Risky Business: Consumption of Self-Caught Fish in Tyrrell County, North Carolina

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EXECUTIVE SUMMARY

Overview

Recreational fishing provides inexpensive protein to low income residents of Tyrrell County, which is the least populated and one of the most economically challenged counties in the state of North Carolina. Located in the Albemarle estuarine system of eastern North Carolina, Tyrrell County is home to an abundance of fish and shellfish but also has a fish consumption advisory for dioxins and mercury for which the levels of awareness of the risks associated with consuming the fish are unknown. The objectives of this research study are twofold: (1) to investigate the methods of and barriers to accessing the local fish, and (2) to evaluate the extent to which residents of Tyrrell County are aware of the risks associated with consuming fish in the Albemarle estuarine system. The results of this research may be useful to environmental managers in improving access to fish and assessing how to effectively communicate risks of consuming fish to residents of rural coastal counties.

Methods

Data for this research study were collected through semi structured interviews of community leaders and surveys of Tyrrell County residents who eat recreationally caught fish, either by catching it themselves or by receiving fish as gifts.

Key Findings

- People depend on catching fish or getting fish as gifts to help with their grocery bills.
- Several barriers exist to freely accessing fish for consumption.
- None of the respondents had accurate information about the Albemarle Sound fish consumption advisory for dioxins in carp and catfish.
- Most people surveyed were not informed about the statewide consumption for mercury, directed especially at women of child-bearing age and developing children.
- Many lower-income residents do not use the internet, which is a main source of updated fish consumption advisories.
- Survey participants incorrectly assumed that fish consumption advisories would be posted at fishing locations with contaminant risks.

Implications

- Recreationally caught fish is important to low income residents of Tyrrell County as a supplement to their grocery costs, yet not all eligible residents have a subsistence waiver. Suggestions include loosening the restrictions on obtaining the waiver and publicizing its availability.
- Better communication about contaminant risks in recreationally caught fish is needed. Suggestions are to post information about contaminant risks at public meeting places (e.g., boat ramps, libraries, and social service offices) and print public service announcements in local newspapers.

INTRODUCTION

Recreational fishing provides inexpensive protein to low income residents of Tyrrell County, which is the least populated (US Census, 2016) and one of the most economically challenged counties in the state of North Carolina (NC Department of Commerce, 2016). Located in the Albemarle estuarine system of eastern North Carolina, Tyrrell County is home to an abundance of fish and shellfish but also has fish consumption advisories for dioxins and mercury (NC Department of Public Health, 2015). The level of awareness of the risks of consuming local fish from water bodies with fish consumption advisories is unknown. The first objective of this research study is to evaluate the extent to which residents of Tyrrell County are aware of the risks associated with consuming self-caught fish in the Albemarle estuarine system. The second objective of this study is to describe County residents' access to fish: how they fish, what barriers to fishing exist, and how important fishing is to each individual, economically and culturally. These results would not only highlight how knowledgeable rural residents are of fish consumption advisories, but would also be useful to environmental managers to assess how to effectively communicate risks associated with consuming fish from contaminated water bodies to residents of rural coastal counties.

Previous surveys of recreational fishers that were conducted by the authors throughout coastal North Carolina in 2012 revealed that low income residents depend heavily on harvesting fish and shellfish to supplement their protein intake (Brown-Pickren, 2012). Preliminary surveys of Tyrrell County residents who commuted to the Outer Banks during the summer of 2014 revealed that few residents have hope of obtaining living-wage benefitted jobs (Griffith et al., 2014), which is supported by the U.S. Census estimate of over 28% of the county living below the poverty level in 2014 (US Census, 2015). These economic challenges and access to rich fishing grounds show the need for better information about contaminant risks.

Tyrrell County is situated in a low lying coastal area bounded by the Albemarle Sound to the north and the Alligator River to the east. The County has an area of ~600 square miles including 390 square miles of land and 210 square miles of water. The extensive rivers and swamp land suggest historic reliance on fish and shellfish for sustenance. The County contains only one incorporated municipality – Columbia, the county seat - and four unincorporated communities. The largely rural population depends on gardening, fishing, and collecting wild food for a good portion of their sustenance (Brown et al., 1998; Vaughan and Vitousek, 2013).

In 2007, a new license structure was put in place in North Carolina that eliminated free fishing for residents within their county and in the ocean. The need for low income residents to fish was acknowledged in the new regulations by including the "Unified Subsistence Inland/Coastal Recreational Fishing License Waiver"

(hereinafter the subsistence waiver) (Fisheries Moratorium Steering Committee, 1996). The subsistence waiver is free for North Carolina residents who receive Medicaid, Food Stamps (SNAP), or Work First Family Assistance and is issued through each county department of social services. Although Tyrrell County is ranked third statewide in per capita number of subsistence fishing waivers in 2015, with 3.0% of the population receiving a waiver (Linehan, 2016), Brown-Pickren (2012) suggests that more economically disadvantaged people are dependent on fishing in Tyrrell County than is indicated by the number of subsistence waivers issued. Since as many as two-thirds of Americans do not participate in assistance programs for which they are eligible (Blank and Ruggles, 1996; Stuber and Schlesinger, 2006), and no state agency has collected information about the type and amount of fish caught by holders of subsistence waivers (C. Wilson, personal communication, May 24, 2016), many more people than expected may be catching their own fish in the County. Thus, the risk to exposure of contaminated fish may be greater than is currently known.

Albemarle Sound has been under a North Carolina Public Health Department fish consumption advisory since 2001 because of the presence of dioxins from the pulp industry on the Roanoke River (Clark, 2004), as well as a statewide advisory for mercury (North Carolina Department of Public Health, 2015). This project is intended to assess the extent to which local residents are dependent on the rivers, creeks, swamps and sound for providing food and evaluate the public awareness of risk associated with consumption of contaminated fish and shellfish.

Relevance to Sea Grant and APNEP missions

This research study addresses the "Safe and Sustainable Seafood Supply" focus areas of the North Carolina Sea Grant 2014-17 Strategic Plan by assessing the extent to which local residents depend on seafood and evaluating the residents' knowledge of and behavioral changes to fish consumption advisories. This project also addresses Objective D2 of the APNEP Comprehensive Conservation and Management Plan by assessing angler knowledge of health advisories and increasing public understanding of the relationship between human and ecosystem health.

METHODS

There were two phases to this project. The first phase was conducted through on-site semi-structured interviews with community leaders (N=15) of Tyrrell County during the fall of 2015. This group included elected officials, social service providers, and fishery managers. The data collection instrument (Appendix A) included questions designed to determine familiarity with fishing regulations and fish consumption advisories, perceptions of socio-economic status of county residents, and residents' dependence on recreationally caught fish. Community leaders were also asked for recommendations for recruiting county residents for the survey purposes.

The second phase was administering surveys (Appendix B) to county residents (N=50), both those who fish and those who do not. All participants were assured of the confidentiality of their responses.

The interview and survey questions were derived from several sources. Fishing conflict questions were adapted from Crosson (2010) and ecology questions were derived from Brown-Pickren (2012). A description of the study, the interview questions and the survey were submitted to the East Carolina University Institutional Review Board and was approved September 16, 2015 (Appendix F).

Survey participants were recruited using two methods. First, an announcement was placed in the Scuppernong Reminder, the regional weekly newspaper, inviting Tyrrell County residents to meet at the library at specified times. Second, after permission was obtained, a flyer was posted in a local convenience store and the interviewer conducted surveys on folding chairs in the parking lot. All potential survey respondents were asked if they were residents of Tyrrell County, asked if they ate recreationally caught fish (either that they caught themselves or were given by a recreational fisher), assured of the confidentiality of their answers, and told they would receive a ten dollar Food Lion gift card upon completion of the survey. Respondents who did not participate in fishing were administered an abbreviated survey.

