



DEC 21 2012

FINDING OF NO SIGNIFICANT IMPACT
on Issuance of an Incidental Take Permit (File No. 16645) to the Georgia Department of
Natural Resources for take of Shortnose and Atlantic Sturgeon in the Georgia
Commercial Shad Fishery

National Marine Fisheries Service

Background:

On March 6, 2012, the National Marine Fisheries Service (NMFS) received a complete application for an incidental take permit and associated Conservation Plan (File No. 16645) from the Georgia Department of Natural Resources (GA DNR), for the incidental take of endangered shortnose (*Acipenser brevirostrum*) and Atlantic sturgeon of all five Distinct Population Segments (*A. oxyrinchus*) associated with the otherwise lawful commercial shad fishery in Georgia.

In accordance with the National Environmental Policy Act, NMFS has prepared an Environmental Assessment (EA) analyzing the impacts on the human environment associated with the proposed action, which is to issue the incidental take permit with additional take limitations, conditions, and monitoring (*Environmental Assessment on the Effects of Issuing an Incidental Take Permit (No. 16645) to Georgia Department of Natural Resources for their Commercial Shad Fishery (EA)*). In addition, a Biological Opinion was issued under section 7 of the Endangered Species Act (ESA) (NMFS 2012) summarizing the results of an interagency consultation. The analyses in the EA, as informed by the Biological Opinion, support the following findings and determination. The EA is incorporated by reference in its entirety.

Analysis:

The National Oceanic and Atmospheric Administration's Administrative Order 216-6 (May 20, 1999) for implementing NEPA, contains criteria for determining the significance of the impacts of a proposed action. In addition, the Council on Environmental Quality (CEQ) NEPA implementing regulations at 40 C.F.R. 1508.27 state the significance of an action should be analyzed both in terms of "context" and "intensity." Each criterion listed below is relevant to making a finding of no significant impact and has been considered individually, as well as in combination with the others. The significance of this action is analyzed based on the NAO 216-6 criteria and CEQ's context and intensity criteria. These include:

(1) Can the proposed action reasonably be expected to cause substantial damage to the ocean and coastal habitats and/or essential fish habitat (EFH) as defined under the Magnuson - Stevens Act and identified in Fishery Management Plans?

Response: The proposed action is not expected to cause substantial damage to the ocean and coastal habitats and/or EFH. The proposed action would provide an exemption to the ESA take prohibitions for capturing shortnose and Atlantic sturgeon incidental to the otherwise lawful Georgia commercial shad fishery and would not alter or affect unique areas, including any components of EFH.



(2) Can the proposed action be expected to have a substantial impact on biodiversity and/or ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc.)?

Response: No substantial impacts on biodiversity or ecosystem function within the affected action areas are expected. The proposed action would provide an exemption to the ESA take prohibitions for capturing shortnose and Atlantic sturgeon incidental to the Georgia commercial shad fishery. The proposed action does not interfere with benthic productivity, predator-prey interactions, or other biodiversity or ecosystem functions. Georgia State regulations require that sturgeon taken in shad nets be released unharmed into the waters from which they were taken [O.C.G.A. § 27-4-71(g)]. A limited number of sturgeon mortalities are expected and would be authorized by the permit, but NMFS expects that these mortalities would not appreciably reduce the species likelihood of survival and recovery in the wild.

(3) Can the proposed action reasonably be expected to have a substantial adverse impact on public health or safety?

Response: The proposed action is not expected to have substantial adverse impacts on public health or safety because it would only provide an exemption to the ESA take prohibitions for capturing shortnose and Atlantic sturgeon incidental to the Georgia commercial shad fishery.

(4) Can the proposed action reasonably be expected to adversely affect endangered or threatened species, their critical habitat, marine mammals, or other non-target species?

Response: The proposed action would provide an exemption to the ESA take prohibitions for capturing ESA-listed shortnose and all listed DPSs of Atlantic sturgeon incidental to the Georgia commercial shad fishery, therefore endangered sturgeon could be affected. The Endangered Species Conservation Division consulted with NMFS Endangered Species Act Interagency Cooperation Division, which determined in its Biological Opinion that issuance of the permit is likely to adversely affect both Atlantic and shortnose sturgeon, but those effects are not likely to jeopardize the continued existence of NMFS ESA-listed species or to result in the destruction or adverse modification of designated critical habitat. The proposed action would not affect marine mammals or other non-target species.

(5) Are significant social or economic impacts interrelated with natural or physical environmental effects?

Response: There would be no significant social or economic impacts interrelated with significant natural or physical environmental effects. The State of GA, by regulation, has closed certain rivers and portions of rivers to commercial shad fishing. These closures resulted in minimal adverse socioeconomic impacts to participants in the fishery. The permit and conservation plan upon which it was based require continued closure consistent with those regulations. But NMFS does not anticipate any additional incremental impact resulting from issuance of the permit.

(6) Are the effects on the quality of the human environment likely to be highly controversial?

Response: A *Federal Register* notice (77 FR 21751) was published to provide the public the opportunity to review and comment on the proposed action. No public comments were received regarding effects of the proposed action on the human environment; therefore NMFS does not expect the issuance of the proposed permit to have highly controversial effects on the quality of the human environment. There is no substantial dispute as to the action's size, nature, or effect and there have been no substantial questions raised as to whether the permit may cause significant degradation of some human environmental factor.

(7) Can the proposed action be reasonably expected to result in substantial impacts to unique areas, such as historic or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers, essential fish habitat, or ecologically critical areas?

Response: The proposed action would provide an exemption to the ESA take prohibitions for capturing shortnose and Atlantic sturgeon incidental to the Georgia commercial shad fishery. The nature of the action is such that it would not result in substantial impacts to unique areas, such as historic or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers, EFH, or ecologically critical areas.

(8) Are the effects on the human environment likely to be highly uncertain or involve unique or unknown risks?

Response: The effects of the proposed action on the human environment would be limited to the shortnose and Atlantic sturgeon authorized to be taken incidental to the Georgia commercial shad fishery and those effects are not unique or unknown. The Endangered Species Conservation Division consulted with NMFS Endangered Species Act Interagency Cooperation Division, which determined in its Biological Opinion that issuance of the permit is not likely to jeopardize the continued existence of NMFS ESA-listed species or to result in the destruction or adverse modification of designated critical habitat. The Conservation Plan and permit rely on proven effective methods for monitoring, minimizing and mitigating the impacts of incidental take in a fishery.

(9) Is the proposed action related to other actions with individually insignificant, but cumulatively significant impacts?

Response: The proposed action is not related to other actions with individually insignificant, but cumulatively significant impacts. The short-term stresses (separately and cumulatively when added to other stresses Atlantic and shortnose sturgeon face in the environment) resulting from the research activities are expected to be minimal. The permit would contain conditions to mitigate adverse impacts to Atlantic and shortnose sturgeon from these activities.

A limited number of mortalities of incidentally captured Atlantic and shortnose sturgeon would be authorized. These takes would kill the individual; however NMFS does not anticipate that the loss of these animals would have a detectable effect on the numbers or reproduction of the affected populations. A limited number of mortalities would be authorized over a limited time period (i.e., the life of the permit).

Overall, the proposed action would be expected to have no more than minimal effects on endangered and threatened sturgeon species. The incremental impact of the action when added to other past, present, and reasonably foreseeable future actions discussed in the EA would be minimal and not significant.

(10) Is the proposed action likely to adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural or historical resources?

Response: The proposed action would provide an exemption to the ESA take prohibitions for capturing shortnose and Atlantic sturgeon incidental to the Georgia commercial shad fishery. The nature of the action is such that it would not result in effects to these areas or resources.

(11) Can the proposed action reasonably be expected to result in the introduction or spread of a non-indigenous species?

Response: The action would not introduce any species; therefore, it would not result in the introduction or spread of a non-indigenous species.

(12) Is the proposed action likely to establish a precedent for future actions with significant effects or represent a decision in principle about a future consideration?

Response: The decision to issue this permit would not be precedent setting and would not affect any future decisions. Issuing a permit to a specific individual or organization for a given activity does not in any way guarantee or imply that NMFS will authorize other individuals or organizations to conduct the same or similar activity.

(13) Can the proposed action reasonably be expected to threaten a violation of Federal, State, or local law or requirements imposed for the protection of the environment?

Response: The proposed action would provide an exemption to the ESA take prohibitions for capturing shortnose and Atlantic sturgeon incidental to the Georgia commercial shad fishery in accordance with the Endangered Species Act. The proposed action would not result in any violation of Federal state or local laws for environmental protection.

(14) Can the proposed action reasonably be expected to result in cumulative adverse effects having a substantial effect on the target species or non-target species?

Response: The action is not expected to result in any cumulative adverse effects to the species that are the subject of the proposed permit. The proposed action would be expected to have no more than minimal effects to sturgeon captured incidental to the fishery. A limited number of mortalities (2.3% of sturgeon captured incidental to set nets and 1% of sturgeon captured incidental to drift nets) would be authorized; however, NMFS anticipates that the removal of these small numbers of individuals is not likely to have a significant impact on the future spawning population size of shortnose or Atlantic sturgeon. The mortalities are authorized over a limited

time period with limits on the total level of take.

Based on the analysis in the EA and supported by the Biological Opinion, NMFS expects that issuance of the proposed incidental take permit 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 that issuance of the proposed permit would not affect reproductive sturgeon adults in a way appreciably reducing their reproductive success, survival of young, or the number of young annually recruiting into the breeding populations.

The incremental impact of the proposed authorization of takes of limited numbers of sturgeon incidental to the otherwise legal Georgia shad fishery, when added to other past, present, and reasonably foreseeable future actions, is not expected to result in population-level effects.

DETERMINATION

In view of the information presented in this document and the analyses contained in the EA prepared for issuance of the permit, pursuant to the ESA, and the ESA section 7 Biological Opinion, NMFS hereby determines that the issuance of Permit No. 16645 would not significantly impact the quality of the human environment as described above. In addition, all direct, indirect and cumulative beneficial and adverse impacts of the proposed action have been addressed in reaching the conclusion of no significant impacts. Accordingly, preparation of an Environment Impact Statement (EIS) for this action is not necessary.



Helen M. Golde
Acting Director
Office of Protected Resources

12/21/12
Date



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

Environmental Assessment

DEC 21 2012

on

the Effects of Issuing an Incidental Take Permit (No. 16645) to Georgia
Department of Natural Resources for their Commercial Shad Fishery

December 2012

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

Responsible Official: Helen M. Golde, Acting 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) 427-8403

Location: Savannah, Ogeechee, and Altamaha Rivers, Georgia

Abstract: The National Marine Fisheries Service (NMFS) proposes to issue an incidental take permit to the Georgia Department of Natural Resources, under Section 10(a)(1)(B) of the Endangered Species Act (ESA) of 1973 as amended (16 U.S.C. 1531 et seq.), and the regulations governing the incidental taking of endangered and threatened species (50 CFR 222.307). The permit would authorize the incidental capture, with a limited amount of harm and mortality, of endangered shortnose (*Acipenser brevirostrum*) and Atlantic sturgeon (*A. oxyrinchus*) from the South Atlantic Distinct Population Segment (DPS), Carolina DPS, Chesapeake Bay DPS, New York Bight DPS, and the threatened Gulf of Maine DPS and would be valid for ten years. The state of Georgia has amended their commercial fishing regulations for the Georgia shad fishery to minimize the incidental capture of sturgeon. The new regulations restrict fishing to the lower portions of the Savannah, Ogeechee, and Altamaha Rivers and close the fishery in the Satilla and St. Mary's Rivers. The Georgia Department of Natural Resources also submitted a completed application and conservation plan with additional measures intended to monitor, minimize, and mitigate the impacts of incidental take in the fishery to the maximum extent practicable.



