Atlantic States Marine Fisheries Commission

Habitat Committee Meeting

June 24, 2021

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.

Webinar Information

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Access Code: 981-758-821

1. Welcome and Introductions (*J. Johnson*)	10:00 am
• New members	
2. Committee Consent (*J. Johnson*) [briefing materials {BM} 1, 2]	10:10
• Approval of agenda	
• Approval of proceedings from fall 2020	
3. ACFHP Update (*L. Havel*)	10:15
4. Dredging Windows Update and Discussion (*W. Laney*) [BM 3, 4]	10:35
5. Living Shorelines Impacts on SAV Policy Update (*L. Chiarella*)	11:00
6. Species Assignments Check-in (*L. Havel*)	11:20
• Striped bass Amendment 7	
• Shad passage comment letter	
• Any changes to assignments?	
7. Lunch	12:00
8. Climate Change Document Check-In (*L. Havel*) [BM 5]	1:30 pm
9. Habitat Hotline 2021 (*L. Havel*)	1:45
• Topic	
• Lead	
10. Acoustic Impacts Update (*L. Havel*) [BM 6]	2:15
11. FHOC Designations Update (*L. Havel*) [BM 7]	2:45
12. Other Business	
• Next meeting	
13. Adjourn	3:30

Atlantic States Marine Fisheries Commission Habitat Committee Virtual Meeting

November 12-13, 2020

ASMFC Staff Present: Lisa Havel, Toni Kerns

HC Members Present: Russ Babb (NJ), Michelle Bachman (NEFMC), Lou Chiarella (NMFS-GARFO), Jessica Coakley (MAFMC), Jimmy Johnson (NC), Sharleen Johnson (SC), Robert LaFrance (CT), Wilson Laney (NCCF), Mark Rousseau (MA), Eric Schneider (RI), Kent Smith (FL), Julia Socrates (NY), Marek Topolski (MD), Kate Wilke (TNC), Tony Watkinson (VA), Phil Colarusso (EPA), Paul Medders (GA), Josh Carloni (NH)

Guests: Trish Murphey (NCDEQ/APNEP), Joseph Zydlewski (University of Maine)

Action items

Action item: Apply for an ACFHP project endorsement here: https://www.atlanticfishhabitat.org/project-endorsement/.

Action item: Lisa will share a version of Joe's presentation with the Habitat Committee.

Action item: Lisa will send out a revised species assignment table.

Action item: Wilson will provide the Striped Bass Report to Congress as part of the FHOC review.

Action item: Habitat Committee members should review their species factsheets (found on the Habitat page of the ASMFC website), and let Lisa know if any updates are needed.

Action item: Lisa will send the Research Priorities document to the Habitat Committee with instructions on the input needed, and deadline.

Action item: Lisa will send the LSL background document to the subcommittee (Jessica, Lou, Kent, Russ, Jimmy, and Trish) in Word format, to get started on the LSL Policy.

Action item: Before going to Policy Board, Habitat Committee members should work with their Management/Policy Board members to get their input on the Policy.

Action item: Wilson will draft a position statement on the dredging windows EA to share with Pat, Spud, and Bob after HC input.

Action item: Wilson will upload acoustics literature to the Google drive set up for this document.

Action item: Lisa will rearrange the current Acoustics document to fit the original outline, and then will share with the subcommittee for editing.

Action item: Michelle will provide hard bottom write up for lobster FHOC.

Action item: We will add a statement about climate change in the introduction, and include temperature for American lobster. They will break down lobster into the two stocks.

Action item: Menhaden will have estuarine nursery and riverine tidal habitats as FHOCs.

Action item: We will include riverine spawning habitats and offshore wintering habitats as FHOCs for striped bass.

Action item: Lisa will talk about Toni about our options for Atlantic sturgeon.

Action item: Russ will report back on black drum acoustics data once he speaks with Dr. Fox.

Action item: Sharleen will check on whether the inshore spawning population of cobia near Cape Romain should have an FHOC designation.

Action item: Robert will check to see if there is a need to designate any FHOCs for horseshoe crabs in NY and CT.

Action item: The HC will not designate FHOCs for Jonah crab right now based on lack of data, but will leave open the possibility of designating it in the future.

Action item: We will add temperature information back in for the Northern shrimp FHOC designations.

Action item: Jimmy will look into NC FMP to see if there's anything to add to the red drum FHOC designation.

Action item: Lisa will set up a call to go through the rest of the FHOC designations.

November 12, 2020, Day 1

Welcome and Introductions

1:03 p.m. Marek convened the meeting. He noted that this is our second virtual meeting. He indicated that he didn't think that we need to do introductions.

Committee Consent on Agenda and Proceedings

He assumed that everyone had looked over the materials. The first thing is to approve the documents from the last meeting. He asked for any changes.

Lisa noted that we do have one new member and asked Robert LaFrance to introduce himself. Robert noted that he was having audio trouble, so he phoned in. Robert is a former employee of CT DEEP. Robert gave us a brief summary of his background. He has extensive experience in conservation, and also has a law degree.

Marek noted that he was also phoned in and viewing on an iPad.

Marek presumed that the past proceedings are approved, hearing nothing to the contrary.

ACFHP Steering Committee Update

Lisa Havel gave the update. She noted that we had begun by discussing the new legislation that codified NFHP. There will be a lot of changes and we don't know what those will be as yet. They did have both a Board meeting and a Coordinators meeting earlier. The biggest change is that the funds will no longer go

through USFWS for distribution. It is yet to be determined whether Beyond the Pond or the Fish Habitat Partnerships (FHPs) themselves, will be managing the funds. There is also a lot of concern regarding the USFWS future role because the USFWS provides so much staff support now, and that could be lost. That and the funding are the two biggest concerns for the FHPs. Another change is that a 1:1 non-federal match for the funding will now be required.

We also reviewed all the current projects that ACFHP has, including the FishAmerica and NOAA-funded projects, as well as those funded by USFWS. We also reviewed the list of 2021 proposed projects. Julie Devers gave us a full report. We had 14 proposals, most of which were strong candidates for funding.

We also discussed our communication strategy. We have completed about a third of the state fact sheets and hope to complete those soon so we can begin using them.

Lisa also reviewed the website analytics. Use of the site has increased by 28 percent since the last evaluation, but the time spent on the site has not increased. We also reviewed business cards, post cards, and an ad that we can use for outreach.

Dr. Mark Nelson gave us a presentation on the National Marine Fisheries Service (NMFS) Northeast Fishery Science Center (NEFSC) Habitat Vulnerability Assessment. We also reviewed the NE and SE mapping work, as well as the project assessment tool that was developed. The tool was used by all applicants this year which allows us to better assess where to put our funding. We are also working to develop a way for us to gather and report the monitoring data from each of the projects that we have funded. We have a plan going forward.

We also discussed project endorsements. We have endorsed one project so far this year, but our goal is to do four, so if any HC members have projects for endorsement, please let Lisa know and we can turn those around quickly. Endorsements can be done for projects at all stages. We will consider any project that members may have.

Action item: Apply for an ACFHP project endorsement here: https://www.atlanticfishhabitat.org/project-endorsement/.

We did have a discussion about how to increase diversity and will continue that discussion at our spring meeting. Lisa asked for any questions. There were no questions.

Wilson noted that we had also reviewed all of the Action Plan items as we do each meeting.

ASMFC American Shad Assessment Presentation (Joe Zydlewski)

Action item: Lisa will share a version of Joe's presentation with the Habitat Committee.

Joe noted that he had to thank all his collaborators and was glad to be able to make the presentation.

Joe noted that there are still some American shad fisheries, but there has been a significant decline for the species, as well as all other diadromous species, as documented by Limburg and Waldman (2009). Joe noted that we today have the four horsemen of the apocalypse adversely affecting anadromous species: overexploitation, habitat loss, fragmentation, and climate change.

Joe noted that he would focus on fragmentation today and would focus on the Penobscot River. He noted that it was heavily used for the lumber industry and was heavily impounded. The river empties

into the Gulf of Maine and was inhabited by a high number of anadromous fish. He noted that none of his video features were working.

One hundred years ago, there were 11 species of migratory fish in the river, and they were used by indigenous peoples and early European colonists. The impoundments began to have a direct impact on the fisheries. The Veazy Dam was removed, and that portion of the river is now free-flowing. The next one upstream, the Great Works Dam, was also removed. The Veazy and Great Works were the first two barriers. Then a couple kilometers upstream was the Milford Dam, which blocked American shad, Atlantic salmon, sea lamprey and others.

Joe noted that managers began to ask the question of just how accessible habitat upstream was. The Penobscot River project only opened up a couple of km, so passage at Milford was really important.

In the year after the first two dams were removed, about 800 fish showed up. Last year the numbers really increased to over 10,000. But they began to consider whether the goals for recovery could be reached, by passage at Milford. Joe, Michael Bailey, and others had put together a model. They took individual fish, gave them demographic data and path choices, and modeled them ascending past the dam and reaching different habitat reaches. Fish could end up in different areas and were able to spawn. Juveniles and post-spawned fish would then migrate out to the ocean.

Joe noted that initially, they wanted to look at where the habitats were, and then determine what passage goals should be in order to meet targets. They could then look to see how populations responded to theoretical constraints. Joe noted that they looked at two scenarios, one with no dams, and another with no passage. He noted that it isn't any surprise that abundance will be lower, when you have no passage. The scope for greatly increased runs is higher, with passage.

Their modeling caused them to look further. There was an unintended consequence, which was, "namely a loss of standing or saliency among issue considered important by society at large." So, they decided to look coastwide at what the potential was for restoration, if dams were not on the rivers. They first did a GIS exercise, to see what the habitat was, pre-impoundment, and also looked to see what habitat remains.

They had four general steps: channel width less than 15 m; validation with local experts and biologists; exclusion of lakes and ponds; and identification of dams, quantifying habitat upstream. Joe explained each step, in detail. Joe noted that there is a lot of variability in the morphology of the systems. He showed us a figure demonstrating the type of rules they used.

They used Dan Stich's Anadrofish (Stich et al. 2020) for age-structured populations. They incorporated geographically appropriate life history parameters (e.g. post spawning survival linked to estimated iteroparity, by latitude) and they used application of realistic passage rates (conservatively favorable).

They compared three scenarios. The first was pre-industrial. All was considered one spawning unit. The second scenario was that no fish gets past the first dam on each system. The last scenario considered that each dam was somewhat permeable, i.e. their rules for passage apply. This enabled them to test the likely outcome for each system.

Joe showed us the kind of data with which they began. He showed us a bar chart for the amount of habitat accessible today, for each East Coast river, as well as the historic habitat. The graph was divided

up into semelparous, and southern and northern iteroparous groups. They then determined the likely amount of fish, given fish passage, relative to what would be there if the rivers were totally open.

Joe noted that the Susquehanna River had more than 9% of the production, for the entire East Coast, historically, but has lost it.

Joe noted that it is hard for him to get his head around all those bar charts. He showed us a pie chart which he felt was easier to understand. The proportional area of historic (2740 km^2) and current unimpounded habitat (1636 km^2), shows about a 40% loss.

Joe moved on to show the amount of habitat loss for each of the sub-populations. Black is current assuming no passage, white is the amount undammed, and gray is the current amount of habitat. Joe showed us one more bar chart, which shows a potential range of up to over 73 million spawners, in comparison to around 40 million, which reflects a significant loss (72.8 vs 42.8 million spawners for intact vs no passage (41% loss). Fish passage may alleviate the spawner loss.

Joe noted that if you just look at habitat, about 40% of historic American shad habitat is not upstream of impoundments. The loss results in a lost spawning potential that is minimally relieved by anthropogenic fish passage structures. Even with extensive fish passage efforts, dams represent an estimated fixed 37% constraint on the fishery potential. Joe noted that there are other things that also influence American shad abundance.

Joe thanked those who had reviewed the work.

Wilson asked, have they published this yet and if so where? Second question is, could this same sort of modeling be done for all of the other diadromous species?

Joe said yes to the second question. He noted that Dan Stich has moved on to Stonybrook and Joe said that he can build a career on doing this work. With respect to publication, they have multiple papers in press. For this work, Joe noted he is close to having a manuscript together and hopes to submit it prior to Christmas.

Marek noted that habitat quality was one of the other issues that Joe had mentioned. He asked if they had considered how habitat quality would affect their work.

Joe said that was a bridge too far. He noted that others, like Joe Hightower, had looked at HIS modeling for American shad. To simplify things, they just assumed that all habitat was of equal value. They used the lower end of management goals, for adult density, to set the thresholds for recruitment curves.

Wilson asked if they had any interest in doing other species, such as Atlantic sturgeon.

Joe said yes, they would definitely be interested. Joe indicated that Wilson could contact him for further discussion.

Wilson noted that he will contact Joe offline, for further discussion.

Joe noted that they are interested in multi-species models as well.

Wilson suggested that it would be good to have Joe give his presentation to the Shad and River Herring Management Board (MB) and asked if that was possible.

Toni noted that they would like to see him give a presentation to the Shad and River Herring Technical Committee (TC), first, to see if they have any recommendations. Then perhaps Joe could give a shorter presentation to the MB.

Note: Lisa talked with TC Coordinator Caitlin Starks and they had already received a presentation on these data.

Wilson concurred that would be a good strategy.

Toni noted that some of the TC members have been involved already but others need to get up to speed.

Kate Wilke asked about the bar graph and asked if that means that fish passage isn't working that well.

Joe noted that what comes out to be the most important part of the story is that if you don't have downstream passage, it doesn't matter how good your upstream passage is. He noted that managers have fixated on the larger fish, rather than the outmigration. If you think about it, dam mortality can happen in two places. You may prevent fish from moving upstream, thereby imposing a "tax" on them, and truncate the size and age distribution on the run, for those fish who access habitat upstream. Joe noted that some of the literature on the CT River suggest that we are losing our older fish; the other way is to say that we are killing fish on the way out, so you haven't appropriately connected that upstream habitat back to the ocean. It is important to interpret how passage relates to the whole picture. This is an issue fundamental to downstream passage. The downstream passage has the potential to truncate the population. You can see this when you look at the populations on the CT, versus the Penobscot. The Penobscot has fish with many spawning checks, even though the habitat was limited.

Wilson noted the issues that we have had to deal with on the Roanoke. Adult migratory behavior, and delayed juvenile outmigration. Fish that were implanted with acoustic transmitters and moved above the third dam on the system (John H. Kerr Reservoir) to where appropriate spawning habitat was located, did not appear to have made an appropriate spawning run; many of them "fell back." Fry had also been stocked upstream to "jump start" the population, and some of them survived to be YOY, but they didn't then engage in normal outmigration in the fall. Some of them stayed in the reservoirs until Age 1 or older.

Joe agreed and noted up north, if the juveniles don't outmigrate in the fall, they may be impacted by the cold temperatures.

Marek asked if we therefore shouldn't be concerned about downstream passage.

Joe said yes, for sure.

Marek noted that is something that we may wish to pass on to ACFHP, with respect to monitoring. They need to look at outmigration, as well as fish passage numbers.

2:03 p.m. Marek noted that another ponder and head-scratching question is how the Federal Energy Regulatory Commission (FERC) process would respond to this. Marek's perception was that the agencies didn't consider downstream passage as much during relicensing.

Wilson responded that he thought those agency hydropower coordinators were equally concerned about both up- and downstream passage. The policy of USFWS and NMFS requires "safe, timely, and

effective" passage in both directions. Wilson noted that the problem with respect to downstream passage was largely one of a lack of technology to effect safe passage.

Joe noted that there is a lot unknown about passage rates, and mortality due to delay.

Toni noted that she would have Caitlin reach out to Joe to schedule a presentation to the Shad and River Herring TC.

Joe noted that he has a video that he had prepared for the AFS meeting, that is also available.

Lisa will contact Joe about getting the link to the video, as well as his presentation. Note – he shared the video in lieu of the presentation.

Marek noted that Robert just shared an article in the chat, about downstream passage.

Marek noted that we are a bit ahead of schedule. He asked Lisa if she wanted to do the species check in. She did.

Species Assignments Check-in

Lisa showed us the current species assignments on the screen. These haven't changed since 2019. Lisa noted that John Gill has retired. He had striped bass, which was covered by both John and Wilson. She asked if anyone else wanted to volunteer to take on that species, to assist Wilson. Also, Ben Lorson has taken another position in PA, and he will eventually be replaced on the HC, once they fill his previous position. Lisa noted that Ben had American eel and Wilson also has that one. Lisa asked Robert if he wanted to take on a particular species. She noted that she had originally assigned species, based on geography and expertise. She asked for input. She reminded us that our assignment is primarily to keep tabs on what is going on with species. She noted that the ISFMP Coordinators may get in touch with us to assist in updating the Habitat Sections of amendments. We can always reach out to other experts, when the need arises.

Marek asked if the first question goes to Robert.

Robert noted that because of his relationships in CT, he can take striped bass, but he is also interested in horseshoe crab, and Atlantic menhaden.

Marek noted that he shares horseshoe crab with Mark, but he is happy to swap it out.

Robert noted that he is rather up to speed on striped bass, and really wants to learn about horseshoe crab. He is able to contribute to either species.

Lisa asked if Wilson wanted to keep SB by himself or share with someone (Marek). Wilson was fine either way.

Lisa suggested that Kate and Robert could tag team Atlantic menhaden; and Robert and Mark tag team on horseshoe crab, and then Wilson keep his diadromous species, and Marek tag team with Wilson on striped bass.

Action item: Lisa will send out a revised species assignment table.

Toni noted that striped bass is going to be undergoing an amendment, and Atlantic menhaden may be.

Wilson noted that he is a co-author of the Striped Bass Report to Congress (along with Max Appelman and others), and his role has been to update the literature, so he can provide all of that as part of the HAPC/FHOC review.

Action item: Wilson will provide the Striped Bass Report to Congress as part of the FHOC review.

Lisa noted that another task the species contacts have, is to annually review and update the species fact sheets for each species. The dates are on them. She noted that if any major changes are needed, we can edit those as needed. She noted that the ISFMP Coordinators, and the TCs, do use the fact sheets, so we need to keep them updated.

Action item: Habitat Committee members should review their species factsheets (found on the Habitat page of the ASMFC website), and let Lisa know if any updates are needed.

Lisa noted that on her last Science Department call, she was asked to look at the Research Priorities document and update it. She noted that there are habitats for each of the species, and they want us to take a look at this by January. She asked that we take a look at your assigned species, and look at the categories for habitat, at the high, moderate and low categories, and see if there is anything that we would modify or remove. If there are modifications that we would make, let Lisa know. She will send us the document and ask us to review by the deadline requested. She noted that the ISFMP and the Science Teams know who is assigned to each species and may contact you. Just because you have a recommended change, doesn't necessarily mean that it will be incorporated into the document. She will send the document out, with the deadline.

Action item: Lisa will send the Research Priorities document to the Habitat Committee with instructions on the input needed, and deadline.

Wilson asked what the date is on this research needs document. It was published in April 2018. They want to make this one current through January 2021.

Wilson noted then that he can look at the last 2.5 years of literature, for ideas and making edits.

Toni noted that the stock assessment recommendations also go into the document.

Lisa noted again that Pat Campfield and Tina Berger want us to look at the document to make sure it has the HC seal of approval. They know what species are assigned to each of us, so they should be getting in touch with us. Lisa explained again for what we should be looking and hoped that it made sense.

2:30 p.m. Marek asked if anyone had anything to share about their species.

Wilson noted the one new finding he had mentioned during our discussion with Joe, about the American shad entering Albemarle Sound primarily going up the Chowan River, rather than the Roanoke, and there is also a lot of interesting information being developed for the American eel population on the Roanoke River, thanks to Dominion Energy and their contractors.

Jimmy noted that the American shad information would be useful in the context of the new MOU between VA and NC.

Toni noted that she would provide us with new information on the Vineyard Wind project Biological Opinion.

Living Shorelines Policy Update

Lou noted that the ISFMP Policy Board had given us authorization to move forward with a statement. The problem statement is perhaps a good start. The key thing is what we want the policy statement to say. We had a lot of back-and-forth about broadening the statement. He noted that Jimmy and the NC folks had a lot to say about not limiting it to just living shorelines. Lou asked for input.

Kent asked Lisa to put on the screen the version that we are currently working from. Lisa did so.

Lou noted that we talked about other nature-based solutions, and he thinks it is important to include those.

Eric noted that he thinks that the authors did a good job conveying the importance of SAV, and direct impacts. He was less clear about how to evaluate indirect impacts and thought that the text would benefit from some examples.

Lou stated that makes sense.

Eric noted that he can envision subtidal impacts running toward a subtidal SAV bed, but also, what about sea level rise (SLR)? In the short term, there may not be any impact, but within a decade or more, could there be an impact?

Lou stated that is something that should be considered. It could be included as a best management practice (BMP) in the guide.

Kent noted that originally, he thought it was a non-issue for FL, because they had developed a lot of their regulatory guidance to avoid any SAV impacts. BUT he sees the collective need for this and wants regulatory folks to understand that we don't want to trade an SAV bed, for oyster reefs or other living shorelines. He noted that he was pretty comfortable with the way the NC concerns were addressed in the problem statement.

Lou felt that we needed a concise policy statement itself. Lou noted folks probably haven't had a chance to think about it. He hoped that people would ultimately weigh in.

Kent noted that ultimately, it would go to the ISFMP Policy Board for their approval. He asked if we got their approval.

Lisa noted that the ISFMP Policy Board gave us the authority to write a statement, but that doesn't necessarily mean they will approve it.

Kent asked if we need to put together a subcommittee to draft a statement.

Lou stated that his staff had taken it as far as it can go, and they want to hear from the HC now.

Lisa noted that Lou, Kent, Russ and Jessica were the subcommittee, so we can keep them if that works.

Jessica noted that she is fine with staying on the group. She asked if it has to be only one key policy statement or would two or three be okay.

Lisa said that Steve Murphey from NC felt that a one size-fits-all policy doesn't work for him. Cheri Patterson (NH) was okay with one. Lynn Fegley (MD) had asked what happens if a project is rejected.

Lisa noted that she had advised that the HC may come up with a hierarchical approach. She recommended including alternatives in the policy. There was concern that what alternative is available if a living shoreline is not appropriate.

Jessica noted that the Mid-Atlantic Fishery Management Council (MAFMC) has broad policies. She gave us an example of the MAFMC policy for oil and gas, which they deem not compatible, but they do consider tiering, for that and for wind. They provide guidance for alternatives.

Lisa noted that this policy to her would be the opposite from the MAFMC oil and gas policy.

Wilson asked if anyone had looked at the South Atlantic Fishery Management Council's (SAFMC) SAV policy statement. He thought that might be useful for the working group.

Kent noted some tiers that could be considered, from an environmental engineering perspective. Kent noted that in terms of implementation, there are ways to treat these things. If a property owner is willing to slope their project a bit, you may be able to push some of the impacts upslope. He noted that he wasn't as worried about an either-or, seawall versus living shoreline. You can always tweak or adjust your policy.

Lou asked Lisa to send him the background document in a Word file. Lisa will do so. Lou noted that he will then send a Google document to the subcommittee then everyone can work off it concurrently. Lou asked if there is a timeline for completion.

Lisa and Toni noted that the next ISFMP Policy Board meeting is in February, and the briefing deadline for meeting materials is January 8th. Toni would prefer that it not be on supplemental, since she knows that some State Directors will want to have some conversations about it with their HC members.

Lou asked when the next Board meeting was after February.

Toni indicated it was May.

Lou asked what the subcommittee members thought. The members were okay with that date.

Lou said that they would shoot for completion by January 8th.

Jimmy asked if the subcommittee wanted someone from NC to be a fly in the ointment.

Lisa noted that the subcommittee will need to have three to four weeks to work on it.

Wilson asked if the January 8th date was for the briefing book, or for the HC?

Toni noted that Wilson was correct. The January 8th date is for the briefing book, the HC will need to have it prior to that date.

Jimmy indicated that he and Trish Murphey would be on the subcommittee for NC.

Russ noted that it would be a good idea for HC members to touch base with their Board members, before this goes to the Board. The big message he thought he needed to share was that projects needed to slow down in order to fully vet the impacts.

Kent noted his agreement and hoped that we ultimately would be able to provide what NJ needs.

Lou noted that he felt he had what he needs.

Lisa felt that she had what she needs as well.

Action item: Lisa will send the LSL background document to the subcommittee (Jessica, Lou, Kent, Russ, Jimmy, and Trish) in Word format, to get started on the LSL Policy.