The interviews and surveys were completed during nine trips to Tyrrell County between October, 2015 and April, 2016. The complete responses are in table form in Appendix C.

RESULTS

Phase I

Community Leader Interviews (N=15)

After explaining the project and obtaining consent, the first interview question asked of respondents was how long they had lived in Tyrrell County. One person commuted to Tyrrell County for work (the minimum of 0 years) and one had lived his entire life and retired in Tyrrell County (the maximum of 68 years). The median length of residency was 33 years.

Respondents were asked how important they thought eating recreationally caught fish was to the residents of Tyrrell County. Community leaders had distinctly opposing views on the importance of self-caught fish to county residents, with one-third of respondents answering that fishing is highly important and almost one-third saying fishing is not at all important. One comment was that people can't feed themselves from fishing because the fishing has gotten so poor and the regulations are too complicated.

When asked for their perception of the employment situation in Tyrrell County, two community leaders responded that there were "a few jobs available", three answered that employment was "getting better", while two-thirds indicated that the situation was bad, using the descriptors "bad", "sucks", "horrible", "rough", "pitiful", and "dire". One person noted that many people have to leave the county to find work.

Community leaders were asked how personally familiar they were with the North Carolina fishing regulations. Almost half said they were "very familiar" with the regulations while four indicated they were not at all familiar.

The next question was whether the community leaders were aware of the various waivers offered from the menu of fishing license types offered in North Carolina. The interviewer mentioned the free waivers for the blind, those in adult care facilities and the subsistence waiver. The responses were equally divided, although two people mentioned the elderly waiver, but this is actually a $10 lifetime license for North Carolina residents over the age of 65.

Community leaders were asked their opinion of the fishing regulations enacted in 2007. Two-thirds of the community leaders viewed the current fishing regulations as positive, including reasons such as maintaining fish stocks, building new boat ramps, and pointing out the subsistence waiver as helpful to economically challenged residents. One third of the community leaders had negative comments about the fishing regulations, including:
"I don't think it is right to charge people to fish."
"The state is trying to get all the money they can and it hurts poor people."
"If you live here you shouldn't have to pay to fish in your own ditch."

The next question asked whether the respondent recreationally fished. 40% fished and 60% did not, although one person who did not fish regularly received recreationally caught fish as gifts.

All respondents, whether they fished or not, were asked if they were worried about contaminants in recreationally caught fish they ate. Only one person said he was worried about contaminants in recreationally caught fish. When asked where he thought the contaminants originated he said the stagnant water in the ditches held on to contaminants, and there was nothing to be done to clean or cook the fish in a particular way to remove contaminants.

Next the community leaders were asked if they were aware of the fish consumption advisories for the area. Although this group is presumed to be well educated, only 20% claimed to be informed about the North Carolina Department of Public Health fish consumption advisories. When pressed for detailed information, all three mentioned mercury, which is a statewide advisory, and nobody mentioned dioxins, which is particular to western Albemarle Sound.

Respondents were asked what changes they had seen in the local rivers and Albemarle Sound during the time they had lived in Tyrrell County. Increased flooding and pollution were mentioned by 75% of the respondents in response to this open ended question. Two respondents mentioned the poor drainage associated with weeds choking the county ditches, one person thought the Albemarle Sound was saltier and one person said there had been no changes.

Community leaders were asked to predict the effects of sea level rise on Tyrrell County residents. One person said, "I don't think sea level rise is as bad as they say." Almost half the respondents predicted more and worse flooding. Three respondents pointed out the need for relocation of many low-situated homes and four respondents indicated that the harshest impacts of sea level rise will be borne by the poorer county residents.

Phase II

Tyrrell County Resident Surveys (N=50)

For comparison the U.S. Census figures are included for Tyrrell County and for North Carolina. http://www.census.gov/quickfacts/table/PST045215/37177/accessible

Sample Characteristics

Tables 1a to 1g summarize the characteristics of the respondents that took the resident surveys. In general, there as an almost even number of males and females that participated in the survey. A greater proportion of the respondents were African American, and over 70% of the respondents were above 50 years old. Only a small proportion of the sample population is currently married and 22% never graduated from high school. Although 40% of the respondents are in some form of gainful employment, most of the respondents earned between $15,000 and $30,000, with none the respondents earning more than $50,000/ year.

Table 1a. Proportion of male and female participants in the survey.

Gender	N	%	% Tyrrell County	% North Carolina
Male	24	48	46.2	48.7
Female	26	52	53.8	51.3

Table 1b. Proportion of participants from different races who participated in the survey.

Race	N	%	% Tyrrell County	% North Carolina
Black / African American	34	68	36.5	22.1
White / Caucasian	16	32	58.4	71.2

Table 1c. Age ranges of participants in the survey.

Age	N	%
21-30	3	6
31-40	4	8
41-50	6	12
51-60	17	34
61-70	15	30
71 and older	5	10
Mean = 51 years		

Table 1d. Marital status of participants in the survey.

Marital Status	N	%
Currently Married	7	14
Divorced	10	20
Widowed	5	10
Never Married	23	46
Separated	5	10

Table 1e. Education attainment of participants in the survey.

Highest Level of Education	N	%	% Tyrrell County	% North Carolina
11th Grade or Less	11	22		
High School Graduate	17	34	70.6	85.4
Some College / Technical Training	13	26		
College Graduate	7	14	8.0	27.8
Graduate Work	2	4		

Table 1f. Employment status of participants in the survey.

Employment Status	N	%
Full Time Employment	14	28
Part Time Employment	6	12
Unemployed	18	36
Disabled	5	10
Retired	7	14

Table 1g. Income level of participants in the survey.

Individual Income	N	%
Less than $15,000	6	10
$15,000 - $30,000	12	60
$30,001 - $50,000	2	10
More than $50,000	0	0
Total	20	

Access to the Resource

In order to gauge access to fishing respondents were asked questions about their fishing habits: how often they fished, which gear and locations they preferred, the length of their fishing experience, how they were taught about fishing, and how they learn about fishing currently. They were asked what type of license they hold, what they do with their catch, and how important fishing (or receiving fish as gifts) is to their families. They were also asked about barriers to fishing: if they had conflicts while fishing, if their physical access to fishing spots had been challenged, and what sorts of changes they had seen in the species of fish and the environment around their fishing spots.

Fishing Habits

An assessment of the fishing habits of the respondents indicates that 15 of the 50 respondents do not fish for themselves (Table 2). Of the fishers, almost 70% fished three or four seasons out of the year and almost 60% fished at least weekly, showing that fishing is a common pastime, whether for recreation or sustenance.

Table 2. Frequency and timing of fishing activity for survey participants.

How often and which months do you go fishing?	N	Percentage All	Percentage of Fishers
All Months	9	18	26
Spring	1	2	3
Summer	8	16	23
Fall	3	6	8
Spring Summer and Fall	14	28	40
Daily	1	2	3
A few times a week	10	20	29
Weekly	9	18	26
A few times a month	4	8	11
Monthly	7	14	20
A few times a year	4	8	11
Don't fish	15	30	

In order to compare this study population to the North Carolina recreational fishing population described in the Crosson (2010) survey of 680 Coastal Recreational Fishing License (CRFL) holders, respondents were asked which type of gear they used (Table 3). Results indicate that most people fish with a fishing rod, although one person used gigs for flounder, one person used crab pots, and one person used a cast net for bait. Although Crosson's (2010) study was of CRFL holders and the Tyrrell residents held a variety of types of fishing licenses, it was surprising that more people in Tyrrell County did not pursue shellfish.

Table 3. Fishing gear preference of survey participants.

