Atlantic States Marine Fisheries Commission

Sturgeon Management Board

May 2, 2012
1:15 p.m. – 3:15 p.m.
Alexandria, Virginia

Draft Agenda

The times listed are approximate; the order in which these items will be taken is subject to change; other items may be added as necessary.

1. Welcome/Call to Order *(R. Beal)*	1:15 p.m.
2. Board Consent • Approval of Agenda • Approval of Proceedings from October 29, 2007	1:15 p.m.
3. Public Comment	1:20 p.m.
4. Discussion of Endangered Species Act Listing • Technical Committee Report *(B. Post)* • Discussion and Development of Response Strategy	1:30 p.m.
5. Georgia Section 10 Application for Public Comment *(S. Woodward)* **Action**	3:00 p.m.
6. Elect Chair **Action**	3:10 p.m.
7. Other Business/Adjourn	3:15 p.m.

The meeting will be held at the Crowne Plaza Hotel, 901 North Fairfax Street, Alexandria, Virginia; 703-683-6000

Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015.

MEETING OVERVIEW

Atlantic Sturgeon Management Board Meeting
Wednesday May 2, 2012
1:15 – 3:15 p.m.
Alexandria, Virginia

Chair: Vacant	Technical Committee Chair: Dewayne Fox (DE)	Law Enforcement Committee Rep: Brannock/Meyer
Vice Chair: Dour Grout	Advisory Panel Chair: Vacant	Previous Board Meeting: October 27, 2007
Voting Members: ME, NH, MA, RI, CT, NY, NJ, PA, DE, MD, VA, NC, SC, GA, FL, D.C., PRFC, USFWS, NMFS (19 votes)		

2. Board Consent

- Approval of Agenda
- Approval of Proceedings from October 27, 2007

3. Public Comment – At the beginning of the meeting, public comment will be taken on items not on the agenda. Individuals that wish to speak at this time must sign-in at the beginning of the meeting. For agenda items that have already gone out for public hearing and/or have had a public comment period that has closed, the Board Chair may determine that additional public comment will not provide additional information. In this circumstance, the Chair will not allow additional public comment on an issue. For agenda items that the public has not had a chance to provide input, the Board Chair may allow limited opportunity for comment. The Board Chair has the discretion to limit the number of speakers and/or the length of each comment.

4. Discussion on Endangered Species Listing 1:30 – 3:05 p.m.
Background • In February the National Marine Fisheries Service published a federal register notice listing Atlantic Sturgeon on the Endangered Species List. Four distinct population segments (DPS) were listed as endangered and one DPS was listed as threatened. The rule became effective April 6, 2012 **(Briefing CD)**.
Presentations • Overview of ESA Listing by K. Taylor **(Briefing CD).** • Technical Committee Report by B. Post

5. Georgia Section 10 Permit Application 3:05 – 3:15 p.m.) Acton
Background • The State of Georgia has submitted a Section 10(a)(1)(B) incidental take permit application for the commercial American shad fishery. Public comment on the application is due by June 11, 2012.
Presentations • Georgia Section 10 Permit Application by S. Woodward
Board actions for consideration at this meeting • Consider public comment on Georgia Section 10 Application

6. Other Business/Adjourn

DRAFT **DRAFT** **DRAFT**

DRAFT PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

STURGEON MANAGEMENT BOARD

Loews Annapolis Hotel
Annapolis, Maryland
October 29, 2007

These minutes are draft and subject to approval by the Sturgeon Management Board.
The Board will review the minutes during its next meeting.

TABLE OF CONTENTS

INDEX OF MOTIONS

ATTENDANCE

Board Members

Terry Stockwell, ME, proxy for Geo. Lapointe (AA)
John Nelson, NH (AA)
Paul Diodati, MA (AA)
Vito Calomo, MA, proxy for Rep. Verga (LA)
Eric Smith, CT (AA)
James Gilmore, NY (AA)
Pat Augustine, NY (GA)
Tom McCloy, NJ, proxy for Chanda (AC)
Erling Berg, NJ (GA)
Dick Herb, NJ, proxy for Asm. Fisher (LA)
Eugene Kray, PA (GA)
Craig Shirey, DE, proxy for Patrick Emory (AA)
Bernie Pankowski, DE, proxy for Sen.Venables (LA)
Howard King, MD DNR (AA)
Russell Dize, MD, proxy for Sen. Colburn (LA)
Catherine Davenport, VA (GA)
Steve Bowman, VA (AA)
Kelly Place, VA, proxy for Sen. Chichester (LC)
Jimmy Johnson, NC,proxy for Rep. Wainwright (LA)
John Frampton, SC (AA)
Robert Boyles, SC (LA)
Malcolm Rhodes, SC (GA)
John Duren, GA (GA)
Spud Woodward, GA,proxy for Susan Shipman (AA)
Steve Meyers, NMFS
Wilson Laney, USFWS
A.C. Carpenter, PRFC

(AA = Administrative Appointee; GA = Governor Appointee; LA = Legislative Appointee)

Ex-Officio Members

Staff

Vince O'Shea
Robert Beal
Nichola Meserve
Erika Robbins

Guests

Dorothy Thumm, NYSDEC
Dan McKiernan, MADMF
Jack Travelstead, VMRC

The Sturgeon Management Board of the Atlantic States Marine Fisheries Commission convened in the Ballroom of the Loews Annapolis Hotel, Annapolis, Maryland, October 29, 2007, and was called to order at 5:05 o'clock p.m. by Chairman Eric Smith.

CALL TO ORDER

CHAIRMAN ERIC SMITH: This is a meeting of the Sturgeon Board. As you recall from meetings past, we cover both species. I am the chairman of this group. Pat Augustine is the vice-chairman. We hold 19 votes on the management board, the states and the two federal agencies, so it's a species of a very widespread coastal interest.

As with every other board, I'll simply say for the benefit of the audience when we have issues that have already gone out to public comment, we may limit debate so that the board has enough time to deal with the issue because the comment period is over. We have not had any of those issues; so in the event there is something of a burning desire, we will take limited debate on the agenda items as we get to them.

APPROVAL OF AGENDA

But, bear in mind that I may have to cut back on comments or limit them as I did with the board a moment ago to make sure we do our business in our allotted time. There is only one item on the agenda of substance, but we have a couple of business issues. First is the approval of the agenda. Are there additions that people would like to add to the agenda? Seeing none, without objection, we'll approve the agenda as written.

APPROVAL OF PROCEEDINGS

Is there a motion to approve the proceedings of the August 2007 meeting? John Nelson makes the motion; Terry Stockwell seconds. Are there comments on the proceedings? Seeing none, we'll call them approved.

PUBLIC COMMENT

Is there public comment on issues that are not on the agenda, other sturgeon issues that you would like to bring before the board? Okay, seeing none, the first and only substantive item, if you recall our August meeting, there is an issue of potential inconsistency between the federal agency guidelines on handling controlled propagation of species that are listed under the ESA and our ASMFC guidelines for stocking cultured Atlantic sturgeon for supplementation or reintroduction.

We had asked Erika to do a side-by-side comparison of the two documents, and she did that. It was a memo distributed to us on the meeting week CD, but Erika will now go through and hit the comparison of the two documents.

REVIEW OF THE ASMFC GUIDELINES FOR STOCKING CULTURED ATLANTIC STURGEON FOR SUPPLEMENTATION OR REINTRODUCTION AND THE USFSW-NMFS POLICY REGARDING CONTROLLED PROPAGATION OF SPECIES LISTED UNDER THE ENDANGERED SPECIES ACT

MS. ERIKA ROBBINS: Thank you, Mr. Chairman. As mentioned already, Atlantic sturgeon was listed as a candidate species in 2006, and the status review team recommended that distinction population segments of Atlantic sturgeon be considered for listing as threatened under the Endangered Species Act. We received a letter from the National Marine Fisheries Service at our August meeting requesting that we consider using their policy regarding controlled propagation of species listed under the Endangered Species Act as guidance for stocking programs.

DISCUSSION OF GUIDELINES FOR STOCKING CULTURED ATLANTIC STURGEON FOR SUPPLEMENTATION OR REINTRODUCTION

In 2006 the commission adopted its own guidelines for stocking of cultured Atlantic sturgeon for supplementation or reintroduction, replacing an earlier 1996 set of guidelines. This presentation compares the National Marine Fisheries Service and Fish and Wildlife Service controlled propagation policy and the ASMFC guidelines for stocking.

ASMFC's guidelines provides guidance relative to the production of Atlantic sturgeon for collection of biological and behavioral data and for use in restoration and enhancement efforts. ASMFC recognizes that natural stock rebuilding has not occurred and most populations are at depressed levels. There is concern that additional decreases to resident populations are possible.

There are seven areas that the guidelines address. The first is planning, monitoring and reporting. Management jurisdictions are instructed to provide a detailed proposal to the commission's technical committee for review and recommendation to the management board before initiating any stocking programs.
The plan should goals, objectives, population surveys, brood stock sources, selection criteria, numbers, sizes and locations to be stocked and timelines for stocking. Annual monitoring of and reporting of these programs are requested to be presented to the technical committee.

The second is habitat quality and population surveys. These should be conducted prior to stocking programs to evaluate the presence or absence of sturgeon and the quality of the habitat in the area to be stocked. The third is tagging. All sturgeon released into the wild are to be tagged, including the brood stock sources.

The fourth is the source of the brood stock. Programs are requested to use brood stock native to the systems that will be stocked; or if that's not possible, to use fish from geographically similar or close locations. The fifth is the number of spawners. The stocking plan will incorporate brood stock collection and progeny of production components to meet the genetic criteria for maximizing effective population size of brood stock while achieving an in-breeding rate of less than 1 percent.

It also addresses the fate of post-spawn brood stock. They should be typically spawned only once unless there is genetic justification to reuse them. Afterwards they should be tagged and returned to the river of origin. The seventh is fate of progeny. This basically says that if you produce more progeny than you consider you'd like to use, you need to outline how you will dispose of those extra fish. The guidelines also address such issues as acquiring juveniles, stocking proportions, in-breeding and selection criteria for reintroduction.

The Fish and Wildlife Service and the National Marine Fisheries Service for their policy regarding controlled propagation of species listed under the Endangered Species Act is intended to address candidate proposed and listed species. Again, Atlantic sturgeon are currently a candidate species.

It focuses primarily on activities involving gamete and subsequent development and grow-out. The Services support controlled propagation when recommended in an approved recovery plan or necessary to prevent extinction. The approved recovery plans that are referred to in the federal policy are for listed species. That only happens after a listing is in place, so currently there is not a recovery plan for Atlantic sturgeon.

The ESA recognizes that controlled propagation is a tool to restore species to their natural habitats. The Fish and Wildlife Service and the National Marine Fisheries Service support controlled propagation when recommended by an approved recovery plan or when necessary to prevent extinction or as a tool for restoration in natural habitats.

This slide outlines the appropriate uses identified in the policy, including supporting recover-related research, maintaining refugia populations, providing animals for reintroduction and conserving species at risk of imminent extinction. The policy seeks to avoid the spread of disease to populations that are maintained in isolation or out in the wild, negative genetic effects and negative responses to essential behaviors.

The Fish and Wildlife Service outlines several requirements for controlled propagation; do not use it unless it's absolutely necessary, coordinate it with other recovery measures such as habitat improvements, and base it on recommendations of the recovery plans. The National Marine Fisheries Service policy also requires that any propagation program be based on sound scientific principles, create a genetics management plan prior to initiating it, and to prevent escapement outside of the native range of the species.

They also recommend using multiple facilities when using controlled propagation so that if you have a catastrophe at one facility you don't wipe out all the brood stock you have; and also to coordinate with multiple agencies; namely, the Fish and Wildlife Service and the National Marine Fisheries Service, but also other state agencies.

The Fish and Wildlife Service and the National Marine Fisheries Service also requests that you provide them information on a regular basis as to what is occurring in your controlled propagation program, and that any program not be implemented until funds for that program have been secured. They also request that a reintroduction plan be developed prior to beginning any propagation program. They also require the ESA and other applicable laws be followed in any program.

In comparing the two documents, it's important to know that the intentions of them are different. The Fish and Wildlife Service and the National Marine Fisheries Service policy is intended to address all candidate, threatened and endangered species under the ESA, and this includes plants, so they specific to fish. It's a little more general than ASMFC's policy.

The policy is mandatory for all listed species, so if Atlantic sturgeon were to be listed as threatened or endangered under the ESA, then all the states would have to follow this policy at that point. The guidelines that ASMFC currently have are recommendations that do not contradict with the Fish and Wildlife Service and the National Marine Fisheries Service policies, which is important to note.

There are things that the guidelines that ASMFC has do not address that the policy from the Fish and Wildlife Service and the National Marine Fisheries Service does address, and that is that habitat improvement is required prior to stocking; that a genetics plan be developed before you initiate controlled propagation; that you prevent accidental reintroduction and spread of disease to species that you have in your own program; and that you have explicit accordance with federal laws.

Again, the Fish and Wildlife Service and the National Marine Fisheries Service policy must be followed if listed. The National Marine Fisheries Service Protected Resources Office has let me know that they're willing to work with any states prior to the potential listing of sturgeon, which may smooth the transition in those programs from pre-listing to post-listing if the species is listed. Thank you.

CHAIRMAN SMITH: Thank you, Erika. Are there questions before I'm going to summarize what seems like four pathways to deal with this, but are there questions on the report first? Pat.

MR. PATRICK AUGUSTINE: Thank you, Mr. Chairman. What would it require – maybe it wasn't that one, the one before, where the differences are between the state and federal policy, the one that talked about the four major differences that we would have to comply with the guidelines versus the policy.

Now, how difficult is it for the states to address any of those four items. Have we identified what the impediments are to getting that done to any degree; and if so, are there any of those that could be knocked out of that list of four to be consistent?

MS. ROBBINS: All four could be added to our current guidelines for stocking. They also could be done on a state-by-state basis. As a state comes up with its own program for stocking, they could address these issues. It would take an amendment – if we wanted to change our guidelines, it would take an amendment to that current document.

MR. AUGUSTINE: A follow on, Mr. Chairman, and then I'll shut up. It just seems to me if we want to be consistent and keep the sturgeon in those possible bodies of water as pure as possible, it just seems to me that we should follow what would be a true guideline, and that would mean that we should have those measures of the states follow the federal guidelines.

If we're going to do it, let's do it right. We get one or two groups out there, we screw up the whole genetic change, and that sure as hell doesn't make sense. So if we could add those in some way, Mr. Chairman, I would like to have others weigh in on it.

CHAIRMAN SMITH: Other comments? John Nelson.

MR. JOHN I. NELSON, JR.: Thank you, Mr. Chairman. Actually to Pat's point, I guess the question is these are not addressing the guidelines. Is it necessary to actually have them in our guidelines where you do have federal policy and other items that provide the guidance, if you will, for a threatened species or even a listed species? Would we be going through an exercise just for the sake of doing it as the exercise versus having something really meaningfully put into our guidelines?

CHAIRMAN SMITH: Frankly, although I take Pat's point, I was looking for questions to make sure people understood rather than suggestions on how to make a change. Rather than the board try and massage these two documents here, one of the pathways, if we decide to pursue it, is to send it to the technical committee with some ideas, like Pat's, that we then fold into and get advice from them as to a revised document.

Let me run the four ways I see us proceeding past you and see if any one of them resonates. By the way, I neglected to introduce my partners in crime up here. Dottie Thumm is the law enforcement captain for the marine patrol in New York. She is our law enforcement committee representative on this board. Welcome. Gene Kray you know; Frank Cozzo you know.

DR. EUGENE KRAY: We're sitting here because there is no place else to sit.

CHAIRMAN SMITH: Well, yes, except I thought Frank was AP. He is not an AP chairman?

DR. KRAY: No, he is a proxy.

CHAIRMAN SMITH: Okay, so you guys are just sitting there. I was looking for technical committee chairs and didn't have any. John.

MR. JOHN DUREN: Thank you, Eric. I would like to just try to clarify something. Over the last two or three years, we've heard several good reports about restoration of Atlantic sturgeon in various locales. My perception is that we're not trying to solve a problem with this issue today. We're trying to prevent any kind of problem in the future. Is that correct?

CHAIRMAN SMITH: Well, it was precipitated by one instance of a fish being handled in a way that got people asking whether we really were either following our own policy or whether we should have our policy revised to conform with the federal one, our guidelines and the federal policy. This is something that went back to the spring or last fall. So, it was precipitated by an instance as opposed to just being a theoretical let's try and fix something.

Here are the four ways we could proceed. We could decide, hearing what we've heard from Erika that the federal policy is only guidance for candidate species, and in effect decline to change our guidelines, because it's not required that we comply with the federal policy; or, we could refer this to the technical committee for their recommendation on either adopting the federal policy instead of our guidelines; or, taking the document that Erika produced, the ideas that Pat has had and fleshing them out into a proposal to come back to the board. Okay, that's number two.

Number three, we could just adopt the federal policy as it is instead of ours, even though it's not required for candidate species. The fourth one is to hold off for now until we find out what the agencies decide on the question of listing. Right now it's a candidate; there is still discussion underway as to what actually will happen. That's the four ways I see of approaching this. I'd welcome a fifth if people thought there was another idea. Jack.

MR. JACK TRAVELSTEAD: Thank you, Mr. Chairman. I guess I like a combination of your options two and four. Because the federal services are currently evaluating whether to list sturgeon, I think we ought to hold off on taking any action on this day, but I certainly it's appropriate to go ahead and task the technical committee with looking at the federal policy and determining how it should be meshed with what we have.

CHAIRMAN SMITH: Thank you. Anyone have an additional comment or is there objection to the suggestion that Jack has made as the course of action? Okay, seeing none, that would be the course of action we would pursue. Thank you. We're at other business. Are there other issues to come before the Sturgeon Board? Steve Meyers.

OTHER BUSINESS

MR. STEVE MEYERS: Good afternoon, Mr. Chairman, thank you. I just want to reiterate a sense of partnership and cooperation among the federal agencies and also with the states in this issue. I think together we can work something out here to the benefit of the resource while also meeting our individual management needs.

I sit here with my colleagues from Region 4 and Region 5 and the U.S Fish and Wildlife Service to guarantee successful cooperation among the agencies in our efforts in working with the states. Thank you very much.

ADJOURN

CHAIRMAN SMITH: Thank you, we look forward to that. Is there any other issue of other business? Seeing none, we are now adjourned.

(Whereupon, the meeting was adjourned at 5:25 o'clock p.m., October 29, 2007.)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
55 Great Republic Drive
Gloucester, MA 01930-2276

FEB 3 2012

John V. O'Shea, Executive Director
Atlantic States Marine Fisheries Commission
1050 North Highland Street
Suite 200A-N
Arlington, VA 22201

Dear Mr. O'Shea:

On February 6, 2012, NOAA's National Marine Fisheries Service (NMFS) published two final rules to list five Distinct Population Segments (DPS) of Atlantic sturgeon under the Endangered Species Act (ESA). The Gulf of Maine DPS will be listed as threatened and the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs will be listed as endangered. All of the listings are effective as of April 6, 2012. We would like to meet with you and your staff as soon as possible to provide more background on the ESA listing and to begin work addressing sturgeon interactions in your fisheries.

Both the Northeast and Southeast Regional Offices received the Atlantic States Marine Fisheries Commission's (ASMFC) comments on the proposed listing rules by letters dated December 21, 2010, which stated that the ASMFC does not support the listing and provided specific comments on information in the two proposed listing rules. Dr. Crabtree and I very much appreciate the information provided by the ASMFC, which we fully considered in making our final listing determination. We also received comments from several coastal states. In all, 118 commenters (including ASMFC) provided comments during the 120-day comment period and six public hearings. We solicited peer review comments on the proposed listing rules from six peer reviewers with expertise on Atlantic sturgeon: three from academia, two from state resource agencies, and one from a federal resource agency.

Information and data provided by commenters supported or did not conflict with our findings for the five DPSs. Some information submitted by commenters as "new" information was information already included and evaluated in our proposed listing rule determination. Some commenters asked us to consider information, such as increased compliance responsibilities and economic costs on agencies and the public; however, the ESA and its implementing regulations prohibit us from considering economic issues in making listing determinations. Many commenters stated that NMFS should postpone a listing determination until the results of recent research are available, further research can be undertaken, state and Federal moratoria on the harvest and possession of Atlantic sturgeon have been in effect for the full planned duration, and/or until non-listing alternatives (e.g., entering into multi-agency partnerships and expanding existing programs) have been explored.

The listing may not be postponed. On October 6, 2009, we received a petition from the Natural Resources Defense Council (NRDC) to list Atlantic sturgeon under the ESA. Section 4(b)(3)(B) of the ESA calls for us to make a finding within 12 months of receiving a petition as to whether the petitioned action is warranted, and section 4(b)(6)(A) calls for a final listing determination within 12 months of publication of the proposed listing rule. We based our listing determination on the best available scientific and commercial information on the decline of Atlantic sturgeon, the failure of populations to rebound despite harvest prohibitions, and the ongoing impacts from bycatch and habitat modification, and the inadequacy of existing regulatory mechanisms. We decided to list the Gulf of Maine DPS as threatened, and the New York Bight, Chesapeake Bay, Carolina and South Atlantic DPSs as endangered. The information provided in the peer review and public comments did not provide any basis for revising our evaluation of the status of Atlantic sturgeon, the nature and significance of the threats and impacts they face, or our listing determinations. We plan to continue to work with ASMFC and other state and Federal partners to expand our knowledge of the species and enhance conservation efforts. However, we do not have grounds to postpone the ESA listing.

In the final rules, we identify incidental catch in fisheries as one of the primary threats to Atlantic sturgeon. This is based primarily on a 2007 analysis by the ASMFC and the Northeast Fisheries Science Center and a previous analysis by Stein *et al.* (2004), which relied on observer data. We know that some fisheries, particularly those that occur exclusively in state waters, may have been unobserved or had low rates of observer coverage. Although information on incidental capture of Atlantic sturgeon in state-managed fisheries is limited, we do know that interactions occur in state-managed fisheries, including some of those managed under ASMFC interstate fishery management plans (e.g., striped bass, shad).

There are certainly some concerns about what an ESA listing means for fisheries that might interact with Atlantic sturgeon. The listing does not mean that fisheries will be closed. However, ESA protections do automatically apply to species listed as endangered. Therefore, effective April 6, 2012, all capture of endangered Atlantic sturgeon will be prohibited. For species listed as threatened, NMFS must implement protective measures through a separate rulemaking. Last year, in anticipation of a possible threatened listing for the Gulf of Maine DPS of Atlantic sturgeon, we proposed protective measures for the DPS that would, with limited exception, prohibit take, including capture, of Gulf of Maine DPS Atlantic sturgeon. The final determination to establish ESA protections for the Gulf of Maine DPS is undergoing agency clearance and review.

The ESA provides exceptions to the prohibition against take of ESA-listed species. For example, section 10 of the ESA provides measures under which NMFS can authorize the incidental, but not intentional, take of a listed species in an otherwise lawful activity (e.g., participating in a state-managed fishery). Given ASMFC's role in management of Atlantic sturgeon, staff from both NMFS regional offices would like to work with you to address incidental capture of Atlantic sturgeon in state-managed fisheries. Therefore, we would like to arrange a meeting with you and your staff to begin work as soon as feasible.

We look forward to coordinating with you on this effort to reduce Atlantic sturgeon incidental take in fisheries. If you have any questions or concerns, please contact David Bernhart at (727) 551-5767 or Kimberly Damon-Randall at (978) 282-8485.

Sincerely,

Daniel S. Morris
Acting Regional Administrator, Northeast Regional Office

Cc: David Bernhart, SERO
Kimberly Damon-Randall, NERO

Atlantic States Marine Fisheries Commission

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Paul J. Diodati, (MA), Chair *Dr. Louis B. Daniel, III, (NC), Vice-Chair* *John V. O'Shea, Executive Director*

Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015

February 29, 2012

James Lecky, Director
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway, 13th Floor
Silver Spring, Maryland 20190

Dear ~~Mr. Lecky~~, Jim,

I am writing on behalf of our Commissioners to provide you with a list of questions related to the Atlantic sturgeon ESA listing. Our Commissioners requested responses in writing to best help them. We met earlier this month to discuss the listing. Lisa Manning from your staff presented a summary of the listing process and permitting consultation; however the ASMFC states had a number of detailed questions that were not able to be answered due to time limitations at the meeting. The questions are included as an attachment to this letter.

Many of the ASMFC member states are not familiar with responding to an ESA listing, including the Section 10 process. Moving forward through this process will require frequent communication between NMFS Protected Resources staff, the states, and Commission staff. To that end, my staff is working with Kim Damon-Randall (NERO) to schedule a conference call with the states from Maine through North Carolina and NERO to provide additional background and develop a plan for moving forward. The states from South Carolina through Florida have been in contact with David Bernhart (SERO).

Once you've had a chance to review these questions it would help if you could let us know how long it will take to answer them. We look forward to continuing and strengthening our cooperative efforts in the conservation of Atlantic sturgeon. Please feel free to contact me, or your staff can contact Bob Beal at (703) 842-0740.

Sincerely,

Vince

John V. O'Shea

Att: List of Questions

cc: Daniel Morris, NERO
Kimberly Damon-Randall, NERO
David Bernhart, SERO
ASMFC Commissioners

Atlantic States Marine Fisheries Commission
Questions Regarding Atlantic Sturgeon ESA Listing

Section 10 General

- What are NMFS strategies/criteria for addressing Section 7 and Section 10 permits, and how is NMFS going to evaluate the priority fisheries/projects?
- How do the ESA Section 10 and Section 7 consultation rules and processes deal with multiple listed species in a single fishery or research project?
- What are the liability issues for states without approved Section 10 permits in place by April 6th?
- What is the current estimated timeline for NMFS to process the Section 10 permits?
- Maryland's current monitoring program is supported by collections from commercial fishermen. What are the conditions under which the Maryland Sturgeon Reward Program could continue?
- When will the determination on the Gulf of Maine protective measures be published?
- How is mixing of DPSs units accounted for in the development of take levels?

Section 10(A)(1)(B)

- Will NMFS require a consolidated conservation plan for shortnose sturgeon, sea turtles and Atlantic sturgeon? Should a state include other endangered species – specifically marine mammals – when developing its Conservation Plan?
- Does every fisher within state waters with the potential to "take" a sturgeon need to have a Certificate of Inclusion?
- Would it be better for a state to have every fishery within state waters that may encounter a sturgeon on one application or to do one for each fishery?
- Does the ITP allow a specific number of takes within a specific period? If yes, what happens if the takes happen in the first, say 10%, of the take period? Fisheries closures for the remainder of the year?
- For states that do not have sufficient resources to conduct the NMFS required level of monitoring in order to adopt a conservation plan, is it possible to gain approval for a plan with reduced monitoring requirements?
- For states that cannot meet NMFS requirements to predict the number of observed annual takes (i.e. there is inadequate supporting data to formulate the "take table"), how will this be handled by NMFS? There are few observations of Atlantic sturgeon "takes", which would also make it difficult to generate a statistically valid take table for this species.
- Can an ITP be issued subsequent to conservation plan approval or are there additional requirements?
- What mechanisms do states have to access NMFS observer data to help develop ITP applications, specifically involving ocean trawls, beach seine, and gill nets?
- Since NMFS is working through the Regional Councils for ITPs for fisheries with bycatch issues in federal waters (i.e. monkfish), is the same true with those fisheries with limited bycatch issues and/or those where the harvest can also be in state waters (i.e. summer flounder)?

Section 10(a)(1)(A) – Research General

- Do federally funded state research programs require a Section 10(a)(1)(A) scientific research permit and/or a section 7 consultation?
- How easy is it to amend a Section 10(a)(1)(A) scientific research permit within the five-year period, if additional research programs come on-line within that period?

Section 10(a)(1)(A) – Stocking

- How do NMFS stocking or recovery plan requirements compare to the ASMFC Guidelines for Stocking Cultured Atlantic Sturgeon for Supplementation or Reintroduction (2006)?
- Disposition of current captive stock:
    - Can hatchery origin Hudson River sturgeon housed in Maryland be stocked into the Hudson River if New York is supportive of such an effort? This was done several years ago using fish cultured at USFWS Northeast Fishery Center.
    - Are Canadian origin hatchery progeny currently held by Maryland DNR and its cooperators subject to all the ESA rules applied to a listed DPS?
    - Can wild-caught sturgeon currently held in captivity be legally released back into Maryland waters at any time?
    - Can currently held captive stock be maintained without a permit if the objective is normal husbandry and medical care? What are the record-keeping requirements for such an arrangement?
- What are the specific requirements for approval of a stocking plan? Specifically:
    - What are acceptable brood sources?
    - Can NMFS identify other specific brood stock selection criteria?
    - Will NMFS require minimum effective brood population size?
    - Can NMFS identify the time period over which minimum brood population size can be attained?
    - Can NMFS identify specific genetic diversity requirements?
    - Is there a minimum inbreeding rate requirement?
    - Can NMFS indicate whether all proposed stocking objectives would have to meet similar requirements? For example, would limited test releases of hatchery fish to investigate habitat suitability be held to the same standards as a major hatchery reintroduction program?
    - Are there specific plan requirements, such as habitat assessment or population monitoring that must be conducted prior to stocking plan approval? If so, what are those requirements?
    - What group in NMFS is responsible for evaluation of proposed stocking plans and is there a peer review and appeals process?
    - The USFWS is a signatory to the joint controlled propagation policy (2000). What role will USFWS play in stocking plan development and approval?
    - The joint controlled propagation policy states that propagation should be used "only when other measures employed to maintain or improve listed species' status in the wild have failed, are determined likely to fail, are shown to be ineffective in overcoming extant factors limiting recovery, or would be insufficient to achieve full recovery." This statement is subjective and lacks identifiable reference points. What assurances does

    - Maryland DNR have that there are any conditions that NMFS would find acceptable to approve a stocking plan?
    - Are there specific written guidelines, other than the broad joint USFWS/NFMS propagation policy, that a state resource agency can use for guidance?
    - Has NMFS ever approved a stocking plan for an endangered species? If so, which species?
- Maryland DNR imports hatchery origin sturgeon annually from Canada. How does the ESA listing impact these imports?
    - Maryland DNR loans out Canadian origin sturgeon for outreach and education (schools, nature centers, aquariums, research institutions). Currently, 37 institutions are holding these fish. Maryland DNR cannot be held responsible to track all these fish for ESA compliance. Do we need to recall these fish and euthanize them or is there a mechanism for these institutions to take responsibility for these animals?

Section 6 Funding

- Atlantic sturgeon research projects are currently being funded through Section 6 grants. How much funding is available to the states through Section 6 grants?
- Since many state research programs overlap with Section 6 funded research programs, do these state programs need to be included in a state's Section 10(a)(1)(A) scientific research permit application? Or does NMFS handle these programs differently?

Ship strikes

- How does NMFS see states addressing boat strikes?
- The biggest impediments to sturgeon in the Delaware River are ship strikes and dredging, over which the Delaware Basin states have limited control. Is NMFS going to allow a certain number of takes for these operations and are they considered when allowing for takes by the Basin states? In other words, does the dredging/ship strikes "takes" supersede those by Basin states?

Other Impacts (Habitat, Dredging, Water Quality, etc...)

- What is going to be given priority, dredging, fisheries, boating, water quality, or other sources of takes?
- What is NMFS doing to address concerns posted in the listing decision, specifically dealing with water quality issues, and climate change? Is NMFS going to pressure the EPA to develop and enforce stricter guidelines on issues that impact Atlantic sturgeon?
- What is NMFS recommending for additional in-water construction and dredging activities?

Atlantic States Marine Fisheries Commission

1050 N. Highland Street • Suite 200A-N • Arlington, VA 22201
703.842.0740 • 703.842.0741 (fax) • www.asmfc.org

Paul J. Diodati, (MA), Chair *Dr. Louis B. Daniel, III, (NC), Vice-Chair* *John V. O'Shea, Executive Director*

Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015

March 30, 2012

Mr. Sam Rauch
Acting Assistant Administrator for Fisheries
National Marine Fisheries Service
1315 East West Highway, Room 14636
Silver Spring, Maryland 20910

Dear Mr. Rauch,

On behalf of the Atlantic States Marine Fisheries Commission, I am writing to request a 12-month delay in the April 6, 2012 effective date of the Endangered Species Act listing of Atlantic sturgeon. A delay will allow the states and NMFS needed time to review the available options and develop protections to support the continued recovery of sturgeon while providing the states take coverage. A listing of this extent has not occurred on the East Coast and with petitions for other Atlantic species being considered, sturgeon will likely be an example for future responses. Specifically, I believe the following steps have the potential to lead to a productive way forward:

- Consider the applicability of the Section 7 process to provide take coverage to states operating fisheries within Commission fishery management plans. This should be looked at from the perspective of a blanket application from the Commission on behalf of its member states, as well as separate applications from the individual states.
- Allow time for NMFS to respond to the Commission's February 29 letter that requests specific information on the listing and necessary state response.
- Allow time for ASMFC to review newly developed bycatch analyses by NMFS NERO, evaluate impacts on the stock status and determine which fisheries may need to be modified to reduce interactions. The review of new state and federal information on the magnitude and distribution of sturgeon interactions will likely result in improved response plans. In this regard, I have directed the Commission staff to schedule a meeting of the Sturgeon Technical Committee, prior to our May meeting, and anticipate a status report on its deliberations at the May Board meeting.
- Consider modifying the Section 10 process through changes to the federal review procedures to be similar to the Section 7 process.
- The primary goal of the states is to put in place effective and efficient measures to reduce Atlantic sturgeon takes as quickly as possible. Exploration of options beyond state specific Section 10 applications will likely result in timelier implementation of such regulations.