Contents

1.0	Purpose of and Need for Action.....	3
2.0	Alternatives Including the Proposed Action	4
3.0	Affected Environment.....	13
4.0	Environmental Consequences	15
5.0	Mitigation Measures	25
6.0	ESA Section 7 Consultation	25
7.0	Public Review and Comment	25
8.0	List of Preparers and Agencies Consulted.....	26
9.0	Literature Cited	26

1.0 Purpose of and Need for Action

Proposed Action: The National Marine Fisheries Service (NMFS), Office of Protected Resources (NMFS PR) proposes to issue an incidental take permit to the Georgia Department of Natural Resources (GA DNR), under Section 10(a)(1)(B) of the Endangered Species Act (ESA) of 1973 as amended (16 U.S.C. 1531 et seq.), and the regulations governing the incidental taking of endangered and threatened species (50 CFR 222.307). Permit Number 16645 would be valid for ten years and would include take levels and monitoring requirements that differ from those requested in the GA DNR permit application.

Purpose of and Need for Action: Section 9(a)(1)(B) of the ESA prohibits “take¹” of endangered species with only a few specific exceptions. Incidental take permits authorize the take of endangered species if, among other things, the taking is incidental to, not the purpose of, an otherwise lawful activity; those takes will not jeopardize the endangered species; the applicant will to the maximum extent practicable monitor, minimize and mitigate the impacts of the taking; implement additional measures deemed necessary or appropriate by NMFS; and ensure adequate funding to implement its commitments under the conservation plan and permit.

The GA DNR implemented new commercial shad fishing regulations for the 2011 season. These regulations were designed to reduce the incidental capture of shortnose sturgeon and comply with mandates of Amendment 3 to the Atlantic States Marine Fisheries Commission’s (ASMFC) Interstate Fisheries Management Plan for Shad and River Herring while minimizing impacts to Georgia’s commercial shad fishery.

The regulations minimize incidental take of shortnose and Atlantic sturgeon, but it is still possible that sturgeon will be captured incidental to the fishery. The State of Georgia has therefore requested an incidental take permit from NMFS to provide an exemption to the ESA take prohibitions for the capture of shortnose and Atlantic sturgeon incidental to the Georgia commercial shad fishery.

Scope of Environmental Assessment (EA): This EA focuses on the effects of the proposed incidental take of shortnose and Atlantic sturgeon. The proposed take is described in the application and associated Conservation Plan submitted by GA DNR and later modified by GA DNR in consultation with NMFS. As required by regulations implementing Section 10(a)(1)(B) of the ESA, the Conservation Plan must, based on the best scientific and commercial data available, specify:

- the impact which will likely result from the taking;
- how the applicant will minimize and mitigate those impacts, and the funding available to implement;
- what alternative actions the applicant considered, and why those actions are not being pursued;
- other measures the Secretary of Commerce may require; and
- all sources of data relied on in preparing the plan.

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 proposed section 10(a)(1)(B) permit would authorize only the incidental take of Atlantic sturgeon from the South Atlantic Distinct Population Segment DPS, Carolina DPS, Chesapeake Bay DPS, New York Bight DPS, and the Gulf of Maine DPS and shortnose sturgeon and NMFS anticipates that the proposed action's effects would be limited to those species. This EA, therefore, focuses on the primary issue of environmental concern, the effects on those two species of NMFS issuance of the proposed incidental take permit subject to the measures included in the supporting conservation plan and permit.

2.0 Alternatives Including the Proposed Action

Background

In February 2010, the Atlantic States Marine Fisheries Commission (ASMFC), of which the State of Georgia is a member, approved and adopted Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring. The development of Amendment 3 was in response to the findings of the 2007 benchmark stock assessment for American shad, which indicates that Atlantic-Coast American shad stocks are currently at all-time lows. Amendment 3 has established a moratorium on commercial and recreational shad fishing in states along the Atlantic Coast unless it can be shown that a fishery is sustainable. All commercial and recreational shad fisheries must be closed by January 1, 2013, unless an approved sustainable fishing plan is in place. Federal law requires that states comply with the terms and conditions of interstate fishery management plans promulgated by ASMFC.

In addition, a recent 3-year study conducted by the University of Georgia revealed that endangered shortnose sturgeon are incidentally captured in certain types of commercial fishing gear used in the American shad fishery. In 2010 GA DNR published final regulations going into effect on the January 1, 2011 opening of the shad fishery to limit the times and areas on three rivers where the commercial shad fishery could occur. These regulations were designed, in part, to minimize the incidental capture of sturgeon in the shad fishery. The state of GA also prohibits fishing for and retaining both Atlantic and shortnose sturgeon.

Georgia shad fishery regulations

As described in the amended regulations (Appendix 1), the Georgia shad fishery would be open from January 1st to as late as April 30th each year. The season would typically end March 31st. Sturgeon, game fish other than American and hickory shad, and all species of catfish taken in shad nets must be released unharmed into the waters from which they were taken. A map of areas open to commercial shad fishing in Georgia is in Appendix 2.

The amended regulations prohibit commercial shad fishing:

- in the St. Marys and Satilla Rivers.
- on the Altamaha River above the U.S. Highway 1 bridge.
- on the Ogeechee River above the GA Highway 204 bridge.
- on the Savannah River above the U.S. Highway 301 bridge.

The amended regulations restrict commercial shad fishing:

- on the Savannah River to downstream of the U.S. Highway 301 bridge. The former boundary was at the mouths of Spirit and Brier creeks.
- on the Altamaha River to below the U.S. Highway 1 bridge. The former boundaries were on the Ocmulgee, Oconee and Ohoopsee Rivers. A small area eastward of the sound/beach boundary at the mouth of the main channel of the Altamaha River is also closed.
- on the Ogeechee River to downstream of the GA Highway 204 bridge.

Prior to 2011:

- the Savannah River could be fished downstream of Spirit Creek and Brier Creek.
- the Altamaha River could be fished downstream of the confluence of the Ocmulgee and Oconee Rivers.
- the Ogeechee River could be fished downstream of the Highway 78 bridge.

In all designated areas of the Savannah, Ogeechee, and Altamaha Rivers, hook and line fishing and trot lines can be used. In addition, drift or stationary gillnets of at least four and one-half inch stretched mesh can be used in various stretches of these rivers while following specific requirements:

- In the Ogeechee River only drift gillnets can be used.
- In the Altamaha River both set and drift gillnets can be used. Because the river is shallow and narrow upstream, set nets are used more often.
- In the Savannah River only drift gillnets can be fished downstream of a line between the mouth of Knoxboro Creek and McCoys Cut at Deadman's Point. Upstream of this location both set and drift gillnets can be used.
- Set nets must be placed at least 600 ft apart and are limited to 100 ft in length. All set nets must have one end secured to the stream's bank and be buoyed at the outer (streamward) end to be clearly visible to boaters.
- Set and drift nets must be situated so as to allow one-half the stream width to be open and free for the passage of fish.
- Drift nets must be at least 300 ft apart and are limited to 1,000 ft long in saltwaters.

Georgia regulations require commercial fishermen to complete trip tickets to document species, sex and pounds of shad harvested each day.

In addition to the information on shad harvest, trip tickets currently document the:

- fisherman's name and license number
- name of dealer that purchases fish
- river fished
- gear type (set or drift net)
- length of net
- total soak time
- number of net sets.

Fishermen and/or dealers are required to return completed trip tickets to the GA DNR by the 10th of each following month (i.e. January tickets would be due by February 10th).

This regulatory structure for the commercial shad fishery in the State of GA would be the same under all three alternatives described here.

Alternative 1 - No Action: Under the No Action alternative no permit would be issued for the incidental take of shortnose or Atlantic sturgeon. The GA DNR would not receive an exemption for the commercial shad fishery from the ESA prohibitions against take. While NMFS cannot know for certain what measures the State would implement absent the permit, we will assume for purposes of analysis in the EA that GA DNR would not likely implement the full suite of specific monitoring, minimization, and mitigation measures included in the proposed conservation plan and permit. In addition, it is possible that GA DNR would amend their commercial shad fishing regulations to be less restrictive than they are under the existing regulatory structure.

Alternative 2 - Issue Permit as Requested in Application: Under Alternative 2, a permit would be issued to exempt GA DNR from the ESA prohibition on taking Atlantic and shortnose sturgeon during the otherwise lawful commercial shad fishery. The permit would be valid for ten years and would require GA DNR to:

- continue to implement the commercial shad fishing regulations last amended on November 4, 2010. If the commercial shad fishing regulations are amended while this permit is active, GA DNR must work with NMFS to ensure that amended regulations are not less restrictive to the species covered by this permit.
- comply with the measures described in the associated conservation plan developed by the applicant and submitted with the original application to minimize and mitigate impacts of the incidental take of sturgeon (see *Monitoring* below) and with other measures deemed necessary or appropriate by NMFS.

Anticipated incidental take

Based on the best available data, results from Bahn and Peterson (2010) and GA DNR's commercial landings data, the applicant expects shortnose and Atlantic sturgeon to be incidentally captured. The majority of those incidentally captured sturgeon would be released live; 2.3% mortality is anticipated (Table 1). Bahn and Peterson's (2010) research analyzed the commercial shad set-net fishery in the Altamaha River from 2007-2009. Results indicated that during 2007-2008 the incidental capture rates of shortnose sturgeon in this fishery were relatively low, however, during 2009 incidental capture rates of shortnose sturgeon increased in the upper section of the Altamaha River. Factors such as the periodic spawning behavior of sturgeon, location of potential spawning sites in the upper section of river, and environmental conditions (i.e. water level), may have all contributed to the increase in catch rates observed in 2009. GA DNR used the incidental capture estimates from Bahn and Peterson (2010) and revised them based on expected reductions in incidental capture resulting from closing portions of each river.

The permit would exempt the incidental take of all lifestages of sturgeon (Table 1).

Table 1. Number of incidental captures, including live releases and mortalities, requested by the applicant.

Species	Maximum No. incidental captures (live release) per year/over 3 consecutive years			Maximum No. incidental mortalities per year/over 3 consecutive years ²		
	Altamaha River	Savannah River	Ogeechee River	Altamaha River	Savannah River	Ogeechee River
Sturgeon, shortnose	175 / 525	75 / 225	10 / 30	4 / 12	2 / 5	1 / 1
Sturgeon, Atlantic	140 / 420	50 / 150	10 / 30	3 / 10	1 / 3	1 / 1

Monitoring of incidental take

As described in the monitoring plan, part of the original Conservation Plan submitted by GA DNR (Appendix 3), GA DNR would use a combination of a trip ticket system and direct observations to monitor the incidental capture of sturgeon in the commercial shad fishery. Georgia regulations require commercial fishermen to complete trip tickets to document species, sex and pounds of shad harvested each day. Trip tickets also currently document the fisherman's name and license number, name of dealer that purchases fish, river fished, gear type (set or drift net), length of net, total soak time, and number of net sets.

If the permit as requested in the application is issued, GA DNR would implement the following measures to monitor, minimize and mitigate the impacts of incidental capture to Atlantic and shortnose sturgeon:

- Trip tickets would be modified to require fisherman to record information on incidental capture of shortnose and Atlantic sturgeon (total numbers of each species intercepted and released) and data would be utilized to monitor sturgeon interactions with the shad fishery.
- GA DNR would develop an informational packet on sturgeon identification, proper handling (emphasizing the importance of fishermen frequently checking their nets and immediately releasing any sturgeon that were incidentally captured), the biological and legal importance of reporting incidental capture of sturgeon, and on the importance of accurately recording sturgeon intercepts and returning the trip tickets in a timely manner, at least by the 10th of each following month.
- Prior to each shad fishing season, this informational packet would be provided to all known commercial shad fishermen. A list of names and addresses of commercial shad fishermen will be compiled from prior trip tickets, the commercial fishing license database, existing shad tagging study, and personal contacts to distribute this information.
- A set of trip tickets, self-addressed return envelopes, and information on how to obtain additional tickets would be provided to each known commercial shad fisherman.
- GA DNR Law Enforcement staff would be supplied additional trip tickets to provide to shad fishermen that are encountered on the river.