What type of gear do you use?	N	Percentage All	Percentage of Fishers	Percentage Crosson
Hook and Line	32	64	91	100
Crab pots	1	2	3	18
Cast net for bait	1	2	3	25
Gig for flounder	1	2	3	-
Rakes for clams	0	0	0	18
Dive	0	0	0	6
Don't fish	15	30		

Participants were asked whether they fished from the bank, a pier or a boat or some combination. Most people (94%) fished off of the bank, which is free and reinforces the idea that fishing is important to low income residents.

Respondents were also asked how long they had been fishing. 91% had been fishing more than 10 years and almost 70% answered that they had fished more than 30 years. The average length of fishing experience was ~25 years. Several people commented "All my life," in answer to this question.

When asked who taught them to fish, most people (89%) replied that they had learned to fish from relatives, usually older relatives including parents, grandparents, aunts and uncles (Table 4). When asked who they currently seek advice on fishing (where to fish, what's running, what bait to use, etc.) 88% responded that they generally ask friends and siblings, with 6% asking a bait store employee.

Table 4. Fishing education in the past and present of survey participants.

Who taught you how to fish?	N	%	% fishers	Who do you ask about fishing now?	N	%	% fishers
Parent	16	32	46		1	2	3
Grandparent	5	10	14		1	2	3
Other relative	10	20	29		10	20	28
Friend	4	8	11		21	42	60
Bait store employee	0	0	0		2	4	6
Don't fish	15	30			15	30	

The most common license was the fresh water / salt water license, with 23% of the fishing respondents holding one (Table 5). The same number of people said they fished without a license. Almost as many, 17%, held a fresh water only license. Two people held a combined fishing and hunting license and four held a senior fishing license. Five respondents (14%) held the subsistence waiver.

Table 5. Types of fishing licenses or waivers held by survey participants.

What type of fishing license do you have?	N	Percentage of All	Percentage of Fishers
Unified Inland/Coastal Recreational Fishing	8	16	23
Inland Recreational Fishing	6	12	17
Unified Sportsman/Coastal Recreational Fishing	1	2	3
Lifetime Sportsman	1	2	3
Unified Subsistence Inland/Coastal Recreational Fishing License Waiver	5	10	14
Senior Coastal Recreational Fishing	4	8	11
Pier	2	4	6
No license	8	16	23
Don't fish	15	30	

When asked their reasons for fishing (Table 6), respondents were given a choice of answers with the option of choosing more than one. Most respondents (54%) chose all three answers. Only one person answered only, "to feed my family," and one person answered only, "to spend time with family or friends." One man said he fished in order to be alone.

Table 6. Reasons survey respondents participate in fishing.

Why do you fish?	N	Percentage of All*	Percentage of Fishers*
It's fun or relaxing.	33	66	94
To help feed my family.	23	46	66
To spend time with family or friends.	27	54	77
Other reason			
To spend time alone.	1	2	3
Don't fish	15	30	

*More than one answer was permitted so the total is more than 100%.

When asked how often they kept fish that they caught, most of the respondents who fished in this survey (57%) said that they kept any legal fish they caught, whereas 34% only kept fish sometimes – generally if they were fishing for a certain species. The question was phrased this way to avoid obtaining information on keeping undersized or out of season fish. Only 9% of fishers in this study practiced catch and release.

Respondents were asked if they had had any conflicts while fishing, with other recreational fishers, commercial fishers, state enforcement agents or federal enforcement agents (Table 7). The question about conflicts while fishing was taken from Crosson's (2010) survey. None of the respondents had had conflicts with the

four categories identified in Crosson's (2010) survey, although one person had had a conflict with a jet ski operator.

Table 7. Conflicts while fishing between survey participants and others.

Have you had any conflicts while fishing?	N	Percentage	Percentage Crosson
With federal enforcement officers		0	1
With state enforcement officers		0	3
With commercial fishers		0	11
With other recreational fishers		0	9
Other (With a Ski-Doo operator)		1	0

Results showing the factors affecting fishing behavior are presented in Table 8. This item was also taken from Crosson's (2010) survey with an added question on competing with other recreational fishers. Respondents to this question agreed with Crosson's (2010) survey respondents for the top two most important factors: keeping up with regulations and water quality. The two groups differed substantially in several areas. First, Crosson's (2010) respondents considered fuel prices the third most important factor while this project's respondents ranked it eighth, which is likely due to the more frequent use of boats by Crosson's (2010) respondents. Second, the weather was ranked sixth most important by Crosson's (2010) respondents while this project ranked weather third, which may be an indicator of the more local fishing behavior; those who were fishing for recreational purposes are more likely to have planned in advance and unwilling to change plans if the weather is marginal; those fishing more frequently or closer to their homes may be more prone to waiting for better weather.

Table 8. Ranked factors affecting fishing behavior.

How important do you consider each of these issues about fishing to you personally?	Not at all important	Not very important	Neutral	Somewhat Important	Extremely important	Ranking, this survey	Ranking, Crosson survey
Keeping up with rules	0	1	0	7	27	1	2
Water quality / pollution	4	2	0	7	22	2	1
Weather	3	4	1	14	13	3	6
Finding enough time in my life to fish	7	7	5	5	11	4	4
Bag or size limits	10	5	0	8	12	5	8
Overfishing / too few fish	14	4	1	9	7	6	5
Losing fishing sites	15	3	0	9	8	7	9
Fuel prices	16	3	1	7	8	8	3
Access issues (lack of boat ramps, parking, etc.)	17	4	2	9	3	9	7
Competition with other fishers / crowding	21	3	1	9	0	10	-
Competition with commercial fishermen	27	4	0	3	1	11	10

Environmental Perceptions

Changes in species available to catch create a type of barrier to fish sources. Each of the respondents who fished was asked if there were types of fish that they catch in the present that they rarely caught in the past in the region. About one-fourth answered in the affirmative and named bass, catfish, flounder, gar, bowfin, mud diggers, and "invasives." They were then asked if there were types of fish they used to catch frequently that they rarely catch now and 37% said yes and named croakers (N=6), spot (N=5), herring (N=2), rockfish (N=2), bass, red drum, sturgeon, trout and white perch as examples of species.

The respondents who fished were asked about changes in the environment during their fishing experiences in the area and given the three choices of "more", "neither", or "less." Those who didn't have enough information to answer the question were tallied in the "neither" column. Table 9 shows the overwhelming answer was the respondent not seeing changes in these categories, with the exception of the category of development, which more than half the respondents said had increased. Pollution was said to have stayed the same by almost half of the respondents, while 40% said it had increased. More than 65% of respondents thought the water in their fishing spots was neither warmer or cooler, and about half thought the number of storms in the area had neither increased nor decreased. Most people (74%) felt unqualified to respond to whether the water was more saline, although 20% thought the salinity had increased.

Table 9. Changes in the environment around fishing areas perceived by survey respondents.

What changes have you seen in this area over the time you have fished here?	More	Neither	Less
Pollution	14	17	4
Development	20	14	1
People fishing	15	15	5
Warmer water	8	23	4
Number of storms	13	18	4
Salinity	7	26	2

Another barrier to access to fishing is flooding events throughout the county that can drown or wash away fishing spots. Most respondents (80%) thought the area flooded often (Table 10) while more than half the respondents said that flooding had not increased.

Table 10. Perceived flooding by survey participants.

Does this area flood often?	N	%	Has flooding increased recently?	N	%
Yes	40	80		22	44
No	10	20		28	56

When asked why the area floods, respondents gave five reasons for flooding:

- Rain (N=40)
  - every time it rains if floods,
  - all the rain this past winter,
  - more storms,
  - during hurricanes
- Ditches need cleaning out (N=7)
- Big tides (N=2)
- Flooding started when the bridge on 64 and visitor center were put in (N=2)
- Sea level rise (N=1)

Contaminant Perceptions

The questions on contaminants were designed to find out how concerned the participants were about the risk of contaminants in the recreationally caught fish they consume, where they think the contaminants originate, and whether they believe they can either clean the fish or cook the fish in a way that will reduce or eliminate contaminants.