The Commission has been concerned about the status of Atlantic sturgeon for more than a decade and took steps in 1998 to protect sturgeon in state jurisdictions throughout its range. We look forward to continuing our collaborative efforts with NMFS to further restore sturgeon stocks.

Sincerely,

Paul J Diodati

Paul J. Diodati

cc: ASMFC Commissioners

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1315 East-West Highway
Silver Spring, Maryland 20910
THE DIRECTOR

APR - 6 2012

Mr. Paul Diodati
Chair, Atlantic States Marine
Fisheries Commission
1050 N. Highland Street
Arlington, VA 22201

Dear Mr. Diodati:

Thank you for your letter regarding a delay in listing of Atlantic sturgeon under the Endangered Species Act (ESA).

The final rule to list Atlantic sturgeon has already published, and we are unable to identify a rationale that would legally permit us to delay the effective date of this listing. We appreciate your efforts to examine various options to exempt incidental take of this species under the ESA and provide responses to your other questions here.

The ESA provides mechanisms for exempting incidental take of listed species during the course of lawful activities conducted by federal and non-federal entities. Section 7 of the ESA addresses activities that are authorized, funded or carried out by federal agencies, while section 10(a)(1)(B) addresses actions of non-federal entities, including states and private individuals.

We acknowledge and share your concern over the time constraints for reviewing and analyzing new data on bycatch and bycatch reduction measures. We will work closely with the Atlantic States Marine Fisheries Commission and the states to synthesize the best available information in a timely manner and to make collective decisions about how best to minimize and mitigate incidental take of Atlantic sturgeon. We will also continue to work cooperatively with the Commission to look at options for structuring section 10(a)(1)(B) incidental take permits. In addition, we will continue to evaluate all other potential options for protecting this species while providing take coverage to the states.

Modification of the section 10 process would require amendment of the ESA or its implementing regulations, either of which would take several years at minimum to complete. Pursuing such amendments would only create further delay in implementing measures to reduce incidental take of Atlantic sturgeon.

I appreciate the Commission's concerns about the status of Atlantic sturgeon, your past efforts to rebuild Atlantic sturgeon stocks, and your continued interest in ensuring that regulatory requirements are met in a timely fashion. We look forward to working in close cooperation with the Commission and the states in developing section 10 permit applications as appropriate.

Sincerely,

Samuel D. Rauch III
Acting Assistant Administrator
for Fisheries

THE ASSISTANT ADMINISTRATOR
FOR FISHERIES

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

APR 1 2 2012

John V. O'Shea, Executive Director
Atlantic States Marine Fisheries Commission
1050 N. Highland Street, Suite 200A-N
Arlington, Virginia 22201

Dear Mr. O'Shea:

Thank you for your letter on behalf of the Commissioners requesting further information relating to the listing of Atlantic sturgeon under the Endangered Species Act (ESA). Responses to the set of questions received are provided in an attachment to this letter. To the extent possible, we provide specific answers to each question given the information available at this time. We look forward to providing additional, detailed information and answers during planned and ongoing communications among the states, NMFS Protected Resources staff, Commission staff, and the U.S. Fish and Wildlife Service regarding permitting of research, state fisheries and hatchery activities. We also appreciate the Commission's continued support of Atlantic sturgeon recovery.

Sincerely,

Helen M. Golde
Acting Office Director,
Office of Protected Resources

Enclosure

Atlantic States Marine Fisheries Commission

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Paul J. Diodati, (MA), Chair *Dr. Louis B. Daniel, III, (NC), Vice-Chair* *John V. O'Shea, Executive Director*

Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015

February 29, 2012

James Lecky, Director
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway, 13th Floor
Silver Spring, Maryland 20190

Dear ~~Mr. Lecky~~, Jim,

I am writing on behalf of our Commissioners to provide you with a list of questions related to the Atlantic sturgeon ESA listing. Our Commissioners requested responses in writing to best help them. We met earlier this month to discuss the listing. Lisa Manning from your staff presented a summary of the listing process and permitting consultation; however the ASMFC states had a number of detailed questions that were not able to be answered due to time limitations at the meeting. The questions are included as an attachment to this letter.

Many of the ASMFC member states are not familiar with responding to an ESA listing, including the Section 10 process. Moving forward through this process will require frequent communication between NMFS Protected Resources staff, the states, and Commission staff. To that end, my staff is working with Kim Damon-Randall (NERO) to schedule a conference call with the states from Maine through North Carolina and NERO to provide additional background and develop a plan for moving forward. The states from South Carolina through Florida have been in contact with David Bernhart (SERO).

Once you've had a chance to review these questions it would help if you could let us know how long it will take to answer them. We look forward to continuing and strengthening our cooperative efforts in the conservation of Atlantic sturgeon. Please feel free to contact me, or your staff can contact Bob Beal at (703) 842-0740.

~~Sincerely~~,

Vince

John V. O'Shea

Att: List of Questions

cc: Daniel Morris, NERO
Kimberly Damon-Randall, NERO
David Bernhart, SERO
ASMFC Commissioners

Atlantic States Marine Fisheries Commission
Questions Regarding Atlantic Sturgeon ESA Listing

Section 10 General

- What are NMFS strategies/criteria for addressing Section 7 and Section 10 permits, and how is NMFS going to evaluate the priority fisheries/projects?
- How do the ESA Section 10 and Section 7 consultation rules and processes deal with multiple listed species in a single fishery or research project?
- What are the liability issues for states without approved Section 10 permits in place by April 6th?
- What is the current estimated timeline for NMFS to process the Section 10 permits?
- Maryland's current monitoring program is supported by collections from commercial fishermen. What are the conditions under which the Maryland Sturgeon Reward Program could continue?
- When will the determination on the Gulf of Maine protective measures be published?
- How is mixing of DPSs units accounted for in the development of take levels?

Section 10(A)(1)(B)

- Will NMFS require a consolidated conservation plan for shortnose sturgeon, sea turtles and Atlantic sturgeon? Should a state include other endangered species – specifically marine mammals – when developing its Conservation Plan?
- Does every fisher within state waters with the potential to "take" a sturgeon need to have a Certificate of Inclusion?
- Would it be better for a state to have every fishery within state waters that may encounter a sturgeon on one application or to do one for each fishery?
- Does the ITP allow a specific number of takes within a specific period? If yes, what happens if the takes happen in the first, say 10%, of the take period? Fisheries closures for the remainder of the year?
- For states that do not have sufficient resources to conduct the NMFS required level of monitoring in order to adopt a conservation plan, is it possible to gain approval for a plan with reduced monitoring requirements?
- For states that cannot meet NMFS requirements to predict the number of observed annual takes (i.e. there is inadequate supporting data to formulate the "take table"), how will this be handled by NMFS? There are few observations of Atlantic sturgeon "takes", which would also make it difficult to generate a statistically valid take table for this species.
- Can an ITP be issued subsequent to conservation plan approval or are there additional requirements?
- What mechanisms do states have to access NMFS observer data to help develop ITP applications, specifically involving ocean trawls, beach seine, and gill nets?
- Since NMFS is working through the Regional Councils for ITPs for fisheries with bycatch issues in federal waters (i.e. monkfish), is the same true with those fisheries with limited bycatch issues and/or those where the harvest can also be in state waters (i.e. summer flounder)?

Section 10(a)(1)(A) – Research General

- Do federally funded state research programs require a Section 10(a)(1)(A) scientific research permit and/or a section 7 consultation?
- How easy is it to amend a Section 10(a)(1)(A) scientific research permit within the five-year period, if additional research programs come on-line within that period?

Section 10(a)(1)(A) – Stocking

- How do NMFS stocking or recovery plan requirements compare to the ASMFC Guidelines for Stocking Cultured Atlantic Sturgeon for Supplementation or Reintroduction (2006)?
- Disposition of current captive stock:
  - Can hatchery origin Hudson River sturgeon housed in Maryland be stocked into the Hudson River if New York is supportive of such an effort? This was done several years ago using fish cultured at USFWS Northeast Fishery Center.
  - Are Canadian origin hatchery progeny currently held by Maryland DNR and its cooperators subject to all the ESA rules applied to a listed DPS?
  - Can wild-caught sturgeon currently held in captivity be legally released back into Maryland waters at any time?
  - Can currently held captive stock be maintained without a permit if the objective is normal husbandry and medical care? What are the record-keeping requirements for such an arrangement?
- What are the specific requirements for approval of a stocking plan? Specifically:
  - What are acceptable brood sources?
  - Can NMFS identify other specific brood stock selection criteria?
  - Will NMFS require minimum effective brood population size?
  - Can NMFS identify the time period over which minimum brood population size can be attained?
  - Can NMFS identify specific genetic diversity requirements?
  - Is there a minimum inbreeding rate requirement?
  - Can NMFS indicate whether all proposed stocking objectives would have to meet similar requirements? For example, would limited test releases of hatchery fish to investigate habitat suitability be held to the same standards as a major hatchery reintroduction program?
  - Are there specific plan requirements, such as habitat assessment or population monitoring that must be conducted prior to stocking plan approval? If so, what are those requirements?
  - What group in NMFS is responsible for evaluation of proposed stocking plans and is there a peer review and appeals process?
  - The USFWS is a signatory to the joint controlled propagation policy (2000). What role will USFWS play in stocking plan development and approval?
  - The joint controlled propagation policy states that propagation should be used "only when other measures employed to maintain or improve listed species' status in the wild have failed, are determined likely to fail, are shown to be ineffective in overcoming extant factors limiting recovery, or would be insufficient to achieve full recovery." This statement is subjective and lacks identifiable reference points. What assurances does

Maryland DNR have that there are any conditions that NMFS would find acceptable to approve a stocking plan?
    - Are there specific written guidelines, other than the broad joint USFWS/NFMS propagation policy, that a state resource agency can use for guidance?
    - Has NMFS ever approved a stocking plan for an endangered species? If so, which species?
- Maryland DNR imports hatchery origin sturgeon annually from Canada. How does the ESA listing impact these imports?
    - Maryland DNR loans out Canadian origin sturgeon for outreach and education (schools, nature centers, aquariums, research institutions). Currently, 37 institutions are holding these fish. Maryland DNR cannot be held responsible to track all these fish for ESA compliance. Do we need to recall these fish and euthanize them or is there a mechanism for these institutions to take responsibility for these animals?

Section 6 Funding
- Atlantic sturgeon research projects are currently being funded through Section 6 grants. How much funding is available to the states through Section 6 grants?
- Since many state research programs overlap with Section 6 funded research programs, do these state programs need to be included in a state's Section 10(a)(1)(A) scientific research permit application? Or does NMFS handle these programs differently?

Ship strikes
- How does NMFS see states addressing boat strikes?
- The biggest impediments to sturgeon in the Delaware River are ship strikes and dredging, over which the Delaware Basin states have limited control. Is NMFS going to allow a certain number of takes for these operations and are they considered when allowing for takes by the Basin states? In other words, does the dredging/ship strikes "takes" supersede those by Basin states?

Other Impacts (Habitat, Dredging, Water Quality, etc...)
- What is going to be given priority, dredging, fisheries, boating, water quality, or other sources of takes?
- What is NMFS doing to address concerns posted in the listing decision, specifically dealing with water quality issues, and climate change? Is NMFS going to pressure the EPA to develop and enforce stricter guidelines on issues that impact Atlantic sturgeon?
- What is NMFS recommending for additional in-water construction and dredging activities?

Responses to Questions Regarding the Atlantic Sturgeon ESA Listing

Section 10 General

The questions raised under this heading touched on multiple topics. In some cases, explicit answers are not possible without knowing more about the particular circumstances associated with a question. Additional information on some of the topics raised by this set of questions is addressed by information provided in subsequent sections.

- The section 10 and section 7 processes are guided by statutory and regulatory requirements. There is no guidance or policy on how to prioritize projects or fisheries. We will process complete applications for section 10 permits in the order in which they are received. However, if requested, we can coordinate with the states and the Commission on deciding which fisheries or projects are priorities and also potential opportunities for efficiencies by combining applications where possible.
- Section 7 consultations must consider the effects of an action on all listed species that may be affected by the action, including those under the jurisdiction of the U.S. Fish and Wildlife Service.
- Now that the listing is effective, "take" of endangered Atlantic sturgeon is illegal under the ESA. Take can be exempted under section 10 (for non-federal actions) or section 7 (for federal actions). Unauthorized take could be subject to litigation by any outside party or to enforcement action by federal or any authorized state agent.
- Section 10(a)(1)(A) permits may take up to a year to process. A batch of 10(a)(1)(A) permits authorizing directed research on Atlantic sturgeon was issued on April 4, 2012. Section 10(a)(1)(B) permits may take up to several years to complete. These permitting processes require: (1) a complete permit application (including a conservation plan in the case of section 10(a)(1)(B) permits), (2) a 30-day public comment period, (3) an analysis under the National Environmental Policy Act (NEPA), and (4) a section 7 consultation. Steps two through four can only begin once a complete application is received.
- Section 10(a)(1)(B) permits are used to authorize incidental take in state fisheries, and permits under section 10(a)(1)(A) are used to authorize scientific research activities. Such authorizations would allow the Maryland Reward Program to operate legally.
- The statutory deadline for the Gulf of Maine protective regulations (e.g., the 4(d) final rule) is June 10, 2012.
- Mixing of fish from different DPSs will be taken into account using the best available acoustic telemetry and genetic data. These data provide information regarding the extent

of mixing throughout the range of the taxonomic species. Various research efforts are adding to the current knowledge base on an ongoing basis, and we intend to refine our analyses whenever new data to improve our analyses become available. We are in the process of gathering additional samples from the Northeast Observer Program and other sources to further analyze the extent of mixing; this analysis is being used to support ongoing section 7 consultations on multiple federal fisheries.

Section 10(a)(1)(B)

The following overview of the process and requirements for section 10(a)(1)(B) permits is provided to respond to the multiple, specific questions raised regarding incidental take permitting. Please let us know if additional clarifications are still needed, keeping in mind that some details are the subject of ongoing discussions among the states, NMFS Protected Resources staff, and Commission staff. Please also note that some specific questions regarding section 10(a)(1)(B) permitting are being addressed through communications with states that have already submitted permit applications.

The main, required element of a section 10(a)(1)(B) permit application is a conservation plan. The ESA requires that we issue an incidental take permit only if the applicant submits a conservation plan that specifies –

1) The impact which will likely result from such taking;
2) What steps the applicant will take to minimize and mitigate such impacts, and the funding that will be available to implement such steps;
3) What alternative actions to such taking the applicant considered and the reasons why such alternatives are not being utilized; and
4) Such other measures that the Secretary [of Commerce] may require as being necessary or appropriate for purposes of the plan.

The ESA implementing regulations at 50 CFR 222.307 further clarify that applications must include a conservation plan, based on the best scientific and commercial data available, that specifies the anticipated impact (i.e., amount, extent, and type of anticipated taking) of the proposed activity on the species or stocks.

We recommend that conservation plans address all listed species that may be incidentally taken as a result of the activity (e.g. a state fishery). Conservation plans need not address all state fisheries and instead can be focused on a particular fishery or fisheries. How a conservation plan is structured in terms of the fisheries to be included is at the discretion of the applicant.

Incidental take permits may include more than one fishery and even fisheries in more than one state. We would like to discuss with the Commission whether pursuing a general incidental take permit that could be issued to the Commission to cover fisheries across multiple states would be advantageous. Under a general incidental take permit, individual state agencies (not the individual fishers) would be issued certificates of inclusion in order to be covered by the general permit.

Permit-holders are responsible for monitoring their take of listed species and evaluating whether they are approaching take limits. If take limits are being reached more rapidly than had been anticipated, permit holders can act proactively by coordinating with NMFS rather than waiting until they exceed their take limit. Our ESA implementing regulations at 50 CFR 222.307 also contain procedures and requirements for addressing changed and unforeseen circumstances. Such procedures can be used to implement additional mitigation and minimization measures where and when appropriate.

The ESA states that we shall issue a section 10(a)(1(B) permit, if we find, after opportunity for public comment, with respect to the permit application and the related conservation plan, that the incidental taking will not appreciably reduce the likelihood of the survival and recovery of the listed species in the wild.

Where data on bycatch exist and are available to us, we can provide those data to applicants to support the development of their application and conservation plan. The NMFS Northeast Regional Office has been compiling data and information to support section 7 consultations on federal fisheries; Kim Damon-Randall can be contacted with any specific information requests (Kim.Damon-Randall@noaa.gov; 978-282-8485). Specific data requests for the Southeast Region can be requested from Kelly Shotts (Kelly.Shotts@noaa.gov; 727-824-5312).

We are currently working with the regional Councils on consultations under section 7 for federally managed fisheries, and we will complete consultations for all federally managed fisheries that may affect listed Atlantic sturgeon. Where these fisheries extend into state waters (e.g. summer flounder and bluefish), we will be coordinating with the Councils and Commission to consider impacts from these fisheries.

Section 10(a)(1)(A) – General

Federally funded research on most listed species requires a section 10(a)(1)(A) permit. Issuance of these permits constitutes a federal action and thus, is subject to a section 7 consultation.

Scientific research permits can be amended once they are issued. The amount of time and effort involved with modifying a permit depends on whether the change is considered a major or minor modification. An increase in the take numbers or adding a new species to the permit would likely qualify as a major modification. A major permit modification can take up to a year; while a minor permit modification can be processed as quickly as a couple days.

Section 10(a)(1)(A) – Stocking

We cannot provide specific requirements for approval of a stocking plan because there are many factors to consider, including stock origin, location details, age of fish to be stocked, habitat suitability, etc. We will review stocking plans for consistency with the September 2000 joint U.S. Fish and Wildlife Service - NMFS controlled propagation policy (65 FR 56916; http://www.nmfs.noaa.gov/pr/pdfs/fr/fr65-56916.pdf).

The Office of Protected Resources, Permits Division reviews section 10(a)(1)(A) research and enhancement permits. Permit applications are announced in the *Federal Register* to provide the public with an opportunity to comment on them. There is no appeals process.

Anyone considering stocking should coordinate with NMFS to develop stocking plans and include the plan in a section 10(a)(1)(A) permit application. This information will be considered by NMFS in determining whether to issue a permit.

We will approve stocking plans if they meet the joint policy criteria. However, if, for example, the habitat proposed for stocking in a stocking plan is not suitable, we would not approve the stocking plan. If bycatch is a significant threat in the area proposed for stocking, we would not likely approve stocking in that area because the likelihood of survival would be low. We will not approve stocking of fish that are not genetically similar to the wild stock. The goal of the ESA is to recover species in their natural environment. The criteria in the joint controlled propagation policy provide general guidance, and if this guidance is adhered to, it should not be too difficult to predict whether a particular stocking plan would be approved. We have no other specific written guidelines. Now that Atlantic sturgeon are listed, the joint controlled propagation policy supersedes any other guidance. We have approved a captive broodstock plan to help recover Snake River sockeye salmon, and we have approved hatchery releases for numerous Pacific salmon conservation and production hatcheries.

Section 6 Funding

Funding available to support grants to states under section 6 (Species Recovery Grants Program) depends on annual appropriations from Congress. Congress appropriated $2.8 million for this program in fiscal year 2012. The President's budget for fiscal year 2013 requests $4.8 million for the Species Recovery Grants Program.

Research supported under a section 6 grant must be authorized under a section 10(a)(1)(A) research permit. There is no difference in requirements or processes for research permits that overlap with research funded under section 6 of the ESA.

We coordinate closely with our Permits Division in the Office of Protected Resources to ensure that research supported through the grant program is either already authorized under a research permit or will soon be authorized under a research permit such that available funding is not tied up on a grant that cannot be executed.

Ship Strikes

Recommendations on ship strikes will likely be included in the draft Recovery Plan for Atlantic sturgeon. At this stage, we recommend collecting data on ship strikes to the extent possible to inform any recovery actions that should be included in the Recovery Plan.

The section 7 process requires that we consider the baseline of those actions already affecting the listed species. For any action undergoing a section 7 consultation, be it dredging, research, or construction, we must consider other ongoing actions that are affecting the species when determining what level of take can be authorized. Take of listed Atlantic sturgeon by dredging and ship strikes does not necessarily "supersede" take that may be authorized under a permit to the states, but if it is ongoing, it must be considered as part of the baseline.

Other Impacts

In the Northeast, we have identified over 50 formal consultations that will most likely require re-initiation under section 7 due to potential interactions with Atlantic sturgeon. These include a variety of activities with various federal action agencies including the Army Corps of Engineers, the Federal Energy Regulatory Commission, Nuclear Regulatory Commission and the Environmental Protection Agency. Of these, we have identified approximately 20 "high priority" Opinions that we are working to get completed as soon as possible given the anticipated start dates of these projects. This includes 11 Federal Fishery Management Plans.

In the Southeast region, we included a "conference" on Atlantic sturgeon in all ongoing section 7 consultations once Atlantic sturgeon were proposed for listing. Such consultations do not need to be re-initiated now that the listing has become effective. We are currently working with other federal agencies (e.g. Army Corps of Engineers) to determine which activities may affect Atlantic sturgeon and thus require a re-initiation of previous section 7 consultations.

We will continue to work with the EPA through the section 7 process on consultations related to the issuance of National Pollutant Discharge Elimination System permits as well as state water quality standards to ensure that they are protective of Atlantic sturgeon. Consultations on in-water and dredging projects will consider the cumulative effects of ongoing activities and include requirements to avoid jeopardizing the continued existence of any affected DPSs.

A Recovery Plan that addresses existing threats to Atlantic sturgeon, including water quality and climate change, will be drafted by a team, released for public and peer review, and finalized and made publicly available. This Recovery Plan will prioritize actions (priority 1, 2, or 3) needed to recovery the species. Highest priority actions (priority 1) are those actions considered necessary to prevent extinction. Recovery Plans are not regulatory; they provide a framework and direction for recovering listed species. We have discussed with the Commission the idea of using the Commission's existing sturgeon technical committee as a significant component of the recovery team in order to capitalize on its existing wealth of experience with Atlantic sturgeon management issues.

Summary of Discard Estimates for Atlantic Sturgeon

Prepared by Tim Miller and Gary Shepherd
Population Dynamics Branch
Northeast Fisheries Science Center

August 19, 2011

Major Summary Points

1. This report provides a summary of sturgeon discard estimates from 2006 to 2010 for otter trawl and sink gillnet fisheries. A secondary objective was to establish an association between the sturgeon encounters and species groups within fishery management plans. This led to a model-based, rather than a design-based estimator of discards.

2. The spatial coverage of observed trips is not sufficient to support precise estimation of discards at the level of 3-digit Statistical Area and monthly resolution

3. The spatial coverage of observed trips is sufficient to support discard estimation at the level of 2 digit Statistical Areas {51,52,53,56,61,62,63}.

4. Given this spatial resolution it is possible to estimate discards at the quarterly level in most years (2006-2010) but the precision of these estimates is expected to be low.

5. Within federal waters, sturgeon were captured primarily in small and large mesh trawls, and small, large and extra large mesh sink gillnets. Captures observed in state waters or observed by state observers are not included in this report.

6. Estimates of discards at the finest level of resolution (Stat Area x Quarter x gear) are expected to be imprecise.

7. Two estimators were examined.

    a. A design based ratio estimator expands the ratio of total sturgeon takes to total landings by the total landings within a cell
    b. A model based estimator incorporates the mixture of species associated with the observed trips. Other factors in the model include year and year x FMP interactions. Separate models were developed for sink gillnets and trawls. Mesh size was not included, but to some extent, the species mixtures will alias the mesh effect, e.g., silver and red hake, butterfish and squid alias small mesh gear.

8. The design based ratio estimator relies on the assumption that discards are proportional to the total amount landed. While this has been observed for many species, the rarity of sturgeon makes it difficult to satisfy this assumption. Variance estimates for the ratio estimator were not computed.

9. The model based estimator takes additional biological information into account and provides some information about the species associations that may influence sturgeon encounter rates. Standard error estimates of the total discards by year and gear are about 25%?

10. The partitioning of discard encounters to FMPs is not a particularly informative exercise because of the high likelihood of inappropriately attributing associations/responsibilities.

11. An application of the method of Warden (2010) to the design based estimator was difficult to interpret. Heterogeneity of fishing activities within each gear* area* year strata led to inappropriate conclusions about the FMP associations.

12. Alternatively, the model based approach led to somewhat more sensible FMP associations and allowed for a comprehensive approach, rather than a two stage process (ie. Ratio estimator, followed by the Warden method).

13. Important caveats for the interpretation of the FMP associations include:
    a. The NEFOP data do not include takes by inshore state water fisheries. These are reliant on state-specific observer programs or programs designed for marine mammals or turtles.
    b. A significant fraction of the sturgeon takes are associated with non FMP species (eg. ASMFC plans or state fisheries).
    c. The influence of an FMP is a measure of association that sums to one across all species groups. HOWEVER, it is not a measure of the incidence rate or probability of capture.
    d. Most trips capture one or more FMP species and the specific gear or deployment patterns within a trip may change. At the trip level it is not possible to identify these finer scale patterns. At the tow level within trip the ability to resolve potential causes may be higher, but it is not possible to expand such inferences to the total database. In other words, the VTR data cannot support such expansions.
    e. Most of the FMPs have multiple species. The bycatch of sturgeon may be more closely associated with one species than the other (eg. fluke, scup, sea bass). Hence the multispecies associations may be too coarse.
    f. Observer coverage for mid Atlantic species is generally lower than coverage rates on Georges Bank and Gulf of Maine.
    g. Recent changes in skate and dogfish fisheries with increased directed fishing may have important temporal effects on associations.
    h. Estimates are based on landings only. The FMPs in question may (will) influence the quantity of landings and consequently the FMP attributable to sturgeon bycatch.

Part 1. Design Based Estimation--Summary of Atlantic sturgeon by-catch in otter trawl and sink gillnet fisheries.

The intent of this analysis was to update previous estimates from 2006 through 2010. Data were limited by observer coverage to waters outside the coastal boundary (fzone>0) and north of Cape Hatteras, NC. Sturgeon included in the data set were those identified by federal observers as Atlantic sturgeon, as well as those categorized as unknown sturgeon. At this time, data were limited to information collected by the Northeast Fishery Observer program. Limited data collected in the At-Sea monitoring program were not included, although preliminary views suggest the incidence of sturgeon encounters was low.

The frequency of encounters in the observer programs were expanded by total landings recorded in vessel trip reports rather than dealer data, since the dealer data does not include information on mesh sizes. Generally the VTR data represents greater than 90% of total landings. Originally the data was to be evaluated by year, month, 3-digit statistical area, gear type and mesh size. Unfortunately the level of observer coverage did not support that degree of partitioning in the data. Tables 1-4 illustrate the sparse data available to support discard estimation at this level of resolution.

Therefore data were combined into division (identified as the first 2 digits in area codes), quarter, gear type (otter trawl (fish) and sink gillnet) and mesh categories. Mesh sizes were categorized for otter trawl as small (<5.5") or large (greater than or equal to 5.5") and small (<5.5"), large (between 5.5" and 8") and extra large (>8") in sink gillnets.

For each cell (year, division, qtr, gear, mesh) the ratio of sturgeon count to total kept weight of all species was calculated. This ratio was then applied to total landed weight in the cell as recorded in VTR data. No imputation was done to estimate sturgeon in missing cells. Total discard estimates for all encounters (alive + dead at capture) for gill nets and trawls in Tables 5 and 6, respectively. Total discards for sturgeon encounters where the observer recorded the fish as dead (a subset of total encounters) are summarized in Table 7 (gill nets) and Table 8 (trawls). The two categories represent bounds of possible sturgeon mortalities. A composite summary across gears is provided in Table 9. Using the ratio estimator the overall fraction of dead discards to total encounters is about 12% for both gears combined. About 20% of the sink gill net encounters were dead at capture while only about 5% of the otter trawl encounters were dead at capture. It must be emphasized that these conclusions are dependent on the validity of the ratio estimator model. Moreover, results should not be considered definitive estimates of Atlantic sturgeon losses because the estimates do not address the issue of missing cells.

Further analyses, not presented here suggested that the ratio estimator may not be sufficient to provide appropriate expansions to total encounters. Attempts to apply the method of Warden (2011) to identify the degree of association by FMP suggested that the total kept estimate within a strata was more heterogeneous than desirable for a ratio estimator. Examination of the actual observer data for trips that caught sturgeon suggested that the species mix within the trip, rather than the mesh within gear, may be a better predictor of encounter rate. Moreover, a model based estimator may help resolve some of the remaining heterogeneity within a stratum. This led to an alternative model described in the next section.

Part 2. Model-Based Estimates of Atlantic Sturgeon Encounters

Concerns about the utility of the design-based ratio estimator for sturgeon encounters led to the development of a model based approach. The model-based estimator attempts to resolve the heterogeneity within spatial and temporal strata by considering the mix of species on a given trip. The basic idea is that mix of species can improve predictions better than the strata x gear x mesh x quarter.

A generalized linear model was used with the sturgeon takes on each trip as the response. A quasi-Poisson assumption was made for the distribution of the response which allows the variance to be greater than that associated with the Poisson distribution. There was necessary because there was substantially greater dispersion in the residuals than expected under the Poisson model.

A variety of candidate models were evaluated with the following factors as predictor variables:

a. Presence/Absence of a species within an FMP (e.g., 1 if bluefish caught, 0 otherwise, 1 if a fluke, scup or seabass was caught, 0 otherwise, and so forth.) Each FMP was included as a binary (0/1) predictor variable.
b. Year as a factor {2007-2011}
c. FMP X Year interactions.
d. Quarter as a factor
e. FMP X Quarter interactions

Separate models were developed for all mesh sizes of gill nets and all mesh sizes of otter trawl. The rationale for ignoring the differences in mesh size is that differences in species composition alias the effects of mesh differences.

The general model for the log-mean take on trip i is

$$\ln\left(\hat{T}_i\right) = \hat{\beta}_0 + \hat{\beta}_1 X_{1i} + \cdots + \hat{\beta}_p X_{pi}$$

where $\hat{\beta}$ are the estimated coefficients and $X_{1i}, \ldots, X_{pi}$ are the covariates that represent FMP, year, quarter and any interactions. For the models we consider here the covariates for each trip are either 0 or 1 depending on whether a particular FMP was landed and what quarter or year the trip took place.

Model fitting is based on observer hauls and landings of each species and takes of any sturgeon on those hauls since 2006. FMP landings are determined by aggregating species landings attributable to each FMP.

To predict sturgeon take for all landings, we are primarily interested in data aggregated to the trip level since VTR data are recorded at this level. Similar to the observer data, FMP landings for each trip in the VTR data since 2006 are determined by aggregating species landings attributable to each FMP. Otter trawl and sink gillnet based landings are discussed separately below, but the general methodologies are the same.

Given estimated coefficients from fitting the model to observer data, we make predictions of the expected sturgeon take for each VTR trip where we have the same information on whether the FMP was landed, and, if necessary, year and quarter. The predictions are made using the anti-log of the same equation above, but where the covariates are for VTR trip i. The total discard estimates represent the sum of all the model predictions over the relevant year, quarter and statistical division. The final models and predicted discards are provided in Appendix A for otter trawls and in Appendix B for sink gillnets.

Model Based Otter Trawl Estimates

In all observed trawl gear (gear code = 50) records from 2006 to 2010, there were no landings attributable to herring, river herring, salmon, tilefish, red crab and surf clams/ocean quahog FMPs when sturgeon were taken. So those FMPs are not considered in further analysis.

When fitting the quasi-poisson generalized linear model to trip-aggregated data on sturgeon takes and FMP catches (model 0), there is a declining trend (significant or not) in mean sturgeon numbers with increased catches for most FMPs. For those where positive trends occur they are not significant except the “other” category of catches that does not include any of the FMPs. Fitting the same type of model with indicator covariates of whether the FMP landed rather than the actual amount landed on the trip (model 1), there is only a significant positive effects for FSB.

When fitting the same type of model as model 1, but with quarterly differences in the effects of the FMP landings indicators (model 2), the determination of meaningful positive effects is complicated because the reference class of trips needs to be defined. The default in the model fitting is a trip without any of the FMPs in the first quarter of the year. Note that the quarterly effects are constant across years in this model (i.e, “year” is not in the model). Other models that we fit allowed effects of the FMPs to be unique for all 20 quarters (year*qtr) (model 3), to differ by year (model 4), to differs by each of the 20 quarters but not affected by FMP (model 5), and to differ by year only (model 6) or by quarter only (model 7). The best performing model of those fitted to the trip specific data based on $QAIC_c$ was model 3 that allowed quarterly effects of the FMPs on sturgeon take.

Model Based Gill Net Estimates

In all observed gillnet gear (gear code = 100, 105,116,117) records from 2006 to 2010, there were no landings attributable to herring, river herring, salmon, tilefish, red crab and surf clams/ocean quaohog FMPs when sturgeon were taken. So those FMPs are not considered in further analysis.

When fitting the quasi-poisson generalized linear model to trip-aggregated data on sturgeon takes and FMP catches for gillnet gear (model 0.gn), there is a declining trend (significant or not) in mean sturgeon numbers with increased catches for most FMPs. For those where positive trends occur they are not significant. Fitting the same type of model with indicator covariates of whether the FMP landed rather than the actual amount landed on the trip (model 1.gn), there is a significant positive effect of presence of for monkfish and striped bass FMPs, and the "other" category.

