A REPORT FROM THE
2019 NORTH CAROLINA FISH FORUM

Engaging Stakeholders to Improve Fish Consumption Advisory Communication

Kathleen Gray and Megan Rodgers
Center for Environmental Health and Susceptibility
at UNC Chapel Hill

Sarah Yelton
UNC Institute for the Environment

Sam Cohen, Catherine Kastleman, Bryan Luukinen,
and Elizabeth Shapiro-Garza
Duke University Superfund Research Center

Katlyn May
NC State University
Center for Human Health & the Environment

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Contributors:

- Crystal Lee Pow Jackson, Environmental Toxicologist, Occupational and Environmental Epidemiology (OEE) Branch, North Carolina Department of Health and Human Services, Division of Public Health
- Jamie Pritchett, Toxicologist and Program Coordinator, Occupational and Environmental Epidemiology (OEE) Branch, North Carolina Department of Health and Human Services, Division of Public Health
- Beth Dittman, Toxicologist and Public Health Assessor, Occupational and Environmental Epidemiology (OEE) Branch, North Carolina Department of Health and Human Services, Division of Public Health
- Kelsey Ellis, Communications & Outreach Specialist, Albemarle-Pamlico National Estuary Partnership
- Chris Bova, Social Scientist/Resource Economist, North Carolina Wildlife Resources Commission

Reviewers:

- George Matthis, President, River Guardian Foundation
- Drew Cade, Park Manager, Lake Crabtree County Park, Wake County Parks, Recreation and Open Space

EXECUTIVE SUMMARY

Background

Fishing is a beloved pastime, and a source of affordable, local food for many North Carolinians. However, eating fish from North Carolina waterways can also pose health risks. Industrial chemical contaminants, including mercury and polychlorinated biphenyls (PCBs), can accumulate in fish and threaten the health of the public. In these cases, fish consumption advisories (FCAs) typically identify how much of a specific fish species can be safely consumed, unless a given species of fish is too contaminated to be eaten at all. Advisories tend to be more restrictive, or even prohibitive, for populations that are most vulnerable to the potential health effects of environmental contaminants, such as children and women of child-bearing age.

Developing FCAs involves multiple state and local government agencies, working in collaboration using environmental data and risk assessment processes. In North Carolina, the NC Department of Environmental Quality (NCDEQ) generally collects fish for testing and retains those data. The NC Department of Health and Human Services (NCDHHS) uses those data in human health risk assessments to set FCAs for specific fish species and waterways in the state. NCDHHS is responsible for communicating the advisories to local health departments. County health departments and other local agencies then reach out to the public by posting signs at fishing locations and by using other outreach materials that they create and/or purchase.

It can be challenging to clearly communicate the complex science and uncertainty that informs these advisories, which makes it more difficult to reach the intended audience. Many of the most vulnerable populations, including subsistence fishers, may either be unaware of FCAs or may disregard the guidelines.

NC Fish Forum

Over the last decade, researchers from the University of North Carolina at Chapel Hill (UNC), North Carolina State University (NCSU), and Duke University have been working with key stakeholders in the FCA process in North Carolina to better understand perceptions of FCAs and ultimately, to improve health outcomes related to fish consumption. In March 2019, representatives from the UNC Center for Environmental Health and Susceptibility (CEHS), NCSU Center for Human Health and the Environment (CHHE), and the Duke University Superfund Research Center (SRC) organized a forum of diverse stakeholders to discuss how to foster a more effective FCA process. The *NC Fish Forum* explored the opportunities and challenges in setting and effectively communicating FCAs and makes recommendations to: 1) increase understanding of advisories, 2) foster greater collaboration among stakeholders, and 3) identify opportunities to improve the current process.

Findings

The *NC Fish Forum* participants identified barriers at all stages of the FCA process. Limited awareness or distrust of the information provided in the FCAs among the public can inhibit safer fish consumption choices. In some cases, limits to coordination and collaboration among government agencies hinder communication efforts to the public. Resource constraints limit all phases (tissue collection, testing, data analysis, and outreach) of the advisory process. Local capacity and resources can vary across the state, leading to uneven implementation of FCAs. Lastly, the narrow focus of most advisories can limit impact, and key messages may conflict with other priorities including size limits for catch.