According to results reported by Bahn and Peterson (2010), direct observations of commercial shad fishing activities did not reveal statistically different rates of incidental capture of sturgeon than those obtained from voluntary log books that were provided to commercial shad fishermen.

² Based on estimated 2.3% mortality of incidentally captured sturgeon reported in Bahn and Peterson (2010).

However, GA DNR believes it is important to periodically observe commercial shad fishing activities. In order to efficiently complete direct observations, GA DNR staff will utilize the same list of names obtained from trip tickets, commercial fishing license database, and existing shad tagging study to establish contact information for a subset of individuals that commercially fish for shad on the Altamaha, Ogeechee, and Savannah rivers.

GA DNR staff will contact fishermen to determine when they will be actively fishing and establish a time and location to observe fishermen pulling their nets within 24-48 hours of notice. Numbers of direct observations for each river will be based on current shad fishing pressure and spawning migrations of shad and sturgeon. GADNR would observe a minimum of 10% of the commercial shad fishing trips on each river. The Ogeechee River has very low commercial shad fishing effort compared to the Altamaha and thus will have fewer direct observations, but GA DNR would attempt to observe at least two trips per year. Monthly observations within a river may also vary. Shad fishing pressure is typically lower on all three rivers in January than February-March because shad abundance is low early in the season. Therefore, the number of direct observations will likely be lower for January than the following months. Monitoring efforts will also be adaptive to the timing of the sturgeon spawning migration and numbers of sturgeon intercepts with direct observations increasing if high numbers of sturgeon intercepts are detected. Data collected from the trip tickets and direct observations will be summarized and provided to the National Marine Fisheries Service no later than the end of February, March, April, and May (if the season is open until the end of April) each year.

The permit would contain a condition requiring that GA DNR implement the mitigation and monitoring described in the Conservation Plan submitted with the original application to remain in compliance with the conditions of this permit. The permit condition would include requirements that GA DNR:

- Educating commercial shad fisherman on recording incidental captures of sturgeon, and identifying sturgeon species, proper handling of sturgeon.
- Collecting trip tickets from authorized commercial fishermen to monitor incidental captures of shortnose and Atlantic sturgeon.
- Conducting direct observations on a minimum of 10% of commercial shad fishing trips annually on each of the rivers where commercial shad fishing is authorized. Monitoring efforts will be adaptive to the timing of the sturgeon spawning migration and the number of observed sturgeon intercepts.
- Increasing law enforcement presence and educational efforts if unusually high sturgeon catch rates are observed.
- Evaluating modifications to the commercial shad fishing regulations for the next year if unusually high sturgeon catch rates are observed.

Alternative 3 - Issue Permit with Alternate Take Numbers and Additional Monitoring (Proposed Action):

Under Alternative 3, a permit would be issued as described in Alternative 2 with the following changes:

Alternate take numbers

The take numbers for the fishery described in the application were based on results from Bahn and Peterson (2010) and GA DNR's past commercial landings data. NMFS expects the number of sturgeon incidentally captured under the new fishing regulations to be lower than that calculated by GA DNR, and therefore the number of sturgeon authorized to be incidentally captured would be lower than that requested by GA DNR and described in Alternative 2, because the Conservation Plan submitted by GA DNR:

- includes closures to areas of the rivers that were open to shad fishing when those data were collected
- decreases the number of days per week that certain areas are open to fishing.

NMFS calculated the anticipated take numbers as follows:

Monitoring by the GA DNR revealed an average of 265 shad fishing trips were taken each year between 2001 and 2010. Bahn et al. (2012) estimated the number of upstream and downstream shortnose sturgeon caught annually was 71 (2007), 53 (2008), and 498 (2009). Of those fish captured during the three year intensive monitoring, 70% of the shortnose sturgeon captured in 2007 were in the lower river (45 individuals), 100% captured in 2008 were from the lower river (53 individuals), and 22% captured in 2009 were from the lower river (111 individuals). All but one individual over 3 years were adults.

Given the three years of lower river data, assuming a slight increase in lower river sampling to compensate for fishermen moving their effort downstream due to the upstream closure, one might expect 140 shortnose sturgeon to be incidentally captured in a year. Assuming 420 shortnose sturgeon will be captured in the Altamaha River during any three consecutive years to account for peak years and down years, we can estimate the number of shortnose sturgeon that will die as a result of this fishery. Mortality was estimated at 2.3% over a three year period, with the highest mortality in one year at 8% (Bahn et al. 2012), therefore the number of mortalities of incidentally captured shortnose sturgeon in the Altamaha River would be expected to be no more than 3 per year and 10 during any consecutive three year period.

The population of adult shortnose sturgeon in the Altamaha River is likely between 1,500 and 2,000 individuals. The Altamaha River is considered a source population for the Ogeechee sink population. The Savannah River population is also considered to be healthy and a source population for nearby smaller rivers. If we assume a consistent proportion of the adult population will be captured in the lower section of each river, we can use the known proportion of sturgeon caught in the lower Altamaha River (4.5-6%) to estimate the number of adult sturgeon captured in the Ogeechee and Savannah Rivers. This would estimate approximately 17-22 adult shortnose sturgeon captured annually in the Ogeechee River (estimate of 368 most recently by Peterson 2007). However, because the fishing season is approximately one fifth the length of the season in

the Altamaha, only 5 shortnose sturgeon would be expected to be captured each year. To account for potential variability in seasons, no more than 20 shortnose sturgeon are expected to be captured during any three consecutive years.

Collins and Smith (1993) caught 600 adults while monitoring the shad fishery between 1984 and 1992, or approximately 67 adults per year. This number is very nearly the same as would be estimated by a 6% catch rate of the adults using the Jolly-Seber upper population estimate of 1075, which would result in the capture of approximately 64.5. It is also very close to the expected catch rate using 4.5% catch rate of the Schnabel estimate of 1676, which would result in an estimate of 75. Therefore, it is reasonable to expect a three-year capture rate of approximately 210 adult shortnose sturgeon in the Savannah River.

Only six Atlantic sturgeon were caught in 3 years of monitoring set nets; however most Atlantic sturgeon would likely be encountered in the estuaries where drift nets are the only authorized form of fishing. Based on annual monitoring of the drift net fishery, GA DNR has annual catch estimates of Atlantic sturgeon from the estuaries. This monitoring reveals that approximately 140 Atlantic sturgeon are captured each year in the Altamaha River estuary. Therefore during any three-year period, NMFS would expect no more than 420 juvenile and sub-adult Atlantic sturgeon to be captured. An analysis of the Ogeechee estuary estimated that the Ogeechee River receives approximately 2% of the fishing pressure in the state. Because of that and the fact that the fishery is only open one day instead of two now, NMFS would expect approximately five Atlantic sturgeon to be captured each year and to account for variability between years, no more than 20 Atlantic sturgeon would be captured during any three consecutive years. In the Savannah River estuary, approximately 35 Atlantic sturgeon are expected to be captured each year based on annual surveys previously conducted by GA DNR. To account for potential peaks, no more than 110 Atlantic sturgeon are likely to be captured during any consecutive three year period. Based on mortality rates reported by shad fishermen and scientific researchers, approximately 1% of sturgeon caught in drift nets die, therefore NMFS anticipates that 1% of the Atlantic sturgeon incidentally captured would result in mortality (Table 2).

The permit would exempt the incidental take of all lifestages of sturgeon (Tables 2 and 3).

Table 2. Number of incidental captures, including live releases and mortalities, anticipated by NMFS.

Species	Maximum No. incidental captures (live release) per year/over 3 consecutive years/over the life of the permit			Maximum No. incidental mortalities per year/over 3 consecutive years ³ /over the life of the permit		
	Altamaha River	Savannah River	Ogeechee River	Altamaha River	Savannah River	Ogeechee River
Sturgeon, shortnose	140 / 420 / 1,680	70 / 210 / 840	5 / 20 / 80	3 / 8	2 / 6	1 / 1
Sturgeon, Atlantic ⁴	140 / 420 / 1,680	35 / 110 / 440	5 / 20 / 80	3 / 5	1 / 1	1 / 1

Additional monitoring

The monitoring plan submitted by GA DNR in their original application and described in Alternative 2 was modified by GA DNR during consultations with NMFS (Appendix 4). In addition to monitoring via trip tickets and direct observation of fisherman, GA DNR have proposed to set their own drift nets in the Altamaha River during the fishing season to monitor the shad run and approximate the rate of incidentally captured shortnose and Atlantic sturgeon. Nets would be 4.5-5 in stretch. GA DNR would generally monitor the shad run:

- 1 day per week the first 3 weeks in January.
- 2 days per week from late-January through mid-March.
- 1 day per week in late March when the shad run starts tapering off.

On average, 18 days of sampling during the shad spawning run would be expected. Records from the past 16 years of monitoring indicate that GA DNR captures an average of 6.4 Atlantic sturgeon and 6.8 shortnose sturgeon each year, with occasional years of higher-than-normal incidental captures. Based on this, the permit would authorize the capture of up to 10 shortnose and 10 Atlantic sturgeon during annual monitoring activities in the Altamaha River, with no more than 50 shortnose sturgeon and 50 Atlantic sturgeon captured during any three consecutive years (Table 3), in addition to the takes specified in Table 2. No mortalities are anticipated.

³ Shortnose sturgeon mortality rates are based on estimated 2.3% mortality of incidentally captured sturgeon reported in Bahn and Peterson (2012) for set nets and 1% mortality in drift nets, rounded to whole fish. Atlantic sturgeon mortality rates are based on 1% mortality observed in drift nets reported by shad fisherman and researchers, rounded to whole fish.

⁴ NMFS expects the maximum intercept rate for each Atlantic sturgeon DPS to be: South Atlantic DPS 95%; Chesapeake Bay DPS 20%; Carolina DPS 15%; New York Bight DPS 10%; and Gulf of Maine DPS 2% of the total number of incidental captures.

Table 3. Number of incidental captures, including live releases and mortalities, during GA DNR monitoring of the shad fishery. Note: Monitoring is proposed for only the Altamaha River. However, the Savannah and Ogeechee are included in the table in the event an incident occurs and triggers incident report permit condition.

Species	Maximum No. incidental captures (live release), with PIT tagging and genetic sampling of Atlantic sturgeon, per year/over 3 consecutive years/over the life of the permit			Maximum No. incidental mortalities per year/over 3 consecutive years/over the life of the permit		
	Altamaha River	Savannah River	Ogeechee River	Altamaha River	Savannah River	Ogeechee River
Sturgeon, shortnose	10 / 50 / 200	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
Sturgeon, Atlantic	10 / 50 / 200	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0

When captured by GA DNR during monitoring or by fisherman while being observed by GA DNR staff, Atlantic sturgeon would be weighed, measured, and scanned for existing passive integrated transponder (PIT) tags. A 1cm² portion of their pelvic fin would be removed for genetic analysis and a PIT tag would be inserted, if none is found when scanned, using the methods described in Kahn and Mohead (2010). Total handling time is expected to be approximately 5-10 min. The sturgeon would then be released alive. NMFS has determined that the additional monitoring for affected sturgeon species, consistent with the State’s past practices, including PIT tagging and tissue collection, is critical to understanding how take is occurring incidental to the covered activities under the proposed permit. NMFS therefore considers this take incidental to those otherwise lawful activities and would include it in the take authorized by the permit. It would require the monitoring as a mandatory measure in the conservation plan or the permit itself.