As for otter trawl gear, we fit models allowing effects of the FMP landings indicators to differ quarterly (model 2.gn), to be unique for all 20 quarters (year*qtr) (model 3.gn), to differ by year (model 4.gn), to differ by each of the 20 quarters but not affected by FMP (model 6.gn), and to differ by year only (model 6.gn) or by quarter only (model 7.gn). The best performing model of those fitted to the trip specific data based on $QAIC_c$ was model 4.gn that allowed yearly effects of the FMPs on sturgeon take.

Part 3. Allocation to FMP from Final Model

Trying to measure the effect of different FMPs on the sturgeon take is complicated because landings attributable to multiple FMPs can occur on the same trip, whether sturgeon are taken or not. Below, we propose a possible method based on the above models.

The method for predicting the take on a given VTR trip is given above. Given the indicators of presence for FMPs for all of the VTR trips, we can predict the total take of sturgeon for all fishing effort in the given year/quarter/mesh-size category k as

$$\hat{T}_{k,i} = \sum_{i=1}^{N_k} \hat{T}_{k,i}$$

The proposed measure of effect for each FMP is the predicted total take on trips where FMP f is present:

$$\hat{T}_f = \sum_{i=1}^{N_f} \hat{T}_{f,i} \, .$$

When there is a combination of strong association of sturgeon take with an FMP or a large number of trips where the FMP is present, this measure will be large. When there is no effect or when the FMP is always absent, this measure will be 0. A possible relative weight for the FMPs is

$$W_{y,q,f} = \frac{\hat{T}_{y,q,f}}{\sum_{f=1}^{F} \hat{T}_{y,q,f}} .$$

The weights sum to 1 and can be used to attribute proportions of the total take to each FMP.

For trawl data we could not use the best model (model 5) for predicting sturgeon take from the VTR data because of the inability to predict sturgeon take due to lack of observations of some types of interactions and the presence of those types of trips in the VTR data., Instead we used the next best model with respect to $QAIC_c$ (model 2, see Appendix A for estimated coefficients) to determined the predicted yearly total takes, the weights $W_{y,f}$ for each FMP in years 2006-2010, and also the total take across all years and corresponding weights determined by the sum of the predicted takes for all trips across years (Table 10). The weights indicate that for otter trawl gear the correlation of FMP landings to sturgeon take are consistently highest for FSB.

Skate and SMB FMPs have the next largest weights which are similar to the “other” category that accounts for landings of fish not attributable any of the FMPs (e.g., lobster and croaker).

For gill net data and using model 4.gn (see Appendix B for estimated coefficients), I determined the predicted yearly total takes, the weights $W_{y,f}$ for each FMP in years 2006-2010, and also the total take across all years and corresponding weights determined by the sum of the predicted takes for all trips across years (Table 11). The weights indicate that for gillnet gear the correlation of FMP landings to sturgeon take are consistently highest for monkfish, but the skate FMP had a similar weight in 2009 and 2010 which resulted in it having the next largest weight among all FMPs when looking at all years (2006-2010) combined. The “other” category has the next largest weight for all data combined and all others are less than 0.1.

References

Warden, ML. 2011. Proration of loggerhead sea turtle (*Caretta caretta*) interactions in US Mid-Atlantic bottom otter trawls for fish and scallops, 2005–2008, by managed species landed. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 11-04; 8 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026

Figure 1. Estimated annual sturgeon take by trawl gear. Vertical bars represent approximate 95% confidence intervals.

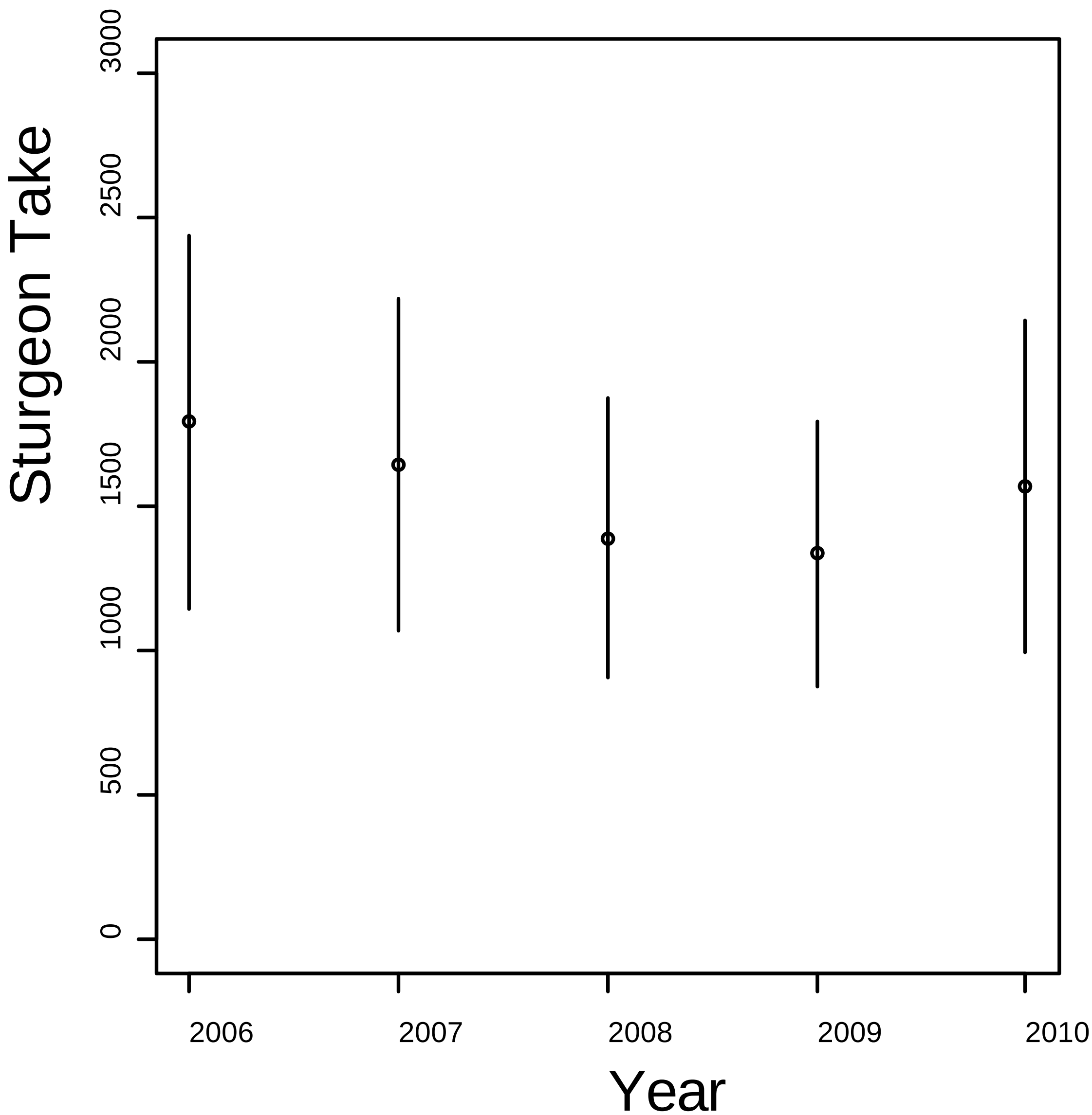

Figure 2. Estimated annual sturgeon take by gillnet gear. Vertical bars represent approximate 95% confidence intervals.

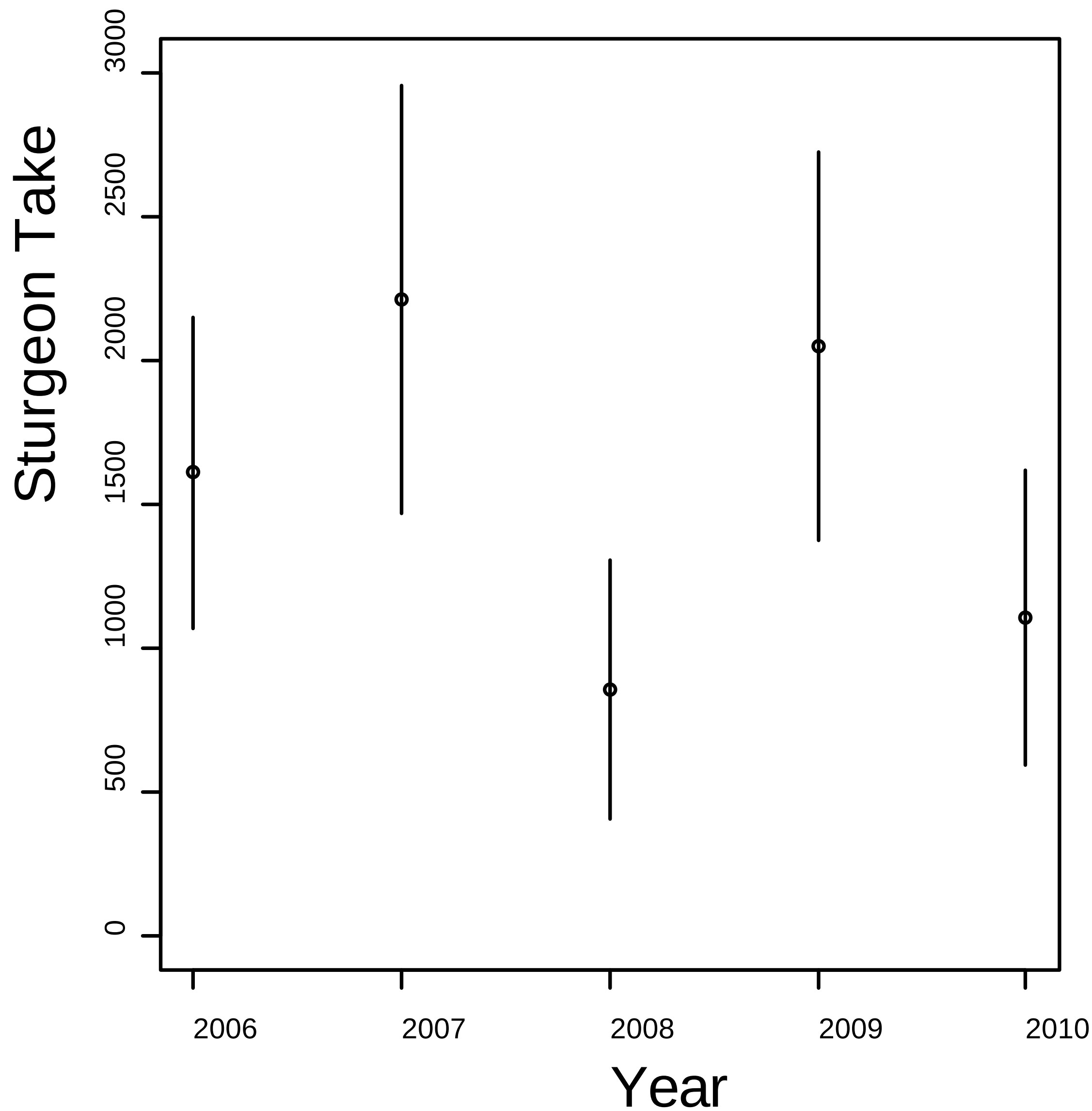

Figure 3. Annual relative influence of FMP on sturgeon take for trawl effort. Vertical bars represent approximate 95% confidence intervals.

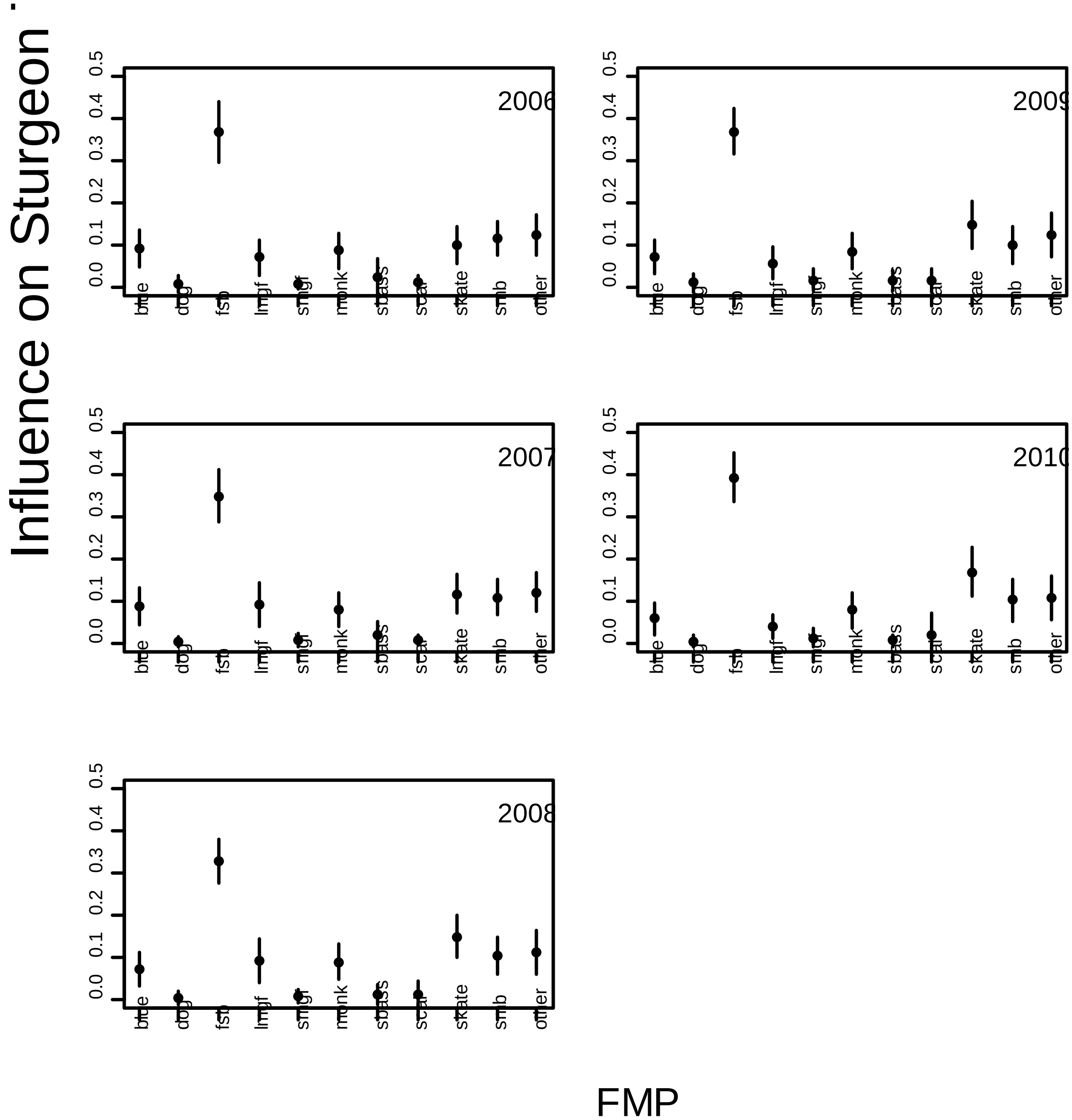

Figure 4. Annual relative influence of FMP on sturgeon take for gillnet effort. Vertical bars represent approximate 95% confidence intervals.

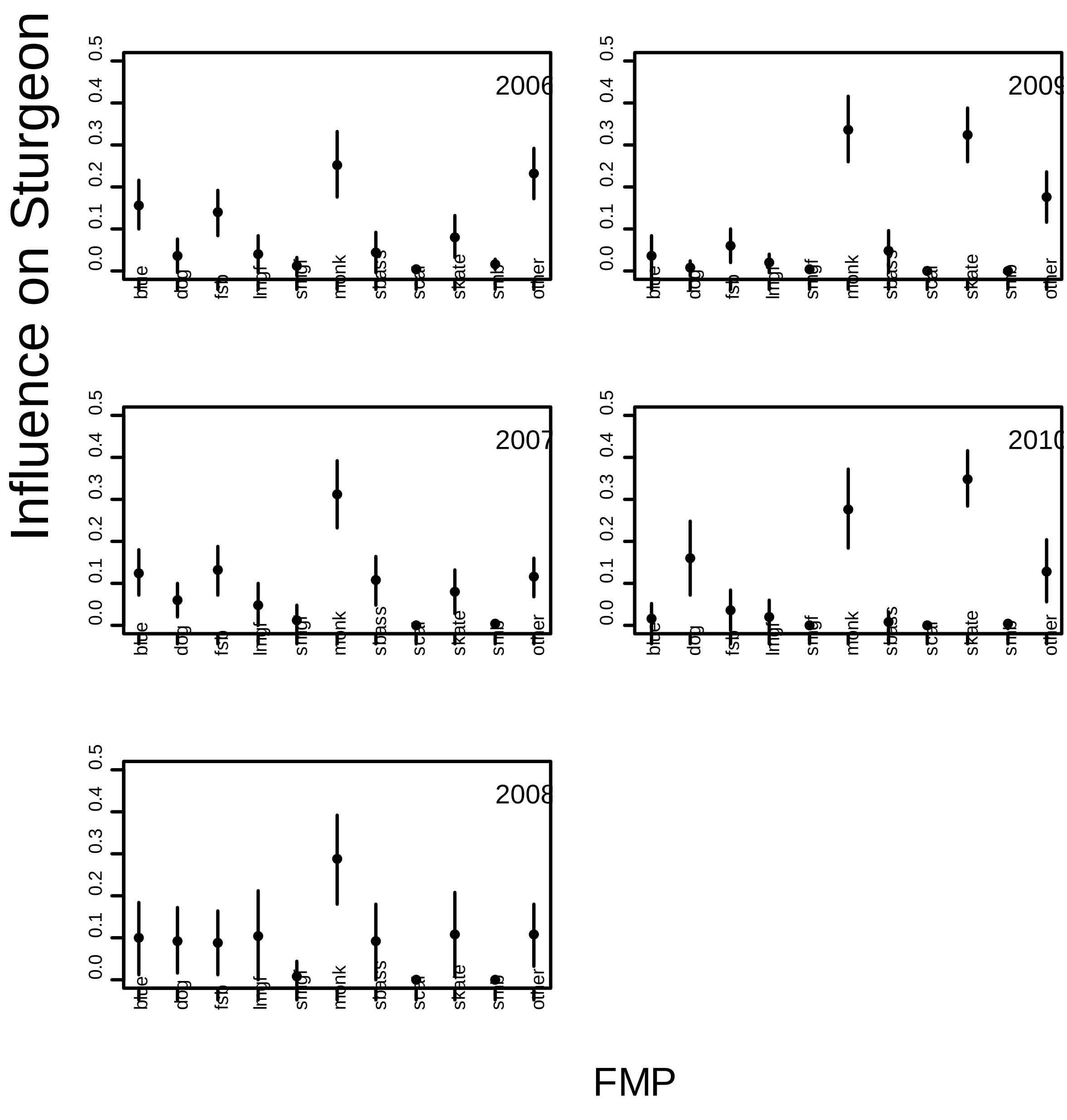

Table 1. Encounters of Atlantic sturgeon and sturgeon, unknown by month, area and mesh size in otter trawl gear, 2006-2010 combined.

Large mesh otter trawl

	month											
area	1	2	3	4	5	6	7	8	9	10	11	12
464	0		0		0					0	0	
465	0		0	0		0	0				0	0
511	0			0								0
512	0		0	0	0	0	0	0	0	0	0	0
513	0	0	0	0		0	0	0	0	0	0	0
514	3	0	0	0	0	0	0	0	0	0	0	0
515	0	0	0	0	0	0	0	0	0	0	0	0
521	0	0	0	0	0	0	0	0	0	0	0	0
522	0	0			0			0	0	0	0	
525			0	0	0	0	0	0				
526	0	0	0	0	0	0	0	0	0	0	0	0
537	0	0	0	0	0	0	0	0	0	0	1	0
538				0	0	0	0	0	0	0	0	
539	0	0	0	0	0	0	0	0	0	0	0	0
562					0	0	0	0				
611	0	0	0	0	0	0	0	0	0	0	0	0
612		1		0	25	5	5	0	33	1	0	0
613	0	0	0	1	0			0	0	0	0	0
614				1	0		0		0			
615	0				0		0	0	0		0	0
616	0	0	0	0					0	0	0	0
621	0	0	0		0	2	0	0	18	0	0	1
622	0	0	0								0	0
625							0			0	0	0
626	0	0		0							0	0
631	0	2										0
632										0		
635	0											0
636										0		

Small mesh otter trawl

	month											
area	1	2	3	4	5	6	7	8	9	10	11	12
465									0			
512							0		0		0	
513	0	0				0	0	0	0		0	
514	0	0	0				0	0	0	0	1	0
515	0		0			0	0		0		0	
521	0	0	0				0	0	0	0	0	0
522							0	0	0	0		
525	0	0	0		0	0	0	0	0	0	0	0
526	0	0	0					0	0	0	0	0
533				0								
537	0	0	0	0	0	1	1	0	0	0	0	0
538				0	0	0	0	0	0	0		
539	0	0	0	0	0	1	0	0	0	0	0	0
562	0	0			0	0	0	0	0	0	0	0
611	0	0		0	1	0	0	0	0	0	0	0
612	0		0	6	14	13	0	0	1	0	0	0
613	0	0	0	0	0	0	1	0	0	1	4	0
614					1	3	0	0	0	0	0	
615	0	0	0	0	0	0	0	0	0	0	0	0
616	0	0	0	0	0	0		0	0	0	0	0
621	0	0	0	0	3	1	1	0	3	9	2	1
622	0	0	0	0	0	0	0	0	0	0	0	0
623	0	0	0					0	0		0	0
625	4		0			0				1	12	18
626	0	0	0	0		0	0	0	0	0	0	0
627	0	0		0			0	0				
631	2	2	22	7						1	4	3
632				0		0	0	0	0	0	0	0
635	10	4	8	1						0	0	0
636	0	0		0		0		0			0	0

Table 2. Encounters of Atlantic sturgeon and sturgeon, unknown by month, area in small mesh sink gillnet gear, 2006-2010 combined.

small mesh sink gillnet

area	month 1	2	3	4	5	6	7	8	9	10	11	12
464			0									
513								0	0	0		
514	0	0	0				0	0				
515			0									
521	0	0	0		0	0	0	0	0	0	0	**1**
522	0											
526					0							
537	0		0	0	0				0		0	
539					**1**							
611					0		0				0	
612				0	0	0	0	**1**	**1**	0		
613				0		0	0	0	0	0	0	
614				**5**	0	0		**1**	0	0	0	
615						0			0	0		
621			0	0	0			0	0	0	0	
625		0	0	**1**	0	**1**	0	0	0	**1**	0	0
626			0	0								
631	**1**	**6**	**8**	**2**	0				0	0	0	0
632				0								
635	**2**	0	**12**	**2**	0	0	0	0	0	0	**1**	**1**
636	0	0	0	0							0	
637	0											
638				0								

Table 3. Encounters of Atlantic sturgeon and sturgeon, unknown by month, area in large mesh sink gillnet gear, 2006-2010 combined.

large mesh sink gillnet

area	month 1	2	3	4	5	6	7	8	9	10	11	12
464		0	0						0			0
513	0		0	0	0	0	0	0	0	0	0	0
514	**6**	**5**	**2**	0	**1**	0	0	0	0	0	0	**2**
515	0	0	0	0	0	0	0	0	0	0	0	0
521	0	0		0	0	**1**	0	0	0	0	0	0
522		0			0							
525											0	
537	0	0		0	0		0					
538					0	0			0		0	
539		0		0	**4**	0	0	0	0	0	0	0
611				0	0			0			0	
612				**5**	0	0	**5**	**9**	0	0	**2**	0
613		0		0	4		0	0	0	0	0	0
614				**9**	**5**	**3**	**4**	**1**	0	0	0	0
615					0				0	0	0	0
621	0		0	**4**	0						0	0
625	**2**	**1**	0	**3**	**7**	**1**			0		**2**	**2**
631	**4**	**4**	0	0	**1**				0	0	0	**4**
632		0										
635	0	**1**	0	0	0	0	0	0	0	0	0	0
636	0	0	0	0								

Table 4. Encounters of Atlantic sturgeon and sturgeon, unknown by month, area in extra large mesh sink gillnet gear, 2006-2010 combined.

X-large sink gillnet

	month											
area	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
464												0
512										0		
513				0		0	0	0	0	0	0	0
514	0	0	0		0	0	0	0	1	0	0	0
515					0		0		0	0	0	0
521	**1**			0	0	0	**1**	0	**1**	**1**	**2**	**1**
522				0			0					0
526		0	0	0	0							
537	**1**	0	**1**	**1**	**5**	0	0	0	0	**1**	0	**1**
538					0							
539	0	0		0	**4**	0	0		0	0	0	0
611					0	**1**						
612	**5**	0	0	0	**1**	**3**	0			0	0	**1**
613	0	0		0	**2**	**1**		0	0	0	**7**	0
614	0			0	**5**	0					0	
615	0	0	0	0	**2**	**2**	0			0	0	**1**
616	0		0	0	0	0				0	0	0
621		0	0	0	**2**						0	
622					0							
625		**2**	**2**	**2**	**4**	0					**1**	**3**
626	0	0	0	**1**	**5**						0	0
631	**2**	**6**	**1**	**5**						0	0	**2**
635	0		**58**	**69**								

Table 5. All Atlantic sturgeon encounters expanded by VTR landings by division, mesh size and year for sink gillnets. 2006 across top row to 2010 across bottom row.

small mesh sink gillnet
All sturgeon
expanded to VTR landings

division	**1**	**2**	**3**	**4**	
51					
52	0				
53			0		
61		157	9	0	
62		4	0	9	
63	0	14	0	6	198
51	0	0	0	0	
52			0	0	
53		12	0	0	
61	0	0	24	0	
62	0	15	0	0	
63	83	0	0	0	135
51	0	0	0	0	
52	0			0	
53		0	0	0	
61	0	0	0	0	
62	0	0	0	0	
63	0	0	0	0	0
51	0		0		
52	0		0		
53	0	0			
61	0	0	0	0	
62	0	0	0	0	
63	98	0	0	0	98
51			0		
52					
53				0	
61			0	0	
62		0	0	0	
63	81	13	0	0	94

large mesh sink gillnet
All sturgeon
expanded to VTR landings

division	**1**	**2**	**3**	**4**	
51	54	0	0	0	
52	0	0	0	0	
53		11	0	0	
61		638	72	0	
62	206	114	0	20	
63	0	0		3	1117
51	29	0	0	0	
52	0	0	0	0	
53	0	27	0	0	
61		0	184	87	
62	0	15		0	
63	34	17		24	416
51	47	0	0	65	
52	0	79	0	0	
53	0	17	0	0	
61		0	0		
62	189	22		20	
63	17	0	0	22	478
51	34	0	0	0	
52	0	0	0	0	
53		0	0	0	
61		0	453	0	
62		193		22	
63	0	0		0	702
51	39	12	0	0	
52	0	0	0	0	
53		0	0	0	
61	0	46	0	0	
62	0	24			
63	0	0	0	0	121

x-large mesh sink gillnet
All sturgeon
expanded to VTR landings

division	**1**	**2**	**3**	**4**	
51	0	0	63	0	
52	0	0	22	44	
53	0	14	0	0	
61	17	62	0	0	
62	0	54		0	
63	13	10			299
51	0	0	0	0	
52	0	0	23	14	
53	0	47	0	14	
61	0	131	0	0	
62	41	128		28	
63	51	17			493
51	0	0	0	0	
52	0	0	0	0	
53	10	0	0	0	
61	0	67	0	84	
62	0	14		0	
63	15	11		0	200
51	0	0	0	0	
52	0	0	0	13	
53	10	104	0	40	
61	40	66	0	136	
62	9	8		26	
63	18	158			628
51	0	0	0	0	
52	12	0	0		
53	0	0			
61	28	66	0	0	
62	0	6			
63		20			132

Table 6. All Atlantic sturgeon encounters expanded by VTR landings by division, mesh size and year for otter trawls. 2006 across top row to 2010 across bottom row.

small mesh otter trawl
All sturgeon
Expanded by ratio to VTR landings

	1	2	3	4	
51	0		0	0	
52	0	0	0	0	
53	0	0	0	0	
56					
61	0	996	0	184	
62	29	0	8	309	
63	20	0	0	0	1546

51	0		0	0	
52	0	0	0	0	
53	0	0	0	0	
56					
61	0	0	0	0	
62	0	0	0	449	
63	47			40	536

51	0	0	0	0	
52	0	0	0	0	
53	0	0	0	0	
56					
61	0	279	80	0	
62	0	21	0	19	
63	19		0	36	454

51	0		0	22	
52	0	0	0	0	
53	0	0	17	0	
56					
61	0	336	9	0	
62	0	9	48	24	
63	435	0	0	6	907

51	0	0	0	0	
52	0	0	0	0	
53	0	39	0	0	
56	0	0	0	0	
61	0	317	0	0	
62	0	0	0	84	
63	41	36	0	24	541

Large mesh otter trawl
All sturgeon
Expanded by ratio to VTR landings

	1	2	3	4	
51	33				
52	0	0	0	0	
53	0	0	0	0	
61		0	0		
62	0	28	0	0	
63	0	0	0		61

51	19	0	0	0	
52	0	0	0	0	
53	0	0	0	0	
56					
61	0	0	0	0	
62	0	0	252	0	
63	0			0	271

51		0		0	
52	0	0	0	0	
53	0	0	0	0	
61	44	218	108	22	
62	0	12	0	0	
63	0	0	0	0	404

51	0	0		0	
52	0	0	0	0	
53	0	0	0	0	
56		0		0	
61	0	113	23	0	
62	0	0	7	0	
63	0				143

51	0	0	0	0	
52	0	0	0	0	
53	0	0	0	0	
56		0	0		
61	0	437	601	0	
62	0	0	0	0	
63	172			0	1211

Table 7. Dead Atlantic sturgeon encounters expanded by VTR landings by division, mesh size and year for sink gillnets. 2006 across top row to 2010 across bottom row.

small mesh sink gillnet
dead sturgeon expanded by VTR

		1	2	3	4	
2006	51					
	52	0				
	53			0		
	61		0	0	0	
	62		0	0	0	
	63	0	0	0	0	0
2007	51	0		0		
	52	0	0	0	1	
	53	0	0		0	
	61		0	0	0	
	62	0	0		0	
	63	0	0		0	1
2008	51	0		0		
	52	0	0	0	0	
	53		0			
	61		0	0		
	62	0	0		0	
	63	0	0	0	0	0
2009	51	0		0	0	
	52	0		0		
	53		0			
	61		0	0	0	
	62		0		0	
	63	0	0		0	0
2010	51			0	0	
	52			0	0	
	53					
	61		0	0	0	
	62		0			
	63	0	0	0	0	0

large mesh sink gillnet
dead sturgeon expanded

		1	2	3	4	
2006	51	0	0	0	0	
	52	0	0	0	0	
	53		0	0	0	
	61	0	28	0	0	
	62	0	38	0	0	
	63	0	0		0	66
2007	51	15	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	61		0	20	0	
	62	0	0		0	
	63	0	0		0	35
2008	51	16	0	0	0	
	52	0	79	0	0	
	53	0	0	0	0	
	61		0	0		
	62	0	0		0	
	63	6	0	0	0	100
2009	51	0	0	0	0	
	52	0	0	0	0	
	53		0	0	0	
	61		0	0	0	
	62		0		0	
	63	0	0		0	0
2010	51	0	0	0	0	
	52	0	0	0	0	
	53		0	0	0	
	61	0	0	0	0	
	62	0	24			
	63	0	0	0	0	24

x-large mesh sink gillnet
dead sturgeon expanded

		1	2	3	4	
2006	51	0	0	63	0	
	52	0	0	22	44	
	53	0	0	0	0	
	61	17	31	0	0	
	62	0	0	0	0	
	63	0	3		0	180
2007	51	0	0	0	0	
	52	0	0	0	0	
	53	0	31	0	14	
	61	0	112		0	
	62	0	107		9	
	63	0	0		0	273
2008	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	61	0	67	0	42	
	62	0	14		0	
	63	4	4		0	131
2009	51	0	0	0	0	
	52	0	0	0	13	
	53	10	69	0	0	
	61	0	33	0	82	
	62	0	8		0	
	63	0	11		0	226
2010	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0			
	61	0	0	0	0	
	62	0	6			
	63		0			6

Table 8. Dead Atlantic sturgeon encounters expanded by VTR landings by division, mesh size and year for otter trawl. 2006 across top row to 2010 across bottom row.

small mesh otter trawl
Expanded by ratio to VTR landings
dead sturgeon expanded

		1	2	3	4	
2006	51	0		0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	56					
	61	0	0	0	61	
	62	29	0	0	0	
	63	0	0	0	0	90
2007	51	0		0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	56					
	61	0	0	0	0	
	62	0	0	0	0	
	63	4			0	4
2008	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	56					
	61	0	0	0	0	
	62	0	0	0	0	
	63	0		0	0	0
2009	51	0		0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	56					
	61	0	0	0	0	
	62	0	0	0	0	
	63	19	0	0	0	19
2010	51	0		0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	56					
	61	0	0	0	0	
	62	0	0	0	0	
	63	7	0	0	0	7

large mesh otter trawl
dead sturgeon expanded
to VTR all kept

51	0	0	0	0	
52	0	0	0	0	
53	0	0	0	0	
61	0	0	0	0	
62	0	0	0	0	
63	0	0	0	0	0
51	0	0	0	0	
52	0	0	0	0	
53	0	0	0	0	
56	0	0	0	0	
61	0	0	0	0	
62	0	0	59	0	
63	0	0	0	0	59
51	0	0	0	0	
52	0	0	0	0	
53	0	0	0	0	
61	0	36	108	0	
62	0	0	0	0	
63	0	0	0	0	145
51	0	0	0	0	
52	0	0	0	0	
53	0	0	0	0	
56	0	0	0	0	
61	0	0	0	0	
62	0	0	0	0	
63	0	0	0	0	0
51	0	0	0	0	
52	0	0	0	0	
53	0	0	0	0	
56	0	0	0	0	
61	0	0	0	0	
62	0	0	0	0	
63	0			0	0

Table 9. Summary of Atlantic sturgeon encounters of all fish and total dead , by gear type and year.

