilized conditions, and the surgical techniques described above, would minimize potential short-term effects from tagging and greatly lower the long-term risks of injury and mortality. NMFS therefore expects the tagging would result in primarily short-term stress to the animal with some unverifiable, but probable mortality resulting from such tagging.

Lastly, many fish have sensitivity to sound energy from 200 Hz up to 800 Hz, and some species are able to detect lower frequency sounds (Popper 2005). However, the potential for the proposed internal sonic transmitters to affect sturgeon carrying them would be small because the frequency of the acoustic tags is 69 kHz, well above the audible threshold of most fish. NMFS also considered unverified potential for predation on tagged sturgeon by seals or other animals having hearing capability in the range of the proposed tags (B. Southall, *pers. comm*., November 2009). However, based on the implantation and subsequent successful tracking of acoustic tags in other sturgeon species by the applicant, NMFS does not believe such predation is an extensive risk for shortnose sturgeon tagged with acoustic tags.

4.2.1.8 Effects of Anesthesia for Transmitter Implantation:

The proposed anesthetic concentration of up to 150 mg/L MS-222 is commonly used by sturgeon biologists to induce light to deep planes of anesthesia for internal acoustic tagging (D. Peterson, D. Fox, M. Collins, T. Savoy, *pers. comm*. Nov. 2009). The induction varies with dosage, water temperature and water chemistry; however, typical induction times are from five to eight minutes. Because telemetry tags can be inserted into the coelom in less than a minute with little reaction to the external stimuli (muscle spasm, contraction) when incised, there is little risk to the sturgeon in this regard (M. Matsche; pers. comm.; December 2009). Complete recovery time from the anesthetic averages four to six minutes (Brown 1988).

Risks associated with anesthetizing with MS-222 at this level would include hypoxia from overexposure (possibly caused by inexperience at recognizing the proper level of narcosis) (Coyle *et al.* 2004), anesthetizing fish in poor health or stressed conditions, and injury from thrashing during the excited phase of anesthetic induction. To reduce such risks, the applicant is personally experienced and accomplished in transmitter implantation using the anesthetic MS-222. Only non-stressed animals in good health would be anesthetized for internal tagging. Fish would be monitored closely during induction to reach the proper level of anesthesia prior to surgery, and would be watched to ensure proper recovery from anesthetic narcosis prior to release. To avoid injury while being anesthetized, sturgeon would be restrained with netting to prevent animals from jumping or falling out the anesthetic bath. Also, because MS-222 is an acidifying solution, potentially extending the induction time for narcosis, bath solutions would be buffered to a neutral pH with sodium bicarbonate and oxygenated prior to use.

MS-222 has been found to be excreted in fish urine within 24 hours and tissue levels decline to near zero in the same amount of time (Coyle *et al*., 2004). Consequently, sturgeon released after treatment, would not present a sizable risk to the environment should potential predators consume a sturgeon. Additionally, an existing FDA 21-day withdrawal period for MS-222 applied to food-fish for human consumption would not be applicable for endangered shortnose sturgeon since they are a federally protected species with prohibitions against take. (F. Pell; FDA; *pers. comm*.; email; 2/24/2009).

Therefore, NMFS considers this anesthetizing protocol for internal tagging to be well established with known risks minimized to produce limited effects on the sturgeon and the environment.

4.3 SUMMARY OF COMPLIANCE WITH APPLICABLE LAWS, NECESSARY FEDERAL PERMITS, LICENSES, AND ENTITLEMENTS

4.3.1 *Compliance with Endangered Species Act* (*ESA*):

4.3.1.1 *Consultations on Impacts on the Target Species under NMFS Jurisdiction*: To comply with Section 7 of the regulations governing takes of shortnose sturgeon (50 CFR 402.14(c)), a Section 7 consultation was initiated by the NMFS, Permits, Conservation and Education Division, Office of Protected Resources under the ESA. In accordance with Section 7 of the ESA of 1973, as amended (16 U.S.C. 1531 *et seq*.), a Biological Opinion was prepared by the NMFS' Endangered Species Division, Office of Protected Resources. It concluded, after reviewing the current status of shortnose sturgeon, the environmental baseline for the action areas, the effects of the take authorized in the permits, and the probable cumulative effects of the proposed permit, would not likely jeopardize the continued existence of shortnose sturgeon or any other NMFS ESA-listed species; nor would it likely destroy or adversely modify designated critical habitat.

4.3.1.2 *Consultations on Non-Target Species under USFWS Jurisdiction*: The USFWS was contacted by email with regard to potential impacts of the proposed activity on listed species (and/or habitats) under the USFWS's jurisdiction. UFWS biologist Dale Suiter (ES Field Office, Raleigh, NC) concurred by email (June 14, 2010) with NMFS PR findings indicating the researcher's activity in North Carolina rivers and Albemarle Sound would not likely adversely affect the listed non-target species identified in Section 3.3.2.1 of this EA.

Additionally, Nicole Adimey, (USFWS; ES Office; Jacksonville, FL) was contacted separately by email regarding potential impacts of the proposed activity on the endangered Florida manatee. Ms. Adimey agreed (by email dated March 09, 2010) with the initial finding of NMFS that Dr. Hightower's research would not likely adversely affect this species, but she did request precautionary measures (outlined in Section 4.5.5 of this EA) be implemented to ensure interactions were avoided and also included precautionary instructions on what to do if one were captured.

4.3.1.3 *Consultations on Non-Target Species under NMFS Jurisdiction*: Communications received by email 5/21/2010 from Joanne McNeill (NMFS Southeast Regional Science Center sea turtle biologist) indicated interactions with ESA protected sea turtles from proposed netting activities would not be anticipated based on sampling methods proposed for

sturgeon. However, she made suggestions to include standard precautionary measures describing how to handle/resuscitate sea turtles. Therefore, appropriate measures summarized in Section 4.5.6 of this EA were added to the permit.

4.3.2 *Compliance with the Magnuson-Stevens Fishery Conservation & Management Act*: NMFS PR contacted the Southeast Regional Office of Habitat Conservation (Beaufort Lab, Beaufort, NC) by email on May 21, 2010. The office concurred with NMFS PR on May 25, 2010 (by email from Fritz Rhode) that the proposed action using anchored gill nets to capture shortnose sturgeon in Albemarle Sound and several North Carolina rivers would have minimal impacts on designated Essential Fish Habitat in these areas.

4.4 COMPARISON OF ALTERNATIVES

While the "no action" alternative would have no environmental effects, the opportunity to conduct this particular research would be lost. Initiation of this research is important to collect information that would contribute to better understanding of shortnose sturgeon and to provide information to NMFS that would be needed to implement NMFS management activities if shortnose sturgeon are present in these river systems. This is important information that would help conserve and manage shortnose sturgeon as required by the ESA and implementing regulations.

The environmental effects of the preferred alternative would mainly be limited to individual shortnose sturgeon. However, effects would be minimal and this alternative would allow collection of valuable information assisting NMFS' efforts to recover shortnose sturgeon. Neither option is expected to have adverse population nor stock-level effects on shortnose sturgeon. Given the preferred option's minimal impact to the environment and the potential positive benefits of the research, NMFS believes the information gained would outweigh any likely negative effect to the target species.

4.5. MITIGATION MEASURES

4.5.1 *Netting, Holding, and Handling Condition*:

- The Permit Holder must take all necessary precautions to ensure sturgeon are not harmed during capture, including use of appropriate net mesh size and twine preventing shutting gill opercula, restricting gill netting activities and decreasing the time of net sets.

- Location (GPS), temperature, dissolved oxygen., gear used (e.g., mesh size, trawl, gill net, trammel), soak time, species captured, and any mortalities should be measured and recorded (at the depth fished) each time nets are set to ensure appropriate values according to the conditions below. This data must be made available to NMFS in annual reports or upon request.

- After removal from capture gear, researchers must hold sturgeon in floating net pens or in onboard live wells while shielding them from direct sunlight.

- To accommodate larger catches, if applicable, researchers must carry secondary net pen(s) in the research vessel; overcrowded fish must be transferred to the spare net pen or else released.

- Sturgeon overly stressed from capture must be resuscitated and allowed to recover inside a net pen or live well and released without further handling, with exception of PIT tagging, Floy tagging, genetic tissue clip, weighing, measuring, and photographing.

- Gear must be deployed only in waters where D.O. levels $\geq$ 4.5 mg/L at the deepest depth sampled by the gear for the entire duration of deployment.

- Netting activities must cease at 28°C or higher until consulting with NMFS-PR.

- Soak times of nets must not exceed one hour at water temperatures above 25°C to 28°C.

- At water temperatures between 15°C to 25°C, net sets must not exceed 4 hours.

- When water temperatures are below 15°C and DO $\geq$ 4.5ppm, nets may be set while tended in daylight hours for a total of 10 hours, with one exception; that is, 14 hours net sets may take place overnight in waters having less than 2ppt salinity and similar temperature and oxygen profiles.

- When fish are onboard the research vessel for processing, the flow-through holding tank must allow for total replacement of water volume every 15 minutes. Backup oxygenation of holding tanks with compressed oxygen is necessary to ensure sturgeon do not become stressed and D.O. levels remain above 4.5 mg/L.

- The total handling time (includes onboard research procedures) must not exceed 15 minutes, unless fish have not recovered from anesthesia or a stressed condition.

- The total holding time of shortnose sturgeon (includes time after removal from the capture gear until returned to water) must not exceed two hours, unless fish have not recovered from anesthesia or a stressed condition.

- The total holding of shortnose sturgeon when water temperature $\geq$ 27°C, must never be longer than 30 minutes.

- Netting may take place at 0 ^{O}C; however, if water temperature $\geq$ 27°C, or is less than 7 ^{O}C, research must be limited to non-invasive procedures (e.g., PIT and Floy tags, measure, weigh, photograph, and genetic tissue clip).

- Fish must be handled carefully and kept in water as much as possible during processing.

- During onboard handling, sturgeon must be supported using a sling or net, and handling should be minimized throughout the procedure.

- Smooth rubber gloves must be worn to reduce abrasion of skin and removal of mucus.

- Shortnose sturgeon (and bycatch) must be allowed to recover before released to ensure full recovery, and must be treated with an electrolyte bath prior to release to help reduce stress and restore slime coat.

- Sturgeon are extremely sensitive to chlorine; therefore, thorough flushing of holding tanks sterilized with bleach would be required between sampling periods.

4.5.2 *Genetic Tissue Sampling:*

- Care must be used when collecting genetic tissue samples (soft fin clips). Instruments should be changed/disinfected and gloves changed between each fish sampled to avoid possible disease transmission or cross contamination of genetic material.

- Submission and archival of genetic tissue samples must be coordinated with Julie Carter (or current designated PI (Permit 13599)) at the NOAA-NOS tissue archive in Charleston, SC between six and twelve months after collection ((843)762-8547).