If the permit as described under Alternative 3 is issued, GA DNR would be required to implement the mitigation and monitoring described in the modified Conservation Plan submitted by GA DNR to remain in compliance with the conditions of this permit. This includes:

- Educating commercial shad fisherman on recording incidental captures of sturgeon, and identifying sturgeon species, proper handling of sturgeon.
- Collecting trip tickets from authorized commercial fishermen to monitor incidental captures of shortnose and Atlantic sturgeon.
- Conducting direct observations on a minimum of 10% of commercial shad fishing trips annually on each of the rivers where commercial shad fishing is authorized. Monitoring efforts will be adaptive to the timing of the sturgeon spawning migration and the number of observed sturgeon intercepts.
- Setting drift nets in the Altamaha River during the fishing season to monitor the shad run and approximate the rate of incidentally captured shortnose and Atlantic sturgeon.
- Using information from monitoring of the shad run to make adjustments to efforts to conduct direct observations of commercial shad fishing trips.

- Increasing law enforcement presence and educational efforts if unusually high sturgeon catch rates are observed.
- Evaluating modifications to the commercial shad fishing regulations for the next year if unusually high sturgeon catch rates are observed.
- Atlantic sturgeon incidentally captured by GA DNR staff must be PIT tagged and fin clipped as described in the monitoring plan, up to the limits in Table 2, before being released into the waters from which they were taken.
 - Extreme care must be used when collecting genetic samples. Instruments must be disinfected and gloves must be changed between each fish sampled to avoid possible disease transmission or cross contamination of genetic material.
 - Prior to placement of PIT tags, the entire dorsal surface of each fish must be scanned with a PIT tag reader to ensure detection of fish tagged in other studies. Previously tagged fish must not be retagged.
 - PIT tags must be inserted immediately anterior to the dorsal fin of the sturgeon.
 - PIT tags larger than 11.5 mm x 2.1 mm must not be inserted into juvenile shortnose sturgeon less than 330 mm in length.
 - Shortnose sturgeon less than 250 mm (10 inches) must not be tagged.

3.0 Affected Environment

Location

The action area is all portions of the Savannah, Ogeechee, and Altamaha Rivers open to commercial shad fishing. This includes:

- the Savannah River, from the mouth upstream to the Highway 301 bridge.
- the Ogeechee River, from the mouth upstream to the Highway 204 bridge.
- the Altamaha River, from the mouth upstream to the U.S. Highway 1 bridge, where it crosses the Altamaha and Ohoopsee Rivers.

A specific description of the areas open to commercial shad fishing is available in the Georgia commercial shad fishing regulations (Appendix 1).

In addition, the action area described in the Biological Opinion prepared for the proposed action is incorporated here by reference.

Status of Affected Species

Shortnose sturgeon: Shortnose sturgeon are listed as endangered under the ESA. Shortnose sturgeon occur in estuaries and rivers along the east coast of North America (Vladykov and Greeley 1963). Their northerly distribution extends 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).

Shortnose sturgeon spend most of their life in their natal river systems, only occasionally entering the marine environment. The species appears to be estuarine anadromous in the southern part of its range, but in some northern rivers, it is "freshwater amphidromous" (i.e., adults spawn in freshwater but regularly enter saltwater habitats during their life (Kieffer and

Kynard 1993). Adult sturgeon occurring in freshwater or freshwater/tidal reaches of rivers in summer and winter often occupy only a few short reaches of the total length (Buckley and Kynard 1985).

Shortnose sturgeon populations in the southeast are generally smaller than shortnose sturgeon populations in the northeast. The largest population of shortnose sturgeon in the southeast is in the Altamaha River, with an estimated abundance of 6,320 adults and juveniles (DeVries 2006). An estimated 328 shortnose sturgeon live in the Ogeechee River (Kirk 2008), though this may be a sink population for sturgeon from the Altamaha River. The Savannah River population is considered to be healthy and a source population for nearby smaller rivers. More information on shortnose sturgeon can be found at:

<http://www.nmfs.noaa.gov/pr/species/fish/shortnosesturgeon.htm>.

A more detailed description of the status of shortnose sturgeon is available in the Biological Opinion prepared for the proposed action, and is incorporated here by reference.

Atlantic sturgeon: Atlantic sturgeon are an anadromous and iteroparous fish that range from Newfoundland in Canada south to Florida. They are listed as five distinct population segments (DPSs): (1) the “Gulf of Maine (GOM) DPS” (*Threatened* in freshwater ranges), including Atlantic sturgeon originating from the Kennebec River and occurring in other GOM rivers; (2) the “New York Bight (NYB) DPS” (*Endangered*), including Atlantic sturgeon originating from the Hudson and Delaware Rivers; (3) the “Chesapeake Bay (CB) DPS” (*Endangered*), including Atlantic sturgeon originating from the James and York Rivers; (4) the “Carolina DPS” (*Endangered*), including all Atlantic sturgeon spawning in the watersheds from the Roanoke River, Virginia, southward along the southern Virginia, North Carolina, and South Carolina coastal areas to the Cooper River; and the (5) the “South Atlantic DPS” (*Endangered*), including all Atlantic sturgeon spawning in the watersheds of the ACE Basin in South Carolina to the St. Johns River, Florida. Further, the marine range of Atlantic sturgeon was found to contain individuals mixed from each of the defined population segments extending from the Bay of Fundy, Canada, to the Saint Johns River, Florida. All of the five DPSs may be affected by the commercial shad fishery in Georgia.

Detailed information on the status of Atlantic sturgeon, including information on population structuring, taxonomy and life history, distribution and abundance, and threats throughout each range, can be found in the Atlantic sturgeon status review (ASSRT 2007; www.nmfs.noaa.gov/pr/pdfs/statusreviews/atlanticsturgeon2007.pdf) and the regional proposed listings (75 FR 61904; www.nmfs.noaa.gov/pr/pdfs/fr/fr75-61904.pdf and 75 FR 61872; www.nmfs.noaa.gov/pr/pdfs/fr/fr75-61872.pdf).

A more detailed description of the status of all five DPSs of Atlantic sturgeon is available in the Biological Opinion prepared for the proposed action, and is incorporated here by reference.

No other species would be affected by issuance of the proposed permit to take sturgeon incidental to the legal shad fishery in Georgia.

4.0 Environmental Consequences

Effects Common to All Alternatives

The GA DNR implemented new commercial shad fishing regulations for the 2011 season. These regulations were designed, in part to minimize incidental capture of sturgeon in the commercial shad fishery and NMFS considers the new regulations to be part of the Conservation Plan and permit application submitted by GA DNR. Because the new regulations have already taken effect, the resulting beneficial effects to Atlantic and shortnose sturgeon by reducing the number of sturgeon that are incidentally captured in the Georgia commercial shad fishery would be the same under all Alternatives.

Negative effects would occur at the time when the Georgia shad fishery results in incidental takes of shortnose and Atlantic sturgeon, including live releases and mortalities. Adult shortnose sturgeon are vulnerable to incidental capture by the Georgia commercial shad fishery because their upstream spawning migration, from late January to March in southern rivers, coincides with the shad fishing season.

The new commercial shad regulations are anticipated to result in long-term beneficial effects to Atlantic and shortnose sturgeon by reducing the number of sturgeon that are incidentally captured in the Georgia commercial shad fishery. The reduction in the number of sturgeon that are incidentally captured would come from:

- Continued prohibition of commercial shad fishing:
 - in the St. Marys and Satilla Rivers.
 - on the Altamaha River above the U.S. Highway 1 bridge, closing commercial shad fishing on approximately 75% of the free flowing portions of the Altamaha River and its major tributaries (Ocmulgee and Oconee rivers). This would close the section of the river that had the highest bycatch rates of shortnose sturgeon in recent studies and is anticipated to decrease estimated sturgeon bycatch by up to 78% (Bahn and Peterson 2010). For example, Bahn and Peterson (2012) estimated that in 2009, the year with the highest incidental capture of shortnose sturgeon between 2007-2009, 387 of the 498 shortnose sturgeon estimated to have been captured were captured in the upper river.
 - on the Ogeechee River above the GA Highway 204 bridge, closing approximately 137 rkm or 66% of the river previously open to commercial fishing. The number of days that the Ogeechee River is open to commercial fishing would also be reduced by 50%, to one day per week, and gear would be limited to drift nets only, which are constantly monitored.
 - on the Savannah River above the U.S. Highway 301 bridge, which reduces the fishing area on the Savannah River to an area approximately 103 rkm or 35% smaller than previously open to commercial shad fishing. Closing the upper portion of the river is expected to decrease incidental bycatch and protect suspected spawning sites of shortnose sturgeon.

Incidental capture of sturgeon in the shad fishery might have negative impacts on the individuals captured. It is important to recognize that an adverse effect on a single individual or a small group of animals does not translate into an adverse effect on the population or species unless it

results in reduced reproduction or survival of the individual(s) that causes an appreciable reduction in the likelihood of survival or recovery for the species. In order for the proposed action to have an adverse effect on a species, the take of individual animals by the fishery would first have to result in:

- direct mortality,
- serious injury that would lead to mortality, or
- disruption of essential behaviors such as feeding or spawning, to a degree that the individual's likelihood of successful reproduction or survival was substantially reduced.

That mortality or reduction in the individual's likelihood of successful reproduction or survival would then have to result in a net reduction in the number of individuals of the species. In other words, the loss of the individual or its future offspring would not be offset by the addition, through birth or emigration, of other individuals into the population. That net loss to the species would have to be reasonably expected, directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of the listed species in the wild.

Some individuals would be incidentally captured in the shad fishery; 2.3% of sturgeon incidentally captured in set nets are expected to result in mortality (Bahn and Peterson 2012). This 2.3% mortality rate takes into account the potential for occasional years with higher sturgeon mortality, such as the 8% mortality rate observed in 2007 in the Altamaha River by Bahn and Peterson (2012). The proposed take numbers account for the variability between years by using three-year averages. Based on mortality rates reported by shad fishermen and scientific researchers, approximately 1% of sturgeon caught in drift nets die. In addition to the captures that are expected to result in known mortalities, an unknown proportion of the Atlantic and shortnose sturgeon that are released alive during any consecutive three year period will succumb to post-release mortality or sub-lethal effects resulting in aborted spawning runs or failed reproductive efforts.

The effects of incidental capture of sturgeon in the shad fishery are expected to be similar to the effects of capture of sturgeon for research purposes using drift and anchored gillnets. Entanglement in nets could result in injury and mortality, reduced fecundity, and delayed or aborted spawning migrations of sturgeon (Moser and Ross 1995, Collins *et al.* 2000, Moser *et al.* 2000). Also, during periods of warm water or low dissolved oxygen, fish have been lethally stressed (Hastings *et al.* 1987, Secor and Gunderson 1998).

As described in the Biological Opinion prepared for the proposed action and incorporated here by reference, handling and restraining sturgeon may cause short-term stress responses, but those responses are not expected to result in pathologies because commercial fishermen release sturgeon immediately after they are removed from their nets. Sturgeon may inflate their swim bladder when held out of water (Moser *et al.* 2000) and if they are not returned to neutral buoyancy prior to release, they will float and be susceptible to sunburn and predation. Collins *et al.* (1996) note that as much as 20% of the shortnose sturgeon bycatch in the shad fishery are injured during capture. Bahn *et al.* (2012) discussed post-release mortality without mentioning any injuries; therefore, we assume there were likely no injuries observed because they would have been important in the post-release mortality discussion. We anticipate the number of sturgeon injured as bycatch to be between the number observed in South Carolina (20%) and the

number reported during monitoring of the Altamaha River (0%), resulting in no more than 10% of the sturgeon bycatch being injured.