Estimated encounters

	sink gillnet	otter trawl	total
2006	1614	1606	3221
2007	1044	807	1851
2008	678	857	1536
2009	1428	1050	2478
2010	347	1752	2099

Estimated dead encounters

	sink gillnet	otter trawl	total
2006	246	90	336
2007	309	63	373
2008	231	145	376
2009	223	19	245
2010	30	7	37

Total

	encounter	dead
2006	3221	336
2007	1851	373
2008	1536	376
2009	2478	245
2010	2099	37

Table 10. Yearly and total predicted sturgeon take and FMP weights for otter trawl gear based on VTR data and model 4 fit to observer data. FMPs not listed have weights of zero.

Year	Total take	blue	dog	fsb	lmgf	smgf	monk	sbass	scal	skate	smb	other
2006	1793.687	0.092	0.008	0.368	0.069	0.007	0.085	0.024	0.011	0.097	0.115	0.123
2007	1645.893	0.089	0.005	0.349	0.092	0.010	0.079	0.020	0.008	0.118	0.109	0.121
2008	1392.025	0.074	0.006	0.328	0.093	0.009	0.092	0.013	0.014	0.151	0.106	0.114
2009	1338.139	0.070	0.010	0.367	0.057	0.017	0.084	0.013	0.014	0.146	0.099	0.122
2010	1570.297	0.059	0.006	0.393	0.040	0.014	0.078	0.007	0.021	0.170	0.103	0.109
2006-2010	7740.041	0.078	0.007	0.361	0.071	0.011	0.084	0.016	0.013	0.134	0.107	0.118

Table 11. Yearly and total predicted sturgeon take and FMP weights for sink gillnet gear based on VTR data and model 6.gn fit to observer data. FMPs not listed have weights of zero.

Year	Total take	blue	dog	fsb	lmgf	smgf	monk	sbass	scal	skate	smb	other
2006	1612.001	0.156	0.035	0.138	0.039	0.010	0.252	0.043	0.002	0.080	0.015	0.230
2007	2216.112	0.126	0.060	0.132	0.049	0.012	0.312	0.107	0.002	0.082	0.003	0.115
2008	858.155	0.100	0.095	0.089	0.106	0.012	0.288	0.092	0.001	0.110	0.000	0.108
2009	2053.346	0.034	0.006	0.059	0.017	0.002	0.336	0.045	0.000	0.323	0.000	0.176
2010	1107.961	0.018	0.159	0.035	0.022	0.000	0.277	0.008	0.000	0.348	0.003	0.130
2006-2010	7847.576	0.089	0.059	0.095	0.040	0.007	0.299	0.062	0.001	0.188	0.004	0.156

Appendix A. Summary of model parameters and discard estimates for Atlantic sturgeon in otter trawls.

Table A1. Estimated parameters for model 4 fitted to the trip-specific observer otter trawl data from 2006-2010.

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-4.540	1.643	-2.762	0.006
blue.ocTRUE	-0.059	0.748	-0.080	0.937
dog.ocTRUE	-15.302	5032.761	-0.003	0.998
fsb.ocTRUE	1.826	1.034	1.767	0.077
lmgf.ocTRUE	-1.662	1.107	-1.501	0.133
smgf.ocTRUE	-2.247	1.774	-1.266	0.205
monk.ocTRUE	-1.063	0.673	-1.578	0.115
sbass.ocTRUE	-0.481	1.423	-0.338	0.736
scal.ocTRUE	-0.342	0.961	-0.356	0.722
skate.ocTRUE	-0.829	1.489	-0.557	0.578
smb.ocTRUE	-0.974	0.750	-1.299	0.194
other.ocTRUE	3.136	1.412	2.221	0.026
factor(QTR)2	-0.429	2.936	-0.146	0.884
factor(QTR)3	-12.762	1133.424	-0.011	0.991
factor(QTR)4	0.386	2.488	0.155	0.877
blue.ocTRUE:factor(QTR)2	0.678	1.040	0.652	0.514
blue.ocTRUE:factor(QTR)3	-1.173	1.625	-0.722	0.470
blue.ocTRUE:factor(QTR)4	-0.162	1.006	-0.161	0.872
dog.ocTRUE:factor(QTR)2	14.189	5032.761	0.003	0.998
dog.ocTRUE:factor(QTR)3	14.887	5032.761	0.003	0.998
dog.ocTRUE:factor(QTR)4	14.743	5032.761	0.003	0.998
fsb.ocTRUE:factor(QTR)2	1.150	2.616	0.440	0.660
fsb.ocTRUE:factor(QTR)3	14.226	1133.423	0.013	0.990
fsb.ocTRUE:factor(QTR)4	0.838	2.113	0.397	0.692
lmgf.ocTRUE:factor(QTR)2	1.514	1.235	1.225	0.221
lmgf.ocTRUE:factor(QTR)3	-0.804	2.652	-0.303	0.762
lmgf.ocTRUE:factor(QTR)4	0.050	1.900	0.027	0.979
smgf.ocTRUE:factor(QTR)2	0.963	2.170	0.444	0.657
smgf.ocTRUE:factor(QTR)3	2.604	3.057	0.852	0.394
smgf.ocTRUE:factor(QTR)4	-0.230	2.477	-0.093	0.926
monk.ocTRUE:factor(QTR)2	0.917	0.877	1.045	0.296
monk.ocTRUE:factor(QTR)3	-1.037	2.396	-0.433	0.665

monk.ocTRUE:factor(QTR)4	0.914	0.992	0.921	0.357
sbass.ocTRUE:factor(QTR)2	-16.830	6566.465	-0.003	0.998
sbass.ocTRUE:factor(QTR)3	-14.623	3941.823	-0.004	0.997
sbass.ocTRUE:factor(QTR)4	1.399	1.802	0.777	0.437
scal.ocTRUE:factor(QTR)2	-1.174	2.591	-0.453	0.651
scal.ocTRUE:factor(QTR)3	1.542	3.359	0.459	0.646
scal.ocTRUE:factor(QTR)4	1.215	1.253	0.970	0.332
skate.ocTRUE:factor(QTR)2	1.850	1.605	1.152	0.249
skate.ocTRUE:factor(QTR)3	1.989	1.609	1.236	0.217
skate.ocTRUE:factor(QTR)4	-1.548	2.284	-0.678	0.498
smb.ocTRUE:factor(QTR)2	0.359	0.958	0.375	0.708
smb.ocTRUE:factor(QTR)3	-0.713	1.484	-0.480	0.631
smb.ocTRUE:factor(QTR)4	1.060	1.006	1.054	0.292
other.ocTRUE:factor(QTR)2	-3.446	1.507	-2.286	0.022
other.ocTRUE:factor(QTR)3	-5.512	1.701	-3.240	0.001
other.ocTRUE:factor(QTR)4	-2.943	1.573	-1.871	0.061

Table A2. Estimated sturgeon takes by otter trawl gear in 2006 by division and quarter. NA is given in cells where no trips were present in VTR records for a quarter and division.

	1	2	3	4
46	0.04	0.06	0	0.02
51	12.17	9.04	0.05	4.7
52	7.28	22.84	1.56	1.82
53	17.39	170.75	189.27	106.73
54	0.01	NA	0	NA
55	NA	NA	NA	NA
56	NA	12.85	0.04	0.15
61	92.61	373.32	359.15	225
62	24.19	26.29	21.04	72.39
63	27.41	0.45	0.1	14.95

Table A3. Estimated sturgeon takes by otter trawl gear in 2007 by division and quarter. NA is given in cells where no trips were present in VTR records for a quarter and division.

	1	2	3	4
46	0.03	0.05	0	0.01
51	12.95	5.95	0.04	5.25
52	6.81	26.1	2.32	1.33
53	15.97	183.85	120.22	57.2
54	0.02	NA	NA	NA
55	NA	NA	NA	NA
56	0.78	8.37	0.08	0.68
61	73.74	449.59	294.77	201.41
62	15.05	20.88	18.83	47.84
63	55.15	0.72	0.14	19.77

Table A4. Estimated sturgeon takes by otter trawl gear in 2008 by division and quarter. NA is given in cells where no trips were present in VTR records for a quarter and division.

	1	2	3	4
46	0.04	0.05	0	0.01
51	52.72	7.05	0.05	4.87
52	6.98	30.51	2.59	1.21
53	14.07	205.33	131.47	36.89
54	0.04	NA	NA	NA
55	NA	NA	NA	0.02
56	0.51	1.27	0	0.25
61	49.16	323.76	255.95	113.49
62	41.51	7.74	6.51	36.71
63	39.71	0.14	0.12	21.31

Table A5. Estimated sturgeon takes by otter trawl gear in 2009 by division and quarter. NA is given in cells where no trips were present in VTR records for a quarter and division.

	1	2	3	4
46	0.09	0.05	0	0.1
51	31.39	6.82	0.05	5.67
52	6.22	26.38	1.86	0.63
53	10.59	158.74	105.15	49.39
54	0	0.88	0.87	NA
55	NA	0.01	NA	NA
56	1.41	1.89	0.06	0.22
61	63.28	258.26	293.27	147.71
62	21.58	8.5	10.36	46.56
63	55.65	1.77	0.05	22.68

Table A6. Estimated sturgeon takes by otter trawl gear in 2010 by division and quarter. NA is given in cells where no trips were present in VTR records for a quarter and division.

	1	2	3	4
46	0.05	0.04	0	0.02
51	47.06	3.79	0.04	2.61
52	6.72	28.02	3.23	0.44
53	12.13	196.87	198.23	43.85
54	0	NA	NA	NA
55	NA	NA	NA	NA
56	0.53	1.92	0.06	0.16
61	52.9	335.08	370.45	116.7
62	37.49	19.04	6.74	52.02
63	21.29	0.46	0.55	11.8

Table A7. Observed sturgeon takes by otter trawl gear in 2006 by division and quarter. NA is given in cells where no trips were observed for a quarter and division.

	1	2	3	4
46	NA	NA	NA	NA
51	1	0	0	0
52	1	0	0	0
53	0	0	0	0
54	NA	NA	NA	NA
55	NA	NA	NA	NA
56	NA	0	0	NA
61	0	11	0	3
62	4	0	1	2
63	5	NA	0	0

Table A8. Observed sturgeon takes by otter trawl gear in 2007 by division and quarter. NA is given in cells where no trips were observed for a quarter and division.

	1	2	3	4
46	NA	NA	NA	NA
51	1	0	0	0
52	0	0	0	0
53	0	0	0	0
54	NA	NA	NA	NA
55	NA	NA	NA	NA
56	0	0	NA	0
61	6	2	0	2
62	3	0	17	24
63	3	NA	NA	0

Table A9. Observed sturgeon takes by otter trawl gear in 2008 by division and quarter. NA is given in cells where no trips were observed for a quarter and division.

	1	2	3	4
46	NA	NA	NA	NA
51	0	0	0	0
52	0	0	0	0
53	0	0	0	0
54	NA	NA	NA	NA
55	NA	NA	NA	NA
56	0	0	NA	NA
61	1	13	5	1
62	2	3	0	3
63	0	NA	0	0

Table A10. Observed sturgeon takes by otter trawl gear in 2009 by division and quarter. NA is given in cells where no trips were observed for a quarter and division.

	1	2	3	4
46	NA	NA	NA	NA
51	0	0	0	1
52	0	0	0	0
53	0	0	1	0
54	NA	NA	NA	NA
55	NA	NA	NA	NA
56	NA	0	NA	0
61	0	13	2	0
62	0	1	4	3
63	23	0	0	0

Table A11. Observed sturgeon takes by otter trawl gear in 2010 by division and quarter. NA is given in cells where no trips were observed for a quarter and division.

	1	2	3	4
46	NA	NA	NA	NA
51	0	0	0	0
52	0	0	0	0
53	0	2	0	0
54	NA	NA	NA	NA
55	NA	NA	NA	NA
56	0	0	0	0
61	1	33	33	1
62	0	0	0	18
63	7	8	0	2

Table A12. Number of VTR trips using otter trawl gear in 2006 by division and quarter.

	1	2	3	4
46	4	10	9	4
51	1494	959	2237	1764
52	533	513	474	449
53	1040	1695	1913	1340
54	3	0	1	0

55	0	0	0	0
56	0	123	23	27
61	1324	3371	3591	2394
62	475	795	660	455
63	78	9	52	109

Table A13. Number of VTR trips using otter trawl gear in 2007 by division and quarter.

	1	2	3	4
46	6	10	4	3
51	1552	890	2246	1508
52	441	503	481	500
53	948	1715	1432	1310
54	1	0	0	0
55	0	0	0	0
56	70	119	23	75
61	1426	3489	3641	2115
62	215	242	314	298
63	181	10	20	150

Table A14. Number of VTR trips using otter trawl gear in 2008 by division and quarter.

	1	2	3	4
46	4	7	3	6
51	2197	1151	2069	1544
52	424	493	370	299
53	970	1715	1450	1110
54	1	0	0	0
55	0	0	0	1
56	40	19	92	147
61	1163	3071	2942	1481
62	390	131	303	265
63	131	8	30	135

Table A15. Number of VTR trips using otter trawl gear in 2009 by division and quarter.

	1	2	3	4
46	4	10	1	10
51	1921	1008	2428	1704

	1	2	3	4
52	392	429	301	341
53	909	1584	1241	946
54	1	8	14	0
55	0	1	0	0
56	44	73	116	78
61	1046	2953	2804	1800
62	430	164	306	319
63	229	24	22	154

Table A16. Number of VTR trips using otter trawl gear in 2010 by division and quarter.

	1	2	3	4
46	4	7	1	3
51	2255	624	1040	810
52	363	445	355	268
53	862	1826	1657	1032
54	1	0	0	0
55	0	0	0	0
56	60	87	61	70
61	833	2705	2707	1688
62	414	199	272	333
63	165	23	83	78

Table A17. Proportion of VTR trips using otter trawl gear with observers in 2006 by division and quarter.

	1	2	3	4
46	0.000	0.000	0.000	0.000
51	0.086	0.011	0.018	0.015
52	0.038	0.019	0.030	0.016
53	0.060	0.013	0.015	0.019
54	0.000	NA	0.000	NA
55	NA	NA	NA	NA
56	NA	0.008	0.043	0.000
61	0.021	0.011	0.015	0.016
62	0.021	0.013	0.024	0.013
63	0.090	0.000	0.038	0.009

Table B18. Proportion of VTR trips using otter trawl gear with observers in 2007 by division and quarter.

	1	2	3	4
46	0.000	0.000	0.000	0.000
51	0.028	0.034	0.023	0.042
52	0.020	0.038	0.040	0.032
53	0.028	0.022	0.036	0.010
54	0.000	NA	NA	NA
55	NA	NA	NA	NA
56	0.071	0.017	0.000	0.013
61	0.015	0.021	0.043	0.020
62	0.014	0.021	0.070	0.070
63	0.094	0.000	0.000	0.073

Table B19. Proportion of VTR trips using otter trawl gear with observers in 2008 by division and quarter.

	1	2	3	4
46	0.000	0.000	0.000	0.000
51	0.024	0.023	0.022	0.052
52	0.059	0.024	0.035	0.054
53	0.021	0.020	0.012	0.027
54	0.000	NA	NA	NA
55	NA	NA	NA	0.000
56	0.075	0.053	0.000	0.000
61	0.017	0.024	0.022	0.024
62	0.044	0.099	0.040	0.057
63	0.053	0.000	0.033	0.074

Table B20. Proportion of VTR trips using otter trawl gear with observers in 2009 by division and quarter.

	1	2	3	4
46	0.000	0.000	0.000	0.000
51	0.084	0.019	0.055	0.053
52	0.033	0.021	0.056	0.053
53	0.031	0.061	0.084	0.071
54	0.000	0.000	0.000	NA

55	NA	0.000	NA	NA
56	0.000	0.041	0.000	0.038
61	0.020	0.024	0.031	0.037
62	0.063	0.085	0.098	0.154
63	0.061	0.042	0.045	0.156

Table B21. Proportion of VTR trips using otter trawl gear with observers in 2010 by division and quarter.

	1	2	3	4
46	0.000	0.000	0.000	0.000
51	0.023	0.045	0.044	0.086
52	0.058	0.011	0.045	0.037
53	0.031	0.045	0.025	0.046
54	0.000	NA	NA	NA
55	NA	NA	NA	NA
56	0.033	0.046	0.033	0.043
61	0.055	0.060	0.039	0.030
62	0.140	0.106	0.118	0.090
63	0.085	0.174	0.120	0.115

Appendix B. Summary of model parameters and discard estimates for Atlantic sturgeon in gill nets.

Table B1. Estimated parameters for model 6gn fitted to the trip-specific observer sink gillnet data from 2006-2010.

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-2.379	0.385	-6.173	0.000
blue.ocTRUE	-0.071	0.330	-0.214	0.830
dog.ocTRUE	-0.512	0.700	-0.732	0.464
fsb.ocTRUE	0.978	0.316	3.095	0.002
lmgf.ocTRUE	-2.354	0.723	-3.256	0.001
smgf.ocTRUE	0.598	1.136	0.526	0.599
monk.ocTRUE	1.139	0.350	3.258	0.001
sbass.ocTRUE	0.205	0.665	0.308	0.758
scal.ocTRUE	-0.780	1.567	-0.498	0.619
skate.ocTRUE	-1.475	0.433	-3.409	0.001
smb.ocTRUE	-0.906	0.501	-1.809	0.070
other.ocTRUE	0.553	0.359	1.537	0.124
factor(YEAR)2007	-0.657	0.585	-1.122	0.262
factor(YEAR)2008	-0.795	0.697	-1.140	0.254
factor(YEAR)2009	-1.051	0.662	-1.588	0.112
factor(YEAR)2010	-1.164	0.729	-1.596	0.110
factor(YEAR)2011	-2.295	1.470	-1.561	0.119
blue.ocTRUE:factor(YEAR)2007	0.127	0.498	0.255	0.799
blue.ocTRUE:factor(YEAR)2008	0.265	0.703	0.376	0.707
blue.ocTRUE:factor(YEAR)2009	-1.102	0.888	-1.240	0.215
blue.ocTRUE:factor(YEAR)2010	-1.075	1.000	-1.075	0.282
blue.ocTRUE:factor(YEAR)2011	1.260	1.490	0.845	0.398
dog.ocTRUE:factor(YEAR)2007	1.003	0.814	1.232	0.218
dog.ocTRUE:factor(YEAR)2008	0.845	0.925	0.914	0.361
dog.ocTRUE:factor(YEAR)2009	-2.369	1.697	-1.396	0.163
dog.ocTRUE:factor(YEAR)2010	1.775	0.838	2.117	0.034
dog.ocTRUE:factor(YEAR)2011	-13.918	1148.485	-0.012	0.990
fsb.ocTRUE:factor(YEAR)2007	-0.136	0.481	-0.283	0.777
fsb.ocTRUE:factor(YEAR)2008	-0.518	0.664	-0.780	0.435
fsb.ocTRUE:factor(YEAR)2009	-1.294	0.541	-2.391	0.017
fsb.ocTRUE:factor(YEAR)2010	-1.844	0.808	-2.282	0.023

fsb.ocTRUE:factor(YEAR)2011	0.761	1.485	0.513	0.608
lmgf.ocTRUE:factor(YEAR)2007	-0.086	0.947	-0.091	0.928
lmgf.ocTRUE:factor(YEAR)2008	0.838	1.078	0.778	0.437
lmgf.ocTRUE:factor(YEAR)2009	-0.032	1.037	-0.031	0.975
lmgf.ocTRUE:factor(YEAR)2010	-0.250	1.190	-0.210	0.834
lmgf.ocTRUE:factor(YEAR)2011	3.816	1.453	2.626	0.009
smgf.ocTRUE:factor(YEAR)2007	-0.064	1.977	-0.033	0.974
smgf.ocTRUE:factor(YEAR)2008	-0.909	1.999	-0.455	0.649
smgf.ocTRUE:factor(YEAR)2009	-1.390	1.604	-0.867	0.386
smgf.ocTRUE:factor(YEAR)2010	-14.082	726.818	-0.019	0.985
smgf.ocTRUE:factor(YEAR)2011	-16.371	1489.100	-0.011	0.991
monk.ocTRUE:factor(YEAR)2007	1.253	0.573	2.188	0.029
monk.ocTRUE:factor(YEAR)2008	0.181	0.767	0.236	0.814
monk.ocTRUE:factor(YEAR)2009	0.192	0.676	0.285	0.776
monk.ocTRUE:factor(YEAR)2010	-1.467	0.830	-1.767	0.077
monk.ocTRUE:factor(YEAR)2011	-1.359	1.190	-1.141	0.254
sbass.ocTRUE:factor(YEAR)2007	2.014	0.814	2.475	0.013
sbass.ocTRUE:factor(YEAR)2008	1.738	0.947	1.835	0.067
sbass.ocTRUE:factor(YEAR)2009	2.579	0.948	2.721	0.007
sbass.ocTRUE:factor(YEAR)2010	0.094	1.794	0.052	0.958
sbass.ocTRUE:factor(YEAR)2011	-14.334	1516.644	-0.009	0.992
scal.ocTRUE:factor(YEAR)2007	1.405	1.945	0.723	0.470
scal.ocTRUE:factor(YEAR)2008	1.877	2.271	0.827	0.408
scal.ocTRUE:factor(YEAR)2009	-15.208	2095.281	-0.007	0.994
scal.ocTRUE:factor(YEAR)2010	0.816	1.942	0.420	0.674
scal.ocTRUE:factor(YEAR)2011	-13.424	6203.050	-0.002	0.998
skate.ocTRUE:factor(YEAR)2007	-0.413	0.615	-0.670	0.503
skate.ocTRUE:factor(YEAR)2008	0.349	0.861	0.405	0.685
skate.ocTRUE:factor(YEAR)2009	2.720	0.675	4.031	0.000
skate.ocTRUE:factor(YEAR)2010	3.569	0.971	3.675	0.000
skate.ocTRUE:factor(YEAR)2011	2.269	0.997	2.276	0.023
smb.ocTRUE:factor(YEAR)2007	-0.892	1.218	-0.732	0.464
smb.ocTRUE:factor(YEAR)2008	-13.967	974.928	-0.014	0.989
smb.ocTRUE:factor(YEAR)2009	-14.084	892.049	-0.016	0.987
smb.ocTRUE:factor(YEAR)2010	-0.110	1.642	-0.067	0.946
smb.ocTRUE:factor(YEAR)2011	2.196	1.072	2.048	0.041
other.ocTRUE:factor(YEAR)2007	-0.734	0.508	-1.444	0.149
other.ocTRUE:factor(YEAR)2008	-0.841	0.616	-1.365	0.172
other.ocTRUE:factor(YEAR)2009	0.773	0.490	1.578	0.115
other.ocTRUE:factor(YEAR)2010	-0.213	0.606	-0.351	0.726
other.ocTRUE:factor(YEAR)2011	-0.249	0.913	-0.272	0.785

Table B2. Estimated sturgeon takes by sink gillnet gear in 2006 by division and quarter. NA is given in cells where no trips were present in VTR records for a quarter and division.

	1	2	3	4
46	0.18	1.96	4.1	0.03
51	14.42	20.16	81.57	46.89
52	8.78	12.7	35.29	17.8
53	51.12	197.56	71.71	45.49
54	NA	NA	NA	NA
55	NA	NA	NA	NA
56	NA	0.13	1.51	0.05
61	47.1	204.16	202.7	213.33
62	26.38	114.62	41.94	49.93
63	73.5	13.45	1.55	10.63
70	1.07	0.21	NA	NA

Table B3. Estimated sturgeon takes by sink gillnet gear in 2007 by division and quarter. NA is given in cells where no trips were present in VTR records for a quarter and division.

	1	2	3	4
46	0.18	0.26	0.48	0
51	16.65	36.46	132.65	77.12
52	5.79	19.09	50.14	16.44
53	31.48	238.49	77.79	62.94
54	NA	NA	NA	NA
55	NA	NA	NA	NA
56	NA	0.04	NA	NA
61	81.71	223.25	243.63	579.41
62	43.76	105.53	12	90.71
63	44.2	8.32	0.48	16.98
70	0.12	NA	NA	NA

Table B4. Estimated sturgeon takes by sink gillnet gear in 2008 by division and quarter. NA is given in cells where no trips were present in VTR records for a quarter and division.

	1	2	3	4
46	0.06	0.14	0.03	NA
51	17.77	27.7	91.56	46.64
52	2.88	7.93	26.14	10.07
53	16.47	94.23	21.34	18.85
54	0.01	NA	0	NA
55	NA	0	NA	NA
56	NA	0.13	1.51	0.05
61	35.06	80.31	60.84	117.6
62	31.41	46.17	9.55	48.92
63	16.65	7.53	0.03	22.24
70	0.04	NA	NA	NA

Table B5. Estimated sturgeon takes by sink gillnet gear in 2009 by division and quarter. NA is given in cells where no trips were present in VTR records for a quarter and division.

	1	2	3	4
46	0.09	0.05	0.13	NA
51	15.1	16.57	33.4	43.35
52	15.32	15.14	67.15	132.07
53	105.12	266.69	41.04	107.5
54	NA	0.43	0.04	NA
55	NA	NA	NA	NA
56	0.01	0.2	NA	NA
61	135.53	354.75	137.4	241.77
62	56.2	138.64	26.53	39.11
63	33.72	24.52	0.58	4.21
70	0.37	NA	NA	0.61

Table B6. Estimated sturgeon takes by sink gillnet gear in 2010 by division and quarter. NA is given in cells where no trips were present in VTR records for a quarter and division.

	1	2	3	4
46	0.01	0	0	NA
51	9.45	23.11	67.63	7.91
52	5.31	25.88	140.93	24.99
53	35.77	156.08	50.72	38.1
54	NA	NA	NA	NA
55	NA	NA	NA	NA
56	0	0	NA	NA
61	56.8	120.79	33.18	179.89
62	4.12	53.19	12.53	20.03
63	22.41	7.08	0.32	11.04
70	0.5	0.04	NA	0.13

Table B7. Observed sturgeon takes by sink gillnet gear in 2006 by division and quarter. NA is given in cells where no trips were observed for a quarter and division.

	1	2	3	4
46	0	NA	NA	0
51	3	0	1	0
52	0	0	1	2
53	0	2	0	0
54	NA	NA	NA	NA
55	NA	NA	NA	NA
56	NA	NA	NA	NA
61	2	32	6	0
62	1	13	0	2
63	31	6	0	3
70	0	16	NA	0

Table B8. Observed sturgeon takes by sink gillnet gear in 2007 by division and quarter. NA is given in cells where no trips were observed for a quarter and division.

	1	2	3	4
46	0	NA	NA	NA
51	2	0	0	0
52	0	0	1	2
53	0	9	0	1
54	NA	NA	NA	NA
55	NA	NA	NA	NA
56	NA	NA	NA	NA
61	1	7	11	2
62	2	9	0	3
63	50	8	0	1
70	0	0	0	0

Table B9. Observed sturgeon takes by sink gillnet gear in 2008 by division and quarter. NA is given in cells where no trips were observed for a quarter and division.

	1	2	3	4
46	0	NA	NA	NA
51	3	0	0	2
52	0	1	0	0
53	1	1	0	0
54	NA	NA	NA	NA
55	NA	NA	NA	NA
56	NA	NA	NA	NA
61	0	2	0	10
62	2	2	0	2
63	10	5	0	2
70	0	0	0	0

Table B10. Observed sturgeon takes by sink gillnet gear in 2009 by division and quarter. NA is given in cells where no trips were observed for a quarter and division.

	1	2	3	4
46	NA	NA	NA	NA
51	4	0	0	0
52	0	0	0	1
53	1	3	0	1
54	NA	NA	NA	NA
55	NA	NA	NA	NA
56	NA	NA	NA	NA
61	2	2	5	5
62	2	4	0	1
63	11	56	0	3
70	0	0	0	0

Table B11. Observed sturgeon takes by sink gillnet gear in 2010 by division and quarter. NA is given in cells where no trips were observed for a quarter and division.

	1	2	3	4
46	NA	NA	NA	NA
51	1	1	0	1
52	1	0	0	0
53	0	0	0	1
54	NA	NA	NA	NA
55	NA	NA	NA	NA
56	NA	NA	NA	NA
61	1	5	0	27
62	0	4	0	1
63	3	4	0	0
70	0	0	0	0

Table B12. Number of VTR trips using sink gillnet gear in 2006 by division and quarter.

	1	2	3	4
46	3	7	9	1
51	956	718	2422	2009
52	118	205	752	434
53	324	1166	278	317

54	0	0	0	0
56	0	2	3	1
61	369	1355	1221	1394
62	164	483	296	357
63	440	78	15	85
70	10	3	0	0

Table B13. Number of VTR trips using sink gillnet gear in 2007 by division and quarter.

	1	2	3	4
46	4	6	2	1
51	1259	831	2562	2050
52	109	257	939	427
53	201	990	395	513
54	0	0	0	0
56	0	1	0	0
61	368	1515	1421	1844
62	209	583	344	422
63	396	66	21	90
70	8	0	0	0

Table B14. Number of VTR trips using sink gillnet gear in 2008 by division and quarter.

	1	2	3	4
46	2	5	1	0
51	1739	1148	3030	2326
52	104	264	798	425
53	305	1260	333	381
54	0	1	0	0
56	0	0	0	0
61	422	1337	844	1083
62	246	561	280	356
63	288	79	1	199
70	2	0	0	0

Table B15. Number of VTR trips using sink gillnet gear in 2009 by division and quarter.

	1	2	3	4
46	4	2	3	0

51	1746	1356	3573	2278
52	66	213	691	271
53	296	1147	446	363
54	0	1	1	0
56	1	3	0	0
61	412	1262	1082	1127
62	145	612	435	523
63	375	101	41	130
70	8	0	0	5

Table B16. Number of VTR trips using sink gillnet gear in 2010 by division and quarter.

	1	2	3	4
46	5	2	1	0
51	2538	961	2150	1086
52	70	203	792	226
53	262	1175	402	302
54	0	0	0	0
56	2	1	0	0
61	350	1127	977	1066
62	70	571	354	390
63	492	178	25	212
70	13	1	0	4

Table B17. Proportion of VTR trips using sink gillnet gear with observers in 2006 by division and quarter.

	1	2	3	4
46	0.333	0.000	0.000	1.000
51	0.093	0.015	0.026	0.038
52	0.119	0.098	0.028	0.032
53	0.040	0.077	0.036	0.069
54	NA	NA	NA	NA
56	NA	0.000	0.000	0.000
61	0.117	0.043	0.045	0.032
62	0.006	0.106	0.139	0.106
63	0.164	0.462	1.133	0.659
70	0.900	6.000	NA	Inf

Table B18. Proportion of VTR trips using sink gillnet gear with observers in 2007 by division and quarter.

	1	2	3	4
46	0.250	0.000	0.000	0.000
51	0.076	0.016	0.028	0.038
52	0.037	0.066	0.026	0.089
53	0.129	0.086	0.025	0.047
54	NA	NA	NA	NA
56	NA	0.000	NA	NA
61	0.027	0.054	0.059	0.038
62	0.072	0.070	0.052	0.073
63	0.331	0.561	0.524	0.489
70	1.500	Inf	Inf	Inf

Table B19. Proportion of VTR trips using sink gillnet gear with observers in 2008 by division and quarter.

	1	2	3	4
46	0.500	0.000	0.000	NA
51	0.048	0.021	0.029	0.031
52	0.058	0.049	0.035	0.064
53	0.085	0.033	0.036	0.042
54	NA	0.000	NA	NA
56	NA	NA	NA	NA
61	0.031	0.030	0.033	0.035
62	0.057	0.096	0.071	0.104
63	0.184	0.203	12.000	0.226
70	2.500	Inf	Inf	Inf

Table B20. Proportion of VTR trips using sink gillnet gear with observers in 2009 by division and quarter.

	1	2	3	4
46	0.000	0.000	0.000	NA
51	0.089	0.012	0.031	0.031
52	0.076	0.023	0.036	0.089
53	0.095	0.016	0.011	0.033
54	NA	0.000	0.000	NA

56	0.000	0.000	NA	NA
61	0.041	0.037	0.018	0.038
62	0.069	0.062	0.037	0.034
63	0.104	0.287	0.268	0.262
70	0.625	Inf	Inf	2.800

Table B21. Proportion of VTR trips using sink gillnet gear with observers in 2010 by division and quarter.

	1	2	3	4
46	0.000	0.000	0.000	NA
51	0.020	0.054	0.023	0.101
52	0.071	0.039	0.051	0.066
53	0.046	0.025	0.002	0.043
54	NA	NA	NA	NA
56	0.000	0.000	NA	NA
61	0.051	0.031	0.016	0.060
62	0.071	0.109	0.048	0.085
63	0.079	0.191	0.920	0.189
70	0.538	12.000	Inf	7.500

Appendix C. Variance and Confidence intervals for yearly predicted sturgeon takes and proportions by FMP.