- The Permit Holder may not transfer biological samples to anyone not listed in the application without obtaining prior written approval from NMFS. Any such transfer will be subject to such conditions as NMFS deems appropriate.

- The terms and conditions concerning samples collected under this authorization will remain in effect as long as the material taken is maintained under the authority and responsibility of the Permit Holder.

4.5.3 *Tagging Conditions:*

- PIT tags must be used to individually identify all captured fish not previously tagged. Prior to placement of PIT tags, the entire dorsal surface of each fish must be scanned with a waterproof PIT tag reader and visually inspected to ensure detection of fish tagged in other studies. Previously PIT-tagged fish must not be retagged.

- Researchers must not insert PIT tags or perform other surgical procedures on juvenile shortnose sturgeon less than 300 mm in length.

- PIT tags must be injected in the left, dorsal musculature just anterior to the dorsal fin with the copper antenna oriented up and scanned after implantation to ensure proper tag function.

- When implanting numbered Floy tags, tags must be anchored in the dorsal fin musculature base, inserted forwardly and slightly downward from the left side to the right through the dorsal pterygiophores.

- The rate of PIT tag and Floy tag retention and the condition of fish at the site of tag injection must be documented during the study and results reported to NMFS in annual and final reports.

- Surgical implantation of internal tags must only be attempted when fish are in excellent condition, and must not be attempted with pre-spawning fish in spring or with fish captured on spawning grounds.

- Between tagging or surgical procedures, instruments must be either sterilized or changed.

- To ensure proper closure of surgical incisions, a single interrupted suturing technique should be applied.

- The total weight of tags must not exceed 2% of the sturgeon's total body weight unless otherwise authorized by NMFS-OPR.

4.5.4 *Anesthetization*:

- Researchers performing anesthesia on shortnose sturgeon must have first received supervised training on shortnose sturgeon or another surrogate species before doing so. The Responsible Party or PI must report this training to NMFS prior to the activity.

- Researchers may use MS-222 at concentrations up to 150 mg/L when anesthetizing shortnose sturgeon to implant sonic transmitters; such solutions must be made fresh daily.

- Prior to anesthetizing shortnose sturgeon with MS-222, researchers must saturate the solution with dissolved oxygen and buffer it to a neutral pH with sodium bicarbonate.

- Only non-stressed animals in good health can be anesthetized for a surgical procedure.

- To avoid injury to anesthetized sturgeon, researchers must use restraint (e.g., netting) to prevent animals from jumping or falling out of bath solutions.

- When inducing anesthesia on shortnose sturgeon, researchers must observe fish closely to establish the proper level of narcosis.

- Researchers must observe shortnose sturgeon closely during anesthetic recovery; and prior to release to their environment, sturgeon must be fully recovered.

- All researchers are required to wear protective clothing, gloves, and goggles when handling MS-222 powder.

- Unused MS-222 solution must be disposed of by using state adopted procedures.

4.5.5 *Endangered Florida Manatee Interaction*: The following conditions are provided by the USFWS to limit interactions and to avoid injury to endangered Florida manatee:

(1) <u>Methods to avoid capture of Florida manatee:</u>

- Vessel personnel must be informed that it is illegal to intentionally or unintentionally harm, harass, or otherwise “take” manatees, and to obey all posted manatee protection speed zone, Federal manatee sanctuary and refuge restrictions, and other similar state and

local regulations while conducting in-water activities. Such information shall be provided in writing to all vessel personnel prior to beginning the permitted research.

- Crew involved in research activities must wear polarized sunglasses to reduce glare while on the water and keep a look out for manatee. The crew shall include at least one member dedicated to watching for manatee during all in-water activities.

- All vessels engaged in netting and trapping shall operate at the slowest speed consistent with those activities.

- Rope attaching floats to nets should not have kinks or contain slack that could present an entanglement hazard to manatee.

- All nets must be continuously monitored. Netting activities must cease if a manatee is sighted within a 100-foot radius of the research vessel or the net, and may resume only when the animal is no longer within this safety zone, or 30 minutes has elapsed since the manatee was last observed within the safety zone.

(2) Methods to avoid injury if a manatee is captured:

- Devote all research staff efforts to freeing the animal. Remember that a manatee must breathe and surface approximately every 4 minutes. The PI must brief all research participants to ensure that they understand that freeing a manatee can be dangerous. This briefing will caution people to keep fingers out of the nets, that no jewelry should be worn, that they be careful to stay away from the manatee's paddle, and that they give the animal adequate time and room to breathe as they are freeing it.

- As appropriate, turn off the vessel or put engine in neutral to avoid injury.

- Release tension on the net to allow the animal the opportunity to free itself. Exercise caution when attempting to assist the animal in freeing itself. Manatees are docile animals but can thrash violently if captured or become entangled in a net. A 1,200 to 3,500 pound manatee can cause extensive damage to nets while trying to escape or breathe, so quick action is essential to protect both the manatee and the net. Ensure that the animal does not escape with net still attached to it.

- For immediate assistance with a captured animal, contact the University of North Carolina, Wilmington, Marine Mammal Stranding Program 910-254-5713. To report any gear or vessel interactions, or sighting of manatees, contact Nicole Adimey (USFWS) at 904-731-3079 (weekdays), fax 904-731-3045. Also contact NMFS, Chief, Permits, Conservation and Education Division at 301-713-2289 as soon as possible.

- Interactions with manatee should be documented with location, date, estimated size, water & air temp, any scar patterns and photos if possible (See Appendix 4: Manatee Sighting Report)

4.5.6 Sea Turtles: Although the potential for encountering a sea turtle was discounted, the following standard condition was suggested by the NMFS SEFSC to address how researchers would handle/resuscitate a sea turtle.

- If a sea turtle were incidentally captured during netting, the Permit Holder, Principal Investigator, Co-investigator(s), or Research Assistant(s) acting on the Permit Holder's behalf must use care when handling a live turtle to minimize any possible injury; and appropriate resuscitation techniques must be used on any comatose turtle prior to returning it to the water. All turtles must be handled according to procedures specified in 50 CFR 223.206(d)(1)(i).

4.5.7 *Bottlenose Dolphin:*

- Nets must not be deployed if a dolphin is sighted within the action area unless it is seen on a path away from the netting area.

- A standard pre-net set monitoring period of 30 minutes shall be used to ensure that there are no dolphins in the area.

- The nets must be observed at all times; -- "net observing" defined as continual, complete, and thorough visual check of nets at all times while set.

- Should any dolphin enter the research area after the nets are set, the lead line must be raised and dropped in an attempt to make dolphins in the vicinity aware of the net. However, no attempt should be made to harass the animal, and they should be allowed to leave on their own.

- Nets must be removed should the animals not leave the area, and must not be reset until the dolphin(s) have departed the area and/or have not been seen for 15 minutes.

- To report (and for immediate assistance with) a captured dolphin, contact NMFS, SEFSC Beaufort Laboratory Stranding Hotline, Beaufort, NC at 252-241-5119; or the University of North Carolina- Wilmington, Marine Mammal Stranding Program, Wilmington, NC at 910-254-5713.

4.5.8 *Atlantic Sturgeon Interaction*:

- If an Atlantic sturgeon is incidentally captured, NMFS requests that it minimally be PIT tagged, genetically sampled, and released.

- NMFS requests Atlantic sturgeon interactions to be reported to Lynn Lankshear, NMFS PR at 978-281-9300 x 6535; (Lynn.Lankshear@noaa.gov). This report should contain descriptions of take, including lethal take, location, and final disposition of the sturgeon. Specimens or body parts of dead Atlantic sturgeon should be preserved (preferably on ice or refrigeration) until sampling and disposal procedures are discussed with NMFS.

4.5.9 *Aquatic Nuisance Species*:

- To prevent potential spread of aquatic nuisance species identified in the watershed, all equipment assigned to the research should not be reassigned to other watersheds until the research is completed or is suspended.

- If the research has been completed or is suspended, all gear and equipment used should be bleached, washed and air dried before being redeployed to another location.

4.5.10 *Incidental Mortality of Shortnose Sturgeon*:

- If a greater incidence of mortality or serious injury should occur than is authorized, NMFS PR would need to be consulted to determine the cause of mortality and to discuss any remedial changes in research methods. The Permits Division could grant authorization to resume permitted activities based on review of the incident depending on the circumstances, or else suspend activities.

4.5.11 *Other Mitigation Measures*:

- Environmental sampling data (e.g., dissolved oxygen, temperature, net set duration, and other data associated with capture) must be recorded and be made available to NMFS in annual reports, or when requested periodically.

- Careful and detailed records should be reported to NMFS annually on the time of recovery and other responses from anesthesia, handling, tissue sampling, as well the condition and health and tag retention of any recaptured shortnose sturgeon.

4.6 UNAVOIDABLE ADVERSE EFFECTS

The measures required by permit conditions are intended to reduce, to the maximum extent practical, the potential for adverse effects of the research on all species. However, because the research involves wild animals not accustomed to being captured, the research activities would unavoidably result in harassment.

The research activities would cause unavoidable disturbance, stress, and minor injury to the captured shortnose sturgeon and other non-target species (temporarily interrupting normal activities such as feeding). The proposed research could also have some incidental sub-lethal effects on some individuals based on planned invasive surgery and schedule of netting over five years. However, mortality is anticipated or authorized and these risks are not expected to have long-term effects on target or non-target individuals or populations.

4.7 CUMULATIVE EFFECTS

In addition to the direct and indirect effects assessed above, in accordance with NEPA, this EA considers the potential for cumulative effects. Cumulative effects are those that result from incremental impacts of a proposed action which when added to other past, present, and reasonably foreseeable future threats or actions, regardless of which agency (federal or nonfederal) or person(s) undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions that take place over a period of time. For shortnose sturgeon range-wide, these effects include: research, bycatch, poaching, artificial propagation, dams, dredging, blasting, water quality and contaminants.

4.7.1 *Other Shortnose Sturgeon Research Permits*:

Shortnose sturgeon have been the focus of field studies since the 1970s. The primary purpose of this research is for monitoring populations and gathering data for physiological, behavioral and ecological studies. Over time, NMFS has issued dozens of permits for takes of shortnose sturgeon within its range for a variety of activities including capture, handling, lavage, laparoscopy, bloodwork, habitat, spawning verification, genetics, aging, and tracking. Research on shortnose sturgeon in the U.S. is carefully controlled and managed so it does not operate to the disadvantage of the species. As such, all scientific research permits are also conditioned with mitigation measures to ensure that the research impacts target and non-target species as minimally as possible.