Action item: Before going to Policy Board, Habitat Committee members should work with their Management/Policy Board members to get their input on the Policy.

Dredge windows discussion

Marek noted that he was now driving his son to soccer practice. He turned the meeting over to Jimmy, to discuss environmental dredging windows.

Jimmy noted that the U.S. Army Corps of Engineers had written an EA, for the Wilmington District, to do away with dredging windows. Some of us received a letter from Dr. Pace Wilber, hoping that the ASMFC-HC would send a letter about this issue. Jimmy stated that this appears mostly to affect NC, since the two ports there are both relatively small (Wilmington and Morehead City). Jimmy noted that the NC ports often wind up with not enough time or needing to do work within the moratorium. Jimmy noted that Wilson, he, and Fritz Rohde (NMFS-Habitat Conservation) were all asked about this. The state ultimately decided to comment through the NC Division of Coastal Management (NC DCM) consistency ruling. The NC DMF letter was just sent about a week ago. So, NC DCM is probably finalizing their letter to the Corps. The letter went to all HC members. We heard from Kent, and from Tony, with respect to environmental windows. At this point, where we stand in NC, is that the CHPP is very strongly committed to environmental windows, environmental dredging windows, so they are trying to oppose the Corps' proposal as much as possible, without being terribly offensive. The NC DMF is now relying on NC DCM for their stand and position. Jimmy noted that the Southern Environmental Law Center (SELC) wrote a letter strongly opposing the Corps' approach. Jimmy noted that Wilson may want to share more, and others may want to share about where their state may be.

Wilson noted that both the SAFMC and SELC had sent letters opposing the change. He noted the excellent document that NMFS had prepared for environmental windows in SC and NC (Wycliffe et al. 2019). Wilson noted that the big concern was the adverse precedent that would be set, and the possibility that the "dominoes" would fall throughout the Corps Districts to both north and south.

Kent noted that if the HC elects to comment on this we need to make the case for fish habitat. He noted that snook spawn in inlets, and so forth.

Wilson noted that his understanding of the current ASMFC policy is, that any project on which the HC comments should potentially have an impact at the population level on a species managed by ASMFC. So, from that perspective, this project didn't seem to rise to the level it needed to rise to. But, if the HC felt that it established a significant enough adverse precedent, then the HC may wish to see comments prepared. Wilson explained why he felt initially that the HC was not likely to weigh in but deferred to Toni to say whether his perception was correct, or not.

Toni indicated that Wilson was essentially correct.

Lisa put the comment criteria up on the screen, and we noted that there are five of them, of which several may apply in this case.

i. The project may have significant stock-level impacts on Commission-managed species and their supporting habitat.
ii. Staff thinks that Commission involvement has the potential to make an impact on the process.
iii. The project has inter-jurisdictional implications.
iv. The project would establish either a highly desirable, or highly undesirable, precedent from the Commission's perspective.
v. Commission staff, with the assistance of Habitat Committee members and/or federal and state agency staff, can adequately research and address the proposed project in a reasonable time frame and within the existing budget.

Toni asked about putting together a subcommittee if anyone wanted to comment.

Wilson indicated that he would assist in drafting a memorandum to ASMFC leadership if the HC decided to move forward.

Kent noted that he would support commenting on this issue, noting again that snook would be definitely affected.

Tony noted that they have had some discussion of this issue in VA, with the Norfolk District. He thought that it was important to reiterate the importance of environmental dredging windows.

Robert from CT supported Tony's statements. He would concur with commenting.

Mark Rousseau indicated that they have restrictions in MA as well, for dredging windows, largely to protect spawning fish, and they take a hard stance on the issue.

Russ noted that he would align himself with the other members. He noted that often in NJ, they have to deal with dredging companies wanting the marine agencies to loosen things up.

Julia noted that they try to maintain a hard line as well in NY. They have a similar situation and try to maintain their standards across the board. They try not to yield concessions here and there.

Sharleen checked to see if they had any conflict with the Savannah and Charleston Districts. They haven't as yet, but they see the potential for precedent, so she favors commenting.

Eric indicated that they also have dredge windows in RI, primarily geared toward winter flounder, but they also consider anadromous species. They may tack a few days on, one end or the other. Their windows are codified in the GPs for RI. There is one exception.

Jimmy thanked everyone for their comments.

Jimmy asked Lisa what more we need to do on this issue.

Lisa said that was a good question. She noted that the ISFMP Policy Board would have to sign off on anything that we prepared.

Toni suggested that some folks put together a bulleted list together, a position statement that would be in the letter, then she can take it to Bob Beal, Pat Keliher, and Spud Woodward, then they can give a readout on whether they want the HC to go ahead and draft a letter. That way, we can draft a letter and get it back to the Board for approval.

Toni asked about the comment deadline.

Wilson and Jimmy noted that the comment deadline had passed already, but the Corps would usually accept letters from management organizations.

Toni noted that the ISFMP Policy Board will need a couple of weeks. She asked where things are.

Wilson stated that it depended on the Corps' reaction to the SELC letter, etc. He and Jimmy can call and find out.

Lisa asked if Wilson was volunteering to do an initial draft of the bullet points.

Wilson indicated that he would do so, working with Jimmy, and also bringing Steve Poland into the mix.

Jimmy noted that there are really three letters, since he has the one that NC DMF sent to the NC DCM. Given those three letters, Wilson and Jimmy felt that they could have a draft by Monday.

Action item: Wilson will draft a position statement on the dredging windows EA to share with Pat, Spud, and Bob after HC input.

Marek rejoined the call.

Toni noted that she wasn't sure she would be on the call tomorrow, since she has some standing calls on Friday. She noted that she hoped that we are all doing well.

Lisa and Marek thanked Toni for being on the call.

Lisa noted that we have a different webinar link for tomorrow, but the phone numbers for the audio are the same.

Marek indicated that we would reconvene the meeting at 9:00 a.m. tomorrow.

Marek recessed the meeting at 3:33 p.m.

Day 2 Reconvene

Marek convened the HC meeting at 9:08 a.m. He welcomed everyone to Day 2 of the meeting.

Status Updates

Habitat Management Series: Acoustics

Lisa noted that if the call drops, we just need to give things a minute and then call back in. She explained that she is in a dead zone for her phone, so she is using wifi for connection.

Lisa noted that not much has changed in the Acoustics document. She pulled it up on the screen for our review (it is Attachment 6). She noted that she had sent the draft that Dr. Grant Gilmore gave us, to the

subcommittee. The original draft that Grant gave us was missing a lot of the pieces that we had sent him originally. Lisa also compared the draft to the outline that we had sent to Grant, and those are a little bit off. Lisa felt that the draft is missing a lot of the meat of the document. The anthropogenic impacts are really a significant part of the document. Lisa noted some of the missing information. She noted that we aren't really getting at the cumulative impacts, and other specific impacts such as food habits impacts. She is not quite sure that is captured in the draft. For the most part, the sections are completed. The introduction is pretty lengthy, and the mitigation section is pretty complete.

Lisa indicated that she isn't sure how we want to proceed: send it back to Grant, send it to the subcommittee for review, or send to the full HC for input.

Lisa noted in addition, the draft is very technical. Kate suggested that we prepare two documents, one which maintains the technicality, and another that is prepared for the Commissioners and other more lay audiences. Lisa thinks that is a good idea. Lisa noted that she hasn't gotten as far as she would have liked on this one, but at least we are making progress.

Marek had a couple thoughts. He likes the idea of a second document. It is doable to make it read for a more general audience. Filling in the original outline is a big deal. He would be hesitant to go back to Grant and request additional work, for reasons Marek stated. Marek wasn't sure what the path forward was. Perhaps we could solicit another expert?

Michelle agreed with everything that Marek said. As a subcommittee member, she is willing to tackle writing some of the sections in yellow. She noted that Brian Hooker, and Ursula Howson, both at BOEM, had assisted us with this. Some of the folks who are writing the white paper for the Offshore Synthesis of Wind workshop, may be willing to review the draft for us. Michelle is happy to assist. She will have time toward the end of the year.

Wilson asked who was writing the white paper.

Michelle explained. She noted that she can reach out to Brian and see if they can identify some people who can review it for us.

Wilson noted that he supports Kate's idea about having a second, less-technical document for the Commissioners and public.

Michelle asked about the second document, and what length it would be.

Lisa stated she envisioned it would be longer than one of our species fact sheets. She noted the information that she would like to include in the less-technical document.

Michelle asked if it would be more of a stand-alone less-technical document.

Lisa confirmed that would be the case. Originally the acoustic document was going to be a lot shorter, but the draft has turned out to be longer. Lisa would like to still create that document, if we can.

Marek asked if she envisioned an Executive Summary of each section, stitched together.

Lisa said that would be correct. She wanted to keep all of Grant's technical information in the long version but create the shorter one as well.

Michelle asked if we would wait until the longer one is completed, before we do the short one.

Lisa said yes.

Jessica agreed that there is value in what has Grant has written, but if no one seeks it out, does it meet the original intent? She noted that for some sections, we may dive into some of the details. Jessica felt that it was worth it to try to create just one document. Maybe we could have call boxes, which include the additional information. The more detailed piece may get completely lost, if we separate the documents.

Marek got what she was saying. He noted that it needs to be digestible for the people who are doing the policy. Marek suggested we can have a link to the technical document, and then a link to the Executive Summary, which would be the shorter document. He noted that managers will be more likely to go for the Executive Summary and pull down a five-pager. He doesn't want to have the technical document only.

Wilson noted that he likes Marek's suggestion, thinking that is a good compromise. Wilson asked Lisa whether the literature is current, noting that there has been a lot of recent work, which he has assembled for SAFMC. He can provide that to ASMFC.

Action item: Wilson will upload acoustics literature to the Google drive set up for this document.

Subcommittee is Michelle, Jessica, Brian Hooker, Sue Tuxbury, Marek, Lisa, and Ursula Howson.

Jessica noted that now we are talking about updating literature, and we have been rolling around with this document for 2.5 years. We sent it out for work, and it wasn't what we expected. Now we are trying to make it into what we want. She thinks that we need to go back to Ursula and others and put all of our energy into a document that we want for our managers. This additional work is a big list, and she is sorry to be the counterpoint, but she thinks that it will be a lot of work and we still won't be where we want to be. That's her two cents' worth.

Marek said it sounds sort of like the Aquaculture document.

Russ said that he was going to say that.

Wilson noted that he understands Jessica's frustration, but likes the approach that Marek outlined. He supports that approach.

Lisa noted that Michelle and Jessica are both on the subcommittee from the HC, but the others are not. Maybe it would help if we had some other HC members on the subcommittee.

Marek volunteered to work on producing short segments. He asked about the literature for the missing segments. Is some of that needed?

Lisa noted that a lot of information has come out in the last five years, about the ecological aspects of acoustics.

Wilson noted that he would be happy to work on the literature review.

Michelle asked if we could create a folder for the literature. She suspects that between all of us, we have a lot of the literature. She has a lot from 2018, 2019, and 2020. Michelle noted that our original outline would have met the need for policy-makers. Our original vision was that just one document would work. Michelle indicated she is with Jessica on having one document. The Synthesis of Science

report on which others are working, will have details, but mostly for offshore wind. That report will be out next year, so it might make sense for us to look at what they produce and have a shorter document. The shorter document is something that we can use now, to comment on projects and so forth. There is a little bit of time-sensitive nature to this project.

Lisa suggested that she would take the current draft and rearrange it to fit the original outline. She will move it into the places where it is supposed to be. She will share it with the subcommittee, including Wilson and Marek, then identify where we need additional literature, and proceed from there.

Kent said it sounds good.

Kate said it sounds good to her to have a thorough Executive Summary at the beginning. It is good to have the science to have the story, but it needs to be written so it is understandable, and managers can use it for decision-making.

Kent noted that if we look at our pattern, and he noted Russ will appreciate this, we need to do an extensive treatise, and then subsample from it for the final document. That to him is the HC process. We reached out to Grant, and in the end, he never did submit an invoice to either FWCC or ASMFC, despite multiple requests. That is a good thing in the long run, that we got the information for free.

Action item: Lisa will rearrange the current Acoustics document to fit the original outline, and then will share with the subcommittee for editing.

Michelle said she would send Wilson the document and flag the references which she needs pdf files for, and Wilson can add/send her any that he has, that she doesn't.

Wilson noted that he will send out to the HC a recent book review from Science, which he thinks is worth reading, about ocean conservation.

Habitat Hotline
Lisa noted that Eric had volunteered to spearhead this one. She noted that she needs to have separate photos, not photos embedded in the text. She asked if the agency should be credited for photos, if they were not already credited.

Mark and Kent said agency crediting was fine.

Lisa noted that she was going to assign authorship as appropriate. That was fine.

Lisa needed any outstanding articles by the middle of next week. She noted that she can't accept things once she starts editing. She needs anything by next Wednesday. She will make the first pass on the edits, and then will let Eric know, so he can do the second pass on the edits, then it will go to Lisa Hartman for formatting.

Wilson confirmed that he and his co-authors were good both with text and photos.

Lisa confirmed that material was complete.

Eric thanked Wilson and all of the other contributors. He noted that they will link all of the habitat articles back to ASMFC habitats and their protection.

Marek asked Lisa when the last little bit of work comes in to send it to him, so he can begin working on the introduction.

Lisa indicated that she would send it to him and Eric after the middle of next week.

Fish Habitats of Concern Designations

Marek noted that we are little bit behind, but he intends to finish up the agenda topics. Marek noted that Lisa had sent out the summary portion of the document, eliminating the tables. The plan is to work through species-by-species and let those working on the species tell us what really should be considered FHOCs, as opposed to more generalized EFH-type information that is broader.

Marek began with American eel. That one was Wilson's, plus Kate and Ben.

Lisa noted that there were 11 different questions for each species, but we weren't necessarily going to publish all of the answers to those questions. Those questions were supposed to help you all get to the FHOC designations. She hoped that those were helpful. She felt that people were getting hung up on the Species-Habitat Matrix.

Lisa noted that for American eel, there are some recommended changes. She suggested that we discuss the recommended changes for each species.

Marek noted that he has a lot of comments in the document.

Wilson stated his considerations for FHOC, could be Sargasso Sea, Gulf Stream, and perhaps inland FW habitats which are important for producing females. He noted that the ASMFC didn't really have jurisdiction over the Sargasso Sea, so he wasn't sure how they would view designation of that habitat as a FHOC. He noted that there were also some scientists who contended that American eels could complete their life cycle without migrating into inland FW, by remaining in estuarine or marine settings, but he didn't believe that was well-documented. He asked Kate to comment.

Kate noted that she felt that Wilson had covered it. She didn't have anything to add.

Lisa stated how she felt we should proceed on each of these habitats.

Robert noted if the Sargasso Sea is an important habitat, we shouldn't worry about jurisdiction.

Lisa suggested that we leave it up to the policy makers, with respect to what we recommend. She noted that there is no legal weight behind the Commission's FHOC designations.

Wilson noted that the Sargasso Sea is clearly a FHOC, since it is essential for spawning and therefore critical for completion of the life cycle.

Robert stated that he would think inland FW is a FHOC as well, given the contribution to SSB.

Wilson noted that some of the literature shows that American eels in inland FW are more heavily female.

Robert stated again that he would discuss with some of the experts in CT.

Marek asked if the FHOC designation would be for female maturation.

Wilson said yes.

Kate asked what we do if we don't have sufficient science. I.e., can the population thrive, without that inland FW habitat?

Lisa asked if we want to base designations on expert opinion, in addition to the literature. Kate noted that there could be push-back, from states, or other stakeholders. She said that she thinks we need to make the designations based on our comfort. Do what we feel comfortable.

Wilson thought that Lisa's advice was good. He felt that what he needed was really a study that documented that most of the female SSB originated from inland FW.

Marek asked if we could add in a statement regarding uncertainty.

Wilson noted that we could certainly do so. He noted that the federal Fishery Management Councils Science and Statistical Committees are obligated, along with the Councils, to address risk and uncertainty for the species they manage.

Josh, Graham, Michelle, and Lou comprise the team that had American lobster.

Michelle noted that she wasn't the expert but was on the call. She noted that they felt that hard-bottom habitat was the most likely candidate for FHOC. She can write it up.

Action item: Michelle will provide hard bottom write up for lobster FHOC.

Wilson asked how climate change and temperature enters into our designations. I.e. for the SNE American lobster stock, temperature due to climate change has rendered habitats that were perfectly suitable, unusable now. Do we address climate change up front in the document?

Michelle agreed that temperature has to be a factor in American lobster habitat suitability.

Lisa and Marek both felt that we should definitely include temperature as a factor in habitat suitability.

Michelle agreed.

Robert noted that he agrees temperature is a factor. There was some discussion regarding pesticides in Long Island Sound, and also predation as well. He agreed that we should include temperature as a factor, and he endorsed including a statement in the document up-front regarding climate change.

Action item: We will add a statement about climate change in the introduction, and include temperature for American lobster. They will break down lobster into the two stocks.

Kate had a general comment. Because the ASMFC does not have EFH or equivalent for ASMFC-managed species, there is nothing for anyone to point to for habitats for ASMFC-managed species. She noted that she is putting on her TNC hat. If there is no equivalent designation, FHOCs become something they can point to. She just wanted to make that point. We can use these FHOC designations as a tool.

Michelle asked if her thought is to err on being more expansive, than not, since these are not like EFH.

Kate noted that the ASMFC didn't decide to designate EFH. How did we decided to use FHOCs equivalent to HAPCs? She noted that we can cite the habitat sections of FMPs.

Lisa asked Wilson to explain the legislative history for Kate's benefit.

Wilson did so. The short version is that the Magnuson-Stevens Fishery Conservation and Management Act includes a legal provision that NMFS and the Councils must designate EFH for species they manage. The Atlantic Coastal Fisheries Cooperative Management Act does not contain a similar provision for ASMFC-managed species. Years ago, the Habitat Committee and the ISFMP Policy Board had decided to use the same terminology, and same definitions, to describe HAPCs for ASMFC-managed species. Years later, it was felt that this caused confusion, so the terminology was changed to FHOC for the ASMFC designations, which carry no legal mandates.

Wilson noted that at some point, someone may suggest when the ACFCMA is being reauthorized, that ASMFC be given the same responsibility as NMFS and the Councils for designating important habitats.

Michelle said be careful what you wish for. She noted that she was uncertain how those who comment on proposed projects, use EFH and/or other authorities and other species, to express their concerns.

Jessica confirmed that was the case. They can cite SAV values, and other species, as well as those for which EFH has been designated.

Michelle stated that it seemed to her that those regulatory review staff would benefit by knowing what ASMFC has designated. She deferred to Lou on that point.

Wilson explained that the impetus for this document was Dr. Pace Wilber's desire to have all of the information in one place, he thought. He asked Lisa for confirmation.

Lisa noted that this one was initiated prior to her coming on board. Marek confirmed that Wilson's recollection was correct.

The Atlantic croaker team was Russ, Jimmy, Pace, and Marek.

Russ noted that there weren't a lot of comments on this species account. Russ expressed appreciation to Kate for her adding to the table for this species. There were no significant comments on this one.

Lisa asked for any thoughts on croaker. There were no comments.

Kate asked if that means we are good with the FHOC with the one change.

Lisa said yes, we will share with the TC, then once we have TC feedback, then we will share with the ISFMP. She noted that once it is rewritten, then it can be reassembled and go back to the HC. If they don't get feedback, then they will keep it as one paragraph.

Kate asked if the tables are important to include.

Wilson thought perhaps we could just put the FHOC designations up front and put all of the supporting information into appendices.

Lisa noted that the entire HC will need to look over everything we are publishing and provide full approval to anything we are going to publish.

Marek asked that we circle back to that once we get back to the FHOCs.

10:45 a.m. Marek asked that we take a short biological break. He asked how much time was needed. Lisa suggested we take ten minutes and come back at 10:55 a.m.

10:55 a.m. Marek reconvened the HC. Marek hoped that members would return soon. He noted that some species should go more quickly than others, due to their management status.

The Atlantic herring is jointly managed, so we will just publish the HAPC information about it.

Atlantic menhaden was Wilson, Kate, and Ben.

Kate reviewed. She noted that the species is found over a wide range. She noted that at the moment, she wasn't proposing to designate any FHOC.

Wilson noted that his only potential FHOC candidate would be the estuarine nursery areas. He agreed that they are widespread but noted the importance of nursery areas. He noted that the South Atlantic estuaries are warming, and that is problematic from an oxygen perspective, such that we are having a lot of kills of juvenile Atlantic menhaden, before they reach sexual maturity.

It was noted that the 2015 habitat fact sheet had multiple habitats listed as FHOC. The question was whether we had changed our position since 2015.

Lisa noted that the recommendation was to eliminate those from consideration.

Marek explained that the reason for dropping those is to narrow the FHOC specification.

Kate noted that she was hearing what Wilson was saying, and suggested that if we leave anything in, it could be the estuarine-subtidal, and riverine-tidal, perhaps.

Robert wondered if those two habitats could be included then in the general descriptive text, if we elect to not designate any FHOC.

Lisa asked if Robert was concerned that we would lose the habitat descriptions.

Yes, that was his concern.

Lisa noted that we can still retain the general habitat descriptions for each species. We won't lose those; the question is whether we designate a FHOC or not.

Robert stated it seems to him that there is some level of description here, for the broader habitats and for the FHOCs, and he didn't want to lose that description. That's all he was saying.

Lisa suggested that when we next update the Atlantic menhaden fact sheet but indicate that we are not using those as a FHOC designation.

Kate asked do we still want to designate estuarine-subtidal and riverine-tidal?

Marek asked if there is a specific habitat of concern, but he didn't see anything rising to that level.

Robert asked if everyone thinks that is correct.

Wilson indicated that was the reason he asked the question in the first place. He asked Kate if we have data that shows that Atlantic menhaden are more abundant in inshore, estuarine, and riverine areas, than they are offshore.

Kate agreed with Wilson's point.

Marek suggested that we further refine the FHOC designation to the estuarine-riverine transition zone, and that would do the trick.

Action item: Menhaden will have estuarine nursery and riverine tidal habitats as FHOCs.

Kate stated, looking at the Species-Habitat Matrix, some habitats in the South Atlantic were important there, but not for the Mid-Atlantic. I.e. no habitat in the Mid-Atlantic scored high.

Marek noted that gets at the spatial component. He noted that horseshoe crabs may be another species where we have this same issue. There may be estuarine areas which we may wish to carve out, within a particular region.

Wilson asked Lisa if we have the latitude to designate a FHOC within a portion of the ASMFC jurisdiction.

Lisa asked whether that was the case for HAPCs.

Wilson noted he didn't know. He noted that at the federal level, each Council did their designations differently. He indicated that he would defer to Michelle or Jessica to say how the Councils did their HAPC designations.

Michelle indicated that for the NEFMC, they did consider geographic differences.

Jessica stated that at MAFMC, they did HAPCs for summer flounder, and golden tilefish. For summer flounder, they designated throughout the range. But for golden tilefish, they did consider geographic differences, because golden tilefish use habitats differently in the marine canyons. There was some political concern there, because of the potential for MPAs. She also noted that SAFMC had designated some very specific FHOCs.

Wilson agreed that Jessica had pointed out the SAFMC specific HAPCs. So, if we can do that for a region within the ASMFC jurisdiction, then we can do so for the South Atlantic, but he would be more comfortable if we had some hard data that supported doing so.

Atlantic striped bass was Wilson and Kate.

Wilson summarized why he felt that the two areas that we should designate would be the riverine or other spawning areas, and the offshore wintering areas. He explained why those are important. The short explanation is that both of these habitats are essential for striped bass to complete their life history, and when they are present in both of these habitats, they are concentrated and very vulnerable to fishing.

Kate wanted us to include maps of the spawning habitats.

Action item: We will include riverine spawning habitats and offshore wintering habitats as FHOCs for striped bass.

The Atlantic sturgeon team was Eric, Julia and Jeff.

Eric reported. He noted that there are no habitats identified by ASMFC as FHOC. The Atlantic sturgeon is listed by NMFS. NMFS identified Critical Habitats under the ESA in 2015. So, there are some habitats

designated as CH, which are consistent with the ASMFC FHOCs. The question is whether we designate these. Eric felt that since these are designated under the ESA, there is no need for us to designate them.

Wilson asked two questions, the first being, what happens when the species is recovered and no longer listed, and ASMFC once again becomes the primary manager. Should we go ahead and designate them now? The second question is, what about estuarine nursery areas, and offshore wintering areas.