The first question about contaminants was whether the participant was concerned about consuming contaminants in fish they caught or were given as gifts. The responses were evenly split between 48% who said they were concerned and 52% who said they weren't. This question did not allow for degrees of concern and showed that about half the respondents were concerned about contaminants to some extent.

Results indicating perceived sources of contaminants are shown in Table 11. The contaminants covered in the North Carolina Department of Public Health fish consumption advisories for western Albemarle Sound are dioxin and mercury (Appendix E). Three people mentioned mercury and nobody mentioned dioxin, although two people thought "industrial pollution" was the source of contaminants. The most common answer was agricultural runoff (39%) and trash or litter (29%).

Table 11. Sources of contaminants perceived by survey respondents.

Where do you think contaminants originate?	N	Percentage
Farm runoff, crop fertilizer	9	39
Trash, litter	7	29
Pollution	2	8
Industrial pollution	2	8
Mercury	3	12
Dioxin	0	0
Sewage	1	4
Total	24	

All respondents were asked if they knew of methods to either clean or cook fish that would reduce or remove contaminants. Of those who fished, 80% said they didn't know of any methods to do so. Although six people answered in the affirmative, when probed further, the methods included cleaning the guts out and cooking in boiling water, neither of which is effective for reducing contaminant loads.

Participants were asked if they knew about the fish consumption advisories for the places they go fishing. Almost 70% of participants who fished were unaware of the local fish consumption advisories. Those who responded in the affirmative were asked to name the consumption advisories. Three mentioned mercury, one mentioned catfish and nobody mentioned dioxins.

Because the Department of Public Health website is one of the few places to find the list of fish consumption advisories, respondents were asked if they used the internet and, if so, where they used it. 58% of respondents said they never used the internet. Of the 21 respondents who said they use the internet, 9 used it at home, 7 used it at the library, 3 used it in their home and the library, and 2 used it from their phone and the library, illustrating the importance of access to the local library.

Those who use the internet to find information were asked if they had ever looked up the North Carolina fishing regulations on the internet. 52% said yes, they had looked up fishing regulations. Each of the internet users were asked if they had ever looked up the North Carolina fish consumption advisories on the internet. Most internet users, 76%, had not visited the fish consumption advisory page on the North Carolina Department of Public Health website (Appendix E).

Each respondent was asked if he or she knew about the "subsistence waiver". Half of the fishers said they had heard of the subsistence waiver and if they hadn't the interviewer described it. The next question was if they thought the subsistence waiver was a good idea or a bad idea. 100% said it was a good idea. During the surveys the interviewer reminded participants that fishing regulations had changed in North Carolina in 2007. The respondents were then asked how they learned of the new fishing license structure. More than half of the respondents learned from state and federal fishery enforcement officers or social service workers (Table 12). Nobody mentioned the internet

Table 12. Sources of information on new fishing regulations.

How did you learn about the new fishing regulations?	N	Percentage
Enforcement agents	10	28
Division of Social Services	8	23
News	6	17
Bait seller	3	9
Moved here after new regulations	1	3
Don't remember	7	20

Importance of Fishing

Respondents were asked if there were other non-employment activities they participated in that helped them feed their family or make money.
Almost one-third of respondents gardened and one-fifth hunted (Table 13). Over half said they did not participate in these activities.

Table 13. Other sustenance activities conducted by survey respondents.

What other activities besides fishing do you do?	N	Percentage*
Garden	15	30
Hunt	10	20
Collect wild plants	6	12
Sell handmade crafts	0	0
Hold yard sales	5	10
None of these	27	54
Other (play guitar)	1	2

*More than one activity was allowed so not equal to 100%.

Those who did not fish were asked how often they received fish as a gift. About half of the respondents received fish more often than three times each month (Table 14). Many of the responses included the caveat, "It depends on the season."

Table 14. Frequency of receiving gift fish by non-fishing survey participants.

How often do you receive fish as a gift from somebody who caught it?	N	Percentage	Percentage of non-fishers
Two times/week	2	4	13
Every week	1	2	7
Two or three times/month	4	8	26
One or two times/month	7	14	47
Less than once/month	1	2	7
Catch my own fish	35	70	

The fifteen survey respondents who did not catch their own fish were asked to rate how important getting fish as gifts was. One-third of non-fishers said that gifted fish were not at all important (Table 15).

Table 15. Importance of receiving gift fish by non-fishing survey participants.

How important is receiving gift fish to your family grocery bill?	N	Percentage	Percentage of non-fishers
Not at all important	5	10	33
Slightly important	6	12	40
Somewhat important	3	6	20
Very important	1	2	7
Catch my own fish	35	70	

DISCUSSION

Access and Importance

This project revealed that residents of Tyrrell County depend substantially on catching fish or getting fish as gifts to help with their grocery costs. About three-quarters of respondents indicated some level of importance, although several mentioned that it was more difficult to catch fish currently because of the increasingly complicated regulations, cost for a fishing license, and decreasing fish stocks. Several older residents remember fishing out of the roadside ditches near their homes but can't do that now because the ditches are blocked with weeds. Two-thirds of those who fish said they did so to help feed their families.

When asked their opinions of the new fishing regulations, most of both groups – community leaders and county residents - responded negatively. While some acknowledged the need for new boat ramps and management, most thought fishing should be free within the county, as it was previous to the 2007 changes.

Several barriers exist which limit Tyrrell County residents' access to the fish in their rivers, streams, and the Albemarle Sound. The increasingly strict catch regulations were mentioned several times, as one respondent said, "I don't even know what I can keep anymore; they keep changing the limits." Although waterfront construction of high end homes is not as rampant in Tyrrell County as much of the rest of the North Carolina coastline, several people mentioned no longer being able to fish in ponds where they used to fish because the property owners had fenced them out or posted "no trespassing" signs. Also mentioned repeatedly was the stagnant water in the local ditches, which were said to previously be moving water and good places to catch fish. Recent strong storms have also washed out previously productive streams or eroded away the access roads to these points.

The subsistence waiver was overwhelmingly thought to be a good idea. One county resident said, "I ought to be able to fish near my house if there's fish in the crick." However, not all those who are eligible for the waiver have one. One man told me, "I'll be damned if I'm going to go on welfare even if it means I could get a free pass to fish." The disconnect between those who have a subsistence waiver and those who are eligible may be suggested by the U.S. Census figure of 28.3% of county residents living in poverty (2015 estimate) while only 3.4% of residents have received the waiver. If every one of the 18.8% of county residents estimated to be under the age of 18 were living in poverty, the number of subsistence waivers would be 9.5% of the population if one was issued to every person eligible. Although the cost of a fishing license in North Carolina is lower than most states, many people are unable to afford it as evidenced by 23% of the survey respondents who fish but do so with no license.

In addition to feeding the family, fishing is also an important cultural event. Most people were taught to fish by older relatives and still go fishing with relatives. Two-thirds of fishers said they enjoy fishing because it lets them spend time with family or friends.

Contaminants

This project was intended to sample the people who consume self-caught fish in Tyrrell County and assess their awareness of the risk associated with consumption of potentially contaminated fish.