Range wide, there are 17 active scientific research permits targeting wild shortnose sturgeon populations with similar objectives as proposed by the applicant (See Appendix 1). Although there are various other researchers studying the unlisted Atlantic sturgeon populations in North Carolina waters, which could potentially impact shortnose sturgeon and its habitat to some extent, there are no other current permitted activities sampling shortnose sturgeon in North Carolina waters. A Biological Opinion was issued for each of these the permits appearing in Appendix A, including the requirement for consideration of cumulative effects to the species (as defined for ESA). For each permit, the Biological Opinion concluded that issuance, as conditioned, was not likely to jeopardize the continued existence of the shortnose sturgeon, either individually or cumulatively.

4.7.2 *Bycatch and Poaching*:

4.7.2.1 Bycatch:

Directed harvest of both shortnose and Atlantic sturgeon is prohibited. As stated, shortnose sturgeon are listed as endangered under the ESA and therefore, prohibited from take. In 1998, the Atlantic States Marine Fisheries Commission (ASMFC) imposed a coast-wide fishing moratorium on Atlantic sturgeon until 20 year classes of adult females could be established (ASMFC 1998). NMFS followed this action by closing the Exclusive Economic Zone (EEZ) to Atlantic sturgeon take in 1999. Shortnose sturgeon has likely benefited from this closure as any bycatch in the fishery targeting Atlantic sturgeon (primarily for meat since the 1950s) has been eliminated.

Although directed harvest of shortnose sturgeons has been prohibited since 1967, bycatch of this species has been documented in other fisheries throughout its range. Adults are believed to be especially vulnerable to fishing gears for other anadromous species (such as shad, striped bass and herring) during times of extensive migration – particularly the spawning migration upstream, followed by movement back downstream (Litwiler 2001). Additionally, bycatch in the southern trawl fishery for shrimp *Penaeus* spp. was estimated at 8% in one study (Collins *et al*. 1996).

The 1998 Recovery Plan for shortnose sturgeon lists commercial and recreational shad fisheries as a source of shortnose bycatch. Although shortnose sturgeon are primarily captured in gill nets, they have also been documented with pound nets, fyke/hoop nets, catfish traps, shrimp trawls and hook and line fisheries (recreational angling).

Bycatch in the gill net fisheries can be quite substantial and is believed a significant threat to the species. The catch rates in drift gill nets are believed to be lower than for fixed nets; longer soak times of the fixed nets appear to be correlated with higher rates of mortalities. In an American shad

gill net fishery in South Carolina, of 51 fish caught, 16% were bycatch mortality and another 20% of the fish were visibly injured (Collins *et al*. 1996).

4.7.2.2 Poaching:

There is evidence of shortnose sturgeon targeted by poachers throughout their range, and particularly where they appear in abundance (such as on the spawning grounds) but the extent this is occurring is difficult to assess (Dadswell 1979, Dovel *et al*. 1992, Collins *et al*. 1996). There have been several documented cases of shortnose sturgeon caught by recreational anglers. One shortnose sturgeon illegally taken on the Delaware River was documented by a New Jersey Department of Fish and Wildlife conservation officer in Trenton New Jersey (NJCOA 2006). Additionally, citations have been issued for illegal recreational fishing of shortnose in the vicinity of Troy, New York on the Hudson River and on the Cooper River in South Carolina. Poaching has also been documented for other sturgeon species in the United States. Cohen (1997) documented poaching of Columbia River white sturgeon sold to buyers on the U.S. east coast. Poaching of Atlantic sturgeon has also been documented by law enforcement agencies in Virginia, South Carolina and New York and is considered a potentially significant threat to the species, but the present extent and magnitude is largely unknown (ASPRT 1998).

4.7.3 *Artificial Propagation*:

Since there are aquaculture or research facilities currently raising captive shortnose sturgeon on watersheds of native shortnose sturgeon, there is a potential for escapement and impact to the wild population. Potential threats from aquaculture escapement include the genetic alterations to native populations and potential competition for space and resources between hatchery-reared and wild fish. Further, since most sturgeon diseases have been documented in captive-reared fish, there is also the chance that escapees could spread pathogens and disease. To date, there have been no reports of escapees from the two facilities in Canada or from the USFWS facilities in South Carolina and Georgia. However, on the Connecticut River six fish artificially spawned from adults captured at Holyoke were released with radio tags upstream of the Holyoke Dam in 1989 and 1990 and they were subsequently never recovered. Additionally, several juveniles were accidentally released in 2006 and unrecovered.

There are currently two private companies producing shortnose sturgeon in Canada. Both are located on the St. John River and one is currently operating at a commercial scale. In the United States, the USFWS has been raising shortnose sturgeon (NMFS Permit No. 1604) for approximately 22 years. Until recently Bears Bluff National Fish Hatchery located on Wadmalaw Island in South Carolina raised the bulk of these fish while some fish were also reared at the USFWS' Warm Springs, GA and Orangeburg, SC hatcheries. Propagation of shortnose sturgeon at the Bears Bluff facility ended in the spring of 2008 but a subset of the broodstock and offspring are still maintained at Warm Springs and Orangeburg.

Captive shortnose sturgeon are also maintained by the USGS at the Conte Anadromous Fish Research Center (Permit No. 1549) located on the Connecticut River. These stocks are held in quarantine and are primarily used as test animals for upstream and downstream fish passage studies, but some progeny are also made available to other research facilities and educational display aquaria when requested. The F-1 progeny are produced periodically using wild native fish from the

Connecticut River in a *living stream* natural spawning environment; however, hatchery protocol is not a research objective at the facility.

4.7.4 *Dams*:

Dams are used to impound water for water resource projects such as hydropower generation, irrigation, navigation, flood control, industrial and municipal water supply, and recreation. Dams can have profound effects on diadromous fish species by fragmenting populations, eliminating or impeding access to historic habitat, modifying free-flowing rivers to reservoirs and altering downstream flows and water temperatures. Direct physical damage and mortality can occur to diadromous fish that migrate through the turbines of traditional hydropower facilities or as they attempt to move upstream using fish passage devices.

In addition to dams impeding anadromous fish migration and associated mortalities, Hill (1996) identified the following potential impacts from hydropower plants: altered DO concentrations; artificial destratification; water withdrawal; changed sediment load and channel morphology; accelerated eutrophication and change in nutrient cycling; and contamination of water and sediment. Furthermore, activities associated with dam maintenance, such as dredging and minor excavations along the shore, can release silt and other fine river sediments that can be deposited in nearby spawning habitat. Dams can also reduce habitat diversity by forming a series of homogeneous reservoirs; these changes generally favor different predators, competitors and prey, than were historically present in the system (Auer 1996a).

The effects of dams on populations of shortnose sturgeon are generally well documented (Kynard 1998, Cooke *et al.* 2004). However, there may be some rivers where shortnose sturgeon have been extirpated almost without notice due to the construction of impassable dams. In these rivers historical presence of shortnose sturgeon was likely, but unknown; there are historical accounts of sturgeon but it is unclear if both Atlantic and shortnose sturgeon used the river and if the river supported spawning of either species. For example, the Susquehanna River is the second largest river on the east coast of the U.S. and there are historical and anecdotal accounts of sturgeon upriver. Currently the Susquehanna has four mainstem dams, the lowermost of which is at approximately rkm 16. The dam has a fish lift but it is unusable by shortnose sturgeon. If the Susquehanna River once supported a population of shortnose sturgeon, it is no longer available to them.

Perhaps the biggest impact dams have on shortnose sturgeon is the loss of upriver spawning and rearing habitat. Migrations of shortnose sturgeon in rivers without barriers are wide-ranging with total distances exceeding 200 km or more depending on the river system (Kynard 1997). The construction of dams has blocked upriver passage for the majority of the shortnose sturgeon populations. Dams have restricted spawning activities to areas below the impoundment, often in close proximity to the dam (Kynard 1997, Cooke *et al*. 2004).

The suitability of riverine habitat for shortnose sturgeon spawning and rearing depends on annual fluctuations in flow, which can be greatly altered or reduced by the presence and operation of dams (Cooke *et al*. 2004). Effects on spawning and rearing may be most dramatic in hydropower facilities operating in peaking mode (Auer 1996a). Daily peaking operations store water above the dam when demand is low and release water for electricity generation when demand is high, creating substantial, daily fluctuations in flow and temperature regimes. Kieffer and Kynard (*in press*), have documented

flow fluctuations for hydroelectric power generation affected access to spawning habitat and possibly deterred spawning of shortnose sturgeon on the Connecticut River. Similar results were reported in studies conducted for lake sturgeon *A. fulvescens* in the Sturgeon River, Michigan (Auer 1996b) and white sturgeon *A. transmontanus* in the Columbia River, Oregon and Washington (Parsley and Beckman 1994). Kieffer and Kynard (in review), have also observed flow regimes from an upstream hydroelectric facility that were either so forceful that they scoured the shortnose sturgeon rearing shoals or so low that the shoals were dry and exposed. Auer (1996b) demonstrated that there is greater spawning success of lake sturgeon on the Sturgeon River, MI, when facilities operated in the more natural "run-of-the-river" mode.

4.7.5 *Dredging and Blasting:*

4.7.5.1 Dredging:

Many rivers and estuaries are periodically dredged for flood control or to support commercial shipping and recreational boating. Dredging also aids in construction of infrastructure and in marine mining. Dredging may have adverse impacts on aquatic ecosystems including direct removal/burial of organisms; turbidity; contaminant resuspension; noise/disturbance; alterations to hydrodynamic regime and physical habitat and actual loss of riparian habitat (Chytalo 1996, Winger *et al.* 2000).

Dredges are generally either mechanical or hydraulic. Mechanical dredges are used to scoop or grab bottom substrate while removing hard-packed materials and debris. Mechanical dredge types are clamshell buckets; endless bucket conveyor, or single backhoe or scoop bucket types; however, such dredges have difficulty holding fine materials in the buckets and do not dredge continuously. Material excavated with mechanical dredges is often loaded onto barges for transport to a designated placement site (USACOE 2008).

Hydraulic dredges are used principally to dredge silt, sand and small gravel. Hydraulic dredges include cutterhead pipeline dredges and self-propelled hopper dredges. Hydraulic dredges remove material from the bottom by suction, producing slurry of dredged material and water, either pumped directly to a placement site, or in the case of a hopper dredge, into a hopper and later transported to a dredge spoil site. Cutterhead pipeline dredges can excavate most materials including some rock without blasting and can dredge almost continuously (USACOE 2008).