Let $\hat{\mathbf{B}}$ be the p x1 vector of coefficients estimated from the best fitted model (trawl or gillnet) and $\hat{\mathbf{V}}$ (p x p) be the estimated covariance matrix of the estimated coefficients (p is the number of estimated coefficients). Also, let $\mathbf{X}_y$ be the n_y x p matrix of covariates for the VTR trips in year y where n_y is the number of trips. Then the log estimated predictions for the n_y VTR trips is $\log\left(\hat{\mathbf{T}}_y\right) = \mathbf{X}_y \hat{\mathbf{B}}$ and the estimated takes are $\hat{\mathbf{T}}_y = e^{\mathbf{X}_y \hat{\mathbf{B}}}$. The n_y x n_y covariance matrix for the log predictions is

$$\hat{\mathbf{V}}_{\log\left(\hat{\mathbf{T}}_y\right)} = \mathbf{X}_y \hat{\mathbf{V}} \mathbf{X}_y^{'}$$

and the approximate (delta method) covariance matrix for the estimated takes is

$$\hat{\mathbf{V}}_{\hat{\mathbf{T}}_y} = \text{diag}\left(\hat{\mathbf{T}}_y\right) \hat{\mathbf{V}}_{\log\left(\hat{\mathbf{T}}_y\right)} \text{diag}\left(\hat{\mathbf{T}}_y\right).$$

The variance of the total take estimate for year y is just the sum of all n_y^2 elements of $\hat{\mathbf{V}}_{\hat{\mathbf{T}}_y}$:

$$\hat{V}\left(\hat{T}_y\right) = \mathbf{1}_y^{'} \hat{\mathbf{V}}_{\hat{\mathbf{T}}_y} \mathbf{1}_y .$$

where $\mathbf{1}_y$ is a n_y x1 vector of ones. Similarly letting $\mathbf{1}_{f,y}$ be a n_y x1 vector of ones where FMP f is present and zero otherwise, the variance of the total take where FMP f is present is

$$\hat{V}\left(\hat{T}_{f,y}\right) = \mathbf{1}_{f,y}^{'} \hat{\mathbf{V}}_{\hat{\mathbf{T}}_y} \mathbf{1}_{f,y} .$$

Likewise, the covariance of estimated takes where FMPs f and g are present is

$$\widehat{Cov}\left(\hat{T}_{f,y}, \hat{T}_{g,y}\right) = \mathbf{1}_{f,y}^{'} \hat{\mathbf{V}}_{\hat{\mathbf{T}}_y} \mathbf{1}_{g,y} .$$

The measure of FMP influence on sturgeon take, is the ratio of two values, the total take where FMP f is present to the sum of those estimates across all FMPs. The variance of the numerator $\hat{V}\left(\hat{T}_{f,y}\right)$ is given above and the variance of the denominator is

$$\hat{V}(D) = \hat{V}\left(\sum_{f=1}^{F} \hat{T}_{f,y}\right) = \sum_{f=1}^{F} \hat{V}\left(\hat{T}_{f,y}\right) + \sum_{f=1}^{F} \sum_{g \neq f}^{F} \widehat{Cov}\left(\hat{T}_{f,y}, \hat{T}_{g,y}\right)$$

and the covariance of the numerator and denominator is

$$\widehat{Cov}(N, D) = \widehat{Cov}\left(\hat{T}_{f,y}, \sum_{g=1}^{F} \hat{T}_{g,y}\right) = \sum_{g=1}^{F} \widehat{Cov}\left(\hat{T}_{f,y}, \hat{T}_{g,y}\right) = \hat{V}\left(\hat{T}_{f,y}\right) + \sum_{g \neq f}^{F} \widehat{Cov}\left(\hat{T}_{f,y}, \hat{T}_{g,y}\right)$$

The approximate variance estimate (delta method) for the ratio ($R = N / D$) is

$$\hat{V}(R) = R^2 \left[\frac{\hat{V}(N)}{N^2} + \frac{\hat{V}(D)}{D^2} + \frac{\widehat{Cov}(N, D)}{ND} \right].$$

Confidence intervals are based on standard errors (square root of variance) and approximate normality of the point estimates.

NATIONAL MARINE FISHERIES SERVICE
APPLICATION INSTRUCTIONS FOR PERMITS FOR THE INCIDENTAL TAKE OF ENDANGERED OR THREATENED SPECIES UNDER THE ENDANGERED SPECIES ACT
In coordination with, but not substituting for 50 CFR 222.307
OMB control number (0648-0230) Expiration date for clearance: 03/31/2012

Information Required in the Application
The Assistant Administrator may issue permits to take endangered or threatened marine species incidentally to an otherwise lawful activity under section 10(a)(1)(B) of the Endangered Species Act of 1973 (ESA). The information collection associated with the following application instructions is required for the purpose of obtaining such a permit. The information provided will be used to process the incidental take permit in accordance with the ESA, including the solicitation of public comments on the justification of the take of ESA-listed species incidental to proposed activities. The information provided by an applicant in accordance with these instructions is not confidential and is subject to public exposure for comments. Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the Paperwork Reduction Act, unless that collection of information displays a currently valid OMB Control Number. Public reporting burden for this collection of information is estimated to average 80 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the address below.

An application for a permit should provide all of the following information. The information needed in the application should be presented in the same structure and format shown below to increase processing efficiency. When a question does not apply, do not overlook the category, but indicate Not Applicable (N.A.). In some cases, a brief explanation as to why the category is not applicable may expedite processing. Please note that for the title and closing statement of the application, specific wording is required.

If the applicant represents an individual or a single entity, such as a corporation, the application should be for an individual incidental take permit. If the applicant represents a group or organization whose members conduct the same or a similar activity in the same geographical area with similar impacts on endangered or threatened marine species, the application should be for a general incidental take permit. To be covered by a general incidental take permit, each individual conducting the activity must have a certificate of inclusion issued under paragraph (f) of 50 CFR 222.307. NMFS estimates a public reporting burden of .5 hour for each certificate of inclusion. The sufficiency of applications will be determined by the Assistant Administrator in accordance with the requirements of 50 CFR 222.307.

I. One of the titles below as appropriate:

A. Application for an Individual Incidental Take Permit under the Endangered Species Act of 1973.

Dan Forster

Dan Forster **or**
Director, Wildlife Resources Division
Georgia Department of Natural Resources
2070 U.S. Hwy 278 SE
Social Circle, GA 30025

Spud Woodward
Director, Coastal Resources Division
Georgia Department of Natural Resources
One Conservation Way
Brunswick, GA 31520

B. Application for a General Incidental Take Permit under the Endangered Species Act of 1973.

II. Date of the application.

February 27, 2012

III. The name, address, telephone, and fax number of the applicant. If the applicant is a partnership, corporate entity or is representing a group or organization, include applicable details.

Dan Forster (770-918-6400) and/or Spud Woodward (912-264-7218)
See above for respective addresses

IV. A description of the endangered or threatened species, by common and scientific name, and a description of the status, distribution, seasonal distribution, habitat needs, feeding habits and other biological requirements of the affected species.

Refer to previously provided report "Altamaha Sturgeon-Section 6 Final Report (Bahn and Peterson, 2010)".

V. A detailed description of the proposed activity, including, but not limited to:

A. The anticipated dates and duration of the activity.

GA commercial shad season dates can be found on pages 17-18 of "Georgia's Commercial Saltwater Fishing Regulations" that was previously provided. GADNR request that this permit be valid for a term of 10 years beginning January 1, 2012.

B. The specific location of the activity. Please include latitude/longitude coordinates if possible.

Waters open to commercial shad fishing can be found on pages 17-18 of "Georgia's Commercial Saltwater Fishing Regulations" that was previously provided.

C. For a general incidental take application, include an estimate of the total level of activity expected to be conducted.

According to mandatory individual records (trip tickets) reported to GADNR Coastal Resources Division (CRD), from 2007 through 2011 total statewide annual commercial shad fishing trips in GA have declined from 388 trips to 241 trips/yr and averaged 316 trips/yr during this time. GADNR anticipates that commercial fishing activity will remain stable or slightly decline over the duration of the requested permit.

VI. The application must include a conservation plan based on the best scientific and commercial data, which specifies:

A. The anticipated impact of the proposed activity on the listed species, including:

1. The estimated number of animals of the listed species and, if applicable, the subspecies or population group, and range.

Estimated total number of shortnose sturgeon incidentally captured by shad set-net fishermen in the Altamaha River ranged from 53-498 fish during 2007-2009 (Bahu and Petereson, 2010). This same study also estimated the Altamaha River population at approximately 6,300 fish. New commercial shad regulations that were instituted January 1, 2011 should substantially reduce incidental bycatch of sturgeon since these rules closed the section of the Altamaha River with the highest bycatch rates. Bahn and Peterson (2010) stated "In fact, we estimate that more shortnose sturgeon were incidentally captured in the upper river during January 2009 (333 fish) than in all months of all three years combined in the lower river (216 fish; Table 2)". For the section of the Atlamaha that is currently open to commercial shad fishing, this study reported that during 2007-2009 the

highest total annual bycatch of sturgeon by fishermen was estimated at 111 fish. GADNR also records incidental sturgeon captures while conducting an American shad fishery independent gill net survey on the Altamaha River and from 2001-2010 a total of 73 shortnose sturgeon were captured and released alive. The catch rate of shortnose sturgeon from the American shad gill net survey averaged 0.41 fish/day over this 10-yr period. During this same 10-yr period, the highest catch rate from any consecutive 3-year period (2001-2002) was 0.94fish/day. These catch rates were significantly impacted by one year in which 41 of the 73 shortnose sturgeon were captured. Other than 2002, the highest number of shortnose sturgeon captured during the GADNR gill net survey in one year was 8 fish. From 2001-2010, reported commercial shad fishing trips on the Altamaha River averaged 265 trips. Utilizing catch rates from the GADNR gill net survey resulted in an estimated range of 109-250 shortnose sturgeon being incidentally captured per year in the commercial shad fishery. Due to the high variability in shortnose sturgeon bycatch rates, GADNR proposes utilizing 3-year running averages to monitor shortnose sturgeon bycatch. GADNR estimates that 3-year averages of incidental bycatch will not likely exceed 175 fish/yr in the Altamaha River.

Bahn and Peterson observed extremely low catch rates of Atlantic sturgeon in the commercial shad fishery during their 2007-2009 study, with only 6 Atlantic sturgeon being captured over the entire 3-year study. Due to the low catch rates an accurate estimate of total Atlantic sturgeon incidental capture could not be produced from the 2007-2009 study (personal comm). GADNR does record incidental Atlantic sturgeon captures while conducting an American shad fishery independent gill net survey on the Altamaha River and from 2001-2010 a total of 33 Atlantic sturgeon were captured and released alive. All of these were sub-adult fish with an average total length of 526 mm. The catch rate of Atlantic sturgeon from the American shad gill net survey averaged 0.19 fish/day over this 10-yr period. During this same 10-yr period, the highest catch rate from any consecutive 3-year period (2006-2008) was 0.41fish/day. From 2001-2010, reported commercial shad fishing trips on the Altamaha River averaged 265 trips. Utilizing the catch rate of 0.41 fish/day results in an estimate of 109 Atlantic sturgeon being incidentally captured per year. Based on this data, GADNR estimates that 3-year averages of incidental bycatch will not likely exceed 140 fish/yr in the Altamaha River.

A similar study was completed on the Savannah River in the 1990's. Collins et al. (1996) reported that during the 1990-92 shad seasons a total of 240-shortnose sturgeon were captured by Savannah River shad fishermen. The Savannah River is open to commercial shad fishing from U.S. Hwy 301 (rkm 192), downstream to the Atlantic Ocean, an area approximately 103 rkm or 35% smaller than previously open to commercial shad fishing. Closing the upper portion of the river should decrease incidental bycatch and protect suspected spawning sites. It is estimated that 3-year averages of shortnose sturgeon incidental bycatch by GA shad fishermen will not exceed 75 fish/yr in the Savannah River.

GADNR does not conduct a fishery independent gill net survey on the Savannah River and does not have any recent data regarding the incidental bycatch of Atlantic sturgeon by the commercial shad fishery for the Savannah River. Therefore, GADNR proposes utilizing bycatch rate developed from the Altamaha fishery independent gill net survey to estimate the anticipated number of Altantic sturgeon that may be intercepted in the Savannah River. From 2001-2010, Savannah River commercial shad fishing effort reported to GADNR has averaged an estimated 85 trips/yr. Utilizing the catch rate of 0.41 fish/day derived from the Altamaha River results in an estimate of 35 Atlantic sturgeon being incidentally captured per year. Based on this data, GADNR estimates that 3-year averages of incidental bycatch will not likely exceed 50 fish/yr in the Savannah River.

Incidental bycatch of sturgeon by the commercial shad fishery has not been evaluated in the Ogeechee River. This is a very small commercial fishery and based on the total number of commercial shad fishing trips from 2007-2011,

approximately 2% of the total statewide effort is exerted on the Ogeechee River. New regulations closed approximately 137 rkm or 66% of the river previously open to commercial fishing and also limited legal gear to drift nets only. GADNR believes that 3-year averages of incidental bycatch will likely not exceed 10 shortnose and 10 Atlantic sturgeon/yr in the Ogeechee River.

2. The type of anticipated taking, such as harassment, predation, competition for space and food, etc.

   GA commercial regulations require that all sturgeon incidentally captured must be immediately released unharmed (pg 18 "Georgia's Commercial Saltwater Fishing Regulations")

3. The effects of the take on the listed species, such as descaling, altered spawning activities, potential for mortality, etc.

   Bahn and Peterson (2010) reported a very low mortality rate of 2.3% for shortnose sturgeon that were captured in set nets targeting American shad in the Altamaha River. Sub-lethal effects are unclear.

B. The anticipated impact of the proposed activity on the habitat of the species and the likelihood of restoration of the affected habitat.

The American shad gill net fishery is a low impact fishery and should have extremely minor physical affects on aquatic habitat utilized by shortnose sturgeon. In addition, the newly established commercial fishery boundaries will provide protection to confirmed and suspected spawning sites in Georgia's rivers.

C. The steps that will be taken to monitor, minimize, and mitigate such impacts, including:

1. Specialized equipment, methods of conducting activities, or other means.

   Refer to page 18 of "Georgia's Commercial Saltwater Fishing Regulations" for information on legal shad fishing gear.

2. Detailed monitoring plans.

   See monitoring plan document that was previously submitted.

3. Funding available to implement measures taken to monitor, minimize and mitigate impacts.

   In 2011, Georgia Department of Natural Resources management and monitoring of commercial fisheries operated under state appropriations and federal awards totaling approximately $180,000. GADNR is mandated by ASMFC to annually monitor commercial shad fisheries and sturgeon populations. GADNR will utilize state appropriated funds, federal awards and existing staff to monitor the commercial shad fishery and incorporate sturgeon bycatch monitoring.

D. The alternative actions to such taking that were considered and the reasons why those alternatives are not being used.

See alternative regulation document that was previously submitted.

E. A list of all sources of data used in preparation of the plan, including reference reports, environmental assessments and impact statements, and personal communications with recognized experts on the species or activity who may have access to data not published in current literature.

Bahn and Peterson (2010)
Collins et al (1996)
GA Commercial Saltwater Fishing Regulations
GADNR (personal comm.)

An application for a certificate of inclusion under a General incidental take permit must include the following:

1. General incidental take permit under which the applicant wants coverage;

2. Applicant's name, address and telephone number (if the applicant is a partnership or corporate entity, then the applicable details);

3. Description of the activity the applicant wants covered under the general permit, including anticipated geographic range and season; and

4. Signed statement that the applicant has read and understood the general incidental take permit and the conservation plan, will apply with the applicable terms and conditions, and will fund the applicable measures of the conservation plan.

Modifications to Permits
Requests for modifications to incidental take permits should address all applicable sections of these instructions, including a detailed description of the proposed changes. Appropriate changes should also be made to the Conservation Plan. Modification requests involving an increased number of animals, additional species, an increased risk to the animals, or a significant change in the location of incidental take are subject to the 30-day public review and are granted or denied at the discretion of the Assistant Administrator for Fisheries.

Where to Send the Application
The application may be submitted electronically, if possible (either by email or by mailing a disk), but one signed original of the complete application must be sent to one of the following addresses.

Send applications for incidental take of all species except sea turtles and Pacific salmon to:

Chief, Endangered Species Division
National Marine Fisheries Service, F/PR3
1315 East-West Highway
Silver Spring, Maryland 20910
Telephone 301-713-1401
Fax 301-713-0376

Send applications for incidental take of sea turtles to:

Chief, Marine Mammal and Turtle Division
National Marine Fisheries Service, F/PR2
1315 East-West Highway
Silver Spring, Maryland 20910
Telephone 301-713-2322
Fax 301-713-4060
Web Site http://www.nmfs.noaa.gov/pr/

Please see separate application instructions for incidental take permits for sea turtles, available on-line at http://www.nmfs.noaa.gov/pr/permits/esa_permits.htm

Send applications for incidental take of anadromous fish in the Pacific to one of these offices:

Pacific Salmon
Northwest Regional Office
National Marine Fisheries Service
7600 Sand Point Way NE
Building 1
Seattle, WA 98115
Phone: (206) 526-6150
Fax: (206) 526-6426

NMFS Northern California Coast Salmon
National Marine Fisheries Service
1655 Heindon Road
Arcata, CA 95521
Phone: (707) 825-5163
Fax: (707) 825-4840

NMFS Central California Coast Salmon
National Marine Fisheries Service
777 Sonoma Ave., Room 325
Santa Rosa, CA 95404
Phone: (707) 575-6050
Fax: (707) 578-3435

NMFS California Central Valley Salmon
National Marine Fisheries Service
650 Capitol Mall, Suite 8-300
Sacramento, CA 95819
Phone: (916) 930-3600 Fax: (916) 930-3629

NMFS Southern California Salmon
National Marine Fisheries Service
501 West Ocean Blvd
Long Beach, CA 90802-4250
Phone: (562) 980-4020 Fax: (562) 980-4027

GA American Shad Fishery Sturgeon Bycatch Monitoring Plan

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.

CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW[1]

[1] Bahn, R. A., D. J. Farrae, and D. L. Peterson *in part to be submitted to* Reviews in Fish Biology and Fisheries summer 2010

The shortnose sturgeon, *Acipenser brevirostrum* LeSueur 1818, is the smallest member of Acipenseridae, and inhabits coastal rivers and estuaries along the Atlantic Coast of North America from the St. John River, Canada, to the St. John's River in northeast Florida (Vladykov and Greeley 1963; Moser and Ross 1995; Bain et al. 2007). Like other members of the genus, shortnose sturgeon are long-lived, late maturing, diadromous fishes with a protracted spawning periodicity (Vladykov and Greeley 1963; Bemis and Kynard 1997). Historical abundance estimates are scarce, however, shortnose sturgeon were exploited for decades along with the sympatric Atlantic sturgeon, *Acipenser oxyrinchus* (Smith et al. 1984). During the last century, shortnose sturgeon had become sufficiently rare that they were listed as an endangered species in the United States in 1967 (National Marine Fisheries Service (NMFS) 1998). Today, few healthy populations exist and many anthropogenic factors impede restoration efforts (Kynard 1997). Many populations, particularly in southern rivers, continue to be threatened with extinction. With federal protection in place, the two primary factors currently affecting population recovery in the Southeastern U.S. are habitat degradation and fishing mortality as a result of unintended capture or "bycatch" in commercial fisheries targeting other species (Collins et al. 2000).

Life History

Sturgeon are long-lived, late maturing, diadromous fishes with a protracted spawning periodicity (Bemis and Kynard 1997). Populations of shortnose sturgeon have life history differences in their northern and southern ranges, but southern populations have not been well studied. In southern rivers, shortnose sturgeon mature sooner, spawn earlier in the year, grow faster, and have shorter life spans compared to those in the northern part of the range (Vladykov and Greeley 1963; Heidt and Gilbert 1978; Dadswell 1979).

As an amphidromous species, shortnose sturgeon require riverine habitats to complete their life cycle, but they will migrate to estuarine and marine habitats for purposes other than spawning (Bemis and Kynard 1997). Shortnose sturgeon typically mature at 500-600 mm total length (TL), which is reached by 2-3 years for males and 3-5 years for females in southern populations (Dadswell 1979; Kynard 1997). After maturity, males spawn every 1-2 years; females spawn every 3-5 years (Dadswell 1979). Southern shortnose sturgeon are estimated to live less than 20 years, compared to 30-67 years for their northern counterparts (Rogers and Weber 1994; Kynard 1997). Spawning occurs from late January (D. Peterson, unpublished data) to March in southern rivers, where shortnose sturgeon migrate to the upstream portion of their population range (Heidt and Gilbert 1978; Bain 1997; Kynard 1997). In the Altamaha River, spawning is thought to occur between river kilometer (rkm) 167 and 215 (DeVries 2006; D. Peterson, unpublished data).

Bycatch

Fishing mortality from bycatch is a problem for many species that have life histories dependent on late maturation and protracted spawning periodicity (Boreman 1997; Stein et al. 2004). Although they are long-lived, sturgeons only spawn once every 3-5 years (Dadswell 1979). Hence, sturgeon populations are especially sensitive to loss of reproductive potential from bycatch mortality (Boreman 1997).

Bycatch of sturgeon in riverine, estuarine, and marine fisheries is a threat to the recovery of many sturgeon populations (Stein et al. 2004; Munro et al. 2007). Although shortnose sturgeon are federally protected, they are frequently captured across their range in commercial fisheries targeting other riverine species (Kynard 1997). Most of this bycatch occurs in anchored and drifted gill net fisheries for American shad (*Alosa sapidissima*; Collins et al. 1996; Kynard 1997).

Bycatch of shortnose sturgeon by commercial shad fisheries is well documented (Heidt and Gilbert 1978; Dadswell 1979; Collins et al. 1996; Weber 1996; Kynard 1997; Collins et. al 2000). Collins et. al (2000) states that the use of anchored gill nets in essential habitats by commercial fishermen is a threat to the recovery of sturgeon populations. In Georgia, commercial shad fisheries are open from January 1 to March 31. Based on total fishing effort, the shad fishery is one of the largest commercial fisheries operated in Georgia (Collins et al. 1996). Adult shortnose sturgeon are vulnerable to incidental capture by commercial shad fisheries because their upstream spawning migration coincides with the peak commercial fishing effort (Collins et al. 2000). Soak time directly affects sturgeon mortality rates in anchored gill net fisheries (Atlantic Sturgeon Status Review Team (ASSRT) 2007). In the Altamaha River, commercial fishermen use both drifted and anchored gill nets in different portions of the river.

Anchored gill nets must have a minimum of 11.43 cm stretched mesh with a maximum length of 30.48 m. Nets must be spaced at least 182.88 m apart with one end attached to the shore, allowing open fish passage through at least ½ of the river channel. Most gill nets deployed upstream of the estuary in the Altamaha River from 2004-08 were anchored gill nets (D. Peterson, unpublished data). Drifted gill nets can be used throughout the river, but are mostly used in the estuary. Only drifted gill nets are permitted in the Altamaha Sound. Collins et al. (1996) and Stein et al. (2004) state that the time non-target species spend tangled in drifted gill nets is likely less than that of anchored gill nets because drifted gill nets must be tended constantly to prevent these nets from becoming entrained on benthic debris. Collins et al. (1996) also states that catch per unit effort (CPUE) of sturgeon may be lower in drifted gill nets because they often do not fish the lower portion of the water column.

Previous studies of shad fisheries have shown that shortnose sturgeon bycatch can be significant. Collins et al. (1996) reported that shad fishermen captured 240 shortnose sturgeon from 1990-92 in the Savannah River. In this study, 97% of captured shortnose sturgeons were mature adults (TL 560 -1060 mm). In 1994, the shortnose sturgeon population in the Savannah River was calculated to be 1676, but this estimate was deemed incorrect because not all assumptions of the Schnabel model were met (NMFS 1998).

Both shortnose sturgeon and American shad migrate to upstream spawning sites in southern rivers during February and March (Hall et al. 1991; Collins and Smith 1995). Spawning shortnose sturgeon leave the estuary in mid-

December, migrating upstream for several hundred kilometers throughout the winter (DeVries 2006). Although Georgia's commercial shad fishery does not open until January, DeVries (2006) documented adult shortnose sturgeon continuing upstream migrations throughout February and early March. Hence, the temporal and spatial overlap of shortnose sturgeon migrations and the commercial fishery creates a potential for incidental capture of spawning shortnose sturgeon. Although commercial fishermen must immediately release any sturgeon caught, soak time of commercial gear is not regulated. Consequently, most commercial fishermen check their nets once daily, thereby increasing the potential for injury or death of entangled shortnose sturgeon. Aside from direct mortality caused by long soak times of anchored gill nets, prolonged entanglement of sturgeon can have sublethal effects, but they have not been well studied (Moser and Ross 1995; Boreman 1997; Kynard 1997). Previous studies have reported instances where radio-tagged shortnose sturgeon aborted their spawning migrations after being captured in commercial anchored gill nets (Moser and Ross 1995; Weber 1996).

Mortality and injury of sturgeons because of bycatch in shad fisheries has been identified as a serious threat to southern sturgeon populations (Kynard 1997; Collins et al. 2000). Because the Altamaha River contains the largest population of adult shortnose sturgeon (~1800 individuals) south of the Delaware River, bycatch of shortnose sturgeon in the shad fishery is a concern to both state and federal agencies (NMFS 1998; DeVries 2006). The observed mortality rate of over 30% in the Altamaha River shortnose sturgeon population (DeVries

2006) is high compared to 22% in the Hudson River (Secor and Woodland 2005). The effect of bycatch on the mortality rate of shortnose sturgeon in the Altamaha River is unknown; however, Collins et al. (1996) documented a 16% mortality rate and a 20% injury rate among shortnose sturgeon captured in the commercial shad fishery of Winyah Bay, SC.

Research Objectives and Justification

The objective of my study was to estimate the bycatch of shortnose sturgeon in the commercial shad fishery of the Altamaha River, GA. The National Marine Fisheries Service has identified studies of shortnose sturgeon bycatch in commercial fisheries as a research priority throughout the Atlantic Coast (NMFS 1998). In a previous study of shortnose sturgeon bycatch in the Savannah River, Collins et al. (1996) recommended the use of a standardized creel survey methodology for future assessments in other southern rivers. Because the effects of sturgeon bycatch have not been well studied, little is known about how Georgia's commercial shad fisheries may be affecting recovery of shortnose sturgeon throughout the state. Although surveys conducted during the 1980s and 1990s documented mortality of shortnose sturgeon in Georgia's shad fisheries, the population level effects were difficult to quantify because shortnose sturgeon abundance estimates were not available (Collins et al. 1996). A recent study by DeVries (2006) however, reported new abundance estimates for Altamaha River shortnose sturgeon, providing a context for quantifying the effects of bycatch. The results of this study provide the first quantified estimates of bycatch and mortality rates of shortnose sturgeon in the Altamaha River commercial shad fishery. The application of these results will provide a framework for evaluating current commercial shad fishing regulations in Georgia and on other rivers where shortnose sturgeon populations exist.

References

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.

Bain, M. B. 1997. Atlantic and shortnose sturgeons of the Hudson River: common and divergent life history attributes. Environmental Biology of Fishes 48:347-358.

Bain, M. B., N. Haley, D. L. Peterson, K. K. Arend, K .E. Mills, and P. J. Sullivan. 2007. Recovery of a US Endangered Fish. PLoS ONE 2(1): e168.

Bemis, W. E. and B. Kynard. 1997. Sturgeon rivers: An introduction to acipensiform biogeography and life history. Environmental Biology of Fishes 48:167-183.

Boreman, J. 1997. Sensitivity of North American sturgeons and paddlefish to fishing mortality. Environmental Biology of Fishes 48:399-405.

Collins, M. R. and T. I. J. Smith. 1995. Characteristics of the adult segment of the Savannah River population of shortnose sturgeon. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 47(1993):485-491.

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

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

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

DeVries, R. J. 2006. Population dynamics, movements, and spawning habitat of the shortnose sturgeon, *Acipenser brevirostrum*, in the Altamaha River system, Georgia. M.S. Thesis, University of Georgia, Athens, Georgia.

Hall, J. W., T. I. J. Smith, and S. D. Lamprecht. 1991. Movements and habitats of shortnose sturgeon, *Acipenser brevirostrum*, in the Savannah River. Copeia 1991:695-702.

Heidt, A. R. and R. J. Gilbert. 1978. The shortnose sturgeon in the Altamaha River drainage, Georgia. Pages 54-60 *in* R. R. Odum and L. Landers, editors. Proceedings of the rare and endangered wildlife symposium. Georgia Department of Natural Resources, Game and Fish Division, Technical Bulletin WL 4, Athens, Georgia.

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

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

Munro, J., R. E. Edwards, and A. W. Kahnle. 2007. Anadromous sturgeons: Habitats, threats, and management. Synthesis and summary. Pages 1-15 *in* J. Munro, D. Hatin, J. E. Hightower, K. McKown, K. J. Sulak, A. W. Kahnle, and F. Caron, editors. Anadromous sturgeons: habitats, threats, and management. American Fisheries Society, Symposium 56, Bethesda, Maryland.

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

Rogers, S. G. and W. Weber. 1994. Movements of shortnose sturgeon in the Altamaha River System, Georgia. Contributions Series No. 57. Coastal Resources Division, Georgia Department of Natural Resources. Brunswick, Georgia.

Secor, D. H., and R. J. Woodland. 2005. Recovery and status of shortnose sturgeon in the Hudson River. Hudson River Foundation for Science and Environmental Research, Inc. 105pp.

Smith, T. I. J., D. E. Marchette, and G. F. Ulrich. 1984. The Atlantic sturgeon fishery in South Carolina. North American Journal of Fisheries Management 4:164-176.

Stein, A. B., K. D. Friedland, and M. Sutherland. 2004. Atlantic sturgeon marine bycatch and mortality on the continental shelf of the northeast United States. North American Journal of Fisheries Management 24:171-183.

Vladykov, V. D. and J. R. Greeley. 1963. Order Acipenseroidei. Pages 24-60 in V. H. Olsen, editor. Fishes of the western North Atlantic, part III. Memoirs of the Sears Foundation for Marine Research, New Haven Connecticut. 630 pp.

Weber, W. 1996. Population size and habitat use of shortnose sturgeon, *Acipenser brevirostrum*, in the Ogeechee River System, Georgia. M.S. Thesis, University of Georgia, Athens, Georgia.

CHAPTER 2

BYCATCH OF SHORTNOSE STURGEON IN THE COMMERCIAL SHAD FISHERY OF THE ALTAMAHA RIVER, GEORGIA[2]

[2] Bahn, R. A. and D. L. Peterson *to be submitted to*

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Abstract

Although the shortnose sturgeon (*Acipenser brevirostrum*) has been federally protected as an endangered species since 1967, incidental capture of shortnose sturgeon in commercial shad fisheries has been documented as a source of mortality that may limit recovery of some populations. As such, shortnose sturgeon bycatch assessments were recently identified as a priority by the National Marine Fisheries Service, as part of the iterative process of identifying and reducing threats to East Coast sturgeon. The objective of our study was to estimate total bycatch and mortality of shortnose sturgeon in the anchored gill net portion of the Altamaha River commercial shad fishery from 2007 - 09. Using a roving creel survey design, we conducted on-the-water counts of commercial shad nets to estimate fishing effort. Catch-per-unit effort was estimated from log books and direct observations of net retrievals by randomly selected commercial fishermen. During the 3 years of the study, total estimated bycatch of shortnose sturgeon was 71, 53, and 498 fish, respectively. Catch rates were highest during January and February of 2009 in upriver commercial nets near previously confirmed spawning locations in the river. Mortality of captured shortnose sturgeon was low in all three years (< 8%), although we did not assess post-release survival. Future studies are needed to better assess population level effects and sub-lethal effects of incidental capture on shortnose sturgeon. Because bycatch is highly variable annually, future studies need to be conducted over several seasons and throughout the extent of the population range in a particular river.

Introduction

Shortnose sturgeon (*Acipenser brevirostrum*) are an amphidromous species that ranges from the St. John River, Canada, to the St. John's River in northeast Florida (Vladykov and Greeley 1963). Although shortnose sturgeon were once common in most major East Coast river systems, commercial exploitation and habitat degradation have reduced populations significantly (Kynard 1997; Collins et al. 2000). The shortnose sturgeon has been federally listed as an endangered species since 1967 (National Marine Fisheries Service (NMFS) 1998).

Northern and southern populations of shortnose sturgeon are known to exhibit several important differences in life history; however, southern populations have not been well studied. In southern rivers, shortnose sturgeon mature sooner, spawn earlier in the year, grow faster, and have shorter life spans compared to those in the northern part of the range (Vladykov and Greeley 1963; Heidt and Gilbert 1978; Dadswell 1979). As an amphidromous species, shortnose sturgeon require riverine habitats to complete their life cycle, but they will feed in estuarine and marine habitats during the winter months (Bemis and Kynard 1997). Shortnose sturgeon typically mature at 500-600 mm total length (TL), which is reached by 2-3 years for males and 3-5 years for females in southern populations (Dadswell 1979; Kynard 1997). After maturity, males spawn every 1-2 years; females every 3-5 years (Dadswell 1979). Southern shortnose sturgeon are estimated to live less than 20 years, compared to 30-67 years for their northern counterparts (Rogers and Weber 1994; Kynard 1997).

Spawning occurs from late January (D. Peterson, unpublished data) to March in southern rivers, where shortnose sturgeon migrate to the upstream portion of their population range (Heidt and Gilbert 1978; Bain 1997; Kynard 1997).