Under some conditions, pre-spawning adults will interrupt or abandon their spawning migrations after being handled (Moser and Ross 1995). However, spawning shortnose and Atlantic sturgeon are not likely to be intercepted by the fishery because of the size gillnets used, the timing, and the location of the nets. Pre-spawn shortnose sturgeon move upstream to spawning grounds before the shad season begins (Bahn *et al.* 2012). The adult shortnose sturgeon that are captured during the shad season are therefore non-reproductive or post reproductive individuals. Only juvenile or sub-adult Atlantic sturgeon would be captured by the shad fishery due to the small mesh sizes used in the shad fishery.

Dissolved Oxygen, Temperature, and Salinity

For all sturgeon species, research has revealed that survival is affected by a relationship between temperature, dissolved oxygen, and salinity. Jenkins *et al.* (1993), Secor and Gunderson (1998), Niklitschek (2001), Secor and Niklitschek (2001 and 2002), and Niklitschek and Secor (2009a and 2009b) demonstrated shortnose and Atlantic sturgeon survival in a laboratory setting was affected by reduced dissolved oxygen, increased temperature, or increased salinity. Other researchers have demonstrated similar relationships between temperature, dissolved oxygen, and salinity in green sturgeon (Van Eenennaam *et al.* 2005, Allen *et al.* 2006, Allen and Cech 2007). Likewise, Altinok *et al.* (1998), Sulak and Clugston (1998), Sulak and Clugston (1999), and Waldman *et al.* (2002) reported high temperatures, low DO, and high salinities result in lower survival of Gulf sturgeon.

Considerable work has been conducted on temperature tolerances of sturgeon (Wang *et al.* 1985, Wehrly 1995, Kynard 1997, Campbell and Goodman 2004, Cech and Doroshov 2004, Van Eenennaam *et al.* 2005, Ziegeweid *et al.* 2007, Sardella *et al.* 2008). In recent work on critical thermal maximum, Ziegeweid *et al.* (2007) demonstrated hatchery-raised young of year shortnose sturgeon can tolerate between 28° and 30°C, while the maximum safe temperature limits for adults ranges between 28° and 31°C. Kynard (1997) also notes empirical temperatures of 28° to 30°C in summer months creates unsuitable shortnose sturgeon habitat. Atlantic sturgeon experience lower survival when water temperatures exceed 28°C (Niklitschek and Secor 2005). Mayfield and Cech (2004) estimated the lethal water temperature for green sturgeon in the wild at 27°C. The water temperature in the action area ranges from 8°C to 18°C (GA DNR, pers. comm.) during the winter shad fishing season; therefore incidentally captured sturgeon are not expected to be affected by high temperatures.

There is no clear evidence to suggest minimum water temperatures negatively affect sturgeon when captured beyond the early life stages. However, when air temperatures are below freezing, sturgeon handling protocols for researchers recommend that handling be limited to less than two minutes to prevent exposure of a sturgeon's skin to freezing temperatures (Kahn and Mohead 2010). Air temperatures in Georgia generally range from 39°C to 62°C during the shad fishing season; therefore incidentally captured sturgeon are not expected to be affected by freezing air temperatures.

Because warm water can hold less dissolved oxygen, percent oxygen saturation is a measurement that accounts for water temperatures and dissolved oxygen concentrations, providing a general index of how much dissolved oxygen is available to sturgeon under various environmental conditions. The 24 hour dissolved oxygen concentration lethal to 50% of the test fish (LC50) for shortnose sturgeon is documented between 2.2 and 3.1 mg/L at temperatures ranging from 22°C to 29°C (Campbell and Goodman 2004) and between 4.3 and 4.7 mg/L shortnose and Atlantic sturgeon at temperatures ranging from 22° and 27°C, respectively (Secor and Niklitschek 2002). Further, acute lethal effects to shortnose and Atlantic sturgeon were observed when DO was 3.3 mg/L at temperatures between 22° and 27°C (Secor and Niklitschek 2002). Survival of Atlantic sturgeon was observed to be 100% in water temperatures of 26°C with 7 mg/L dissolved oxygen; however, 12% survival was observed in waters with 3 mg/L dissolved oxygen at the same temperature (Secor and Gunderson 1998). Even when water temperatures were only 19°C and dissolved oxygen was 3 mg/L, 25% of the Atlantic sturgeon died. Jenkins *et al.* (1993) confirmed 12% mortality for 339 mm juvenile sturgeon when held at 2.5 mg/L dissolved oxygen and 22.5°C, while no sturgeon died when dissolved oxygen was above 4 mg/L at any temperature. Likewise, Secor and Gunderson (1998) found the dissolved oxygen level required avoiding mortality was 5 mg/L. Hypoxia for many *Acipenser* species has been documented to begin at 4 mg/L (Cech *et al.* 1984, Jenkins *et al.* 1993, Secor and Gunderson 1998). Similarly, Cech and Crocker (2002) identified hypoxia for sturgeon as 58% oxygen saturation.

NMFS recognizes that there are synergistic effects of water temperature and dissolved oxygen, but it is clear from reported empirical catch data and scientific literature that higher temperatures and lower dissolved oxygen levels stress sturgeon; even if the percent oxygen saturation remains constant or increases, water temperature and dissolved oxygen can be responsible for mortality events. Each individual sturgeon will react differently to changes in environmental conditions such as water quality, salinity, and stress associated with incidental capture. Because the Georgia shad fishery takes place from January to March, with potential extension to April, water temperatures would be colder than the temperatures described above; therefore NMFS does not anticipate a high mortality rate based on high temperatures and low dissolved oxygen concentration.

Given the implications of water temperature, dissolved oxygen, and percent oxygen saturation, both soak times and mesh size of gillnets are important factors in the survival of incidentally captured sturgeon. Mesh size that is too small for the targeted life stage is more likely to constrict gills resulting in mortality via suffocation. Therefore, NMFS recommendations for researchers intentionally capturing sturgeon indicate mesh size for gill netting sturgeon should be carefully considered and appropriate for the species and life stage targeted (Kahn and Mohead 2010). For example, due to disproportionately high reports of mortality using ten inch stretch mesh with Atlantic sturgeon (Balazik *et al.* 2009), NMFS recommends this size mesh not be used to sample adult Atlantic or Gulf sturgeon (Kahn and Mohead 2010). Georgia State regulations for commercial shad fishing require that nets be at least 4 ½ inch stretch mesh.

Safe net soak times are influenced by water temperature, dissolved oxygen, and, to a lesser extent, salinity. While there are no publications documenting the effects of soak times on mortality rates of sturgeon, there is consensus among sturgeon researchers that shorter soak times are safer than longer soak times (Mark Collins, South Carolina Department of Natural Resources; Matt Fisher, Delaware Division of Fish and Wildlife; Dewayne Fox, Delaware State

University; Chris Hager, Virginia Institute of Marine Science; Doug Peterson, University of Georgia; William Post, South Carolina Department of Natural Resources; Mike Randall, United States Geological Survey (USGS); and Ken Sulak, USGS, pers. comm.).

Georgia State regulations allow commercial shad fishing:

- Tuesday through Friday on the Savannah River system downstream from the I-95 bridge. Nets could be set for up to four consecutive days.
- Wednesday through Saturday on the Savannah River system upstream from the I-95 bridge. Nets could be set for up to four consecutive days.
- Friday on the Ogeechee River system. Nets would only be set for one day.
- Monday through Friday on the Altamaha river system downstream from the Seaboard Coastline Railroad bridge. Nets could be set for up to five consecutive days.
- Tuesday through Saturday on the Altamaha river system upstream from the Seaboard Coastline Railroad bridge. Nets could be set for up to five consecutive days.

NMFS recommends maximum net set durations at certain water temperatures for intentional capture of sturgeon during research (Table 4; Kahn and Mohead 2010). Mortalities have been documented in the empirical records of researchers while fishing above 20°C at net set durations ranging from 45 minutes to 24 hours. Commercial shad fishermen in Georgia generally check their nets once a day on days when shad fishing is allowed; therefore if sturgeon are incidentally caught in stationary gillnets, NMFS expects they would be released within 24 hours. Water temperatures in the Savannah, Ogeechee, and Altamaha River systems from January 1 to April 30 would be between 8°C to 18°C (GA DNR, pers. comm.), therefore NMFS expects minimal mortality, estimated at 2.3%, of incidentally captured sturgeon.

Table 4. Appropriate fishing protocols for Gulf, Atlantic, and shortnose sturgeon.

Net set duration (hours)	Temperature at sampling depth	Minimum DO at sampling depth	% oxygen saturation at sampling depth
14 [†]	Up to 15°C	4.5 mg/L	55%
4	15° to 20°C	4.5 mg/L	55%
2	20° to 25°C	4.5 mg/L	55%
1	25° to 28°C	4.5 mg/L	55%
No sampling	Over 28°C	4.5 mg/L	55%

[†] Net set duration for Gulf sturgeon should not exceed four hours for all temperatures up to 20°C.

When following the protocols in Table 4 between 2005 and 2009, East Coast sturgeon researchers recorded over 3,800 captures of shortnose sturgeon resulting in no mortality. However, while fishing outside of these recommended criteria, the same researchers experienced a 0.6% mortality rate of captured shortnose sturgeon.

When drift gillnetting, nets are allowed to drift on the rising tide or in slack tide until just after high tide for approximately thirty minutes to several hours, depending on the location and swiftness of the tide. Drift nets are tended constantly because of the risk of gear entanglement or

loss of gear resulting in ghost nets; therefore NMFS expects limited incidental capture and minimal mortality in drift gill nets.

Bahn and Peterson (2012) found that only 4 of 172 (2.3%) shortnose sturgeon captured in commercial gill nets in the Altamaha River from 2007 to 2009 were dead when the net was retrieved. Mortality rates due to netting activities in NMFS-permitted research ranged from 0 to 1.22% prior to 2004. Of the total 5,911 shortnose sturgeon captured by gill nets or trammel nets, 23 died, yielding an average incidental mortality rate of 0.39%. Under Permit Number 1247, about 4 to 7% of the shortnose sturgeon captured died in gillnets prior to 1999, although between 1999 and 2005, none of the more than 600 shortnose sturgeon that were gillnetted died as a result of their capture. Under Permit Number 1174, all seven of the reported shortnose sturgeon mortalities occurred during one sampling event. Moser and Ross (1995) reported gill net mortalities approached 25% when water temperatures exceeded 28°C even though soak times were often less than 4 hours. The primary causes of mortality identified during a review of all permits issued prior to 2005 were due to high water temperature, low D.O. concentration, and extended net set duration. Because the Georgia shad fishery takes place from January to March, with potential extension to April, water temperatures would be colder than the temperatures described above; therefore NMFS does not anticipate a mortality rate of more than 2.3% of incidentally captured sturgeon based on high temperatures and low dissolved oxygen concentration.

Because the new commercial shad fishery regulations went into effect for the 2011 fishing season, burdens to licensed commercial shad fishermen resulting from closing specific parts of the river exist under all alternatives. GA DNR considered economic impacts to commercial shad fishermen while reviewing options to amend their regulations. Therefore, this alternative is expected to have minimal socio-economic impacts.

Effects of the No Action Alternative

In this EA, NMFS will assume for the No Action Alternative that the status quo would largely be maintained for the fishery. Because no incidental take permit would be issued, GA DNR would not receive an exemption from the ESA prohibitions against take, therefore any incidental takes of sturgeon resulting from the Georgia commercial shad fishery would not be exempted. Any incidental takes of sturgeon would result in the effects described in the “Effects Common to All Alternatives” section.

While NMFS cannot know for certain what measures the State would implement absent the permit, we will assume for purposes of analysis in the EA that the full suite of measures to monitor, minimize, and mitigate the impact of incidental take under the proposed conservation plan and permit would not likely be implemented. Thus, the overall beneficial effects expected for the species from implementing that full suite of measures would not be achieved. In addition, it is possible that GA DNR would amend their commercial shad fishing regulations to be less restrictive than they are under the existing regulatory structure. The shad fishery would thus continue to result in adverse effects to sturgeon species at levels commensurate with the fishery as operated under its past or current regulatory structure.