Both the community leaders interviewed and the county residents surveyed were mostly unaware of the contaminant risks in the recreationally caught fish from the area. Nobody in either group mentioned dioxins and very few people interviewed had accurate information about the statewide fish consumption advisory for mercury. Many survey participants assumed that there would be warnings posted any place there is a risk, but that is not the case. The only sources for fish consumption advisories are in the print copies of the inland fishing regulation booklet and online, and yet many Tyrrell County residents do not use the internet. North Carolina has fewer people who own home computers and use the internet compared to other states (File and Ryan, 2014). Also, internet usage is considerably lower in rural communities than urban communities (Carlson and Goss, 2016). Thus, relying on the internet to disseminate information about contaminant risks may not be as effective as previously thought.

Two people said they knew ways to cook fish to reduce contaminants but neither method – boiling and deep frying - was appropriate for reducing contaminants in fish. Although the effectiveness of removing contaminants by cooking and cleaning techniques varies widely among species (Foran et al., 2005; Shen et al., 2016), dioxin contamination can be reduced by certain cooking methods that remove the belly flap, skin, and lateral line, as dioxin is stored in lipids (Zabik and Zabik, 1999). It is not clear whether the respondents applied these food preparation techniques in an attempt to reduce contaminants.

Mercury levels cannot be reduced in fish through cooking (Burger et al., 2003). Studies have shown that mercury loads actually increase during cooking (Perugini et al., 2016; Ouedraogo and Amyot, 2011; Maulvault et al., 2011) because the loss of moisture concentrates the mercury during the cooking process. No respondents mentioned combining fish with other foodstuffs to reduce mercury risk, although tomato products (Gagne et al., 2013), coffee and green tea (Ouédraogo and Amyot, 2011), and tropical fruit (Passos et al., 2007) have been shown to reduce mercury bioavailability during digestion.

Limitations

There are several limitations to this study. The selection of participants for the survey was limited to within the city of Columbia. Attempts were made to conduct surveys in the rural convenience stores in the Gumneck and Alligator communities but were unsuccessful. According to the 2010 Census, about one-fourth of the county's residents live in Columbia. Although Hispanics comprise 7% of the population of the county, none participated in the survey, when a representational sample would have been 3 or 4 Hispanics.

Key Findings

- People depend on catching fish or getting fish as gifts to help with their grocery bills.
- Several barriers exist to freely accessing fish for consumption.
- None of the respondents had accurate information about the Albemarle Sound fish consumption advisory for dioxins in carp and catfish.
- Most people surveyed were not informed about the statewide consumption for mercury, directed especially at women of child-bearing age and developing children.
- Many lower-income residents do not use the internet, which is a main source of updated fish consumption advisories.
- Survey participants incorrectly assumed that there will fish consumption advisories would be at locations with contaminant risks.

Impacts

The findings of this study were presented in a public meeting in the Tyrrell County Library on June 21, 2015, which led to an article in the Scuppernong Reminder, the local newspaper, published July 5, 2015.

A one-page flyer on contaminant risk in Tyrrell County (Appendix D) was developed and distributed to the library, the planning office, the post office, both rural grocery stores, and the Division of Social Service office.

Respondents to the survey each received a $10 gift card for the Food Lion grocery store, totaling $500 dispersed to County residents.

Funds were applied to one very appreciative doctoral student's dissertation research.

This study was used to leverage funding for a similar study in neighboring Hyde County from the ECU Coastal Maritime Council. The study used the same interview guide and survey resulting in ten additional county leader interviews and twenty additional county resident surveys.

Recommendations

The study findings will be offered to management agencies with two recommendations.

Better dispersal of information about contaminant risks is essential. The lack of internet usage among survey participants suggests that signs should be posted in public areas, including libraries, Division of Social Service offices, and, especially, at boat ramps. The Department of Public Health fish consumption advisories are

published in the inland fishing regulations and should also be included in the saltwater fishing regulations.

Broadening the eligibility of those who receive subsistence waivers would help the most economically challenged North Carolina residents. Many people who are eligible for various types of assistance do not participate, whether because of the stigma attached or because they are unaware of their eligibility. Since the fishing regulations changed in 2007 to require a license or waiver for all fishing many residents are fishing without a license, risking steep fines if they are caught.

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Appendix A
Data Collection Instrument for County Leaders

Interview questions for Tyrrell County leaders, including church leaders, social service workers, county law enforcement, county commissioners, business leaders, fishery managers, state water quality personnel, regional environmental groups, and regional economic development organizations.

1. How long have you lived in Tyrrell County?
2. What proportion of county residents do you think fish regularly to feed themselves and their family?
3. What is the employment situation in the county?
4. How familiar are you with fishing regulations?
5. Do you know of the various fishing waivers?
6. Specifically the subsistence waiver?
7. What is your personal opinion of the fishing regulations?
8. What do you think the general opinion about fishing regulations is held by county residents?
9. Do you fish?
10. What do you do with the catch? (keep and eat, give to friends/neighbors, release)
11. Are you worried about contaminants in your catch?
12. Which contaminants?
13. What do you do about contaminants?
14. Are you familiar with the fish consumption advisories?
15. What changes have you seen in the rivers and Sound in the time you've lived here?
16. How do you think the county will be affected by sea level rise?

Appendix B - Data Collection Instrument for County Residents

Risky Business: Consumption of Self-caught fish in Tyrrell County, North Carolina
Coastal Resources Management Program, East Carolina University
Interview Guide

We are interested in learning about the experiences of the people who fish recreationally in Tyrrell County. Your participation in this study is voluntary. You are free to end the interview at any time and to refuse to answer any question you do not want to answer. We would like to record the interview for accuracy, but any names or other identifiers will be removed from the transcripts we produce from the recordings. The information you provide will be kept confidential. While we will be using an interview guide, we encourage you to speak about any issues you believe are relevant to your experience as a Tyrrell County resident who fishes or has family members who fish. For your participation, you will be given a $10.00 Food Lion gift card.

Section I for fishers

4.How often do you go fishing? Daily, weekly, monthly, yearly

5.Months fished (circle all) J F M A M J J A S O N D All

6.What gear do you use and what do you target?

- — Hook and line for finfish
- — Clams ___Rakes or ___Other method_____
- — Crabs ___Pots or ___Other method_____
- — Cast net
- — Gig for flounder
- — Dive

7.Where do you fish?

- — Bank
- — Pier
- — Boat ___Own ___Rent ___Friend owns
  - If owns boat, how big is it and where is it kept?

8.Do you ever fish in another state? No__ Yes__(which state?)_____

9.How long have you been fishing? (in years) _____
10.Who taught you how to fish?
___Parent ___Grandparent ___Other relative ___Friend ___Self ___Other_____
11.Who do you ask about fishing now?
___Parent ___Grandparent ___Other relative ___Friend ___Self ___Other_____
12.Are you concerned with contaminants in the fish you catch? Yes No Sometimes
13.Where do you think the contaminants come from?_____
14.Do you cook or clean the fish any way to reduce contaminants? Yes No
If 'yes' please explain_____
15.Can you tell if there are contaminants in fish by looking at the water? Yes No
If 'yes' please explain_____

1. Date_____

2. Time_____

3. Location
_____

16.Where do you get information about contaminants in fish?_____

17.Are you aware of the consumption advisories for this spot? Yes No

18.Do you use the internet to find information? Yes No

19.Where do you use the internet? Home Library Other_____

20.Have you looked up fishing regulations on the internet? Yes No

21.Have you looked up fish consumption advisories on the internet? Yes No

22.In the last year have you had any conflicts while fishing? If yes, please explain:

- With other recreational fishers
- With commercial fishers
- Federal officers (like the Coast Guard)
- State officers (like Marine Patrol)
- Other

How important do you consider each of these issues about fishing to you personally?