Lisa will consult with Toni and we agreed to leave the possibility on the table until we hear back from her. Also – new science has come out since the designations. Should we just use the current designations or can we add more current information?

Action item: Lisa will talk about Toni about our options for Atlantic sturgeon.

Black drum was Russ, Jimmy, Pace, and Mark.

Russ stated that black drum is another generalist. He thinks that estuaries are important. They can further define. The black drum doesn't even show up in the Mid-Atlantic. They have a ton of data in Delaware Bay.

Wilson asked if there are any hydroacoustic data (meaning derived from listening with hydrophones for drumming sounds made by males during spawning) that show where black drum are spawning.

Russ noted that he will check with Dr. Dewayne Fox to see if he has any acoustic data that would so indicate. He noted that there is a significant fishery in Delaware Bay, such that you can almost walk from boat-to-boat during that fishery.

Action item: Russ will report back on black drum acoustics data once he speaks with Dr. Fox.

Lisa asked for any other comments on black drum. There were no other comments.

Black sea bass was skipped, along with bluefish, and coastal sharks.

Cobia was Kent, Sharleen, and Paul.

There was no FHOC or recommendation, due to the fact that cobia are such generalists.

Kent checked in with the experts at FWRI and that is what they said. They will associate with structure.

Sharleen noted that in SC, they have a genetically unique inshore spawning population (a DPS), near Cape Romain, and it may benefit from FHOC designation.

Wilson noted that was his only question with respect to FHOC designation.

Sharleen will look into that question and get back to the HC on that point.

Action item: Sharleen will check on whether the inshore spawning population of cobia near Cape Romain should have an FHOC designation.

Horseshoe crab was Marek, Jessica, and Tony.

Marek noted that he pretty much put this one together. He recommended removing some of the spatial areas from the text which seemed to be thrown in. He recommends focusing on spawning areas, including a pretty detailed description of the beach substrate. He focused on Delaware Bay.

Wilson noted that there are other spawning locations further south and wondered if we should consider designating those areas. He didn't know if there is good documentation for those sites. He does know that red knots do stop at some of those southern locations and consume HC eggs. He asked Marek if the Delaware Bay population is the epicenter of the stock.

Marek noted that he is aware that other populations exist, and also agrees with Wilson that documentation may not be present.

Jessica asked what the management unit is. She wondered if we modified the text to note that there are other spawning areas, and describe the habitat conditions, that would be adequate. Is there information to support that and tighten up that final paragraph.

Marek thought that it is managed as one unit stock.

Wilson confirmed that it is managed as one unit stock. He noted that the species extends south to FL and that there was a huge population in the Indian River Lagoon at one time, where a huge die-off occurred. He deferred to Kent for further information on that sub-population.

Kent confirmed that horseshoe crabs exist all the way south to Biscayne Bay, so would support extending the FHOC designation.

Robert noted that he would check with CT and NY because those states have been encouraged to consider more management.

Action item: Robert will check to see if there is a need to designate any FHOCs for horseshoe crabs in NY and CT.

Josh, Graham, Michelle, and Lou were designated for Jonah crab.

Michelle reported. She recommended not identifying anything for that species at present. Josh noted that there is a data workshop coming up next week. A lot of research is ongoing right now. They will have more science in a couple of years so we may be able to say something more concrete.

Lisa asked if that sounds good to everyone (it did). She noted that we can change designations in the future.

Action item: The HC will not designate FHOCs for Jonah crab right now based on lack of data, but will leave open the possibility of designating it in the future.

Northern shrimp was the same team.

Michelle reported. She noted that temperature is also very important for this species, and they recommended reframing the designation. She wondered if they shouldn't revise the text to indicate that coldwater refuges are needed.

Marek noted that he was going to ask that question.

Lisa confirmed that we will add temperature information to Northern shrimp. No one had any other comments.

Action item: We will add temperature information back in for the Northern shrimp FHOC designations.

Russ, Mark, and Jimmy had red drum.

Mark noted that red drum was similar to black drum. They are a generalist. He asked if Jimmy had anything to add.

Jimmy noted that we have a good FMP for the species in NC and he will look at it to see what he can learn.

Action item: Jimmy will look into NC FMP to see if there's anything to add to the red drum FHOC designation.

Wilson noted that Dr. Joe Luczkovitch at East Carolina University may have some hydroacoustic data for red drum spawning in Pamlico Sound, so that may merit an FHOC regional designation. It may be that southern estuaries are making a larger stock contribution.

Marek noted that it was noon, and we still have more species to address. He noted that he and Lisa have consulted, and they propose that we do a two-hour call, to finish this task.

Lisa suggested that we try to do this prior to Thanksgiving. She noted that we are more than halfway done. She noted that this process is really productive. We can finish up all the designations and get it to the TCs.

Everyone was in agreement.

Action item: Lisa will set up a call to go through the rest of the FHOC designations.

Other Business

Marek noted that we need to determine the next Vice Chair.

Lisa noted that Jimmy will be moving up to Chair, so we need a new Vice Chair.

Wilson asked if we had any volunteers.

Lisa noted that the Vice Chair for the HC is not as much work as the ACFHP Vice Chair.

Kent noted that he has done them both at the same time and can confirm Lisa's statement.

Someone noted that Russ had left the call. Russ chimed in and said that he was running two laptops, but he was willing to step in. He confirmed that Jimmy would be the new Chair.

Wilson noted that we had a motion from him nominating Russ as Vice Chair, and a second from Mark. There were no objections to Russ becoming Vice Chair.

Many of the members expressed their appreciation to Marek for his service of four years, as Vice Chair and then Chair.

Wilson gave a brief update to the full HC, on the NC dredge issue (see previous discussion above).

Marek summarized our action items. We are considering a two-hour call, prior to Thanksgiving, to complete the FHOC review.

The meeting adjourned at 12:10 p.m.

FOR IMMEDIATE RELEASE: May 3, 2021

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OHM, SELC Challenge Unprecedented Changes to Georgia Dredging Windows

Savannah, GA– Today, the coastal Georgia nonprofit One Hundred Miles (OHM), represented by the Southern Environmental Law Center (SELC), filed a challenge against the U.S. Army Corps of Engineers' unlawful decision to eliminate highly successful seasonal limitations on dredging projects that have protected sea turtles and other marine life for decades.

Because hopper dredging can be harmful to sea turtles, fisheries, and other coastal wildlife, the Corps has historically conducted dredging activity in Georgia during the winter months (December 15-March 31), when adult loggerheads and other sensitive species are far less abundant in Georgia's coastal waters.

The Corps is now proposing to conduct annual, year-round operation and maintenance dredging, and intends to begin dredging Brunswick Harbor as early as mid-May. The timing presents an even greater risk given that Georgia's loggerhead nesting season traditionally begins May 1 and continues until October. The first nest of the 2021 season was discovered on Little Cumberland Island this past Saturday, May 1.

The lawsuit and motion for a preliminary injunction filed with the U.S. District Court for the Southern District of Georgia allege that the Corps did not conduct the environmental review required by the National Environmental Policy Act (NEPA).

"State and federal agencies have relied on seasonal dredging windows for decades for the simple fact that these windows have proven to be effective in reducing risks to sea turtles and other coastal wildlife," said Megan Huynh, Senior Attorney for the Southern Environmental Law Center. "The Corps has not fully studied the impacts of this harmful about-face, nor has it offered adequate opportunities for public comment."

The Corps' proposed year-round dredging goes against strong opposition from the Georgia Department of Natural Resources (DNR). According to DNR's scientific analysis, spring and summer dredging could conceivably kill as many as 87% of the females nesting in the vicinity of the Brunswick shipping channel, and 47% of those near the Savannah shipping channel. Because loggerheads are slow to reach reproductive maturity, it will take at least another 30 years to replace each nesting turtle killed in the population

Both OHM and SELC agree that routine operations and management dredging plays an essential role in keeping Georgia's harbors safe and navigable—but assert that these needs can continue to be safely met in adhering to established winter dredging windows, as has been done for three decades. Further, they reject the Corps' claims that winter dredging poses a risk to the North Atlantic right whale, pointing to more than three decades of scientific data showing no injuries, fatalities, or other interactions between dredge vessels and right whales.

"Georgia's coast must continue to be a safe place for both our ships and our wildlife," said Megan Desrosiers, President/CEO of One Hundred Miles. "We are committed to ensuring that our harbors are responsibly maintained and that our beloved wildlife, like loggerhead sea turtles and

North Atlantic right whales, are protected—just as they have been over the past 30 years of winter dredging. There is no justifiable reason for the Corps to remove these windows now."

DNR's recent two-week comment period in March 2021 generated more than 1,500 letters in opposition to year-round maintenance dredging in connection with the Brunswick Harbor Modification Study—a testament to Georgia's long commitment to sea turtle conservation.

The Georgia coast is home to the oldest loggerhead nesting project in the world, started in 1964 on Little Cumberland Island. Since that time, the Georgia Sea Turtle Cooperative has grown to include hundreds of dedicated volunteers, researchers, and federal and state employees who devote thousands of hours and significant financial resources every year to protecting loggerhead sea turtles and the habitats on which they depend.

"Our state has long rallied around our loggerhead sea turtles and invested in their protection," said Catherine Ridley, Coordinator for the St. Simons Island Sea Turtle Project and Vice President of Education and Communications at One Hundred Miles. "Georgians aren't about to let the Corps throw away nearly six decades of conservation progress based on their illogical arguments and complete disregard for scientific data. We have too much to lose—and as the overwhelming public outcry makes clear, we won't stand for it."

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About One Hundred Miles: *One Hundred Miles is a nonprofit conservation organization with a mission of protecting and preserving Georgia's 100-mile coast through advocacy, education, and public engagement. Founded in 2013, OHM is the only organization focused on combatting the multiple threats to Georgia's entire 100-mile coast and promoting the significance of its robust wildlife, vast landscapes, and vibrant communities. Our team of ten employees works out of offices in Savannah and Brunswick to empower citizens to fight poor decision-making that threatens our coast and to participate in important community dialogues about growth, sea level rise, economic development, and conservation. OneHundredMiles.org*

About Southern Environmental Law Center: *For more than 30 years, the Southern Environmental Law Center has used the power of the law to champion the environment of the Southeast. With over 80 attorneys and nine offices across the region, SELC is widely recognized as the Southeast's foremost environmental organization and regional leader. SELC works on a full range of environmental issues to protect our natural resources and the health and well-being of all the people in our region. www.SouthernEnvironment.org*

GEORGIA
DEPARTMENT OF NATURAL RESOURCES
WILDLIFE RESOURCES DIVISION

MARK WILLIAMS
COMMISSIONER

TED WILL
DIRECTOR

February 22, 2021

MEMORANDUM

TO: Kelie Moore

FROM: Mark Dodd

SUBJECT: Summary of Georgia DNR concerns regarding proposed summer hopper dredging in Georgia channels and the 2020 SARBO

Background

- The USACE uses trailing suction hopper dredges to maintain shipping channels in Georgia (Savannah, Brunswick, and Kings Bay). Annual removal of sediment is required to maintain shipping channels at approved depths for navigation.

-Hopper dredging activity has resulted in significant effects on protected species populations. Federally-listed species that may be impacted by hopper dredging activity in Georgia include: 1) North Atlantic right whale, 2) hard shelled sea turtles (loggerhead, Kemp's ridley, green), and 3) Atlantic sturgeon. Shortnose sturgeon are a species of concern but mortality has not been documented in hopper dredges in Georgia. Historically, loggerhead sea turtles have been the most significantly impacted by dredging activities through unrestricted summer hopper dredging activities and the loss of reproductively active females.

-The Georgia Department of Natural Resources (GADNR) has coordinated sea turtle, right whale and sturgeon conservation in Georgia for over 30 years. GADNR collects and maintains data for population assessments, conducts research, and implements management actions to recover listed species. The State of Georgia has invested significant resources over the last 30 years to recover sea turtle, right whale and sturgeon populations.

-The mortality of sea turtles in hopper dredging activities in Georgia is well documented. In 1991, a single observer monitoring spring and summer hopper dredging in the Brunswick and Savannah channels documented 35 sea turtle mortalities (Slay 1991). This estimate was considered a gross undercount of total sea turtle mortality because monitoring was limited to 25%-50% of total dredge loads. In addition, observers monitored overflow screening only. It's assumed that only a small proportion of the total sea turtle carcasses taken by hopper dredges are detected in the overflow screening. Most turtle carcasses are thought to be buried in sediment or are negatively buoyant and sink

to the bottom of the hopper where they cannot be detected. Based on the 1991 estimate of mortality, NMFS issued a biological opinion that found that channel maintenance dredging activity in the southeast "jeopardized the continued existence" of listed sea turtles. The 1991 SARBO required dredging in the winter months to avoid times of high sea turtle abundance (12/1-3/31). In addition, protective measures were put in place to minimize any interactions between dredges and support vessels and right whales during the calving season. Atlantic sturgeon were not considered a species of concern at that time and not included in the development of early conservation measures. The winter dredging windows were adjusted several times over the following 7 years using sea turtle mortality data collected by observers on dredges.

-In 1995, GADNR added winter dredging requirements to the state's Clean Water Act 401 certifications for the Savannah channel maintenance dredging as a result of concerns over NMFS expansion of the dredging windows in the 1995 SARBO. Similar conditions were added on all subsequent 401 certifications issued by the state including the King's Bay ship channel and the Savannah Harbor Expansion Project. Requirements for the winter dredging window were also added to the Coastal Zone Management Act Federal consistency determination for King's Bay.

-In 1998, the USACE SAD developed a protocol based on negotiation with southeastern state resource agencies that restricted hopper dredging in southeast channels from 15 December to 31 March annually. During the same period USACE, NMFS and other agencies developed protocols to mitigate risk to right whales, including the Early Warning System (EWS) aerial surveys, speed measures for hopper dredges and requirements for dredge observers to report all whale sightings and collisions.

-In 2020, NMFS issued a new biological opinion for channel maintenance dredging in the south Atlantic coast. The opinion eliminated the use of hopper dredge windows to reduce sea turtle mortality. The USACE Savannah District has informed Georgia DNR that they intend to dredge the Brunswick and Savannah channels during the spring/summer 2021 (April-June).

Summary of protected species mortality in hopper dredges in Georgia

-There is significant spatial and temporal variation in the occurrence of Federally-listed species in shipping channels in Georgia. North Atlantic right whales and Atlantic sturgeon are present during the winter months (15 November-15 April). Sea turtles are found in shipping channels year round but abundance is several orders of magnitude higher in the spring, summer, and fall (1 April- 15 December). Data required to determine the optimal timing for hopper dredging in Georgia includes: 1) an estimate of the probability of mortality event by species and 2) the potential effect of the mortality on population recovery. In the following sections, we summarize the available data on the probability of protected species mortality in Georgia (take data) and the effects of the mortality on population recovery (status).

<u>Take levels associated with channel maintenance dredging</u>

-Data on sea turtle mortality in hopper dredging is available beginning in 1987. Initial observations were limited to the monitoring of overflow screening. The subsequent development of inflow boxes substantially improved the detectability of protected species mortality on hopper dredges. For the

purposes of this summary, we use a time-series beginning in 1994 which represents a period where inflow boxes were implemented fleet-wide (C. Slay, pers. comm.). There are several caveats regarding this data including:

1) Channel maintenance dredging operations from 1994 to present were conducted during winter months (11/30-3/30).
2) Detectability of carcasses in inflow boxes is known to vary by project depending on box configuration, screen size, and the functionality of equipment (hydraulic box door failure, clogging, etc.).
3) From the period 1994-2007, relocation and sweep net trawling were used periodically during maintenance dredging when sea turtle mortality warranted protection measures.
4) NMFS discontinued the use of relocation trawling in 2008 as a result of concerns over the effects of capture and handling on sea turtles. Sweep or open bag trawling was used exclusively from 2008 to the present in cases where additional protection measures were warranted. The only exception was the Savannah Harbor Expansion Project (SHEP; 2016-2018) where relocation trawling was used.

-From 1994-2019, sea turtle mortality averaged 1.9 turtles per year in Georgia channels (Table 1). Approximately 66% of sea turtle mortalities were loggerheads. All sea turtle mortalities were in juvenile or subadult size classes.

Table 1. Protected species mortality for channel maintenance hopper dredging activities in Georgia channels, 1994-2019 (summarized from ODESS). The time series represents the period when the use of inflow screening was implemented in hopper dredges in Georgia. Data from Kings Bay 2013-2014 were not entered in ODESS and not included in this summary.

Channel	Years Maint. Dredging (1994-2019)	Loggerhead	Kemp's ridley	Green	Unk	Total Sea turtle	avg. sea turtle/yr	Atlantic sturgeon	Avg. Atlantic sturgeon/yr	shortnose sturgeon	right whale
Savannah	26	17	5	2	0	24	0.9	4	0.2	0	0
Brunswick	26	35	18	3	0	56	2.2	8	0.3	0	0
Kings Bay	24	45	14	8	1	68	2.8	5	0.2	0	0
Total	76	97	37	13	1	148	1.9	17	0.2	0	0

- Atlantic sturgeon were Federally listed in 2012. It's not clear when observers were first required to record sturgeon mortality in hopper dredges in Georgia. The first documented mortality of an Atlantic sturgeon in a hopper dredge per ODESS system was in 2015. For the purposes of this assessment, we will use data from the last 5 years because it represents a period of consistent survey effort. Mortality averaged 3.4 Atlantic sturgeon per year from 2015-2019 and mortalities were documented in all Georgia channels. Of the three Atlantic sturgeon mortalities for which length measurements were available, two (2) were subadults and 1 was a juvenile. The detectability of Atlantic sturgeon carcasses in hopper dredges is unknown but assumed to be lower than hard shelled sea turtle species.

-The genetic composition of Atlantic sturgeon taken in Georgia channels is not well known. During the winter months, adult and marine migratory juveniles from other river systems are known to use Georgia

estuaries. Fox et al. 2018 found that 40% (8/20) of the tagged migratory Atlantic sturgeon in the St Marys River estuary (Cumberland Sound) were from Georgia populations. The remaining migratory sturgeon were from other river systems in the South Atlantic DPS. More research is necessary to determine the genetic composition of marine migratory Atlantic sturgeon taken during hopper dredging activities in Georgia.

-No lethal or injurious collisions were documented between North Atlantic right whales and hopper dredges or dredge support vessels in Georgia since the beginning of observation in 1991. The SARBO describes one potential interaction between a whale and a dredge in 2005, but a dead or injured whale was not observed and the encounter was never verified.

-Overall, the use of dredging windows was considered a highly successful multi-species approach to managing threatened and endangered species in Georgia. For over two decades, winter dredging windows have allowed the USACE to maintain deep water channels and protect Georgia's nesting loggerhead sea turtles and Atlantic sturgeon—and no lethal or injurious vessel collisions with right whales have been documented in the process.

<u>Take levels associated with 2009 summer dredging demonstration project</u>

-USACE Savannah District conducted a test project to determine the feasibility of summer dredging in the Brunswick and Savannah channels in 2009. Sweep trawling began in Brunswick on 8/30/09. Two dredges began work in Brunswick on 9/1/09. Four (4) loggerheads were killed in 9 days of dredging and the project was discontinued in Brunswick. One of the loggerheads had an estimated SCL of 81.5 cm (presumed subadult or adult). Dredging began in Savannah on 9/11/09 after 12 hours of open net trawling. Two (2) loggerheads were killed in 6 days of dredging. One of the animals was considered to be of adult size. Overall, 6 loggerheads were taken in 15 days of dredging. The CPUE for the summer demonstration project was 0.000020 turtle mortalities/cu yrd (6/292,734 cu yrd), over 8 times higher than the overall CPUE for sea turtle mortality during the winter dredging window (0.0000024; Table 2). The hypothesis put forth by Dickerson et al. 2007 that capture rates of sea turtles may be lower in the summer due to higher activity rates and less time on the bottom was not supported by this study. One caveat with the 2009 summer dredging project is that the sample size of this study is very low. The results may not be representative of all summer dredging in all years.

-No Atlantic sturgeon or right whales were taken during the summer dredging demonstration project.

Table 2. Sea turtle mortality and cubic yards dredged by hopper dredges during channel maintenance dredging in Georgia, 1994-2018. Data downloaded from ODESS and includes only years where sea turtle mortality and cubic yards of sediment dredged were available (Savannah-1994-2018; Brunswick-1994-2018; Kings Bay-1995-2012,2015-2017). The time series represents the period when inflow screening was used in hopper dredges in Georgia. A caveat from the USACE regarding this data is that it may not be 100% accurate for all dredge volumes. Reports from the contractor, DQM, and CESAS QA personnel do not agree in all areas.

	Years Maint. Dredging (1994-2018)	No. sea turtle mortalities	mortalities /yr	total cubic yards	CPUE-mortalities/cu yrd
Savannah	25	24	1.0	18,370,621	0.0000013
Brunswick	25	56	2.2	27,659,857	0.0000020
Kings Bay	21	68	3.2	16,661,919	0.0000041
Total	61	148	2.4	62,692,397	0.0000024

Take Levels Associated with SHEP

-From 2016-2018, the USACE deepened the Savannah channel from 42 to 47 feet to allow Post-Panamax vessels to use port facilities in Savannah. Closed-net relocation trawling was employed on 408 of the 463 total trawl days (88% of project). During the three-year project, a total of 26 sea turtle (12 loggerheads, 7 Kemp's ridley, and 7 green turtles) and 7 Atlantic sturgeon mortalities were documented. The overall CPUE for sea turtle mortality during SHEP project was ~0.0000033 (26/8 mil cu yrds) which is approximately 1.3 times higher than for overall channel maintenance dredging in Georgia (Table 2). It's unclear why the rate of sea turtle mortality was higher for SHEP particularly when relocation trawling was employed during the project. One difference between the SHEP project and channel maintenance dredging was that SHEP included the construction of new channel segments that had not been dredged previously which may have made trawling less effective. Also, hopper dredging activity for SHEP was continued through the end of March in each of the 3 years of the project which is a time of increasing water temperature and sea turtle abundance.

- The size class of loggerheads taken during the project was difficult to determine because 83% of carcasses were not collected intact. Four (4) of the loggerheads captured during the project were documented by observers as adults; however, it's not clear what standards were used by observers to make this determination. All Kemp's ridley and green turtles captured by hopper dredges were juveniles. A Kemp's ridley and four (4) green turtles were found alive in the hopper during this project. The capture of live juvenile sea turtles in the hopper is attributed to the use of large screening in the inflow boxes (9" x 9") which allowed small turtles to pass through the box.

- The CPUE for Atlantic sturgeon mortality for the SHEP project was 0.0000009 (7/8,000,000). Sturgeon mortality from SHEP was approximately 1.6 times lower than the CPUE for overall channel maintenance dredging (Table 3). This result suggests that relocation trawling may be effective in reducing Atlantic sturgeon mortality in hopper dredging operations. As with the 2009 summer dredging project, the

sample size was very low and the results may not be representative of all projects with relocation trawling in all years. More data should be collected to determine if relocation trawling has a real effect on reducing sturgeon mortality in Georgia.

Table 3. Atlantic sturgeon mortality and cubic yards dredged by hopper dredges during channel maintenance dredging in Georgia, 2014-2018. Data downloaded from ODESS and includes only the most recent 5-year period where sea turtle mortality and total cubic yards of sediment dredged were available (Brunswick-2014-2018; Kings Bay-2015-2017). The time series represents a period from 2014-2018 when inflow screening was fully implemented on hopper dredges in Georgia. A caveat from the USACE regarding this data is that it may not be 100% accurate for dredge volumes. Reports from the contractor, DQM, and CESAS QA personnel do not agree in all areas.

	Years Maint. Dredging (2014-2018)	No. Atlantic sturgeon mortalities	mortalities /yr	total cubic yards	CPUE-mortalities/cu yrd
Savannah	5	4	0.8	3,026,993	0.0000013
Brunswick	5	8	1.6	3,785,604	0.0000021
Kings Bay	3	3	1.0	3,820,447	0.0000008
Total	13	15	1.2	10,633,044	0.0000014

-Length measurements were obtained for 3 of the 7 Atlantic sturgeon mortalities. Two of the 3 sturgeon were adult sized animals and one was a juvenile.

-a total of 137 Atlantic sturgeon were captured during relocation trawling. The age classes of captured sturgeon were 41.6% juvenile, 19.7% subadults, and 38.7% adult.