To the extent that this alternative would limit additional burdens on licensed commercial shad fishermen (e.g. avoiding additional reporting requirements, education etc.), the No Action Alternative would have less of a socio-economic impact than the two action alternatives.

Effects of Issuing the Permit as Requested in the Application

The issue most relevant to this analysis is the potential for impacts on the incidentally captured sturgeon. Implementation of Alternative 2 has the potential to result in both positive and negative effects on the target species. In addition to the effects described in the “Effects Common to All Alternatives” section, positive effects to the sturgeon species would occur upon implementation of the Conservation Plan and compliance with the terms and conditions of the permit.

Implementation of the proposed mitigation and monitoring measures would provide education to commercial shad fisherman on identification of sturgeon species; proper handling techniques to minimize impacts to incidentally captured sturgeon, including the importance of frequently checking nets and immediately releasing sturgeon that were incidentally captured; the biological and legal importance of reporting incidental capture of sturgeon; and the importance of accurately recording sturgeon intercepts and returning the trip tickets in a timely manner.

The combination of a trip ticket system (i.e., self-reporting of incidental sturgeon capture by fishermen) and direct observations to monitor the incidental capture of sturgeon in the commercial shad fishery would result in GA DNR better tracking incidental captures of ESA-listed sturgeon in the commercial shad fishery, compared to the No Action alternative. In turn, GA DNR would report incidental captures to NMFS, resulting in a better understanding of the number of ESA-listed sturgeon being taken by the commercial shad fishery.

Issuance of the proposed permit would not interfere with benthic productivity, predator-prey interactions, or other biodiversity or ecosystem functions. Georgia State regulations require that sturgeon taken in shad nets be released unharmed into the waters from which they were taken [O.C.G.A. § 27-4-71(g)]. Thus, effects on biodiversity and ecosystem function are not anticipated. A limited number of sturgeon mortalities are expected and would be authorized by the permit, but NMFS expects that these mortalities would not appreciably reduce the species likelihood of survival and recovery in the wild.

Issuance of the proposed permit would not involve alteration of substrate, movement of water or air masses, or other interactions with physical features of ocean and coastal habitat. Thus, effects on habitat are not anticipated.

Issuance of the proposed permit would not occur in or indirectly affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or cause loss or destruction of significant scientific, cultural or historical resources or preclude their availability for other scientific, cultural, or historic uses. Thus, effects on such unique areas are not anticipated.

To the extent that this alternative would result in additional burdens to licensed commercial shad fishermen, fishermen would be provided with educational materials by GA DNR so that they

could more accurately report sturgeon captures to GA DNR and learn to properly handle incidentally captured sturgeon to minimize impacts. The additional information sturgeon (total numbers of Atlantic and shortnose sturgeon intercepted and released) fishermen would provide in trip tickets already required by the fishery is expected to require minimal time and effort. The time and effort spent by GA DNR compiling information in trip tickets and reporting to NMFS, as required by the permit, is also expected to be minimal. Therefore, this alternative is expected to have minimal socio-economic impacts.

Effects of Alternative 3 (Proposed Action)

The issue most relevant to this analysis is the potential for impacts on incidentally captured sturgeon. Implementation of Alternative 3 has the potential to result in both positive and negative effects on the target species. In addition to the effects described in the “Effects Common to All Alternatives” section, positive effects would occur upon implementation of the Conservation Plan and compliance with the terms and conditions of the permit. The effects of the education, trip tickets, and direct observations of the commercial shad fishery would be the same as described above in the “Effects of Issuing the Permit as Requested in the Application” section.

This alternative would result in a lower number of takes authorized by the proposed permit for Atlantic and shortnose sturgeon than in Alternative 2. NMFS believes that, because the new regulations to minimize incidental captures of sturgeon have already gone into effect, the number of takes resulting from the fishery would be lower than those requested by GA DNR in their application.

In addition to the effects already discussed, GA DNR would potentially incidentally capture sturgeon while monitoring the shad run using drift nets. Captured individuals would be PIT tagged and a 1cm² portion of their pelvic fin removed for genetic analysis using the methods described in Kahn and Mohead (2010). Total handling time is expected to be approximately 5-10 min. The sturgeon would then be released alive.

Effects of PIT Tagging

PIT tags ensure unique identification upon capture or recapture for population and growth estimates. To avoid duplicate tagging, all sturgeon would be scanned with a PIT tag reader prior to the insertion of a PIT tag. Tagging procedures could result in stress during restraint and minor wounds from insertion. PIT tag use is not known to have any other direct or indirect effects on sturgeon when tags are appropriately sized and inserted correctly. There has been reported shortnose sturgeon mortality as a result of PIT tags being too large for the fish or inserted too deeply. Henne et al. (2003) found that 14mm tags inserted into smaller shortnose sturgeon (150 to 220 mm total length TL) caused 40% mortality after 48 hours; however, no mortality occurred in a larger group of juvenile sturgeon measuring 250 to 330 mm TL using smaller 11.5mm PIT tags. Therefore, to address these concerns, permit conditions would restrict GA DNR from PIT tagging sturgeon <250mm TL, the same size animals that have been authorized to be tagged for over 10 years in prior permits resulting in no mortality. As such, the tagging of Atlantic sturgeon with PIT tags is unlikely to have significant adverse impacts on sturgeon.

Effects of Genetic Tissue Sampling

Collection of a small (1 cm²) genetic tissue sample, clipped with surgical scissors from a section of soft fin rays of incidentally captured sturgeon, does not appear to impair the sturgeon's ability to swim and is not thought to have any long-term adverse impact (Kahn and Mohead 2010). Many researchers have removed tissue samples according to this same protocol reporting no adverse effects; therefore NMFS does not anticipate any long-term adverse effects to the sturgeon from this activity.

NMFS believes these additional monitoring measures are important to properly evaluate and predict incidental take authorized under the permit. The additional monitoring would have beneficial effects in addition to those described in Alternatives 1 and 2.

A consultation with NMFS' Endangered Species Act Interagency Cooperation Division under section 7 of the ESA resulted in the determination, described in its Biological Opinion and incorporated here by reference, that issuance of the permit and the resulting authorized take of Atlantic and shortnose sturgeon is not likely to jeopardize the continued existence of NMFS ESA-listed species or to result in the destruction or adverse modification of designated critical habitat.

To the extent that this alternative would result in additional burdens to licensed commercial shad fishermen, there would be no additional burdens to those described in Alternative 2. The time and effort spent by GA DNR PIT tagging and collecting genetic samples from sturgeon captured incidental to their shad run monitoring activities and reporting these additional activities to NMFS, as required by the permit, is also expected to be minimal. The cost of analyzing genetic samples is expected to be minimal over the life of the permit and is part of the assurance for funding provided by GA DNR in their application and conservation plan. Therefore, this alternative is expected to have minimal socio-economic impacts.

Cumulative Impacts

Cumulative effects are defined those that result from incremental impacts of a proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of which agency (federal or nonfederal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions that take place over a period of time.

Historically, one of the major contributors to declines in sturgeon populations was commercial harvest. A coast-wide moratorium on harvesting Atlantic sturgeon was implemented in 1998 pursuant to Amendment 1 of the Atlantic States Marine Fisheries Commission's (ASMFC) Interstate Fishery Management Plan for Atlantic sturgeon (ASMFC, 1998). Retention of Atlantic sturgeon from the U.S. Exclusive Economic Zone (EEZ) was prohibited by NMFS in 1999 (64 FR 9449; February 26, 1999). However, despite these prohibitions on directed fishing for and retention of incidentally caught Atlantic sturgeon, other anthropogenic activities continue to take Atlantic sturgeon. These include incidental bycatch in commercial fisheries, vessel strikes, activities affecting water quality, and habitat disturbances such as dredging.

Today, sturgeon may be adversely affected by human activities including incidental capture and poaching, ship strikes, artificial propagation, dams, dredging and blasting, poor water quality, and contaminants. For all of these activities, lethal takes of sturgeon and the disturbance

resulting in displacement of animals or abandonment of behaviors such as feeding or breeding by groups of animals are possible and may have cumulative effects on the species.

Shortnose and Atlantic sturgeon have been the focus of field studies for decades. Over time, NMFS has issued dozens of permits for takes of 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 have been conditioned with mitigation measures to ensure that the research impacts target and non-target species as minimally as possible.

Range wide, there are currently 13 active scientific research permits targeting wild shortnose sturgeon populations and 12 permits for Atlantic sturgeon research occurring in similar or overlapping action areas. A biological opinion was issued for each of these actions, including the requirement for consideration of cumulative effects to the species (as defined for ESA). For each of the actions, the biological opinion concluded that issuance, as conditioned, would not likely jeopardize the continued existence of the species studied, either individually or cumulatively.

Conclusion and Summary of Cumulative Effects

Overall, the preferred alternative would not be expected to have more than short-term adverse effects on shortnose and Atlantic sturgeon that are captured and released alive. The impacts of incidental capture and release are not expected to have more than short-term adverse 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 would be expected because the increase in stress levels from the previous capture should have already dissipated.

NMFS anticipates a mortality rate of 2.3% of sturgeon incidentally captured in set nets and 1% of sturgeon incidentally captured in drift nets, and the proposed permit would authorize small numbers of mortalities (Table 2). The Altamaha River has a population of approximately 6,300 shortnose sturgeon, of which, NMFS believes as many as 3, or 0.05% of that population would die each year as a result of incidental capture in the fishery. The Ogeechee has a population of approximately 370 shortnose sturgeon, of which NMFS believes no more than 1, or 0.27% of the population, would die each year as a result of incidental capture in the fishery. The Savannah River has a shortnose sturgeon population of approximately 1,000 shortnose sturgeon, of which NMFS believes as many as 2, or 0.2% of that population, would die each year as a result of incidental capture in the fishery. An unknown proportion of shortnose sturgeon that are released alive could die after release.

The estimated juvenile abundance of Atlantic sturgeon in the Altamaha River is approximately 2,000 (Schueller and Peterson 2010), and this is believed to be the largest Atlantic sturgeon population in the state of Georgia. NMFS believes up to 3, or 0.15% of that population, would die each year as a result of incidental capture in the fishery.

The size of the Ogeechee and Savannah River Atlantic sturgeon populations are unknown. In the Ogeechee and Savannah Rivers, no more than one mortality in each river is anticipated in any year as a result of incidental capture in the fishery.

The removal of these small numbers of individuals is not likely to have a significant impact on the future spawning population size of shortnose or Atlantic sturgeon.

Based on the analysis in this EA and supported by the Biological Opinion, NMFS expects that issuance of the proposed incidental take permit 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 that issuance of the proposed permit would not affect reproductive sturgeon adults in a way appreciably reducing their reproductive success, survival of its young, or the number of young annually recruiting into the breeding populations.

The incremental impact of the proposed authorization of takes of limited numbers of sturgeon incidental to the otherwise legal Georgia shad fishery, when added to other past, present, and reasonably foreseeable future actions, is not expected to result in population-level effects.

5.0 Mitigation Measures

There are no additional mitigation measures beyond those described by GA DNR or included as permit conditions, as discussed in the description of the Preferred Action. The applicant's protocols are incorporated into the permit by reference.

In summary, the permit conditions limit the level of take and require monitoring and reporting.

6.0 ESA Section 7 Consultation

The Endangered Species Conservation Division determined that issuance of the proposed permit is likely to adversely affect NMFS ESA-listed shortnose and all DPSs of Atlantic sturgeon that are the subject of the permit. The Endangered Species Conservation Division consulted with NMFS Endangered Species Act Interagency Cooperation Division, which determined in its Biological Opinion that issuance of the permit is not likely to jeopardize the continued existence of NMFS ESA-listed species or to result in the destruction or adverse modification of designated critical habitat. No permit conditions were added to the permit based on the consultation. There were no conservation recommendations in the Biological Opinion.