The impacts of dredging operations on sturgeon are often difficult to assess. Hydraulic dredges can lethally take sturgeon by entraining sturgeon in dredge drag arms and impeller pumps (NMFS 1998). Mechanical dredges have also been documented to lethally take shortnose sturgeon (Dickerson 2006). In addition to direct effects, indirect effects from either mechanical or hydraulic dredging include destruction of benthic feeding areas, disruption of spawning migrations, and deposition of resuspended fine sediments in spawning habitat (NMFS 1998). Another critical impact of dredging is the encroachment of low D.O. and high salinities upriver after channelization (Collins *et al.* 2001). Adult shortnose sturgeon can tolerate at least short periods of low D.O. and high salinities, but juveniles are less tolerant of these conditions in laboratory studies. Collins *et al*. (2001) concluded harbor modifications in the lower Savannah River have altered hydrographic conditions for juvenile sturgeon by extending high salinities and low D.O. upriver.

In addition to impacts of dredging, Smith and Clugston (1997) reported dredging and filling eliminates deep holes, and alter rock substrates. Nellis *et al.* (2007) documented dredge spoil drifted 12 km downstream over a 10 year period in the Saint Lawrence River, and those spoils have significantly less macrobenthic biomass compared to control sites. Using an acoustic trawl survey, researchers found Atlantic and lake sturgeon were substrate dependent and avoided spoil dumping grounds (McQuinn and Nellis, 2007). Similarly, Hatin *et al*. (2007) tested whether dredging operations affected Atlantic sturgeon behavior by comparing CPUE before and after dredging events in 1999 and 2000. The authors documented a three to seven-fold reduction in Atlantic sturgeon presence after dredging operations began, indicating sturgeon avoid these areas during operations.

4.7.5.2 Blasting:

Bridge demolition and other projects may include plans for blasting with powerful explosives. Fish are particularly susceptible to effects of underwater explosions and are killed over a greater range than other organisms (Lewis 1996). Unless proper precautions mitigate the damaging effects of shock wave transmission to physostomous fish like shortnose sturgeon, internal damage and/or death may result (NMFS 1998).

A study testing the effects of underwater blasting on juvenile shortnose sturgeon and striped bass was conducted in Wilmington Harbor, NC in December 1998, and January 1999 (Moser 1999). There were seven test runs including 32-33 blasts (3 rows with 10-11 blast holes per row and each hole ~ 10 ft apart) with about 24-28 kg explosives per hole. For each blast 50 hatchery reared shortnose sturgeon and striped bass were placed in cages three feet from the bottom at distances of 35, 70, 140, 280 and 560 ft upstream and downstream of the blast area. A control group of 200 fish was held 0.5 miles from the blast site (Moser 1999). Test blasting was conducted with and without an air curtain in-place 50 ft from the blast site. Survival was similar for both species. External assessments of impacts to the caged fish were conducted immediately after the blasts and 24 h later. After the 24 h period, a subsample of the caged fish, primarily from those cages nearest the blast, at 35 ft and some from 70 ft, were sacrificed for later necropsy.

Externally, shortnose sturgeon and striped bass selected for necropsy all appeared to be in good condition externally and behaviorally after blasts. However, results of necropsies found many had substantial internal injuries. Moser concluded many of the injuries would have resulted in eventual mortality (Moser 1999). Therefore, based on necropsy results, an apparent estimate of mortality was conducted finding that fish held in cages at 70 ft from blast sites were less seriously impacted by the test blasting than those held at 35 ft. Lastly, it was concluded shortnose sturgeon suffered fewer, less severe internal injuries than striped bass tested. For striped bass and shortnose sturgeon held in cages at 35 ft, approximately 66 and 12 percent, respectively, would have probably not survived the blasts due to their internal injuries. Also there appeared to be no reduction of injury in fish experiencing blasts while air curtains were in place

4.7.6 *Water Quality and Contaminants*:

The quality of water in river/estuary systems is affected by human activities conducted in the riparian zone and those conducted more remotely in the upland portion of the watershed. Industrial activities can result in discharges of pollutants, changes in water temperature and levels of D.O., and the addition of nutrients. In addition, forestry and agricultural practices can result in erosion, run-off of fertilizers, herbicides, insecticides or other chemicals, nutrient enrichment and alteration of water

flow. Coastal and riparian areas are also heavily impacted by real estate development and urbanization resulting in storm water discharges, non-point source pollution, and erosion.

The water quality over the range of shortnose sturgeon varies by watershed but is notably poorer in the north than in the south. The U.S. Environmental Protection Agency (EPA) published its second edition of the National Coastal Condition Report (NCCR II) in 2005, a "report card" summarizing the status of coastal environments along the coast of the United States (USEPA 2005; See Table 7 below). The report analyzes water quality, sediment, coastal habitat, benthos, and fish contaminant indices to determine status. The northeast region and the Chesapeake Bay received grades of F. The Southeast region received an overall grade of B-, the best rating in the nation.

Table 7. Summary of the USEPA National Coastal Condition Report (NCCR II) for the U.S. east coast published by the U.S. Environmental Protection Agency (2005) grading coastal environments. (Northeast Region = ME through VA; southeast region = NC-FL; and the Chesapeake Bay = the central region).

	Region		
Status Index	**Northeast**	**Chesapeake Bay**	**Southeast**
Water Quality	D	F	B
Sediment	F	F	B
Coastal Habitat	B	-	C
Benthos	F	F	C
Fish Tissue	F	F	A
Overall	**F**	**F**	**B-**

Areas of concern having poor index scores were: 1) Hudson River – water quality, sediment, and tissue contaminants, 2) Delaware River – water quality and tissue contaminants, 3) Upper Chesapeake Bay – water quality and sediment, 4) Potomac River – sediment, 5) Pamlico Sound – water quality, 6) ACE Basin – water quality, and 7) St. Johns River – sediment. There was also a mixture of poor benthic scores scattered along the Northeast and Southeast region.

Although the south region scored fairly well in water quality, low D.O. and high temperature may limit available habitat and survival of juveniles. Secor (1995) noted a correlation between low numbers of sturgeon during this century and decreasing water quality caused by increased nutrient loading and increased spatial and temporal frequency of hypoxic water. Further, Secor and Gunderson (1998) and Collins *et al* (2001) hypothesized survival of juvenile sturgeon in estuaries may be compromised due to combined effects of increased hypoxia and temperature in nursery areas impacted by human activity. Hypoxia affects sturgeon species more than other fish species due to their limited ability to oxyregulate at low D.O. (Secor and Gunderson 1998, Secor 2002). Sturgeon's first year of life may leave it particularly susceptible to low D.O. at early life stages and the limited means to escape from hypoxic waters (Secor and Niklitschek 2002).

Niklitschek (2001) modeled suitable habitat availability for juvenile shortnose and Atlantic sturgeon in the Chesapeake Bay using a multivariable bioenergetics and survival model. Results show the cumulative stresses of hypoxia, high temperatures and salinity during summer months caused large reductions in potential nursery habitat for both species during 1990-1999 (Niklitschek 2001). The modeling established during dry years, when persistent hypoxia in deeper areas consistently precluded access to thermal refuges, there may little suitable habitat for juvenile sturgeon.

The EPA adjusted open water minimum D.O.-criteria for the Chesapeake Bay (increased from ~2 ppm to 3.5 mg/L) to provide protection specifically for sturgeon species, requiring higher levels of D.O. than other fish species (USEPA 2003). Niklitschek and Secor (2005) modeled the achievement of EPA's D.O. criteria for Atlantic sturgeon predicting available habitat for Atlantic sturgeon would increase by 13% per year, while an increase of water temperature by 1°C would reduce available habitat by 65%. Similar results may occur for sturgeons in southern rivers where high water temperatures and low D.O. are a common occurrence during the summer months.

Life history of shortnose sturgeon (i.e., long lifespan, extended residence in estuarine habitats, benthic foraging) predispose them to long-term, repeated exposure to environmental contamination and potential bioaccumulation of heavy metals and other toxicants (Dadswell 1979, NMFS 1998). However, there has been little work on the effects of contaminants on shortnose sturgeon to date.

Chemicals and metals such as chlordane, dichlorodiphenyl dichloroethylene (DDE), DDT, dieldrin, PCBs, cadmium, mercury, and selenium settle to the river bottom and are later consumed by benthic feeders, such as macroinvertebrates, and then work their way higher into the food web (e.g. to sturgeon). Some of these compounds may affect physiological processes and impede a fish's ability to withstand stress, while simultaneously increasing the stress of the surrounding environment by reducing D.O., altering pH, and altering other physical properties of the water body.

Although there have been very few analyses of shortnose sturgeon tissues for contaminants, shortnose sturgeon collected from the Delaware and Kennebec rivers had total toxicity equivalent concentrations of polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), PCBs, DDE, aluminum, cadmium, and copper above adverse effect concentration levels reported in the literature (ERC 2002, 2003). In the Hudson, six fish have been tested over the past 37 years. Most fish carried very high burden load of PCBs, or one of its derivatives (DDT).

Dioxin and furans were detected in ovarian tissue from shortnose sturgeon caught in the Sampit River/Winyah Bay system (SC). Results showed that four out of seven fish tissues analyzed contained tetrachlorodibenzo-*p*-dioxin (TCDD) concentrations greater than 50 pg/g (parts-per-trillion), a level which can adversely affect the development of sturgeon fry (J. Iliff, NOAA Habitat Restoration Division, Silver Spring, MD, unpublished data).

Heavy metals and organochlorine compounds accumulate in sturgeon tissue, but their long-term effects are not known (Ruelle and Henry 1992, Ruelle and Keenlyne 1993). High levels of contaminants, including chlorinated hydrocarbons, in several other fish species are associated with reproductive impairment (Cameron *et al*. 1992, Longwell *et al*. 1992, Hammerschmidt *et al*. 2002, Giesy *et al*. 1986, Mac and Edsall 1991, Matta *et al*. 1998, Billsson *et al*. 1998), reduced survival of larval fish (Berlin *et al*. 1981, Giesy *et al*. 1986), delayed maturity (Jorgensen *et al*. 2004) and posterior malformations (Billsson *et al*. 1998). Pesticide exposure in fish may affect anti-predator and homing behavior, reproductive function, physiological maturity, swimming speed and distance (Beauvais *et al*. 2000, Scholz *et al*. 2000, Moore and Waring 2001, Waring and Moore 2004). Sensitivity to environmental contaminants also varies by life stage.

Early life stages of fish appear to be more susceptible to environmental and pollutant stress than older life stages (Rosenthal and Alderdice 1976). Dwyer *et al*. (2005) compared the relative

sensitivities of common surrogate species used in contaminant studies to 17 listed species including shortnose and Atlantic sturgeons. The study examined 96-hour acute water exposures using early life stages where mortality is an endpoint. Chemicals tested were carbaryl, copper, 4-nonphenol, pentachlorophenal (PCP) and permethrin. Of the listed species, Atlantic and shortnose sturgeon were ranked the two most sensitive species tested (Dwyer *et al*. 2005). Additionally, a study examining the effects of coal tar, a byproduct of the process of destructive distillation of bituminous coal, indicated that components of coal tar are toxic to shortnose sturgeon embryos and larvae in whole sediment flow-through and coal tar elutrtraite static renewal (Richland *et al*. 1993).