	Not at all important	Not very important	Neutral	Somewhat Important	Extremely important
23.Keeping up with rules					
24.Finding enough time in my life to fish					
25.Weather					
26.Bag or size limits					
27.Water quality / pollution					
28.Competition with other fishers / crowding					
29.Competition with commercial fishermen					
30.Overfishing / too few fish					
31.Fuel prices					
32.Losing fishing sites					
33.Access issues (lack of boat ramps, parking, etc.)					
34.Other					

35.Are there fish you rarely catch here now that you used to catch frequently? Yes No
36.What type(s)?

37.Are there fish that you catch now that you almost never caught in the past? Yes No
38.What type(s)?

39.Have you noticed any change in size of fish over the years? Yes No
40.What type(s)?

What changes have you seen in this area over the time you have fished here?

41.Pollution __More __ Neither more or less __Less
42.Development __More __ Neither more or less __Less
43.People fishing here __More __ Neither more or less __Less
44.Warmer water __More __ Neither more or less __Less
45.More storms __More __ Neither more or less __Less
46. Salinity changes __More __ Neither more or less __Less

47.What other changes have you seen in this fishing spot?

48.Why do you fish? (Select all that apply)
- — It's fun or relaxing
- — To help feed my family
- — To spend time with family/friends
- — Some other reason (describe)

49.How often do you keep fish to eat?
- — all legal fish I catch
- — only certain species
- — sometimes
- — only catch/release

50.Do you keep fish for your household or share the catch?

51.Whom do you share it with? (Family, neighbors, church, other)

52.How often do you give fish away? never occasionally frequently everything

53.How important is catching fish to your family grocery bill?
__ not at all __slightly important __somewhat important __very important __vital

54.What other activities do you participate in besides fishing?
___Garden ___Hunt ___Collect wild plants ___Sell crafts ___Have yard sales ___Other

55.What type of fishing license do you have?

56.When and how did you find out about the new fishing regulations?

57.Have you heard of the various types of the fishing license waivers? Yes No
58.If 'yes': Do you know anybody who uses one? Yes No
59.Do you think the waiver system is a good idea or a bad idea and why? Good Bad

Why?

Section 2 for non-fishers

60.How often does somebody give you fish?
61.Are you worried about contaminants in local fish?
62.What types of contaminants?
63.Do you have ways to clean or cook the fish to reduce contaminants?

64.How important is receiving gift fish to your family grocery bill?
__ not at all __slightly important __somewhat important __very important __vital

65.What other activities do you participate in?
___Garden ___Hunt ___Collect wild plants ___Sell crafts ___Have yard sales ___Other

Section 3 for everybody

66.Does this area flood often? Yes No

67.Has flooding increased recently? Yes No

68. Why do you think flooding has increased?

69.How far do you live from here (either ___ miles or ___minutes to drive)

70. (If home is nearby) What will you do if the flooding gets worse?

Demographics

71.Year of birth_____

72.Ethnicity
- ___ Hispanic / Latino
- ___ White / Caucasian
- ___ Black / African-American
- ___ Asian / Pacific Islander
- ___ Native American

73.Marital status
- ___ Currently married
- ___ Divorced
- ___ Widowed
- ___ Never married
- ___ Separated

74.Education
- ___ Less than high school diploma
- ___ High school diploma
- ___ Some college or technical school
- ___ College diploma
- ___ Graduate work
- ___ Graduate degree

Income

75.Do you work? Yes No (if yes) Full time or part time? (if part time) How many hours?

76.How far do you have to drive to go to work?

77.How do you get there? ____own car ____public transportation ____share rides ____other

78.How much do you make?

Yearly	Monthly	Weekly	Hourly	Piece
<$15,000	<$1,200	$290	$7.25	
$15,001-$30,000	$1,601-$2,001	$400	$10.00	
$30,001-$50,000	$2,001-$4,000	$600	$15.00	
$50,001-$75,000	$4,001-$7,000	$800		
$75,001-$100,000	$7,001-$9,000	$1000		
>$100,001	>$9,001	>$1200		

79.Do you receive benefits at your job? Yes No

80.What type(s)? ___Medical insurance ___Disability ___Life Insurance ___Retirement

Household size:

81.How many people live in your household?

82.____Working adults

83.____Unemployed adults

84.____Children

85.How many people do you financially support that don't live in your household?____

Thank you for your time. Please sign the sheet to acknowledge that you received a Food Lion card.

Appendix C. All Responses in Table Form

**Table numbers reflect (the order of the survey questions / tables used in narrative)*

Tyrrell County Community Leader Interviews

Table 1. Community Leader Length of residency in Tyrrell County

Tyrrell County Residency	Min	Max	Median
Years	0	68	33

Table 2. Community Leader Perception of Fish Importance to Residents

	Not at all important	Slightly important	Somewhat important	Highly important
How important is catching fish to County residents?	4	3	2	5

Table 3. Community Leader Perception of County Employment

Bad	A few jobs available	Getting Better
10	2	3

Table 4. Community Leader Familiarity with Fishing Regulations

How familiar are you with local fishing regulations?	N	Percentage
Very	7	46
Somewhat	4	27
Not at all	4	27

Table 5. Community Leader Familiarity with Fishing License Waivers

Do you know about the free waivers for fishing licenses?	N	Percentage
Yes	7	49
No	8	51

Table 6. Community Leader Opinion of Fishing Regulations

Opinion of fishing regulations	N	Percentage
Positive	10	66
Negative	5	33

Table 7. Community Leader Fishing Activity

Do you go fishing?	N	Percentage
Yes	6	40
No	9	60

Table 8. Community Leader Contaminant Risk Perception

Are you worried about contaminants in fish?	N	Percentage
Yes	1	7
No	14	93

Table 9. Community Leader Familiarity with Fish Consumption Advisories

Are you aware of the fish consumption advisories for this area?	N	Percentage
Yes	3	20
No	12	80

Table 10. Community Leader Perceived Changes in Water Bodies

	No changes	More flooding	Poor drainage	More saline	More pollution
Times mentioned	1	5	2	1	5

Table 11. Community Leader Predicted Effects of Sea Level Rise on County

	No changes	More flooding	Relocation needed	Poor will suffer
Times mentioned	1	7	3	4

Tyrrell County Resident Surveys

Table 12/2. Frequency of Fishing Activity

How often and which months do you go fishing?	N	Percentage All	Percentage of Fishers
All Months	9	18	26
Spring	1	2	3
Summer	8	16	23
Fall	3	6	8
Spring Summer and Fall	14	28	40
Daily	1	2	3
A few times a week	10	20	29
Weekly	9	18	26
A few times a month	4	8	11
Monthly	7	14	20
A few times a year	4	8	11
Don't fish	15	30	

Table 13/3. Fishing Gear Preference

What type of gear do you use?	N	Percentage All	Percentage of Fishers	Percentage Crosson
Hook and Line	32	64	91	100
Crab pots	1	2	3	18
Cast net for bait	1	2	3	25
Gig for flounder	1	2	3	-
Rakes for clams	0	0	0	18
Dive	0	0	0	6
Don't fish	15	30		

Table 14. Fishing Location Preference

Where do you fish?	N	Percentage All	Percentage of Fishers
Bank	13	60	37
Pier	4	8	11
Boat	1	2	3
Bank and Pier	13	26	37
Bank and Boat	2	4	6
Bank, Pier and boat	2	4	6
Don't fish	15	30	

Table 15. Years of Fishing Experience

How long have you been fishing?	N	Percentage	Percentage of Fishers
Fewer than 10 years	3	6	9
10-19 years	7	14	20
20-29 years	1	2	3
30-39 years	6	12	17
40-49 years	7	14	20
50-59 years	7	14	20
More than 60 years	4	8	11
Don't fish	15	30	

Table 16/4. Fishing Instruction

Who taught you how to fish?	N	%	% fishers	Who do you ask about fishing now?	N	%	% fishers
Parent	16	32	46		1	2	3
Grandparent	5	10	14		1	2	3
Other relative	10	20	29		10	20	28
Friend	4	8	11		21	42	60
Bait store employee	0	0	0		2	4	6
Don't fish	15	30			15	30	

Table 17/5. Type of Fishing License

What type of fishing license do you have?	N	Percentage of All	Percentage of Fishers
Unified Inland/Coastal Recreational Fishing	8	16	23
Inland Recreational Fishing	6	12	17
Unified Sportsman/Coastal Recreational Fishing	1	2	3
Lifetime Sportsman	1	2	3
Unified Subsistence Inland/Coastal Recreational Fishing License Waiver	5	10	14
Senior Coastal Recreational Fishing	4	8	11
Pier	2	4	6
No license	8	16	23
Don't fish	15	30	

Table 19/6. Reasons for Fishing

Why do you fish?	N	Percentage of All*	Percentage of Fishers*
It's fun or relaxing.	33	66	94
To help feed my family.	23	46	66
To spend time with family or friends.	27	54	77
Other reason			
To spend time alone.	1	2	3
Don't fish	15	30	

*More than one answer was permitted so the total is more than 100%.

