Blue Crab FMP

Draft Blue Crab FMP Amendment 3 Public and Advisory Committee Review Results

DEPARTMENT OF ENVIRONMENTAL QUALITY

Marine Fisheries

NCMFC | Jason Rock and Corrin Flora | Nov. 15, 2019

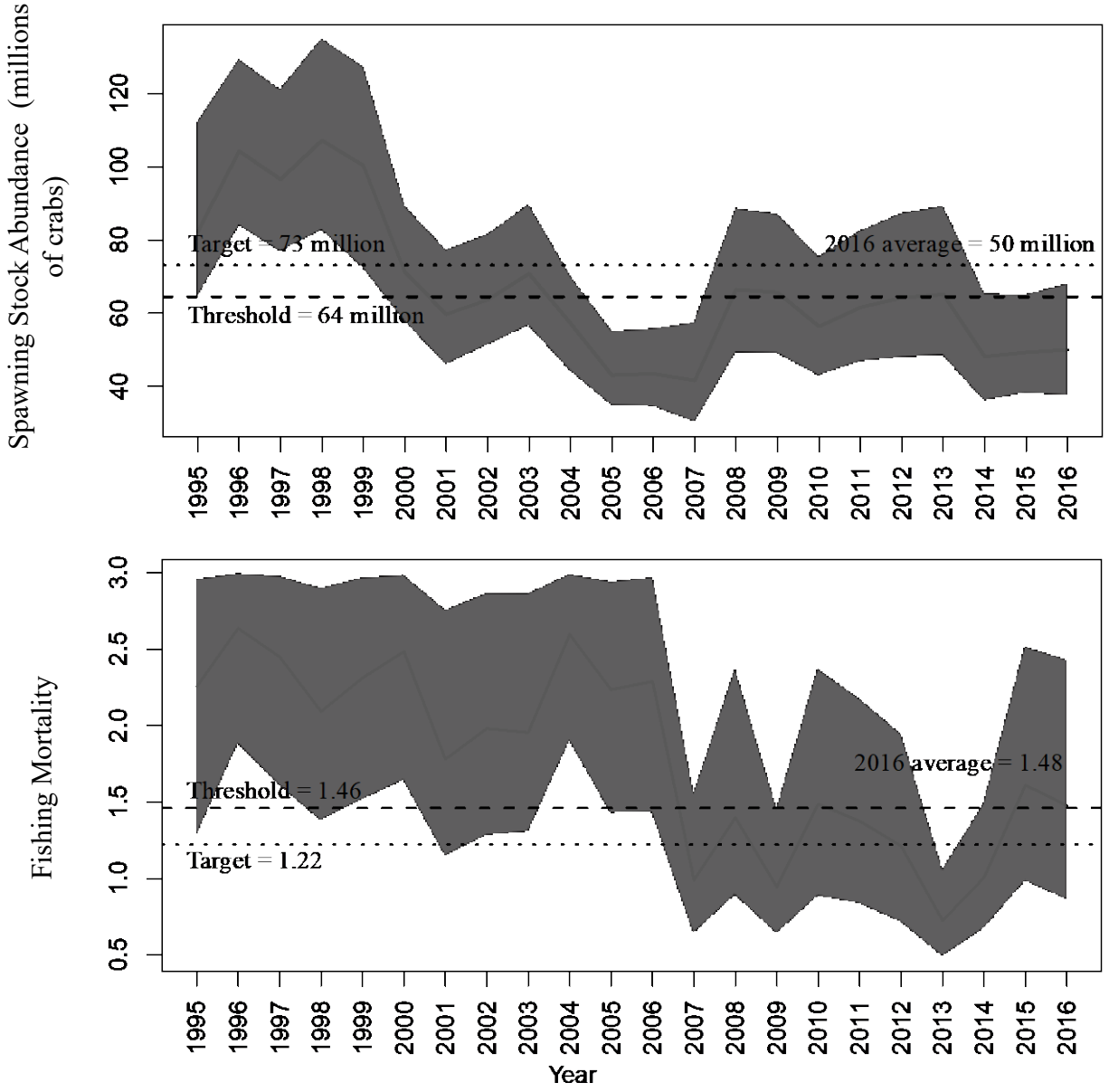
TIMELINE FOR AMENDMENT 3 TO THE BLUE CRAB FMP

DATE		MILESTONES
September 2017 – June 2018	1	Orient AC and Discuss Issues, Goal and Objectives
June 2018 – June 2019	2	Draft/Revise and Review Informational Sections and Issue Papers in the FMP and Establish NCDMF/AC Positions
August 2018	3	Present Timeline to NCMFC; Solicit NCMFC Input on Issues; NCMFC Approve Goal and Objectives
August 2019	4	Obtain NCMFC Approval for Review of FMP by Advisory Committee and Public
September - October 2019	5	Advisory Committee and Public Review of FMP
November 2019	6	NCMFC for Select Preferred Management Options
December 2019 – January 2020	7	Review of FMP by Department and Legislature
YOU ARE HERE → February 2020	8	Final FMP Approval by NCMFC
No Sooner than 48 hours for proclamation	9	Selected Management Measures Implemented by Proclamation

Issues

1. Achieving Sustainable Harvest
2. Non-quantifiable Management Measures
3. Water Quality
4. Crab Spawning Sanctuaries
5. Terrapin Excluder Devices
6. Bottom Disturbing Gear

Achieving Sustainable Harvest



Achieving Sustainable Harvest

Year	Estimated Harvest Reduction (%)						
	Mature Female						
	6.75" Maximum Size	6.5" Maximum Size	5" Minimum Size	5.25" Minimum Size	Prohibit Immature Female Harvest	Season Closure – March	Reduce Cull Tolerance to Zero
2011	1.6	4.2	1.2	3.9	1.2	4.5	4.5
2012	2.5	6.0	0.9	2.9	1.2	3.0	5.3
2013	2.7	6.4	1.4	3.8	1.3	0.9	2.3
2014	3.2	6.7	0.7	1.8	1.7	0.5	2.8
2015	2.4	5.4	0.3	1.6	0.9	0.9	3.8
2016	**1.5**	**4.3**	**0.9**	**4.1**	**0.5**	**5.0**	**3.6**
Average	2.3	5.4	0.9	3.0	1.1	2.5	3.8

Achieving Sustainable Harvest

Proposed Adaptive Management Framework for Amendment 3:

1. Update the stock assessment at least once in between full reviews of the FMP, timing at the discretion of the division
2. If the stock is overfished and/or overfishing is occurring, then management measures shall be adjusted using the director's proclamation authority
3. Any quantifiable management measure, including those not explored in this paper, with the ability to achieve sustainable harvest (as defined in the stock assessment), either on its own or in combination, may be considered
4. Use of the director's proclamation authority for adaptive management is contingent on:
    a. consultation with Northern, Southern, and Shellfish/Crustacean advisory committees
    b. approval by the Marine Fisheries Commission
5. If the stock is not overfished and overfishing is not occurring, then current management measures shall remain in place until a new benchmark stock assessment and the next scheduled review of the FMP is completed

Upon evaluation by the division, if a management measure adopted to achieve sustainable harvest (either through Amendment 3 or a subsequent Revision) is not working as intended, then it may be revisited and either: 1) revised or 2) removed and replaced as needed provided it conforms to steps 3 and 4 above.

Achieving Sustainable Harvest

Northern AC

- Support Blue Crab AC recommendation
- Support NCDMF recommendation for adaptive management framework
- **3.1% harvest reduction (50%-67% probability of success)**

Southern AC

- North of Hwy 58 Bridge: Dec.-Jan. closure
- South of Hwy 58 Bridge: Jan. closure
- 5-inch mature female minimum size limit
- **Maintain 5 percent cull tolerance**
- **Prohibit harvest of immature female hard crabs**
- Leave adaptive management decision to MFC
- **4.9% harvest reduction (67%-90% probability of success)**

Achieving Sustainable Harvest

Shellfish/Crustacean AC

- Table FMP process until the stock assessment is updated with data through 2019 to see the effects of the 2016 regulations

- Support consideration of habitat as part of the overall strategy for management of the blue crab fishery

Habitat and Water Quality AC

No position

Achieving Sustainable Harvest

Online Questionnaire

- Mature female size limit (67%)
- Limit harvest of immature females (67%)

Public Comment

March closure period would be devastating

- Prices are high
- When crabbers stock up Jimmie crabs for peeler bait

Achieving Sustainable Harvest

Blue Crab AC

- North of the Highway 58 Bridge: Jan. 1 through Jan. 31 closed season, a 6.75” mature female maximum size limit, and **prohibit immature female harvest**
- South of the Highway 58 Bridge: March 1 through March 15 closed season and **prohibit immature female harvest**
- **3.1% harvest reduction (50%-67% probability of success)**
- **Maintain 5% cull tolerance established in 2016 Revision**
- Adopt adaptive management framework including ability to relax regulations if assessment update shows the stock is not overfished and not overfishing
- Update stock assessment once 2019 data is available

Achieving Sustainable Harvest

NCDMF

- **Recommend maintaining 5% cull tolerance established in 2016 Revision**
- Recommend adopting updated adaptive management framework
- Recommend a minimum harvest reduction of 2.2% to meet the spawning stock biomass threshold within 10 years (50% probability of success)
- Encourage a reduction of at least 5.9% to meet fishing mortality target (90% probability of success) and to include:
  - 5-inch mature female minimum size limit
  - **Prohibit immature female hard crab harvest**
  - Continuous closure period with at least a 4.6% harvest reduction

Achieving Sustainable Harvest

NCMFC

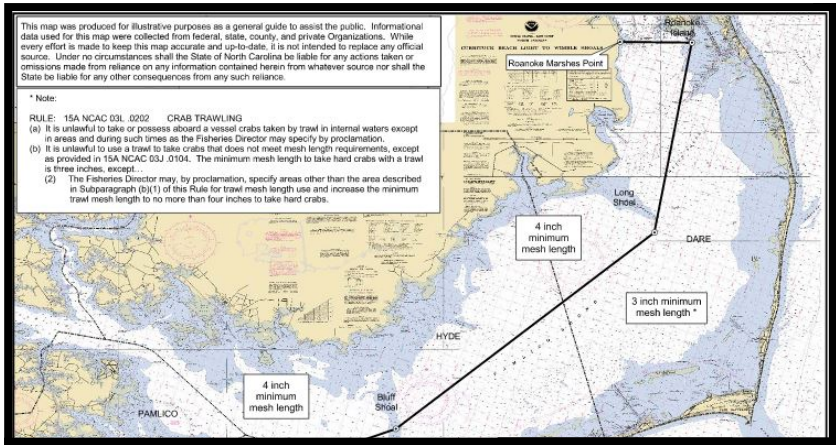
Motion: *Support the Division of Marine Fisheries recommendation for a minimum harvest reduction of 2.2% to achieve a sustainable harvest within ten years and end overfishing within two years in the blue crab fishery.*

Motion: *Accept the Blue Crab Advisory Committee recommendation for achieving sustainable harvest and ending overfishing.*

Specific management measures selected were:

- North of the Highway 58 Bridge:
  - January 1 through January 31 closed season
  - 6.75-inch maximum size limit for mature females
  - Prohibit the harvest of immature females
- South of the Highway 58 Bridge
  - March 1 through March 15 closed season
  - Prohibit the harvest of immature females
- Season closures replace current pot closure period and remain closed for entire period
- Maintain 5% cull tolerance established in 2016 Revision to Amendment 2
- Revised adaptive management framework
- Update stock assessment once 2019 data is available

Non-quantifiable Management Measures



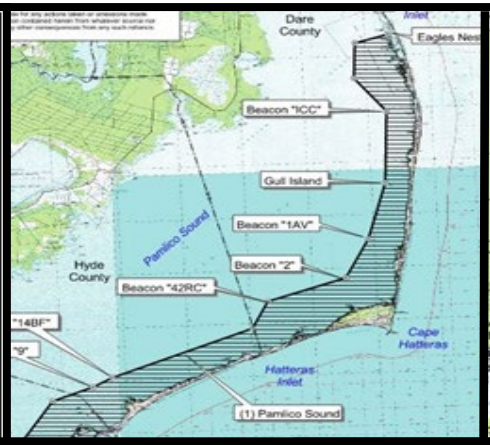
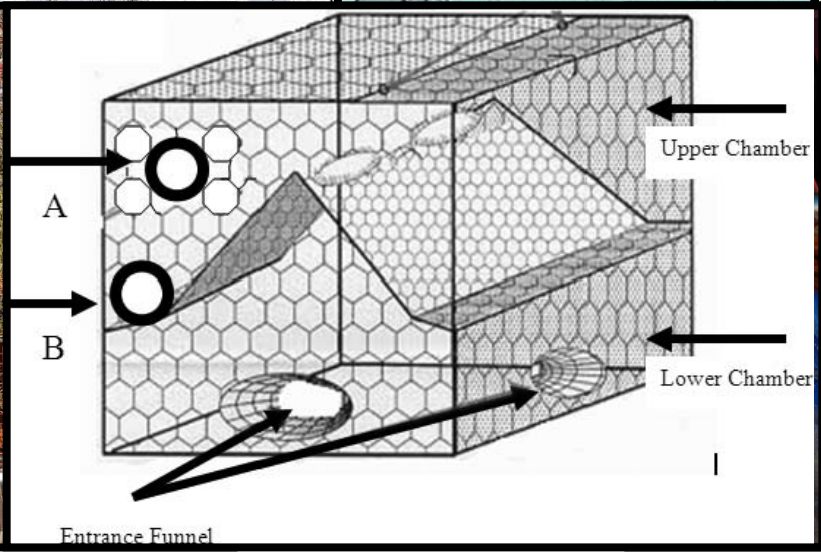



Photo by Jessica Lee



Non-quantifiable Management Measures

Management Measure	Sub-Option
1) Increase Cull Ring Size	a) Increase cull ring size to 2 3/8 inches b) Increase cull ring size to 2 7/16 inches
2) Number of Cull Rings	**a) Increase to 3 per pot (2016 Revision)** b) Increase to 4 per pot c) Decrease to 2 per pot
3) Placement of Cull Rings	**a) Require one cull ring in modified position (2016 Revision)** b) Require two cull rings in modified position
4) Remove Cull Ring Exemptions	a) Remove exemption for Newport River b) Remove exemption for Pamlico Sound c) Remove exemptions for Newport River and Pamlico Sound and prohibit designation of exempt areas in the future d) Re-establish proclamation authority for exemptions in Newport River and Pamlico Sound with specific criteria for use
5) Require Degradable Panels in Pots	N/A
6) Increase Crab Trawl Mesh Size to 4-inches Statewide	N/A
7) Limit Harvest of Sponge Crabs	**a) Prohibit dark sponge crab harvest from April 1 - April 30 (2016 Revision)** b) Prohibit harvest of all sponge crabs from Jan. 1 - May 31 c) Prohibit harvest of all sponge crabs year-round
8) Peeler/Soft Crab Minimum Size Limit	a) Establish 3-inch minimum size limit b) Establish 3 1/4-inch minimum size limit
9) Pot Limit	N/A
10) Fishing Time Restrictions	N/A

Non-quantifiable Management Measures

Northern AC

Support Blue Crab AC recommendation

Southern AC

- Support Blue Crab AC recommendation regarding number and placement of cull rings
- Support NCDMF recommendation to remove the cull ring exemptions for Newport River and eastern Pamlico Sound
- **Support maintaining the prohibition of dark sponge crab harvest during the month of April**

Non-quantifiable Management Measures

Shellfish/Crustacean AC

No position

Habitat and Water Quality

No position

Online Questionnaire

- Limit the harvest of sponge crabs (100%)
- Minimum size limit for soft and peeler crabs (61%)
- Pot limit (61%)

Non-quantifiable Management Measures

Blue Crab AC

Leave in existing rules implemented in 2016 and do not adopt anything else at this time. Except with 2 options on cull rings: 1) 2 cull rings in proper corner placement or **2) keeping the 3 cull rings with 1 in proper placement**.

Non-quantifiable Management Measures

NCDMF

- **Maintain minimum of 3 cull rings per pot**
- 2 cull rings placed within one full mesh of the corner and the apron on opposite outside panels in the upper chamber
- Remove cull ring exemptions for Newport River and eastern Pamlico Sound and prohibit designation of exempt areas in the future
- Prohibit harvest of sponge crabs year-round
- Establish a 3-inch minimum size limit for peeler and soft crabs at point of harvest

Non-quantifiable Management Measures

NCMFC

***Motion**: Leave in the existing rules established in 2016 and add option 4C.*

Specific management measures selected were:

- Increase number of cull rings in pots to 3 (established in 2016 Revision)
- Require one cull ring to be placed within one full mesh of the corner and the apron in the upper chamber of the pot (established in 2016 Revision)
- Prohibit harvest of dark sponge crabs from April 1 through April 30 (established in 2016 Revision)
- Remove cull ring exemptions in the Newport River and eastern Pamlico Sound

Water Quality

Water Quality

Northern AC

Support Blue Crab AC recommendation to support these strategies

Southern AC

Support NCDMF and Blue Crab AC recommendation to support these strategies

Shellfish/Crustacean AC

No position

Water Quality

Habitat and Water Quality AC

Recommend accepting the water quality recommendation from the Blue Crab AC and adding the Habitat and Water Quality AC to the reporting groups

Online Questionnaire

Support recommendations to address water quality concerns (89%)

Water Quality

Blue Crab AC

- Support all management options in this paper
- Support making the highest priority option four tasking the CHPP steering committee to what is suggested here and follow up with each of the other recommendations as that step is justified
- Have the habitat staff report back to the Shellfish/Crustacean AC with progress

Water Quality

NCDMF

- Support all management options in this paper
- Recommend option four as the highest priority
- Have staff report back to the Habitat and Water Quality and Shellfish/Crustacean ACs with progress

Water Quality

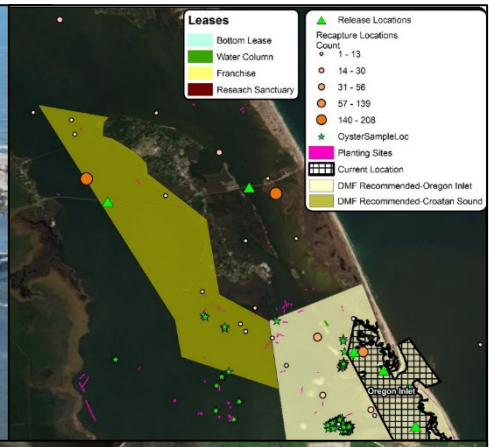
NCMFC

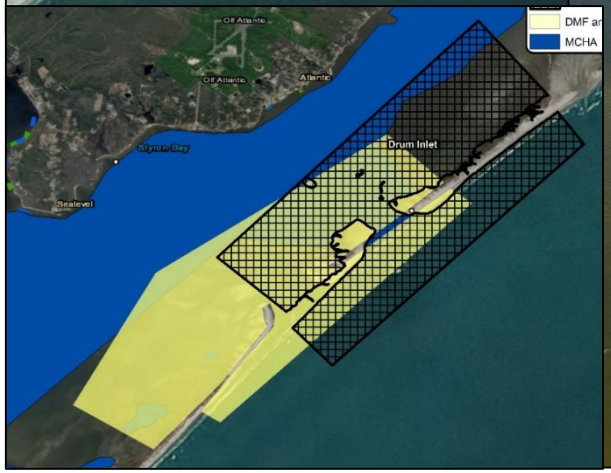
***Motion**: Accept the Division of Marine Fisheries water quality recommendations.*

Specific management measures selected were:

- Highlight problem areas and advise other regulatory agencies
- Push to create an interagency workgroup
- Support the Clean Water Act
- Task the CHPP Steering Committee to prioritize blue crab water quality impacts
- Send letters to other state agencies sharing concerns about water quality and Best Management Practices
- Invite other agencies to future MFC meetings to present their efforts to address water quality
- Initiate public outreach on how to report crab and fish kills
- Have division staff regularly provide progress reports to the Habitat and Water Quality and Shellfish/Crustacean advisory committees

Crab Spawning Sanctuaries





Crab Spawning Sanctuaries

Northern AC

- Split consensus on whether to expand or keep boundaries for existing spawning sanctuaries
- Support NCDMF and Blue Crab AC recommendation to move Drum Inlet spawning sanctuary
- Support Blue Crab AC recommendation for southern spawning sanctuary boundaries (excluding Cape Fear River)
- Support NCDMF recommended boundary for Cape Fear River spawning sanctuary
- March 1 – Oct. 31 closure for spawning sanctuaries south of Hwy 58 Bridge
- Do not support a spawning sanctuary (migration corridor in Croatan Sound)

Crab Spawning Sanctuaries

Southern AC

Support Blue Crab AC recommendation

Shellfish/Crustacean AC

No position

Crab Spawning Sanctuaries

Habitat and Water Quality AC

- Recommend keeping Oregon, Hatteras, and Ocracoke spawning sanctuary boundaries the same
- Support NCDMF and Blue Crab AC recommendation to move Drum Inlet spawning sanctuary
- Support Blue Crab AC recommendation for southern spawning sanctuary boundaries (excluding Cape Fear River)
- Support NCDMF recommended boundary for Cape Fear River spawning sanctuary
- March 1 – Oct. 31 closure for spawning sanctuaries south of Hwy 58 Bridge
- Do not support a spawning sanctuary (migration corridor in Croatan Sound)

Crab Spawning Sanctuaries

Online Questionnaire

- Establish new crab spawning sanctuaries at all inlets without a crab spawning sanctuary (61%)
- Establish a crab spawning sanctuary to serve as a migration corridor in Croatan Sound (56%)

Blue Crab AC Recommendation

- Keep Oregon, Hatteras, and Ocracoke the same and change Drum and Barden to proposed boundaries.
- Add spawning sanctuaries from Beaufort through Tubbs inlets using AC recommended boundaries with a closure period of March 1 – Oct. 31 with same restrictions as existing sanctuaries

Crab Spawning Sanctuaries

NCDMF

- Expand boundaries as presented for Oregon, Hatteras, Ocracoke, and Barden inlets
- Move boundary for Drum Inlet crab spawning sanctuary as presented
- Concur with Blue Crab AC recommendations Beaufort, Bogue, Bear, Browns, New River, Topsail, Rich, Mason, Masonboro, Carolina Beach, Shallotte, Lockwoods Folly, and Tubbs inlets
- Use NCDMF recommended boundary for Cape Fear River crab spawning sanctuary
- Establish a crab spawning sanctuary to serve as a migration corridor on the east side of Croatan Sound as presented in conjunction with expanding Oregon Inlet spawning sanctuary
- Close Croatan Sound spawning sanctuary from May 16 – July 15 with the same restrictions as existing sanctuaries