Participants at the *NC Fish Forum* also identified potential opportunity areas where improved collaboration and policy changes could help better leverage available resources. To encourage resource sharing and limit duplication of effort, participants requested a better understanding of who works on FCAs within state agencies. Local government participants voiced a desire to be included earlier and more regularly in FCA discussions in their regions. Some participants suggested that NPDES (wastewater discharge) permits be changed to require permittees to carry out or fund fish tissue collection and testing to offset the high costs of these activities. Lastly, participants suggested that academic partners and state agency staff could create toolkits to support local governments in creating effective communication materials to share FCAs with the public.

Vision for the Future

Our ultimate goal is that fewer people - particularly those who are most vulnerable to harm, such as children and pregnant women - eat unhealthy amounts of contaminated fish. To make this vision a reality, the participants made the following recommendations for change:

1. FCA procedures (e.g. which fish to collect, sampling and analysis costs, risk assessment process) should be clearly communicated and widely available. Such accessibility would assist local governments with concerns about fish safety to efficiently use their resources to evaluate the need for an FCA.
2. State agencies and other stakeholders involved in setting advisories, along with university partners, should engage and consult with local governments early and throughout the process. Local governments know their communities and can meaningfully contribute to better health outcomes when they are empowered to advocate for fish testing and encourage safe fish consumption habits.
3. FCA outreach efforts should specifically involve and target vulnerable populations, including subsistence fish consumers, non-native English speakers, and other hard-to-reach groups.

Next Steps

To overcome the inherent challenges and create more effective advisories, *NC Fish Forum* participants generally agreed that they would like the stakeholder group to continue meeting, but to

expand participants to include subsistence fish consumers. Other potential action items recommended by participants for the stakeholder convening group to carry out include:

- Define and refine roles of the various stakeholders. This includes universities, who can leverage their own resources in support of fish tissue collection and testing, communication support, and more (see Fig. A).
- Develop templates and other resources to support local governments in FCA communication and outreach. Academic partners could help address this gap by developing templates for impactful communication materials and strategies that are grounded in research findings and best practices.
- Engage vulnerable populations such as subsistence fish consumers with well-designed and creative communication tailored to their perspectives and needs, and communicated through the channels most likely to reach them.

Through these important next steps and the collaboration of all of our agency, local government, academic, and community partners, we hope to progress toward our shared vision of healthy fish consumption for all populations across the state of North Carolina.