-Forty (40) loggerheads were captured during winter relocation trawling in SHEP. Three of the 40 were adult sized animals (>90 cm ccl). Two of the three adults were captured in late March when adult females are known to be present in Georgia coastal waters prior to the initiation of nesting in early May. All Kemps ridley (27) and green turtle captures (4) were in the juvenile size classes.

Species Status

Loggerhead Sea turtle

- Georgia DNR collaborated with Warnell School of Forest Resources and the USGS Coop Unit at the University of Georgia, North Carolina Wildlife Resources Commission and South Carolina DNR to develop a Bayesian integrated population model for the Northern Recovery Unit (NRU) of loggerhead turtles (see attached). We used a matrix population model operating at the level of the NRU linked to a multi-state mark-recapture model (10 years of genetic data) that allows detection probability to vary in the study area. Parameters are shared between the model components improving estimation and allowing prediction of the population trajectory into the future. Results from the model show that the NRU loggerhead population was very close to extirpation in the late 1990s, and that the population

abundance is currently approximately half to a third of the size it was in the 1960s. A pulse of hatchlings from early nest protection efforts in the 1970s and 1980's and the implementation of Turtle Excluder Devices (TEDs) resulted in recent increases in nesting (last 10 years). The model predicts that a lack of recruitment from low nesting in the early 2000s will result in a plateau in population growth at current levels. If all current management protections stay in place, the population is predicted to remain stable or decline slightly until 2040. At that point, the population is expected to begin increasing toward historic levels. The model is particularly sensitive to adult female mortality and suggests that, at a minimum, protections for reproductive age loggerheads should stay in place over the next 20 years to ensure the population does not decline from current levels. Given the size of the NRU population, it's unlikely that the loss of 214 benthic juvenile loggerheads over 3 years will influence population recovery. The loss of 214 adult female loggerheads over a 3-year period could result in NRU population decline or declines in local populations adjacent to shipping channels. We intend to further refine the model including conducting sensitivity analysis to assess the effect of the loss of reproductively active females on overall population recovery.

-In 2019, the NMFS/USFWS Loggerhead Recovery Team published an assessment of population status for loggerhead turtles (NMFS/USFWS 2019). The recovery team reviewed progress toward recovery for the NW Atlantic Population of loggerheads 10 years after publication of the recovery plan (2008). Three of the 5 recovery units did not show an increasing trend in nesting. This was a particular concern for the Peninsular Florida Recovery Unit because it represents the largest loggerhead nesting assemblage in the NW Atlantic subpopulation. One of the four recovery units (Northern) showed an annual increase in the number of nests of 1.3% annually. This rate of increase is below the 2% annual increase criterion for consideration for a change in listing status. The data from the Dry Tortugas population was too incomplete to determine a trend.

- Georgia DNR collaborated with Warnell School of Forest Resources at the University of Georgia, North Carolina Wildlife Commission and South Carolina DNR to develop a database of genetic tags (genotypes) for the NRU loggerhead nesting females. A single egg was taken from every documented nest in the NRU over a 10-year period allowing researchers to estimate the size of Georgia's female nesting population. The number of loggerheads using Georgia beaches over the most recent 3-year period (2017-2019) was 2,022 females. The 2020 SARBO allows the USACE to legally take approximately 11% (214/2,022) of the adult female nesting population in Georgia over a 3-year period. The number of loggerhead females using beaches adjacent to the Brunswick ship channel (Jekyll, St. Simons, Sea Island) and the Savannah ship channel (little Tybee, Tybee, Daufuskie, Hilton Head Island) was 245 and 456, respectively. The SARBO allows the USACE to legally take up to 87% (214/245) and 47% (214/456) of the females nesting in the vicinity of the Brunswick and Savannah ship channels over a 3-year period. Data was not available from Florida beaches at the writing of this summary, so a similar estimate could not be generated for the King's Bay channel. Georgia has 3 ship channels which means a significant proportion of Georgia's sea turtle nesting population will be affected by mortality in ship channels. This level of mortality could lead to significant declines in local loggerhead nesting populations.

-Loggerhead turtles exhibit natal homing and high nesting site fidelity. If local nesting populations are significantly reduced or extirpated, its unlikely loggerheads from adjacent beaches will reestablish nesting in a reasonable amount of geological time. The recovery of Georgia's loggerhead turtle population is considered a high priority for the state. As such, Georgia DNR has spent considerable time and energy recovering Georgia's loggerhead sea turtle population.

North Atlantic Right Whale

-Pace et al. 2017 developed a Bayesian mark-recapture model to assess trends in North Atlantic right whale population abundance. The authors found that North Atlantic right whale abundance increased at approximately 2.8% from 1990 to 2010 followed by a decline in abundance from 2010 to 2015. The probability of the post-2010 decline was estimated to be very high (99.9%). In addition, the survival rate for adult females was found to be lower than males leading to a proportionally larger reduction in adult females. Recent data collected since the publication of the model shows a continued declining trend in total and adult female abundance. The overall population estimate is less than 400 animals. The poor outlook for population recovery for North Atlantic right whales is a result of low adult female survival from entanglements in fishing gear and vessel mortality. In addition, low calving rates are not sufficiently high to replace the loss of adults.

-Hopper dredges and associated support vessels have been operating in Georgia waters (with restrictions) during the calving season for over 30 years. No lethal or injurious interactions have been documented. There is no evidence that hopper dredging activity has contributed to population decline in the North Atlantic right whale. There is no reason to assume that the probability of interaction between North Atlantic right whales and hopper dredges or support vessels will increase in the future.

Atlantic Sturgeon

-Georgia supports two of the largest remaining populations of Atlantic Sturgeon in the South Atlantic DPS including the Altamaha and Savannah river populations. Three additional rivers in Georgia hold remnant populations including the Ogeechee, Satilla, and St. Marys rivers (Fox et al. 2018; Fox and Peterson 2019). Monitoring abundance and status of adult sturgeon populations is difficult due to their migratory behavior. However, young juvenile sturgeon remain in nursery habitats for the first year allowing annual cohorts to be effectively sampled. The Altamaha River hosts the largest known population of Atlantic sturgeon in the southeast DPS with annual recruitment from several hundred to thousands of individuals (Schueller and Peterson 2010). More recent information on Atlantic sturgeon recruitment in the Altamaha River are being summarized and will be available in 2021. In the Savannah River, Fox et al. 2020 found consistent presence of age 1 cohorts from 2013-2020 indicating that the population is reliably reproducing. Recruitment remained stable over that period suggesting that the population was recovering. The Savannah population is of particular concern due to loss of spawning habitat (Augusta Bluff Lock and Dam) and significant modifications to the lower river system from the Savannah Harbor Expansion Project. The Ogeechee and Satilla Rivers have small populations with intermittent recruitment. The St. Mary's population was thought to be extirpated for several decades but a recent study documented successful reproduction in 1 of 7 years of surveys (Fox et al. 2018). The St. Marys river population persists at a remnant level.

-Population models are not available to assess the status of Atlantic sturgeon populations or the effect of anthropogenic mortality on population recovery in Georgia. However, based on the size of the Savannah and Altamaha river populations and the fact that documented mortalities to date are primarily juveniles and subadults, it's unlikely that the current level of mortality associated with channel maintenance dredging (3.4 Atlantic sturgeon annually across 3 channels) will have an effect on population recovery. There is a concern that the loss of adults from the King's Bay ship channel could have an effect on the remnant local population in the St. Marys River. As such, it is suggested that the use of hopper dredges in the inner harbor at King's Bay be discontinued in favor of a pipeline dredge.

Relocation trawling should be used if a hopper dredge is used in the inner harbor during the winter months to reduce Atlantic sturgeon mortality.

Risk-based Assessment Conclusions

-Unrestricted hopper dredging in Georgia will result in significant mortality of marine wildlife and the possible extirpation of species including loggerhead turtles, Atlantic sturgeon, and North Atlantic right whales.

- North Atlantic right whales occur off the Georgia coast from 15 Nov-15 April. The North Atlantic right whale population is currently declining and has a significant chance of extinction unless entanglement in fishing gear and vessel strikes are mitigated. Hopper dredging activity has occurred concurrently with the right whale calving season in Georgia for over 30 years. No fatal on injurious incidents have occurred. Although the consequences of a single right whale mortality are high, the data shows that the probability of an event occurring is extremely low. The risk of hopper dredging in the right whale calving season is discountable. With mitigation measures in place hopper dredging can occur safely year-round without any effect on population recovery.

-Loggerhead turtles occur in Georgia ship channels year-round. Loggerhead abundance is low during the winter months (15 December-31 March), increases in early spring (1 April) and peaks during the fall (September; Dickerson et al. 1995). Adult nesting loggerheads are found in ship channels from 1 April through 31 August. The NRU loggerhead population came very close to extirpation in the early 2000's and has sustained a recent increase in nesting as a result of intensive beach management and the implementation of TEDs. Modeling exercises predict that the population will plateau and possibly decline slightly as a result of lack of recruitment from low nesting in the early 2000s. Allowable take limits for adult loggerheads in the 2020 SARBO (214 over 3 years) could lead to a decline in the overall NRU population or declines in local populations adjacent to ship channels. The risk of mortality of nesting females is high during the spring and summer and hopper dredging should be avoided during this period. Similarly, dredging during fall will result in high mortality rates estimated to be 8 times higher than winter. Dickerson et al. 1995 found that sea turtle abundance and activity in southeast channels declined at water temperatures below 16 degrees Celsius. The seasonal time periods that corresponds to water temps below 16 degrees C in Georgia is 15 December through 31 March. In order to assure recovery of the NRU population of loggerheads, hopper dredging activity in Georgia should be restricted to winter months (15 December-31 March).

- Atlantic sturgeon are found in the lower estuaries and shipping channels during the winter and spring (Dec-May). Georgia supports two of the largest remaining populations of Atlantic Sturgeon in the South Atlantic DPS including the Altamaha and Savannah river populations. Three additional rivers in Georgia hold remnant populations including the Ogeechee, Satilla, and St. Marys rivers (Fox et al. 2018; Fox and Peterson 2019). Population models are not available to assess the status of Atlantic sturgeon populations or the effect of anthropogenic mortality on population recovery in Georgia. The optimal time to dredge to avoid the take of Atlantic sturgeon is summer and fall. However, based on the size of the Savannah and Altamaha river populations and the fact that documented mortalities to date are primarily juveniles and subadults, it's unlikely that the current level of mortality associated with channel maintenance dredging (3.4 Atlantic sturgeon annually across 3 channels) will have an effect on population recovery. There is a concern that the loss of adults from the King's Bay ship channel could have an effect on the remnant local population in the St. Marys River.

Overall, the loggerhead turtle population has been most significantly impacted by hopper dredging activity in Georgia. Dredging can occur at any time of year without having effects on population recovery of North Atlantic right whale or Atlantic sturgeon population recovery. The mortality of adult female loggerheads during the spring and summer could lead to population declines in the NRU. We do not concur with the USACE's and NMFS's claim that the 2020 SARBO has improved multi-species management of threatened and endangered species in Georgia. For over two decades, winter dredging windows have allowed the USACE to maintain deep water channels and protect Georgia's nesting loggerhead sea turtles—and no lethal or injurious vessel collisions with right whales have been documented in the process.

Deficiencies with the 2020 SARBO

-The 2020 SARBO has significant deficiencies that should be addressed prior to implementation including:

1- The primary justification provided in the SARBO for eliminating seasonal dredging restrictions in Georgia was to shift dredging effort outside the winter right whale calving season to minimize the chances of vessel collision. Further, it is argued that "high speed" survey vessels are necessary for channel maintenance dredging and pose risks to right whales. The available data does not support either of these arguments. First, hopper dredges have been used in Georgia channels during the calving season with restrictive measures in place for 30 years with no whale fatalities. The SARBO describes one potential interaction between a whale and a dredge in 2005, but a dead or injured whale was not observed and the encounter was never verified. It's illogical to conclude that winter hopper dredging activity should be shifted from the calving season when there have been no fatalities or injurious events in over 30 years.

Second, the SARBO suggests that "high speed surveys vessels" are required for dredging operations (survey and transit) in Georgia. The SARBO implies that survey vessels must travel at high speeds to complete surveys. This is not the case. Survey vessels can travel at a range of speeds including slower speeds ($\leq$ 10 knots) where they will not pose a threat to right whales. Most survey work is conducted at speeds less than 10 knots. Survey work at the ends of the channel or offshore disposal sites does not require vessels to travel at high speeds. Further, survey vessels are not required to transit to and from channels and disposal sites at high speed. Small trailerable vessels can be launched from inshore boat ramps (e.g. Gannett) and larger survey vessels can transit between channels using the intracoastal waterway. In particular, the survey vessel used by the USACE in NE Florida and SE Georgia (Florida II) is inappropriate for offshore use in seasonal right whale habitat at speeds $\geq$ 10 knots. Again, for more than 30 years, "high speed" survey vessels have been used for hopper dredging activities in Georgia. No right whale mortalities or interactions have been documented.

2-The 2020 SARBO proposes to mitigate right whale collision risk with adaptive measures that require vessels to temporarily reduce their speed when whales are sighted within a specified distance of vessels. Adaptive measures like this are less protective than static seasonal speed reductions because: 1) detection probability from aerial platforms is only approximately 50% (Hain et al. 1999), 2) survey teams can only fly 2-3 days per week on average because of weather and other constraints and 3) telemetry data show that individual whales can move 40-60 miles in a day (Georgia DNR unpubl. data). As such, we recommend that all dredges, survey vessels and other support vessels operate at 10 knots or less within the Southeast SMA from 15 November to 15 April, and from 1 November to 30 April in the Mid-Atlantic SMA.

3- A significant deficiency of the SARBO is that NMFS does not take into account the age class or life stage of species taken by hopper dredging activities when assessing jeopardy and developing take limits. This is particularly important for sea turtle species with delayed sexual maturity. Loggerhead turtles, Georgia's primary nesting sea turtle, are not sexually mature until approximately 30 years of age. Other species of concern in Georgia (Atlantic sturgeon and right whales) are sexually mature at an average age of 8-10 years. It takes approximately 3 times as long to replace an adult loggerhead that is removed from the population by dredging than the other species of concern. The large discrepancy in age to sexual maturity should be taken into account when assessing take and the effects of mortality on population recovery.

5- Georgia DNR collaborated with Warnell School of Forest Resources and the USGS Coop Unit at the University of Georgia, North Carolina Wildlife Resources Commission and South Carolina DNR to develop a Bayesian integrated population model for the Northern Recovery Unit loggerhead population (see attached). We used a matrix population model operating at the level of the NRU linked to a multi-state mark-recapture model (10 years of genetic data) that allows detection probability to vary in the study area. Parameters are shared between the model components improving estimation and allowing prediction of the population trajectory into the future. Results from the model show that the NRU loggerhead population was very close to extirpation in the late 1990s, and that the population abundance is currently approximately half to a third of the size it was in the 1960s. A pulse of hatchlings from early nest protection efforts in the 1970s and 1980's and the implementation of Turtle Excluder Devices (TEDs) resulted in recent increases in nesting (last 10 years). The model predicts that a lack of recruitment from low nesting in the early 2000s will result in a plateau in population growth at current levels. If all current management protections stay in place, the population is predicted to remain stable or decline slightly until 2040. At that point, the population is expected to begin increasing toward historic levels. The model is particularly sensitive to adult female mortality and suggests that, at a minimum, protections for reproductive age loggerheads should stay in place over the next 20 years to ensure the population does not decline from current levels. Given the size of the size of the NRU population, it's unlikely that the loss of 214 benthic juvenile loggerheads over 3 years will influence population recovery. The loss of 214 adult female loggerheads over a 3-year period could result in population decline particularly in local populations. We intend to further refine the model including conducting sensitivity analysis to assess the effect of the loss of reproductively active females on overall population recovery.

6-The legal allowable take for adult loggerheads could lead to significant local declines in loggerhead populations in Georgia. Nesting loggerhead sea turtles are known to use shipping channels during the inter-nesting period (Scott 2006). Georgia DNR collaborated with Warnell School of Forest Resources at the University of Georgia, North Carolina Wildlife Commission and South Carolina DNR to develop a database of genetic tags (genotypes) for the NRU loggerhead nesting females. A single egg was taken from every documented nest in the NRU over a 10-year period allowing researchers to estimate the size of Georgia's female nesting population. The number of loggerheads using Georgia beaches over the most recent 3-year period (2017-2019) was 2,022 females. The 2020 SARBO allows the USACE to legally take approximately 11% (214/2,022) of the adult female nesting population in Georgia over a 3-year period. The number of loggerhead females using beaches adjacent to the Brunswick ship channel (Jekyll, St. Simons, Sea Island) and the Savannah ship channel (little Tybee, Tybee, Daufuskie, Hilton Head Island) was 245 and 456, respectively. The SARBO allows the USACE to legally take up to 87% (214/245) and 47% (214/456) of the females nesting in the vicinity of the Brunswick and Savannah ship channels over a 3-year period. Data was not available from Florida beaches at the writing of this summary, so a

similar estimate could not be generated for the King's Bay channel. Georgia has 3 ship channels which means a significant proportion of Georgia's sea turtle nesting population will be affected by the mortality of nesting loggerhead females in ship channels. This level of mortality could lead to significant declines in local loggerhead nesting populations.

7-- The take estimates and conclusions regarding jeopardy for sea turtles developed in the 2020 SARBO are based on rates of mortality documented during the winter dredging window. The calculation of mortality for sea turtles does not take into account high sea turtle mortality rates associated with summer dredging. In 2009, The USACE conducted a demonstration project to assess the effects of hopper dredging activity on sea turtles in the summer months in Georgia. Hopper dredging was initiated in the Brunswick ship channel on 1 September and the Savannah channel on 11 September. Sweep trawling was used to disturb turtles in the channel in the hope of reducing sea turtle mortality. Six loggerhead turtles were taken in 15 days including two loggerheads that were either large subadults or adults. Capture/mortaliity rates in September were found to be 8 times higher than during the winter dredging window. Results from the summer dredging project in Georgia suggest that year-round dredging will result in take levels substantially higher than those used to assess jeopardy.

8-The SARBO does not take into account important recent information on the status of loggerhead turtles. In 2019, the NMFS/USFWS Loggerhead Recovery Team published an assessment of population status for loggerhead turtles (NMFS/USFWS 2019). The recovery team reviewed progress toward recovery for the NW Atlantic Population of loggerheads 10 years after publication of the recovery plan (2008). Three of the 5 recovery units did not show an increasing trend in nesting. This was a particular concern for the Peninsular Florida Recovery Unit because it represents the largest loggerhead nesting assemblage in the NW Atlantic subpopulation. One of the four recovery units (Northern) showed an annual increase in the number of nests of 1.3% annually. This rate of increase is below the 2% annual increase criterion for consideration for a change in listing status. The data from the Dry Tortugas population was too incomplete to determine a trend. The assessment of loggerhead trends in nesting in the 2020 SARBO is limited to a qualitative assessment of nesting patterns (i.e. the population increased for a number of years or declined for a number of years). It's common for sea turtle nesting populations to show annual and cyclic variation in nesting. NMFS should use a quantitative model to assess trends over the time series to assess population status.

9-NMFS does not present a risk assessment in the SARBO as a basis for how decisions were made regarding seasonal restrictions on dredging activity. NMFS should be required to provide a risk assessment including the probability and consequences of dredge mortality on Federally-listed species to justify how decisions were made regarding the elimination of dredging windows.

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Altantic States
Marine Fisheries Commission

State Climate Change Initative Gaps and Recommendations

prepared by

Lisa N. Havel and the ASMFC Habitat Committee

Approved by the ASMFC Policy Board
February 8, 2018

Atlantic States Marine Fisheries Commission
State Climate Change Initiative Gaps and Recommendations

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Background

The Atlantic States Marine Fisheries Commission's (Commission) Habitat Committee (Committee), a branch of the Interstate Fisheries Management Program, was developed to identify, enhance, and cooperatively manage vital fish habitat for conservation, restoration, and protection, as well as support the cooperative management of the Commission and jointly managed species.

In 2016 the Committee identified each state's ongoing practices that address climate change impacts, with a focus on state coastal regulatory planning (Appendix I).

This document builds upon the information gathered in 2016, adding new information since the report was produced, as well as identifying gaps in climate change initiatives among states and providing recommendations for the future. It addresses Strategy 4.6, Task 4.6.2 of the 2017 Action Plan:

4.6 Engage in state and federal agency efforts to ensure climate change response strategies are included in habitat conservation efforts.

4.6.2 Identify gaps in state coastal regulatory planning regarding climate change impacts and make recommendations to increase resiliency.

This document is informational in purpose, providing a snapshot of initiatives underway in each Atlantic coast state at the time of writing. The initiatives do not necessarily reflect the views of the Commission.

Summary of State Initiatives that Address Climate Change

From the information gathered in 2016, state initiatives were grouped into eight different categories:

1. Established a working group or legislation to reduce carbon output
2. Established a working group or legislation to respond to climate change threats
3. Produced reports on climate change
4. Assesses and monitors the effects of climate change
5. Has mechanisms in place for collaboration among agencies and other organizations
6. Addresses climate change in planning documents
7. Has responded to climate change on the ground
8. Includes climate change in outreach efforts.

Each state* has implemented 1 – 8 of the initiative categories listed above. New Hampshire, New York, New Jersey, and Virginia have practices in place that meet all eight categories. A table of each state's practices can be found in Appendix II (also Figure 1). All states address climate change in their planning documents (Initiative 6), at a minimum in their 2015 State Wildlife Action Plans. All but one are also assessing and monitoring the effects of climate change (Initiative 4). This includes habitat distribution and condition, sea level rise, changes in species distribution and abundance, and more. Twelve out of 14 states have produced reports on climate change (Initiative 3), some of which are regularly updated.

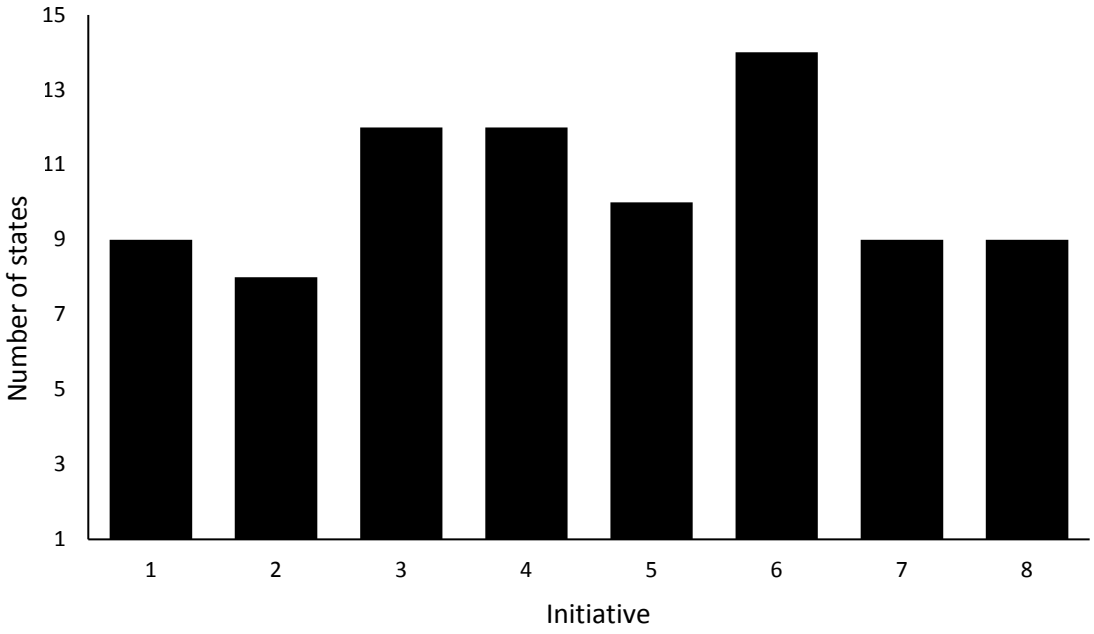

Figure 1. Number of Atlantic coast states carrying out each initiative category. List of categories can be found on page 1.