Crab Spawning Sanctuaries

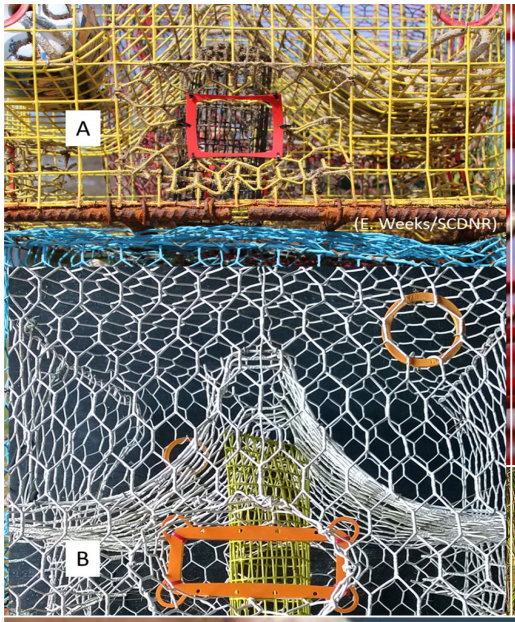
NCMFC

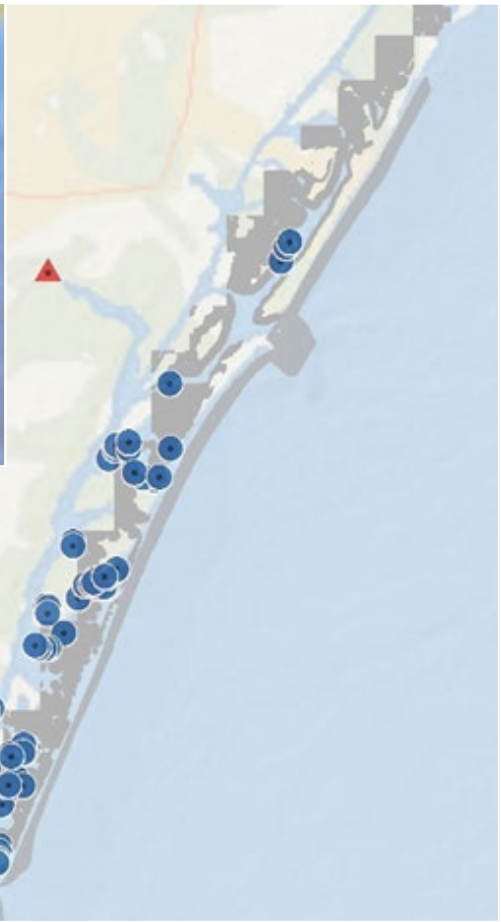
***Motion**: Accept the Blue Crab Advisory Committee recommendation for spawning sanctuaries, with the addition of using the Division of Marine Fisheries recommendation for the Cape Fear River Inlet crab spawning sanctuary.*

Specific management measures selected were:

- Modify the boundaries of the existing Drum Inlet and Barden Inlet sanctuaries
- Add spawning sanctuaries from Beaufort Inlet through Tubbs Inlet using Blue Crab AC recommended boundaries, except use the DMF recommended boundary for the Cape Fear River spawning sanctuary
- New sanctuaries will be closed from March 1 through October 31 with the same restrictions as existing sanctuaries

Terrapin Excluder Devices





Appendix 4.5: Establish A Framework To Implement The Use Of Terrapin Excluder Devices In Crab Pots

Criteria 1

- The following terrapin excluder devices shall be considered approved for use in DTMAs:
  - the pre-made plastic shell width limiting “SC design” measuring 5.1-6.4 x 7.5 cm (2-2.5 x 3.1 in.)
  - any pre-made plastic shell height limiting excluder devices with an internal opening no larger than 4 x 16 cm (1.6 x 6.3 in.) height by width
  - any shell height limiting excluders made from at least 10-gauge galvanized wire and hog rings with an internal opening no larger than 4 x 16 cm (1.6 x 6.3 in.) height by width
- A diamondback terrapin bycatch reduction workgroup of fisherman, academic researchers, and managers will be created.
- Additional or alternative terrapin excluder devices or modified pot designs recommended through the workgroup may be approved by NCDMF, in consultation with the Shellfish/Crustacean Advisory Committee, provided they have been shown to reduce impacts to blue crab catch or cost to fisherman and maintain the level of diamondback terrapin protection offered by the terrapin excluder devices initially approved and listed above.

Appendix 4.5: Establish A Framework To Implement The Use Of Terrapin Excluder Devices In Crab Pots

Criteria 2

- As peak captures of diamondback terrapins in crab pots occur in early spring as individuals emerge and become active, it is important to account for annual variably in spring temperature and have terrapin excluder devices employed before diamondback terrapins become active.
- Based on NCDMF interactions and research conducted in North Carolina, terrapin excluder devices shall be used in designated DTMAs from March 1 through October 31 to cover the entirety of the potential diamondback terrapin active season to limit diamondback terrapin bycatch.
- Both commercial and recreational crab pots would be required to use terrapin excluder devices when fishing in DTMA's during the diamondback terrapin active season.

Criteria 3

- Based on available data, areas both less than 250 m (820 feet) from any shoreline and less than 3 m (9.8 feet) deep at low tide shall be generally identified as areas of potential overlap between diamondback terrapins and the crab pot fishery.
- These criteria may be revised as additional research is completed.

Appendix 4.5: Establish A Framework To Implement The Use Of Terrapin Excluder Devices In Crab Pots

Criteria 4

Diamondback terrapin presence and overlap with the crab pot interaction zone shall be verified using any of the following: data from the NCDMF, NC National Heritage Program, other agencies, universities, and peer-reviewed published literature.

Criteria 5

- Boundaries of DTMAs shall be drawn to incorporate a significant portion of the potential interaction zone containing verified population(s) of diamondback terrapins and to minimize the inclusion of areas not identified in the potential interaction zone.
- Boundaries of existing natural or conservation areas may be used as DTMA boundaries to simplify enforcement and support the conservation goals of these areas.

Appendix 4.5: Establish A Framework To Implement The Use Of Terrapin Excluder Devices In Crab Pots

Criteria 6

The division shall produce an information paper (with the information outlined above), present the information to the appropriate regional advisory committee for their input, inform the public of the proposed DTMA via a press release, hold a 30-day public comment period, and contact local crab fishermen and diamondback terrapin researchers for their comment.

Criteria 7

The division will issue a proclamation and mark the boundaries of the DTMA at least one month prior to its effective date.

Appendix 4.5: Establish A Framework To Implement The Use Of Terrapin Excluder Devices In Crab Pots

Additional Discussion:

- Targeted approach improves localized protection of diamondback terrapins and minimizes impacts to the crab fishery
- Uses best available scientific data and allows for new data to be incorporated in the future
- Minimizes inclusion of areas too deep or far from shore
- Addressing this issue may improve fishery ratings from groups like Seafood Watch and aid in sustainability certifications from groups like the Marine Stewardship Council

Terrapin Excluder Devices

Northern AC

Support NCDMF recommendation to use these criteria

Southern AC

Support NCDMF recommendation to use these criteria

Shellfish/Crustacean AC

No position

Habitat and Water Quality

No position

Terrapin Excluder Devices

Online Questionnaire

Support criteria for designating Diamondback Terrapin Management Areas (59%)

Blue Crab AC Recommendation

Use science on locally specific pot funnel design to reduce terrapins and identify individual creeks with terrapin population hot spots that would be closed to potting.

NCDMF

Use the criteria as outlined in this paper for the establishment of Diamondback Terrapin Management Areas (DTMAs)

Terrapin Excluder Devices

NCMFC

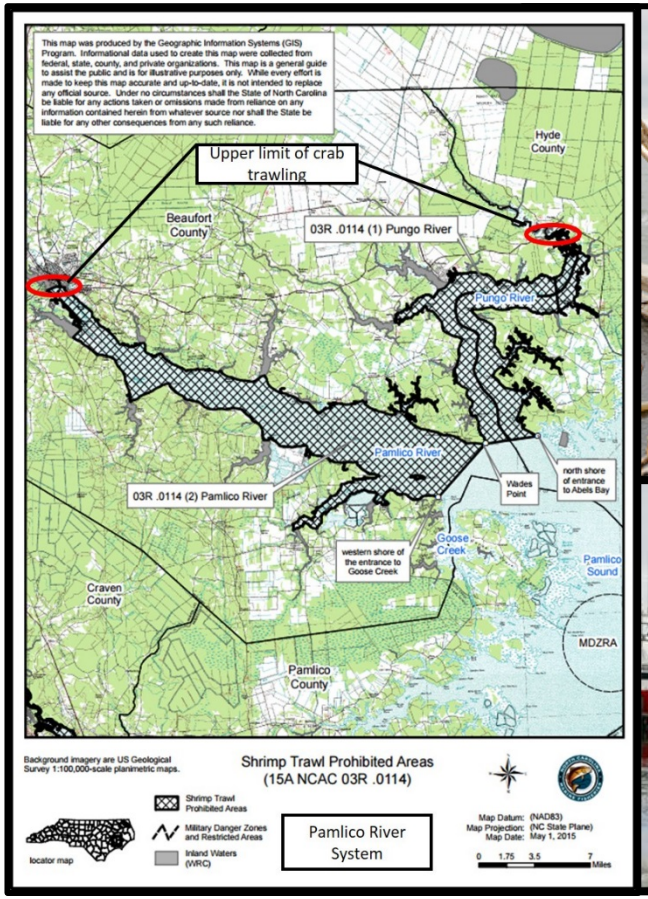
***Motion**: Use science on locally specific pot funnel design to reduce terrapin interactions and identify individual areas with terrapin hotspots that would be closed to potting unless an excluder is used.*

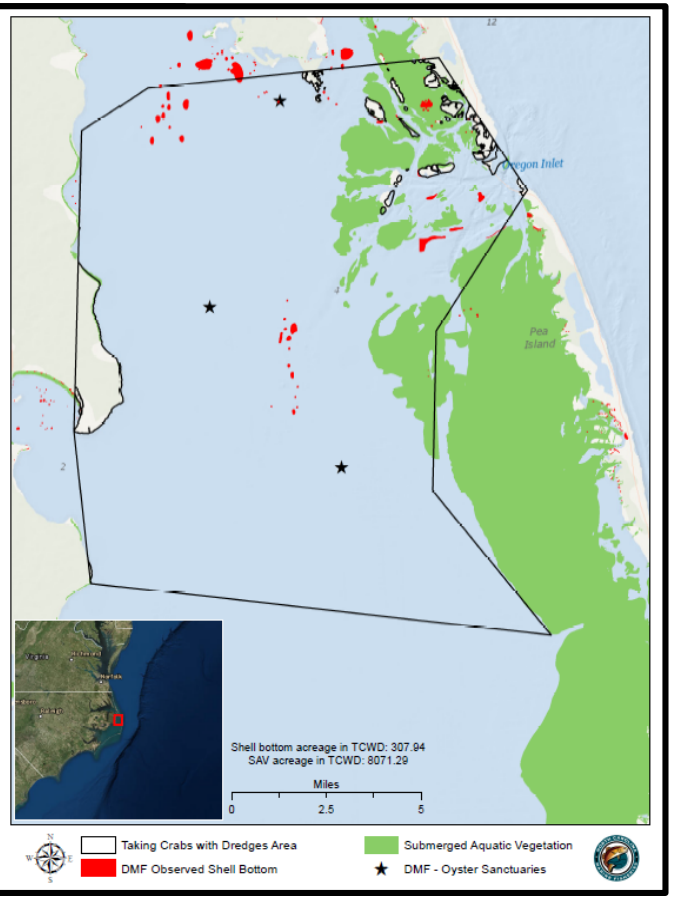
Specific management measures selected were:

- Research the effectiveness of pot funnel design modifications in reducing diamondback terrapin bycatch
- Identify areas where pots should be fished with a terrapin excluder device

NOTE: Proclamation authority for requiring terrapin excluder devices in crab pots is contingent upon development of criteria to guide that process and consultation with the Shellfish/Crustacean AC, which occurred on October 1, 2019. Proclamation authority cannot be used until the MFC approves these criteria.

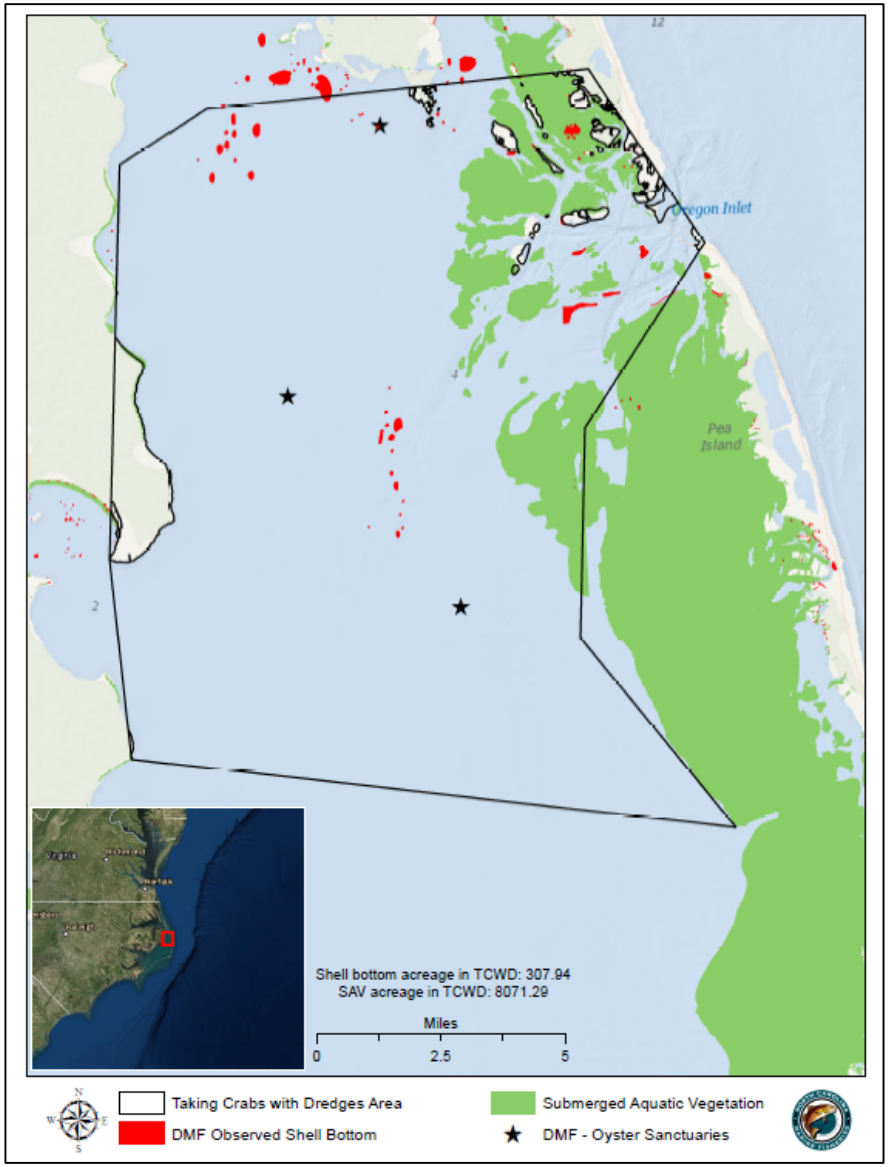
Bottom Disturbing Gear



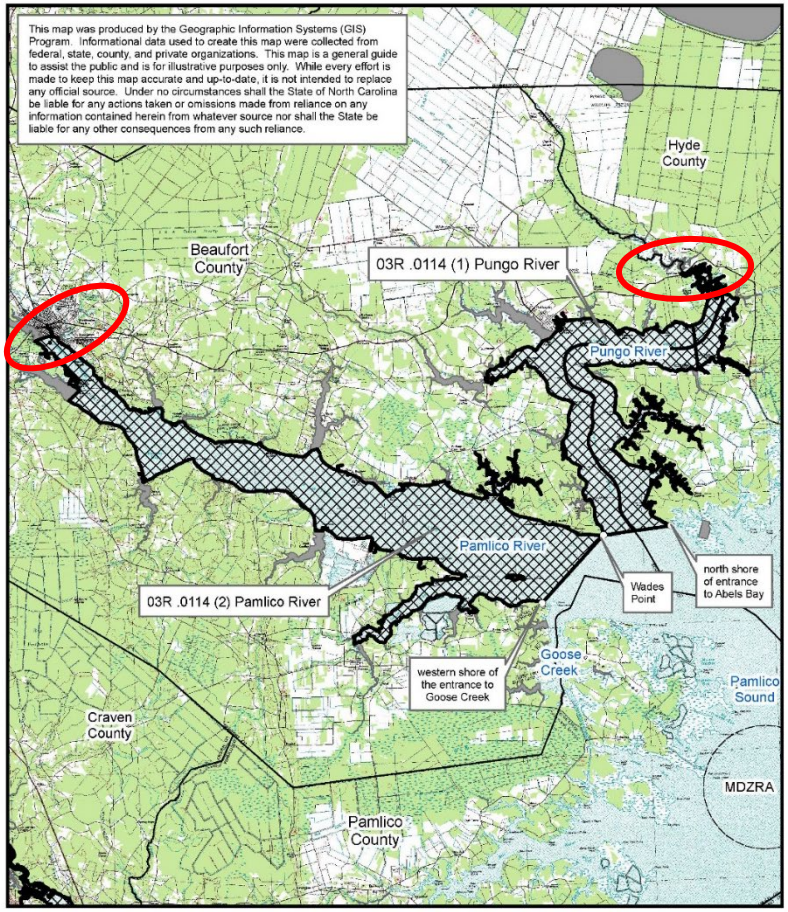


Appendix 4.6: Bottom Disturbing Gear In The Blue Crab Fishery

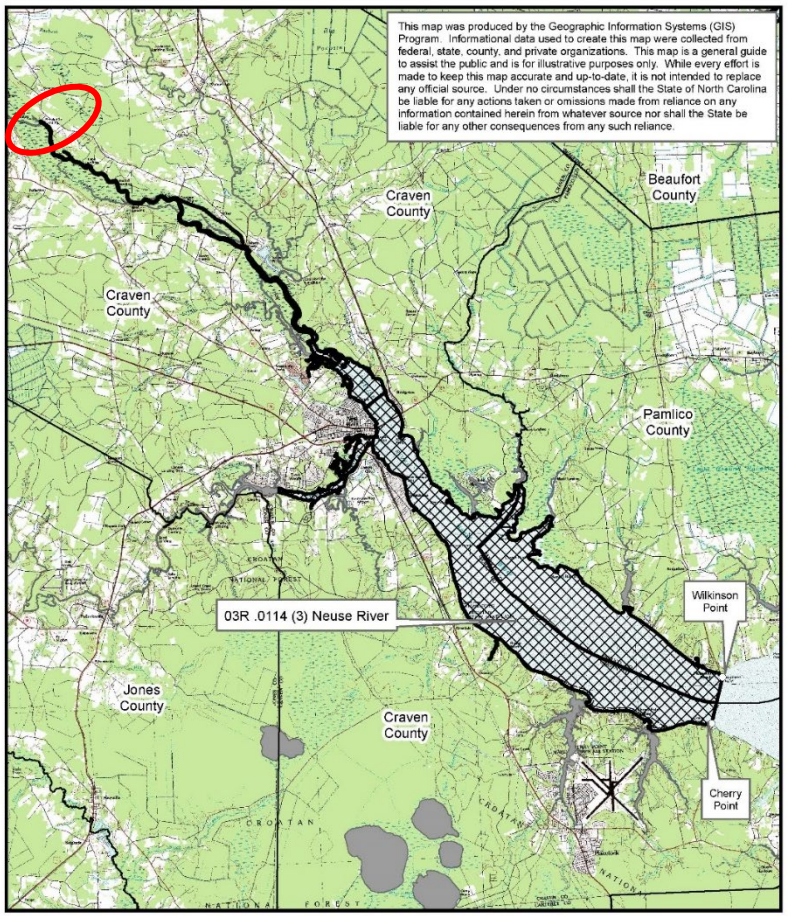
- Crab dredges limited to northern Pamlico Sound
- Open Jan. 1 – March 1
- Currently closed as part of 2016 Revision to Amendment 2
- Incidental harvest while oyster dredging is still permitted
- Oyster dredge trip limit allows targeted crab dredging outside of designated crab dredge area
- Less than 0.1% of entire blue crab fishery by landings and ex-vessel value



Appendix 4.6: Bottom Disturbing Gear In The Blue Crab Fishery



Pamlico and Pungo rivers



Neuse River

Bottom Disturbing Gear

Northern AC

- Support NCDMF recommendation to prohibit the taking of crabs with crab dredges
- Do not support reducing bycatch limit for oyster dredges until landings are examined
- No consensus on support of NCDMF recommendation to prohibit the use of crab trawls where shrimp trawls are already prohibited in the Pamlico, Pungo, and Neuse rivers

Southern AC

Support Blue Crab AC recommendation to not adopt any of the proposed measures

Bottom Disturbing Gear

Shellfish/Crustacean AC

No position

Habitat and Water Quality AC

- Recommend accepting NCDMF recommendation to prohibit taking of crabs with crab dredges
- Recommend accepting NCDMF recommendation to reduce the bycatch limit from oyster dredges to 10% of the total weight of the crab and oyster catch or 100 pounds, whichever is less
- Do not recommend accepting NCDMF recommendation to prohibit the use of crab trawls where shrimp trawls are already prohibited in the Pamlico, Pungo, and Neuse rivers

Bottom Disturbing Gear

Online Questionnaire

- Prohibit taking of crabs with crab dredges and oyster dredges (67%)
- Reduce the bycatch limit of crabs from oyster dredges to 10% of the total weight of the combined oyster and crab catch or 100 pounds, whichever is less (78%)
- Prohibit the use of crab trawls statewide (53%)

Blue Crab AC Recommendation

Not adopt any of the recommended management options on crab dredge and leave crab trawl lines as is