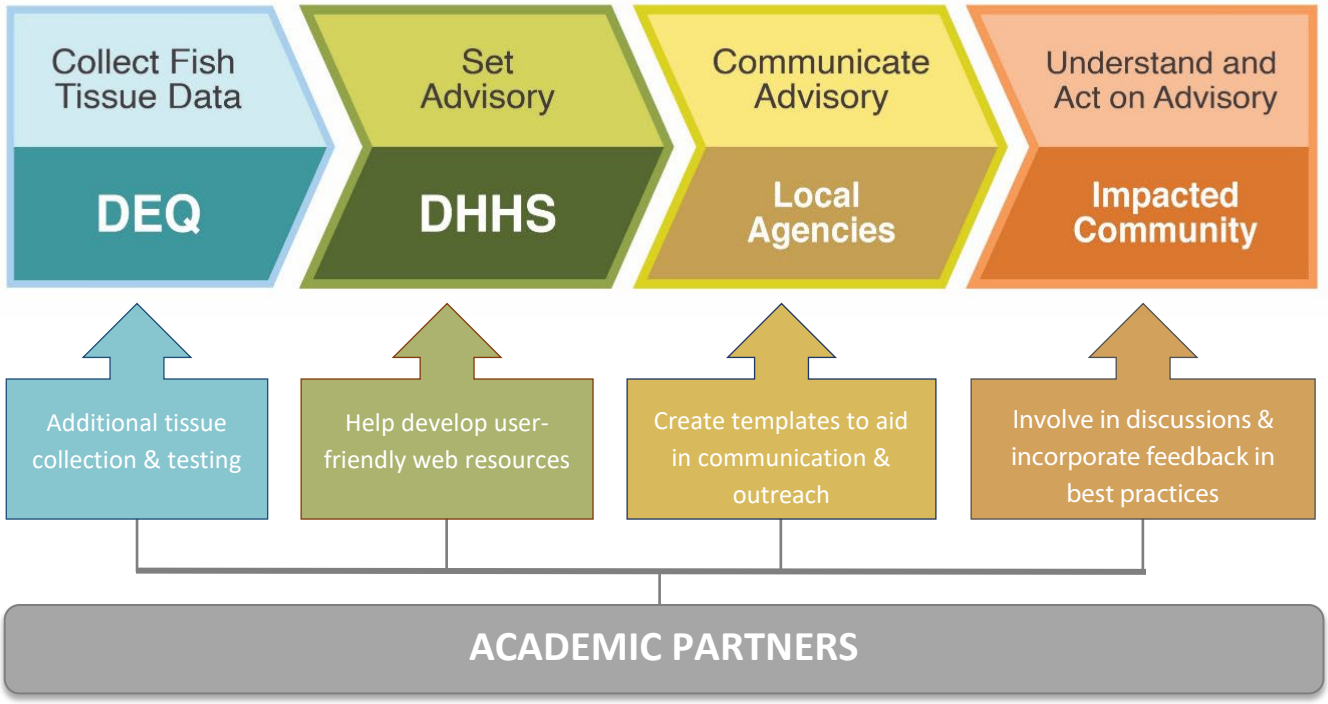

Figure A. Diagram of fish consumption advisory process in North Carolina, revised to include roles for academic partners.

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1. INTRODUCTION

In the United States, every state and several territories and tribes issue fish consumption advisories (FCAs). These advisories alert people to the potential health risks associated with consuming fish species that have levels of contamination that could harm human health (U.S. EPA 2019). The most common contaminants addressed by such advisories are methylmercury and polychlorinated biphenyls (PCBs). In North Carolina (NC), the Department of Health and Human Services lists FCAs for 28 waterbodies on its website (NCDHHS 2019). Advisories typically identify how much of a specific fish species can be safely consumed, unless it is too contaminated to be eaten at all. Advisories tend to be more restrictive, or even prohibitive, for populations that are more vulnerable to the potential health effects of environmental contaminants, such as children and women of child-bearing age.

Across the U.S., research has shown that FCAs are generally not well understood or followed by people who catch and/or consume fish. Some studies have found that women are less aware of advisories than men (Tan et al. 2011; Imm et al. 2013). Other studies saw a similar pattern for ethnic minority populations (Burger and Gochfeld 2008). Research conducted in Badin, NC, found that shore anglers were less aware of advisories than boat anglers, and male shore anglers (8%, n=3) were less aware of advisories than boat anglers (79%, n=19) that could impact the health of women and children with whom they shared fish (LePrevost et al. 2013). In one study, awareness of an advisory did not influence participants' beliefs about the safety of fish, nor did it change their fish consumption behavior (Tan et al. 2011). Further, although some people may be more aware of the general benefits than the risks associated with consuming fish under advisory (Burger and Gochfeld 2008), a recent review suggested that women may limit their intake of fish due to uncertainty about which fish are safe to eat, and a lack of knowledge of health benefits (Lauber et al. 2013). Consumers often weigh risks and benefits when deciding to eat fish, but research shows that comparing the risks of eating fish to the risks of eating a different food tend to be more likely to change behavior (Knuth et al. 2003). Additionally, tailored and culturally appropriate messages, that make clear to whom risks and benefits accrue, can be effective at communicating risk and promoting behavior change in fishing communities (Derrick et al. 2008).

1.1 THE FISH CONSUMPTION ADVISORY PROCESS

FCAs are typically issued by state agencies for specific water bodies, though statewide advisories exist in some states. The overall complexity of messaging about FCAs can be further complicated when multiple agencies are involved in setting and promoting advisories, such as is the case in NC (Figure 1). In North Carolina, the NC Department of Environmental Quality (NCDEQ) collects fish tissue for testing, collects and stores fish tissue data, and makes it available to the public. The NC Department of Health and Human Services (NCDHHS) uses this fish tissue testing data in human health risk assessment to set FCAs for specific waterways in the state. NCDHHS is also responsible for communicating advisories directly to local health departments and on a website. Local health departments are then responsible for posting FCAs at waterways in their jurisdictions, including paying for signage, and updating the advisories as necessary. Although the NC Wildlife Resources Commission (WRC) is not involved in setting FCAs, it does set guidelines for size and creel (or daily catch) limits and monitors the health of fisheries through active management that includes periodic catches.