There is a lot of opportunity regarding initiatives 1, 2, 5, 7, and 8. Only nine of the states have responded to climate change on the ground. Examples of on-the-ground responses that have taken place include installing or working towards offshore wind facilities, encouraging living shorelines during the permitting process, minimizing road crossing impacts on aquatic habitats, and restoring connectivity among habitats. Restoration efforts that promote resiliency, adaptive strategies, and habitat enhancement are also underway. Working groups or legislation to reduce carbon outputs have been created in nine states, and working groups or legislation to respond to climate change threats have been created in eight states. Initiatives range from no action to Maryland's commitment to 100% clean energy by 2050. There is also room for more collaboration and outreach – only ten states work with other agencies or organizations, and nine include climate change in their outreach efforts. Example of outreach that states are

* Except Delaware – data not available.

conducting include messaging in K-12 and teacher education programs, community preparedness programs, providing guidance on best management practices, and more.

Recommendations

Through collaboration, communication, and coordination among federal, state, local, tribal, and nongovernmental organizations, make progress towards the following:

1. Energy production and use
    a. Promote renewable energy production where appropriate. Renewable energy is more compatible with healthy fish habitat if properly sited, constructed, and operated. Via comment letters or other forms of engagement:
        i. Encourage BOEM, energy developers, and others to minimize habitat impacts of projects.
        ii. Encourage BOEM and developers to engage with the fishing industry to understand and minimize fishery impacts.
    b. Promote energy efficient fishery harvest techniques.
        i. For example, consider energy efficiency implications associated with setting trip limits (number of trips, time fishing).
        ii. Encourage the use of energy efficient gears where appropriate.
2. Science and monitoring
    a. Prioritize and encourage funding to be allocated for long term, ongoing environmental monitoring.
    b. Develop indicators and metrics for decision support.
    c. Support continued climate vulnerability assessments to monitor long term changes in fish species and their habitats.
    d. Promote research to understand the effects of climate change on fish species and their habitats. This could include effects on individual species (e.g. ocean acidification) as well as ecosystem and community-level effects (e.g. shifting community distributions and dynamics).
3. Increasing resiliency
    a. Promote consideration of climate change during planning for coastal development.
        i. Encourage state and federal agencies to incorporate climate change analysis in NEPA or other environmental review documents.
    b. Encourage state and federal agencies to recognize potential for sea level rise and storm surge flooding (e.g. https://www.epa.gov/cre/risk-based-adaptation).
    c. Promote the use of best management practices to support coastal habitat resiliency in the face of climate change.
        i. For example, encourage the use of living shorelines and other natural solutions.

Additional Literature and Initiatives

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Please see Appendix III for NOAA and US Fish and Wildlife Service climate change initiatives.

Appendix I 2016 Report on State Climate Change Initiatives

Please note that some states have made additional steps towards addressing climate change since the 2016 report, or highlighted existing actions that were not captured in the 2016 report. These have not been incorporated in Appendix I but were included in Appendix II.

Background

The Atlantic States Marine Fisheries Commission's (Commission) Habitat Committee (Committee), a branch of the Interstate Fisheries Management Program, was developed to identify, enhance, and cooperatively manage vital fish habitat for conservation, restoration, and protection, as well as support the cooperative management of the Commission and jointly managed species. In 2016 the Committee has been focused on Goal 4 of the current Commission Action Plan: to 'Protect and enhance fish habitat and ecosystem health through partnerships and education.'

This document addresses Strategy 4.6, Task 4.6.2 of the Action Plan:

4.6 Engage in state and federal agency efforts to ensure climate change response strategies are included in habitat conservation efforts.

4.6.2 Identify ongoing practices in the state coastal regulatory planning that address climate change impacts.

It contains information on climate change initiatives, as well as links to documents and websites, as reported by each within the Commission's boundaries. This information is the first step towards identifying gaps and making recommendations for improving coastal preparedness and resiliency to climate change.

Maine

In 2013, the State of Maine established the Environmental and Energy Resources Working Group to identify administrative and strategic opportunities to improve Maine's ability to respond and adapt to changing physical conditions in the environment due to climatic influence. The Working Group was led by the Commissioner of the Department of Environmental Protection, and included the Director of the Governor's Energy Office, and the Commissioners of the Departments of Transportation; Marine Resources; Agriculture Conservation and Forestry; and Inland Fisheries and Wildlife. The report, Monitoring, Mapping, Modeling, Mitigation and Messaging: Maine Prepares for Climate Change, presents current programs and activities and contains 32 recommendations. In general, the recommendations are to continue the interdepartmental cooperation; as well as current monitoring, mapping, modeling, and mitigation activities.

The Department of Environmental Protection's Sustainability Division is developing mechanisms for cross agency partnerships, information sharing, efficiencies, and streamlining. These efforts will provide specific and identifiable tools to assist decision-makers. The Adaptation Toolkit, in

development, will aid climate adaptation efforts by providing a centralized source to go to for the information one might need for designing and implementing resiliency practices, as well as information on important regulations and standards to integrate into their project or planning process, and opportunities to connect with state and other engaged practitioners for technical expertise.

In 2015, The Maine Department of Inland Fisheries and Wildlife collaborated with over 150 public and non-profit Conservation Partner groups (including private landowners, conservation organizations, sporting groups, scientists, and governmental agencies) to draft Maine's 2015 Wildlife Action Plan. The Action Plan addresses the full array of Maine's wildlife across all taxa groups and habitats and identifies 378 Species of Greatest Conservation Need and provides species-specific and habitat-based actions to help prevent further species declines over the next ten years. In an effort to understand which of Maine's species and habitats are most vulnerable to climate change impacts, the Department of Inland Fisheries and Wildlife collaborated with the Manomet Center for Conservation Science and other partners on a climate change vulnerability assessment. The report, Climate Change and Biodiversity in Maine: Vulnerability of Habitats and Priority Species, classifies the vulnerability of the species and habitats to climate change.

The Maine Stream Connectivity Work Group and Maine's Aquatic Resources Management Strategy are working to minimize the impacts of road crossings on Maine's aquatic systems, which are becoming stressed by more frequent and severe storms.

The Department of Marine Resources continues to implement a wide range of fisheries research monitoring activities for stock assessments; however, the time series will also be useful for understanding changing environmental conditions.

The Department of Marine Resources has maintained an Environmental Monitoring Program in Boothbay Harbor for over a century. The observations began in March of 1905 and constitutes one of the longest running, continuous series of sea temperature observations for any point on the North American Atlantic Coast. Currently, observations of air temperature, barometric pressure, sea surface temperature, relative humidity, wind speed, and wind direction are recorded at daily intervals.

New Hampshire

The New Hampshire Fish and Game Department (NHFG) is addressing climate change through four different avenues: planning, science, outreach, and communication.

The NHFG's 2015 Wildlife Action Plan (WAP) Update specifically recognized climate change as a risk factor for both habitats and species. Because of this, species and habitat profiles include their sensitivity to climate change-related parameters, and the weighted risk of those species and habitats in regards to impacts such as sea level rise (SLR), changes in precipitation, increased storm activity, changes to air and sea temperature, etc.

The Great Bay National Estuarine Research Reserve (NERR, part of NHFG) continuously monitors salt marsh distribution and condition along with information about the salinity of pore water and marsh elevation. Over time, this information will help inform if and how SLR is impacting salt marsh health at three sites around Great Bay. NHFG also has detailed habitat maps for Great Bay (and will have them for the whole coastal region by next fall). These are considered baseline maps from which to compare future changes. The NERR is also installing a tide gauge in the southern reach of Great Bay to monitor water level over time. The Sea Level Affecting Marsh Migration Model (SLAMM) was run for all of coastal New Hampshire as a part of the WAP, predicting how salt marsh distribution is likely to change under different SLR scenarios and where there is potential for migration. This information was combined with current condition information to determine where the highest quality marsh is likely to migrate, and where restoration opportunities are likely to be valuable in light of potential SLR.

The Great Bay NERR and NH Department of Environmental Services co-chair the Coastal Adaptation Workgroup – a group of outreach professionals that coordinate to bring the best climate-related science to local communities. Much of this revolves around wise planning to protect both natural and built assets. The Great Bay NERR hosts a Climate Summit each spring (topics this year include: living shorelines, presentations about the WAP, fisheries impacts in the Gulf of Maine, impacts on groundwater along the coast, culvert assessment work, dune restoration, city planning case studies, etc.). NHFG is also incorporating climate-related messages into their K-12 and teacher education programs. This summer they will host a teacher training workshop focused on how protected places can be observed to determine climate-related impacts over time; and the NHFG will be hosting an intern who will be developing a volunteer phenology program for the center.

NHFG has two representatives on the Coastal Risks and Hazards Commission, a state wide legislatively-directed commission that was charged with providing guidance and consistent information to state agencies and municipalities on how to assess and prepare for coastal storms, SLR, and increased precipitation. A draft report and recommendations on "Preparing New Hampshire for Projected Storm Surge, Sea-level Rise, and Extreme Precipitation" has been prepared. Because of the recommendations from the report, each state agency is going to be asked to review its rules and regulations in light of the science and recommendations provided by the commission. The legislation is pending now (2016), and if passed would likely go into effect next year (2017).

Additional Links:
The NH Fish and Game Department's Wildlife Action Plan:
http://www.wildlife.state.nh.us/wildlife/wap.html
The State of New Hampshire website: http://www.nh.gov/climate/
The NH Department of Environmental Services:
http://des.nh.gov/organization/divisions/air/tsb/tps/climate/

Massachusetts

In 2008 Massachusetts passed a global warming solutions act to reduce emissions, increase green infrastructure, and to analyze strategies for adapting to predicted changes in climate. The Massachusetts Climate Change Adaptation Report released in September 2011 by the Executive Office of Energy and Environmental Affairs includes an overview of anticipated impacts and key adaptation strategies to increase resilience and preparedness.

Regarding fisheries, Massachusetts sits on the boundary of two biogeographic provinces, the Gulf of Maine and the Mid-Atlantic Bight. The state is already seeing shifts in species range distributions (black sea bass, American lobster, northern shrimp). The Division of Marine Fisheries collects bottom temperature data, every two hours at 60-70 sites across the state. Bottom temperature data is stored in an in-house database containing over 2 million readings dating back as far as 1986 for some sites. The Division of Marine Fisheries also has trawl data back to the 1970's.

In 2007 the mayor of Boston passed an Executive Order Relative to Climate Action, which called for a plan every three years. The first update was produced in 2014 (summary here: http://www.cityofboston.gov/images_documents/Greenovate%20Boston%202014%20CAP%20Update_Summary_tcm3-49733.pdf), and includes a variety of proposals, addressing open space, education, renewable energy, etc.

Rhode Island

In July 2014, the Rhode Island General Assembly approved the Resilient RI Act (RIGL §42-6.2), which formally established the Executive Climate Change Coordinating Council, as well as set specific greenhouse gas reduction targets, and incorporated consideration of climate change impacts into the powers and duties of all state agencies. The Coordinating Council is comprised of Directors and Commissioners from nine state agencies/offices and is supported by an Advisory Board and Science and Technical Advisory Board. It is charged with leading and coordinating state agencies in responding to the challenges posed by climate change in a timely and effective manner, focusing in particular on:

- assessing, integrating and coordinating efforts throughout state agencies to reduce greenhouse gas emissions, strengthen the resilience of communities, and prepare for the impacts of climate change;
- improving our understanding of the effects climate change will have in RI;
- working in partnerships to identify, develop and implement strategies to be better prepared, and reduce risk and losses.

There are several projects underway that will provide information to support future Coordinating Council recommendations. A few coastal related projects include the following. As first step in helping to reduce Rhode Island's greenhouse gas emissions is the completion of the 30 Megawatt Block Island Offshore Wind Project. This will be the first offshore wind project in the country. Located approximately three miles southeast of Block Island, the project which started construction in 2015, is now complete and currently undergoing operational tests. The system is expected to be commercially operational by the end of 2016. The spatial planning and fisheries-related research and monitoring used to guide this work may provide a blueprint for other states and coastal communities.

To assess the effects climate change in Rhode Island the Executive Council's Science and Technical Advisory Board prepared a brief synopsis of the state of knowledge of the following manifestations of climate change: SLR, warming air temperatures, warming water (marine and fresh) temperatures, storm frequency and intensity, biodiversity (changes in species and habitats), and precipitation and inland flooding. The information summarized in this report will assist state agencies, decision-makers, and the public understand the real impacts RI is already experiencing due to a changing climate.

The Coastal Resources Management Council continues work on the Shoreline Change Special Area Management Plan, developing scientifically-based data and tools to aid in coastal hazard adaptation planning. The Management Council has completed revised Shoreline Change Maps for the shout shore communities showing how Rhode Island's shoreline has changed over time due to erosion, and how we might expect it to change in the future. Additional tools and other key resources are available from the website to aid the state and municipalities in supporting sound policy decisions which address coastal erosion, SLR and storm surge inundation problems.

The Department of Environmental Management has also addressed considerations related to climate change throughout the recently updated State Wildlife Action Plan. In short, Wildlife Action Plan reviewed vulnerability assessments for several species of great concern, identified threats to species and their habitats, and proposed actions to reduce these threats. In addition, the Division of Fish and Wildlife's Marine Fisheries Section continues to conduct long-term monitoring programs and collaborate on several local and regional research projects investigating the effects of climate change on managed species and the state's marine resources. State Wildlife Action Plans also have to specifically take into account climate change adaptation. Climate change is primarily in Chapters 1 (species), 2 (habitats), 3 (threats), and 4 (actions to abate threats to species and habitats).

In October 2015, the State Planning Council voted to adopt Rhode Island's new State Energy Plan "Energy 2035" as an element of the State Guide Plan, codifying the Plan as the state's formal long-term, comprehensive energy strategy. The Plan, produced by the Office of Energy Resources in collaboration with the Division of Planning, represents Rhode Island's first data-driven energy planning and policy document. Its vision is to provide energy services across all sectors—electricity, thermal, and transportation—using a secure, cost-effective, and sustainable energy system

In January 2016, the Management Council adopted amendments to Section 145 - Climate Change and Sea Level Rise of the Coastal Resources Management Program to update SLR projections for short-, mid- and long-term timelines of 2035, 2050, and 2100 respectively, as calculated using the current NOAA methodology, and based on the Newport, RI NOAA tide gauge.

In early 2016, OER launched the state's first ever electric vehicle rebate program to support adoption of electric vehicles by Ocean State drivers: Driving RI to Vehicle Electrification (DRIVE).

The program made $200,000 available for qualified RI residents interested in purchasing or leasing an electric vehicle to apply for a financial rebate of up to $2,500, based upon vehicle battery capacity. Modeled closely on existing rebate programs offered in other states, DRIVE offers the potential to increase the total number of EVs on RI roadways by 20-35%.

Connecticut

The Connecticut Climate Change Action Plan was initiated in 2005 with the goal of reducing greenhouse gas emissions to achieve regional goals set by the New England Governors/Eastern Canadian Premiers. The Action Plan addresses quantification of benefits and costs of greenhouse gas reductions using existing analytical measures and a newly developed desktop modeling tool developed under the direction of the Environmental Protection Agency (EPA). As the first state to utilize this new tool, Connecticut was able to identify benefits previously not quantified. To successfully meet the requirements of the Action Plan, a Governor's Steering Committee established working committees at both the agency head and staff level to develop, implement, and track progress on recommended actions.

Additional legislation passed in following years, and complementary to the Action Plan, Connecticut adopted California emissions standards; promoted hybrid fuel cars through tax incentives; set efficiency standards for products and appliances; and promoted the purchase of "Connecticut Grown" foods. A Governor's Executive Order requires the state to purchase renewable energy in increasing amounts, leading to 100% clean energy by 2050. Legislation also simplified the permitting process in ways that encourage implementation of 'living shorelines' in place of shoreline armoring.

Additional monitoring programs include:

Long Island Sound Study Sentinel Monitoring for Climate Change: A multidisciplinary scientific approach to provide early warning of climate change impacts to Long Island Sound ecosystems. This program is conducted jointly by EPA Regions 1 & 2, Connecticut Department of Energy and Environmental Protection, New York Department of Environmental Conservation, and several academic institutions.

Connecticut Institute for Resilience and Climate Adaptation: Established in 2013 under the direction of the Department of Energy and Environmental Protection and the University of Connecticut to conduct research, outreach, and education projects as well as guide the development of technologies and regulatory provisions that increase the protection of ecosystems, coastal properties, other lands, and attributes of the state that are subject to the effects of rising sea level.

New York

New York has an Office of Climate Change within the New York Department of Environmental Conservation that coordinates efforts relating to climate change. The New York State Energy Research and Development Authority developed the Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation in New York State report that includes the impacts of climate change and recommendations.

New York developed a Sea Level Rise Task Force Report in 2009, which includes impacts and recommendations as well. The report led to the 2014 Community Risk and Resiliency Act. This Act:

1) Incorporates state-adopted SLR projections as regulation by Jan. 1, 2016 (Department of Environmental Conservation) and establishes a new 6 New York Community Risk and Resiliency Part 490, Projected Sea-level Rise (Part 490). Part 490 will establish projections of SLR in three specified geographic regions over various time intervals, but will not impose any requirements on any entity.

2) Adds mitigation of SLR, storm surge, and flooding to Smart Growth Public Infrastructure Policy Act criteria and guidance by Jan. 1, 2017 (Department of Environmental Conservation, Department of State).

3) Models local laws to enhance resiliency by Jan. 1, 2017 (Department of Environmental Conservation, Department of State).

4) Considers SLR, storm surge, and flooding in 19 programs (facility-siting regulations, permits and funding) by Jan. 1, 2017 (Department of Environmental Conservation, Department of State), including a checklist on how to consider SLR, storm surge and flooding in permitting decisions.

5) Requires guidance on implementation of the Community Risk and Resiliency Act and the use of natural resiliency measures to reduce risk by Jan. 1, 2017 (Department of Environmental Conservation, Department of State), considering the ability of natural resiliency measures to provide for storm-related and other benefits.

New York also has guidance on flood risk management standards, culvert sizing, living shorelines, nature-based shorelines, and wetland migration. The Office of Climate Change also has a greenhouse gas emissions initiative, which develops caps, performance standards for CO_2 emissions, Climate Smart Communities programs – certifying communities for climate-friendly actions, greenhouse gas emissions targets, and grants to assist in implementation.

The New York State Energy Research and Development Authority conducts environmental research and analysis and provides technical expertise and support to New Yorkers in order to increase renewable energy usage and efficiency. They are currently studying atmospheric deposition and impacts on natural resources. New York also has a Climate Change Science

Clearinghouse, which provides New York State-related climate change data and information to inform decision making.

New York is involved in National Estuary Programs and National Estuarine Research Reserve sites, which conduct research monitoring, the results of which are integrated in all climate change management plans and state wildlife action plans, ultimately affecting how we manage resources. Vulnerability assessments are being conducted – these assess at-risk natural resources and infrastructure, develop adaptation strategies, support low impact development and green infrastructure, and include wetland migration pathway modeling to advise management decisions.

Finally, New York also has monitoring networks (climate sentinel monitoring projects, sediment elevation tables, water quality, is developing wetland rapid assessments, and conducting marsh loss trend assessments). Restoration efforts support habitat connectivity, large scale wetland restoration, and focus on managing threats to trust species.

New Jersey

There are many efforts underway in New Jersey to mitigate and respond to the impacts of climate change including: substantial investment in clean energy initiatives such as renewable energy production from solar, wind, and geothermal sources; improving energy efficiency; and reducing overall energy use and intensity. In addition, the State of New Jersey has taken significant steps in creating climate change-related community preparedness programs with a focus on resiliency and adaptation efforts at the local and state level. These programs involve strong interaction with local governments at the land use planning level as well as efforts to protect critical infrastructure and ecosystems, and new suites of regulations related to the design of buildings, roads, and bridges (www.globalchange.gov).

Following Superstorm Sandy, New Jersey State Departments and Agencies have incorporated resiliency strategy and planning into every aspect of the recovery process in an effort to rebuild better and more resilient than before. Many of these initiatives will serve to make New Jersey more resilient to the adverse effects of future climate change. Among the initiatives are: beach and dune projects, acquisition of properties in repetitive flood loss areas, energy resilience at critical facilities throughout the State, and actions to address emergency fuel – highlighted during Superstorm Sandy by building resilience in fuel supply and distribution. As part of their long-term recovery strategy, New Jersey has committed to rebuilding by focusing on implementing *resilient* infrastructure projects and mitigation opportunities to prevent future damage, and utilizing construction techniques and materials that will better withstand future weather events. The State will continue to leverage existing federal and state resources to pursue these long-term strategic priorities and empower local governments to revitalize their communities. New Jersey has also focused its efforts on future emergency response programs. For more detailed information, please visit the Governor's Office of Recovery and Rebuilding website at http://nj.gov/gorr/.

The continued development of a long-term comprehensive statewide adaptation plan needs to involve the input and action of many parties, including federal, state and local governments; non-governmental organizations; academia; private industry; and the citizens of New Jersey. Safeguarding New Jersey's residents, its built and natural environment, and ensuring that the State continues to grow in a manner that is both sustainable and resilient to the adverse effects of climate change will require adaptation planning. More information on New Jersey's Adapting to a Changing Environment Program is available at http://www.nj.gov/dep/aqes/adapting.html.

Additionally, Rutgers University formed the New Jersey Climate Adaptation Alliance in 2011 (http://njadapt.rutgers.edu). The Climate Adaptation Alliance is described as *"a network of policymakers, public and private sector practitioners, academics, and NGO and business leaders designed to build climate change preparedness capacity in New Jersey…The Alliance is focused on climate change preparedness in key impacted sectors (public health; watersheds; rivers and coastal communities; built infrastructure; agriculture; and natural resources)."* The ultimate goal of this initiative is to assess climate vulnerability and preparedness needs for critical sectors in New Jersey and to develop capacity for response implementation in New Jersey. One of the important products of the Climate Adaptation Alliance was the development of the New Jersey Climate Adaptation Directory. According to the Climate Adaptation Alliance, *"the directory was created to provide resources that assist in guiding practitioners in New Jersey through the adaptation planning process. This directory brings together geographic data, tools, reports, model policies and ordinances, case studies, and current projects focused on evaluating vulnerabilities and developing and implementing climate change adaptation plans and strategies. The resources included are aimed at professionals in a range of fields, including but not limited to infrastructure, public health, emergency management, hazard mitigation, natural resources, economic development, agriculture, and land use planning."* This resource can be found here: http://njadapt.rutgers.edu/resources/climate-adaptation-directory#.

Pennsylvania

Pennsylvania has two separate fish and wildlife agencies: Pennsylvania Fish and Boat Commission and Pennsylvania Game Commission. The state also has the Pennsylvania Department of Environmental Protection, which is primarily regulatory, and the Department of Conservation and Natural Resources that manages the State Parks and Forests.

The Pennsylvania Climate Change Act of 2008 required the Department of Environmental Protection to produce a report on the anticipated climate change impacts in Pennsylvania and also a Climate Change Adaptation Strategy. Both are to be updated every three years. The original reports were produced in 2009 and have both been updated in 2013 and 2015 (http://www.dep.pa.gov/Business/Air/BAQ/AdvisoryGroups/CCAC/Pages/default.aspx#.VyJQWYLD-po). The report addresses freshwater tidal waterfront on page 197. From the report: Pennsylvania has approximately 56 miles of coastline on the Delaware Estuary that is largely freshwater and home to diverse flora and fauna. This includes approximately 1200 acres of freshwater tidal wetlands. Impacts to these habitats include decreased dissolved oxygen

concentrations, SLR, and salinity intrusion. The potential for loss of these wetlands is high if accretion rates do not keep up with SLR. There is a low potential for migration due to development. Further discussion on typical climate change impacts and strategies is extensive in these documents.

The Department of Conservation and Natural Resources has developed the DCNR and Climate Change: Planning for the Future document describing climate change's current and projected impacts on the state parks and forests, and their approach to adapt to these impacts. The 2015-2025 Pennsylvania Wildlife Action Plan offers a review of threats posed by climate change. This plan includes species with declining or imperiled populations, or with secure populations, but substantial environmental threats, and their habitats. Among the primary climate change information sources in this plan include the Northeast Climate Science Center (Staudinger et al. 2015), and state documents produced by the Department of Environmental Protection. Climate change is identified as a threat to 29.5% (196 species of a total 664) of the Species of Greatest Conservation Need in the plan, which also discusses vulnerability and associated risk of those species and habitats to climate change (2015-2025 Pennsylvania Wildlife Action Plan, Chapter 3, pp. 29-70 and 95-107). The Plan (Chapter 4, pp 85-101) also includes conservation actions to address climate change, including regional (Staudinger et al. 2015) and national adaptation strategies (National Fish Wildlife Plants Climate Adaptation Partnership 2012).