Although shortnose sturgeon have been federally protected for more than 40 years, they are frequently captured across their range in commercial fisheries targeting other riverine species (Kynard 1997). Most of this "bycatch" occurs in anchored and drifted gill net fisheries for American shad (*Alosa sapidissima*; Collins et al. 1996; Kynard 1997). Several authors have shown that fishing mortality from bycatch poses an especially serious threat to species with reproductive strategies that depend on late maturation and protracted spawning periodicity (Boreman 1997; Stein et al. 2004; Munro et al. 2007). Despite their long life spans, shortnose sturgeon spawn only once every 2-5 years after reaching maturity (Dadswell 1979), making them particularly sensitive to the cumulative losses of reproductive potential resulting from chronic bycatch mortality (Boreman 1997).

Bycatch of shortnose sturgeon in commercial shad fisheries has been well documented (Heidt and Gilbert 1978; Dadswell 1979; Collins et al. 1996; Weber 1996; Kynard 1997; Collins et. al 2000), but population level effects are poorly understood. Previous studies of commercial shad fisheries have shown that shortnose sturgeon bycatch can be significant and Collins et al. (2000) suggest that this bycatch may be among the most serious impediments to the recovery of southern shortnose sturgeon populations. In South Carolina, previous studies have shown that shad fishermen captured 240 shortnose sturgeon from 1990-92 in the Savannah River and that 97% of those captured were mature adults (TL 560 -1060 mm; Collins et al. 1996). In 1994, the shortnose sturgeon population in the Savannah River was estimated at 1,676 individuals, suggesting that annual bycatch in this commercial fishery may have resulted in the incidental capture of up to 15% of the entire adult population.

Although shortnose sturgeon accidentally captured in commercial shad fisheries must be immediately released, delayed mortality and injury resulting from incidental capture has been identified as a serious threat to populations in several southern rivers (Kynard 1997; Collins et al. 2000). Collins et al. (1996), for example, documented a 16% mortality rate and a 20% injury rate for shortnose sturgeon captured in commercial shad nets in Winyah Bay, SC.

In many Atlantic Coast rivers, spawning runs of American shad largely overlap with those of shortnose sturgeon (Hall et al. 1991; Collins et al. 1996; NMFS 1998). Consequently, adult shortnose sturgeon are particularly vulnerable to incidental capture in commercial shad fisheries because their annual upstream migrations coincide with the peak commercial fishing effort (Collins et al. 2000). Because bycatch is a known problem for recovering shortnose sturgeon populations, NMFS has identified studies of bycatch in commercial fisheries as a research priority as part of the iterative process of identifying and reducing threats to the recovery of sturgeons (NMFS 1998).

In Georgia, the Altamaha River contains the largest population of shortnose sturgeon (~1,800 adults) within the southern portion of the range (Peterson and DeVries 2006). Hence, bycatch of shortnose sturgeon in the

Altamaha commercial shad fishery is of particular concern to both state and federal management agencies (NMFS 1998). In the Altamaha River, the commercial shad fishery is open from 1 January to 31 March and fishermen may use both drifted and anchored gill nets, depending on where they operate. Drifted gill nets can be used throughout the river, but their use is largely restricted to estuarine waters because of an abundance course woody debris above the head of tide. Anchored gill nets can be used upstream of the estuary. Because drifted nets must be tended constantly, the average duration of fish entanglement is typically much lower in drifted nets compared to anchored nets (Collins et al. 1996; Stein et al. 2004). Collins et al. (1996) also noted that catch-per-unit-effort (CPUE) of shortnose sturgeon may be lower in drifted gill nets because they usually do not extend down to the benthos where shortnose sturgeon are typically found. Anchored nets must have a minimum of 11.43-cm stretched mesh with a maximum length of 30.48 m. Nets must be spaced at least 182.88 m apart with one end attached to the shore, allowing unhindered fish passage through at least ½ of the river channel. Most gill nets deployed upstream of the estuary in the Altamaha River from 2004-06 were anchored gill nets (D. Peterson, unpublished data).

In southern rivers, both shortnose sturgeon and American shad migrate to upstream spawning sites in southern rivers from December to March (Hall et al. 1991; Collins and Smith 1993; Bahn et al. 2010). Although Georgia's commercial shad fishery does not open until January, DeVries (2006) documented adult shortnose sturgeon moving upstream in December, and continuing their migration through February and early March. Hence, the temporal and spatial overlap of shortnose sturgeon spawning migrations and the commercial shad fishery creates a potential for incidental capture of spawning shortnose sturgeon. Soak time directly affects sturgeon mortality rates in anchored gill net fisheries (Atlantic Sturgeon Status Review Team (ASSRT) 2007). Although commercial fishermen must immediately release any shortnose sturgeon caught, soak time of commercial gear is not regulated. Consequently, most commercial fishermen check their nets only once daily, thereby increasing the potential for injury or death of entangled shortnose sturgeon. Aside from direct mortality caused by long soak times of anchored gill nets, sublethal effects of prolonged entanglement have been documented for shortnose sturgeon (Moser and Ross 1995; Kynard 1997). Previous studies have reported several instances where radio-tagged shortnose sturgeon aborted spawning migrations after capture in anchored gill nets (Moser and Ross 1995; Weber 1996).

Because the effects of sturgeon bycatch have not been well studied, little is known about how Georgia's commercial shad fisheries may be affecting recovery of shortnose sturgeon throughout the state. The objective of our study was to quantify bycatch of shortnose sturgeon in the anchored gill net commercial shad fishery in the Altamaha River from 2007-2009. Although surveys conducted during the 1980s and 1990s documented mortality of shortnose sturgeon in Georgia's shad fisheries, the population level effects were difficult to quantify because shortnose sturgeon abundance estimates were not available (Collins et al. 1996). A recent study by Peterson and DeVries (2006) however, provided new abundance estimates for Altamaha River shortnose sturgeon, providing the key context necessary for quantifying the effects of bycatch in this population. In this study, we report the first quantified estimates of total bycatch and mortality rates of shortnose sturgeon in the Altamaha River commercial shad fishery. The application of these results may provide an important new framework for evaluating current commercial shad fishing regulations in Georgia and on other rivers where shortnose sturgeon populations coexist with commercial shad fisheries.

Study Site

The Altamaha River is formed on the coastal plain of Georgia by the confluence of the Ocmulgee and Oconee rivers near Hazlehurst, GA (Figure 1). The river flows southeast 215 km to the Atlantic Ocean near Darien, GA. The watershed contains approximately 800 km of unimpounded channel habitat accessible to diadromous fishes including shortnose sturgeon. Because the stream drains over one-quarter of the state, channel depths are highly variable depending on seasonal rainfall patterns and hydropower operation on reservoirs in the Ocmulgee and Oconee rivers. The head of tide is typically located between rkm 45-55, again depending on discharge. Mean channel depth is typically 50-70 m in width and 2-3 m in depth (Heidt and Gilbert 1978). Depths greater than 10 m are common in the tidally influenced section of the river. Deep cutbanks (10 m and greater) and channel scours below bridges are found above the head of tide.

Methods

Experimental Design

To estimate the number of shortnose sturgeon incidentally captured in the commercial shad fishery, we conducted a standardized fishery assessment of the Altamaha River mainstem from 1 January to 31 March, 2007-2009. Based on a priori knowledge of known and suspected shortnose sturgeon spawning locations (Peterson and DeVries 2006), we divided the river into two strata (Figure 1). The upper river stratum began at rkm 215 and extended downstream to rkm 184. The lower river stratum began at rkm 184 and extended downstream to rkm 21.

Using a roving creel survey design (Malvestuto 1996), we conducted weekly counts of anchored gill nets by traversing the entire 215 rkm of the study area by boat. In 2007 and 2008, these weekly counts were completed in two consecutive days, beginning with a random starting location and direction of travel. In 2009, counts were conducted continuously from upstream to downstream, so that they could be completed in one day. In each year, a running count of shad nets was made by checking each floating net buoy encountered during these counts to confirm that an actively fishing net was present. Nets that did not comply with published fishing regulations were included in all net count totals, but were not reported to law enforcement until the end of the season to prevent any potential bias in fisherman behavior.

For each month of each season, CPUE was obtained using a combination of direct observations of net retrievals and log books from five to seven commercial fishermen. The individual fishermen selected to provide this information were chosen based on the river section where they fished and their willingness to participate in the study. Specific locations of their nets were independent of each other and interspersed throughout the study area. Each fisherman was compensated US$500 annually in return for their cooperation in allowing us to observe randomly selected net pulls and for keeping accurate log books of both effort and catch. Direct observations of fishermen were randomized with some allowance for the individual schedules of each. Fishermen were not compensated, however, until accuracy of log books had been verified at the conclusion of each fishing season. Accuracy of log books was verified using two methods: 1) using a matched-pair t-test to compare days when observers were and were not present, and 2) using a matched-pair t-test to identify any significant differences of effort and catch data in log books versus those obtained through direct observations.

Direct observations of catch were conducted at least three times for each participating fishermen during each shad season. During each observation, we followed the fishermen to his nets in a separate boat so that we could record the number of each species captured as the net was retrieved. After all nets had been pulled, we recorded soak times, net dimensions, and mesh sizes. During 2008 and 2009, we also recorded total length (TL) and weight (g) of each shortnose sturgeon that was captured.

Data Analysis

To estimate total annual effort, we first calculated the mean number of nets fished in each stratum for each month of the season. Total net-hours was then calculated for each month based on the number of nets counted each week and the total number of fishing hours that the season was open. This included 12 hours for opening and closing days and 24 hours for all other days. Total monthly fishing effort for each stratum was then calculated using the formula:

Total fishing effort (net hrs) = Σ ((Mean nets observed / mo) x (Total fishing hrs / mo))

Accuracy of log book data from each fisherman was evaluated using a one sample matched-pair t-test ($\alpha = 0.05$) to compare the mean of the differences between days when observers were and were not present. We then used a one sample matched-pair t-test ($\alpha = 0.05$) to compare the mean of the differences between logged and observational data. To perform this test, the total annual number of shortnose sturgeon observed in the catch of each individual fishermen was standardized to the total number of net-hours recorded in his log book to calculate a monthly CPUE for each fisherman. Estimates of total monthly effort and catch were then calculated for each fisherman by supplementing the direct observational data with those from the log books recorded on days when observers were not present. A total monthly CPUE for shortnose sturgeon (SNS) was then estimated for each stratum using the formula:

CPUE = (Number SNS observed + number SNS logged) / Total net hrs

The variance of each of these estimates was used to calculate 0.95 confidence intervals. Assuming a linear relationship between effort and catch, we then estimated total monthly bycatch in each stratum using the formula:

Total monthly catch = (Total fishing hrs / mo) x (Mean monthly CPUE)

To identify any potential bias of mean CPUE calculations and to evaluate the accuracy of CPUE variance estimates, we resampled our original data using bootstrap analysis with replacement as described by Efron and Tibshirani (1994) using SAS (SAS Institute, Cary, NC). We constructed resample sets of both 100 and 1,000 bootstrap samples to compare resampled means and variances to those of the original data. For each month in each year in each stratum, we randomly constructed 100 and 1,000 bootstrap samples containing the same number of observations as the year-month-stratum data from which we were resampling (e.g. from 70 field observations we generated 100 and 1,000 bootstrap resample sets with 70 observations each). For example, because the original data from the lower stratum in January 2007 contained i = 70 observations, each bootstrap sample in the resample sets for the lower stratum in January 2007 also contained i = 70 observations. We then calculated the mean of each bootstrap sample and used these means to calculate grand means and variances for the resample sets (by year-month-stratum, both 100 and 1,000 bootstrap samples) for comparison with original field data.

Results

During each of the three commercial fishing seasons sampled, we conducted a total of 7-12 net counts totaling 1,358-2,328 rkm sampled annually. We also collected catch data from 192-336 direct observations, and 10,382 – 15,410 net hours of log book entry data (Table 1). From these data, we estimated that the total anchored gill fishery was comprised of 13-20 fishermen annually. Of these participants, 2-4 operated in the upper stratum compared to 11-16 in the lower stratum. Over the three fishing seasons, data collected from log books and direct observations annually accounted for 48% – 66% of all fishing effort in the anchored gill net fishery (Table 1).

Total estimated effort for the entire anchored gill net fishery varied from 22,689 – 27,405 hours annually (Table 2). Weekly effort varied from 6 – 35 nets per week during all three years of the study (Figure 2). In the upper river, fishing effort peaked in February of each year; however, effort was not consistent among months or years in the lower river (Figure 2). In the upper river, mean weekly effort ranged from 0.8 – 4.0 nets per week. Mean weekly effort in the lower river varied from 14.0 – 28.7 nets per week (Figure 2). Monthly effort varied from 495 – 1536 hours in the upper river compared to 5,712 – 11,700 hours in the lower river (Table 2). Despite this variability, several spatial and temporal trends in bycatch were evident. Most fishing effort (56.3%) occurred between rkm 35 - 100; however, most bycatch occurred in the upper river. In fact, we estimate that more shortnose sturgeon were incidentally captured in the upper river during January 2009 (333 fish) than in all months of all three years combined in the lower river (216 fish; Table 2).

Analysis of log book data from all three years showed that catch data recorded on days when observers were present was not significantly different than on days when observers were absent ($p > 0.61$ for all three years). Furthermore, total catch of shortnose sturgeon recorded during direct observations was not significantly different than that provided in fishermen log books ($p > 0.42$ for all three years).

Total estimated bycatch varied from a low of 53 shortnose sturgeon in 2008 to 498 shortnose sturgeon in 2009 (Table 2). We estimated that 387 shortnose sturgeon were incidentally captured in the upper river during the 2009 shad season. No bycatch was recorded in the upper river in March during all three years of the study. In 2008 and 2009, bycatch peaked in February in the lower river (36 and 74 fish, respectively), and then declined in March (Table 2). This trend was not observed in 2007, however.

During months when shortnose sturgeon were incidentally captured in the upper river, CPUE was always higher than that of the lower river (Figure 3). For example, in January 2009, CPUE in the upper river was 0.5007 SNS/hr, compared to only 0.0015 SNS/hr in the lower river (Figure 3). During February 2007 and 2009, CPUE in the upper river was also higher (0.0126 and 0.0512 SNS/hr, respectively) than during the same period in the lower river (0.0019 and 0.0110 SNS/hr, respectively; Figure 3). During 2008 and 2009, CPUE in the lower river was lowest in January, followed by an increase of over 100% in February, and then a decline in March (Figure 3).

Bootstrap results of both the 100 and 1,000 resample sets showed that the observed mean CPUE values for our study were unbiased (Table 3). The associated standard errors for the randomized bootstrap sample sets were smaller than those of the estimated mean CPUE for both strata, indicating that the variance estimates of mean CPUE in both strata were also accurate (Table 3).

Except for one juvenile fish captured in the upper river during January 2009, all shortnose sturgeon we observed during 2008 – 09 measured ≥590 mm TL. Most fish appeared to be in healthy condition and swam away after release, however, we were unable to assess any sublethal or post-release effects of incidental capture. Only 4 of the 172 shortnose sturgeon captured in commercial gill nets were dead upon net retrieval, yielding a mortality rate of 2.3% (Table 2).

Discussion

The results of this study provide the first quantified estimate of annual bycatch and mortality of shortnose sturgeon in the anchored gill net commercial shad fishery of the Altamaha River. Although shortnose sturgeon were captured during all three years of the study, a key finding of this study was that bycatch varied by as much as 900% across years. During the 2007 and 2008 seasons, fewer than 40 shortnose sturgeon were observed in the commercial catch, but in 2009, we recorded 105 captures yielding an expanded estimate of 498 captures over the entire three month fishery. Because of stochastic variables in habitat conditions and the protracted spawning periodicity of shortnose sturgeon, we caution against future researchers forming conclusions about sturgeon from short-term data.

The Altamaha River is thought to have the largest shortnose sturgeon population among southern rivers; however, the adult abundance is low compared to that of northern river systems. Throughout the study, all but one fish observed in commercial nets were adults (≥590 mm TL). A recent study by Peterson and DeVries (2006) showed that the Altamaha population contains 1,500-2,000 adults, so we can estimate that in 2009 between 19 and 49 percent of the adult population was "caught" in a net. In southern rivers, females spawn every 3-5 years, and males every 1-2 years. We estimated that 470 (95% CI 278-686) adult shortnose sturgeon were captured in January and February, suggesting that 25 to 80 percent of the spawning run was captured. The observed mortality rate of 2.3% is lower than the 16% previously observed by Collins et al. (1996) in southern shad fisheries. However, studies on sub-lethal and post-release effects of bycatch are lacking. Because incidental capture of spawning adults has been shown to negatively affect spawning behavior, bycatch has indirect population level effects (Moser and Ross 1995; Weber 1996).

The highest bycatch rates occurred in the upper river strata, during the month of February. In this stratum, there were never more than five fishermen operating at any one time; however, many of their nets were fished in known spawning areas of shortnose sturgeon. During January 2009, we observed several net retrievals in this reach of the river in which 4-16 shortnose sturgeon were captured in one net. In total, 36 adult shortnose sturgeon were recorded in the upper river during January and February 2009, and many of the males were running ripe. In contrast, no sturgeon were captured in the upper river during March in any year, suggesting that the spawning period was probably limited to a four to six week interval lasting from mid-January to late-February.

In all three years of the study, few shortnose sturgeon were captured in the lower river in January. Previous telemetry studies by Peterson and DeVries (2006) suggest that spawning shortnose sturgeon have already reached their spawning grounds by the start of the commercial fishing season while non-spawners remain in the estuary. Although many shortnose sturgeon were captured in the lower river during 2009, CPUE of shortnose sturgeon in the lower 184 km of the river was only 0.0015 compared to 0.5007 in the upper river during the same period. These findings suggest that spawning adult shortnose sturgeon are highly vulnerable to incidental capture in the upper 30 km of the Altamaha River.

Reducing bycatch of shortnose sturgeon in commercial fisheries is a critical component of recovering populations throughout the Atlantic coast. Further studies are needed in southern rivers, including the Altamaha, to quantify both direct (mortality) and indirect (sub-lethal and post-release) population level effects of bycatch on shortnose sturgeon populations. Although several potential management strategies already exist to minimize bycatch, the results of this study suggest that river-specific research and monitoring programs are needed to provide quantified data on the spatial and temporal variation in shortnose sturgeon movements for implementation of an effective adaptive fisheries management plan. For example, Collins et al. (2000) suggested the establishment of riverine and estuarine reserves that are completely closed to commercial gill net fisheries. Although closure of critical habitats may or may not be an important component, our results suggest that on the Altamaha River, delaying the opening of commercial shad fishing in the upper river stratum until 1 March, would almost completely eliminate bycatch of migrating shortnose sturgeon with only a minimal (5-15%) impact of total shad landings (Bahn et al. 2010). Regardless of which specific management actions are used, an adaptive approach that incorporates real-time monitoring of commercial bycatch is the only reasonable means of adequately protecting shortnose populations exposed to commercial gill netting operations. Although complete closure of shad fisheries is probably unnecessary, the annual variability of shortnose sturgeon spawning runs and commercial fishing behavior will preclude any type of "one size fits all" management approach. Consequently, future efforts to minimize shortnose sturgeon bycatch while maintaining the economic and social benefits provided by commercial fisheries will require close cooperation among federal and state management agencies as well as commercial fishermen.

References

Atlantic Sturgeon Status Review Team (ASSRT). 2007. Status Review of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). Report to National Marine Fisheries Service, Northeast Regional Office. Washington, D. C.

Bain, M. B. 1997. Atlantic and shortnose sturgeons of the Hudson River: common and divergent life history attributes. Environmental Biology of Fishes 48:347-358.

Bahn, R. A., D. Harrison, J. Fleming, and D. L. Peterson. 2010. The anchored gill net shad fishery of the Altamaha River, Georgia. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 63:183-187.

Bemis, W. E. and B. Kynard. 1997. Sturgeon rivers: An introduction to acipensiform biogeography and life history. Environmental Biology of Fishes 48:167-183.

Boreman, J. 1997. Sensitivity of North American sturgeons and paddlefish to fishing mortality. Environmental Biology of Fishes 48:399-405.

Collins, M. R. and T. I. J. Smith. 1993. Characteristics of the adult segment of the Savannah River population of shortnose sturgeon. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 47:485-491.

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

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

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

DeVries, R. J. 2006. Population dynamics, movements, and spawning habitat of the shortnose sturgeon, *Acipenser brevirostrum*, in the Altamaha River system, Georgia. Master's thesis. University of Georgia, Athens, Georgia.

Efron, B. and R. J. Tibshirani. 1994. An Introduction to the Bootstrap. Chapman & Hall. Boca Raton, Florida.

Hall, J. W., T. I. J. Smith, and S. D. Lamprecht. 1991. Movements and habitats of shortnose sturgeon, *Acipenser brevirostrum*, in the Savannah River. Copeia 1991:695-702.

Heidt, A. R. and R. J. Gilbert. 1978. The shortnose sturgeon in the Altamaha River drainage, Georgia. Pages 54-60 *in* R. R. Odum and L. Landers, editors. Proceedings of the rare and endangered wildlife symposium. Georgia Department of Natural Resources, Game and Fish Division, Technical Bulletin of Wildlife 4, Athens, Georgia.

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

Malevestuto, S. P. 1996. Sampling the Recreational Creel. Pages 591-623 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2^{nd} edition. American Fisheries Society, Bethesda, Maryland.

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

Munro, J., R. E. Edwards, and A. W. Kahnle. 2007. Anadromous sturgeons: habitats, threats, and management. Synthesis and summary. Pages 1-15 *in* J. Munro, D. Hatin, J. E. Hightower, K. McKown, K. J. Sulak, A. W. Kahnle, and F. Caron, editors. Anadromous sturgeons: habitats, threats, and management. American Fisheries Society, Symposium 56, Bethesda, Maryland.

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

Peterson, D. L. and R. J. DeVries. 2006. Population dynamics and critical habitats of the shortnose sturgeon, *Acipenser brevirostrum*, in the Altamaha River System, Georgia. Final report to NMFS.

Rogers, S. G. and W. Weber. 1994. Movements of shortnose sturgeon in the Altamaha River System, Georgia. Contributions Series Number 57. Coastal Resources Division, Georgia Department of Natural Resources. Brunswick, Georgia.

Stein, A. B., K. D. Friedland, and M. Sutherland. 2004. Atlantic sturgeon marine bycatch and mortality on the continental shelf of the northeast United States. North American Journal of Fisheries Management 24:171-183.

Vladykov, V. D. and J. R. Greeley. 1963. Order Acipenseroidei. Pages 24-60 *in* V. H. Olsen, editor. Fishes of the western North Atlantic, part III. Memoirs of the Sears Foundation for Marine Research, Yale University, New Haven, Connecticut.

Weber, W. 1996. Population size and habitat use of shortnose sturgeon, *Acipenser brevirostrum*, in the Ogeechee River System, Georgia. Master's thesis. University of Georgia, Athens, Georgia.

Table 1. Summary data from Altamaha River shortnose sturgeon bycatch study, 2007-09.

Year	Number of net counts	Number of direct observations	Logged net hours	Percent of fishery Observed
2007	7	336	14,271	66.4
2008	11	252	15,410	59.4
2009	12	192	10,382	48.2

Table 2. Raw number of shortnose sturgeon captured (number dead in parentheses), CPUE, 95% CI, estimated total fishing effort (h), and estimated shortnose sturgeon bycatch (95% CI in parentheses) by river strata of the anchored gill net commercial shad fishery in the Altamaha River, Georgia, 2007 – 09. * = No data available. ** = Estimate was lower than observed value.

Year	Month	Number of SNS captured	CPUE	95% CI	Estimated total fishing effort (h)	Mean estimated bycatch (95% CI)	
Upper River							
2007	Jan	*	*	*	1,050	*	
	Feb	4	0.0126	± 0.0115	1,536	19	(4 - 37)
	Mar	0	0.0000	± 0.0000	1,185	0	
2008	Jan	0	0.0000	± 0.0000	333	0	
	Feb	0	0.0000	± 0.0000	612	0	
	Mar	0	0.0000	± 0.0000	594	0	
2009	Jan	33 (1)	0.5007	± 0.1695	666	333	(220 - 446)
	Feb	3	0.0512	± 0.0645	1,056	54	(3 - 122)
	Mar	0	0.0000	± 0.0000	495	0	
Lower River							
2007	Jan	13 (1)	0.0023	± 0.0013	9,744	22	(9 - 35)
	Feb	17	0.0019	± 0.0010	5,712	**	**
	Mar	5 (2)	0.0021	± 0.0023	6,489	13	(5 - 28)
2008	Jan	9	0.0013	± 0.0009	7,236	9	(9 - 16)
	Feb	14	0.0031	± 0.0028	11,700	36	(14 - 69)
	Mar	5	0.0012	± 0.0012	6,930	8	(5 - 16)
2009	Jan	8	0.0015	± 0.0012	6,180	9	(8 - 16)
	Feb	47	0.0110	± 0.0042	6,720	74	(47 - 102)
	Mar	14	0.0037	± 0.0021	7,572	28	(14 - 44)

Table 3. Comparison of mean and associated standard errors (SE) of observed CPUE and CPUE of bootstrap resample sets, 100 and 1000 bootstrap samples. * = No data available.

Upper River

Year	Month	Observed CPUE	SE	100 bootstrap resamples	SE	1,000 bootstrap resamples	SE
2007	Jan	*	*	*	*	*	*
	Feb	0.0126	0.00585	0.0129	0.00155	0.0131	0.00182
	Mar	0.0000	—	—	—	—	—
2008	Jan	0.0000	—	—	—	—	—
	Feb	0.0000	—	—	—	—	—
	Mar	0.0000	—	—	—	—	—
2009	Jan	0.5007	0.08650	0.5121	0.04673	0.5169	0.04778
	Feb	0.0512	0.03292	0.0550	0.01491	0.0616	0.01552
	Mar	0.0000	—	—	—	—	—

Lower River

Year	Month	Observed CPUE	SE	100 bootstrap resamples	SE	1,000 bootstrap resamples	SE
2007	Jan	0.0023	0.00065	0.0023	0.00006	0.0023	0.00002
	Feb	0.0019	0.00053	0.0019	0.00005	0.0019	0.00005
	Mar	0.0021	0.00118	0.0022	0.00013	0.0021	0.00013
2008	Jan	0.0013	0.00045	0.0012	0.00005	0.0013	0.00005
	Feb	0.0031	0.00145	0.0032	0.00013	0.0031	0.00013
	Mar	0.0012	0.00064	0.0013	0.00007	0.0012	0.00007
2009	Jan	0.0015	0.00060	0.0017	0.00007	0.0015	0.00008
	Feb	0.0110	0.00215	0.0113	0.00021	0.0113	0.00023
	Mar	0.0037	0.00107	0.0037	0.00012	0.0037	0.00014

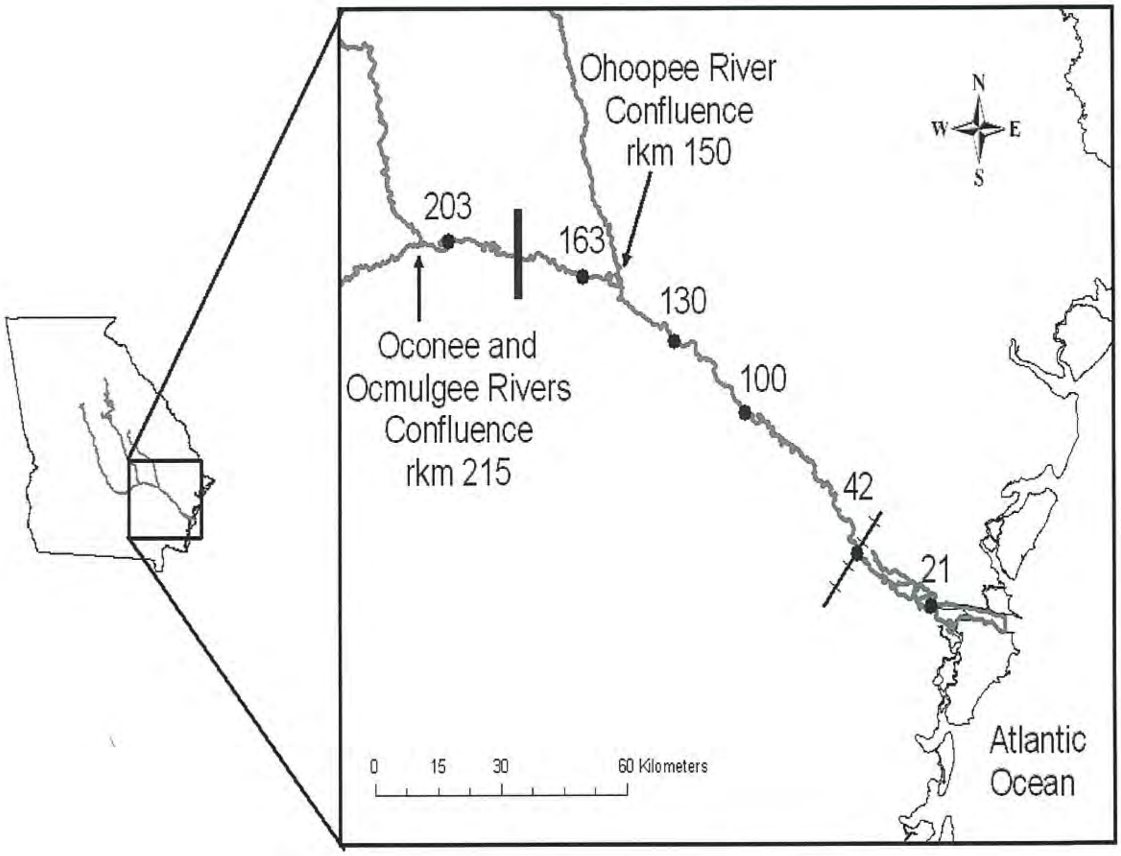

Figure 1. The Altamaha River with locations of commercial fishermen observed during the study. • = Six locations and river kilometer of fishermen surveyed in each year of the study. The Seaboard Coastline Railroad Bridge (rkm 42) divides the river into two strata under current GDNR regulations. The line downstream of rkm 203 is the U.S. 1 Bridge (rkm 184) which demarcates the lower and upper river strata used during this study.