Figure 1. Diagram of fish consumption advisory process in North Carolina

2. APPROACH

2.1 PRIOR STAKEHOLDER ENGAGEMENT

Researchers in NC have been engaging with key stakeholders on FCA communication for the last decade. Starting in 2009, the UNC Superfund Research Program (SRP) worked with fishermen, regulatory agencies, and local stakeholders to improve communication of fish consumption advisories associated with several hazardous waste sites (Gray et al. 2016b). In 2015, UNC SRP partnered with the NCSU Center for Human Health and Environment (CHHE) to facilitate meetings with stakeholders who were concerned about communication of FCAs, with a goal of improving such communication across the state. NCSU faculty members who participated in these meetings had a long history of research on fish biology and the health of NC's fisheries. Together, NCSU CHHE and UNC SRP explored stakeholder interest in developing common templates to communicate advisory information and identifying key messages for those templates. Participants included representatives from state health, environmental, and wildlife agencies, local governments, fishing clubs, environmental nonprofits, consulting firms, and academia. The 2015 meeting was likely the first time that such a diverse group of stakeholders discussed challenges to FCA communication in the state. Based on the findings and recommendations of the 2015 stakeholder meetings, participants conducted research on the effectiveness of signage for communicating FCAs (Gray et al. *in review*).

The research found that standalone signs were not an effective way to communicate FCA information and that wildlife agency staff were more commonly perceived as resources on FCAs than health agency staff (Gray et al. *in review*). Study participants also reported confusion from multiple signs and messaging at fishing locations, some of which addressed creel limits, while others addressed health-based advisories. In June 2017, NCSU CHHE and UNC SRP again convened a stakeholder group, this time focused on sharing results of this research and facilitating dialogue on how to improve FCA communication across agencies and organizations. These findings led stakeholders to identify a need for greater coordination among the health, environmental, and wildlife agencies responsible for developing and communicating FCAs.

The Duke University Superfund Research Center (Duke SRC) also has engaged with the issue of exposure to contaminated fish among subsistence fish consumers in both southeastern Virginia (Gray et al. 2016b) and in the Northeast Cape Fear River region (Cape Fear River Watch 2019). Duke SRC conducted focus groups in Eastern NC, and helped to develop a household survey of subsistence fish consumers conducted by researchers at Wake Forest University School of Medicine in southeastern NC. Additionally, Duke SRC's community partners identified a need for more locally specific fish tissue data to inform advisories and, as a result, Duke and NCSU are conducting surveys of subsistence fish consumers in the Cape Fear River region.

This prior research and stakeholder engagement, along with authors' participation in the *"What's in Your Fish?" Forum 2.0* convened by the Boston University SRP, led to a 2019 stakeholder meeting, jointly sponsored by the Center for Environmental Health and Susceptibility at UNC-Chapel Hill (UNC-CEHS), Duke SRC, and NCSU CHHE. Entitled *NC Fish Forum,* this new engagement brought new stakeholders into ongoing conversations about FCA effectiveness in NC and emphasized the needs and accomplishments of local governments. This meeting also incorporated a new focus on per- and polyfluoroalkyl substances (PFAS). The issue was brought to the forefront because of demands for more information from citizens in areas where emerging contaminants had been detected in NC waterways and drinking water supplies.

2.2 NC FISH FORUM MODEL

In fall 2018, an organizing committee with representatives from UNC-CEHS, NCSU CHHE, and Duke SRC invited participation from a diverse group of people engaged in the FCA process, including agencies and organizations that collect fish tissue data, conduct human health risk assessments, and communicate with the fishing public, as well as people who fish for recreation and subsistence. Forum goals included: (a) increasing understanding of the current FCA process, (b) fostering greater collaboration among stakeholders, and (c) identifying opportunities to improve existing processes, especially local communication of FCAs.

The forum was structured to provide an overview of the FCA process in NC followed by two local government case studies, one from central NC and one from the Cape Fear River region of coastal NC. Both provided examples of innovative approaches to FCA communication at the county level. These case studies were followed by small group breakout sessions that each addressed three issues: (a) challenges in development and communication of FCAs, (b) alternative approaches, and (3) ideas for implementing those approaches. These discussions were designed to inform a collaborative vision of an improved FCA process in NC. Facilitators led the discussion, and participants shared ideas on flip charts and sticky notes. These materials were compiled and reviewed by the organizing committee. Additionally, a visual note-taker created a graphic summary of the meeting (Figure 2).