Lastly, the operation of power plants can have unforeseen and detrimental impacts to water quality which can affect shortnose sturgeon. For example, the St. Stephen Power Plant near Lake Moultrie, South Carolina was shut down for several days in June 1991 when large mats of aquatic plants entered the plant's intake canal and clogged the cooling water intake gates (Balciunas *et al.* 2002). Decomposing plant material in the tailrace canal coupled with the turbine shut down (allowing no flow of water) triggered a low D.O. water condition downstream and a subsequent fish kill. The South Carolina Wildlife and Marine Resources Department reported that twenty shortnose sturgeon were killed during this low D.O. event.

4.7.7 *Summary of Cumulative Impacts*:

Effects of past and ongoing human and natural factors and current threats (fisheries, water quality, dredging, dams, existing NMFS research permits, and other actions) are occurring (or have occurred) in or near the action area that have contributed to the current status of the species, are described above, and are also included in the baseline section of the Biological Opinion issued for this proposed research activity. These activities and threats are expected to continue into the future.

Overall, the preferred alternative would not be expected to have more than short-term effects on shortnose sturgeon if sturgeon are present in the research locations. The impacts of the non-lethal research activities are not expected to have more than short-term effects on individual animals and any increase in stress levels from the capture and handling would dissipate rapidly. Even if an animal was exposed to additional capture (e.g., a week later), no significant cumulative effects from the research itself would be expected given the nature of the effects. Based on the analysis in this EA and supported by the Biological Opinion, NMFS expects the proposed authorization of shortnose sturgeon research activities of the preferred alternative would not appreciably reduce the species likelihood of survival and recovery in the wild nor would it adversely affect spawning, mortality rates, or recruitment rates. In particular, NMFS expects the proposed research activities not to affect adult reproductive adults in a way that appreciably reduces their reproductive success, the survival of young, or the number of young that annually recruit into the breeding populations.

The incremental impact of the proposed research on these animals, when added to other past, present, and reasonably foreseeable future actions discussed here, would not be significant at an individual or a population level. Therefore, no species level events would result from the capture, handling, and release of shortnose sturgeon. The data collected during sampling activities linked with the proposed action would help assess movement and habitat use of juvenile shortnose sturgeon found in the North Carolina river waters. The research would provide information helpful in managing, conserving, and recovering this species and would outweigh any adverse impacts.

Moreover, the Biological Opinion prepared for File No. 14759 provides an integration and synthesis of the information about the status of the species, past and present activities affecting the species, possible future actions that might affect the species, and effects of the proposed action to provide a basis for determining the additive effects of the take authorized in this permit on ESA listed sturgeon, in light of their present and anticipated future status. The conclusion of the biological opinion for File No. 14759 was the proposed action would not likely jeopardize the continued existence of the species.

The opinion also indicated that NMFS is not aware of any future State, tribal, local, or private actions in the action area that may have a bearing on the risk assessment, and finds that the that the issuance of the proposed permit would have only negligible impacts to shortnose sturgeon. The analysis of past, present and reasonably foreseeable actions indicates that no cumulatively significant impacts would occur associated with the proposed action.

CHAPTER 5 LIST OF PREPARERS AND AGENCIES CONSULTED

Preparers:
Office of Protected Resources
National Marine Fisheries Service
Permits, Conservation and Education Division
Silver Spring, MD 20910

Agencies and Personnel Consulted:

Office of Protected Resources National Marine Fisheries Service Endangered Species Division, Silver Spring, MD 20910	Section 7 formal consultations on effects on ESA target species (shortnose sturgeon)
Ecological Services, Raleigh Field Office United States Fish and Wildlife Service 551F Pylon Drive Raleigh, NC 27606	Section 7 informal consultations on effects on ESA non-target species (shortnose sturgeon)
NMFS SE Fisheries Science Center Center for Coastal Fisheries and Habitat Research Beaufort, NC 28516	Informal consultations on effects on non-target species (dolphin & sea turtles)
Habitat Conservation Division NMFS Southeast Regional Office Beaufort, NC 28516	Informal consultations on effects on EFH of federally managed species

LITERATURE CITED

Armstrong, J.L. and J.E. Hightower. 2002. Potential for restoration of the Roanoke River population of Atlantic sturgeon. Applied Ichthyology 18:475-480.

Atlantic Sturgeon Plan Development Team (ASPRT). 1998. Amendment 1 to the Interstate Fishery Management Plan for Atlantic Sturgeon. Atlantic States Marine Fisheries Commission, Washington, D.C. Fishery Management Report No. 31:1-43.

ASMFC 1998. Amendment 1 to the interstate fishery management plan for Atlantic sturgeon. Management Report No. 31, 43 pp.

Auer, N. A. 1996a. Importance of habitat and migration to sturgeons with emphasis on lake sturgeon. *Canadian Journal of Fisheries and Aquatic Sciences* 53(S1): 152-160.

Auer, N. A. 1996b. Response of spawning lake sturgeons to change in hydroelectric facility operation. *Transactions of the American Fisheries Society* 125: 66-77.

Bain, M. B. 1997. Atlantic and shortnose sturgeons of the Hudson River: Common and Divergent Life History Attributes. *Environmental Biology of Fishes* 48: 347-358.

Balciunas F.K., M. J. Grodowitz, A.F Cofrancesco, J.F. Shearer. 2002. Hydrilla. *In*: Van Driesche, R., *et al.*, 2002, Biological Control of Invasive Plants in the Eastern United States, USDA Forest Service Publication FHTET-2002-04, 413 p.

Basinwide Planning Section. 2006. Roanoke River Basinwide Water Quality Plan. North Carolina Department of Environment and Natural Resources, Division of Water Quality, Raleigh.

Basinwide Planning Section. 2007. Chowan River Basinwide Water Quality Plan. North Carolina Department of Environment and Natural Resources, Division of Water Quality, Raleigh. 160 pp.

Beauvais, S.L., S.B. Jones, S.K. Brewer, and E. E. Little. 2000. Physiological measures of neurotoxicity of diazinon and malathion to larval rainbow trout (*Oncorhynchus mykiss*) and their correlation with behavioral measures. *Environmental Toxicology and Chemistry* 19: 1875-1880.

Berlin, W.H., R.J. Hesselberg, and M.J. Mac. 1981. Chlorinated hydrocarbons as a factor in the reproduction and survival of Lake Trout (*Salvelinus namaycush*) in Lake Michigan. Technical Paper 105, U.S. Fish and Wildlife Service. 42 pp.

Billsson,K., L.Westerlund, M.Tysklind, and P.Olsson. 1998. Developmental disturbances caused by polychlorinated biphenyls in zebrafish (*Brachydanio rerio*).*Marine Environmental Research* 46: 461-464.

Brännäs, E., H. Lundqvist, E. Prentice, M. Schmitz, K. Brännäs and B. Wiklund. 1994. Use of the passive integrated transponder (PIT) in a fish identification and monitoring system for fish behavioral studies. Transactions of the American Fisheries Society Symposium 123:395-401.

Braun-McNeill, J.Sasso, C., Epperly, S.P. and Rivero, C. In press. The use of sea surface temperature imagery and the management of sea turtle interactions in the Mid Atlantic Bight. Proceedings of the 12rd Annual Symposium on Sea Turtle Biology and Conservation, 17-21 March 2003, Kuala Lumpur, Malaysia.

Brown L.A. 1988. Anesthesia in fish. *In:* Veterinary Clinics of North America: *Small Animal Practice*, 1988, vol 18, pp. 317-330.

Burkhead, N.M. 1983. Ecological studies of two potentially threatened fishes (the orangefin madtom, *Noturus gilberti*, and the Roanoke logperch *Percina rex*) endemic to the Roanoke River drainage. Report to Wilmington District Corps of Engineers, Wilmington, NC.

Cameron, P. J. Berg, V. Dethlefsen and H.Von Westernhagen. 1992. Developmental defects in pelagic embryos of several flatfish species in the southern North Sea. *Netherlands Journal of Sea Research* 29(1-3):239-256.

Chytalo, K. 1996. Summary of Long Island Sound dredging windows strategy workshop. In: Management of Atlantic Coastal Marine Fish Habitat: Proceedings of a Workshop for Habitat Managers. ASMFC Habitat Management Series #2.

Clugston, J.P. 1996. Retention of T-bar anchor tags and passive integrated transponder tags by gulf sturgeon. North American Journal of Fisheries Management 16:682-685.

Cohen, A. 1997. Sturgeon poaching and black market caviar: a case study. *Env. Biol. Fish*. 48:423-426.

Collins, M.R., T.I.J. Smith, and L.D. Heyward. 1994. Effectiveness of six methods for marking juvenile shortnose sturgeon. Progressive Fish Culturist 56:250–254.

Collins, M.R., S.G. Rogers, and T.I.J. Smith. 1996. Bycatch of sturgeons along the southern Atlantic coast of the USA. *North American Journal of Fisheries Management* 16:24-29.

Collins, M.R., S.G. Rogers, T.I.J. Smith, and M.L. Moser. 2000. Primary factors affecting sturgeon populations in the southeastern United States: fishing mortality and degradation of essential habitats. *Bulletin of Marine Science* 66(3):917-928.

Collins, M.R., W.C Post, and D.C. Russ. 2001. Distribution of Shortnose Sturgeon in the Lower Savannah River. Final Report to the Georgia Ports Authority, 2001. 21pp.

Conant, T.A., P.H. Dutton, T. Eguchi, S.P. Epperly, C.C. Fahy, M.H. Godfrey, S.L. MacPherson, E.E. Possardt, B.A. Schroeder, J.A. Seminoff, M.L. Snover, C.M. Upite, and B.E. Witherington. 2009. Loggerhead sea turtle *(Caretta caretta)* 2009 status review under the U.S. Endangered Species Act. Report of the Loggerhead Biological Review Team to the National Marine Fisheries Service, August 2009. 222 pp.

Cooke, D.W., J.P. Kirk, J.V. Morrow, Jr., and S.D. Leach. 2004. Population dynamics of a migration limited shortnose sturgeon population. *Proceedings of the Annual Conference, Southeastern Association of Fish and Wildlife Agencies* 58:82-91.

Copeland, B.J., R.G. Hodson, S.R. Riggs and J.E. Easley, Jr. 1983. The ecology of Albemarle Sound, North Carolina: an estuarine profile. U.S. Fish and Wildlife Service, Division of Biological Services, Washington, D.C. FWS/OBS-83/01. 68 pp.

Coyle, S.D., Durborow, R.M., and Tidwell, J.H. 2004. Anesthetics in aquaculture. SRAC, Nov 2004., Publication No. 3900; 6 pp.