Maryland

Maryland has developed the Climate Change Maryland website to educate citizens about climate change and the actions that the state is taking to reduce its carbon footprint. This program includes participation from over 12 states agencies. It contains information on the Greenhouse Gas Reduction Plan, which was written in 2012 (and updated in 2015) to address the 2009 Greenhouse Gas Emissions Reduction Act. The Greenhouse Gas Reduction Plan's goals are to reduce greenhouse gas emissions by 25% by 2020 by reducing all sectors' (energy, transportation, agriculture, etc.) carbon footprint. It has more than 150 programs and initiatives to address carbon emissions related to energy, construction, fisheries, forestry, etc.

The state also has a two phase plan to reducing Maryland's vulnerability to climate change. Phase I was published in 2008 and addresses SLR and coastal storms. Phase II was completed in 2011 and focuses on building societal, economic, and ecological resilience.

In 2012 the Climate Change and CoastSmart Construction Executive Order was signed to ensure all new and reconstructed state structures have minimal to no flood risk based on improved planning and construction.

Virginia

The Governor's Commission on Climate Change published A Climate Change Action Plan in 2008, which includes the effects of climate change (on the built environment, insurance,

natural systems, etc.), recommendations, and commission deliberations. In December of 2014, the state published Virginia Accomplishments Since the 2008 Climate Action Plan Release. According to the executive summary, Virginia has taken many mitigation and adaptation actions in regards to climate change, but these changes were not necessarily in response to particular recommendations or carried out in a coordinated manner. One year later, in December 2015, the Governor Terence R. McAuliffe's Climate Change and Resiliency Update Commission published the Report and Final Recommendations to the Governor, which includes the top five recommendations to address climate change in the state. These include: i.) establishing a climate change and resilience resource center, ii.) creating a new Virginia bank for energy and resiliency, iii.) establishing a renewable energy procurement target for Commonwealth agencies, iv.) adopting a zero emission vehicle program, and v.) leveraging federal funding to make coastal communities more resilient. During the 2016 legislative session Virginia created the Commonwealth Center for Recurrent Flooding Resiliency, a joint venture of Old Dominion University, the College of William & Mary and the Virginia Institute of Marine Science. With an initial budget allocation of $2 million in state support these institutions will work together to provide critical research, policy, and outreach resources to protect natural resources and create resilient communities across the Commonwealth.

North Carolina

In 2015, the North Carolina Coastal Resource Commission Science Panel completed their five-year update of their 2010 Report and the 2012 Addendum as mandated by the General Assembly in Session Law 2012-202. This update incorporated the most recent science and uses a 30-year projection for SLR. The report emphasized the different rates of SLR across the coast of North Carolina. These differences were attributed to subsidence and the effects of water movements within the ocean itself. The panel recommended that the report continue to be updated every five years.

The 2016 update of North Carolina's Coastal Habitat Protection Plan addresses SLR and climatic changes in several locations with recommendations specifically to the protection of wetlands and buffers to help offset the expected rise. The Source Document for the Coastal Habitat Protection Plan, and the Plan itself, can be accessed at: http://portal.ncdenr.org/web/mf/habitat/chpp/downloads.

The Albemarle-Pamlico National Estuary Partnership, through its 2012-2022 Comprehensive Conservation and Management Plan incorporates climatic impacts throughout, but has three actions focused on climate change and SLR. Two actions address the impacts of SLR and climate change on the regional ecosystem as well as supporting research on adapting to those impacts. The third action supports engaging state, regional, and local governments and assisting them with incorporating SLR and climate change into their planning processes.

Both the North Carolina National Estuarine Research Reserve and the U.S. Fish and Wildlife Service have incorporated significant aspects of SLR and climate change research into their strategic plans. With several extensive National Wildlife Refuge systems on North Carolina's

coast and four National Estuarine Research Reserve sites in eastern North Carolina, significant research is being done in those locations. Much of the research deals with hydrologic restoration and the study of wetlands and their mitigating impacts on SLR.

South Carolina

In 2013, the South Carolina Department of Natural Resources compiled a report titled "Climate Change Impacts to Natural Resources in South Carolina." The following two sentences from the report highlight the goal the agency had in writing it: "The Department of Natural Resources is taking a lead role among South Carolina state agencies to advance the scientific understanding of the vulnerability of South Carolina's vital natural resources during an era of changing climate. This will enable the agency, its partners, constituents, and all Palmetto State citizens to avoid or minimize the anticipated impacts while protecting South Carolina's natural resources." The report identifies a number of concerns for the state's natural resources including SLR, ocean acidification, and temperature rise effects. The state has a high proportion of the coastline that is comprised of marshes, barrier islands, and hammock islands. Many of these lands are owned by state and federal entities. The document has various strategies for research and for developing and protecting land to provide for migration.

Other scientists, such as Dr. James Morris from the University of South Carolina, are conducting research evaluating the fate of marshes due to potential SLR. The recent thousand-year rain event in the state and King Tides are raising public awareness of what SLR will probably entail.

Georgia

In Georgia, most of the authority for responding to climate change rests with the local governments. There is not a statewide plan or regulatory measures in place. Their State Wildlife Action Plan, however, does address climate change. With that in mind, there aren't any vulnerability assessments regarding fisheries. NOAA Fisheries Science Centers are working on assessing climate vulnerabilities for many species at the federal level.

Georgia is home to Gray's Reef National Marine Sanctuary, and NOAA is taking a three-pronged approach to address climate change: they are using Gray's Reef as a sentinel site, responding to change through adaptive management, and increasing climate change communication. Climate change links for Gray's Reef and other National Marine Sanctuaries include:
http://sanctuaries.noaa.gov/science/sentinel-site-program/climate-change-ocean-acidification.html
http://marineprotectedareas.noaa.gov/sciencestewardship/climatechangeimpacts/
http://sanctuaries.noaa.gov/science/sentinel-site-program/grays-reef/climate-change-ocean-acidification.html

Florida

The Florida Fish and Wildlife Commission led a stakeholder summit on Climate Change in 2008. A report was generated in 2009 from this summit entitled "Florida's Wildlife: On the front line of climate change." As a result of this summit and due to the resulting recommendations, the Fish and Wildlife Commission established a Climate Change Oversight Team and developed adaptive strategies to address identified climate change threats to fish and wildlife and their habitats. Climate change considerations have been integrated into Florida's State Wildlife Action Plan, and funding has been provided to aquatic habitat projects supporting climate change adaptive strategies, such as living shoreline projects and regional climate change effects mitigation planning efforts. Funding opportunities for aquatic habitat restoration and enhancement projects supported by the Fish and Wildlife Commission ensure evaluation of climate change adaptation in all project proposals submitted. The state follows guidance in Adapting to Climate Change: A Planning Guide for State Coastal Managers, a 2010 report from NOAA.

The Florida Oceans and Coastal Council published The Effects of Climate Change on Florida's Ocean and Coastal Resources in 2009, and updated the report in December 2010. These reports were written for the Florida Energy and Climate Commission and the residents of Florida. The original report included information on the 2007 Intergovernmental Panel on Climate Change Report, the impacts of climate change on Florida's infrastructure, human health, and economy, the effects of the 'drivers' of climate change, and research priorities, while the update focused on SLR effects and research priorities.

Florida has also worked with partner organizations, such as The Nature Conservancy, to implement projects addressing resiliency and plan for coastal climate change. This has been a key focus of south Florida, which is generally recognized as being one of the most vulnerable regions in the Commission management region to SLR. Partners have developed shoreline resiliency and coral reef teams including the Shoreline Resiliency Working Group and Southeast Florida Coral Reef Initiative, which are focused on assessing and addressing the effects of climate change on coastal habitats. The Governor's South Atlantic Alliance recently sponsored (April 2016) a southeast U.S. Living Shorelines Summit in Jacksonville, Florida, which specifically addressed coastal habitat resiliency in the face of accelerated SLR. This effort has resulted in the development of a number of different regional resources, including a living shoreline training academy, which provides managers and the public with a certification in living shoreline design and implementation.

Appendix II Summary of Climate Change Initiatives by State

For a table on the current climate change initiatives in each state, visit: http://www.asmfc.org/uploads/file/5a5e340eClimateChangeActionsGaps.pdf.

Appendix III NOAA and US Fish and Wildlife Service Climate Change Initiatives

NOAA

NOAA Program	Climate Change Initiative Description
Annual NOAA/NCDC State of the Climate Reports	These began in 1991 and can be downloaded from http://www.ncdc.noaa.gov/bams-state-of-the-climate/
NOAA-wide effort	The Third National Climate Assessment (2014). It includes regional chapters, as well chapters for coastal and oceans, ecosystems, and ancillary reports with additional details for some regions and subject areas. http://nca2014.globalchange.gov/report
NOAA Restoration Center, Community-based Restoration Program and Damage Assessment, Remediation and Restoration Program	Restoration project designs consider climate change impacts to both the immediate restoration and long-term stewardship of project sites. E.g., sea level rise impacts
NOAA Restoration Center, Northeast Region	Guidance on flood frequency estimates for resilient infrastructure and stream restoration. The Restoration Center has been studying historical climatic trends in river floods in the Northeast to support the design of fish passage and river restoration projects, and findings have documented increasing flood magnitudes and frequencies in recent decades. They have also developed Planning for Sea Level Rise in the Northeast: Considerations for the Implementation of Tidal Wetland Habitat Restoration Projects (2011)
NMFS Habitat Conservation Division (HCD), Essential Fish Habitat and Hydropower License – Fish Passage Prescriptions	Consider climate change effects on habitats from the action. Includes climate effects on the proposed action that result in adverse effects to habitat
NMFS HCD (GARFO)	Developing a regional climate change guidance document to assist in integrating climate change information in consultation processes
NMFS Office of Habitat Conservation	Climate Smart Habitat Conservation webpage on climate change information with links for Coastal Blue Carbon, addressing sea level rise in salt marsh restoration projects, and other climate-related topics. http://www.habitat.noaa.gov/ourwork/climate.html
NOAA Climate Program Office	U.S. Climate Resilience Toolkit, hosted by NOAA's National Centers for Environmental Information. https://toolkit.climate.gov/. The U.S. Climate Resilience Toolkit includes training materials and guidance documents to assist coastal resource managers in incorporating climate change information into new or existing conservation plans. https://coast.noaa.gov/digitalcoast/training/considering-climate-change

NOAA Coral Reef Conservation Program	Competitive grant program providing funding and coordination for external and internal NOAA activities on shallow-water coral reef conservation, including research on ocean acidification and bleaching
NOAA Chesapeake Bay Office	Program contributes to climate change research, monitoring, resiliency, and adaptation, e.g., research on climate change effects on oysters
NOAA Sentinel Site Cooperative in North Carolina and Chesapeake Bay	NOAA works with regional partners and leverages resources on issues related to climate change, including sea level rise and inundation through coordinated data sharing, monitoring, research, local community capacity building, and adaptation support, which includes habitat conservation
National Fish, Wildlife, and Plants Climate Adaptation Strategy	Office of Habitat Conservation contributed to the development of this broad strategy that includes coastal habitat adaptation needs
NMFS Office of Habitat Conservation, Coastal Blue Carbon	General information on coastal blue carbon, with a number of links for further reading on the subject including research and development and protocol standards. http://www.habitat.noaa.gov/coastalbluecarbon.html
NOAA Living Shorelines Guidance	NOAA's living shorelines webpage contains background and technical information on, as well as examples of, living shorelines: https://www.habitatblueprint.noaa.gov/living-shorelines/; NOAA Fisheries Office of Habitat Conservation's Restoration Center website contains information related to living shorelines: http://www.habitat.noaa.gov/restoration/techniques/livingshorelines.html; NOAA guidance on living shorelines can be downloaded here: http://www.habitat.noaa.gov/pdf/noaa_guidance_for_considering_the_use_of_living_shorelines_2015.pdf
NOAA Regional Coastal Resilience Grant Program	Grants program to support regional approaches that build resilience of coastal regions, communities, and economic sectors to the negative impacts from extreme weather events, climate hazards, and changing ocean conditions. https://www.coast.noaa.gov/resilience-grant/
NMFS Saltonstall-Kennedy Grant Program	$10 million competitive grant program to build resilient coastal communities and sustainable marine resources.
NMFS Northeast Region Fishery Science Center, Ecosystems Dynamics and Assessment Program	Program website includes a comprehensive review of climate change effects on the Northeast Continental Shelf ecosystem. https://www.nefsc.noaa.gov/ecosys/
NMFS Climate Science Strategy and Regional Climate Science Action Plans	Informs NMFS science activities (monitoring, research, modeling, and assessments), including tracking current conditions, providing early warnings and forecasts, understanding the mechanisms of climate impacts, and projecting future conditions, evaluating possible options for fisheries management and protected resources conservation in a changing world
NOAA's Earth Science Research Laboratory, Physical Sciences Division (PSD)	Climate Change Portal, a web interface that users can access and display climate and earth system model output. https://www.esrl.noaa.gov/psd/ipcc/ocn/

NOAA National Oceanographic Data Center, National Centers for Environmental Information, Ocean Climate Laboratory Team	Provides support for the Northwest Atlantic Regional Climatology webpage, providing high-resolution ocean climatology as part of the NOAA-wide Sustained Marine Ecosystem in Changing Climate Project. https://www.nodc.noaa.gov/OC5/regional_climate/nwa-climate/
NOAA's Office for Coastal Management	In collaboration with The Nature Conservancy and ESRI, NOAA developed the Climate Wizard, a web-based interactive mapping platform which provides access to U.S. and global climate change information including historical and projected temperature and precipitation data using different greenhouse gas emission scenarios for two future time periods. http://climatewizard.org/. Digital Shoreline Analysis System is an ArcGIS-based software package jointly developed by NOAA and the U.S. Geological Survey. The software computes the rate of shoreline change using historical shoreline positions represented in a GIS. https://coast.noaa.gov/digitalcoast/tools/dsas.html. The Digital Coast is a sea level rise projection mapping tool. https://coast.noaa.gov/digitalcoast/tools/slr
The National Ocean Service (NOS) National Center for Coastal and Ocean Science	Ecosystem Effects of Sea Level Rise research program provides a suite of science products to inform coastal managers of local coastal vulnerability and solutions to mitigate flood risk.
NOAA's National Centers for Environmental Information (NCEI)	Arctic Regional Climatology Data. https://www.nodc.noaa.gov/OC5/regional_climate/arctic/

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Kunkel, K.E., L.E. Stevens, S.E. Stevens, L. Sun, E. Janssen, D. Wuebbles, J. Rennells, A. DeGaetano and J.G. Dobson. 2013: Regional Climate Trends and Scenarios for the U.S. National Climate Assessment: Part 1. Climate of the Northeast US NOAA Technical Report NESDIS 142-1. 87 pp. National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service, Washington, DC [Available online at http://www.nesdis.noaa.gov/technical_reports/NOAA_NESDIS_Tech_Report_142-1-Climate_of_the_Northeast_U.S.pdf].

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Department of Interior

DOI Program	Climate Change Initiative Description
US Geological Survey (USGS)	Responsible for climate change science leadership within the Department of Interior
USGS Climate Science Centers and National Climate Change and Wildlife Science Center	Work with natural and cultural resource managers to gather the scientific information and build the tools needed to help fish, wildlife, and ecosystems adapt to the impacts of climate change. https://nccwsc.usgs.gov/
US Fish and Wildlife Service (FWS) The Climate of Conservation in America: 50 Stories in 50 States	State-by-state look at how accelerating climate change is impacting or may impact fish and wildlife across America. https://www.fws.gov/home/climatechange/stories505050.html
National Fish, Wildlife and Plants Climate Adaptation Strategy	National, government-wide strategy to safeguard fish, wildlife, plants, and the natural systems upon which they depend. Led by FWS, NOAA, and New York Division of Fish, Wildlife, and Marine Resources. https://www.wildlifeadaptationstrategy.gov/index.php
FWS Climate Change Strategic Plan	Rising to the Urgent Challenge, Strategic Plan for Responding to Accelerating Climate Change. https://www.fws.gov/home/climatechange/pdf/CCStrategicPlan.pdf

Anthropogenic Noise Impacts on Spawning and Ecology of Atlantic Fisheries: Implications for Managers and Long-Term Fishery Productivity.

REVISED BY R. GRANT GILMORE, JR., PH.D.

I added in some of the text we sent to Grant in orange. So some of the information might be redundant and need to be combined, but I wanted to see what you wanted to leave in vs. remove

Grant's text is VERY scientific and does not follow the outline in regards to length of different sections. This should be remedied but I wanted you to see what you think we should keep/remove

****The Habitat Committee wants to use superscript numbers for the references, instead of listing the names and dates in the text, similar to a Science publication, to make it easier to read. I will do this at the end once we have the text finalized****

*****The Habitat Committee would like to include a figure displaying the distance different sounds travel in the ocean (e.g. freighter vs. whale call vs. air gun vs. SCUBA diver). If you know of one, please add it in*****

******We plan to add links to recordings of different sounds, which I will do once the text is finalized******

*******I have not checked the citations yet – some are probably missing and some might be duplicates. I'll do that at the end*******

I. Introduction

The oceans are full of both natural and anthropogenic sounds. The importance of auditory stimuli is amplified in aquatic environments due to differences in the way sound, light, and chemicals behave underwater. Because water is denser and more viscous than air, the propagation of light and the diffusion of molecules are both severely inhibited. In contrast, sound can move over four times faster and travel farther with less degradation underwater than it can through the air (Rogers and Cox 1988; Ward 2015). Thus sound, not light, is the most important sensory system for many aquatic organisms, including most fishes (Tavolga 1960, 1980; Richardson et al, 1995; Stocker 2002; Au and Hastings 2008; Staaterman et al. 2013, 2014).

Unfortunately, many human activities occurring in coastal and marine habitats add noise to the natural soundscape, and these noises affect aquatic organisms and their interactions with one another. For example, as rates of sound production correlate to rates of spawning and reproductive success, any disruptions to the effective communication within fish and invertebrate species has the potential to

Commented [WL1]: I think that Grant's text here is important and should remain. Guess you could make it a bit more lay-reader-friendly, but the current language is okay by me.

reduce reproductive output and recruitment. The purpose of this report is to summarize our current understanding of the acoustic environment experienced by fishes, the human impacts on the marine soundscape, and how that impacts fish habitat and fisheries. While there is vast literature on the production and use of sound by marine mammals, including the effects of human-generated sound on these species, this is beyond the scope of this report, given ASMFC's fisheries management focus.

Commented [WL2]: While I'm okay with saying it is beyond the scope of this report, at some point I hope that we note that some marine mammals (Bottlenose Dolphin comes to mind)) prey on fishes and use sound to hunt them, which is why their prey (American Shad for one) have such sophisticated abilities to detect sound underwater.

II. The natural acoustic landscape and its importance to fishes

Aquatic environments, especially the oceans, are filled with abiotic sounds including tectonic activity, sea surface agitation, and sea ice activity. These sounds range from <10 Hz to >150,000 Hz with varying intensities and intermittency. Ocean waves and seismic activity produce constant low frequency noises of a moderate intensity, while dramatic seismic events, such as earthquakes or volcanic eruptions, produce relatively short bursts of very loud sounds. Weather, such as precipitation or high wind speeds, contributes to surface agitation causing increased abundance of 100-10,000 Hz noise (Martin et al 2014; Nowacek 2007; Peng 2015). Most abiotic, natural sounds are caused by surface agitation such as bubbles or spray impacting the water's surface. Weather conditions contribute to agitation, causing increased abundance of 100-10,000 Hz noise from precipitation or high wind speeds for the duration of the event (Martin et al. 2014; Nowacek 2007; Peng 2015).

Underwater noise is also generated by biotic sources, such as sound unintentionally produced as organisms move, forage, and release gas (Paxton et al. 2017). In addition to unintended noise, marine organisms make a variety of pointed sounds or calls to perform myriad biological and behavioral functions across different species (Peng 2015). Field and laboratory studies of fish physiology and behavior indicate that sound is a preferred sensory mechanism to detect predators or prey, find suitable habitat, orient, migrate, communicate, attract mates, and coordinate spawning (Putland et al. 2018 Journal of Fish Biology, Ecology of fish hearing). Not only do many species use sound to locate reproductive partners or indicate reproductive intent (Bass et al. 1997; Maruska and Mensinger 2009; Lamml and Krammer 2005, Montie et al. 2017), but some species, like the Pacific marine toadfish *Porichthys notatus*, become more sensitive to particular frequencies or their counterpart's sounds during periods of reproductive availability (Sisneros 2009; Maruska et al. 2012). Rates of sound production correlate to rates of spawning and reproductive success. Territorial species use agonistic calls to delineate an individual's territory and intimidate or deter competitors or predators (Ladich 1997; Vester et al. 2004; Maruska and Mensinger 2009**)**. Other uses of sound include navigation and orientation in the marine landscape, especially for planktonic larval stages of fishes and invertebrates (Radford et al. 2011; Vermeij et al. 2010), for the avoidance of predation (Remage-Healey et al. 2006; Hughes et al. 2014), and for communication (Buscaino et al. 2012; Janik 2014; van Oosterom 2016), and for locating suitable habitats for settlement (Simpson et al. 2004).

Commented [WL3]: We should define "agonistic."

Commented [LH4R3]: the complex of aggression, threat, appeasement, and avoidance behaviors that occurs during encounters between members of the same species. – Encyclopedia of Stress 2nd edition 2007.

III. Sources of anthropogenic noise in the oceans

Noise (unwanted sound) generated from human activities covers the full frequency of sound energies used by marine fishes. Anthropogenic sources of ocean noise are acute (episodic) and chronic (ongoing or continuous). Both types may occur within estuaries, on the continental shelf, or in open-ocean regions. Acute sources include pile driving, dredging, cable laying, bridge removal, and seismic surveys. Chronic sources include commercial and recreational boating, shipping activities, and wind turbine generators.

Watercraft of all kind produce very loud undersea noise, and are the most common sources of anthropogenic sound in coastal waters (Stocker 2002). These sounds can be amplified by complex reflected paths, scattering and reverberating because of the geography and geology of the submerged shoreline and bottom. Watercraft generate sound primarily from propeller action, propulsion machinery, generators, and water flow over the hull (Hildebrand 2005). Combined, these sounds generated from a large container vessel can exceed 190 dB at the source (Jasny 1999; see the case study below). Metropolitan areas and ports contain a diverse array of watercraft which constitute the dominant human derived soundscape: commercial and private fishing boats, recreational watercraft, coastal industrial vessels, public transport ferries, military craft, personal watercraft, and many others. Significant underwater sound production can also be generated from bridge automobile traffic, particularly during peak traffic periods.

Other inshore industrial and construction activities contribute to the aquatic soundscape. Underwater blasting with explosives is typically used for dredging new navigation channels in rocky substrates; decommissioning and removing bridge structures and dams; and construction of new in-water structures such as gas and oil pipelines, bridges, dams, and wind turbines. The potential for injury and death to fish from underwater explosives has been well-documented (Hubbs and Rechnitzer 1952; Teleki and Chamberlain 1978; Linton et al. 1985; Keevin et al. 1999). Pile driving activities, which typically occur at frequencies below 1000 Hz, have also led to fish kills (Hastings and Popper 2005). Intensity levels of pile driving have been measured up to 193 dB in certain studies (Hastings and Popper 2005).

Sonar systems are used for a wide variety of civilian and military operations. Active sonar systems send sound energy into the water column. Sonar systems can be classified into low (<1,000 Hz), mid (1,000 – 20,000 Hz), and high frequency (>20,000 Hz). High frequency sonar telemetry is associated with vessel positioning, locating, steering, and remotely operated vessel control to support resource extraction operations (Stocker 2002). Most vessels have sonar systems for navigation, depth sounding, and “fish finding.” Some commercial fishing boats also deploy various acoustic deterrent devices (pingers) to keep dolphins, seals, and turtles from running afoul of the nets (Stocker 2002). There is little information on the effects of acoustic deterrent devices on fish, however.

The loudest anthropogenic noises are generated by marine extraction industries such as oil drilling and mineral mining (Stocker 2002). The most common source of sounds is from air guns used to create and

read seismic disturbances (Popper and Hastings 2009; Popper et al. 2005, 2014; NOAA 2016; Popper and Hawkins 2016). Air guns are used to generate and direct huge impact noises into the ocean substrate. The sound pressure wave created aids in reflection profiling of underlying substrates for oil and gas. Peak source sound levels typically are 250-255 dB. Following the exploration stage; drilling, coring, and dredging are performed during extraction. Each of these activities also generates loud noises.