Bottom Disturbing Gear

NCDMF

- Prohibit taking of crabs with crab dredges
- Reduce the bycatch limit from oyster dredges to 10% of the total weight of the combined oyster and crab catch or 100 pounds, whichever is less
- Prohibit the use of crab trawls where shrimp trawls are already prohibited in the Pamlico, Pungo, and Neuse rivers

Bottom Disturbing Gear

NCMFC

***Motion**: Accept the Division of Marine Fisheries recommendation regarding crab dredging (option 1A).*

***Motion**: Accept option 1D regarding oyster dredging.*

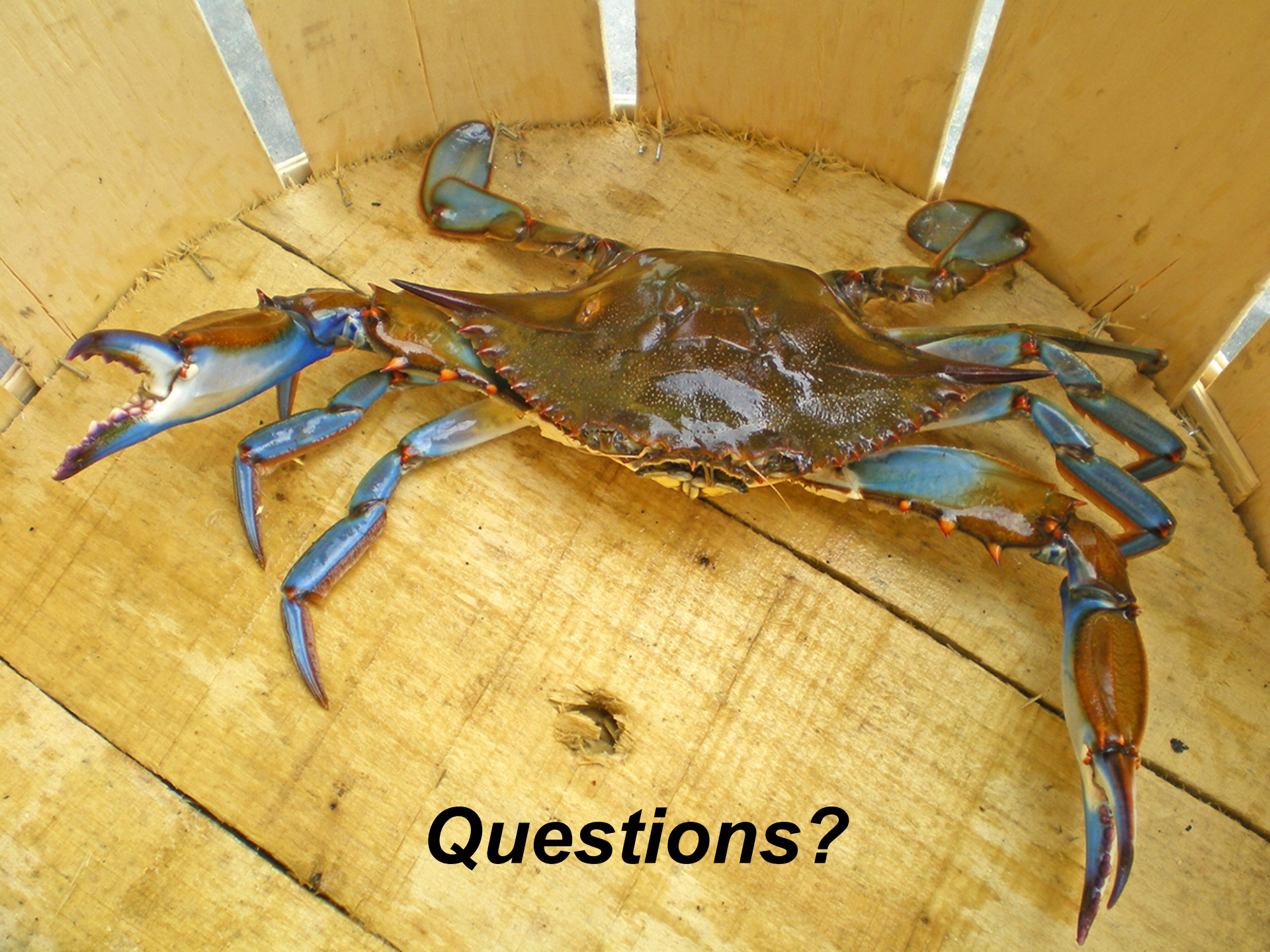
***Motion**: Accept option 2A regarding crab trawls in areas where shrimp trawls are already prohibited in the Pamlico, Pungo, and Neuse rivers.*

Specific management measures selected were:

- Prohibit the taking of crabs with crab dredges
- Reduce the trip limit of crabs from oyster dredges to 10% of the total weight of the combined oyster and crab catch or 100 pounds, whichever is less
- Prohibit the use of crab trawls in areas where shrimp trawls are prohibited in the Pamlico, Pungo, and Neuse rivers

Next Steps

Feb. 2020: NCMFC vote on final approval of Amendment 3


Questions?

Appendix 4.1: Achieving Sustainable Harvest In The North Carolina Blue Crab Fishery

Establish Size Limit for Mature Female Blue Crabs

Year	Mature Female Harvest Percent >6.75" Carapace Width				Value ($)	Percent of Total Value
	Albemarle	Pamlico	Southern	Overall		
2011	0.6	0.9	0.1	1.6	244,793	1.4
2012	0.6	1.7	0.1	2.5	375,392	1.9
2013	2.1	0.5	<0.1	2.7	558,381	2.1
2014	1.8	1.3	0.1	3.2	901,165	3.0
2015	0.8	1.5	<0.1	2.4	587,445	2.0
2016	0.2	1.2	0.1	1.5	296,399	1.4
2017*	0.8	1.0	0.1	1.9	272,161	1.5
2011-2016 Average	1.0	1.2	0.1	2.3	493,929	2.0
***2017 shown for informational purposes only, not used in stock assessment.**						

Year	Mature Female Harvest Percent >6.5" Carapace Width				Value ($)	Percent of Total Value
	Albemarle	Pamlico	Southern	Overall		
2011	1.6	2.3	0.3	4.2	627,286	3.5
2012	1.9	3.8	0.3	6.0	950,835	4.7
2013	4.7	1.5	0.2	6.4	1,355,304	5.1
2014	4.2	2.3	0.2	6.7	1,885,193	6.3
2015	1.9	3.3	0.1	5.4	1,334,084	4.5
2016	1.1	3.0	0.2	4.3	788,728	3.8
2017*	1.5	2.2	0.2	3.8	554,013	3.1
2011-2016 Average	2.5	2.7	0.2	5.4	1,156,905	4.8
***2017 shown for informational purposes only, not used in stock assessment.**						

Establish Size Limit for Mature Female Blue Crabs

Year	Mature Female Harvest Percent <5.25" Carapace Width				Value ($)	Percent of Total Value
	Albemarle	Pamlico	Southern	Overall		
2011	0.8	3.0	0.2	3.9	558,223	3.1
2012	0.9	1.7	0.3	2.9	451,630	2.2
2013	0.9	2.2	0.7	3.8	782,678	3.0
2014	0.5	0.6	0.8	1.8	468,715	1.6
2015	1.0	0.5	0.2	1.6	453,072	1.5
2016	1.4	2.2	0.4	4.1	726,198	3.5
2017*	1.9	1.4	0.9	4.2	639,781	3.6
2011-2016 Average	0.9	1.7	0.4	3.0	573,419	2.4
***2017 shown for informational purposes only, not used in stock assessment.**						

Year	Mature Female Harvest Percent <5" Carapace Width				Value ($)	Percent of Total Value
	Albemarle	Pamlico	Southern	Overall		
2011	0.0	1.2	0.0	1.2	155,675	0.9
2012	0.2	0.6	0.1	0.9	135,483	0.7
2013	0.2	0.9	0.3	1.4	328,168	1.2
2014	0.2	0.2	0.3	0.7	169,988	0.6
2015	0.1	0.1	0.1	0.3	72,376	0.2
2016	0.3	0.5	0.1	0.9	165,365	0.8
2017*	0.8	0.4	0.4	1.6	254,034	1.4
2011-2016 Average	0.2	0.6	0.1	0.9	171,176	0.7
***2017 shown for informational purposes only, not used in stock assessment.**						

Life Stage Closure: Limit Harvest of Immature Female Hard Blue Crabs

Year	Immature Female Harvest Percent				Value ($)	Percent of Total Value
	Albemarle	Pamlico	Southern	Overall		
2011	0.7	0.5	0.0	1.2	132,871	0.7
2012	1.0	0.2	0.0	1.2	173,246	0.9
2013	1.2	0.1	0.0	1.3	245,834	0.9
2014	1.5	0.2	0.0	1.7	375,154	1.3
2015	0.6	0.3	0.0	0.9	203,234	0.7
2011-2015 Average	1.0	0.3	0.0	1.2	226,068	0.9
2016*	0.4	0.1	0.0	0.5	62,658	0.3
2017**	0.1	0.1	0.0	0.1	11,650	0.1
Percent Harvest Reduction (2011-2015 average minus 2017)	0.9	0.2	0.0	1.1	214,418	0.8
***2016 not used in reduction calculation because prohibition on immature female harvest began in June 2016**						
****2017 shown for informational purposes only, not used in stock assessment**						

Season Closure

Year	Region	Monthly Harvest Percent												December Value ($)	December Percent of Value
		Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.		
2011	Albemarle	0.0	0.0	2.1	1.4	12.5	18.1	13.8	13.3	18.1	13.5	6.5	0.7	59,675	0.7
	Pamlico	0.2	0.7	6.7	8.9	13.4	15.4	15.3	10.9	12.9	8.7	5.1	1.8	178,456	2.3
	Southern	0.2	4.1	10.2	3.4	10.6	10.2	9.6	10.5	11.3	6.8	11.8	11.4	144,113	11.9
	Overall	0.1	0.6	4.5	4.7	12.8	16.5	14.2	12.1	15.6	11.1	6.2	1.7	382,244	2.1
2012	Albemarle	0.0	0.2	1.6	0.9	14.7	21.0	18.9	16.2	11.6	10.0	4.4	0.6	85,706	0.7
	Pamlico	0.3	1.1	5.4	9.7	19.7	19.4	16.0	11.6	6.5	5.9	3.3	1.3	95,196	1.7
	Southern	2.4	4.9	5.4	8.7	13.5	10.0	10.0	11.3	8.4	7.1	9.4	8.8	163,448	10.7
	Overall	0.3	0.8	3.0	4.1	16.1	19.7	17.4	14.4	9.9	8.5	4.5	1.4	344,350	1.7
2013	Albemarle	0.0	0.0	0.3	1.2	5.3	15.0	15.8	19.3	20.5	18.3	4.1	0.3	54,346	0.3
	Pamlico	0.1	0.1	1.5	8.6	14.5	17.0	14.6	12.6	10.2	11.4	7.7	1.7	104,716	1.7
	Southern	1.5	3.5	4.3	3.9	13.6	14.0	14.3	12.0	8.4	9.0	8.8	6.7	128,162	6.5
	Overall	0.2	0.3	0.9	3.1	8.0	15.4	15.4	17.2	17.3	16.0	5.3	1.1	287,224	1.1
2014	Albemarle	0.0	0.0	0.2	1.3	8.8	15.0	12.7	19.6	22.7	16.3	3.2	0.2	42,958	0.2
	Pamlico	0.2	0.4	0.9	7.0	11.0	13.3	15.8	16.3	15.4	13.2	5.1	1.4	99,213	1.4
	Southern	1.1	1.8	2.8	2.9	13.4	14.1	14.5	11.9	10.2	9.3	11.3	6.7	106,907	5.7
	Overall	0.1	0.2	0.5	2.6	9.6	14.6	13.5	18.4	20.4	15.2	4.0	0.9	249,078	0.8
2015	Albemarle	0.0	0.0	0.2	1.6	8.1	12.4	10.3	18.4	18.9	19.4	9.0	1.7	233,916	1.3
	Pamlico	0.2	0.1	1.2	4.2	7.2	13.1	16.8	15.3	12.9	11.7	11.4	5.9	543,818	5.4
	Southern	1.2	0.8	7.9	4.7	15.3	14.8	9.7	9.5	8.3	8.7	9.6	9.6	115,664	6.1
	Overall	0.1	0.1	0.9	2.6	8.2	12.7	12.4	17.0	16.4	16.4	9.8	3.4	893,398	3.0
2016	Albemarle	0.4	0.1	3.3	0.9	8.5	19.7	14.8	13.0	14.2	15.5	8.2	1.4	107,301	1.0
	Pamlico	1.5	0.4	6.8	3.7	9.0	11.2	13.7	13.3	11.7	13.2	11.0	4.4	382,383	4.5
	Southern	2.1	2.8	6.2	7.1	16.7	12.4	11.4	9.5	9.0	7.6	8.8	6.5	89,334	5.3
	Overall	1.0	0.4	5.0	2.4	9.2	15.8	14.1	12.9	12.9	14.0	9.4	2.9	579,018	2.8
2017*	Albemarle	0.2	0.6	0.9	0.8	16.6	22.5	11.7	13.6	13.3	14.8	4.9	0.2	21,781	0.2
	Pamlico	1.2	4.0	3.4	6.3	15.9	19.3	14.9	14.0	9.6	7.2	3.7	0.5	43,407	0.7
	Southern	3.0	7.3	3.6	5.2	13.7	11.3	10.2	10.4	8.6	9.2	10.1	7.2	128,119	6.7
	Overall	0.8	2.3	2.0	3.1	16.1	20.4	12.7	13.5	11.6	11.7	4.9	0.9	193,307	1.1
2011-2016 Average	**Albemarle**	**0.1**	**0.1**	**1.2**	**1.2**	**9.6**	**16.6**	**14.2**	**16.9**	**17.9**	**15.6**	**5.9**	**0.8**	**97,317**	**0.7**
	Pamlico	**0.5**	**0.5**	**4.3**	**6.8**	**12.1**	**14.6**	**15.4**	**13.1**	**11.7**	**10.5**	**7.5**	**3.0**	**233,964**	**3.1**
	Southern	**1.4**	**3.1**	**6.2**	**5.3**	**13.8**	**12.4**	**11.5**	**10.8**	**9.2**	**8.0**	**9.9**	**8.3**	**124,605**	**7.4**
	Overall	**0.3**	**0.4**	**2.5**	**3.3**	**10.7**	**15.7**	**14.4**	**15.3**	**15.4**	**13.5**	**6.7**	**2.0**	**455,885**	**1.9**

***2017 shown for informational purposes only, not used in stock assessment or reduction calculations**

Season Closure

Closure Period	2016 Harvest Reduction (%)	2016 Value (%)
January 15 - February 7 Closure	0.1	0.2
January 1 - January 31 Closure	1.0	1.0
January 1 - February 28/29 Closure	1.3	1.6
March 1 - March 15 Closure	2.6	3.6
March 16 - March 31 Closure	2.4	3.1
March 1 - March 24 Closure	4.1	5.5
March 8 - March 31 Closure	4.3	5.7
March 1 - March 31 Closure	5.0	6.6
January 1 - January 31 Harvest Closure North of 58 Bridge	0.9	0.2
March 1 - March 15 Closure South of 58 Bridge	0.1	0.1
February 20 - March 15 Closure South of 58 Bridge	0.2	0.2

Adjust the Cull Tolerance for Prohibited Hard Blue Crabs

Year	Sublegal Male Harvest Percent				Value ($)	Percent of Total Value
	Albemarle	Pamlico	Southern	Overall		
2011	3.5	0.9	0.1	4.5	465,443	2.6
2012	3.5	1.6	0.2	5.3	639,218	3.2
2013	1.8	0.4	0.1	2.3	401,069	1.5
2014	2.2	0.5	0.2	2.8	564,363	1.9
2015	2.5	1.1	0.1	3.8	686,496	2.3
2016*	2.5	0.9	0.2	3.6	452,896	2.2
2017**	3.1	0.5	0.1	3.7	462,804	2.6
2011-2015 Average	2.8	0.9	0.1	3.8	534,914	2.2
2017 Immature Female Harvest	0.1	0.1	0.0	0.1	11,650	0.1
Combined 2011-2015 Average Sublegal Male and 2017 Immature Female Harvest	2.8	1.0	0.1	4.0	546,564	2.3

***2016 not used because prohibition on immature female harvest and reduction in cull tolerance began half way through the year**

****2017 shown for informational purposes only, not used in stock assessment**

Appendix 4.1: Achieving Sustainable Harvest In The North Carolina Blue Crab Fishery

Management Option	Management Measure	2011-2016 Average Reduction (%)	2016 Reduction (%)	Management Option	Management Measure	2011-2016 Average Reduction (%)	2016 Reduction (%)
Options 1-5: Do not meet required 50% probability of ending overfished				13	6.5" Mature Female Maximum Size	5.4	4.3
1	Prohibit Immature Female Harvest	1.1	0.5				
				14	6.75" Mature Female Maximum Size	4.3	4.4
2	5" Mature Female Minimum Size	0.9	0.9		December Closure		
3	5" Mature Female Minimum Size	2.0	1.4	15	5" Mature Female Minimum Size	5.0	4.6
	Prohibit Immature Female Harvest				Reducing Cull Tolerance to Zero		
4	6.75" Mature Female Maximum Size	2.3	1.5	16	5.25" Mature Female Minimum Size	4.1	4.6
					Prohibit Immature Female Harvest		
5	6.75" Mature Female Maximum Size	3.4	2.0				
	Prohibit Immature Female Harvest			17	6.5" Mature Female Maximum Size	6.4	4.8
					Prohibit Immature Female Harvest		
Reduction with a 50% probability of ending overfished			**2.2**				
6	December Closure	2.0	2.9	18*	6.75" Mature Female Maximum Size	5.3	4.8
					Prohibit Immature Female Harvest		
7	Prohibit Immature Female Harvest	3.1	3.4		December Closure		
	December Closure						
				19	5" Mature Female Minimum Size	5.9	4.9
8	Reducing Cull Tolerance to Zero	4.1	3.7		Prohibit Immature Female Harvest		
					Reducing Cull Tolerance to Zero		
Reduction with a 67% probability of ending overfished			**3.8**				
9	5" Mature Female Minimum Size	2.9	3.8	20	6.75" Mature Female Maximum Size	6.3	5.1
	December Closure				Reducing Cull Tolerance to Zero		
10	Prohibit Immature Female Harvest	5.1	4.1	21	6.75" Mature Female Maximum Size	7.2	5.5
	Reducing Cull Tolerance to Zero				Prohibit Immature Female Harvest		
					Reducing Cull Tolerance to Zero		
11	5.25" Mature Female Minimum Size	3.0	4.1				
				Reduction with a 90% probability of ending overfished			**5.9**
12*	5" Mature Female Minimum Size	4.0	4.3	22	Reducing Cull Tolerance to Zero	6.0	6.5
	Prohibit Immature Female Harvest				December Closure		
	December Closure						

Appendix 4.1: Achieving Sustainable Harvest In The North Carolina Blue Crab Fishery

Management Option	Management Measure	2011-2016 Average Reduction (%)	2016 Reduction (%)	Management Option	Management Measure	2011-2016 Average Reduction (%)	2016 Reduction (%)
23	Prohibit Immature Female Harvest	7.0	6.9	33	5.25" Mature Female Minimum Size	7.9	8.0
	December Closure				Prohibit Immature Female Harvest		
	Reducing Cull Tolerance to Zero				Reducing Cull Tolerance to Zero		
24	5.25" Mature Female Minimum Size	4.9	6.9	34	6.5" Mature Female Maximum Size	10.2	8.2
	December Closure				Prohibit Immature Female Harvest		
					Reducing Cull Tolerance to Zero		
25	6.5" Mature Female Maximum Size	7.3	7.1				
	December Closure			35	6.75" Mature Female Maximum Size	9.1	8.3
					Prohibit Immature Female Harvest		
26	5" Mature Female Minimum Size	6.9	7.3		Reducing Cull Tolerance to Zero		
	December Closure				December Closure		
	Reducing Cull Tolerance to Zero						
				Reduction with a 96% probability of ending overfished			**9.3**
27	5.25" Mature Female Minimum Size	6.0	7.3	36	5.25" Mature Female Minimum Size	8.8	10.3
	Prohibit Immature Female Harvest				December Closure		
	December Closure				Reducing Cull Tolerance to Zero		
28	6.5" Mature Female Maximum Size	8.3	7.5	37	6.5" Mature Female Maximum Size	11.1	10.5
	Prohibit Immature Female Harvest				December Closure		
	December Closure				Reducing Cull Tolerance to Zero		
29	5.25" Mature Female Minimum Size	7.0	7.6	38	5.25" Mature Female Minimum Size	9.7	10.7
	Reducing Cull Tolerance to Zero				Prohibit Immature Female Harvest		
					Reducing Cull Tolerance to Zero		
30	5" Mature Female Minimum Size	7.8	7.7		December Closure		
	Prohibit Immature Female Harvest						
	Reducing Cull Tolerance to Zero			39	6.5" Mature Female Maximum Size	12.0	10.9
	December Closure				Prohibit Immature Female Harvest		
31	6.5" Mature Female Maximum Size	9.3	7.8		Reducing Cull Tolerance to Zero		
	Reducing Cull Tolerance to Zero				December Closure		
32	6.75" Mature Female Maximum Size	8.2	7.9				
	December Closure						
	Reducing Cull Tolerance to Zero						

Appendix 4.1: Achieving Sustainable Harvest In The North Carolina Blue Crab Fishery

Management Option	Management Measure	2011-2016 Average Reduction (%)	2016 Reduction (%)
Option 12.1: Does not meet required 50% probability of ending overfished			
12.1	5" Mature Female Minimum Size	2.2	1.5
	Prohibit Immature Female Harvest		
	January 15 - February 7 Closure		
Reduction with a 50% probability of ending overfished			**2.2**
12.2	5" Mature Female Minimum Size	2.4	2.3
	Prohibit Immature Female Harvest		
	January 1 - January 31 Closure		
12.3	5" Mature Female Minimum Size	2.9	2.7
	Prohibit Immature Female Harvest		
	January 1 - February 28/29 Closure		
12.4	5" Mature Female Minimum Size	3.4	3.7
	Prohibit Immature Female Harvest		
	March 16 - March 31 Closure		
Reduction with a 67% probability of ending overfished			**3.8**
12.5	5" Mature Female Minimum Size	3.2	4.0
	Prohibit Immature Female Harvest		
	March 1 - March 15 Closure		
12.6	5" Mature Female Minimum Size	4.1	5.4
	Prohibit Immature Female Harvest		
	March 1 - March 24 Closure		
12.7	5" Mature Female Minimum Size	4.2	5.6
	Prohibit Immature Female Harvest		
	March 8 - March 31 Closure		
Reduction with a 90% probability of ending overfished			**5.9**
12.8 (PDT)	5" Mature Female Minimum Size	4.6	6.3
	Prohibit Immature Female Harvest		
	March 1 - March 31 Closure		