Dadswell, M.J. 1979. Biology and population characteristics of the shortnose sturgeon, *Acipenser brevirostrum* LeSueur 1818 (*Osteichthyes: Acipenseridae*), in the Saint John River estuary, New Brunswick, Canada. *Canadian Journal of Zoology* 57:2186-2210.

DeVries, R.D. 2006. Population dynamics, movments, and spawning habitat of the shortnose sturgeon, *Acipenser brevirostrum*, in the Altahmha River System, Georgia. (MS Thesis) University of Georgia; 103pp.

Dickerson, D. 2006. Observed takes of sturgeon and turtles from dredging operations along the Atlantic Coast. Supplemental data provided by U.S. Army Engineer R&D Center Environmental Laboratory, Vicksburg, Mississippi.

Dovel, W.L., A.W. Pekovitch, and T.J. Berggren. 1992. Biology of the shortnose sturgeon (*Acipenser brevirostrum* Lesueur, 1818) in the Hudson River estuary, New York. Pages 187-216 *in* C.L. Smith (Ed) Estuarine Research in the 1980s. State University of New York Press, Albany, New York.

Dwyer, F. J., D. K. Hardesty, C. E. Henke, C. G. Ingersoll, D. W. Whites, T. Augspurger, T. J. Canfield, D. R. Mount, and F. L. Mayer. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: part III. Effluent toxicity tests. Archives of Environmental Contamination and Toxicology 48: 174-183.

Environmental Protection Agency (USEPA). 2003. Ambient water quality criteria for dissolved oxygen, water clarity and chlorophyll-a for the Chesapeake Bay and its tributaries. pp. 343, U.S. Environmental Protection Agency, Washington, DC (USA). http://www.epa.gov/Region3/chesapeake/baycriteria.htm

Environmental Protection Agency (USEPA). 2005. National Coastal Condition Report II. Washington, DC. EPA-620/R-03/002.

Environmental Research and Consulting, Inc. (ERC). 2002. Contaminant analysis of tissues from two shortnose sturgeon (Acipenser brevirostrum) collected in the Delaware River. Prepared for National Marine Fisheries Service. 16 pp. + appendices.

Environmental Research and Consulting, Inc. (ERC). 2003. Contaminant analysis of tissues from a shortnose sturgeon (Acipenser brevirostrum) from the Kennebec River, Maine. Report submitted to National Marine Fisheries Service, Protected Resources Division, Gloucester, MA. 5 pp.

Epperly, S.P. and S.W. Ross. 1986. Characterization of the North Carolina Pamlico-Albemarle estuarine complex. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Beaufort Laboratoy, Beaufort, NC. NOAA Technical Memorandum NMFS-SEFC-175:1-55.

Epperly, S.P., J.Brawn, and A.J. Chester. 1995. Aerial surveys for sea turtles in North Carolina estuarine waters. Fish. Bull. 93(2):254-261.

Everman, B.W., and B.A. Bean. 1898. Indian River and its fishes. Report of United States Fisheries Commission 1896:227-248.

Fox, D. A., J. E. Hightower, and F. M. Parauka. 2000. Gulf Sturgeon spawning migration, and habitat in the Choctawhatchee River System, Alabama-Florida. Transactions of the American Fisheries Society 129:811-826.

Giesy, J.P., J. Newsted, and D.L. Garling. 1986. Relationships between chlorinated hydrocarbon concentrations and rearing mortality of chinook salmon (*Oncorhynchus tshawytscha*) eggs from Lake Michigan. Journal of Great Lakes Research 12(1):82-98.

Hammerschmidt C.R., Sandheinrich M.B., Wiener J.G., Rada R.G. 2002. Effects of dietary methylmercury on reproduction of fathead minnows. Environmental Science and Technology 36:877-883.

Hatin, D, S. Lachance and D. Fournier. 2007. Effect of dredged sediment deposition on use by Atlantic sturgeon and lake sturgeon at an open-water disposal site in the St. Lawrence estuarine transition zone. Pages 235-256 in J. Munro, D. Hatin, J.E. Hightower, K. McKown, K.J. Sulak, A.W. Kahnle and F. Caron, editors. Anadromous sturgeons: habitats, threats and management. American Fisheries Society, Symposium 56, Bethesda, Maryland.

Henne, J.P. R.L. Crumpton, K.M. Ware, and J. Fleming. 2008. Guidelines for marking and tagging juvenile endangered shortnose sturgeon, *Acipenser brevirostrum*. Aquaculture America 2008, meeting abstract.

Henwood, T.A. and L.H. Ogren. 1987. Distribution and migrations of immature Kemp's ridley turtles (*Lepidochelys kempii*) and green turtles (Chelonia mydas) off Florida, Georgia, and South Carolina. Northeast Gulf Science, 9(2): 153-160.

Hightower, J.E., A.M. Wicker and K.M. Endres. 1996. Historical trends in abundance of American shad and river herring in Albemarle Sound, North Carolina. North American Journal of Fisheries Management 16:257-271.

Hill, J. 1996. Environmental Considerations in Licensing Hydropower Projects: Policies and Practices at the Federal Energy Regulatory Commission. American Fisheries Society Symposium 16: 190-199.

Hildebrand, H. 1963. Hallazgo del area de anidacion de la tortuga "lora" *Lepidochelys kempii* (Garman), en la costa occidental del Golfo de Mexico (Rept. Chel.). Ciencia Mex., 22(4):105-112.

Hirth, H.F. 1997. Synopsis of biological data on the green turtle *Chelonia mydas* (Linnaeus, 1758). U.S. Dept. of the Interior, Fish and Wildlife Service, p. 120.

Huff, J.A. 1975. Life History of Gulf of Mexico Sturgeon, *Acipenser oxyrhynchus desotoi*, in Suwannee River, FL. Florida Department of Natural Resources; Marine Research Laboratory Number 16, November 1975.

Jorgensen, E. H., O. Aas-Hansen, Al G. Maule, J. E. T. Strand, M. M. Vijayan. 2004. PCB impairs smoltification and seawater performance in anadromous Arctic char (*Salvelinus alpinus*). *Comparative Biochemsitry and Physiology*, Part C 138: 203-212.

Kieffer, M. and B. Kynard. In Press. Long-term evaluation of external and internal telemetry tagged shortnose sturgeon. Chapter 11 in Life history and behavior of Connecticut River shortnose sturgeon and other sturgeons. Special Publication 4, World Sturgeon Conservation Society.

Kynard, B. 1997. Life history, latitudinal patterns, and status of the shortnose sturgeon, *Acipenser brevirostrum*. *Environmental Biology of Fishes* 48: 319–334.

Kynard, B. 1998. Twenty-two years of passing shortnose sturgeon in fish lifts on the Connecticut River: What has been learned? Pages 255–264. In M. Jungwirth, S. Schmutz, and S. Weiss, editors. Fish migration and fish bypasses. Fishing News Books, London.

Lewis, J.A. 1996. Effects of underwater explosions on life in the sea. Autrailian Government, Defense, Science, and Technology Organization. http://dspace.dsto.defence.gov.au/dspace/.

Litwiler, T.L. 2001 Conservation plan for sea turtles, marine mammals, and the shortnose sturgeon in Maryland, Maryland Department of Natural Resources Technical Report FS-SCOL-01-2, Oxford, Maryland. 134 pp.

Longwell, A.C., S. Chang, A. Hebert, J. Hughes, and D. Perry. 1992. Pollution and developmental abnormalities of Atlantic fishes. *Environmental Biology of Fishes* 35:1-21.

Lutcavage, M. and J.A. Musick. 1985. Aspects of the biology of sea turtles in Virginia. Copeia 1985(2): 449-456.

Mac, M.J., and C.C. Edsall. 1991. Environmental contaminants and the reproductive success of lake trout in the Great Lakes: An epidemiological approach. *Journal of Toxicology and Environmental Health* 33:375-394.

Mangin, E. 1964. Croissance en Longueur de Trois Esturgeons d'Amerique du Nord: Acipenser oxyrhynchus, Mitchill, *Acipenser fulvescens*, Rafinesque, et *Acipenser brevirostrum* LeSueur. Verh. Int. Ver. *Limnology* 15: 968-974.

Matta, M.B., C. Cairncross, and R.M. Kocan. 1998. Possible Effects of Polychlorinated Biphenyls on Sex Determination in Rainbow Trout. *Environ. Toxicol. Chem. 17*:26-29.

McClellen, C.M. 2009. Behavior, Ecology, and Conservation of Sea Turtles in the North Atlantic Ocean. Dissertation, Duke University, Dept. of Environment. Durham, North Carolina.

McQuinn, I.H. and P. Nellis. 2007. An acoustic-trawl survey of middle St. Lawrence estuary demersal fishes to investigate the effects of dredged sediment disposal on Atlantic sturgeon and lake sturgeon distribution. Pages 257-272 in J. Munro, D. Hatin, J.E. Hightower, K. McKown, K.J. Sulak, A.W. Kahnle and F. Caron, editors. Anadromous sturgeons: habitats, threats and management. American Fisheries Society, Symposium 56, Bethesda, Maryland.

Moore A. and C. P. Waring. 2001. The effects of a synthetic pyrethroid pesticide on some aspects of reproduction in Atlantic salmon (*Salmo salar* L.). *Aquatic Toxicology* 52:1-12.

Moser, M.L. and S.W. Ross. 1995. Habitat use and movements of shortnose and Atlantic sturgeons in the Lower Cape Fear River, North Carolina. *Transactions of the American Fisheries Society* 124:225-234.

Moser, M.L. 1999. Cape Fear River Blast Mitigation Tests: Results of Caged Fish Necropsies. Final Report to CZR, Inc. under Contract to U.S. Army Corps of Engineers, Wilmington District.

Moser, M. L., M. Bain, M. R. Collins, N. Haley, B. Kynard, J. C. O'Herron II, G. Rogers and T. S. Squiers. 2000. A Protocol for use of shortnose and Atlantic sturgeons. U.S. Department of Commerce NOAA Technical Memorandum-NMFS-PR-18:18 pp.

North Carolina Marine Fisheries Commission (NCDMF). 2006. Sea Turtle Interactions with North Carolina Fisheries Review and Recommendations to the North Carolina Marine Fisheries Commission. Sea Turtle Advisory Committee, June 12, 2006. 65pp.

North Carolina Division of Water Resources (NCDWR). 2001. North Carolina State Water Supply Plan. North Carolina Department of Environment and Natural Resources, Division of Water Resources, Raleigh. [available on the Division of Water Resources web site at: www.ncwater.org]

North Carolina Division of Environmental Management (NCDEM). 1982. Chowan River Water Quality Management Plan. North Carolina Department of Natural Resources and Community Development Raleigh. Draft Report.