Table 20. Catch Retention

How often do you keep fish to eat?	N	Percentage of All*	Percentage of Fishers*
All legal fish I catch.	20	40	57
Only certain species.	7	14	20
Sometimes I keep fish to eat.	5	10	14
I only catch and release.	3	6	9
Don't fish	15	30	

Table 21/7. Conflicts While Fishing

Have you had any conflicts while fishing?	N	Percentage	Percentage Crosson
With federal enforcement officers		0	1
With state enforcement officers		0	3
With commercial fishers		0	11
With other recreational fishers		0	9
Other (With a Ski-Doo operator)		1	0

Table 22/8. Factors Affecting Fishing Behavior

How important do you consider each of these issues about fishing to you personally?	Not at all important	Not very important	Neutral	Somewhat Important	Extremely important	Ranking, this survey	Ranking, Crosson survey
Keeping up with rules	0	1	0	7	27	1	2
Water quality / pollution	4	2	0	7	22	2	1
Weather	3	4	1	14	13	3	6
Finding enough time in my life to fish	7	7	5	5	11	4	4
Bag or size limits	10	5	0	8	12	5	8
Overfishing / too few fish	14	4	1	9	7	6	5
Losing fishing sites	15	3	0	9	8	7	9
Fuel prices	16	3	1	7	8	8	3
Access issues (lack of boat ramps, parking, etc.)	17	4	2	9	3	9	7
Competition with other fishers / crowding	21	3	1	9	0	10	-
Competition with commercial fishermen	27	4	0	3	1	11	10

Table 23. Concern about Contaminants

Are you concerned about contaminants in the fish you catch?	N	Percentage
Yes	24	48
No	26	52

Table 24/9. Perceived Contaminant Sources

Where do you think contaminants originate?	N	Percentage
Farm runoff, crop fertilizer	9	39
Trash, litter	7	29
Pollution	2	8
Industrial pollution	2	8
Mercury	3	12
Dioxin	0	0
Sewage	1	4
Total	24	

Table 25. Perceived Contaminant Reduction Techniques

Can you clean or cook a fish to reduce contaminants?	N	Percentage
Yes	6	12
No	29	58
Don't fish	15	30

Table 26. Awareness of Fish Consumption Advisories

Are you aware of the fish consumption advisories for this area?	N	Percentage of All	Percentage of Fishers
Yes	11	22	31
No	24	48	69
Don't fish	15	30	

Table 27. Internet Usage

Do you use the internet to find information?	N	Percentage
Yes	21	42
No	29	58

Table 28. Internet Source of Fishing Regulations

Have you ever looked up fishing regulations on the internet?	N	Percentage
Yes	11	52
No	10	48

Table 29. Internet Source of Fish Consumption Advisories

Have you ever looked up fish consumption advisories on the internet?	N	Percentage
Yes	5	24
No	16	76

Table 31. Awareness of Subsistence Waiver

Have you heard of the "subsistence waiver"?	N	Percentage
Yes	17	48
No	18	52

Table 32. Opinion of Subsistence Waiver

Do you think the "subsistence waiver" is a good or bad idea?	N	Percentage
Good	35	100
Bad	0	0

Table 33/10. Source of New Regulation Information

How did you learn about the new fishing regulations?	N	Percentage
Enforcement agents	10	28
Division of Social Services	8	23
News	6	17
Bait seller	3	9
Moved here after new regulations	1	3
Don't remember	7	20
Internet	0	0

Table 34. Changes in Fish Stocks

Are there types of fish here you catch now that you rarely caught in the past?	N	%	Are there types of fish here you used to catch frequently but rarely catch now?	N	%
Yes	9	26		13	37
No	26	74		22	62
Species named: bass, catfish, flounder, gar, bowfin, mud diggers, invasives			Species named: croakers (6), spot (5), herring (2), rockfish (2), bass, red drum, sturgeon, trout, white perch		

Table 35/11. Changes in Ecosystem

What changes have you seen in this area over the time you have fished here?	More	Neither	Less
Pollution	13	17	4
Development	19	14	1
People fishing	14	15	5
Warmer water	7	23	4
Number of storms	12	18	4
Salinity	6	26	2

Table 36/12. Other Sustenance Activities

What other activities besides fishing do you do?	N	Percentage*
Garden	15	30
Hunt	10	20
Collect wild plants	6	12
Sell handmade crafts	0	0
Hold yard sales	5	10
None of these	27	54
Other (play guitar)	1	2

*More than one activity was allowed so not equal to 100%.

Table 37/13. Frequency of Gift Fish

How often do you receive fish as a gift from somebody who caught it?	N	Percentage	Percentage of non-fishers
Two times/week	2	4	13
Every week	1	2	7
Two or three times/month	4	8	26
One or two times/month	7	14	47
Less than once/month	1	2	7
Catch my own fish	35	70	

Table 38/14. Importance of Gift Fish to Grocery Bill

How important is receiving gift fish to your family grocery bill?	N	Percentage	Percentage of non-fishers
Not at all important	5	10	33
Slightly important	6	12	40
Somewhat important	3	6	20
Very important	1	2	7
Catch my own fish	35	70	

Table 39/15. Perceived Flooding

Does this area flood often?	N	%	Has flooding increased recently?	N	%
Yes	40	80		22	44
No	10	20		28	56

Table 40/1. Sample Characteristics

Gender	N	%	% Tyrrell County	% North Carolina
Male	24	48	46.2	48.7
Female	26	52	53.8	51.3

Race	N	%	% Tyrrell County	% North Carolina
Black / African American	34	68	36.5	22.1
White / Caucasian	16	32	58.4	71.2

Age	N	%
21-30	3	6
31-40	4	8
41-50	6	12
51-60	17	34
61-70	15	30
71 and older	5	10
Mean = 51 years		

Marital Status	N	%
Currently Married	7	14
Divorced	10	20
Widowed	5	10
Never Married	23	46
Separated	5	10

Highest Level of Education	N	%	% Tyrrell County	% North Carolina
11th Grade or Less	11	22		
High School Graduate	17	34	70.6	85.4
Some College / Technical Training	13	26		
College Graduate	7	14	8.0	27.8
Graduate Work	2	4		

Employment Status	N	%
Full Time Employment	14	28
Part Time Employment	6	12
Unemployed	18	36
Disabled	5	10
Retired	7	14

Household Income	N	%
Less than $15,000	6	10
$15,000 - $30,000	12	60
$30,001 - $50,000	2	10
More than $50,000	0	0
Total	20	

Appendix D

Flyer developed for distribution to Tyrrell County residents

Eating Local Fish

If you eat fish you catch yourself or fish somebody gives you as a gift there are a few things you should know.