Management Option	Management Measure	2011-2016 Average Reduction (%)	2016 Reduction (%)
Option 18.1: Does not meet required 50% probability of ending overfished			
18.1	6.75" Mature Female Maximum Size	3.5	2.1
	Prohibit Immature Female Harvest		
	January 15 - February 7 Closure		
Reduction with a 50% probability of ending overfished			**2.2**
18.2	6.75" Mature Female Maximum Size	3.7	2.9
	Prohibit Immature Female Harvest		
	January 1 - January 31 Closure		
18.3 (AC)	Prohibit Immature Female Harvest	3.7	3.2
	Jan. 1 - Jan. 31 Closure North of Hwy 58 Bridge		
	March 1 - March 15 Closure South of Hwy 58 Bridge		
	6.75" Mature Female Max. Size North of Hwy 58 Bridge		
18.4	Prohibit Immature Female Harvest	3.8	3.2
	Jan. 1 - Jan. 31 Closure North of Hwy 58 Bridge		
	Feb. 20 - March 15 Closure South of Hwy 58 Bridge		
	6.75" Mature Female Max. Size North of Hwy 58 Bridge		
18.5	6.75" Mature Female Maximum Size	4.2	3.3
	Prohibit Immature Female Harvest		
	January 1 - February 28/29 Closure		
Reduction with a 67% probability of ending overfished			**3.8**
18.6	6.75" Mature Female Maximum Size	4.7	4.3
	Prohibit Immature Female Harvest		
	March 16 - March 31 Closure		
18.7	6.75" Mature Female Maximum Size	4.6	4.5
	Prohibit Immature Female Harvest		
	March 1 - March 15 Closure		
Reduction with a 90% probability of ending overfished			**5.9**
18.8	6.75" Mature Female Maximum Size	5.4	6.0
	Prohibit Immature Female Harvest		
	March 1 - March 24 Closure		
18.9	6.75" Mature Female Maximum Size	5.5	6.2
	Prohibit Immature Female Harvest		
	March 8 - March 31 Closure		
	6.75" Mature Female Maximum Size	5.9	6.9
18.10	Prohibit Immature Female Harvest		
	March 1 - March 31 Closure		

Appendix 4.2: Management Options Beyond Quantifiable Harvest Reductions

Management Options: Cull Ring Size

- Current rule requires 2 5/16-inch minimum inside diameter cull ring
- Rudershausen and Turano (2009)
  - Tested: 2 5/16-inches, 2 3/8-inches, and 2 7/16-inches cull rings
  - Sublegal males were reduced as cull ring size increased
  - Legal males and mature females not significantly different
- Rudershausen and Hightower (2016)
  - Tested: 2 5/16-inches, 2 3/8-inches, and 2 7/16-inches cull rings
  - Sublegal male crabs significantly less with larger cull rings
  - Legal male crabs not significantly different

Percent of sampled (2011-2017) commercial crab pot trips with various cull ring sizes.

	Percent of Sampled Trips by Cull Ring Size	
Cull Ring Size	2011-2016	2017
2 5/16-inch (minimum legal size)	82%	85%
2 3/8-inch	8%	12%
2 7/16-inch	8%	3%
2 1/2-inch	1%	
>2 1/2-inch	1%	

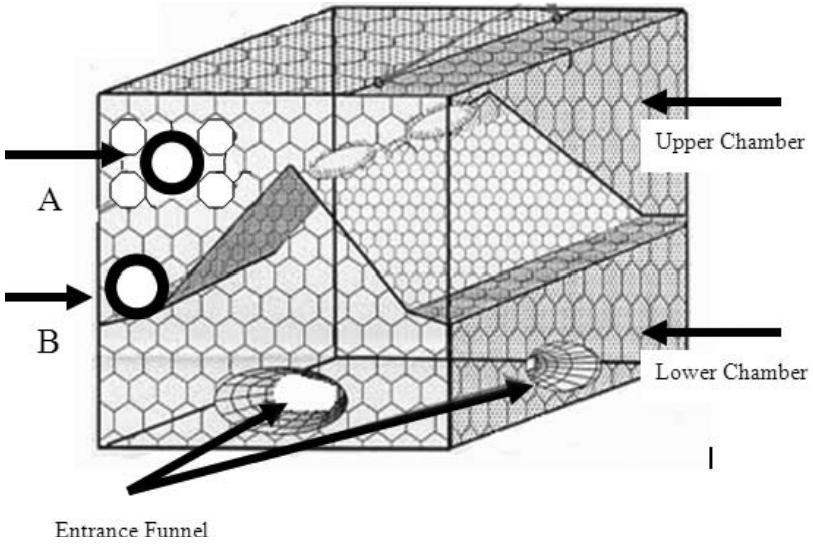
Management Options: Number of Cull Rings

- Current rule requires 3 cull rings
  - Increased January 2016
  - Prior, 2 cull rings required since February 1, 1989
- Rudershausen and Turano (2009)
  - Tested 2 5/16-inches, 2 3/8-inches, and 2 7/16-inches cull rings
  - Increasing number of cull rings had no significant effect on catch

Percent of sampled (2011-2017) commercial crab pot trips with varying number of cull rings.

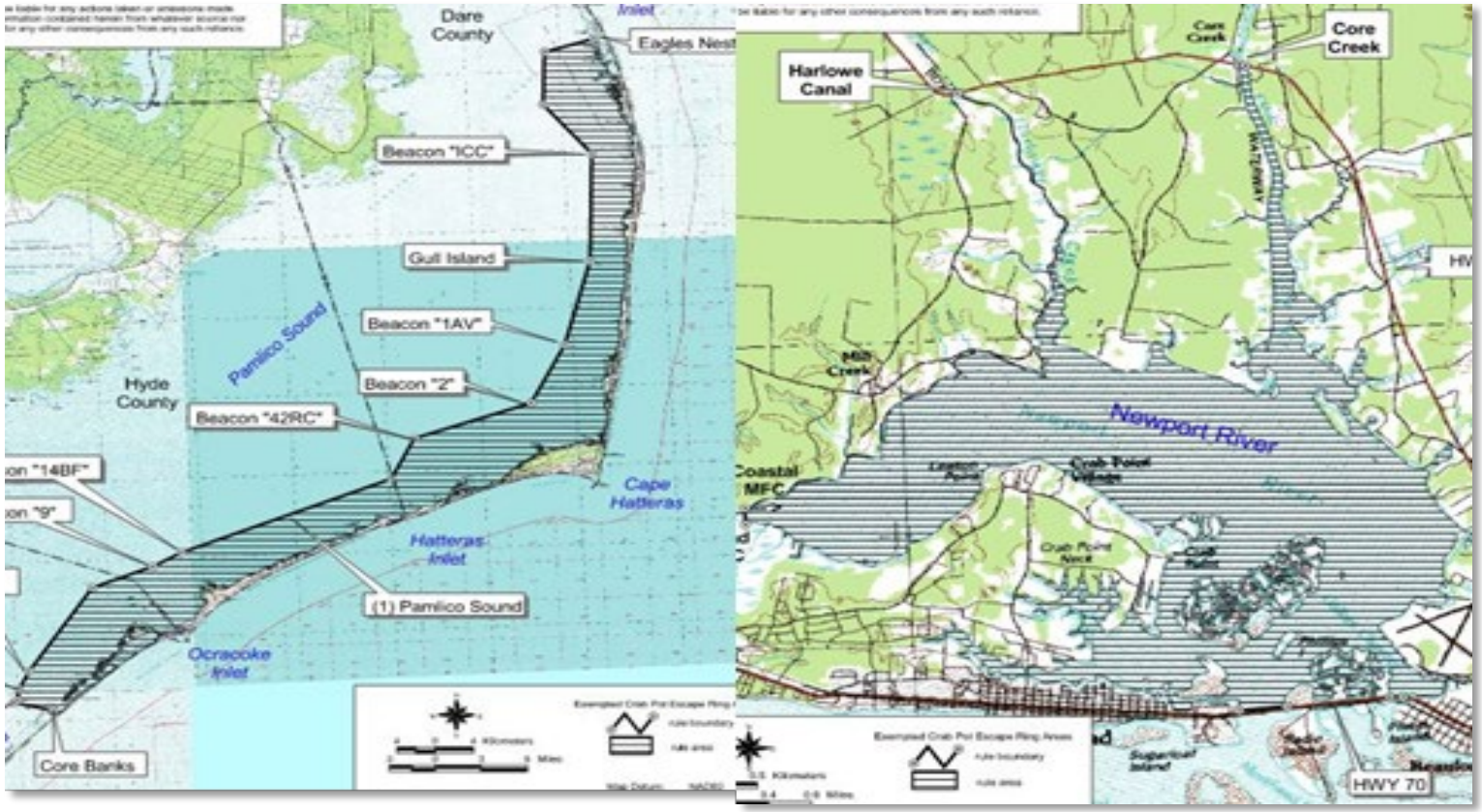
Number of Cull Rings	Percent of Sampled Trips	
	2011-2016	2017
2	87%	5%
3	8%	86%
4	3%	7%
5	1%	1%
>5	1%	1%

Management Options: Cull Ring Placement



- Current rule requires one cull ring to be placed within one full mesh of the corner and one full mesh of the bottom of the divider in the upper chamber of the pot
- Havens et al. (2009) tested modified placement
  - 60 percent sublegal crabs escaped modified pots within one hour
  - 4 percent sublegal crabs escaped unmodified pots within one hour
- Industry feedback has been positive regarding cull ring placement
- Two other states have placement requirements (GA and LA)

Management Options: Removing Cull Ring Exemptions



Escape ring exempted areas in Pamlico Sound, NC (left) and Newport River, NC (right).

Management Options: Removing Cull Ring Exemptions

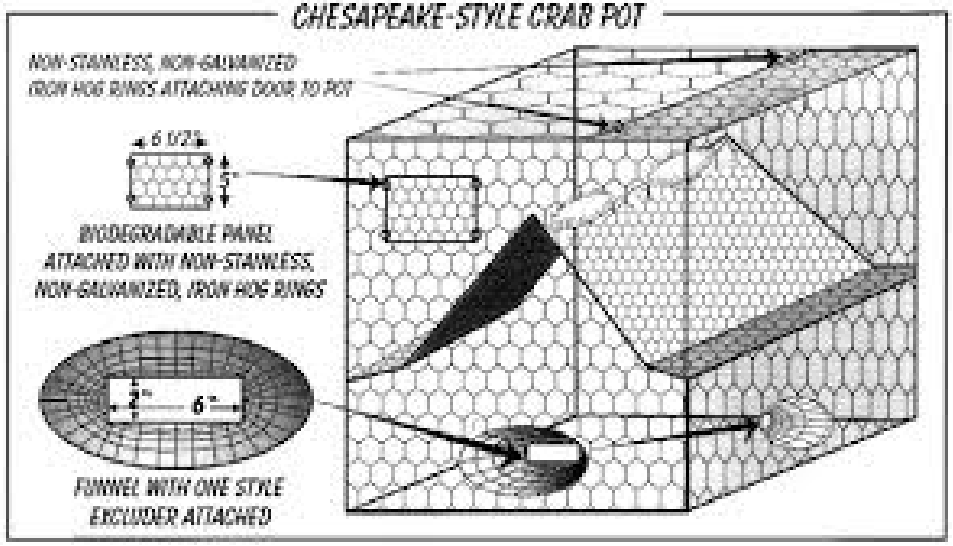
- Amendment 2 set long-standing proclamation allowing escape ring exemption in eastern Pamlico Sound and Newport River into rule
- Cull ring designed to allow crabs under five-inches out
- Mature females exempt from five-inch minimum size limit
- Recoupment would likely occur as males grow to five-inch minimum and immature females undergo terminal molt
- Would reduce harvest by approximately 13 percent in eastern Pamlico Sound region

Percent of sampled commercial crab pot trips with varying sizes of cull rings in escape ring exempted areas. 2011-2016 n=64, 17 from the Newport River. 2017 n=9, 2 from the Newport River.

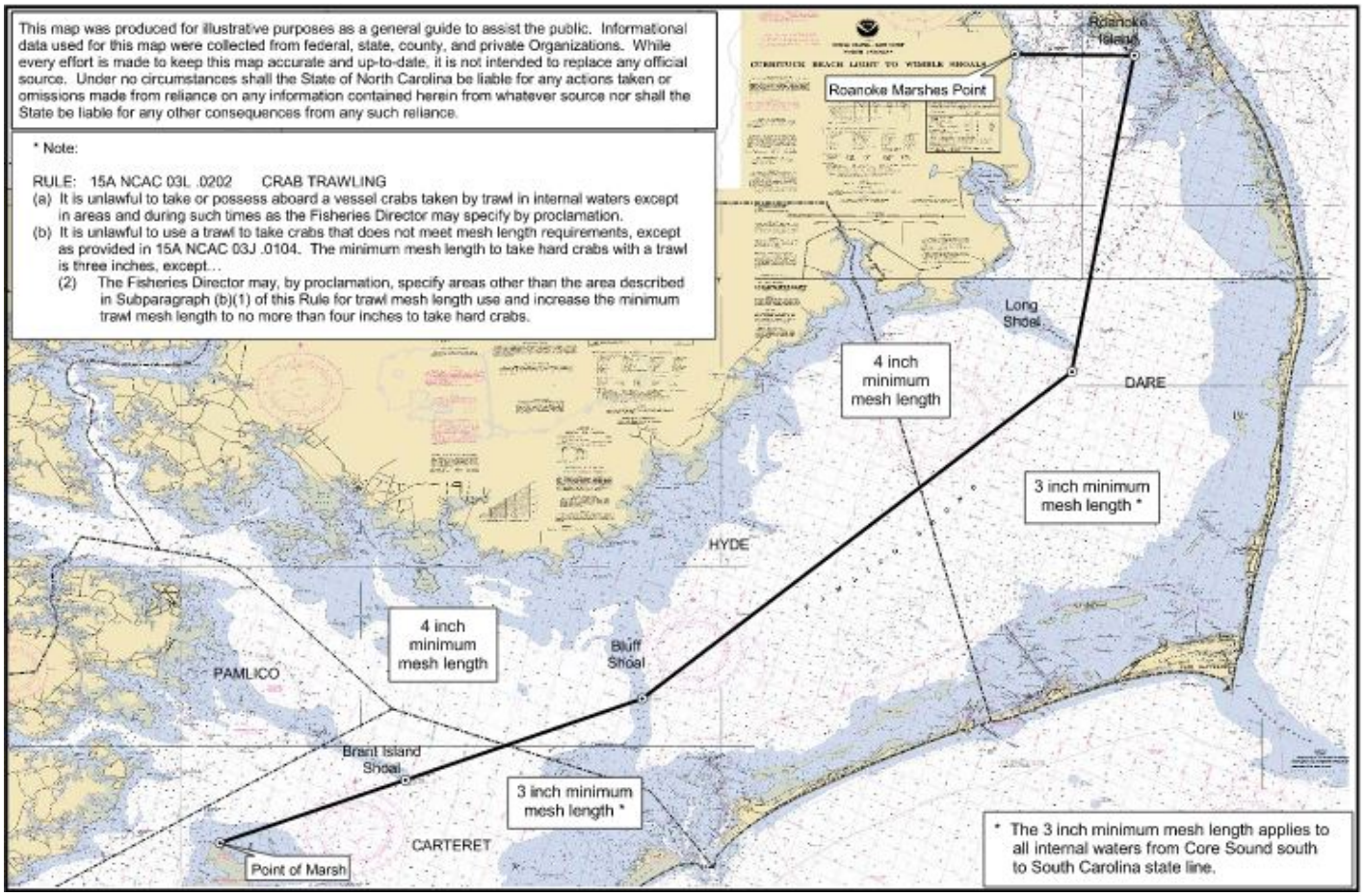
	Percent of Sampled Trips	
Number of Cull Rings	2011-2016 (n = 64)	2017 (n = 9)
0	15%	
1		
2	76%	
3	7%	100%
4	2%	

Management Option: Degradable Panels

- Estimated 17 percent of crab pots lost annually
- Degradable panels disarm gear once lost
- NCDMF (2008) study of several natural twines and non-coated steal wire
  - Complex study with both fishery-independent and fishery-dependent components
  - None of the degradable materials had average break times within the critical four-week period
  - Several potentially promising degradable materials were identified for continued testing by commercial crabbers
  - Panels functioned better than lid straps
- Currently two states require degradable panels in commercial pots



Management Option: Crab Trawl Mesh Size

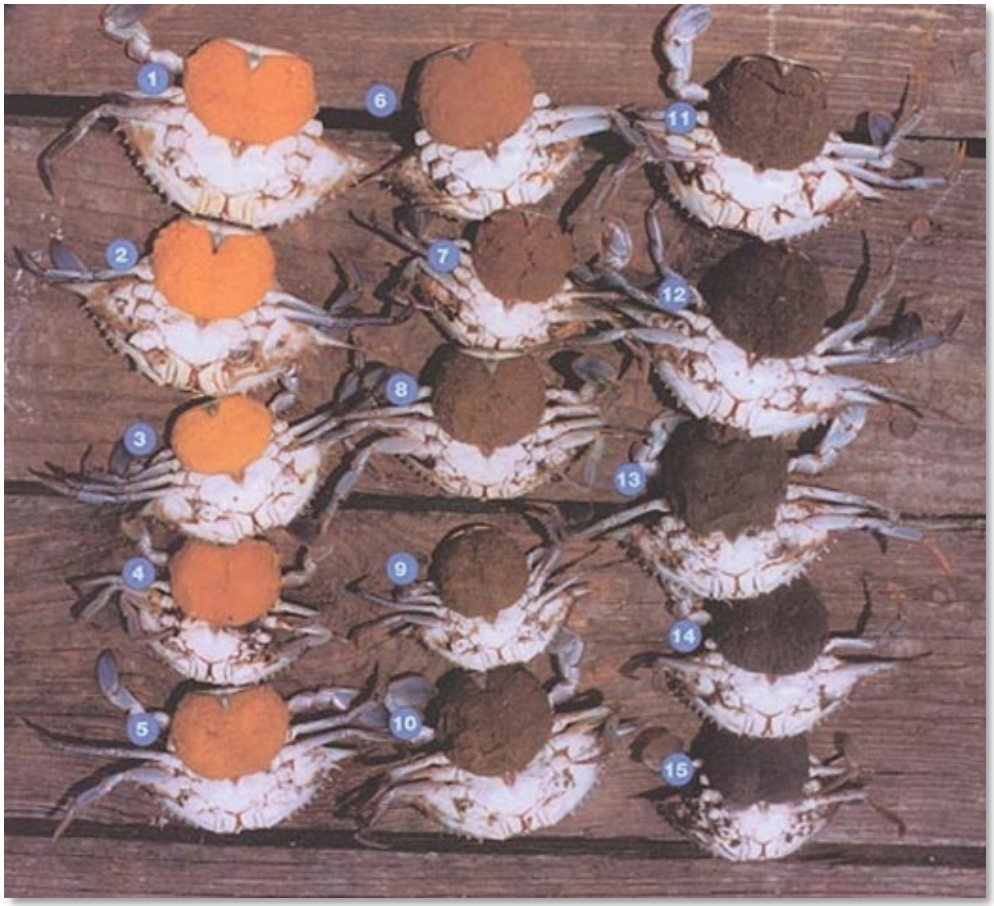


Current 3-inch and 4-inch crab trawl minimum mesh size boundary in Pamlico Sound.

Management Option: Crab Trawl Mesh Size

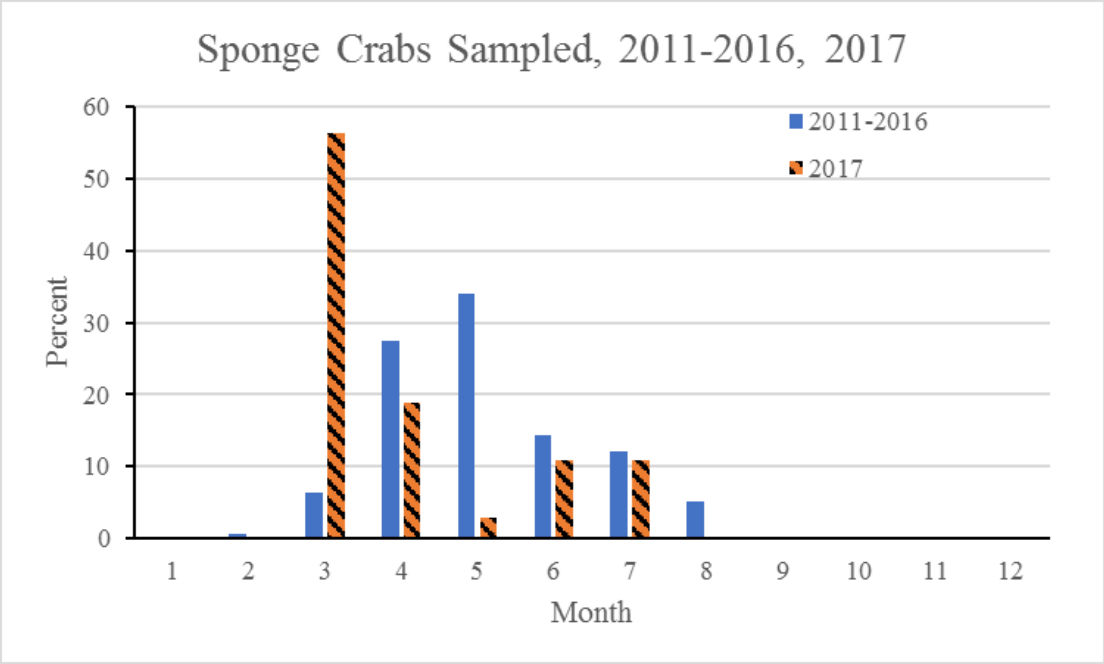
- Current rule requires minimum stretched mesh of 3-inches for crab trawls for taking hard crabs, except that the Director may, by proclamation, increase the minimum mesh length to no more than 4-inches
- Increasing minimum mesh length of crab trawls across the state would further reduce catch and mortality of sublegal crab bycatch
- McKenna and Clark (1993)
  - 13 percent reduction of sub-legal crabs with a 4-inch tail bag
  - Legal crabs reduced seven percent
- McKenna and Camp (1992)
  - Overall survival rate 64 percent for trawl-caught crabs
  - Overall survival rate 93 percent for pot-caught crabs

Management Option: Sponge Crab Closure



- Current rule prohibits dark sponge crab (brown and black) harvest from April 1-April 30
- Sponge crab closure prohibits harvest of sponge crabs during periods of peak abundance
- Would give mature females opportunity to spawn, possibly more than once
- Current prohibition has had minimal effect due to limited duration and specification of sponge color
- Additionally, limiting to dark sponge crabs leads to enforcement complications.