North Carolina State University (NCSU). 2008. NCSU Water Quality Programs, River Basin Characteristics. College of Agriculture and Life Sciences, North Carolina Extension Water Quality Information System. http://www.water.ncsu.edu/chowan.html

NOAA/SEA. 1998. North Carolina Increasing Salinity Time Period. http://ccma.nos.noaa.gov/products/biogeography/efh/sa-efh/ncsali.gif

Nellis, P., S. Senneville, J. Munro, G. Drapeau, D. Hatin, G. Desrosiers and F.J. Saucier. 2007. Tracking the dumping and bed load transport of dredged sediment in the St. Lawrence estuarine transition zone and assessing their impacts on macrobenthos in Atlantic sturgeon habitat. Pages 215-234 in J. Munro, D. Hatin, J.E. Hightower, K. McKown, K.J. Sulak, A.W. Kahnle and F. Caron, editors. Anadromous sturgeons: habitats, threats and management. American Fisheries Society, Symposium 56, Bethesda, Maryland.

Niklitschek, E. J. and D.H. Secor. 2005. Modeling spatial and temporal variation of suitable nursery habitats for Atlantic sturgeon in the Chesapeake Bay. Estuarine, Coastal and Shelf Science 64 135-148.

Niklitschek, E. J. 2001. Bioenergetics modeling and assessment of suitable habitat for juvenile Atlantic and shortnose sturgeons (*Acipenser oxyrinchus* and *A. brevirostrum*) in the Chesapeake Bay. Dissertation. University of Maryland at College Park, College Park.

NJCOA. 2006. Monthly Highlights. New Jersey Division of Fish and Wildlife. Beureau of Law Enforcement, April 2006. http://www.njcoa.com/highlights/H_06_04.html.

NMFS and USFWS 1991. Recovery Plan for U.S. Population of Loggerhead Turtle. National Marine Fisheries Service, Washington, D.C., 64pp.

NMFS 1998. Final recovery plan for the shortnose sturgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. 104 pages.

Oakley, N.C. and J.E. Hightower. 2007. Status of shortnose sturgeon in the Neuse River, North Carolina. American Fisheries Society Symposium 56:273-284.

Ogren, L.H. 1989. Distribution of juvenile and sub-adult Kemp's ridley sea turtle: Preliminary results from 1984-1987 surveys. Pp. 116-123 *In* Caillouet, C.W. and A.M. Landry (eds), First Intl. Symp. on Kemp's Ridley Sea Turtle Biol, Conserv. and Management. Texas A&M Univ. Galveston, TX., Oct. 1-4, 1985, TAMU-SG

Parsley, M.J. and Beckman,L.G. 1994. White sturgeon spawning and rearing habitat in the Lower Columbia River. North American Journal of Fisheries Management 14:812-827.

Popper, A.N. 2005. A Review of Hearing by Sturgeon and Lamprey. Environmental BioAcoustics, LLC. Rockville, Maryland. Submitted to the U.S. Army Corps of Engineers, Portland District. August 12, 2005.

Pritchard, P.C.H. 1969. Endangered species: Kemp's ridley turtle. Florida Naturalist, 49: 15-19.

Richland, WA. Kocan, R. M., M. B. Matta, and S. Salazar. 1993. A laboratory evaluation of Connecticut River coal tar toxicity to shortnose sturgeon (*Acipenser brevirostrum*) embryos and larvae. Final Report, December 20, 1993. 23 pp.

Rosenthal, H. and D. F. Alderdice. 1976. Sublethal effects of environmental stressors, natural and pollutional, on marine fish eggs and larvae. *Journal of the Fisheries Research Board of Canada* 33: 2047-2065.

Ruelle, R., and C. Henry. 1992. Organochlorine Compounds in Pallid Sturgeon. Contaminant Information Bulletin, June, 1992.

Ruelle, R., and K.D. Keenlyne. 1993. Contaminants in Missouri River Pallid Sturgeon. *Bulletin of Environmental Contamination and Toxicology* 50:898-906.

Scholz N. L., N. K. Truelove, B. L. French, B. A. Berejikian, T. P. Quinn, E. Casillas and T. K. Collier. 2000. Diazinon disrupts antipredator and homing behaviors in Chinook salmon (*Oncorhynchus tshawytscha*). *Canadian J. of Fisheries and Aquatic Sciences* 57: 1911-1918.

Scott, W.B. and M.G. Scott. 1988. Atlantic fishes of Canada. *Canadian Bulletin of Fisheries and Aquatic Sciences* No. 219.

Secor, D. H. 1995. Chesapeake Bay Atlantic sturgeon: current status and future recovery. Summary of Findings and Recommendations from a Workshop convened 8 November 1994 at Chesapeake Biological Laboratory. Chesapeake Biological Laboratory, Center for Estuarine and Environmental Studies, University of Maryland System, Solomons, Maryland.

Secor, D.H. and T.E. Gunderson. 1998. Effects of hypoxia and temperature on survival, growth, and respiration of juvenile Atlantic sturgeon, Acipenser oxyrinchus. Fishery Bulletin 96: 603-613.

Secor, D. H. 2002. Atlantic sturgeon fisheries and stock abundances during the late nineteenth century. American Fisheries Society Sympos. 28: 89-98.

Secor, D.H. and E.J. Niklitschek. 2002. Sensitivity of sturgeons to environmental hypoxia: A review of physiological and ecological evidence, p. 61-78 In: R.V. Thurston (Ed.) Fish Physiology, Toxicology, and Water Quality. Proceedings of the Sixth International Symposium, La Paz, MX, 22-26 Jan. 2001. U.S. Environmental Protection Agency Office of Research and Development, Ecosystems Research Division, Athens, GA. EPA/600/R-02/097. 372 pp.

Smith, T.I.J., S.D. Lamprecht, and J.W. Hall. 1990. Evaluation of Tagging Techniques for Shortnose Sturgeon and Atlantic Sturgeon. American Fisheries Society Symposium 7:134-141.

Smith, T. I. J. and J. P. Clugston. 1997. Status and management of Atlantic sturgeon, *Acipenser oxyrinchus*, in *North America. Environmental Biology of Fishes* 48:335-346.

Snoddy, J.E. 2009. Physiological status and post-release mortality of sea turtles released from gillnets in the lower Cape Fear River, North Carolina. Master's Thesis. UNC-Wilmington.

Stanley, D.W. 1992. Historical trends: water quality and fisheries, Albemarle-Pamlico Sounds, with emphasis on the Pamlico River Estuary. University of North Carolina Sea Grant College Publication UNC-SG-92-04. Institute for Coastal and Marine Resources, East Carolina University, Greenville, NC. 215 pp.

Street, M.W., A.S. Deaton, W.S. Chappel and P.D. Mooreside. 2005. North Carolina Coastal Habitat Protection Plan. North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City. 630 pp.

TEWG. 1998. An assessment of the Kemp's ridley (*Lepicochelys kempii*) and loggerhead (*Caretta caretta*) sea turtle populations in the Western North Atlantic. NOAA Technical Memorandum NMFS-SEFSC-409. 96 pp.

The Nature Conservancy (TNC) and the Southeast Aquatic Resources Partnership. 2005. Conserving the Roanoke River. Conservation Action Plan. The Nature Conservancy, North Carolina Chapter, Durham, North Carolina. 61 pp.

USFWS 2009. Species Reports. Environmental Conservation Online System. http://www.fws.gov/endangered/wildlife.html#Species.

USGS 2010. Nonindigenous Aquatic Species Database; Center for Aquatic Resource Studies. <http://nas.er.usgs.gov/>.

USACOE. 2008. Dredging. <http://www.nap.usace.army.mil/dredge/d2.htm>

Waite, R., J. Giordano, M. Scully, K. Rowles, J. Steel, M.W. Rumley, T. Stroud, G. Stefanski, A. Coburn, L. Everett, L. Webb-Margeson, J. Chazal, L. Peck and N. Petrovich. 1994. Comprehensive Conservation and Management Plan, Technical Document, Albemarle-Pamlico Estuarine Study. North Carolina Department of Health and Natural Resources, Albemarle-Pamlico Estuary Study, Raleigh, and U.S. Environmental Protection Agency, Washington, D.C. 179 pp. + appendices.

Waring C. P. and A. Moore. 2004. The effect of atrazine on Atlantic salmon (*Salmo salar*) smolts in fresh water and after sea water transfer. *Aquatic Toxicology* 66:93-104.

Winger, P.V., P.J. Lasier, D.H. White, J.T. Seginak. 2000. Effects of contaminants in dredge material from the lower Savannah River. *Archives of Environmental Contamination and Toxicology* 38: 128-136.

Wydoski, R. and L. Emery. 1983. Tagging and marking. Pages 215-237 in: L.A. Nielson and D.L. Johnson (Eds.). *Fisheries Techniques*. American Fisheries Society, Bethesda, Maryland.