7.0 Public Review and Comment

On April 11, 2012 NMFS published a Notice of Receipt (NOR) of the State's application for a Section 10(a)(1)(B) permit for its commercial shad fishery and made available the application and conservation plan for public review and comment for 30 days. NMFS thus presented information relevant to the environmental issues and impacts associated with the proposal to issue a permit for the activities and species proposed for coverage in the permit and solicited public comment. NMFS has received and reviewed comments received on the NOR in preparing

this EA. One general comment was received and was not related to potential impacts to the human environment.

8.0 List of Preparers and Agencies Consulted

This document was prepared by the Endangered Species Conservation Division of NMFS' Office of Protected Resources (F/PR3) in Silver Spring, Maryland.

F/PR3 consulted with GA DNR in preparing this document.

9.0 Literature Cited

- Atlantic Sturgeon Status Review Team (ASSRT). 2007. Status Review of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). Report to National Marine Fisheries Service, Northeast Regional Office. February 23, 2007. 174 pp.
- Allen, P.J. and J.J. Cech, Jr. 2007. Age/size effects on juvenile green sturgeon, *Acipenser medirostris*, oxygen consumption, growth, and osmoregulation in saline environments. *Environmental Biology of Fishes* 79(3-4):211-229.
- Allen, P.J., M. Nicholl, S. Cole, A. Vlazny, and J.J. Cech Jr. 2006. Growth of larval to juvenile green sturgeon in elevated temperature regimes. *Transactions of the American Fisheries Society* 135:89-96.
- Altinok, I., S.M. Galli, and F.A. Chapman. 1998. Ionic and osmotic regulation capabilities in Gulf of Mexico sturgeon, *Acipenser oxyrinchus de sotoi*. *Comparative Biochemistry and Physiology Part A* 120:609-616.
- Bahn, R.A., J.E. Fleming, and D.L. Peterson. 2012. Bycatch of shortnose sturgeon in the commercial American shad fishery of the Altamaha River, Georgia. *North American Journal of Fisheries Management* 32:557-562.
- Balazik, M., S. Cameron, D. Clarke, C. Frederickson, S. Giordano, C. Hager, J. Lazar, S. McIninch, K. Reine, C. Dickerson, W. Shuart, A. Spells. 2009. Movements and habitat associations of Atlantic sturgeon in the James River estuary, Virginia. Oral Presentation Abstract, 139th Meeting of the American Fisheries Society, Nashville, Tennessee.
- Buckley, J., and B. Kynard. 1985. Habitat use and behavior of pre-spawning and spawning shortnose sturgeon, *Acipenser brevirostrum*, in the Connecticut River. Pages 111-117 in: F.P. Binkowski and S.I. Doroshov, eds. *North American sturgeons: biology and aquaculture potential*. Developments in Environmental Biology of Fishes 6. Dr. W. Junk Publishers, Dordrecht, Netherlands. 163pp.
- Campbell, J.G. and Goodman, L.R. 2004. Acute sensitivity of juvenile shortnose sturgeon to low dissolved oxygen concentrations. *Transactions of the American Fisheries Society* 133:772-776.
- Cech, J.J., Jr. and S.I. Doroshov. 2004. Chapter 3: Environmental requirements, preferences, and tolerance limits of North American sturgeons. Pages 73-86 in G.T.O. Lebreton, F.W.H. Beamish, and R.S. McKinley (eds), *Sturgeons and Paddlefish of North America*. Netherlands: Kluwer Academic Publishers.
- Cech, J.J., S.J. Mitchell, and T.E. Wragg. 1984. Comparative growth of juvenile white sturgeon and striped bass: effects of temperature and hypoxia. *Estuaries* 7:12-18.
- Cech J.J., Jr., and C.E. Crocker. 2002. Physiology of sturgeon: effects of hypoxia and hypercapnia. *Journal of Applied Ichthyology* 18:320-324.
- Collins, M.R. and T.I.J. Smith. 1993. Characteristics of the adult segment of the Savannah River population of shortnose sturgeon (*Acipenser brevirostrum*). Southeastern Association of Fish and Wildlife Agencies.
- 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.

- DeVries, R.J. 2006. Population dynamics, movements, and spawning habitat of the shortnose sturgeon, *Acipenser brevirostrum*, in the Altamaha River. Master's Thesis, University of Georgia. 103 p.
- Evermann, B. W. and B. A. Bean. 1898. Indian River and its fishes. United States Commission of Fish and Fisheries.
- Hastings, R.W., J.C. O'Herron II, K. Schick, and M.A. Lazzari. 1987. Occurrence and distribution of shortnose sturgeon, *Acipenser brevirostrum*, in the upper tidal Delaware River. *Estuaries* 10:337-341.
- Jenkins, W.E., T.I.J. Smith, L. Heyward, and D.M. Knott. 1993. Tolerance of shortnose sturgeon, *Acipenser brevirostrum*, juveniles to different salinity and dissolved oxygen concentrations. *Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies* 47:476-484.
- Kahn and Mohead 2010. A protocol for use of shortnose, Atlantic, Gulf, and green sturgeon. U.S. Department of Commerce. NOAA Tech. Memo. NMFS-OPR-45,62p.
- Kieffer, M. C., and B. Kynard. 1993. Annual Movements of shortnose and Atlantic sturgeons in the Merrimack River, Massachusetts. *Transactions of the American Fisheries Society* 122:1088–1103.
- Kirk, J. T. 2008. Final report to NMFS on ESA Permit No. 1489 documenting research results of shortnose sturgeon on the Ogeechee River, Georgia.
- Kynard, B. 1997. Life history, latitudinal patterns and status of shortnose sturgeon, *Acipenser brevirostrum*. *Environmental Biology of Fishes* 48(1-4):319-334.
- Mayfield, R.B. and J.J. Cech, Jr. 2004. Temperature effects on green sturgeon bioenergetics. *Transactions of the American Fisheries Society* 133:961-970.
- 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.
- 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.
- 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.
- Niklitshek, E.J. and D.H. Secor. 2009a. Dissolved oxygen, temperature and salinity effects on the ecophysiology and survival of juvenile Atlantic sturgeon in estuarine waters: I. Laboratory results. *Journal of Experimental Marine Biology and Ecology* IN PRESS.
- Niklitshek, E.J. and D.H. Secor. 2009b. Dissolved oxygen, temperature and salinity effects on the ecophysiology and survival of juvenile Atlantic sturgeon in estuarine waters: II. model development and testing. *Journal of Experimental Marine Biology and Ecology* IN PRESS.
- Niklitshek, 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.
- Peterson, D.L. 2007. NMFS Permit 1489. 2007. Annual Report of Take: Ogeechee River Shortnose Sturgeon Research Update. Report to National Marine Fisheries Service, October 8, 2007.
- Sardella, B.A., E. Sanmarti, and D. Kultz. 2008. The acute temperature tolerance of green sturgeon (*Acipenser medirostrum*) and the effect of environmental salinity. *Journal of Experimental Zoology* 309A:477-483.
- Scott, W.B., and M.G. Scott. 1988. Atlantic fishes of Canada. *Canadian Bulletin of Fisheries and Aquatic Sciences* 219, 731 pages.
- Schueller, P. and D. L. Peterson. 2010. Abundance and recruitment of juvenile Atlantic sturgeon in the Altamaha River, Georgia. *Transactions of the American Fisheries Society* 139:1526-1535.
- 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.
- 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.
- Sulak, K.J. and J.P. Clugston. 1999. Recent advances in life history of Gulf of Mexico sturgeon, *Acipenser oxyrinchus desotoi*, in the Suwannee River, Florida, USA: a synopsis. *Journal of Applied Ichthyology* 15:116-128.
- Sulak, K.J. and J.P. Clugston. 1998. Early life history stages of Gulf sturgeon in the Suwannee River, Florida. *Transactions of the American Fisheries Society* 127:758-771.
- Van Eenennaam, J.P., J. Linares-Casenave, X. Deng, and S.I. Doroshov. 2005. Effect of incubation temperature on green sturgeon embryos, *Acipenser medirostris*. *Environmental Biology of Fishes* 72:145-154.
- Walburg C.H. and P.R. Nichols. 1967. Biology and management of the American shad and status of the fisheries, Atlantic Coast of the United States, 1960. U.S. Fish and Wildlife Service Special Scientific Report on Fisheries, 550. 105p.
- Waldman, J.R., C. Grunwald, J. Stabile, and I. Wirgin. 2002. Impacts of life history and biogeography on the genetic stock structure of Atlantic sturgeon, *Acipenser oxyrinchus oxyrinchus*, Gulf sturgeon, *A. oxyrinchus desotoi*, and shortnose sturgeon, *A. brevirostrum*. *Journal of Applied Ichthyology* 18:509-518.
- Wang, Y.L., F.P. Binkowski, and S.I. Doroshov. 1985. Effect of temperature on early development of white and lake sturgeon, *Acipenser transmontanus* and *A. fulvescens*. *Environmental Biology of Fishes* 14(1):43-50.
- Wehrly, K.E. 1995. The effect of temperature on the growth of juvenile lake sturgeon, *Acipenser fulvescens*. Michigan Department of Natural Resources, Fisheries Division, Research Report 2004, Lansing.
- Weiss-Glanz, L.S., J.G. Stanley, and J.R. Moring. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic) – American Shad. U.S. Fish and Wildlife Service Biological Report 82(11.59). U.S. Army Corps of Engineers TR EL-82-4. 16p.
- Van Eenennaam, J.P., J. Linares-Casenave, X. Deng, and S.I. Doroshov. 2005. Effect of incubation temperature on green sturgeon embryos, *Acipenser medirostris*. *Environmental Biology of Fishes* 72:145-154.
- Vladykov, V. D. and J. R. Greely. 1963. Order Acipenseroidei. In: *Fishes of Western North Atlantic*. Sears Foundation. Marine Research, Yale Univ. 1 630 pp.
- Ziegeweid, J.R., C.A. Jennings, D.L. Peterson. 2007. Thermal maxima for juvenile shortnose sturgeon acclimated to different temperatures. *Environmental Biology of Fishes* 82(3):299-307.

Appendix 1. Georgia Commercial Shad Fishing Regulations.

391-2-4-.02 Commercial Shad Fishing.

(1) **Purpose.** The purpose of these Rules is to implement the authority of the Board of Natural Resources to promulgate rules and regulations based on sound principles of wildlife research and management, establishing the seasons, days, places and methods for fishing commercially for shad.

(2) Areas Open to Commercial Shad Fishing.

(a) Nets shall be set or fished only in flowing water within the banks of the stream channels. Nets may not under any circumstances be set or fished in waters that are not flowing such as in sloughs or dead oxbow lakes.

(b) Waters of the Savannah River system open to commercial shad fishing are the Savannah River downstream of the U.S. Highway 301 bridge, Collis Creek, Albercorn Creek, Front River, Middle River, Steamboat River, McCoy's Cut, Hometown Cut, Back River upstream from Corps of Engineers New Savannah Cut, New Savannah Cut, North Channel Savannah River downstream to a line running due south of the easternmost tip of Oyster Bed Island, South Channel Savannah River downstream to a line running from the southeast tip of Cockspur Island to the mouth of Lazaretto Creek, and Elba Island Cut between North and South Channels of the Savannah River.

(c) Waters of the Ogeechee River system open to commercial shad fishing are the Ogeechee River downstream from Georgia Highway 204 bridge, Hell's Gate cut, and Ossabaw Sound upstream from the sound/beach boundary (see 391-2-4-.03) to a line running from the northwest tip of Raccoon Key across buoy R "86" to the southernmost tip of marsh adjacent to Green Island.