Management Option: Sponge Crab Closure



Average monthly sponge crab frequency in commercial crab sampling, 2011 –2017. 2011-2016 n=2,963, 2017 n=571

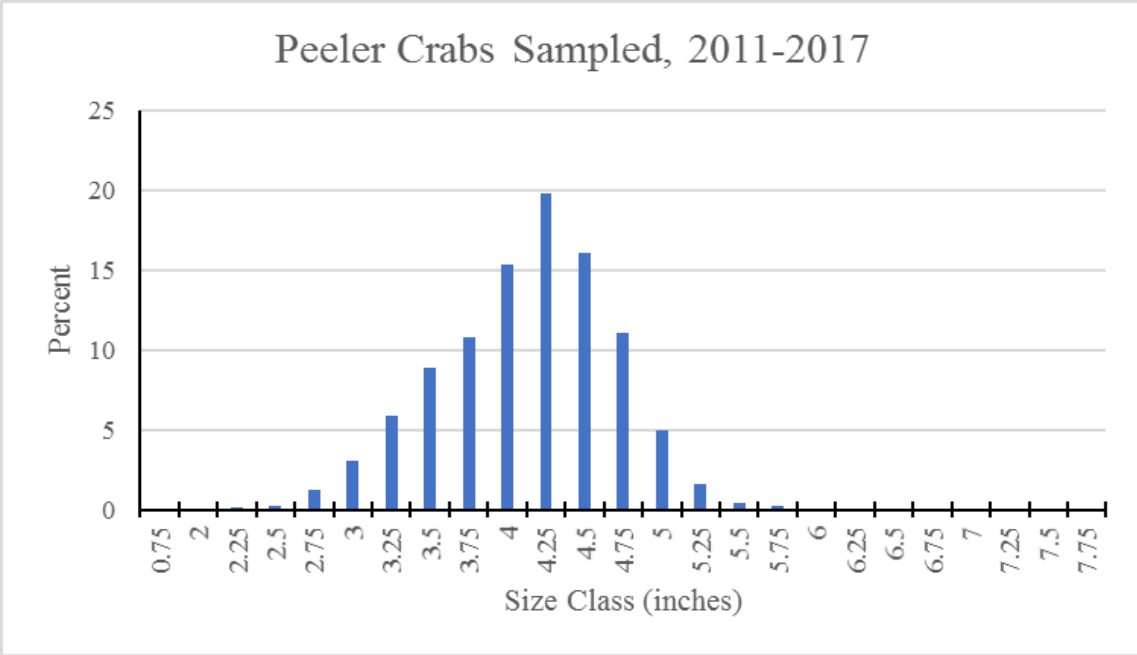
Percent of sampled sponge crabs by area from NCDMF commercial fish house sampling, 2011-17.

	2011-2016	2017
Albemarle Sound	< 0.5%	
Pamlico Sound	82.0%	62%
Southern	17.5%	38%

Management Option: Peeler/Soft Crab Minimum Size

- Peeler and soft crabs are exempt from the 5-inch minimum size limit
- Would reduce fishing mortality on smaller crabs, especially females
- Should increase yield to the fishery
- Recoupment may occur as crabs grow
- Time between sheds does increase as they grow
  - Interval between sheds of 3 to 3 ½ - inch crabs 1-3 months (Rothschild et al. 1992)
- Value of fishery might be enhanced
- Size limit may increase handling mortality and waste
- A peeler size limit could allow more efficient and effective enforcement within and among states
  - Minimum size limit of 3 inches would address regulatory consistency among Atlantic Coast states
  - Potentially foster interstate trade

Management Option: Peeler/Soft Crab Minimum Size



Peeler/soft crab size frequency in commercial crab sampling, 2005 –2017 (n=17,708).

Estimated harvest reduction (pounds) for various minimum size limits for peeler crabs.

	Peeler Size Limit Reduction Percent			
Minimum Size Limit	Albemarle	Pamlico	Southern	Statewide
3-inch	1.1%	2.8%	0%	1.8%
3 ¼-inch	3.2%	7.3%	2.1%	4.8%
3 ½-inch	6.9%	15.3%	4.1%	10.2%
3 ¾-inch	13.4%	28.2%	10.3%	19.2%

Management Option: Effort Control

Pot Limit

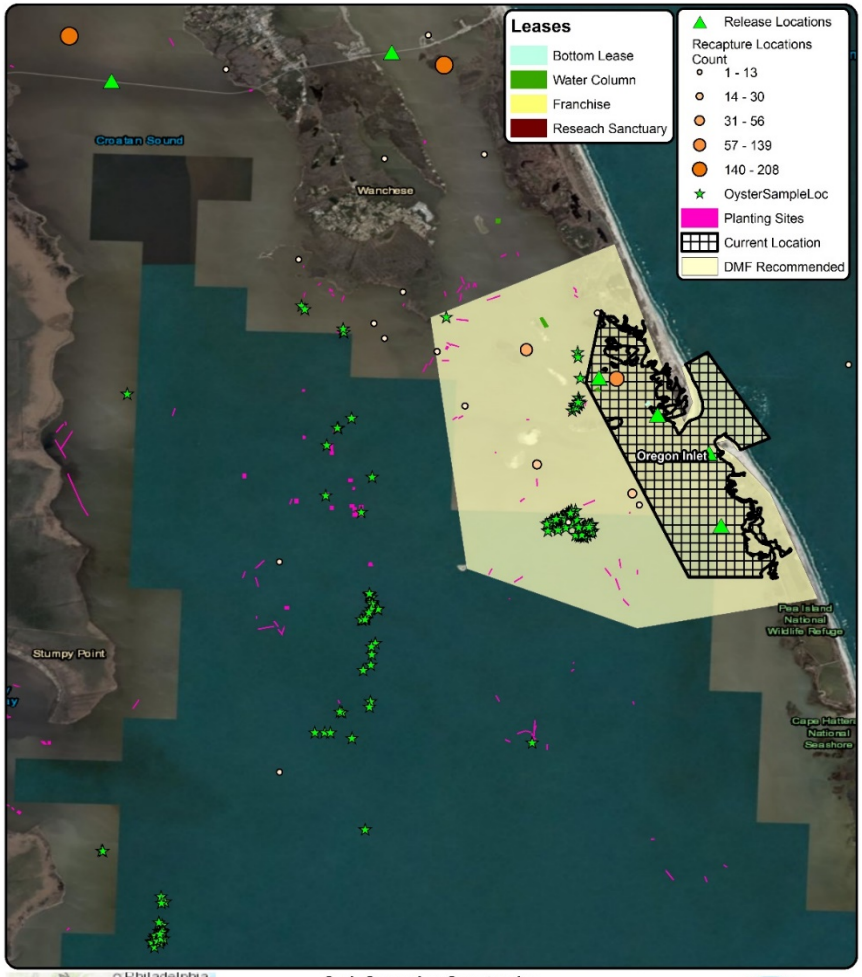
- Limiting pots discussed since 1950s
- Only existing pot limit is a 150 pot per vessel limit in Newport River
- 1998 a Regional Stakeholder Advisory Committee was convened in part to discuss pot limits
  - Regional pot limit criteria and pot tagging system were developed
  - The MFC in 2000 did not implement any aspects of proposed regional strategy
- A marked increase in crab pots occurred in the North Carolina hard crab fishery from 2007-2016

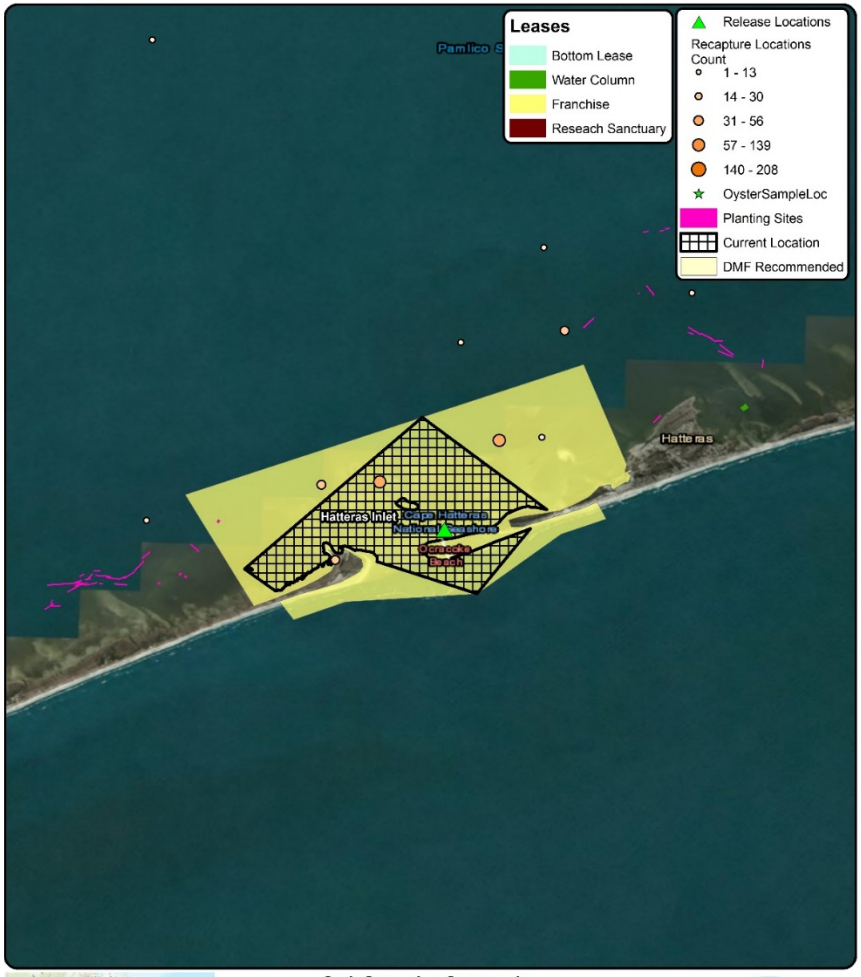
Restrict Fishing Time

- Restricting daily pot fishing time period
  - e.g., 6 a.m. until 2 p.m.
- Could reduce the overall amount of gear used and harvest
- Would significantly impact or eliminate fishermen who work other jobs
- Problems could develop in tidal areas
  - Potential for regional management
- Many fish houses have self imposed fishing times

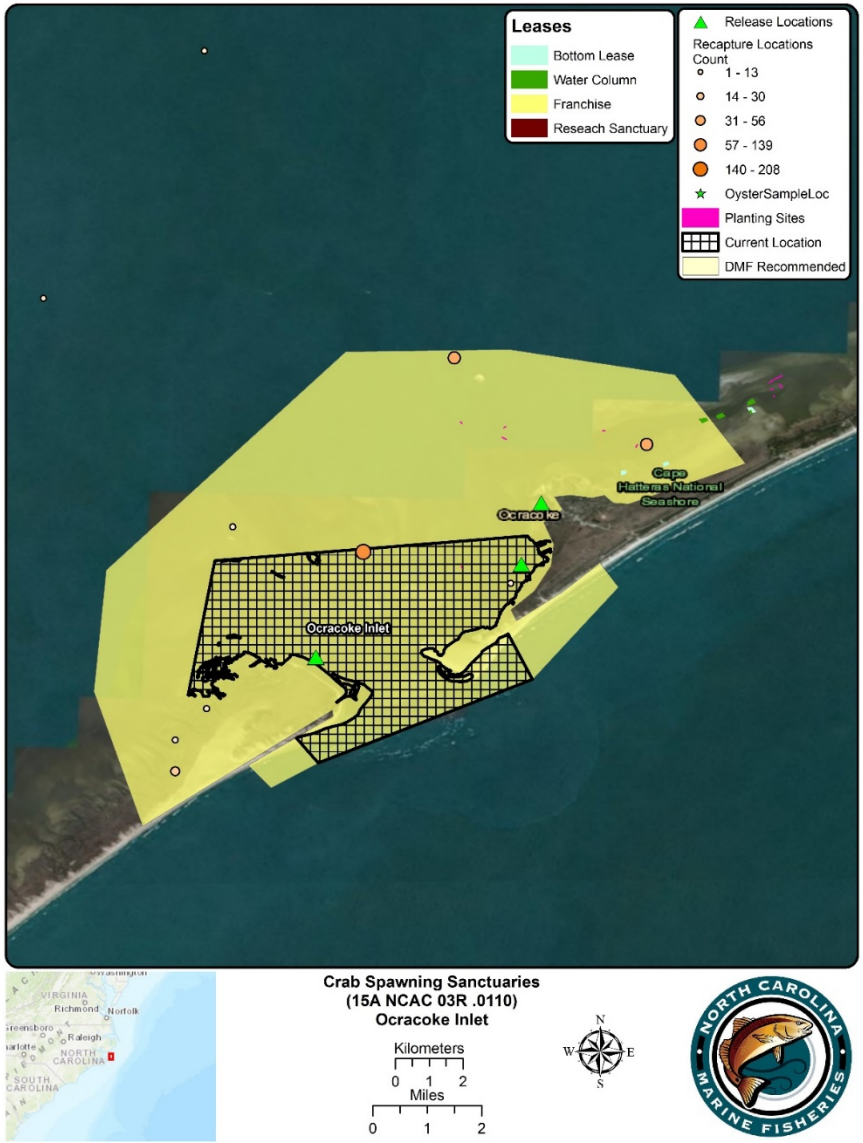
Appendix 4.4: Expand Crab Spawning Sanctuaries To Improve Spawning Stock Biomass