Appendix 1

Existing shortnose sturgeon research permits similar to the proposed action.			
Permit No.	**Location**	**Authorized Take**	**Research Activity**
10115 Expires: 8/3/2013	Saint Marys & Saltilla Rivers, FL & GA	85 adult/juv 20 ELS	Capture, handle, measure, weigh, PIT tag, tissue sample, collect ELS
14394 Expires: 9/30/14	Altamaha River and Estuary, GA	500 adult/juv. (1 lethal), 100 ELS	Capture, handle, weigh, measure, PIT tag, transmitter tag, tissue sample, anesthetize, laparoscopy, blood collection, fin ray section, collect ELS
10037 Expires: 4/30/2013	Ogeechee River and Estuary, GA	150 adult/juv. (2 lethal), 40 ELS	Capture, handle, measure, weigh, PIT tag, tissue sample, fin-ray section, anesthetize, laparoscopy, blood collection, radio tag, collect ELS
1447 Expires: 2/28/2012	S. Carolina Rivers and Estuaries	100 adult/juv. (2 lethal), 100 ELS	Capture, handle, measure, weigh, PIT and DART tag, transmitter tag, anesthetize, tissue sample, gastric lavage, collect ELS
1505 Expires: 5/15/2011	S. Carolina Rivers and Estuaries	98 adult/juv. (2 lethal), 200 ELS	Capture, handle, measure, weigh, PIT and DART tag, transmitter tag, anesthetize, laparoscopy, blood collection, tissue sample, gastric lavage, collect ELS
1542 Expires: 7/31/2011	Upper Santee River Basin, SC	5 adult/juv.; 100 ELS	Capture, handle, weigh, measure, PIT and dart tag, tissue sample, ELS collection
1543 Expires:11/30/2011	Upper Santee River Basin, SC	3 adult/juv.	Capture, handle, weigh, measure, tissue sample
14396 Expires: 12/31/2014	Delaware River and Estuary NJ & DE	100 adult/juv. (1 lethal),	Capture, handle, measure, weigh, Floy tag, PIT tag, tissue sample, anesthetize, ultrasonic tag,
14604 Expires: 4/19/2015	Delaware River and Estuary NJ & DE	1,000 adult/juv (1 lethal) 500 ELS	Capture, handle, weigh, measure, PIT tag, Floy tag, ultrasonic tag, tissue sample, anesthetize, laparoscopy, blood/biopsy collection, collect ELS
1547 Expires:10/31/2011	Hudson River, (Haverstraw & Newburgh), NY	500 adults/juv.	Capture, handle, weigh, measure, PIT & Carlin tag, tissue sample
1575 Expires11/30/2011	Hudson River (Tappan-Zee), NY	250 adult/juv.	Capture, handle, measure
1580 Expires: 3/31/2012	Hudson River and Estuary, NY	82 adult/juv.; 40 ELS	Capture, handle, measure, weigh, PIT tag, Carlin tag, photograph, tissue sample, collect ELS
1449 Expires: 3/31/2010	Upper Conn. River, MA	80 adult/juv.; 200 ELS	Capture, handle, measure, weigh, PIT tag, external radio tag, collect ELS
1549 Expires: 1/31/2012	Upper Conn. River, MA	673 adult/juv (5 lethal), 1,430 ELS from East Coast rivers	Capture, handle, measure, weigh, anesthetize, PIT tag, TIRIS tag, radio tag, temperature/depth tag, tissue sample, borescope, laboratory tests, photographs, collect ELS
1516 Expires: 5/15/2011	Lower Conn. River & Estuary., CT	500 adult/juv (2 lethal); 300 ELS	Capture, handle, measure, weigh, PIT tag, sonic/radio tag, gastric lavage, fin ray section, collect ELS
1578 Expires: 11/30/2011	Kennebec River and Estuary, ME	500 adult/juv.; 30 ELS	Capture, handle, measure, weigh, tissue sample, PIT tag, acoustic tag, anesthetize, collect ELS
1595-03 Expires: 3/31/2012	Penobscot River and Estuary, ME	200 adult/juv. (2 lethal); 50 ELS	Capture, handle, measure, weigh, borescope, photograph, tissue sample, blood sample, Carlin tag, PIT tag, anesthetize, transmitter tag, collect ELS

Appendix 2

Requested Annual Take

Species	**Life Stage**	**Sex**	**Expected Annual Take**	**Take Action**	**Location**
Shortnose sturgeon (*Acipenser brevirostrum*)	Juvenile & adult	Male & female	Up to 10 annually, or a total of 20 over 5yrs	Capture, hold, measure, weigh, photograph/video, Floy T-bar tag, PIT tag, & genetic tissue sample	Chowan River and all tributaries; NC/VA
Shortnose sturgeon (*Acipenser brevirostrum*)	Juvenile & Adult	Male & female	Up to 5 annually, or a total of 10 over 5 yrs	Capture, hold, measure, weigh, photograph/video, Floy T-bar tag, PIT tag, & genetic tissue sample; anesthetize w/ MS-222; & implant acoustic tag	Chowan River and all tributaries; NC/VA
Shortnose sturgeon (*Acipenser brevirostrum*)	Juvenile & Adult	Male & female	Up to 20 annually; or a total of 40 over 5 yrs	Capture, hold, measure, weigh, photograph/video, Floy T-bar tag, PIT tag, & genetic tissue sample	Roanoke River and all tributaries; NC
Shortnose sturgeon (*Acipenser brevirostrum*)	Juvenile & Adult	Male & female	Up to 5 annually; or a total of 10 over 5 yrs	Capture, hold, measure, weigh, photograph/video, Floy T-bar tag, PIT tag, & genetic tissue sample; anesthetize w/ MS-222; & implant acoustic tag	Roanoke River and all tributaries; NC
Shortnose sturgeon (*Acipenser brevirostrum*)	Juvenile & Adult	Male & female	Up to 10 annually, or a total of 20 over 5yrs	Capture, hold, measure, weigh, photograph/video, Floy T-bar tag, PIT tag, & genetic tissue sample	Cape Fear River and all tributaries; NC
Shortnose sturgeon (*Acipenser brevirostrum*)	Juvenile & Adult	Male & female	Up to 5 annually; or a total of 10 over 5 yrs	Capture, hold, measure, weigh, photograph/video, Floy T-bar tag, PIT tag, & genetic tissue sample; anesthetize w/ MS-222; & implant acoustic tag	Cape Fear River and all tributaries; NC
Shortnose sturgeon (*Acipenser brevirostrum*)	Juvenile & Adult	Male & female	Up to 10 annually, or a total of 20 over 5yrs	Capture, hold, measure, weigh, photograph/video, Floy T-bar tag, PIT tag, & genetic tissue sample	Albermarle Sound and all tributaries; NC
Shortnose sturgeon (*Acipenser brevirostrum*)	Juvenile & Adult	Male & female	Up to 5 annually; or a total of 10 over 5 yrs	Capture, hold, measure, weigh, photograph/video, Floy T-bar tag, PIT tag, & genetic tissue sample; anesthetize w/ MS-222; & implant acoustic tag	Albermarle Sound and all tributaries; NC

Appendix 3

Table 1. Species likely to be encountered as bycatch by proposed shortnose sturgeon gillnetting in Albemarle Sound and its tributaries (NCDMF 2010)

Common name	Scientific name
Bass, Striped	*Morone saxatilis*
Bass, Striped x White	*M. saxatilis x chrysops*
Bluefish	*Pomatomus saltatrix*
Bowfin	*Amia calva*
Carp, Common	*Cyprinus carpio*
Carp, Grass	*Ctenopharyngodon idella*
Catfish, Blue	*Ictalurus furcatus*
Catfish, Bullhead, Brown	*Ameiurus nebulosus*
Catfish, Bullhead, Yellow	*Ameiurus natalis*
Catfish, Channel	*Ictalurus punctatus*
Catfish, White	*Ameiurus catus*
Drum, Black	*Pogonias cromis*
Drum, Red	*Sciaenops ocellatus*
Eel, American	*Anguilla rostrata*
Flounder, Southern	*Paralichthys lethostigma*
Flounder, Summer	*Paralichthys dentatus*
Gar, Longnose	*Lepisosteus osseus*
Jack, Crevalle	*Caranx hippos*
Lamprey, Sea	*Petromyzon marinus*
Menhaden, Atlantic	*Brevoortia tyrannus*
Mullet, Striped	*Mugil cephalus*
Mullet, White	*Mugil curema*
Needlefish, Atlantic	*Strongylura marina*
Pickerel, Chain	*Esox niger*
Seatrout, Spotted	*Cynoscion nebulosus*
Seatrout, Weakfish	*Cynoscion regalis*
Shad, American	*Alosa sapidissima*
Shad, Gizzard	*Dorosoma cepedianum*
Shad, Hickory	*Alosa mediocris*
Sturgeon, Atlantic	*Acipenser oxyrhynchus*
Suckers	*Moxostoma sps.*
Crab, Blue	*Callinectes sapidus*
Crabs-Mud	*Xanthidae sps.*
Ctenophora	*Ctenophora sps.*
Jelly Fish	*Cnidaria sps.*

Table 2. Species likely to be encountered as bycatch by the proposed shortnose sturgeon gillnetting in the Cape Fear River Basin and its tributaries (NCDMF 2010).

Common name	**Scientific name**
Blue crab	*Callinectes sapidus*
Atlantic stingray	*Dasyatis sabina*
Atlantic sturgeon	*Acipenser oxyrhynchus*
Atlantic menhaden	*Brevoortia tyrannus*
Gizzard shad	*Dorosoma cepedianum*
American shad	*Alosa sapidissima*
hickory shad	*Alosa mediocris*
Common carp	*Cyprinus carpio*
Grass carp	*Ctenopharyngodon idella*
White catfish	*Ameiurus catus*
Blue catfish	*Ictalurus furcatus*
Channel catfish	*Ictalurus punctatus*
Flathead catfish	*Pylodictis olivaris*
Bluefish	*Pomatomus saltatrix*
Largemouth bass	*Micropterus salmoides*
Striped bass	*Morone saxatilis*
Hybrid striped bass	*Morone saxatilis x chrysops*
Spotted seatrout	*Cynoscion nebulosus*
Red drum	*Sciaenops ocellatus*
Southern flounder	*Paralichthys lethostigma*
Snapping turtle	*Chelydra serpentina*
Painted turtle	*Chrysemys picta*
Yellowbelly turtle	*Chrysemys scripta*

Table 3. Species likely to be encountered as bycatch in proposed shortnose sturgeon gillnetting in the Roanoke and Chowan River Basins (NCDMF 2010).

Common name	**Scientific name**
Alewife	*Alosa pseudoharengus*
Atlantic needlefish	*Strongylura marina*
American shad	*Alosa sapidissima*
Blueback herring	*Alosa aestivalis*
Blue catfish	*Ictalurus furcatus*
Black crappie	*Pomoxis nigromaculatus*
Bowfin	*Amia calva*
Common carp	*Cyprinus carpio*
Channel catfish	*Ictalurus punctatus*
Chain pickerel	*Esox niger*
American Eel	*Anguilla rostrata*
Gizzard shad	*Dorosoma cepedianum*
Hickory shad	*Alosa mediocris*
Hybrid striped bass	*M. chrysops X M. saxatilis*
Largemouth bass	*Micropterus salmoides*
Longnose gar	*Lepisosteus osseus*
Notchlip redhorse	*Moxostoma collapsum*
Redear Sunfish	*Lepomis microlophus*
Southern flounder	*Paralichthys lethostigma*
Shorthead redhorse	*Moxostoma macrolepidotum*
Striped bass	*Morone saxatalis*
Striped mullet	*Mugil cephalus*
White catfish	*Ameriurus catus*
White perch	*Morone americana*
Yellow perch	*Perca flavescens*

Appendix 4:

Manatee Sighting Report

Sighting Information

Date of Sighting:_____ Time of Sighting:_____

Number of Manatee:_____ Number of Calves (<4 ft):_____

Direction of Travel (check one): North South East West Stationary Unknown

Location (detailed description):

_____

Location Coordinates (decimal degrees):_____N _____W

Photos Taken: Yes No Type: Digital Prints Slides Video

Comments (behavior, was animal tagged, etc.; additional space on back):

_____

Contact Information

Date of Report: _____ Name:_____

Address or Affiliation:_____

Telephone:_____Email:_____

To Report any Gear or Vessel Interactions, or Sightings of Manatee – Contact: Nicole Adimey (USFWS) at 904-731-3079 (weekdays), fax 904-731-3045.

Report Dead or Injured Manatees Immediately – Contact: The University of North Carolina, Wilmington, Marine Mammal Stranding Program at (910) 254-5713; or NMFS Beaufort Laboratory Stranding Hotline, Beaufort, NC at 252-241-5119.