(d) Waters of the Altamaha River system open to commercial shad fishing are the Ohoopee River upstream to the U.S. Highway 1 bridge; the Altamaha River downstream of the from U.S. Highway 1 bridge including Cobb Creek Oxbow, Beards Creek from its mouth upstream to the Long-Tatnall County line (Big Lake), Sturgeon Hole from the Altamaha River to the lower mouth of Harper Slough, Old Woman's Pocket, South Branch, General's Cut, South Altamaha River, Champney River, Butler River, One Mile Cut, Wood Cut, Darien River upstream to the confluence Darien Creek and Cathead Creek, Buttermilk Sound upstream to the mouth of Hampton River, Hampton River, Altamaha sound to the sound/beach boundary (see 391-2-4-.03), Rockdedundy River, Little Mud River, South River, Back River, North River upstream to Hird Island Creek and Doboy Sound from the sound/beach boundary upstream to a line from range F1 R4 sec A across buoy R "178" to Sapelo Island. Old River and Mid Slough of the Penholoway River and Ellis Creek are closed to commercial shad fishing.

(e) Reserved.

(f) Reserved.

(3) Seasons. The commercial shad fishing season shall be open as provided in subparagraphs (a), (b) and (c) of this paragraph from 1 January to 31 March; however, the Commissioner of Natural Resources, in accordance with current, sound principles of wildlife research and management, may at his discretion open or close the season 30 days after 31 March on any or all areas open to commercial shad fishing.

(a) The Altamaha River system downstream from the Seaboard Coastline Railroad bridge (at Altamaha Park) will be open to commercial shad fishing Monday through Friday each week. Upstream of this point will be open Tuesday through Saturday each week.

(b) The Savannah River system downstream from the I-95 bridge will be open to commercial shad fishing Tuesday through Friday each week. Upstream of the I-95 bridge it will be open Wednesday through Saturday each week.

(c) The Ogeechee River system will be open to commercial shad fishing Friday of each week.

(4) Gear and Methods for Taking Shad.

(a) Commercial Shad Fishing Gear.

1. Set nets and drift nets of at least four and one-half inch stretched mesh or trot lines (in accordance with O.C.G.A. 27-4-91) may be used to commercially fish for shad, provided, however, that only drift nets may be used in the Savannah River system downstream of a line between the mouth of Knoxville Creek and McCoys Cut at Deadman's Point; the Ogeechee River; Altamaha Sound; and Doboy Sound.

2. Nothing in this section shall preclude the commercial use of pole and line gear as identified in O.C.G.A. 27-4-35.

(b) Methods for Taking Shad.

1. Set nets must be placed at least six hundred (600) feet apart and shall be limited to one hundred (100) feet in length. All set nets must have one end secured to the stream's bank and be buoyed at the outer (streamward) end so as to be clearly visible to boaters.

2. Set and drift nets must be situated so as to follow one-half the stream width open and free for the passage of fish.

3. Drift nets shall not be fished closer than three hundred (300) feet apart and shall be limited to a maximum of one thousand (1,000) feet in length in saltwaters.

Authority O.C.G.A. Title 27. **History.** Original Rule entitled "Commercial Shad Fishing" adopted. F. Dec. 28, 1979; eff. Jan. 17, 1980. **Amended:** F. Dec. 28, 1983; eff. Jan. 17, 1984. **Amended:** F. Dec. 2, 1987; eff. Dec. 22, 1987. **Amended:** F. June 19, 1989; eff. July 9, 1989. **Amended:** F. Dec. 9, 1994; eff. Dec. 29, 1994. **Amended:** F. Nov. 4, 2010; eff. Nov. 24, 2010.

Appendix 2. Based on current regulations, areas open to commercial shad fishing in Georgia are highlighted in purple.



Appendix 3. Original GA American Shad Fishery Sturgeon Bycatch Monitoring Plan Submitted by GA DNR

The Georgia Department of Natural Resources (GADNR) proposes to utilize a combination of a trip ticket system and direct observations to monitor the bycatch of shortnose sturgeon in the commercial shad fishery. Georgia regulations currently require commercial fishermen to complete trip tickets to document species, sex and pounds of shad harvested each day. In addition to the information on shad harvest, these tickets capture the fisherman's name and license number, name of dealer that purchases fish, river fished, gear type (set or drift net), length of net, total soak time, and number of net sets. Fishermen and/or dealers are required to return completed trip tickets to the Georgia Department of Natural Resources by the 10th of each following month (i.e. January tickets would be due by February 10). The current trip ticket will be modified to require fisherman to record information on sturgeon bycatch (total numbers of sturgeon intercepted and released) and data will be utilized to monitor sturgeon interactions with the shad fishery. Modified trip tickets will have rows and/or columns for fishermen to separately record incidental catches of shortnose and Atlantic sturgeon.

GADNR will make a concerted effort to educate commercial shad fishermen on the importance of both accurately recording sturgeon incidental catches and returning the trip tickets in a timely manner, at least by the 10th of each following month. GADNR will develop an informational packet on sturgeon identification, proper handling (emphasizing the importance of fishermen frequently checking their nets and immediately releasing any sturgeon that are incidentally caught), and the importance of reporting incidental sturgeon catches. Prior to each shad season, this informational packet will be provided to all known commercial shad fishermen.

A list of names and addresses of commercial shad fishermen will be compiled from prior trip tickets, the commercial fishing license database, and a list of cooperators in shad tagging studies. A set of trip tickets, self-addressed return envelopes, and information on how to obtain additional trip tickets will also be provided to each fisherman on this list. In addition to these direct handouts and mailings, GADNR Law Enforcement staff will be supplied additional trip tickets to be provided to shad fishermen encountered during routine patrol.

According to results reported by Bahn and Peterson (2010), estimated shortnose sturgeon bycatch determined from direct observations of commercial shad fishing activities did not differ significantly from those estimated from commercial shad fishermen log book data for the same time period. However, GADNR believes that it is still important to periodically observe commercial shad fishing activities. Thus, GADNR staff will utilize the same list of names obtained from trip tickets, the commercial fishing license database, and the list of cooperators in shad tagging studies to establish contact information (i.e. phone numbers) for a subset of individuals that commercially fish for shad on the Altamaha, Ogeechee, and Savannah rivers.

Once contact information has been established for a set of fishermen for each river, GADNR staff will contact fishermen to determine when they will be fishing and to establish a time and location to observe fishermen pulling their nets. The goal will be to make observations within 24-48 hours of contact with the fisherman. Numbers of direct observations for each river will be based on current shad fishing pressure and spawning migrations of shad and sturgeon.

GADNR will attempt to observe a minimum of 10% of the commercial shad fishing trips on each river. Based on averaging the last 3 years of commercial fishing effort, GA DNR would need to observe approximately 25, 5, and 1 trip each year, respectively, for the Altamaha, Savannah, and Ogeechee rivers. Since commercial shad fishing effort is extremely low on the Ogeechee River, GADNR will attempt to observe at least 2 trips per year on the Ogeechee River.

Monthly observations for a river system may also vary. Shad fishing effort is typically lower on all three rivers in January than in February and March due to the fact that shad abundance is less early in the season. Therefore, the number of direct observations will likely be lower for January than for the following months.

GADNR monitors the shad spawning migration every week during the commercial shad season, which allows staff to know when the spawning run and resulting fishing pressure are peaking. This information will allow GADNR to make necessary adjustments in monitoring efforts to ensure that at least 10% of all commercial shad fishing trips are observed annually. Monitoring efforts will also be adaptive to the timing of the sturgeon spawning migration and the number of sturgeon intercepts. GADNR will increase direct observations if high numbers of sturgeon intercepts are detected. GADNR is confident that this approach will ensure that an adequate number of observations are made during the peak of both the shad and sturgeon spawning migrations so that sturgeon bycatch is accurately estimated.

If unusually high catch rates are being observed, GADNR will immediately increase law enforcement presence and educational efforts. Staff will also begin evaluating additional modifications to the commercial shad fishing regulations for the next year. Data collected from the trip tickets and direct observations will be summarized and provided to the National Marine Fisheries Service no later than the end of February, March, and April each year.

Appendix 4. Modified GA American Shad Fishery Sturgeon Bycatch Monitoring Plan Submitted by GA DNR

The GA DNR proposes to utilize a combination of a trip ticket system and direct observations to monitor the bycatch of shortnose sturgeon in the commercial shad fishery. Fishermen and/or dealers are required to return completed trip tickets to the GA DNR by the 10th of each following month (i.e. January tickets would be due by February 10). The current trip ticket will be modified to require fisherman to record information on sturgeon bycatch (total numbers of sturgeon intercepted and released) and data will be utilized to monitor future sturgeon interactions with the shad fishery. Modified trip tickets will have rows and/or columns for fishermen to separately record incidental catches of shortnose and Atlantic sturgeon.

GA DNR will develop an informational packet on sturgeon identification, proper handling (emphasizing the importance of fishermen frequently checking their nets and immediately releasing any sturgeon that are incidentally caught), and the importance of reporting incidental sturgeon catches. Prior to each shad season, this informational packet will be provided to all known commercial shad fishermen.

In addition, GA DNR currently utilizes a shad monitoring program, which has been established for over 30 years, to concurrently estimate sturgeon catch rates. This portion of the monitoring program is conducted by sampling with drift nets of 4.5"-5" stretch mesh, as this is the primary fishing technique and gear used by commercial shad fishermen. GA DNR typically monitors the shad run 1-day/week the first 3 weeks in January, 2-days/week from late-January through mid-March, and then back to 1-day/week in late March when the run starts tapering off. GA DNR field staff average about 18 days of sampling/year during the shad spawning run. The two goals of this monitoring are to determine the size of the shad run and the approximate bycatch rate of shortnose and Atlantic sturgeon. As long as this shad monitoring protocol continues, GA DNR proposes to PIT tag each sturgeon that lacks a PIT tag and to collect genetic samples from an estimated 10 fish each year. These two components will provide valuable information that can be used to enhance sturgeon conservation measures by ensuring that the number of takes issued is not exceeded. PIT tagging will help determine the frequency at which individual sturgeon are handled per year or across years. If high recapture rates are identified, appropriate mitigation measures could then be identified to ameliorate the effects of multiple recaptures. Genetic samples will provide information on which DPS Atlantic sturgeon are from. While annual sample rates are expected to be small, over time, a clear picture will likely develop and provide a better estimate of the affect the fishery is having on each DPS. NMFS will provide the PIT tags and GA DNR currently possesses several PIT tag readers and syringes for the tagging component. If necessary, GA DNR will purchase an additional reader or syringe. GA DNR does not currently have the equipment necessary to analyze genetic samples collected, but will pay to have these samples examined at an estimated annual cost average of \$350/year. Cost associated with the PIT tagging and genetic sampling components will be funded through the sources identified in Section VI(C)(3) of GA DNR's 10(a)(1)(b) application.

According to results reported by Bahn *et al.* (2012), estimated shortnose sturgeon bycatch determined from direct observations of commercial shad fishing activities did not differ significantly from those estimated from commercial shad fishermen log book data for the same

time period. However, GA DNR believes that it is still important to periodically observe commercial shad fishing activities. Thus, GA DNR staff will utilize the list of names obtained from trip tickets, the commercial fishing license database, and the list of cooperators in shad tagging studies to establish contact information (i.e. phone numbers) for a subset of individuals that commercially fish for shad on the Altamaha, Ogeechee, and Savannah rivers. GA DNR will observe approximately 10% of the total number of shad fishing trips made on each river each year. This monitoring will observe both drift net and set net fishermen at the approximate rate that they are being fished.

Once contact information has been established for a set of fishermen for each river, GA DNR staff will contact fishermen to determine when they will be fishing and to establish a time and location to observe fishermen pulling their nets. The goal will be to make observations within 24-48 hours of contact with the fisherman. Numbers of direct observations for each river will be based on current shad fishing pressure and spawning migrations of shad and sturgeon.