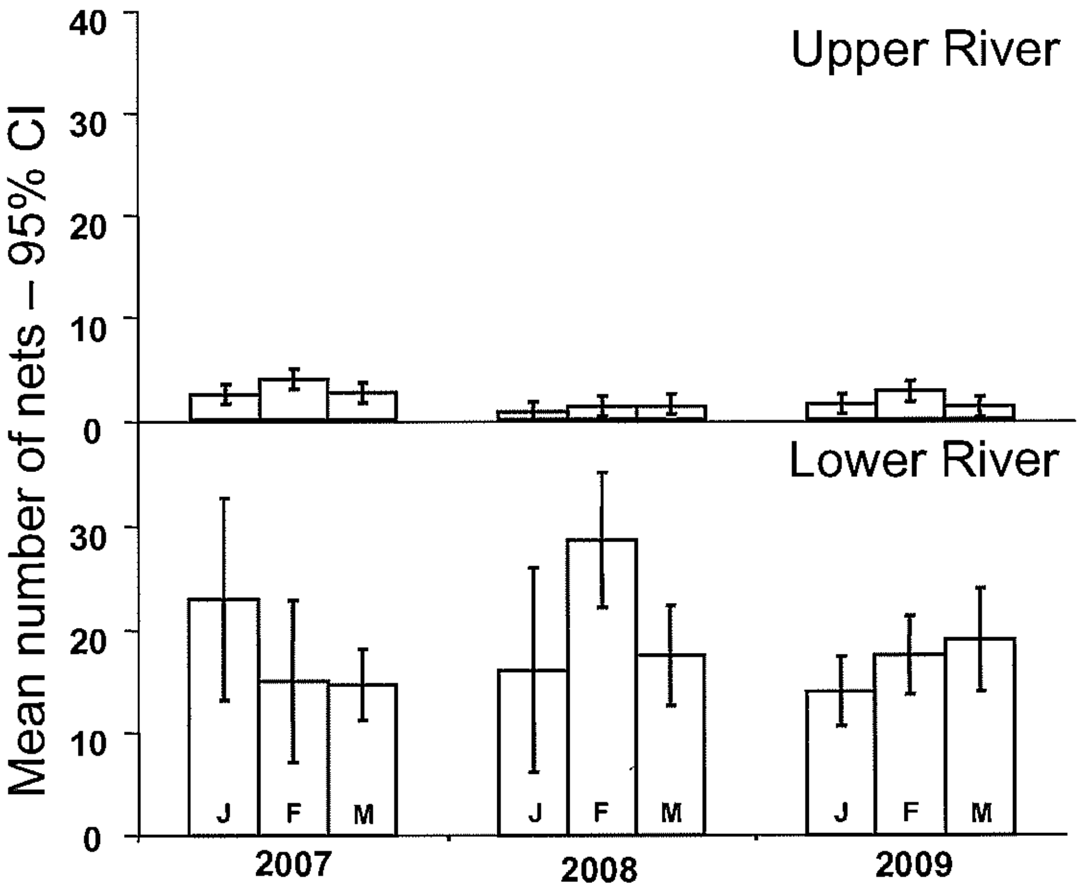

Figure 2. Mean number of anchored gill nets with associated 95% confidence intervals observed in the Altamaha River by strata by month and year from 2007 – 09. J = January, F = February, M = March

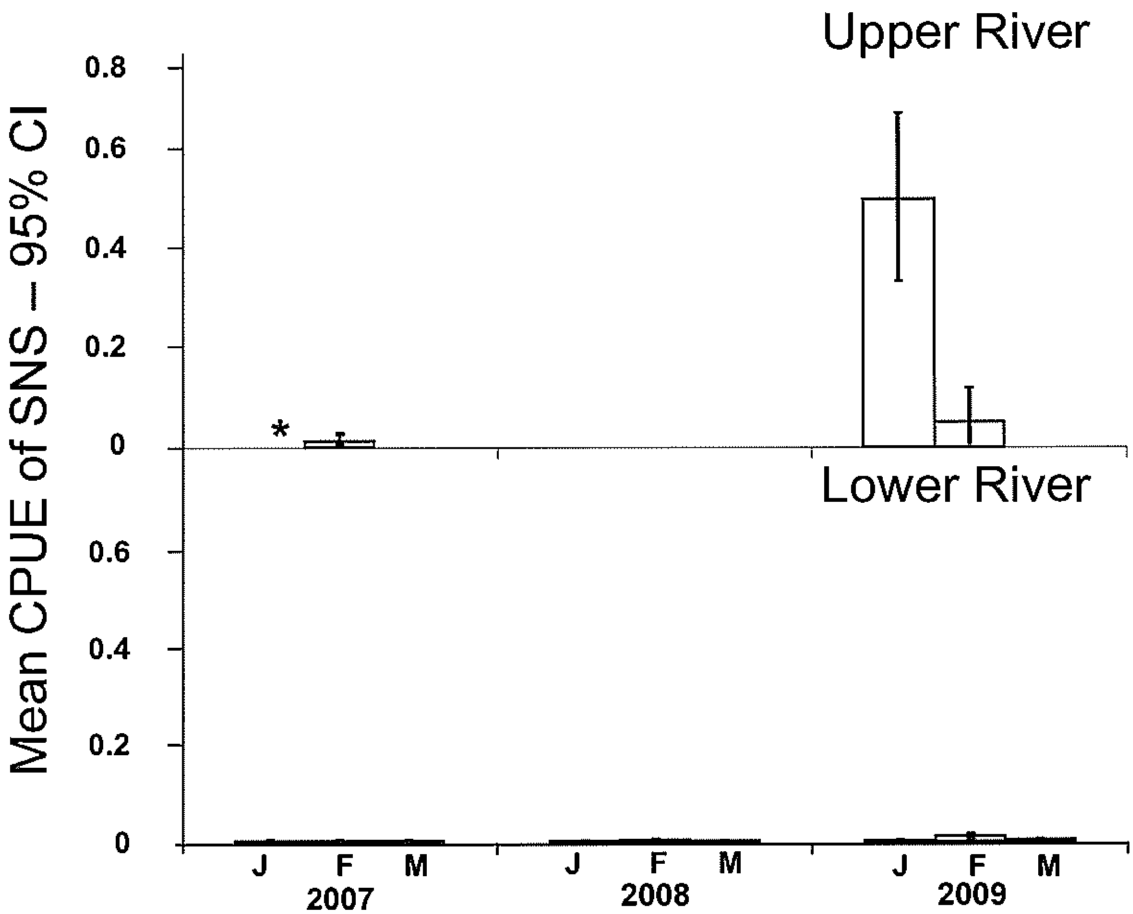

Figure 3. CPUE of shortnose sturgeon with associated 95% confidence intervals in the Altamaha River by strata by month and year from 2007 – 09. J = January, F = February, M = March, * = No data

CHAPTER 3

ABUNDANCE AND RECRUITMENT OF JUVENILE ATLANTIC STURGEON IN THE ALTAMAHA RIVER, GEORGIA[3]

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Abstract

Juvenile Atlantic sturgeon remain in natal rivers for several years prior to out-migrating to marine environments during later portions of their life history. Data regarding river-resident juvenile population dynamics are unknown. During the summers of 2004 – 2007, we performed mark-recapture of juvenile Atlantic sturgeon in the Altamaha River to assess age-specific abundance, apparent survival, per capita recruitment, and factors influencing recruitment. The objectives of this study were to estimate age-specific abundance, overall juvenile recruitment and apparent survival, and to determine factors influencing recruitment. Estimates indicated that juvenile abundance ranged from 1072 – 2033 individuals, and age-1 and age-2 individuals comprised greater than 87% of the juvenile population, while abundance of age-3 or older individuals was less than 13% of the population. Estimates of apparent survival and per capita recruitment from Pradel models indicated that the juvenile population experienced high annual turnover, as apparent survival rates were low (< 33%) and per capita recruitment was high (from 0.82 to 1.38). Fall discharge, which had a positive relationship with recruitment, was the only factor assessed that significantly explained time variation in per capita recruitment. The findings of this study suggest that juvenile populations at the southern extreme of the Atlantic sturgeon's range may remain in natal rivers for less time than northern counterparts. This is further evidence of difference in life history between northern and southern populations of Atlantic sturgeon. Potential findings of density dependence could have major implications for both population recovery and management of this species.

Introduction

Atlantic sturgeon (*Acipenser oxyrinchus*) are a long-lived, anadromous species that spend the early portion of their juvenile stage in freshwater (Scott and Crossman 1973). Adults inhabit marine environments in most years, but females enter coastal rivers for spawning every 3 – 5 years while males spawn every 1 – 5 years (Smith 1985). In southern rivers females typically spawn by age-10 and males by age-8 (Smith 1985), but age at maturity in northern populations may require 20 years or more (Scott and Crossman 1973). Spawning occurs well upriver from the saltwater interface of most rivers (Van Eenennaam et al. 1996, Caron et al. 2002, Hatin et al. 2002), as embryos and larvae are intolerant of salinity (Van Eenennaam et al. 1996). At hatching, embryonic Atlantic sturgeon seek cover within interstitial spaces of rocky substrates, but after 8 – 10 d they emerge as true larvae and disperse downstream (Kynard and Horgan 2002). Larval migration continues for approximately 12 d, and although most movements occur at night during the first 6 d, little diel preference has been observed thereafter (Kynard and Horgan 2002). In early juvenile development, individuals primarily use deep water habitats near the fresh/saltwater interface (Moser and Ross 1995, Bain 1997). After 2 – 6 years in these habitats, juveniles leave their natal rivers for marine environments (Dovel and Berggren 1983).

Throughout their range, Atlantic sturgeon populations have suffered declines resulting from decades of anthropogenic activities. Throughout much of the 20th Century, adults were harvested during spring spawning migrations for both meat and caviar (Smith 1985). As northern stocks declined, commercial fishing shifted to southern rivers, particularly during the 1970s and

1980s (Colligan et al 1998). While overexploitation was likely a primary cause of most population declines, habitat degradation may be impeding or limiting recovery of many populations (Smith 1985). Degraded water quality from industrial effluents and poor land use practices has adversely affected spawning and nursery habitats throughout the species' range (Smith 1985, Colligan et al. 1998). Especially in southern rivers, thermal effluents and excessive ground water pumping often degrades juvenile habitats by increasing water temperatures and lowering dissolved oxygen (Rochard et al. 1990, Collins et al. 2000, Niklitscheck and Secor 2005).

Although Atlantic sturgeon have been federally protected since 1996 (ASMFC), recovery has been difficult to assess because (1) historical abundance data are largely lacking, (2) the cryptic and complex life cycle of the species makes quantitative assessments difficult, and (3) latitudinal variation in ecology and population dynamics confounds direct comparisons of data from northern and southern river systems. Despite uncertainties regarding recruitment mechanisms and other basic aspects of juvenile ecology, long-term monitoring of juvenile abundance (i.e. recruitment) is currently one of the most critical research needs for assessing species recovery (Atlantic Sturgeon Status Review Team. 2007). In the Hudson River for example, Peterson et al. (2000) estimated abundance of age-1 juveniles to demonstrate the severity of recruitment declines resulting from decades of overfishing. Unfortunately, those authors relied on the presence of hatchery-reared juveniles to estimate the abundance of wild juveniles, an experimental approach which may not be appropriate or even possible on other rivers systems. Furthermore, studies of recruitment mechanisms in Atlantic sturgeon have not been attempted in any Atlantic coast river system.

While both scientists and managers agree that quantified methods of assessing sturgeon recruitment are essential for evaluating population trends and identifying key environmental factors that affect year class formation, early life stages of most sturgeon species are notoriously difficult to sample. In both freshwater and estuarine environments, juvenile sturgeons are widely dispersed and/or invulnerable to most types of sampling gear. Consequently, quantified estimates of abundance and mortality of juvenile sturgeons have persisted as critical information gaps in our understanding of recruitment mechanisms of sturgeon stocks worldwide (Pine et al. 2001, Secor et al. 2002; Peterson et al. 2006). Recently, however, some notable successes have been obtained using both empirical data and modeling methods. For example, Pine et al. (2001) used age-structured models to estimate first year survival in Gulf sturgeon. In a field study of lake sturgeon on the Peshtigo River, Wisconsin, Caroffino et al. (2010) sampled eggs, larvae, and age-0 juveniles to estimate first-year survival. Similar studies have been completed for a few other species, but quantified estimates of post-recruit juveniles are lacking. The Altamaha River, Georgia is currently thought to contain the 2nd largest population of Atlantic sturgeon in US waters (Peterson et al. 2008, Atlantic Sturgeon Status Review Team. 2007), but unlike the Hudson River, recruitment studies of Atlantic sturgeon have not been attempted there. The objectives of this study were to: 1) estimate annual age-specific abundance, 2) estimate annual apparent survival and per capita recruitment and 3) identify key factors that influence recruitment processes of juvenile Atlantic sturgeon in the Altamaha River.

Methods

Study Site/Fish Sampling

The study was conducted entirely within the tidally influenced portion of the Altamaha River system, near Darien, Georgia (Figure 1). To ensure spatial distribution of sampling locations, specific sampling sites were randomly distributed within three contiguous 10-km strata compromising the lower 30 rkm of the Altamaha Estuary. Within each stratum, channel habitats deeper than 3 m were sampled weekly from June to August, 2004 – 2007. Juvenile Atlantic sturgeon (Ages 1 – 3+) were captured using both trammel nets and experimental gill nets measuring 91 m by 3 m. Experimental gill nets consisted of three 30.5-m panels of 7.6, 10.2, and 15.2-cm monofilament mesh (stretch measure). Trammel nets were made from 7.6-cm mesh inner panel and two 30.5-cm mesh outer panels. Nets were deployed perpendicular to the current, anchored to the bottom, and fished for 25 – 90 min during slack tides only.

As nets were retrieved, juvenile Atlantic sturgeon were removed and placed in a floating net pen, where they were allowed to recover for 10-15 minutes prior to data collection. Each fish was then checked for PIT tags using a portable PIT tag reader. If no tag was detected, one was injected beneath the fourth dorsal scute. Measurements of total length (mm) and weight (kg) were then recorded for each fish. Prior to release a 0.5 – 1.0-cm section of the leading pectoral fin spine was removed from a random sub-sample of 32 and 25 fish in 2005 and 2006 respectively for subsequent age determination.

Data Analysis

Ages of juvenile Atlantic sturgeon were determined based on modal distributions of length-frequency histograms as described by Peterson et al. (2000) and subsequently, by McCord et al. (2007). Accuracy of modal distribution age assignments was verified from fin spines sections collected from a random sub-sample of captured juveniles. Using the basic methods described by Cuerrier (1951), pectoral fin spine sections were first air dried for at least one month, cross-sectioned using a Beulher Isomet® low-speed saw, and viewed under a dissecting scope to reveal growth annuli.

Modeling Overview

The modeling approaches used to meet the objectives of the study involved the use of robust design based model types. Traditional robust design models implement a combination of open and closed model types (Kendall et al. 1995). Open population models, such as the Cormack-Jolly-Seber model (or CJS; Cormack 1964, Jolly 1965, Seber 1965), are used between primary occasions that are widely spaced, such as annual sampling, to provide estimates of apparent survival. Apparent survival is defined as the probability of an individual surviving and remaining in the study are during the interval from time i to time $i + 1$.Within primary occasions, a series of sampling events, known as secondary occasions, are taken at shorter intervals, days or a week, when the population is assumed closed, allowing the use of traditional closed population abundance estimators (Otis et al. 1978). The assumptions of the traditional robust design are as follows:

1. The conditional probability of surviving from primary period i to $i + 1$ is the same for all fish
2. The conditional probability of being caught at each primary period is the same for all marked fish
3. The fates of fish with respect to survival and capture are independent
4. Marks are retained and correctly recorded
5. Sampling periods are instantaneous, or very short, and recapture fish are released immediately

6. All emigration is permanent
7. Within primary periods, the population is closed to birth, death, immigration, and emigration

Two different modeling approaches were used to address the objectives of the study. Robust design models have been modified to incorporate multi-state models among primary periods, enabling the use of traditional closed capture models to estimate state specific abundance within primary periods, while allowing for state transitions between primary periods (Kendall and Bjorkland 2001, White et al. 2006). The closed robust design multi-state model type helped address the first objective by allowing us to estimate capture and recapture probabilities, determine factors influencing these probabilities, and therefore estimate state-specific abundance. The Pradel robust design model was used to estimate apparent survival, per capita recruitment, and factors influencing recruitment. Per capita recruitment was defined as the number of new juveniles in the population at time i per juvenile in the population at time $i - 1$. This is a relatively simple extension of the traditional robust design, where a Pradel model is used between primary periods rather than a CJS. Age-specific abundance estimates were not used to estimate these parameters because of potential for biased estimates. Both error in the age determination process and violations of assumptions could lead to biased age-specific abundance estimates, making them less useful than the direct estimates from the Pradel model. The assumptions of the Pradel robust design model are the same as the traditional robust design.

We used a closed robust design multi-state model to estimate annual age-specific abundance and to identify factors influencing capture and recapture probabilities. Individual capture histories were constructed by using each sampling week during the summer as an individual sampling period. Eight secondary periods (4 weeks in June, and 4 weeks in July) within four primary periods (summers of 2004 – 2007) yielded a total of 32 sampling periods. Captured juveniles were first categorized into three different age strata: age-1, age-2, or age-3+. We then used the Huggins formulation of the multi-state robust design model (Huggins 1989; 1991) to estimate annual abundance of each age class. The closed robust design multi-state model assumes the population is closed (i.e. no birth, death, immigration, emigration, or state transitions) within primary periods (summers), but open between primary periods. By using age as a state within the model, we were able to estimate annual abundance of each age class, while quantifying the effects of weekly sampling effort, water temperature, and river discharge on capture and recapture probabilities.

A candidate set of models with different combinations of parameters for capture and recapture probabilities was constructed to identify potential differences among age-classes, behavioral responses, and to quantify influences of environmental predictor variables. Apparent survival and state transition probabilities were modeled as constant across time and ages in all models. Capture and recapture probabilities were modeled either as constant or as functions of predictor variables specific to secondary period sampling. Sampling effort was measured as number of nets set per week. Weekly means in water temperature and discharge were included as key environmental variables. Water temperature data were obtained from the Georgia Coastal Ecosystem – Long Term Ecological Research (GCE-LTER) monitoring station (~rkm 14, in South Altamaha River), while discharge data were obtained from the United States Geologic Survey (USGS) gauging station at rkm 100 (#02226000). All predictor variables were standardized, with a mean of zero and a standard deviation of one, across years before incorporation into models. The effects of predictor variables on capture and recapture probabilities were modeled as either constant or varying among summers. Behavioral response to capture (increased or decreased recapture rates after initial capture) was evaluated by including all models in the candidate set with capture and recapture probabilities set equal. To test for potential heterogeneity in capture and recapture probabilities among age classes, all models in the candidate set were rerun with separate parameters for each age class.

The relative likelihood of each model was evaluated with an information theoretic approach (Burnham and Anderson 2002), by calculating Akaike's information criterion (Akaike 1973) with a small sample size adjustment (AICc; Hurvich and Tsai 1989). As survival and state transition probabilities were consistent among models, assessing model likelihoods allowed us to identify sources of variation in capture and recapture probabilities. The most plausible model was then used for age-specific abundance estimates, with the corresponding parameterization of capture and recapture probabilities used in subsequent models to assess juvenile recruitment.

Pradel temporal symmetry models with robust design were used to estimate parameters specific to the entire juvenile population (Kendall et al. 1995, Pradel et al. 1996). Open mark-recapture models are conditioned on first capture and use observed capture histories to estimate apparent survival and recapture probability. Reverse time models are conditioned on last observation of individuals and the reverse capture history is used to estimate the probability of an individual being in the population at a prior time (known as seniority probability) and recruitment of new individuals. Pradel temporal symmetry models use both forward and reverse time approaches simultaneously to estimate recruitment, population growth, and seniority probability (Pradel 1996). Like the closed robust design multi-state model, the Pradel robust design model also assumes the population is closed within primary periods (summers), but open between primary periods. Incorporation of Pradel models between primary periods (summers of

2004 – 2007) of robust design models was used to estimate apparent survival, per capita recruitment, and juvenile population abundance.

Per capita recruitment was defined as the number of new juveniles in the population at time i per juvenile in the population at time $i - 1$. Apparent survival was defined as the probability of an individual surviving and remaining in the river during the interval from time i to time $i + 1$. Apparent survival was modeled as constant or time varying. Capture and recapture probabilities were modeled using the same parameters as the best approximating closed robust design multi-state model.

A candidate set of models with different combinations of recruitment parameters was constructed to evaluate the effect of various predictor variables on annual variation in juvenile recruitment. The candidate set also included models with recruitment time varying without predictor variables. Predictor variables used to explain annual variation in recruitment included spawner abundance and seasonal averages of water temperature and river discharge at time of age-0. Mean water temperature and discharge during March – May (spring), June – August (summer), and September – November (fall) were used as predictor variables because seasonal changes in flow and temperature have been previously recognized as important variables influencing Atlantic sturgeon recruitment (Secor and Gunderson 1998). Estimates of spawner abundance were derived from previous assessments of adult abundance by Peterson et al. (2008). All predictor variables were standardized among years, with a mean of zero and standard deviation of one.

As in closed robust design multi-state models, the relative plausibility of each model was determined with an information theoretic approach (Burnham and Anderson 2002). Models with recruitment predictor variables were only considered important if they were more plausible than time varying recruitment models lacking a predictor variable. As model weights were dispersed among several models, model-averaged parameter estimates were used to account for model selection uncertainty (Burnham and Anderson 2002). Model-averaged estimates and unconditional standard error were calculated for both the apparent survival and recruitment parameters and juvenile population abundance estimates.

Results

In the four consecutive years of study, a total of 1,034 juvenile Atlantic sturgeon were tagged in a total of 391 net sets. A total of 86 individuals were recaptured at least once (Table 1). During summer sampling, water temperature and discharge varied only slightly among years, except in 2005 when river discharge was higher and water temperature was lower. In all other years, summer water temperatures remained near 30° C and discharge varied from 70.5 to 154.6 m^3/s. Average number of nets set in a sampling week varied from 11.6 to 13.3 among sampling years. Catch-per-unit-effort varied from 2.04 to 3.75 juveniles per net from 2004 – 2007. Sizes of captured juveniles varied from 350 – 1050 mm total length, although 90% of juveniles measured less than 714 mm (Figure 2). While relative abundance of juvenile age-classes varied annually, the size distribution of juveniles within year classes was similar in each year of the study.

Length frequency analyses of the catch identified a distinct modal distribution of juveniles. Length frequency analyses combined with age-determination from the random sub-sample of fin spines confirmed that age-1 juveniles measured 350 – 550 mm, age-2 juveniles measured 550 – 800 mm, while age-3+ juveniles measured 800 – 1050 mm (Figure 3). These results were consistent among all years of the study, except 2007 where the boundary between age-2 and age-3+ individuals was estimated to be 750 mm. After assigning ages to all juveniles captured in each year, we calculated that the total catch from 2004 to 2007 was comprised of 568 age-1, 403 age-2, and 63 age-3+ juveniles (Table 2). Although annual abundance of the total juvenile population ranged from a low of 1,072 in 2004 to a high of 2,033 in 2006, ages 1-2 comprised 87-96% of the juvenile population in all years of the study.

Closed robust design multi-state models revealed the best-fitting model had capture and recapture probabilities equal and as a function of weekly effort varying annually (Table 3). Model comparisons showed that this model was 10.5 times more plausible than the second best model, which also had capture and recapture probabilities equal but as a function of temperature varying annually. These analyses indicated that there was no significant behavioral response to capture, and there was no evidence that capture and recapture probabilities differed among age groups.

The best-fitting Pradel model indicated survival was time varying and that annual recruitment was significantly influenced by fall discharge, which had a positive relationship with recruitment (Table 4; Figure 4). In fact, this model was 1.69 times more plausible than the second best model, which had survival and recruitment time varying with no predictor variables. The third ranked model included recruitment as a function of spring Schnabel adult abundance estimates, but as this model was less likely than time varying recruitment lacking a predictor variable, it was not considered to be important. Model averaged parameters from Pradel models indicated that apparent survival and per capita recruitment estimates varied annually, with highest recruitment of 1.379 occurring in 2005 and highest apparent survival of 0.338 in the interval prior to 2006 (Table 5).

Discussion

Length-frequency histograms were combined with ages determined from fin spines collected from randomly selected juveniles to estimate the ages of captured juveniles. There were some discrepancies between age determinationmethods. Ages determined from fin spines suggested that age-1 individuals could reach lengths of 600 mm; however, the length-frequency histograms from those years showed several distinct, non-overlapping modes. Because the modal distributions of age-1 juveniles predicted a maximum length of 550 mm for that age group, we used 550 mm as the upper limit for defining age-1 cohorts. This same approach was used by Peterson et al. (2000) who found that age-1 Atlantic sturgeon in the Hudson River were always <550 mm through the month of August (the end of our sampling season). Regardless, setting maximum size of age- cohorts in this study at 600 mm would only have changed the age assignment of a few individuals. As both approaches are subject to error, by combing length frequency analyses with fin spine collection we hoped to minimize any potential bias in our age estimates. Furthermore, average length at age-1 of Altamaha juveniles was virtually identical to that of age-1 juveniles from coastal rivers in South Carolina (McCord et al. 2007). Although these results suggest that age-estimates from length-frequency histograms and fin spines can be used to accurately identify age-1 cohorts in other southern rivers, spatial and temporal variations in growth could potentially complicate age assignment for older juveniles. Hence, future studies using known age juveniles, possibly from hatchery origin, are needed to validate age estimates of juveniles $\geq$ age 2.

Closed robust design multi-state models provided estimates of age specific juvenile abundance and identified potential sources of variation in capture probability. Model results showed that individuals of all age classes were equally likely to be captured or recaptured. The analyses also confirmed the accuracy of the estimates by demonstrating that heterogeneity in capture probability was minimal, and hence, did not bias the abundance estimates. Consequently, we suggest that similar modeling approaches be used for other Atlantic sturgeon populations, so that results can be compared with those presented here. Provided that adequate numbers of juveniles can be captured over several consecutive years, such comparisons will greatly improve current knowledge of recruitment trends in many river systems.

The use of Pradel robust design models allowed for direct estimates of apparent survival and per capita recruitment, which together revealed a high turnover rate of the juvenile population. Apparent survival estimates were low, ranging from 0.03 to 0.34. Given that Atlantic sturgeon are a long lived species (Scott and Crossman 1973), low apparent survival values were most likely most caused by high rates of out-migration rather than true mortality. Per capita recruitment estimates in this study ranged from 0.82 to 1.38, indicating that annual recruitment to age-1 was nearly equal to, or greater than, the abundance of the entire juvenile population in the preceding year. Likewise, apparent survival was lowest when recruitment was highest, suggesting that a higher percentage of age-2 and older juveniles leave the river in years when newly recruited age-1 fish are more abundant. The surprisingly high turnover rate of river-resident juveniles observed in this study is consistent with findings of previous studies suggesting that the temporal scale of Atlantic sturgeon life history of is condensed in southern populations (Van Den Avyle 1984, Smith 1985,) compared to those of northern rivers where adults mature later and live longer (Scott and Crossman 1973, Van Eenennaam 1996). These findings also suggest that out-migration of river-resident juveniles older than age-1 may be influenced by density dependence. The source of density dependence could be competition with younger cohorts. Because early juveniles are intolerant of salinity, they are likely unable to seek alternative foraging habitats in coastal waters if riverine food resources become limited. Older juveniles, however, have no such constraints, but may prefer the relatively predator free environments of brackish water estuaries as long as food resources are not limited. To our knowledge, no research on competition among cohorts for river food sources has been researched in Atlantic sturgeon. Although further studies are needed, confirmation of density dependence in river-resident juvenile Atlantic sturgeon would have major implications for understanding ontogenetic variations in growth, survival, migration rates, and recruitment to marine life stages.

Obtaining separate estimates of annual survival and out-migration rates was not possible in this study. In using the open population models to estimate apparent survival of juvenile cohorts in the Altamaha river, the requisite assumption was that emigration of juveniles was permanent (Williams et al. 2002). Consequently, apparent survival represented the probability of any individual surviving after time i and remaining in the river until time $i + 1$. As apparent survival was confounded by permanent emigration, mark-recapture methods were not capable of providing separate estimates of annual survival and out-migration, yet these rates are critical in understanding recruitment processes for the species. Future studies are needed to obtain quantified recruitment data using alternative methods such biotelemetry and known-fates modeling approaches (Cox and Oakes 1984).

Although we examined the potential effects of several environmental variables, fall discharge was the only predictor variable that significantly explained annual variation in annual year class strength. The most plausible model was that with fall discharge as a predictor of recruitment, but the model with time-variation but no predictor variables also carried substantial relative weight. The fact that a model with time-variation but no predictor variables was the only other model to carry relative weight could indicate that other time varying factors not addressed in this study are important to the recruitment process. Adult abundance from the proceeding spring was the next best predictor variable, but these models were less likely than those with time varying recruitment lacking a predictor variable. Recent studies of Gulf sturgeon on the Suwannee River suggest that mean river flow during September and December may be positively related to recruitment of age-0 juveniles (Randall and Sulak 2007). The authors speculate that increased flow in fall and early winter may help increase dissolved oxygen and reduce salinity, thereby increasing potential foraging habitats available to age-0 juveniles. Given the number of hydro-generating facilities currently located on Atlantic coast rivers, future studies addressing the effects of flow on year class formation in Atlantic sturgeon should be considered as a high priority for long-term restoration of the species.

The results of this study provide the first quantified recruitment data of a juvenile Atlantic sturgeon population in a southern river. Although further studies are needed to better understand recruitment mechanisms and variables affecting out-migration of river-resident juveniles, our results show that stage-based projection or population viability models can be used to assess population recovery of Atlantic sturgeon in the Altamaha and other Atlantic coast rivers. Similar approaches have been used in previous studies of other sturgeon species to project population trends (Pine et al. 2001), to identify survival bottlenecks at specific life history stages (Paragamian et al. 2005), and to quantify survival rates necessary to achieve recovery goals (Morrow et al. 1998). With regard to Atlantic sturgeon, however, current demographic data are needed to complete similar analyses. The results of this study provide quantified estimates of age-1 recruitment, apparent survival, and age-specific abundance, all of which could be used in simplified population viability analyses.

Despite the difficulties sampling juvenile sturgeons in large river systems, quantified recruitment data are essential to monitoring population recovery and to better understand the environmental variables that affect juvenile survival. Because juvenile Atlantic sturgeon remain in their natal rivers for at least 2 years after birth, quantified estimates of age-1 juveniles may offer the best opportunity to obtain these data. Similar approaches also may be possible for other sturgeon species, but the field methods employed must be developed based on a thorough understanding of specific life history traits and seasonal habitat needs. Thorough assessment of population status and recovery will require proper sampling designs and statistical approaches. Although future studies of sub-adult and adult life stages are needed, quantified assessment of river-resident juveniles can provide fisheries managers with the current data needed for evaluating population trends. Previous studies of Atlantic sturgeon on the Altamaha River have shown that population inference based on adult spawning runs can be confounded by the presence of non-spawning adults and immature fish (Peterson et al. 2008). The results of this and other studies show that sampling of river-resident juveniles, particularly the age-1cohort, can provide reliable estimates of recruitment, a key aspect of evaluating population recovery (Bain et al. 1999, Peterson et al. 2000). The importance of monitoring juvenile populations is further supported by the finding that adult abundance does not accurately reflect variation in juvenile recruitment.

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References

Akaike, H. 1973. Information theory and an extension of the maximum likelihood principle. Pages 267-281. *in* B.N. Petrov and F. Csaki, editors. Second international symposium on information theory. . Akademiai Kiado, Budapest, Hungary.

Atlantic Sturgeon Status Review Team. 2007. Status Review of Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus). Report to National Marine Fisheries Service, northeast regional office. February 23, 2007.

Bain, M.B. 1997. Atlantic and shortnose sturgeons of the Hudson River: Common and divergent life history attributes. Environmental Biology of Fishes 48: 347-358.

Bain M. B, D. L. Peterson, K. A. Arend, and N. Haley. 1999. Atlantic sturgeon population monitoring for the Hudson River estuary: sampling design and gear recommendations. Final report to the Hudson River fisheries unit, New York Department of Environmental Conservation, New Paltz, NY and The Hudson River Foundation, New York, NY. New York Cooperative Fish and Wildlife Research Unit,Cornell University, Ithaca, NY.

Burnham, K.P., and D.R. Anderson. 2002. Model selection and mulimodel inference: a practical information-theoretic approach. Springer-Verlag, New York, New York, USA.

Caron, F., D. Hatin, and R. Fortin. 2002. Biological characteristics of adult Atlantic sturgeon (*Acipenser oxyrhinchus*) in the St. Lawrence River estuary and the effectiveness of management rules. Journal of Applied Ichthyology 18: 580-585.

Caroffino D. C., T. Sutton, R. Elliott, and M. Donofrio. 2010. Early life stage mortality rates of lake sturgeon in the Peshtigo River, Wisconsin. North American Journal of Fisheries Management 30:1, 295-304.Colligan, M., M. Collins, A. Hecht, M. Hendrix, A. Kahnle, W. Laney, R. St. Pierre, R.Santos, and T. Squiers. 1998. Status review of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). Atlantic Sturgeon Status Review Team. 124.

Collins, M.R., S.G. Rodgers, 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 Sciences 66: 917-928.

Cox, D.R., and Oakes, D. 1984. Analysis of Survival Data. Chapman and Hall, London.

Cuerrier, J.P. 1951. The use of pectoral fin rays for determining age of sturgeon and other species of fish. Canadian Fish Culturalist 11: 10-18.

Dovel, W.L., and T.J. Berggren. 1983. Atlantic sturgeon of the Hudson River estuary, New York. New York Fish and Game Journal 30: 140-172.

Hatin, D., R. Fortin, and F. Caron. 2002. Movements and aggregation areas of adult Atlantic sturgeon (*Acipenser oxyrinchus*) in the St. Lawrence River estuary, Quebec, Canada. Journal of Applied Ichthyology 18: 586-594.

Huggins, R.M. 1989. On the statistical analysis of capture experiments. Biometrika 76:133-140.

Huggins, R.M. 1991. Some practical aspects of conditional likelihood approach to capture experiments. Biometrics 47:725-732.

Hurvich, C.M., and C. Tsai. 1989. Regression and time series model selection in small samples. Biometrika 76: 297-307.

Kendall, W.L., K.H. Pollock, and C. Brownie. 1995. A likelihood-based approach to capture-recapture estimation of demographic parameters under the robust design. Biometrics 51: 293-308.

Kynard, B., and M. Horgan. 2002. Ontogenetic behavior and migration of Atlantic sturgeon, *Acipenser oxyrinchus oxyrinchus*, and shortnose sturgeon, *A. brevirostrum*, with notes on social behavior. Environmental Biology of Fishes 63: 137-150.

McCord, J.W., M.R. Collins, W.C. Post, and T.I.J. Smith. 2007 Attempts to develop an index of abundance for age-1 Atlantic sturgeon in South Carolina, USA. Pages 397 – 403 *in* J. Munro, D. Hatin, J.E. Hightower, K. McKown, K.J. Sulak, A.W. Kahnle, and F. Caron, editors. Anadromous sturgeons: habitat, threats, and management. American Fisheries Society, Symposium 56, Bethesda, MD.

Morrow, J.V., J.P. Kirk, K.J. Killgore, H. Rogillio, and C. Knight. 1998. Status and recovery potential of Gulf sturgeon in the Pearl River system, Louisiana-Mississippi. North American Journal of Fisheries Management 18: 798-808.

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

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

Paragamian, V.L., R. C. Beamesderfer, and S. C. Ireland. 2005. Status, population dynamics, and future prospects of the endangered Kootenai River white sturgeon population with and without hatchery intervention. Transactions of the American Fisheries Society. 134:518-532.

Peterson, D.L., M.B. Bain, and N. Haley. 2000. Evidence of declining recruitment of Atlantic sturgeon in the Hudson River. North American Journal of fisheries Management 20: 231-238.

Peterson, D.L., P. Schueller, R. DeVries, J. Fleming, C. Grunwald, and I. Wirgin. 2008. Annual run size and genetic characteristics of Atlantic sturgeon in the Altamaha River, Georgia. Transactions of the American Fisheries Society 137: 393-401.

Pine III, W.E., M. S. Allen, and V. J. Dreitz. 2001. Population viability of the Gulf of Mexico sturgeon: Inferences from capture-recapture and age-structured models. Transactions of the American Fisheries Society 130: 1164-1174.

Pradel, R. 1996. Utilization of capture-mark-recapture for the study of recruitment and population growth rates. Biometrics 52: 703-709.

Randall, M.T., and K.J. Sulak. 2007. Relationship between recruitment of Gulf sturgeon and water flow in the Suwannee River, Florida. Pages 69-83 *in* J. Munro, D. Hatin, J.E. Hightower, K. McKown, K.J. Sulak, A.W. Kahnle, and F. Caron, editors. Anadromous sturgeons: habitat, threats, and management. American Fisheries Society, Symposium 56, Bethesda, MD.