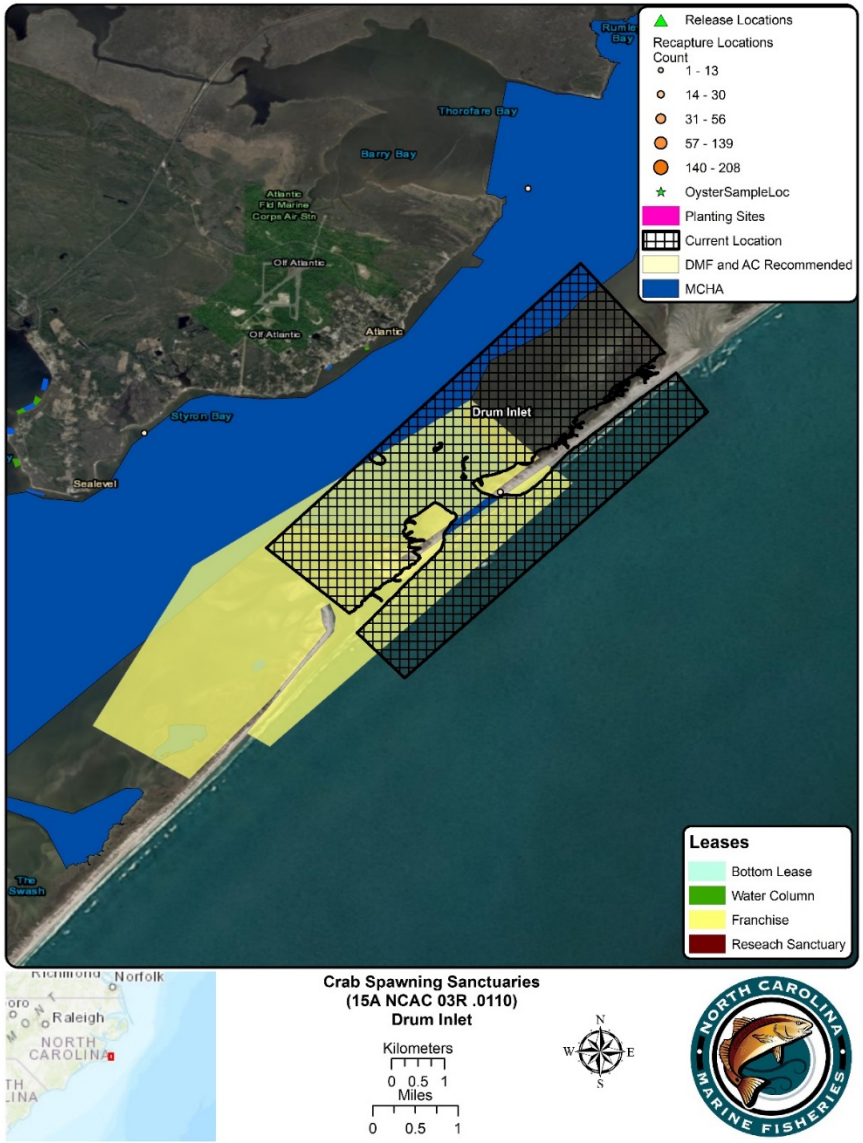
Oregon and Hatteras Inlets



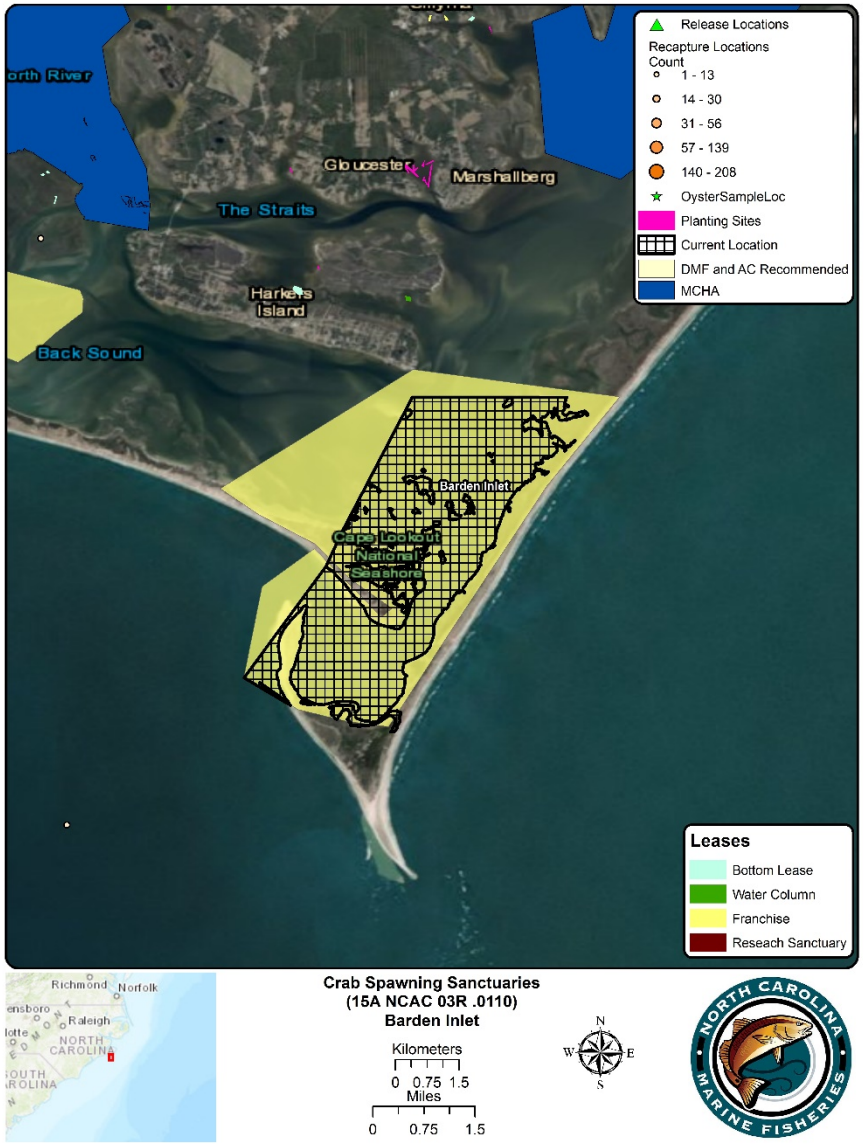


Ocracoke and Drum/Ophelia Inlets





Barden Inlet

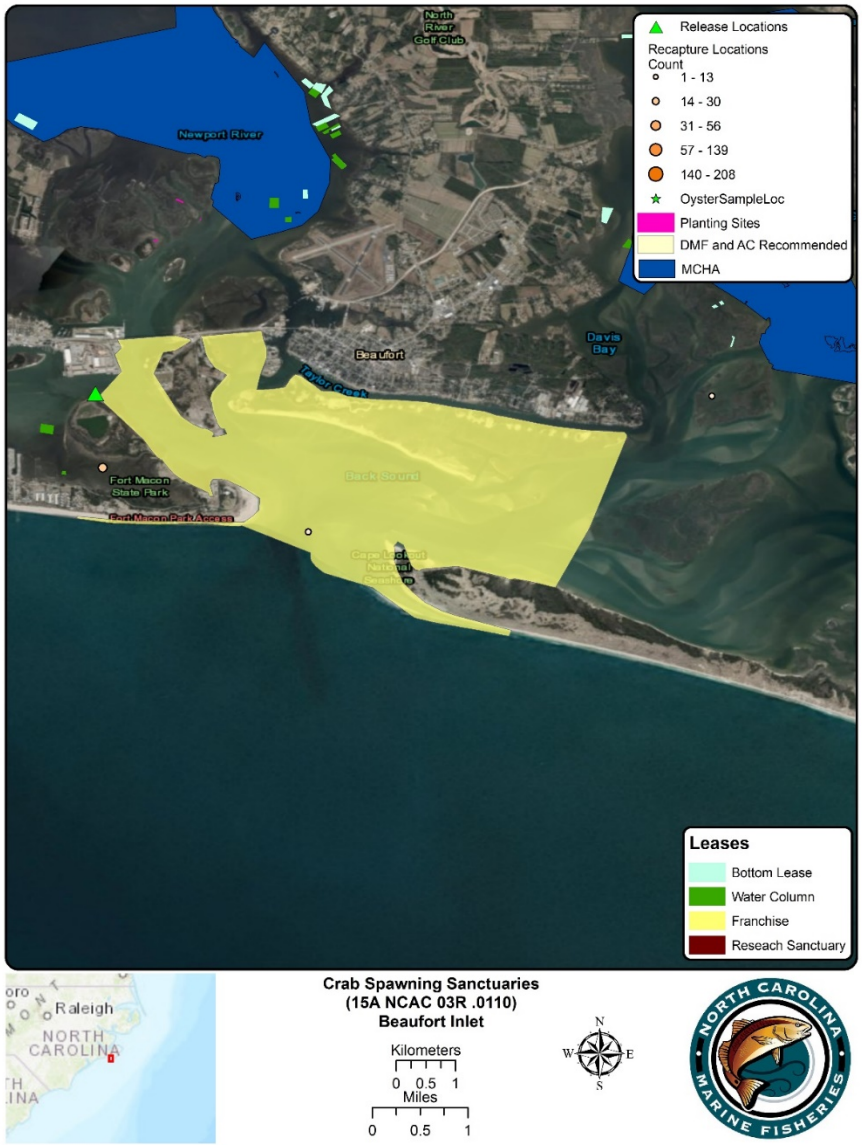


New Crab Spawning Sanctuaries

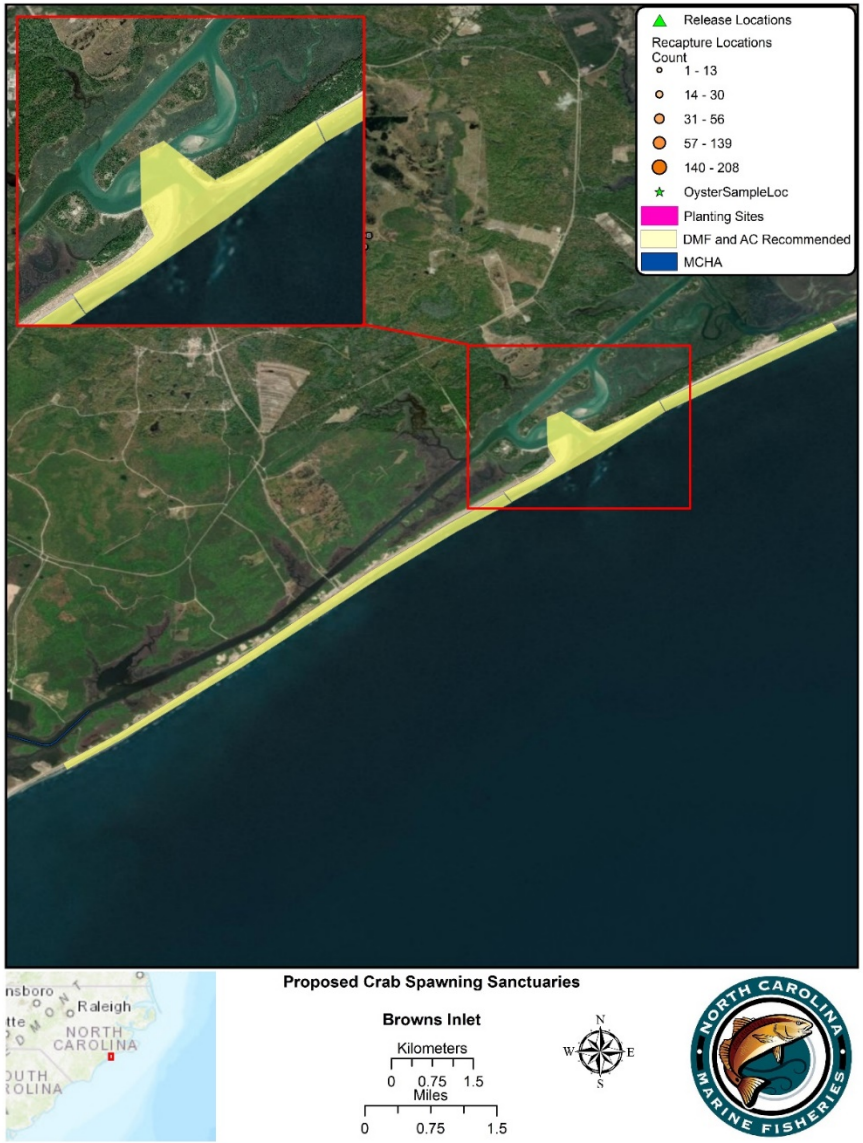
Designating new crab spawning sanctuaries

- 14 inlets south of Barden Inlet without sanctuaries
- Southern inlets tend to be smaller, closer together, and more tidally influenced
- Mature females likely less concentrated at any one inlet
- Closer proximity of inlets to mating areas may allow higher proportion to reach spawning grounds