IV. Hearing in fishes and effects of anthropogenic noise

To understand whether and how these noises are likely to impact fishes, we need to understand their sensitivity to sound. This varies by species. Many species have the same hearing frequency sensitivity that humans do (10 to 20,000 Hz; Tavolga 1960, 1980; Fine et al 1977; Fay et al. 2008; Popper and Hastings 2009; Popper and Fay 2011), and most fish produce sounds below 200,000 Hz (Tavolga 1960, 1980; Fine et al 1977; Fay et al. 2008). Sound frequencies below 100,000 Hz scatter and dissipate least, travel farthest underwater (Wenz 1962; Au and Hastings 2008; Ward 2015), and are the frequencies fish typically use for communication (Bass et al. 1997; Au and Hastings 2008; Popper and Fay 2011). Certain groups of fish, such as the herrings, sardines and menhaden (clupeids) can detect ultrasound frequencies above 100,000 Hz (Fine et al. 1977b; Nestler et al 1992; Mann et al. 1997, 2001; Narins et al. 2013).

Sound energy is transmitted through both sound pressure and water particle motion. Although there is growing evidence that fish and invertebrates are sensitive to the particle motion caused by underwater noise (Mooney et al. 2010; Mueller-Blenkle et al. 2010; Nedelec et al. 2016; Hawkins and Popper 2017; Sole et al. 2017; Popper and Hawkins 2018), it is technically challenging to measure. This has led to poor assessments of the impacts of particle motion on fish and invertebrates (Popper and Hawkins 2018). There is more information and research on effects in bony fishes, therefore these sections are focused on this group in particular.

Fishes as a group have very complex and diverse interaction with sound and how they perceive it; however, relatively little direct research has been conducted on the impacts of noise to marine fish behavior, physiology, and life history. Some studies and formal observations have been conducted that identify general categories of noise impacts to fish: (1) physiological; (2) acoustic; (3) behavioral; and (4) cumulative. Add NOAA 2008 Tech memo “ocean noise” reference.

Most fish sound production and habitat soundscape acoustic signatures are at frequencies below 5,000 Hz (Fish and Mowbray 1970; Zelick et al. 1999; Myrberg and Fuiman 2002). This is the range of frequencies where underwater sound propagates best. Most human-generated chronic sounds are also below 5,000 Hz (Richardson et al. 1995; Au and Hastings 2008), which is of concern as fish are very sensitive to intense sounds below 1,000 Hz. Impacts include damage to ear, nerve, and lateral line tissue that can lead to sound sensing loss or threshold shifts in hearing (Jasny 1999; Heathershaw et al. 2001; Hastings and Popper 2005`). Threshold shifts result from exposure to low levels of sound for a relatively long period of time or high levels of sound for shorter periods, which may be temporary or permanent. Threshold shifts can impact a fish’s ability to carry out its life functions. Any organ with a markedly

different density to seawater (e.g. swim bladder) may be susceptible to pressure-related impacts. Some of the resulting effects on fish include a rupturing of organs and death (Hastings and Popper 2005).

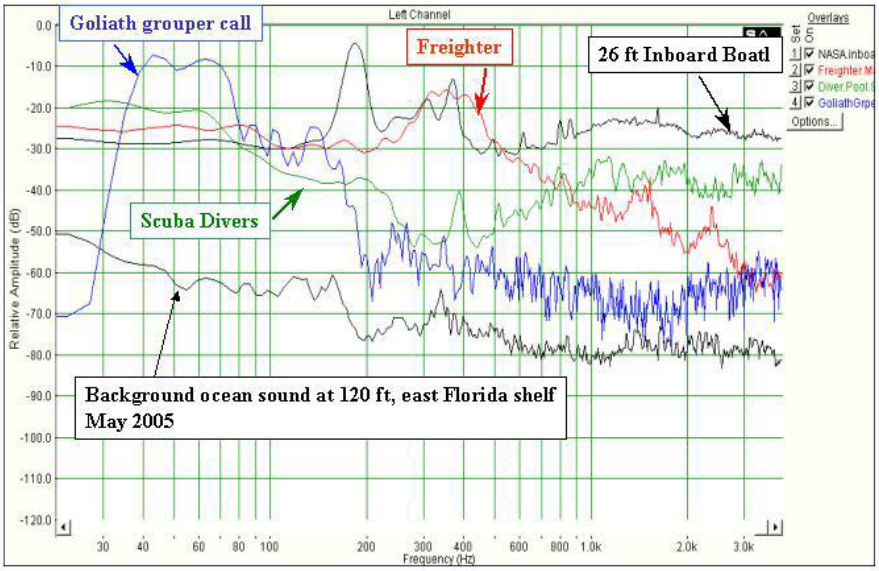

Figure 1. Illustration of the spectrum of various human activity generated and fish (Goliath grouper, *Epinephelus itajara*) sound sources. Note the low frequency sound region where most biologically important sounds are produced (<3 kHz.)

Commented [LH5]: Citation?

Commented [WL6R5]: Possibly comes from some of Dr. Laurent Cherubin's work. I looked but couldn't find the graphic quickly. Let me know if you need more help finding it.

Near field (close proximity) percussion events produced by explosions and pile driving can have a lethal impact on fish through particle motion and sound wave compression. However, the distance from the disturbance and environmental setting (water density, turbulence, etc.) undoubtedly have major influences on potential physiological effects of particle motion and need further study before they can be treated in detail (Kevin et al. 1999; Thomson et al. 2015). The lethality of underwater blasts on fish is dependent upon the intensity of the explosion; however, a number of other variables may play an important role including the size, shape, species, and orientation of the organism to the shock wave; the amount, type, and detonation depth of explosive; water depth; and bottom type (Linton et al. 1985). Fish with swim bladders are the most susceptible to underwater blasts, due to the effects of rapid changes in hydrostatic pressures on this gas-filled organ. The kidney, liver, spleen, and sinus structures are other organs typically injured after underwater blasts (Linton et al. 1985). Smaller fish are more likely to be impacted by the shock wave of underwater blasts than are larger fish, and eggs and embryos tend to be particularly sensitive (Wright 1982). However, early fish larvae tend to be less sensitive to blasts than eggs or post-larval fish, probably because the larval stages do not yet possess swim bladders (Wright 1982).

The most chronic and pervasive impacts on regional fisheries occur when human generated sounds cause behavioral changes that affect critical life history activities required to maintain healthy populations. Masking biologically significant sounds may compromise feeding, breeding, community bonding, and schooling synchronization, in addition to all of the more subtle communications between these behaviors. Anthropogenic sounds that falsely trigger fish responses may cause animals to expend energy without benefits (Stocker 2002). Several studies have indicated that increased background noise and sudden increases in sound pressure can lead to elevated levels of stress in many fish species (Hastings and Popper 2005). Increased ambient noise created by watercraft activity potentially reduces the ability of marine organisms, particularly larval forms, to receive the appropriate sound cues to settle in critical habitats (Jasny 1999; Scholik and Yan 2002; Hastings and Popper 2005; Stanley et al. 2012; Staaterman et al. 2014).

Anthropogenic noise has been demonstrated to affect catch rates. Several studies indicate that catch rates of fishes decreased in areas exposed to seismic air gun blasts (Engås et al. 1996; Hastings and Popper 2005). These results imply that fish relocate to areas beyond the impact zone (area of highest sound intensity), which have been corroborated with visual studies on fish abundance before and after seismic surveys (Paxton et al. 2017). One study indicated that catch rates increased 30-50 km away from the noise source, showing that redistribution of fish populations can occur over broad areas (Hastings and Popper 2005).

V. Case Studies

Clupeids and ultrasound

As noted above, fishes are impacted by sound both physiologically and behaviorally. Physiological responses are somewhat consistent across families. However, behavioral responses can vary depending on species-specific hearing and sensitivity to sound. Within the family Clupeidae, the subfamily Alosinae (alewife, blueback herring, menhaden, shad) have poor sound detection ability, such that sound must be loud (high intensity) in order to hear. However, they differ from other fishes in that they have evolved the ability to hear in the ultrasound range of frequencies (25,000 – 180,000 Hz) if the sound intensity is above a certain threshold (e.g. American shad - 145 dB, Mann et al. 1997). The ability may have evolved as an avoidance mechanism for echolocating predatory toothed whales (Narins et al. 2013).

Alewife responded to high frequency pulsed sound at 110,000 – 150,000 Hz above 157 dB (Dunning et al. 1992), while menhaden can detect sound at 40,000 – 80,000 Hz (Mann et al. 2001). Ultrasound pulses have been used to deter alosines from power plant intakes (Narins et al. 2013).

Because sound intensity above the clupeid sensitivity threshold of 145 dB and within the ultrasound range could impact behavior of the fish, there is concern that certain anthropogenic activities, for example, the use of Acoustic Deterrent Devices for marine mammals near pile driving activities, could impact spawning migration (Boyle & New 2018).

Commented [WL7]: We could definitely cite a personal communication here from Capt. Monty Hawkins, if we wanted to do so, based on his personal observations for Black Sea Bass.

Commented [HB8]: Again, important to point out the duration of the effect.

Commented [LH9]: Missing the rest of this section of the outline:

- Cumulative impacts to fish
- Impacts to fish habitat
- Degradation of the acoustic environment and habituation (i.e. 'urban fish') that masks normal communications in fishes and makes spawning, feeding, etc. difficult (would be nice to organize and link these to the 5 categories we introduced upfront):
  - Reproduction
  - Navigation and orientation
  - Communication
  - Foraging (e.g. echolocation)
  - Protection
- Food web effects
  - Impacts of air guns on plankton
  - Impacts to forage fish
- Direct damage to habitats from sound-producing equipment/impacts of particle motion
- Resulting impacts to fisheries
  - Loss of fish on fishing grounds and resultant redistribution of fishing effort, increasing costs and possibly interactions with other types of fishing or other activities
  - Also reference direct biological impacts to fish tissues, etc., although I think we want to keep our focus on effects related to habitat
  - Potential local/regional population effects (tied to repeated reproduction impacts)

Commented [WL10R9]: Lisa, does the acoustics review team think it is important to add this section back in to the document? Seems like some important points that need to be made.

Commented [LH11]: https://prod-drupal-files.storage.googleapis.com/documents/resource/public/ORJIP%20Piling%20Study%20Final%20Report%20Aug%202018%20%28PDF%29.pdf

Long-term monitoring of human interference with biological sound production in East Florida

Long term deployment of hydrophones in East Florida freshwater tributaries, estuaries, and continental shelf reef formations was used to isolate specific fish spawning sites for long term monitoring and continuous acoustic assessment (Gilmore 2002; Gilmore et al. 2003). The hydrophone array allowed for monitoring the impact of single freighter engine/propeller noise on subtropical reef fish. A complex, high relief (2-8 m) rock reef formation known locally as "Horseshoe Reef" was chosen for a multiple day deployment of three "Passive Acoustic Monitoring Systems" (PAMS) (Gilmore et al. 2003). PAMS were deployed on July 9, 2004 for a period of 72 hrs to continuously record all sounds between 10 and 20,000 Hz (Gilmore et al. 2003). Vessel noise interference with biological sounds was documented (Figures 2 & 3) on a mid-continental shelf reef where fishery species are known to spawn: groupers (Goliath grouper, *Epinephelus itajara*; gag, *Mycteroperca microlepis*; scamp*, M. phenax*; red grouper, *Epinephelus morio*), black sea bass, *Centropristis striatus*, and various snappers (red, *Lutjanus campechanus*; mutton, *L. analis*; and lane, *L. synagris)*. Each of these species uses acoustic signals during mating events (Mann 2006; Mann et al. 1997, 2007, 2009, 2010; Locascio and Mann 2005, 2008, 2011).

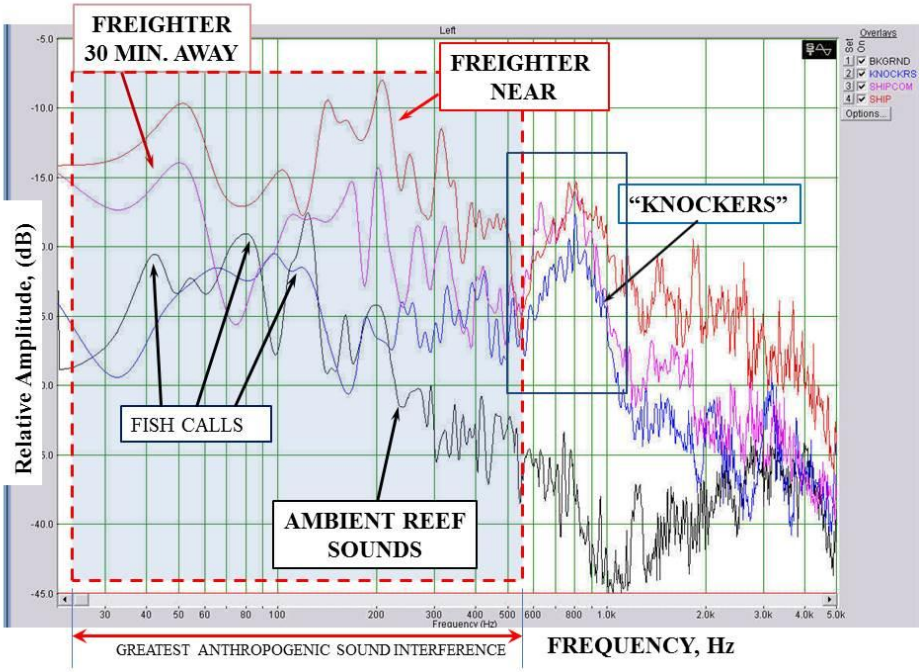

Figure 2. Spectral curves for diurnal ambient reef sounds produced on Horseshoe Reef (black curve) are compared to nocturnal biological sounds produced by an unidentified organism, labeled as "knockers", whose acoustic pulses

center around 1,000 Hz, and fish calls (grouper/snapper) below 300 Hz (blue curve) with an approaching freighter 30 min away (purple curve), and same vessel nearby (red curve). Note that the greatest anthropogenic interference is below 600 Hz.

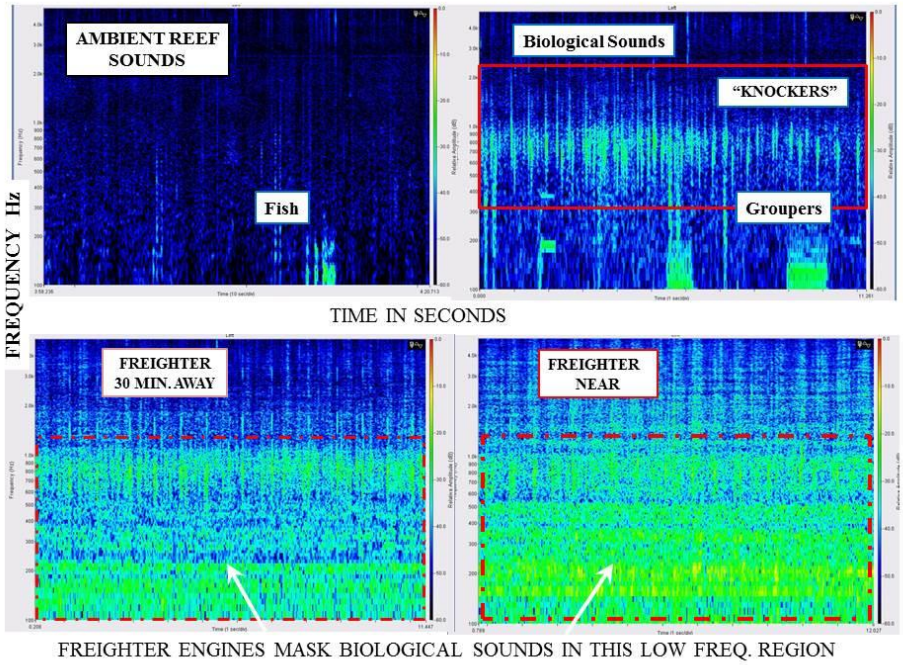

Figure 3. Horseshoe Reef sonogram depicting the same acoustic signals presented in Figure 2, revealing the greatest anthropogenic interference is from highly energetic sounds, engine and propeller noise below 600 Hz.

VI. Mitigation

Commented [12]: I assume there is lots more we can include in this section?

There are several measures that could be implemented to mitigate anthropogenic acoustic impacts. New technologies are available to reduce vessel noise making them less acoustically intrusive. As technology allows, use of alternative propeller design and propulsion systems such as diesel-electric hybrid, electric motors, LNG pumps, and rotor sails that are quieter than internal combustion engines can be employed. Ship generators are also a substantial source of underwater noise. Insulated or sound proofed ship hulls may be necessary in major shipping industries to further reduce acoustic impacts. When in port, vessels should connect to on-shore power systems when possible.

Commented [MT13]: Flettner rotor

Location and timing of when damaging sounds are generated can also be managed. Critical spawning and aggregation sites can be designated as off limits to vessels at night which is when spawning chorus

events typically occur. These sites can be remotely monitored with vessel tracking technologies currently in use allowing for violating vessels to be identified.

Commented [WL14]: Do we have any examples of where a "noise exclusion window" has been put in place to protect a spawning aggregation or spawning behavior? Would be good to cite if we do have one or more examples.

Sound from dredging, seismic, and construction activities should be restricted from time frames and locations of vital fishery spawning to reduce potential negative impacts. When avoidance is not possible, sound dampening measures, such as bubble curtains, should be used. Acoustic transects can be used to isolate and map specific sites based on sound production of fishery aggregations (Gilmore 1994, 1996, 2002; Luczkovich et al. 1999; Rountree et al. 2003). These maps can then be used to minimize sound impacts through marine spatial planning efforts.

VII. Data gaps and research needs

Commented [LH15]: Go through Popper and Hawkins 2019 for an overview of data gaps.

Commented [MT16]: Is this section intended to be a bulleted list? Its current format suggests it is.

There is little long term data on the effect of chronic, cumulative, anthropogenic sounds from watercraft and wind turbine generators on the behavior of invertebrates and fish, particularly at spawning sites (Hawkins and Popper 2016, 2017).

Subtle and long-term effects on behavior or physiology could result from persistent exposure to certain noise levels leading to an impact on the survival of fish populations (Jasny 1999; Hastings and Popper 2005). It is important to conduct integrated laboratory, behavioral, and physiological experiments under a variety of acoustic conditions, and coordinate these lab studies with field studies using the same organism. This is of critical importance as chronic sound has the potential to directly impact periodic spawning events at specific locations. These are periods and locations when and where biological acoustic fish behaviors are most important. Most fishes studied to date produce sounds associated with communication between individuals of the same species, including during low light courting and spawning events. This would likely be the most pervasive and influential impact of aquatic human generated sounds. Long-term acoustic listening stations should be deployed at spawning sites where significant human activities occur to determine if mitigation measures are needed. Identifying and mapping these critical areas to create management areas limiting human generated sound is also needed.

More information on the impacts and importance of sound to fish larvae and eggs, as well as invertebrates at all life stages, is needed.

Mining the tens of thousands of hours of long duration historical recording data made by various aquatic bioacoustic investigators whose literature contributes to this review should be conducted to further identify and characterize potential human acoustic interference.

Another important data gap is the need to improve our understanding of the effects of particle motion, and in standardizing the methodology for measuring particle motion in the field. To address these data gaps, Popper and Hawkins (2018) outline several recommendations.

Commented [MT17]: Such as?

Commented [WL18R17]: I think Marek is saying we should list them, and I agree.

VIII. Additional information

The Discovery of Sound in the Sea website, https://dosits.org/ introduces users to the science and uses of Sound in the Sea. There are several major sections on the site such as The Science of Sound in the Sea, People and Sound in the Sea, and Animals and Sound in the Sea. This page focuses on resources for decision makers.

Commented [LH19]: Can link to other webpages, reports, etc.

Commented [WL20R19]: Popper has a good web site for which we can include a link.

IX. Literature Cited

Commented [LH21]: This has not been checked yet.

Commented [WL22R21]: Lisa, one way to perhaps proceed is to separate Literature Cited from a Bibliography of other references which our readers may find useful, but which we didn't cite. I'd be willing to assist you in ferreting out which ones go where. Just let me know. I also can check my hard drive acoustic literature files against what we have included here, and then add any we missed to the Bibliography, if you want.

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FHOC Designations

American eel (*Anguilla rostrata*)

Though no threats to the functional health of the Sargasso Sea have been reported, it is a Fish Habitat of Concern for spawning adults and eggs because this is where reproduction for the panmictic population occurs exclusively. Sargassum seaweed is currently harvested in U.S. waters by trawling primarily by one company. The harvesting of sargassum began in 1976, but has only occurred in the Sargasso Sea since 1987. Since 1976, approximately 44,800 dry pounds of sargassum have been harvested, 33,500 pounds of which were from the Sargasso Sea (SAFMC 1998). It is unknown whether this harvest is having direct or indirect influences on American eel mortality. Harvesting sargassum is being eliminated in the south Atlantic EEZ and State waters by January 1, 2001 through a management plan adopted by the South Atlantic Fisheries Management Council (SAFMC 1998). The extent of eel bycatch in these operations is unknown.

The drift of leptocephalus larvae from the Sargasso Sea towards the Atlantic coast may be impacted by changes in the ocean currents. Such changes have been predicted to be due to climate change. The potential impact on the drift of larvae is unknown at this time, but the predicted weakening of the Gulf Stream may reduce larval transport to coastal and fresh waters. Currents, primary production, and potential influence of toxins transferred from the adults to the eggs influence the success of hatch, larval migration, feeding and growth.

Glass eel survival (growth, distribution and abundance) on the continental shelf is probably impacted by a variety of activities. Channel dredging, shoreline filling, and overboard spoil disposal are common throughout the Atlantic coast, but currently the effects are unknown. Additionally, these activities may damage American eel benthic habitat. However, the significance of this impact also remains unknown. Changes in salinity in embayments, as a result of dredging projects, could alter American eel distribution.

Elver and yellow eel abundance is probably also impacted by physical changes in the coastal and tributary habitats. Lost wetlands or access to wetlands and lost access to the upper reaches of tributaries have significantly decreased the availability of these important habitats with wetland loss estimated at 54% (Tiner 1984), and Atlantic coastal tributary access loss or restriction estimated at 84% (Busch et. al 1998).

Habitat factors are probably impacting the abundance and survival of yellow and silver eel. The nearshore, embayments, and tributaries provide important feeding and growth habitat. The availability of these habitats influences the density of the fish and may influence the determination of sex. Therefore, since females may be more common in lower density settings (Krueger and Oliveira 1999, Roncrati et al. 1997, Holmgren and Mosegaard 1996, Vladykov 1966, Liew 1982, Columbo and Rossi 1978), it is crucial that the quantity and quality of these habitats be protected and restored (including upstream access). The blockage or restriction to upstream migration caused by dams reduces or restricts the amount of available habitat to support eel distribution and growth, and therefore tributary headwaters are a particular Fish Habitat of Concern. Fish that succeeded to reach upstream areas may also face significant stresses during downstream migration. If eel have to pass through turbines, mortality rates range from 10 to 60 percent (J. McCleave, U. of Maine, Person. Com.) and the amount of injury is not well documented.

American lobster (*Homarus americanus*)

Scientists, managers, and fishermen are concerned about the habitat conditions for American lobster in southern New England waters where rising water temperature has combined with degraded water

quality to create conditions lethal to lobsters. Such a combination of environmental factors and events resulted in a massive die-off of lobster in western Long Island Sound in late 1999, with lesser events in later years. Continued elevated water temperatures, coupled with routine fall hypoxia and other water quality stress factors, have caused recruitment failure for the stock of lobster south of Cape Cod. North of Cape Cod, the same rise in water temperature has resulted in historically high reproduction and survival of young lobsters.

Other Fish Habitats of Concern include gravel, cobble, boulder, and embedded rock for young-of-year, juvenile, and adult life stages. Areas where these habitats are limited and in close proximity to offshore shoals are susceptible to various types of anthropogenic impact.

Atlantic croaker (*Micropogonias undulates*)
Estuaries serve as important nursery and spawning areas for Atlantic croaker. For juveniles in particular, this includes mud substrate with high detrital content. Many estuarine environments may have insufficient water quality to support Atlantic croaker habitat, due to land-based activities such as coastal development, pollution, chemical and nutrient discharges, and runoff. These activities can result in a reduction of dissolved oxygen and can create hypoxic or anoxic conditions.