Rochard, E., G. Castelnaud, and M. Lepage. 1990. Sturgeons (Pisces: Acipenseridae); threats and prospects. Journal of Fish Biology 37: 123-132.

Scott, W.B., and E.J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada Bulletin 184. 966 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.

Secor, D. H., P. J. Anders, W. Van Winkle, and D. Dixon. 2002. Can we study sturgeons to extinction? What we do and don't know about the conservation of North American sturgeons. Pages 3-10 in W. Van Winkle, P. J. Anders, D. H. Secor, and D. A. Dixon, editors. Biology, management, and protection of North American sturgeons. American Fisheries Society, Symposium 28, Bethesda, Maryland.

Smith, T.I.J. 1985. The Fishery, biology, and management of Atlantic sturgeon, *Acipenser oxyrinchus*, in North America. Environmental Biology of Fishes 14.1:61-72.

William, B.K., J.D. Nichols, and M.J. Conroy. 2002. Analysis and management of animal populations. Academic Press, New York.

Van Den Avyle, M.J. 1984. Species profiles: life history and environmental requirements of coastal fishes and inverterates (South Atlantic) – Atlantic sturgeon. U.S. Fish Wildl. Sew. FWS/OBS-82/11.25. U.S. Army Corps of Engineers, TR EL-82-4.

Van Eenenaam, J.P., S.I. Doroshov, G.P. Moberg, J.G. Watson, D.S. Moore, and J. Linares. 1996. Reproductive conditions of the Atlantic sturgeon (*Acipenser oxyrinchus*) in the Hudson River. Estuaries 19: 769-777.

Table 1. Number of fish tagged, number of fish recaptured, catch-per-unit-effort (CPUE), mean and range of effort (nets set per week), water temperature (° C), and discharge (m^3/s) values used to model capture probability of Atlantic sturgeon captured in the Altamaha River from June – August 2004 to 2007.

				Effort		Temperature		Discharge	
Year	Number Tagged	Number Recaptured	CPUE	Mean	Range	Mean	Range	Mean	Range
2004	174	15	2.04	11.6	3 - 21	29.8	29.1 - 30.8	154.6	80.2 - 258.3
2005	249	30	2.75	12.8	3 - 27	27.7	25.9 - 29.0	481.5	261.9 - 869.3
2006	315	18	3.72	11.3	5 - 15	30.0	28.6 - 31.5	70.5	54.3 - 90.4
2007	296	23	3.03	13.3	8 - 18	29.4	26.7 - 31.1	84.7	62.1 - 131.0

Table 2. Number of juvenile Atlantic sturgeon tagged in the Altamaha River per age class, age-specific abundance estimates from multi-state models, juvenile population abundance estimates from Pradel models, confidence intervals, and proportion of the population for 2004 to 2007.

Year	Age Class	Number Tagged	Abundance Estimate (95% CI)	Proportion of Population
2004	1	79	483 (368 – 643)	0.45
	2	89	544 (424 – 707)	0.51
	3+	6	37 (9 – 294)	0.03
Total		174	1072 (815 – 1330)	
2005	1	226	1345 (1077 – 1697)	0.91
	2	18	107 (28 – 784)	0.07
	3+	5	30 (6 – 935)	0.02
Total		249	1493 (1154 – 1833)	
2006	1	52	333 (246 – 460)	0.17
	2	250	1600 (1420 – 1808)	0.79
	3+	13	83 (38 – 209)	0.04
Total		315	2033 (1582 – 2485)	
2007	1	211	1318 (1053 – 1668)	0.71
	2	46	287 (132 – 727)	0.16
	3+	39	244 (101 – 711)	0.13
Total		296	1865 (1449 – 2282)	
Study Total	1	568		
	2	403		
	3+	63		

Table 3. Top five closed robust design multi-state models using predictor variables to describe variation in capture and recapture probability of Atlantic sturgeon in the Altamaha River for 2004 to 2007.

Capture Probability as a function of	Recapture Probability as a function of	AICc	AICc Weights	Model Likelihood	K
Weekly effort varying annually	Equal to capture probability	5251.59	0.845	1.000	7
Temperature varying annually	Equal to capture probability	5256.30	0.080	0.095	7
Weekly effort constant annually	Equal to capture probability	5258.15	0.032	0.038	4
Weekly effort varying annually	Weekly effort varying annually	5259.40	0.017	0.020	12
Weekly effort constant annually, varying by age class	Equal to capture probability	5259.75	0.014	0.017	6

Table 4. Top five Pradel robust design models using predictor variables (Fall discharge and adult abundance from two different model types, Schnabel and POPAN ;Schueller 2008) to describe variation in apparent survival and annual per capita recruitment of Atlantic sturgeon in the Altamaha River for 2004 to 2007.

Apparent Survival	Per Capita Recruitment	AICc	AICc Weights	Model Likelihood	K
Time varying	Fall discharge	8003.94	0.587	1.000	10
Time varying	Time varying	8004.99	0.347	0.592	11
Time varying	Schnabel adult abundance	8009.57	0.035	0.060	10
Constant	Time varying	8011.89	0.011	0.019	9
Time varying	POPAN adult abundance	8013.06	0.006	0.010	10
Constant	Fall discharge	8013.70	0.004	0.008	8

Table 5. Parameter estimates, and lower (LCI) and upper (UCI) 95% confidence intervals for annual apparent survival and per capita recruitment of Atlantic sturgeon in the Altamaha River for 2005 to 2007.

Parameter	Estimate	LCI	UCI
Apparent Survival '04 - '05	0.030	0.003	0.226
Apparent Survival '05 - '06	0.338	0.182	0.539
Apparent Survival '06 - '07	0.125	0.060	0.243
Per Capita Recruitment '05	1.379	1.071	1.687
Per Capita Recruitment '06	0.980	0.000	1.000
Per Capita Recruitment '07	0.823	0.609	0.933

Figure Captions

Figure 1. Netting locations (hollow triangles) and 10-km sampling strata (separated by black bars) for juvenile Atlantic sturgeon sampling within the Altamaha River, Georgia from 2004 to 2007.

Figure 2. Length (mm) frequency histogram and age assignments of all captured juvenile Atlantic sturgeon in the Altamaha River from summer sampling in 2004 to 2007.

Figure 3. Total length (mm) as a function of age, estimated from fin spines, of juvenile Atlantic sturgeon capture in the Altamaha River, Georgia.

Figure 4. Expected relationship (solid black line) and 95% confidence interval bands (dashed black line) between fall discharge and recuitment of juvenile Atlantic sturgeon based on pradel model averaged parameter estimates.

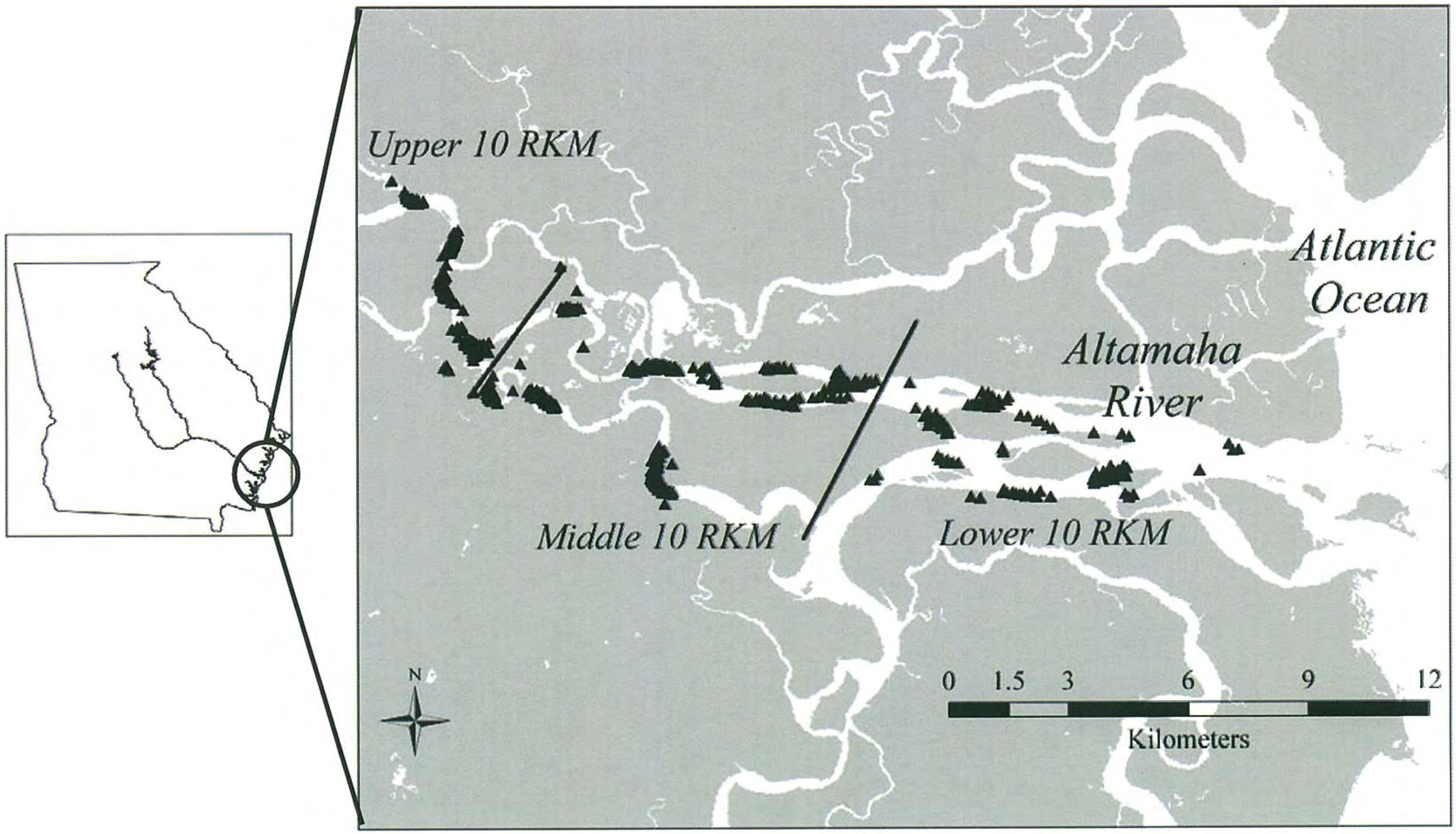
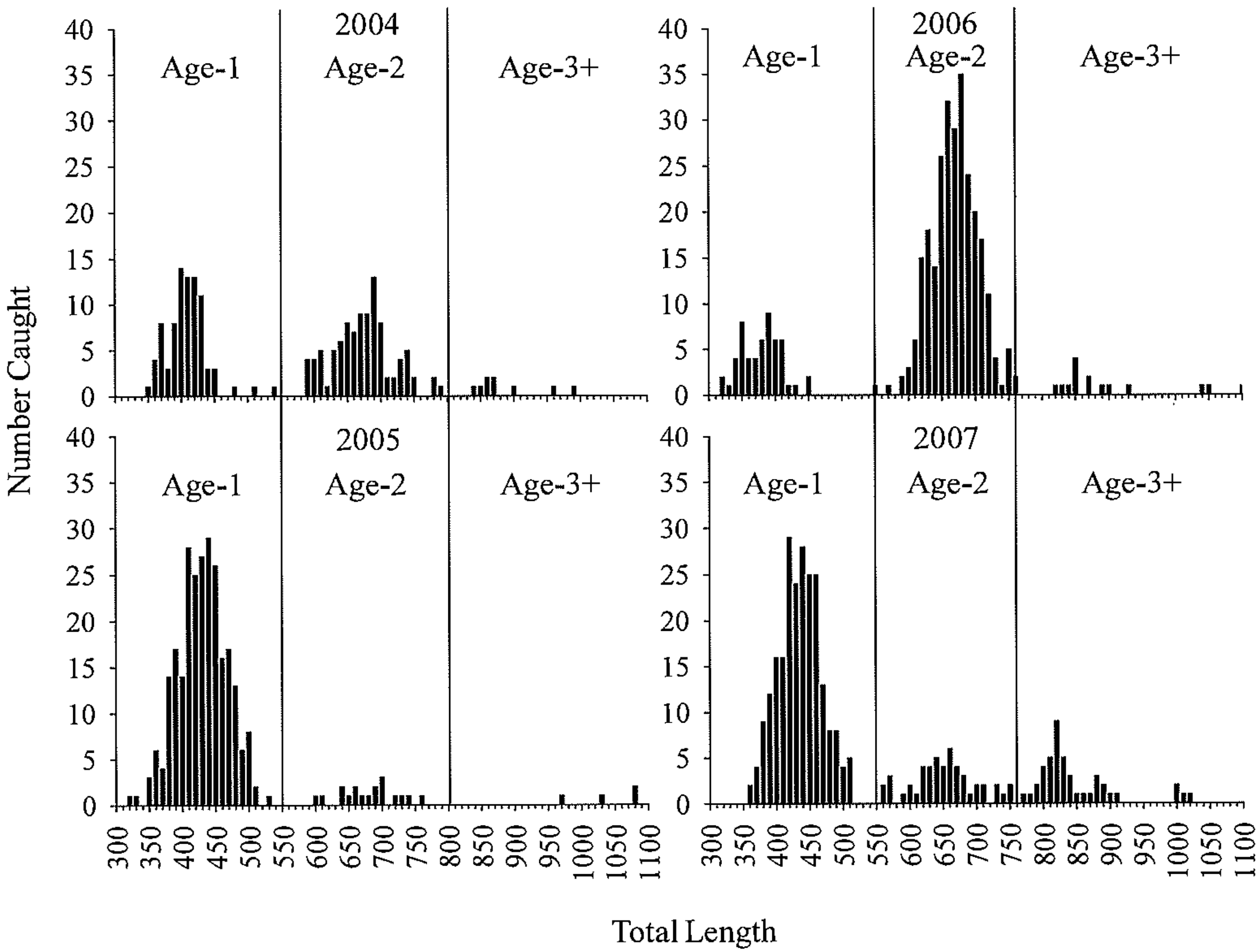

Upper 10 RKM
Atlantic
Ocean
Altamaha
River
Middle 10 RKM
Lower 10 RKM
N
0 1.5 3 6 9 12
Kilometers

Figure 1.



2004
Age-1
Age-2
Age-3+
2005
Age-1
Age-2
Age-3+
2006
Age-1
Age-2
Age-3+
2007
Age-1
Age-2
Age-3+
Number Caught
Total Length

Figure 2

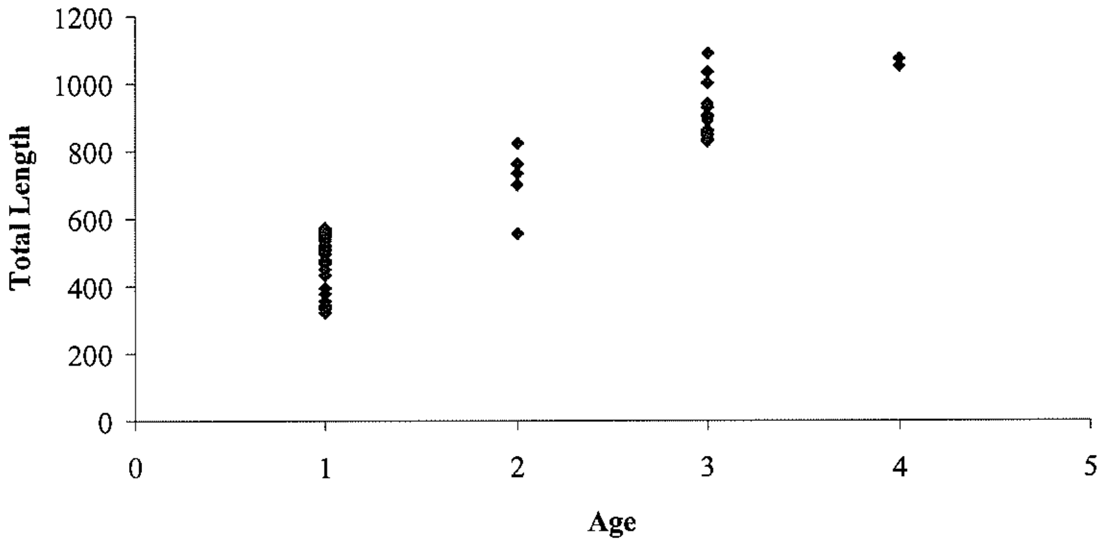


Figure 3.

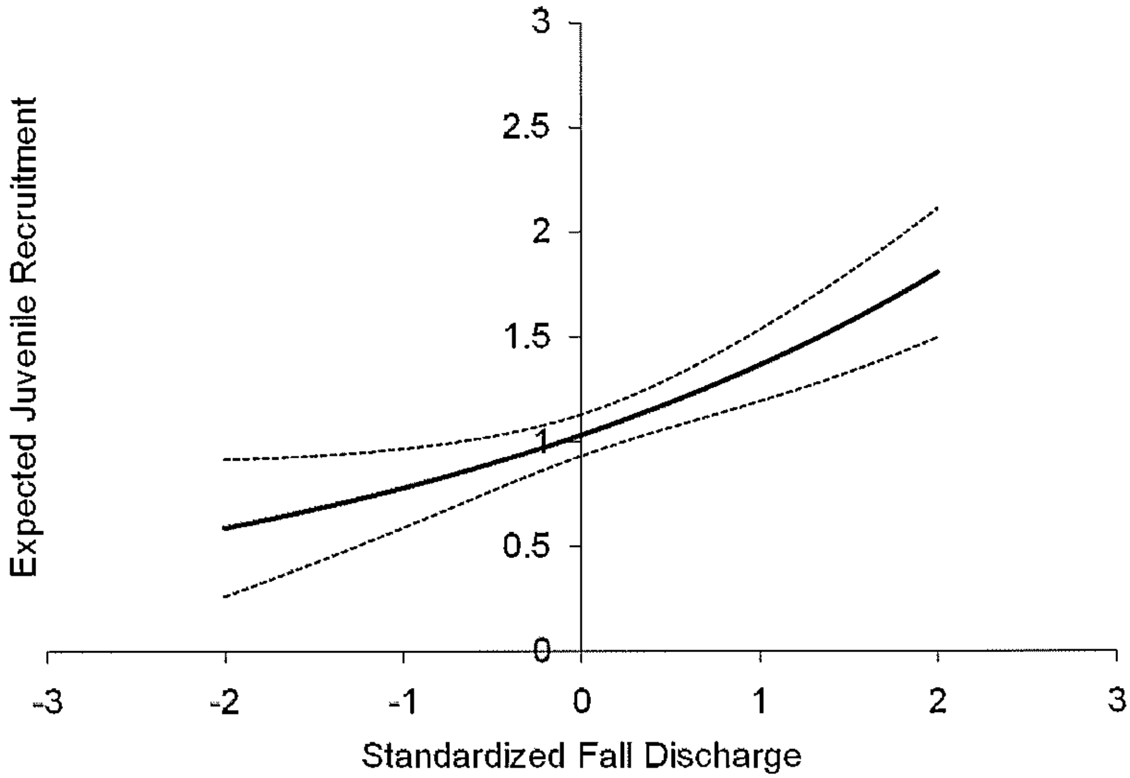

Expected Juvenile Recruitment
3
2.5
2
1.5
1
0.5
0
-3
-2
-1
0
1
2
3
Standardized Fall Discharge

Figure 4.

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

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, Housetown 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 Fl 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 Knoxboro 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.

Georgia Commercial Shad Fishery Regulation Options

The Georgia Department of Natural Resources (GA DNR) implemented new commercial shad regulations for the 2011 shad season. This action was taken in response to recent study findings that illustrated that potentially significant numbers of shortnose sturgeon could be incidentally captured in shad gill nets and the adoption of Amendment 3 to the Atlantic States Marine Fisheries Commission's (ASMFC) Interstate Fisheries Management Plan for Shad and River Herring. GA DNR utilized the best available data, results from Bahn and Peterson (2010) and GA DNR's commercial landings data, when evaluating changes to the commercial shad regulations. Bahn and Perterson's (2010) research analyzed the commercial shad set-net fishery in the Atlamaha River from 2007-2009. Results from this study revealed that during 2007-2008 the bycatch rates of shortnose sturgeon in this fishery were relatively low, however, during 2009 bycatch rates of shortnose sturgeon greatly 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. In an attempt to reduce shortnose sturgeon bycatch in Georgia's commercial shad fishery and comply with Amendment 3 mandates, the following options were considered:

Option 1:

No change to existing commercial shad regulations. However, a status quo approach would not have provided any additional conservation measures for shortnose sturgeon nor satisfy mandates outlined in ASMFC's Amendment 3. Therefore, this option was not selected.

Option 2:

Establish new upper boundaries for commercial shad fishing on the Altamaha and Savannah rivers, while the Ogeechee, Satilla, and St. Marys rivers would have been completely closed to commercial shad fishing. It is believed that such actions would have provided adequate protection for shortnose sturgeon and satisfied Amendment 3 mandates. However, this option was not chosen due to the negative economic impacts that a total closure would have had on Ogeechee River commercial shad fishermen.

Option 3 (Preferred/Chosen Option):

Establish new upper boundaries for commercial shad fishing on the Altamaha, Ogeechee, and Savannah rivers and completely closed the Satilla and St. Marys rivers to commercial shad fishing. It is believed that these actions will provide adequate conservation measures for shortnose sturgeon and satisfied ASMFC Amendment 3 mandates.

The new upper boundary for the Altamaha River was set at the U.S. Hwy 1 bridge crossing and effectively closed commercial shad fishing on approximately 75% of the free flowing portions of the Altamaha River and it's major tributaries (Ocmulgee and Oconee rivers). According to results reported by Bahn and Peterson (2010), this would decrease estimated sturgeon bycatch by up to 78% while only decreasing Altamaha River shad set-net landings by approximately 9%.

Other upper boundaries for the Altamaha River were considered (confluence of the Ohoopee River, U.S. Highway 84 bridge, and the Seaboard Coastline Railroad bridge). Utilizing 2009 creel estimates from Bahn and Peterson (2010), moving the upper boundary to one of these lower points revealed minimal reductions in estimated shortnose sturgeon bycatch beyond those expected by setting the boundary at the U.S. Hwy 1 bridge, while having greater impacts to the commercial shad fishery. Due to the relatively small conservation advantages and larger impacts to the commercial shad fishery, GA DNR chose to set the upper commercial shad fishery boundary at U.S. Hwy 1.

No recent data on shortnose sturgeon bycatch was available for the Savannah and Ogeechee rivers. However, based on the findings from the Altamaha River it was presumed that closing the upper portions of these rivers would also likely provide greatly increased protection to shortnose sturgeon, while having relatively little impact on the commercial shad fisheries in these rivers. The upper commercial shad fishery boundary on the Savannah River was set at the U.S. Hwy 301 bridge crossing and resulted in closure of approximately 47% of the free flowing portion of the Savannah River. On the Ogeechee River, an upper commercial shad fishery boundary was established at the GA Hwy 204 bridge, which closed approximately 80% of the 245 miles of free flowing river. The number of days that the Ogeechee River remained open to commercial fishing was also reduced by 50% to one day per week and gear was limited to drift net only.

GA DNR does not have any reports off commercial shad landings on either the Satilla or St. Marys rivers since 1989. Therefore, it was concluded that entirely closing these two rivers would protect sturgeon in these two rivers and have no impact on commercial shad fishermen.

governing the taking, importing, and exporting of endangered and threatened species (50 CFR 222–226).

File 16549: The applicant is requesting authorization for a scientific research permit for takes of shortnose sturgeon in the wild and captivity. The applicant proposes to determine up and downstream migrations, habitat use, spawning periodicity, seasonal movements of shortnose sturgeon in the Connecticut River (from Agawam, MA to Montague, MA). The applicant also proposes captive animal research in laboratory tests of up- and downstream fish passage studies, swimming performance tests, tagging studies, anesthesiology, behavior, physiology and contaminant studies, as well as producing progeny for further research. Additionally, the applicant requests authorization to collect fertilized embryo from each of the following rivers: Merrimack River (MA), Kennebec River and Androscoggin River (ME). The permit would be valid for five years from the date of issuance.

File 17095: The purpose of the research would be the monitoring of sturgeon abundance and distribution through the Hudson River Biological Monitoring Program (HRBMP). The action area includes the Hudson River from River Mile 0 (Battery Park, Manhattan, NY) to River Mile 152 at Troy Dam (Albany, NY). The focus of the monitoring program would be fish identification, mark and recapture, and enumeration within defined Hudson River regions and depth strata. Researchers would non-lethally capture, handle, measure, weigh, scan for tags, insert passive integrated transponder (PIT) and dart tags, photograph, tissue sample, and release up to 82 shortnose sturgeon and 82 Atlantic sturgeon annually. Additionally, researchers would be permitted each year to lethally collect up to 40 shortnose sturgeon and up to 40 Atlantic sturgeon eggs and/or larvae (ELS). The permit would be valid for five years from the date of issuance.

Dated: April 5, 2012.

Tammy C. Adams,

Acting Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service.

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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XB152

Endangered Species; File No. 16645

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; receipt of application.

SUMMARY: Notice is hereby given that the Georgia Department of Natural Resources (GA DNR) has applied in due form for a permit pursuant to the Endangered Species Act of 1973, as amended (ESA). The permit application is for the incidental take of ESA-listed shortnose (*Acipenser brevirostrum*) and Atlantic sturgeon (*A. oxyrinchus*) associated with the otherwise lawful commercial shad fishery in Georgia. The duration of the proposed permit is 10 years. NMFS is furnishing this notice in order to allow other agencies and the public an opportunity to review and comment on the application materials. All comments received will become part of the public record and will be available for review.

DATES: Written comments must be received at the appropriate address or fax number (see **ADDRESSES**) on or before June 11, 2012.

ADDRESSES: The application is available for download and review at *http://www.nmfs.noaa.gov/pr/permits/esa_review.htm* under the section heading *ESA Section 10(a)(1)(B) Permits and Applications.*

The application is also available upon written request or by appointment in the following office: Endangered Species Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Room 13626, Silver Spring, MD 20910; phone (301) 427–8403; fax (301) 713–4060.

You may submit comments on this document, identified by NOAA–NMFS–2012–0090, by any of the following methods:

- Electronic Submission: Submit all electronic public comments via the Federal e-Rulemaking Portal *www.regulations.gov.* To submit comments via the e-Rulemaking Portal, first click the ''submit a comment'' icon, then enter NOAA–NMFS–2012–0090 in the keyword search. Locate the document you wish to comment on from the resulting list and click on the ''Submit a Comment'' icon on the right of that line.
- Mail: Submit written comments to Endangered Species Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Room 13626, Silver Spring, MD 20910; Attn: Kristy Beard or Angela Somma.
- Fax (301) 713–4060; Attn: Kristy Beard or Angela Somma.

Instructions: Comments must be submitted by one of the above methods to ensure that the comments are received, documented, and considered by NMFS. Comments sent by any other method, to any other address or individual, or received after the end of the comment period, may not be considered. All comments received are a part of the public record and will generally be posted for public viewing on *www.regulations.gov* without change. All personal identifying information (e.g., name, address, etc.) submitted voluntarily by the sender will be publicly accessible. Do not submit confidential business information, or otherwise sensitive or protected information. NMFS will accept anonymous comments (enter ''N/A'' in the required fields if you wish to remain anonymous). Attachments to electronic comments will be accepted in Microsoft Word or Excel, WordPerfect, or Adobe PDF file formats only.

FOR FURTHER INFORMATION CONTACT: Kristy Beard or Angela Somma at (301) 427–8403.

SUPPLEMENTARY INFORMATION: Section 9 of the ESA and Federal regulations prohibit the ''taking'' of a species listed as endangered or threatened. The ESA defines ''take'' to mean harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. NMFS may issue permits, under limited circumstances, to take listed species incidental to, and not the purpose of, otherwise lawful activities. Section 10(a)(1)(B) of the ESA provides for authorizing incidental take of listed species. NMFS regulations governing permits for threatened and endangered species are promulgated at 50 CFR 222.307.

Background

NMFS received a draft permit application from GA DNR on September 12, 2011. Based on a review of the application, NMFS requested further information. The applicant submitted a complete application on March 6, 2012 for take of ESA-listed shortnose and Atlantic sturgeon that may be caught incidental to the Georgia shad fishery. The State of Georgia has amended their commercial fishing regulations for the Georgia shad fishery to minimize the incidental capture of ESA-listed shortnose and Atlantic 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 River. The Georgia shad fishery is open from January 1 to as late as April 30 each year, but would typically end March 31. Georgia regulations require that sturgeon captured in shad nets must be released unharmed into the waters from which they were taken. GA DNR would use a combination of a trip ticket system (self-reporting by fishermen) and direct observations to monitor the number of sturgeon incidentally captured each month in the commercial shad fishery.

GA DNR requests 3-year running averages for takes to account for the potential for a high-take year before or after low-take years. GA DNR estimates that incidental bycatch would not exceed 175 shortnose sturgeon per year (no more than 525 in a 3-year period) and 140 Atlantic sturgeon per year (no more than 420 in a 3-year period) in the Altamaha River, 75 shortnose sturgeon per year (no more than 225 in a 3-year period) and 50 Atlantic sturgeon per year (no more than 150 in a 3-year period) in the Savannah River, and 10 shortnose sturgeon per year (no more than 30 in a 3-year period) and 10 Atlantic sturgeon per year (no more than 30 in a 3-year period) in the Ogeechee River. A mortality rate of approximately 2.3 percent is anticipated based on recent research.

Conservation Plan

GA DNR's conservation plan describes measures designed to minimize, monitor, and mitigate the incidental take of ESA-listed sturgeon. The conservation plan includes Georgia's amended commercial fishing regulations for the Georgia shad fishery, which are expected to minimize the bycatch of sturgeon by closing to shad fishing sections of the rivers that previously had the highest bycatch rates. These closures would also protect known and suspected sturgeon spawning sites. Georgia regulations require that sturgeon captured in shad nets be released unharmed into the waters from which they were taken. GA DNR would use a combination of a trip ticket system (self-reporting by fishermen) and direct observations to monitor the incidental take of sturgeon in the commercial shad fishery. Other monitoring or mitigation actions will be undertaken as required. Monitoring would be funded by GA DNR's Annual Operating Budget.

GA DNR considered and rejected two other alternatives: (1) No change to commercial shad regulations, and (2) establishing new upper boundaries for commercial shad fishing on the Altamaha and Savannah rivers, while completely closing the Ogeechee, Satilla, and St. Mary's rivers to commercial shad fishing.

National Environmental Policy Act

Issuing a permit would constitute a Federal action requiring NMFS to comply with the National Environmental Policy Act (NEPA; 42 U.S.C. 4321 *et seq.*) as implemented by 40 CFR parts 1500–1508 and NOAA Administrative Order 216–6, *Environmental Review Procedures for Implementing the National Environmental Policy Act* (1999). NMFS intends to prepare an Environmental Assessment to consider a range of reasonable alternatives and fully evaluate the direct, indirect, and cumulative impacts likely to result from issuing a permit.

Next Steps

This notice is provided pursuant to section 10(c) of the ESA. NMFS will evaluate the application, associated documents, and comments received during the comment period to determine whether the application meets the requirements of section 10(a) of the ESA. If NMFS determines that the requirements are met, a permit will be issued for incidental takes of ESA-listed sturgeon. The final NEPA and permit determinations will not be made until after the end of the comment period. NMFS will publish a record of its final action in the **Federal Register**.

Dated: April 5, 2012.

Lisa Manning,

Acting Chief, Endangered Species Conservation Division, Office of Protected Resources, National Marine Fisheries Service.

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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XB153

New England Fishery Management Council; Public Meeting

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice of a public meeting.

SUMMARY: The New England Fishery Management Council (Council) will hold an evening public hearing on Wednesday, April 25, 2012 to obtain public input on measures proposed for inclusion in Amendment 5 to the Atlantic Herring Fishery Management Plan.

DATES: The hearing will be held on Wednesday, April 25, 2012 at 6 p.m.

ADDRESSES: The hearing will be held at the Hilton Hotel, 20 Coogan Boulevard, Mystic, CT 06355–1900; telephone: (860) 572–0731; fax: (860) 572–0328.

Council address: New England Fishery Management Council, 50 Water Street, Mill 2, Newburyport, MA 01950; telephone: (978) 465–0492.

FOR FURTHER INFORMATION CONTACT: Paul J. Howard, Executive Director, New England Fishery Management Council; telephone: (978) 465–0492.

SUPPLEMENTARY INFORMATION:

Tuesday, April 25, 2012

Following the first day of the April 24–26, 2012 New England Fishery Management Council meeting in Mystic, CT, the Council will host a public hearing, the last in a series of coastwide meetings, to obtain public comments on measures under consideration for inclusion in Amendment 5 to the Atlantic Herring Fishery Management Plan. Management measures could include adjustments to the fishery management program, reporting requirements and measures to address trip notification, carrier vessels and transfers of herring at-sea. A catch monitoring program also is being considered as well as measures to address river herring bycatch and criteria for midwater trawl vessel access to the year-round groundfish closed areas.

Although other non-emergency issues not contained in this agenda may come before this Council for discussion, those issues may not be the subjects of formal action during this meeting. Council action will be restricted to those issues specifically listed in this notice and any issues arising after publication of this notice that require emergency action under section 305(c) of the Magnuson-Stevens Act, provided that the public has been notified of the Council's intent to take final action to address the emergency.

Special Accommodations

This meeting is physically accessible to people with disabilities. Requests for sign language interpretation or other auxiliary aids should be directed to Paul J. Howard (see **ADDRESSES**) at least 5 days prior to the meeting date.