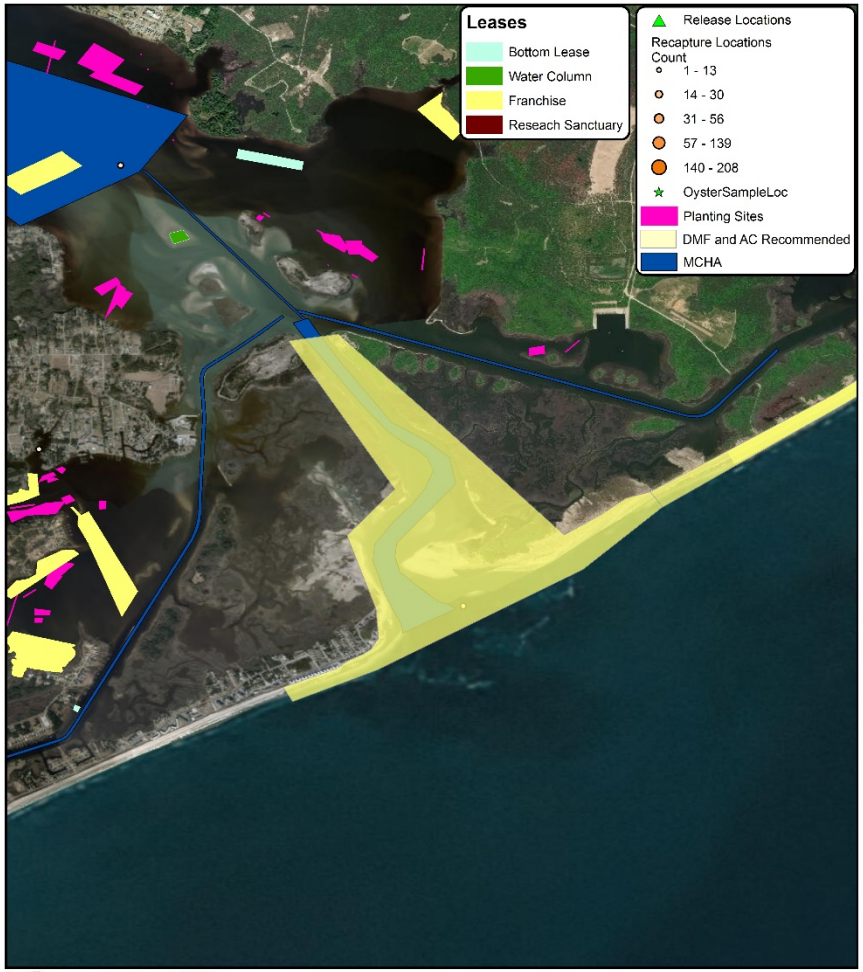
Beaufort and Bogue Inlets

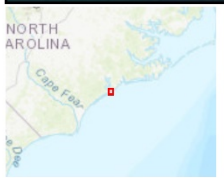


Bear and Browns Inlets



New River and Topsail Inlets

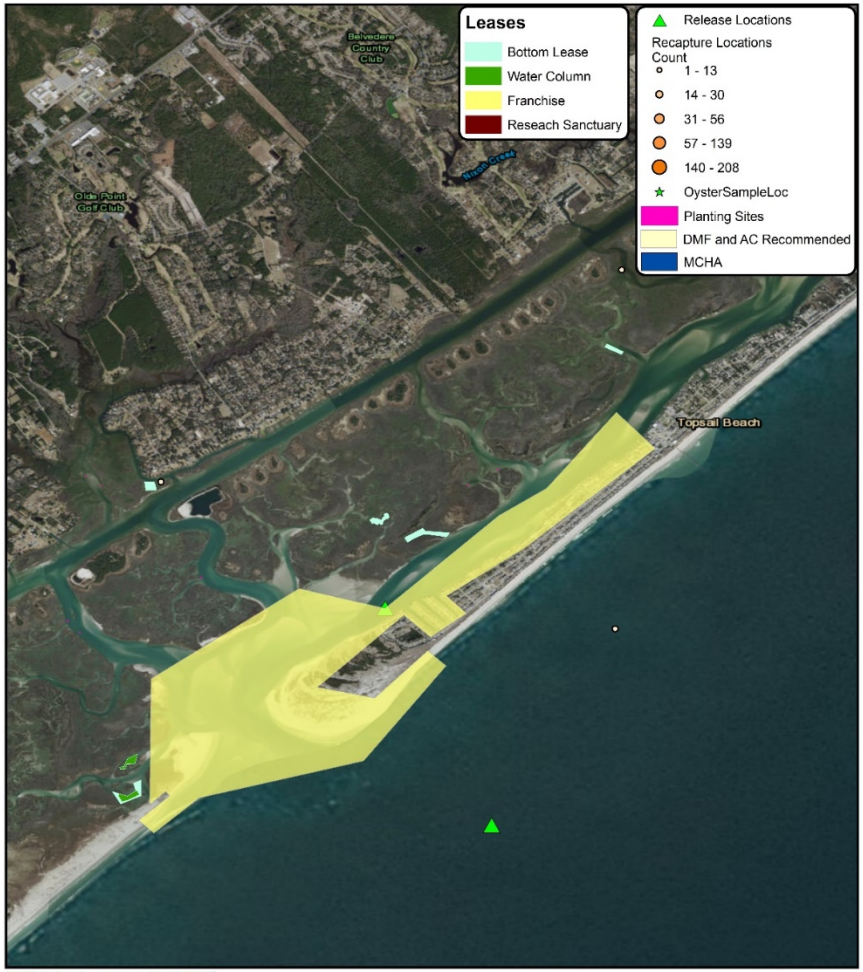


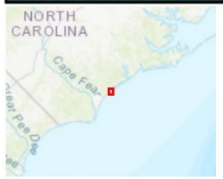


Proposed Crab Spawning Sanctuaries

New River Inlet

Kilometers
0 0.425 0.85
Miles
0 0.425 0.85



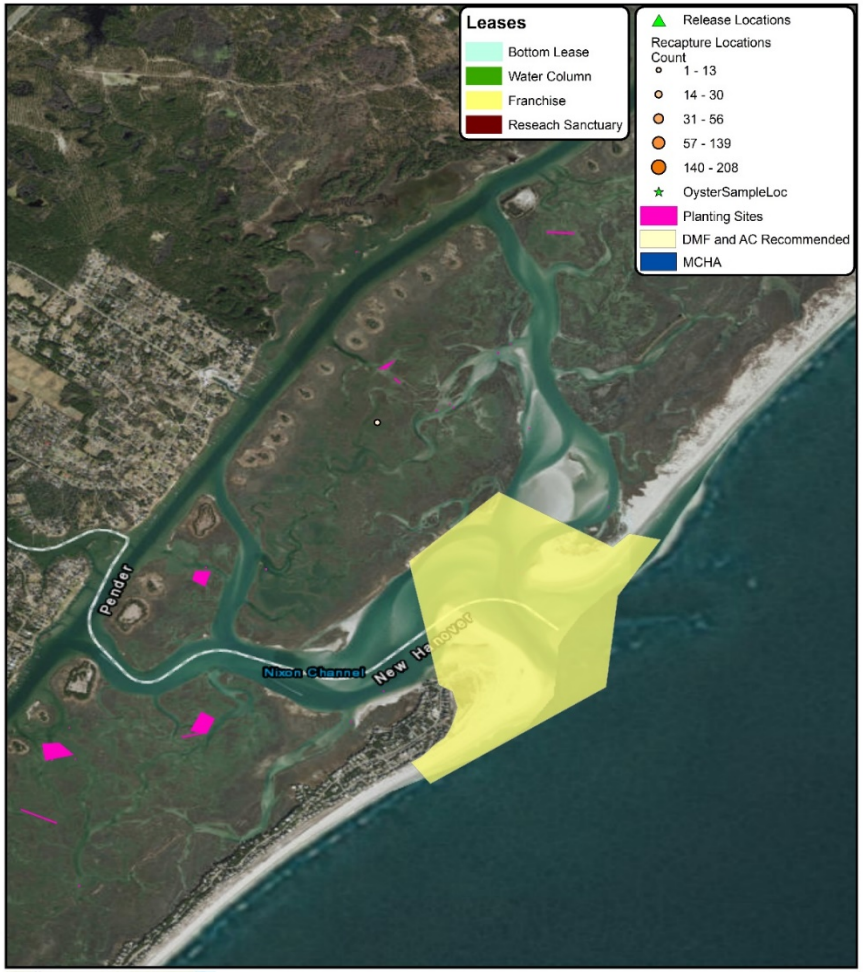


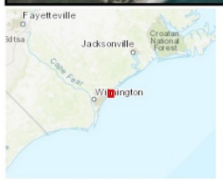
Proposed Crab Spawning Sanctuaries

Topsail Inlet

Kilometers
0 0.5 1
Miles
0 0.5 1

Rich and Mason Inlets

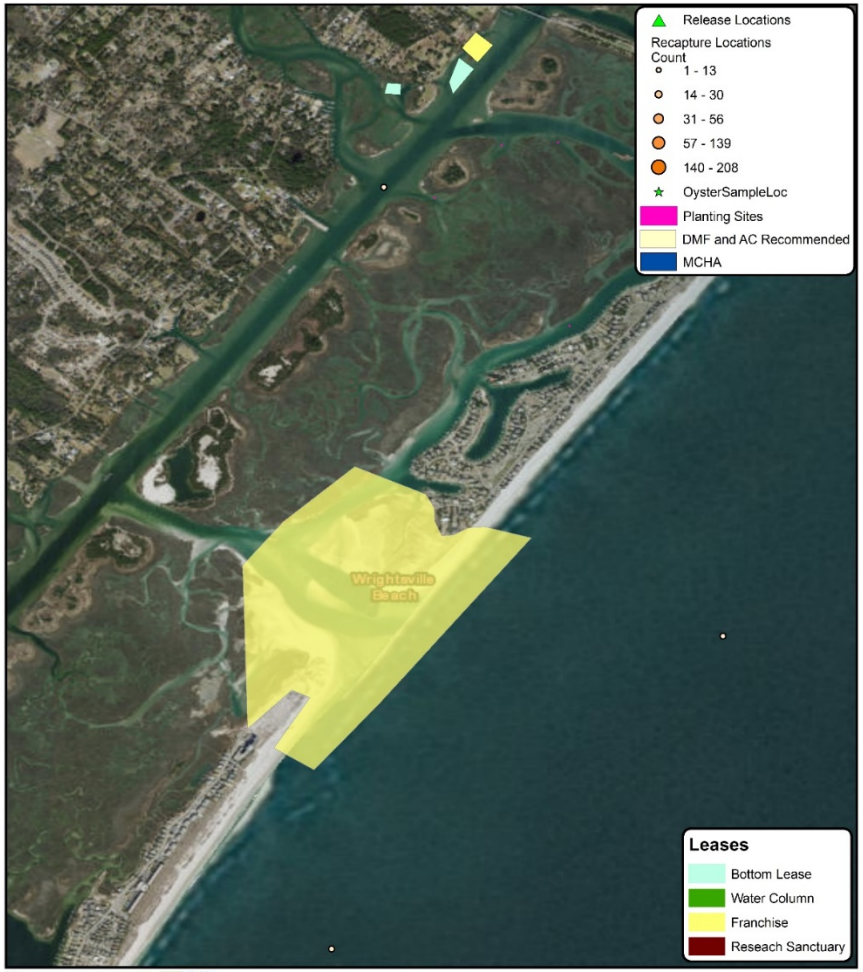




Proposed Crab Spawning Sanctuaries

Rich Inlet

Kilometers
0 0.3 0.6
Miles
0 0.3 0.6

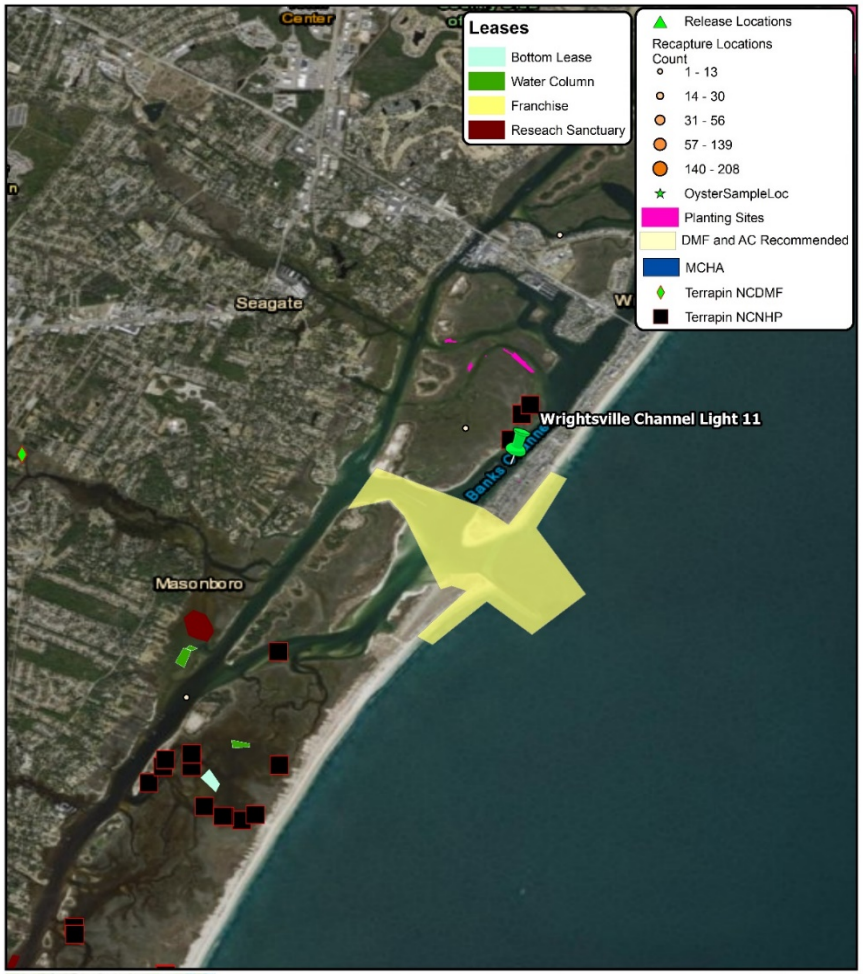


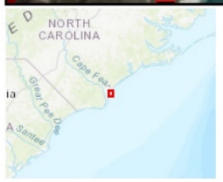
Proposed Crab Spawning Sanctuaries

Mason Inlet

Kilometers
0 0.25 0.5
Miles
0 0.25 0.5

Masonboro and Carolina Beach Inlets

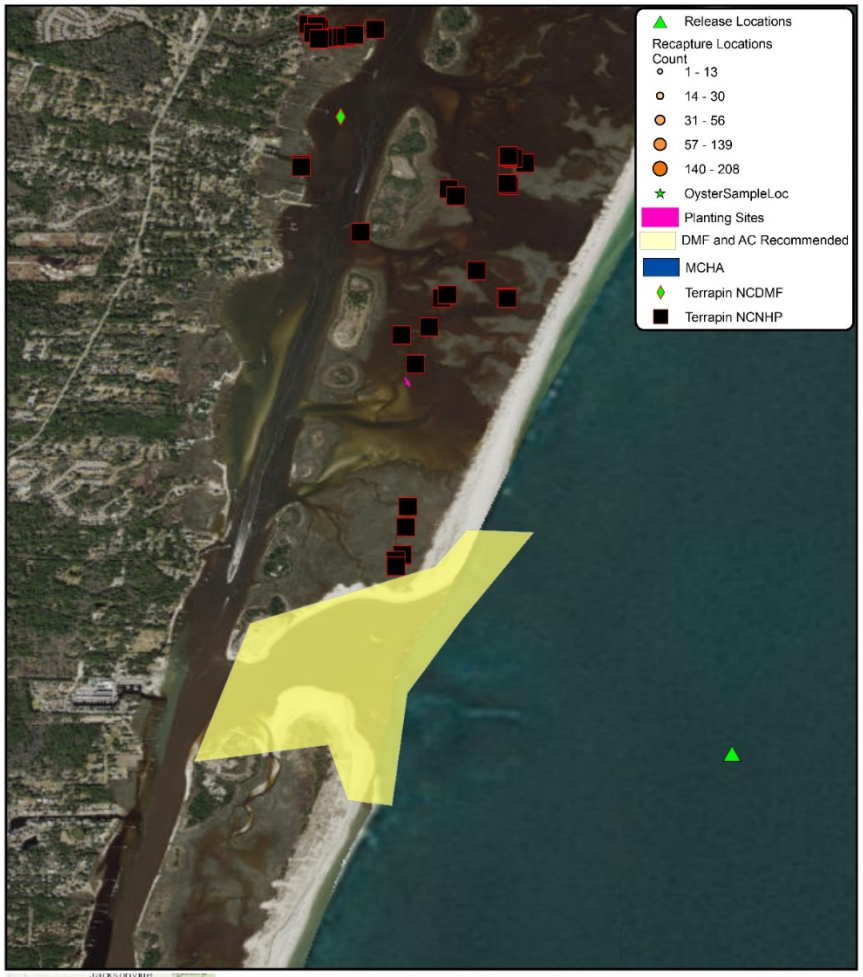


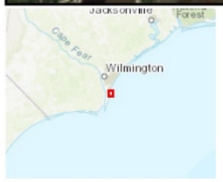


Proposed Crab Spawning Sanctuaries

Masonboro Inlet

Kilometers
0 0.5 1
Miles
0 0.5 1



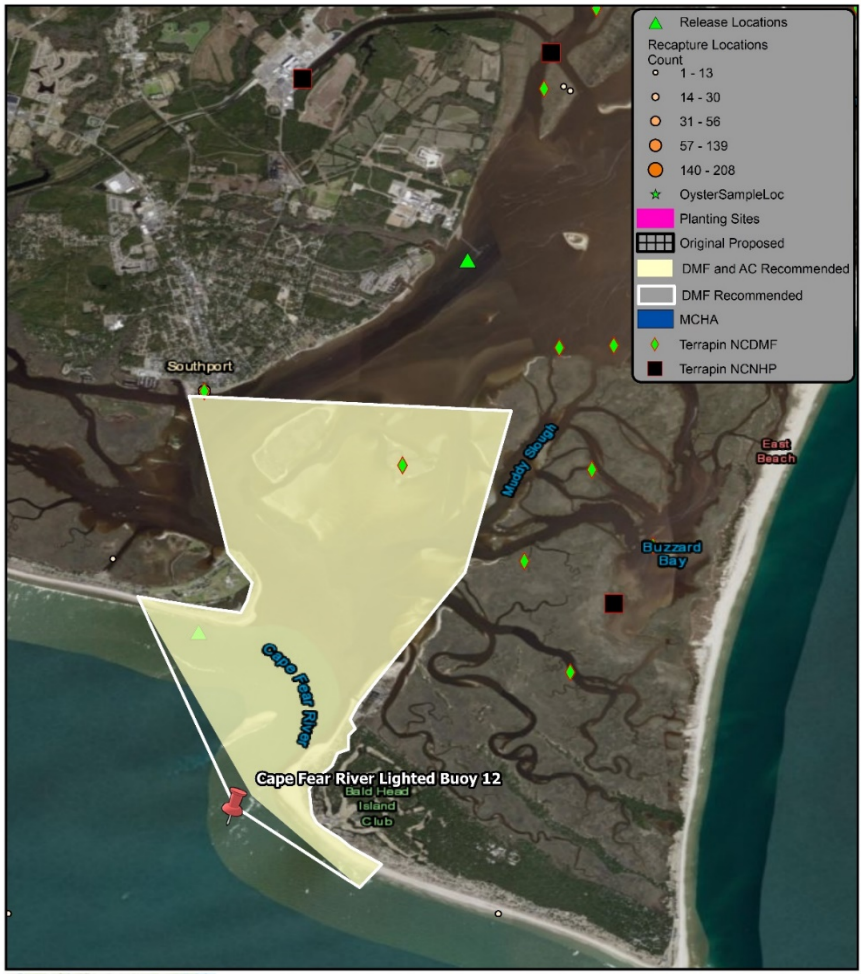


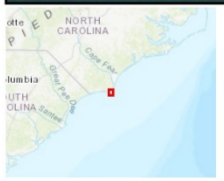
Proposed Crab Spawning Sanctuaries

Carolina Beach Inlet

Kilometers
0 0.25 0.5
Miles
0 0.25 0.5

Cape Fear River and Lockwoods Folly Inlets

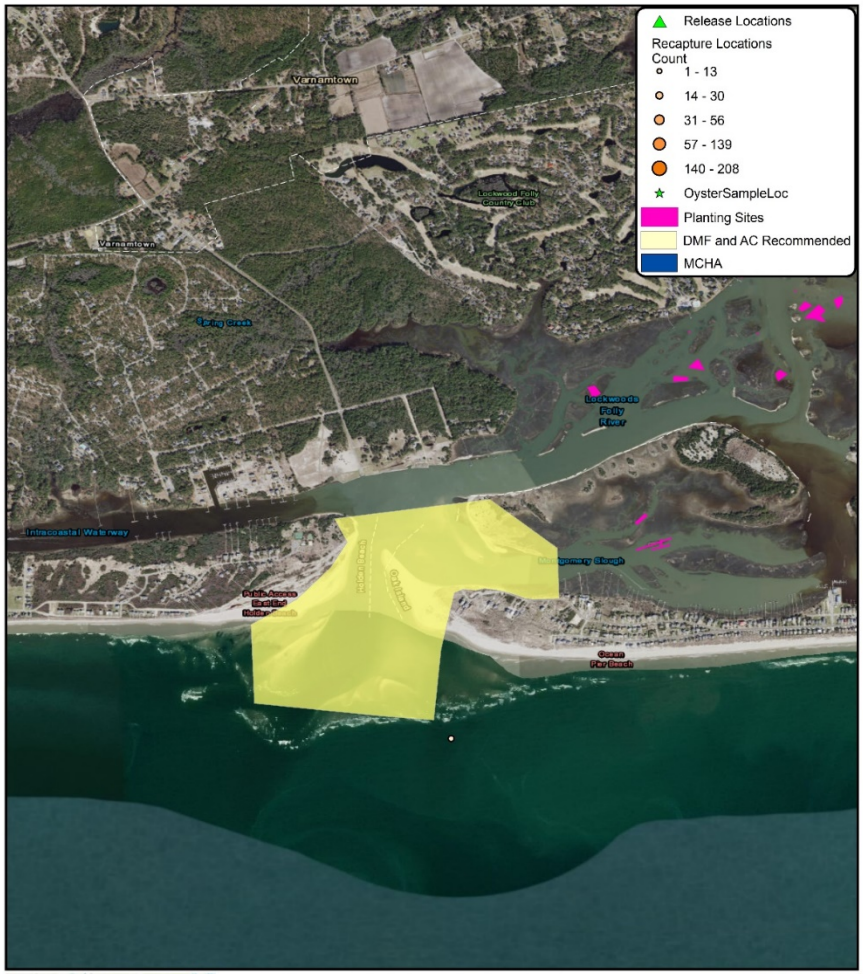


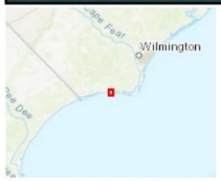


Proposed Crab Spawning Sanctuaries

Cape Fear Inlet

Kilometers
0 0.75 1.5
Miles
0 0.75 1.5



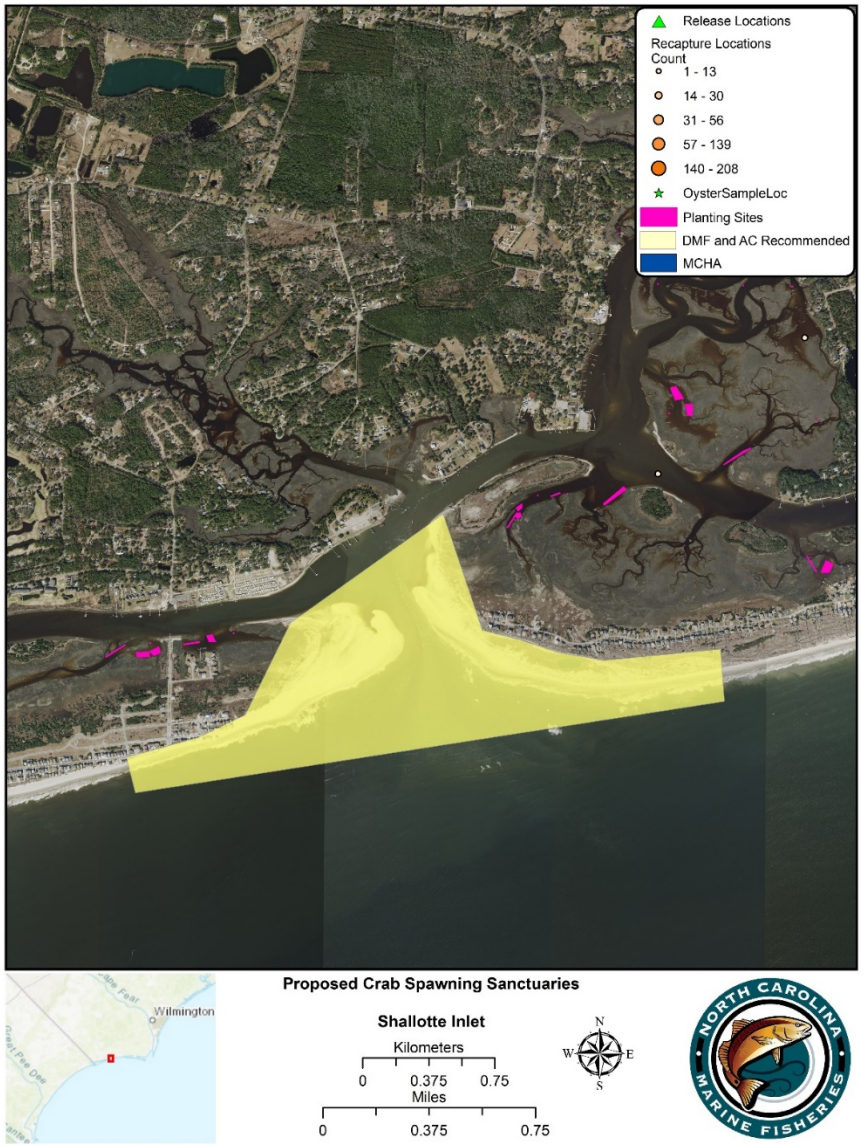


Proposed Crab Spawning Sanctuaries

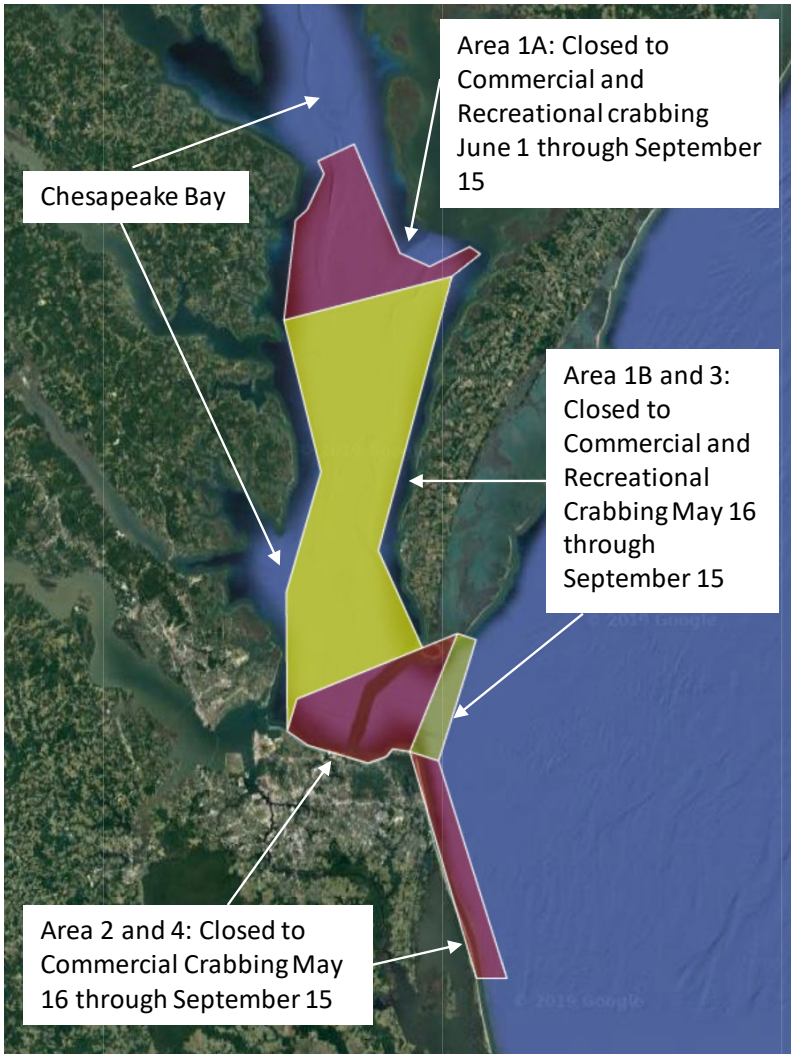
Lockwood Inlet

Kilometers
0 0.375 0.75
Miles
0 0.375 0.75

Shallotte and Tubbs Inlets



Migration Corridor Example: Chesapeake Bay



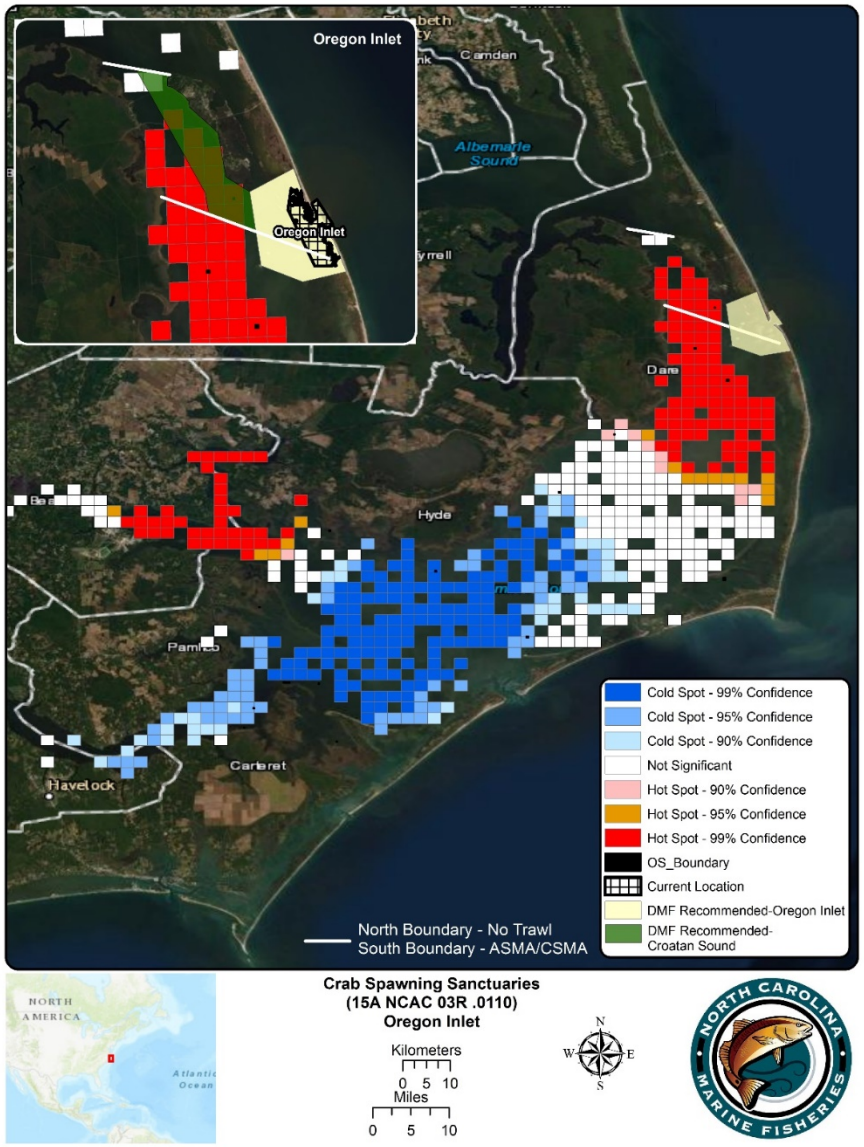
Chesapeake Bay

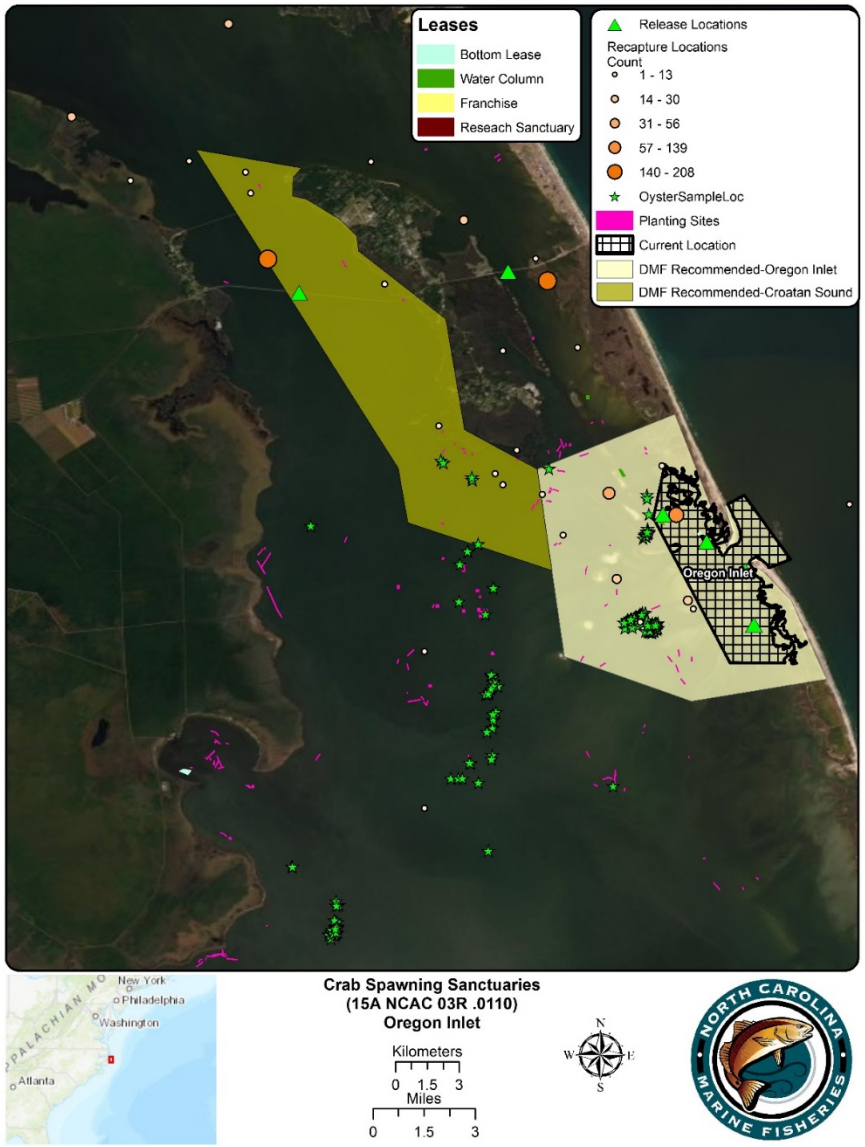
- Closed seasonally
  - May 16 through September 15
  - June 1 through September 15
- Estimated to protect 70% of mature females

North Carolina

- Eggleston et al. 2009 did not detect distinct migration corridor in Albemarle-Pamlico system
- Females migrating from Albemarle Sound area must pass through Croatan and Roanoke sounds to reach spawning grounds

Croatan Sound





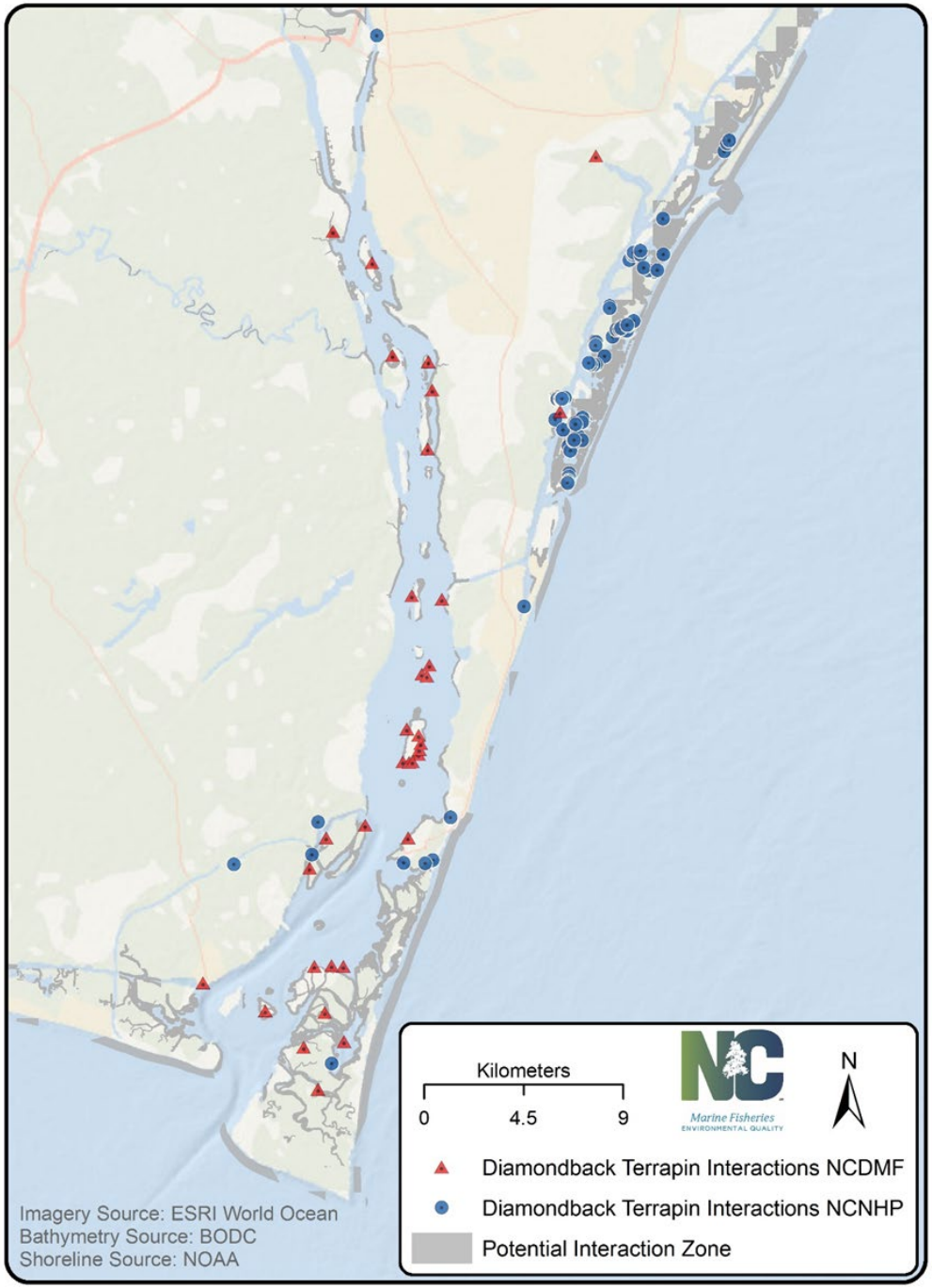
Appendix 4.5: Establish A Framework To Implement The Use Of Terrapin Excluder Devices In Crab Pots