Atlantic menhaden (*Brevoortia tyrannus*)
Atlantic menhaden have a wide geographic range encompassing variable physical and physicochemical habitat. For this reason, Fish Habitat of Concern designations are not recommended.

While not designated Fish Habitats of Concern, estuarine and riverine tidal areas along the Atlantic coast from Florida to Nova Scotia, especially the Chesapeake Bay, New England, and southeastern estuaries, serve as important habitat for juvenile and/or adult Atlantic menhaden. Within this wide geographic range, hydrographic and circulation features constrain population distribution (MDSG 2009). Adult menhaden distribution is bounded by the Gulf Stream Front on the seaward side and by water temperatures greater than 10°C (MDSG 2009). Adult Atlantic menhaden spawn in oceanic waters along the continental shelf, as well as in sounds and bays in the northern extent of their range (Judy and Lewis, 1983). Winds and tides transport larvae shoreward from the shelf (Checkley et al., 1988; Werner et al., 1999) toward nursery grounds in the subtidal estuaries. Larvae are between one and three months old, usually closer to two months, at first ingress into estuaries (Warlen et al., 2002; MDSG, 2009). After entering the estuary, larvae congregate in large concentrations near the upstream limits of the riverine tidal zone, where they metamorphose into juveniles (June and Chamberlin 1959, Houde 2011).

Atlantic striped bass (*Morone saxatilis*)
Striped bass are highly concentrated and most vulnerable in their riverine spawning areas and offshore wintering grounds. Therefore these two habitats are Fish Habitats of Concern for striped bass.

Striped bass spawn in freshwater or nearly freshwater of Atlantic Coast rivers and estuaries. Such sites provide the critical ecological function of reproduction; are sensitive to anthropogenic impacts such as dam emplacement, nutrient and sediment loading, and pollution; are susceptible to navigational dredging and other coastal development activities; and are relatively small in extent and extremely rare in comparison to the areal extent of other migratory striped bass habitats. They spawn above the tide in mid-February in Florida but in the St. Lawrence River they spawn in June or July. The bass spawn in turbid areas as far upstream as 320 km from the tidal zone (Hill, 1989). The tributaries of the

Commented [LH1]: Note I cut out a lot of info here and focused just on the spawning and wintering grounds.

Chesapeake Bay are the primary spawning areas for striped bass, but other major areas include the Hudson River, Delaware Bay and the Roanoke River. Spawning is triggered by increased water temperature (Shepherd, 2000). Spawning occurs between 10 and 23 degrees Celsius, but optimal temperature for spawning is between 17 and 19 degrees Celsius. No spawning occurs below 13 degrees Celsius or above 22 degrees Celsius (Bain, 1982). Spawning is characterized by brief excursions to the surface by females surrounded by males, accompanied by much splashing. Females release eggs in the water. This is where fertilization occurs (Raney, 1952).

A temperature range of 17-19 degrees Celsius is important for egg survival as well as for maintaining appropriate dissolved oxygen levels (Bain, 1982). Minimum water velocities of 30 cm/sec are needed to keep the eggs suspended, and fluctuations in the water velocity causes changes in the size of the oil globule surrounding the eggs (Albrecht, 1964). Without the buoyancy, the eggs sink to the bottom, where the sediment may smother them. It is possible for the eggs to hatch if the sediment is course and not sticky or muddy, but that survival is limited (Bayless, 1968). Eggs hatch from about 30 hours at 22 degrees Celsius to about 80 hours at 11 degrees Celsius (Hill, 1989).

Wintering grounds occur in the nearshore Atlantic Ocean from the Gulf of Maine south to at least Topsail Island, North Carolina. These habitats provide the critical ecological function of foraging and cover for adults most of the year; are sensitive to human-induced environmental degradation due to fishing activities, commercial navigation, offshore oil and gas exploration, and construction of offshore liquid natural gas (LNG) facilities; they are all coastal and subject to the aforementioned coastal development activities; and they are restricted to a relatively narrow band of nearshore ocean, although not as rare as spawning habitats and inlets.

Atlantic sturgeon (*Acipenser oxyrhincus*)

The Fish Habitats of Concern for Atlantic sturgeon are NOAA Fisheries' Critical Habitat designations. The designations can be found here: https://www.fisheries.noaa.gov/action/critical-habitat-designation-atlantic-sturgeon.

Commented [LH2]: OR do we not want to designate habitats since it has federal designations? OR do we want to add habitats with the new science that has come out (if this option – Wilson please include the new science).

Black drum (*Pogonia cromis*)

Black drum are habitat generalists, so no Fish Habitats of Concern are designated. At various life stages they can be found in the following habitats: tidal freshwater, estuarine emergent vegetated wetlands (flooded salt marshes, brackish marsh, and tidal creeks), estuarine scrub/shrub (mangrove fringe), submerged rooted vascular plants (seagrasses), oyster reefs and shell banks, unconsolidated bottom (soft sediments), ocean high salinity surf zones, and artificial reefs. The estuarine system as a whole serves as the species' primary nursery areas.

Cobia (*Rachycentron canadum*)

While cobia are habitat generalists, good water quality in high salinity sounds in South Carolina and Virginia where spawning aggregations occur and eggs and larvae develop is necessary. Fish Habitats of Concern should be designated for Port Royal Sound, St. Helena Sound, Beaufort, Barden's, Hatteras, and the mouth of the Chesapeake Bay, especially for the months of April through June, when extensive eggs and larvae have been documents (Lefebvre and Denson 2012). The timing of seasonal migrations and

spawning aggregations appear to be driven by water temperature, therefore interannual variation in the water temperature and climate change could affect the timing of spawning and recruitment from year-to-year in the future.

Along the Atlantic coast, there are three genetically distinct groups of cobia: 1) NC/SC offshore, 2) inshore SC (Port Royal Sound and St. Helena Sound), a 3) inshore VA (Darden et al. 2014, Perkinson et al. 2019).

Horseshoe crab (*Limulus polyphemus*)

The distribution of high quality spawning beaches, which are exposed to minimal human disturbance, presents a potential bottleneck to reproductive success for this species. Beach areas that provide spawning habitat are Fish Habitats of Concern for adult horseshoe crabs. Composition of suitable spawning beaches are sand having grain sizes that range from 0.4-1.1 mm and are well drained having a moisture content of 1.5-7.5% at 9.4 cm depth. Sand must have an oxygen content >4 mg/L. Sand temperature >13.5 °C and water temperature ≥ 15 °C are required. Minimum depth of sand is 1 cm, but a sand depth > 20 cm is optimal. Beach slope is shallow at 4.5-9.5%. Presence of sulfate (from marsh peat) and anaerobic conditions will deter use of beach Delaware Division of Fish and Wildlife's 16-foot bottom trawl survey data indicated that over 99% of juvenile horseshoe crabs (<160 mm prosomal width) were taken at salinities >5 (Michels, 1997). Larger juveniles and adults use deep water habitats to forage for food, but these are not considered Fish Habitats of Concern. Of these habitats, the beaches are the most critical (Shuster 1994). Optimal spawning beaches may be a limiting reproductive factor for the horseshoe crab population.

The densest concentrations of horseshoe crabs in New Jersey occur on small sandy beaches surrounded by salt marshes or bulkheaded areas (Loveland et al. 1996). The spawning beaches within Delaware Bay are critical habitat because they support the highest density of spawning horseshoe crabs along the US Atlantic Coast. Good spawning habitat is widely distributed throughout Maryland's Chesapeake and coastal bays, including tributaries. Horseshoe crabs are restricted to areas that exceed salinities of 7 (Maryland Department of Natural Resources 1998). Prime spawning beaches within the Delaware Bay consist of sand beaches between Maurice River and the Cape May Canal in New Jersey and between Bowers Beach and Lewes in Delaware (Shuster 1994). In South Carolina and Georgia, horseshoe crabs spawn in substantial numbers on a variety of substrates including sandy beaches, salt marshes, and coarse-grained oyster shell. These are known stopover locations for red knot. While viability of eggs deposited in salt marshes are slightly reduced compared the sandy beaches, horseshoe crabs apparently use these habitats for spawning frequently in SC (Pers. Comm. SCDNR; Kendrick et al. In Review).

Commented [MRK3]: Kendrick, M.R. et al. (In Review). Assessing the Viability of American Horseshoe Crab (Limulus polyphemus) Embryos in Salt Marsh and Sandy Beach Habitats.

Jonah crab (*Cancer borealis*)

More research is needed before designating Fish Habitats of Concern for Jonah crab.

Northern shrimp (*Pandalus borealis*)

Deep, muddy basins in nearshore waters (out to 10 miles) in the southern region of the Gulf of Maine act as cold water refuges for adult shrimp during periods when most water in the Gulf reaches lethal temperatures, and is therefore a Fish Habitat of Concern. Temperature serves as a habitat bottleneck for this species. Nearshore water provides habitat for larval and juveniles stages of northern shrimp.

Red drum (*Sciaenops ocellatus*)

Red drum Fish Habitats of Concern include inlets, channels, sounds, and outer bars due to their importance for red drum spawning activity.

A species' primary nursery areas are indisputably essential to its continuing existence. Primary nursery areas for red drum can be found throughout estuaries, usually in shallow waters of varying salinities that offer certain degree of protection. Such areas include coastal marshes, shallow tidal creeks, bays, tidal flats of varying substrate, tidal impoundments, and seagrass beds. Since red drum larvae and juveniles are ubiquitous in such environments, it is impossible to designate specific areas as deserving more protection than others. Moreover, these areas are not only primary nursery areas for red drum, but they fulfill the same role for numerous other resident and estuarine-dependent species of fish and invertebrates, especially other sciaenids. Similarly, subadult red drum habitat extends over a broad geographic range and adheres to the criteria that define HAPCs. Subadult red drum are found throughout tidal creeks and channels of southeastern estuaries, in backwater areas behind barrier islands and in the front beaches during certain times of the year. Therefore, the estuarine system as a whole, from the lower salinity reaches of rivers to the mouth of inlets, is vital to the continuing existence of this species.

While there is currently no supporting evidence to suggest a particular habitat type limits red drum populations, seagrass beds as especially important for newly settled individuals, and oyster reefs are especially important to red drum during the juvenile and sub-adult life stages. In fact, data from Georgia's Marine Sportfish Health Survey indicate over 80% of juvenile red drum are associated with shell habitats. Changes in water flow and conditions due to watershed activities may also limit recruitment of larvae at a local scale.

River herring: alewife (*Alosa aestivalis*) and blueback herring (*Alosa pseudoharengus*)

Fish Habitat of Concern

NOTE: Due to the dearth of information on Fish Habitat of Concern for alosine species, this information is applicable to American shad, hickory shad, alewife, and blueback herring combined. Information about one alosine species may be applicable to other alosine species and is offered for comparison purposes only. Certainly, more information should be obtained at individual FHOC for each of the four alosine species.

~~All habitats described in the FMP Amendment 2 (spawning adult, egg, larval, juvenile, sub-adult, and adult resident and migratory) are deemed essential to the sustainability of anadromous alosine stocks, as they presently exist (ASMFC 1999).~~ ~~Klauda et al. (1991b) concluded that the~~ River herring conform to a metapopulation paradigm (e.g., a group of spatially separated populations of the same species which interact at some level) with adults frequently returning to their natal rivers for spawning but with some limited straying occurring between rivers (Jones, 2006; ASMFC, 2009a). ~~c~~Critical life history stages for American shad, hickory shad, alewife, and blueback herring, are the egg, prolarva (yolk-sac or pre-feeding larva), post-larva (feeding larva), and early juvenile (through the first month after transformation) (Klauda et al. 1991b). Spawning grounds and nursery habitat where these critical life stages grow and mature broadly includes freshwater ponds, rivers, and tributaries. The substrate preferred for spawning varies greatly and can include gravel, detritus, and submerged aquatic vegetation. Blueback herring prefer swifter moving waters than alewives do (ASMFC, 2009a). Nursery areas include freshwater and semi-brackish waters. Access to these spawning and nursery habitats may be blocked or impeded by dams or other barriers. Juvenile alosines, which leave the coastal bays and estuaries prior to reaching adulthood, also use the nearshore Atlantic Ocean as a nursery area (ASMFC 1999).

Commented [KW4]: This sentence refers to EFH. Removing to focus on FHOC.

Commented [KW5]: This text and the blue sentence below comes from the RH 2013 ESA status determination document. I did not find updated habitat information in the 2019 review.

Commented [KW6]: Possibly include inlets which provide access to coastal bays and estuaries.
Inlets were included in Amendment 2 above

Tables (X & XX) contain environmental, temporal, and spatial values/factors that affect the distribution of alewife, ~~and~~ blueback herring, American shad and hickory shad. ~~Alosines spend the majority of their life cycle outside of state waters, and the Commission recognizes that all habitats used by these species are essential to their existence.~~

Habitat quantity

Thousands of kilometers of historic anadromous alosine habitat have been lost due to development of dams and other obstructions to migration. In the 19th century, organic pollution from factories created zones of hypoxia or anoxia near large cities (Burdick 1954; Talbot 1954; Chittenden 1969). Gradual loss of spawning and nursery habitat quantity and quality, and overharvesting are thought to be the major causative factors for population declines of American shad, hickory shad, alewife, and blueback herring (ASMFC 1999).

It is likely that American shad spawned in all rivers and tributaries throughout the species' range on the Atlantic coast prior to dam construction in this country (Colette and KleinMacPhee 2002). While precise estimates are not possible, it is speculated that at least 130 rivers supported historical runs; now there are fewer than 70 systems that support spawning. Individual spawning runs may have numbered in the hundreds of thousands. It is estimated that runs have been reduced to less than 10% of historic sizes. One recent estimate of river kilometers ~~lost to~~unavailable for spawning is 4.36 x 103 compared to the original extent of the runs. This is an increase in available habitat ~~over~~ as compared with estimates from earlier years, with losses estimated at 5.28 x 103 in 1898 and 4.49 x 103 in 1960. The increase in available habitat has largely been due to restoration efforts and enforcement of pollutant abatement laws (Limburg et al. 2003).

Some states have general characterizations of the degree of habitat loss, but few studies have actually quantified impacts in terms of the area of habitat lost or degraded (ASMFC 1999). It has been noted that dams built during the 1800's and early to mid-1900's on several major tributaries to the Chesapeake Bay have substantially reduced the amount of spawning habitat available to American shad (Atran et al. 1983; CEC 1988), and likely contributed to long-term stock declines (Mansueti and Kolb 1953). North Carolina characterized river herring habitat loss as "considerable" from wetland drainage, stream channelization, stream blockage, and oxygen-consuming stream effluent (NCDENR 2000). Sixteen state and cooperative river basin habitat plans provide greater local detail on American shad habitat and are available at http://www.asmfc.org/species/shad-river-herring.

Some attempts have been made to quantify existing or historical areas of anadromous alosine habitat, including spawning reaches. Most recently, the American shad benchmark assessed and compared the amount of currently available habitat for American shad in Atlantic Coast rivers to historic habitat availability (ASMFC 2020). See section 2.7.2 for a description of this analysis. Results are presented for individual systems in each system stock section (Section 3), and overall coastwide results are provided in section 4.4.2. ~~For example~~Previously, Maine estimated that the American shad habitat area in the Androscoggin River is 10,217,391 yd^2. In the Kennebec River, Maine, from Augusta to the lower dam in Madison, including the Sebasticook and Sandy rivers, and Seven Mile and Wesserunsett streams, there is an estimated 31,510,241 yd^2 of American shad habitat and 24,606 surface acres of river herring habitat. Lary (1999) identified an estimated 90,868 units (at 100 yd^2 each) of suitable habitat for American shad and 296,858 units (at 100 yd^2 each) for alewife between Jetty and the Hiram Dam along the Saco River, Maine. Above the Boshers Dam on the James River, Virginia, habitat availability was estimated in terms of the number of spawning fish that the main-stem area could support annually, which was estimated at 1,000,000 shad and 10,000,000 river herring (Weaver et al. 2003).

Commented [KW7]: Recommend including tables from Section II of each alosine species chapter.

They contain significant environmental, temporal, and spatial factors that affect the distribution of American shad, hickory shad, alewife, and blueback herring. Additional tables found on the included DVD contain confirmed, reported, suspected, or historical state habitat for American shad, hickory shad, alewife, and blueback herring.

Commented [KW8]: Does this belong in a description of FHOC? Again, seems like a reference to EFH not FHOC.

Commented [KW9]: Consider pasting in the table from the ASMFC RH/S webpage—possibly modified to include only the two columns showing the percent of historic riverine habitat for American shad that is currently unobstructed (http://www.asmfc.org/species/shad-river-herring)

Commented [KW10]: Citation:
ASMFC. 2020. 2020 American Shad Benchmark Stock Assessment and Peer Review Report. http://www.asmfc.org/uploads/file/5f999ba1AmShadBenchmarkStockAssessment_PeerReviewReport_2020_web.pdf

Commented [LH11]: Is it sq yds or just yds? This sentence had a 2 but the others don't.

Commented [KW12R11]: Should be squared. I checked the Diadromous doc and inserted the correct square below

Commented [KW13R11]: I was looking for a source for this sentence, there wasn't one listed in the Diadromous doc.

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Although many stock sizes of alosine species are decreasing or remain at historically low levels, some stock sizes are increasing. It has not been determined if adequate spawning, nursery, and adult habitat presently exist to sustain stocks at recovered levels (ASMFC 1999).

Habitat quality

Concern that the decline in anadromous alosine populations is related to habitat degradation has been alluded to in past evaluations of these stocks (Mansueti and Kolb 1953; Walburg and Nichols 1967). This degradation of alosine habitat is largely the result of human activities. However, it has not been possible to rigorously quantify the magnitude of degradation or its contribution to impacting populations (ASMFC 1999).

Of the habitats used by American shad, spawning habitat has been most affected. Loss due to water quality degradation is evident in the northeast Atlantic coast estuaries. In most alosine spawning and nursery areas, water quality problems have been gradual and poorly defined; it has not been possible to link those declines to changes in alosine stock size. In cases where there have been drastic declines in alosine stocks, such as in the Chesapeake Bay in Maryland, water quality problems have been implicated, but not conclusively demonstrated to have been the single or major causative factor (ASMFC 1999).

Toxic materials, such as heavy metals and various organic chemicals (i.e., insecticides, solvents, herbicides), occur in anadromous alosine spawning and nursery areas and are believed to be potentially harmful to aquatic life, but have been poorly monitored. Similarly, pollution in nearly all of the estuarine waters along the East Coast has certainly increased over the past 30 years, due to industrial, residential, and agricultural development in the watersheds (ASMFC 1999).

Recommend adding maps that show spawning habitat (pull from Diadromous fish doc).

Shad: American shad (*Alosa sapidissima*) and hickory shad (*Alosa mediocris*)

Recommend using the same text from River Herring section above for “alosine species”

Spot (*Leiostomus xanthurus*)

For larval spot, Fish Habitats of Concern include mesohaline/polyhaline SAV and brackish/saltwater marsh. Fish Habitats of Concern for juvenile and adult spot include mud and detrital substrates that have epifaunal and infauna.

Spot are strongly associated with the bottom as juveniles and adults and are seasonally dependent on estuaries. From Delaware to Florida, primary nursery habitat includes low salinity bays and tidal marsh creeks with mud and detrital bottoms. In the Chesapeake Bay and North Carolina, juveniles can also be found in eelgrass.

Spotted seatrout (*Cynoscion nebulosus*)

Submerged aquatic vegetation (SAV) and salt marsh, especially where SAV is not available, are Fish Habitats of Concern for spotted seatrout. Seagrass beds provide important habitat for both juvenile and adult spotted seatrout, but are in decline along much of the Atlantic coast. Spawning takes place on or near seagrass beds, as well as sandy banks, natural sand, shell reefs, near the mouths of inlets, and off

Commented [LH14]: Wilson to include citations.

the beach (Daniel 1988; Brown-Peterson et al. 2002). Environmental conditions in spawning areas may affect growth and mortality of egg and larvae, as sudden salinity reductions cause spotted seatrout eggs to sink, thus reducing dispersal and survival (Holt and Holt 2003).

Tautog (*Tautoga onitis*)

All structured habitats that are used by juvenile and adult tautog (e.g. outcrops, shells, reef, hard and soft corals, and sea whips), as well as inlets adjacent to estuaries serving as important refuge and spawning sites are Fish Habitats of Concern. SAV is a Fish Habitat of Concern for larvae and young-of-year.

Weakfish (*Cynoscion regalis*)

Commented [LH15]: Can Wilson refine based on unpublished data?

Important habitats for weakfish include nursery and spawning areas distributed along the coast from Maine through Florida. The principal spawning area is from North Carolina to Montauk, NY (Hogarth et al. 1995b), although extensive spawning and presence of juveniles has been observed in the bays and inlets of Georgia and South Carolina (pers. Comm, D. Whitaker, SCDNR).

Spawning sites include coastal bays, sounds, and the nearshore Atlantic Ocean. Nursery areas include the upper and lower portions of the rivers and their associated bays and estuaries. While disturbance to a nursery area will affect the overall coastal weakfish population it would be expected to have the greatest impact on the specific sub-population and the local fisheries that depend on it.
Egg and larval habitat include the nearshore waters as well as the bays, estuaries, and sounds to which they are transported by currents or in which they hatch.

Juvenile weakfish inhabit the deeper waters of bays, estuaries, and sounds, including their tributary rivers. They also use the nearshore Atlantic Ocean as a nursery area. In North Carolina and other states, they are associated with sand or sand/seagrass bottom. In Chesapeake and Delaware Bays, they migrate to the Atlantic Ocean by December.

Adult weakfish reside in both estuarine and nearshore Atlantic Ocean habitats. Warming of coastal waters in the spring keys migration inshore and northward from the wintering grounds to bays, estuaries and sounds. Larger fish move inshore first and tend to congregate in the northern part of the range. Catch data from commercial fisheries in Chesapeake and Delaware Bays and Pamlico Sound indicate that the larger fish are followed by smaller weakfish in summer. Shortly after their initial spring appearance, weakfish return to the larger bays and nearshore ocean to spawn. In northern areas, a greater portion of the adults spends the summer in the ocean rather than estuaries. Weakfish form aggregations and move offshore as temperatures decline in the fall. They move generally offshore and southward. The Continental Shelf from Chesapeake Bay to Cape Lookout, North Carolina, appears to be the major wintering ground. Winter trawl data indicate that most weakfish were caught between Ocracoke Inlet and Bodie Island, NC, at depths of 18 -–55 meters (59 – 180 feet). Some weakfish may remain in inshore waters from North Carolina southward.

The quality of weakfish habitats has been compromised largely by impacts resulting from human activities. It is generally assumed that weakfish habitats have undergone some degree of loss and degradation; however, few studies that quantify impacts in terms of the area of habitat lost or degraded.

Loss due to water quality degradation is evident in the northeast Atlantic coast estuaries. The New York Bight is one example of an area that has regularly received deposits of contaminated dredged material,

sewage sludge and industrial wastes. These deposits have contributed to oxygen depletion and the creation of large masses of anoxic waters during the summer months.

Some losses have likely occurred due to the intense coastal development that has occurred during the last several decades, although no quantification has been done. Losses have likely resulted from dredging and filling activities that have eliminated shallow water nursery habitat. Further functional losses have likely occurred due to water quality degradation resulting from point and non-point source discharges. Intensive conversion of coastal wetlands to agricultural use also is likely to have contributed to functional loss of weakfish nursery area habitat.

Other functional loss of riverine and estuarine areas may have resulted from changes in water discharge patterns resulting from withdrawals or flow regulation. Estuarine nursery areas for weakfish, as well as adult spawning and pre-spawning staging areas, may be affected by prolonged extreme conditions resulting from inland water management practices.

Power plant cooling facilities continue to impact weakfish populations. The EPA in recent rules regarding these facilities estimates that the number of total weakfish age 1 equivalents lost as a result of entrainment at all transition zone cooling water intake structures in the Delaware Bay is over 2.2 million individuals. Other threats stem from the continued alteration of freshwater flows and discharge patterns to spawning, nursery, and adult habitats in rivers and estuaries. Additional threats in the form of increased mortality resulting from placement of additional municipal water intakes in spawning and nursery areas will occur, although the impacts may be mitigated to some degree with proper screening.