- Fish is a great source of good lean protein.
- There are contaminant risks in some fish.

Albemarle Sound Consumption Advisories

Dioxins

Catfish and carp from these waters may contain low levels of dioxins. Women of childbearing age and children should not eat any catfish or carp from this area until further notice. All other persons should eat no more than one meal per month of catfish and carp from this area. Swimming, boating, and other recreational activities present no known significant health risks and are not affected by this advisory.

Mercury

Women of Childbearing Age (15-44 years), Pregnant Women, Nursing Women, and Children under 15: Do not eat fish high in mercury, including largemouth bass caught in the state. Eat up to two meals per week of fish low in mercury. A meal is 6 ounces of uncooked fish for adults, or 2 ounces of uncooked fish for children under 15.

All Other Individuals: Eat no more than one meal per week of fish high in mercury, including largemouth bass caught in the state. Eat up to four meals per week of fish low in mercury. A meal is 6 ounces of uncooked fish for adults, or 2 ounces of uncooked fish for children under 15.

Catching Local Fish

- Get a license – they are not expensive and the fine for fishing without a license is steep.
- To reduce certain contaminants remove fat and cook so fat drips away: broil, bake or grill and do not use the drippings.

Further information:

- Updated consumption advisories can be found on the internet: http://epi.publichealth.nc.gov/oee/fish/advisories.html
- Project results: Contact Liz Brown-Pickren at 252-737-4371 or e-mail brownpickrene09@students.ecu.edu

This study was funded by North Carolina Sea Grant and the Albemarle Pamlico National Estuary Partnership.

Appendix E

Detailed Information on Contaminant Risks in Self-Caught Fish in Tyrrell County
Retrieved from http://epi.publichealth.nc.gov/oee/fish/advisories.html

Site-Specific Advisories by Body of Water

- **Albemarle Sound**

Affected Counties: Bertie, Camden, Chowan, Currituck, Pasquotank, Perquimans, Tyrrell, and Washington

Site: Albemarle Sound from Bull Bay to Harvey Point; West to the mouth of the Roanoke River and to the mouth of the Chowan River to the U.S. Highway 17 Bridge

Pollutant: Dioxins

Date Issued: October 2001

Advisory: Catfish and carp from these waters may contain low levels of dioxins. Women of childbearing age and children should not eat any catfish or carp from this area until further notice. All other persons should eat no more than one meal per month of catfish and carp from this area. Swimming, boating, and other recreational activities present no known significant health risks and are not affected by this advisory.

Statewide Advisories

Pollutant: Mercury

Date Issued/Updated: April 2, 2008

Advisory:
Women of Childbearing Age (15-44 years), Pregnant Women, Nursing Women, and Children under 15:
Do not eat fish high in mercury, including largemouth bass caught in the state. Eat up to two meals per week of fish low in mercury. A meal is 6 ounces of uncooked fish for adults, or 2 ounces of uncooked fish for children under 15.
All Other Individuals:
Eat no more than one meal per week of fish high in mercury, including largemouth bass caught in the state. Eat up to four meals per week of fish low in mercury. A meal is 6 ounces of uncooked fish for adults, or 2 ounces of uncooked fish for children under 15.

Affected Fish: Fish high in mercury

Additional information on mercury in fish is provided at
http://epi.publichealth.nc.gov/oee/mercury/in_fish.html

A list of fish considered high in mercury and low in mercury is provided at
http://epi.publichealth.nc.gov/oee/mercury/safefish.html

The Department of Epidemiology has developed a flyer explaining the mercury risks:

What fish are safe to eat?

From the North Carolina Division of Public Health

Most fish are good to eat and good for you - high in protein and other nutrients, and low in fat. But some kinds of fish contain high amounts of mercury, which can cause health problems in people, especially children. To help you make the healthiest choices, North Carolina offers the following advice. For more information, see www.epi.state.nc.us/epi/fish/ or call (919)707-5900.

Avoid or limit fish consumption based on the following:	
Women of childbearing age (15 to 44 years), pregnant women, nursing mothers and children under age 15	**All other people**
Do not eat fish from the HIGH in mercury list.	Eat only 1 meal of fish per week from the HIGH in mercury list.
Eat up to 2 meals per week of fish from the LOW in mercury list.	Eat up to 4 meals of fish per week from the LOW in mercury list.

Eat Fish **LOW** in mercury

Ocean Fish		Freshwater Fish
Black drum	Pollock	Bluegill sunfish
Canned light tuna	Pompano	Farm-raised catfish
Cod	Red drum	Farm-raised trout
Crab	Salmon (canned, fresh or frozen)	Farm-raised crayfish
Croaker	Scallops	Tilapia
Flounder	Sheepshead	Trout
Haddock	Shrimp	
Halibut	Skate	
Herring	Southern kingfish (sea mullet)	
Jacksmelt	Spot	
Lobster	Speckled trout (spotted sea trout)	
Mahi-mahi	Tripletail	
Ocean perch	Whitefish	
Oysters	White grunt	

Avoid Fish **HIGH** in mercury

Ocean Fish		Freshwater Fish
Albacore (white) tuna** fresh or canned	Little tunny	Blackfish (bowfin)*
Almaco jack	Marlin	Black crappie***
Banded rudderfish	Orange roughy	Catfish (caught wild)*
Cobia	Shark	Jack fish (chain pickerel)*
Crevalle jack	Spanish mackerel	Largemouth bass (statewide)
Greater amberjack	Swordfish	Walleye in Lake Fontana & Lake Santeetlah (Graham & Swain counties)
South Atlantic grouper (gag, scamp, red and snowy)	Tilefish	Warmouth*
King mackerel	Tuna, fresh or frozen**	Yellow perch*
Ladyfish		

*High mercury levels have been found in blackfish (bowfish), catfish, jack fish (chain pickerel), warmouth, and yellow perch caught south and east of Interstate 85.
**Different species from canned light tuna
***High mercury levels have been found in black crappie caught south and east of Interstate 95.

Spanish version: "¿Cuáles pescados son seguros para comer?"

North Carolina Department of Health & Human Services • Division of Public Health • Occupational & Environmental Epidemiology
www.ncdhhs.gov • http://publichealth.nc.gov/
NC DHHS is an equal opportunity employer and provider 3/2013

Appendix F
Institutional Review Board Approval Letter

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board Office
4N-70 Brody Medical Sciences Building· Mail Stop 682
600 Moye Boulevard · Greenville, NC 27834
Office 252-744-2914 · Fax 252-744-2284 · www.ecu.edu/irb

Notification of Initial Approval: Expedited

From: Social/Behavioral IRB
To: Elizabeth Brown-Pickren
CC: Alex Manda
Date: 9/16/2015
Re: UMCIRB 15-001438
Risky Business: Consumption of Self-Caught Fish in Tyrrell County, North Carolina

I am pleased to inform you that your Expedited Application was approved. Approval of the study and any consent form(s) is for the period of 9/16/2015 to 9/15/2016. The research study is eligible for review under expedited category # 6, 7. The Chairperson (or designee) deemed this study no more than minimal risk.

Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The Investigator must adhere to all reporting requirements for this study.

Approved consent documents with the IRB approval date stamped on the document should be used to consent participants (consent documents with the IRB approval date stamp are found under the Documents tab in the study workspace).

The approval includes the following items:

Name	Description
InterviewQs08-23.doc	Interview/Focus Group Scripts/Questions
Revised Consent Form	Additional Items
Risky Business Consent Form	Consent Forms
Risky Business: Consumption of Self-Caught Fish in Tyrrell County, North Carolina	Study Protocol or Grant Application
Survey08-23.doc	Surveys and Questionnaires