Application: Framework Steps1, 2, and 3 Summary of Diamondback Terrapin Research

- Areas behind Masonboro and Bald Head have been identified as containing populations of diamondback terrapins vulnerable to capture in crab pots
- NCDMF & NCNHP datasets
- 9 studies examined diamondback terrapins, their biology, capture in crab pots, and population decline in these areas

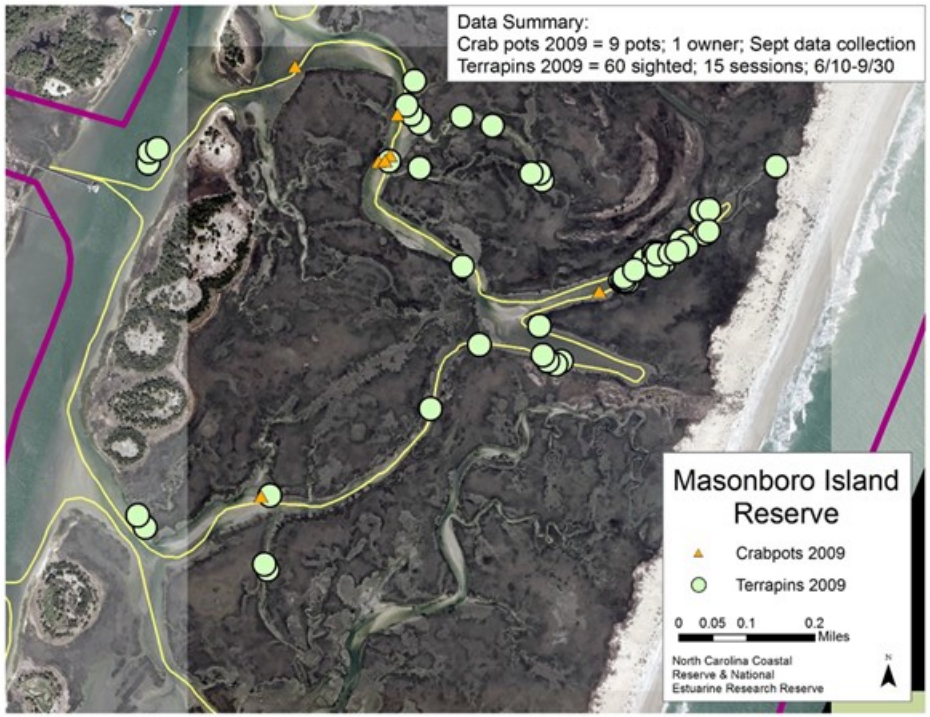
Application: Framework Step 4 Presence and Potential Interaction with Fishery

- NCDMF & NCNHP documented terrapin locations
- Potential interaction zone: water less than 3 m (9.8 ft.) deep and less than 250 m (820.2 ft.) from shore

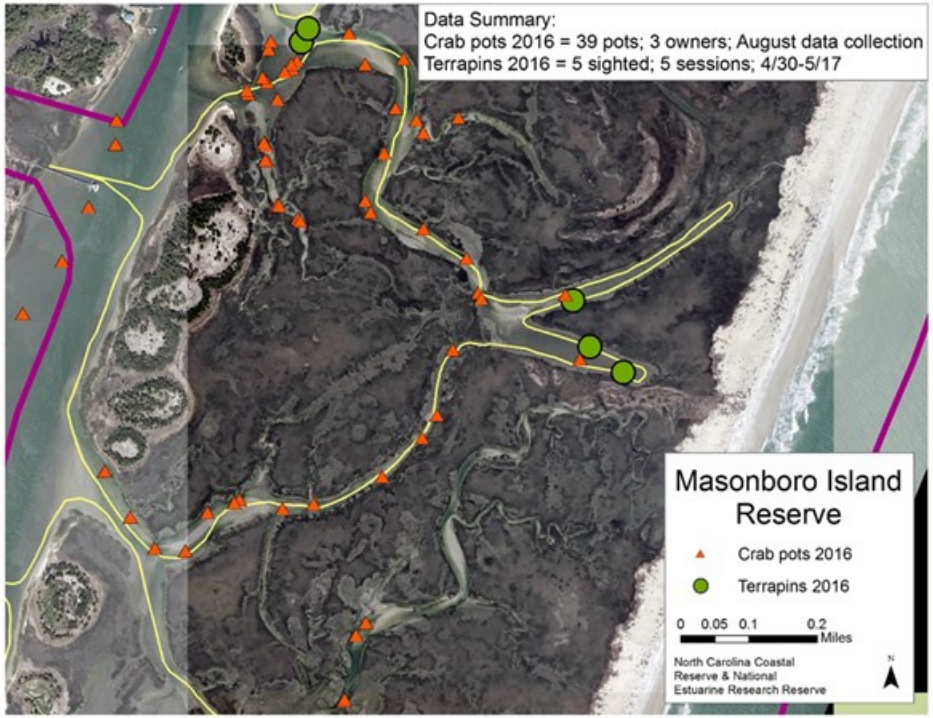


Application: Framework Step 4
Presence and Potential Interaction with Fishery

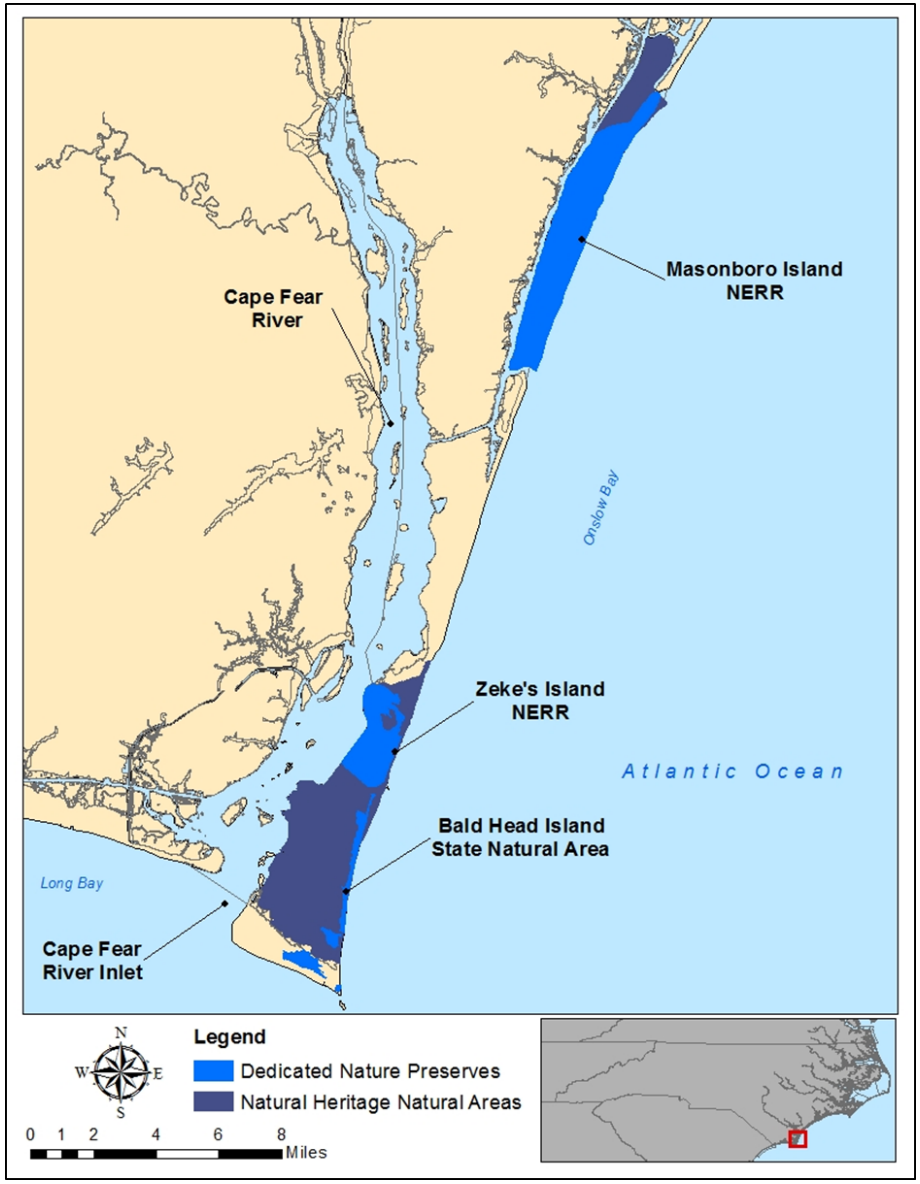
2009

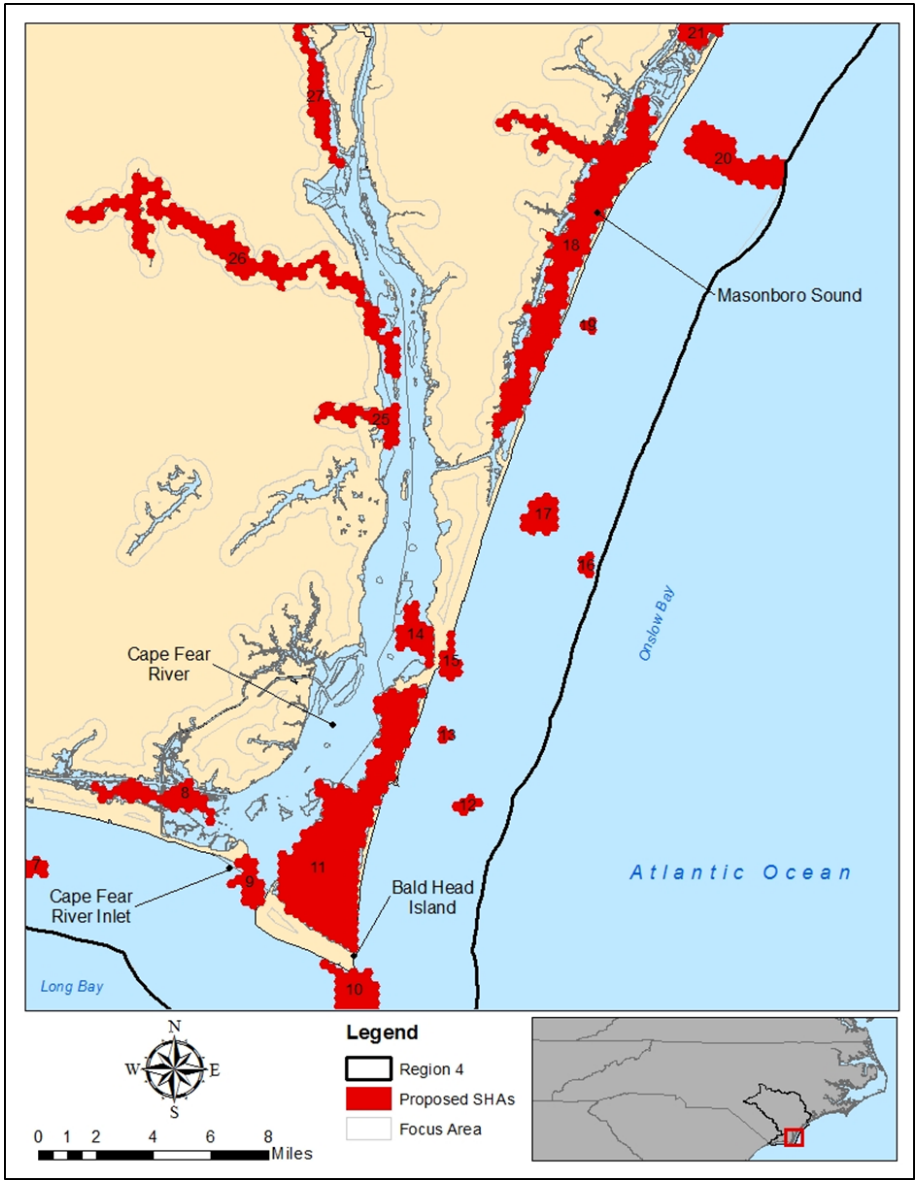


2016



Application: Framework Step 5
Existing Ecological Areas





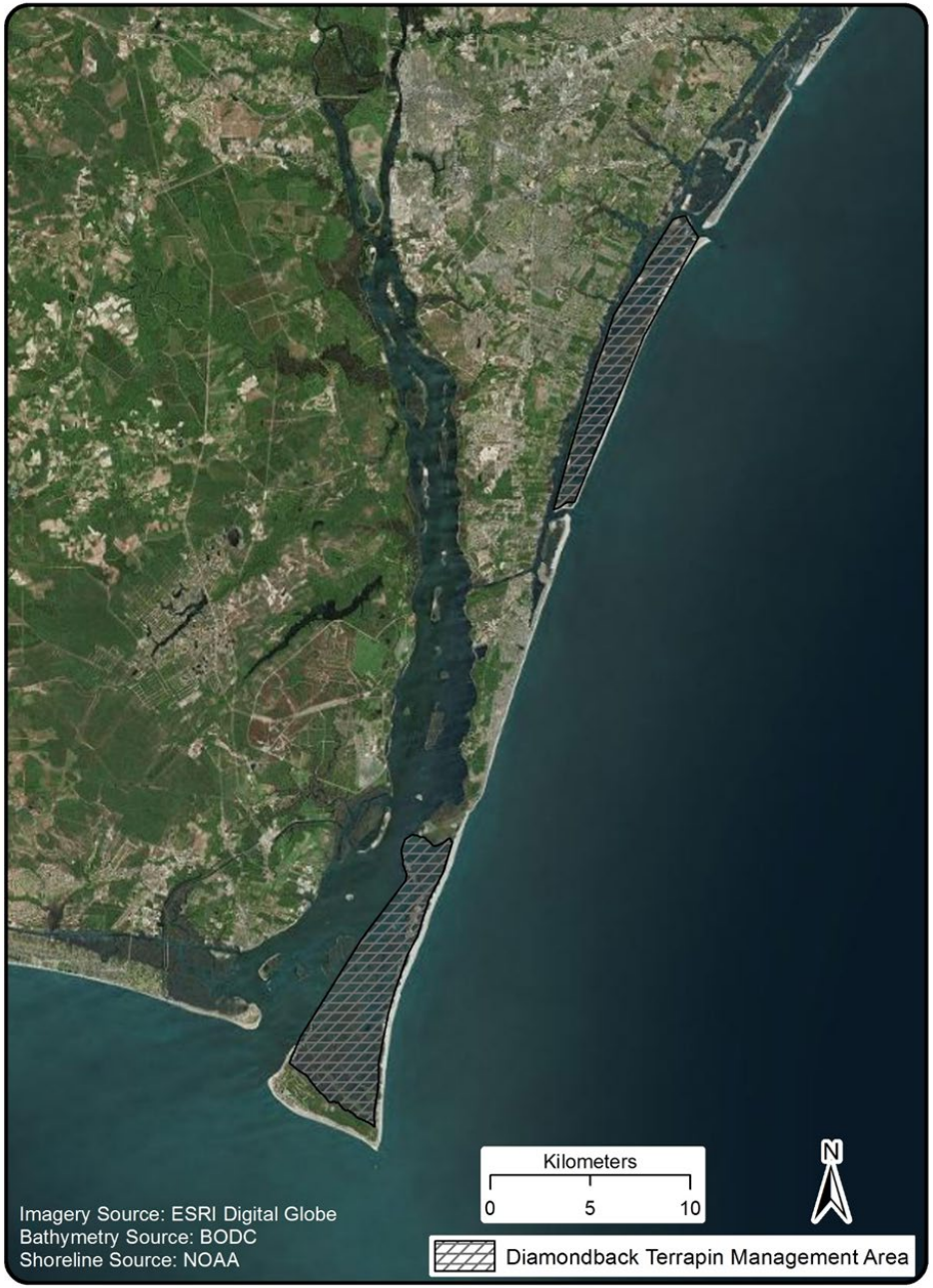
Application: Framework Step 5 Potential DTMAs

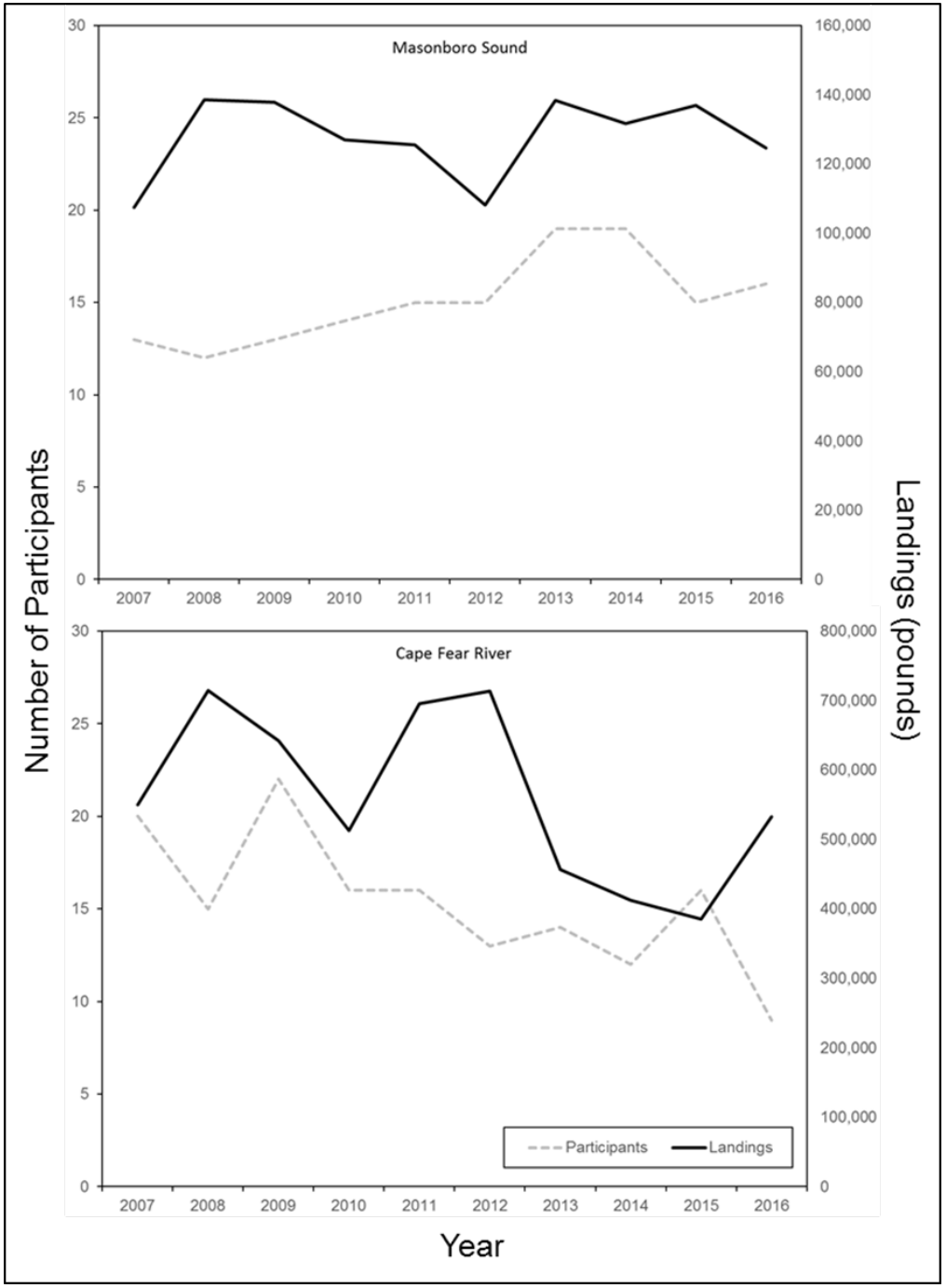
Masonboro DTMA

- 85% of water in interaction zone
- 64% of Trip Ticket reporting area

Bald Head DTMA

- 61% of water in interaction zone
- 29% of Trip Ticket reporting area





Application: Framework Steps 6 and 7 Local Blue Crab Fishery Information

- Fishery Information: 2007 - 2016
  - 12-19 (average 15) participants Masonboro
  - 9-22 (average 15) participants Bald Head
  - Masonboro DTMA smaller but comprises higher portion of trip ticket area and may impact more individuals than Bald Head DTMA
- Hold Public Meeting
- Issue Proclamation

Appendix 4.6: Bottom Disturbing Gear In The Blue Crab Fishery

Dredges

- Crab Dredging is only permitted in January and February
- Due to seasonality and location of crab dredging, the gear harvests overwintering adult females in some areas

Average monthly blue crab landings (pounds) and value from crab and oyster dredges in the past ten years (2008-2017).

	Crab Dredge		Oyster Dredge		Total	
Month	Weight (lb)	Value ($)	Weight (lb)	Value ($)	Weight (lb)	Value ($)
January	4,016	3,316	1,851	1,344	5,867	4,660
February	3,395	2,993	2,041	1,547	5,436	4,540
March	0	0	656	562	656	562
April	0	0	25	16	25	16
October	0	0	5	3	5	3
November	0	0	1,303	1,060	1,303	1,060
December	0	0	1,126	1,065	1,126	1,065

Trawls

Trawl landings of crabs in the Pamlico, Pungo, and Neuse rivers have declined since 1995 and have been minimal since 2007

	Crab Trawl			Shrimp Trawl		
Year	Neuse River	Pamlico River	Pungo River	Neuse River	Pamlico River	Pungo River
1995	35,618	154,056	267,400	34,019	7,452	0
1996	212,979	486,829	298,657	50,710	0	1,412
1997	411,998	400,922	401,605	57,808	11,144	2,883
1998	306,178	559,477	203,993	40,883	1,526	0
1999	243,473	457,575	208,396	31,644	4,264	1,123
2000	47,674	104,043	78,764	11,144	1,472	714
2001	41,030	43,164	17,625	5,390	2,284	462
2002	2,877	4,506	142,682	11,985	1,532	1,027
2003	41,411	139,386	81,037	6,410	<500	<3,000
2004	35,363	76,990	63,604	12,444	0	0
2005	18,982	159,327	8,857	4,992	<500	<500
2006	6,057	19,512	<5,000	1,195	76	<500
2007	1,283	<500	<500	<1,000	<500	0
2008	<500	<500	<500	900	0	0
2009	<500	<500	<500	105	<2,000	0
2010	<500	<500	0	<500	0	0
2011	0	<500	0	<500	<500	0
2012	<500	0	0	0	<500	0
2013	0	0	0	904	0	0
2014	<500	0	0	2,561	0	0
2015	<500	<500	<500	451	<500	0
2016	<1000	<500	<500	<500	<500	0
2017	<500	<500	0	360	0	0