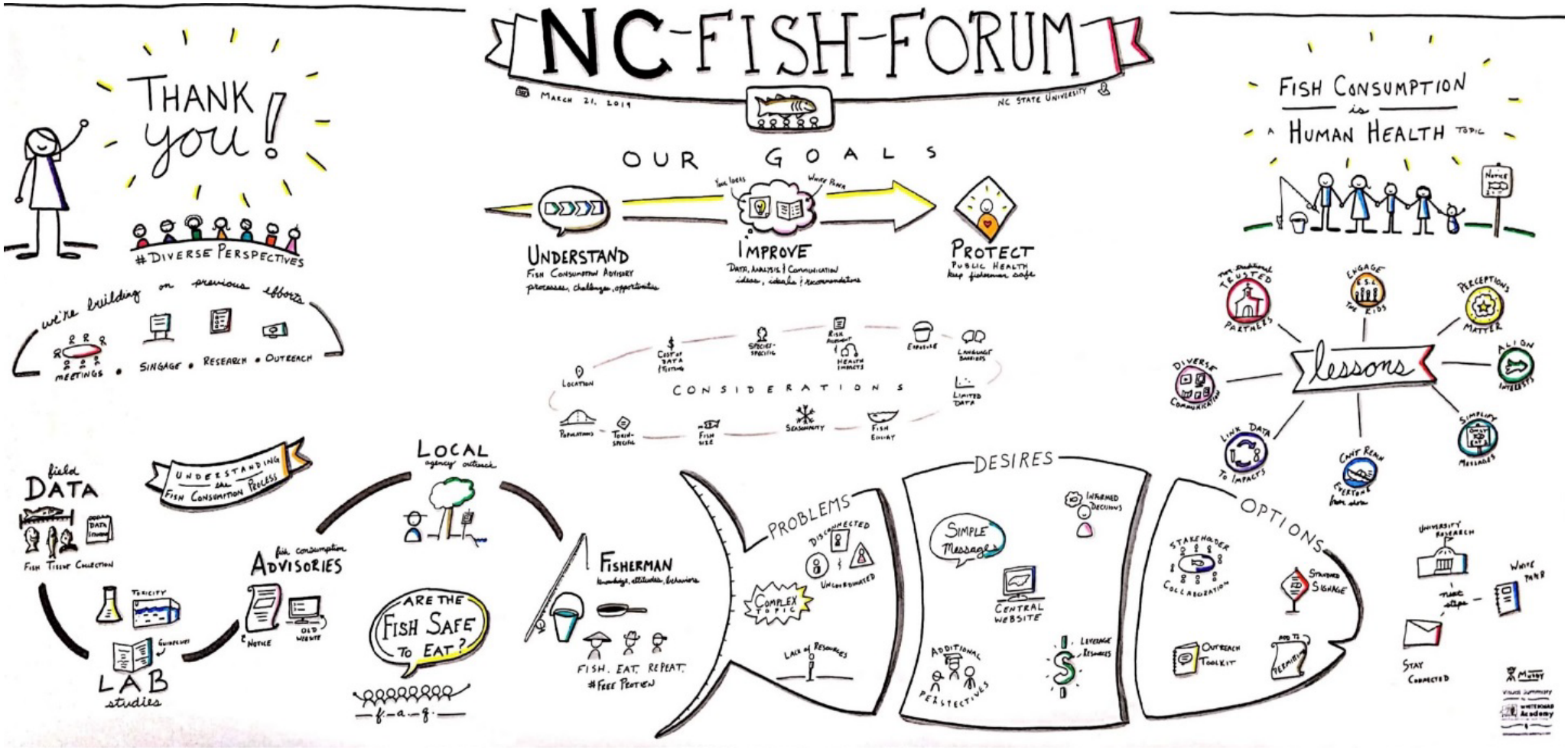


Figure 2. Graphic summary of the *NC Fish Forum* in March 2019, by Mike "Muddy" Schlegel

3. FINDINGS

During the *NC Fish Forum,* participants identified **challenges** that make it difficult to develop and promote fish consumption advisories as well as **opportunities for success.**

3.1 CHALLENGES

Four primary challenges were identified by participants. Each is summarized below with highlights from the discussion.

1 NEGATIVE PERCEPTIONS AND LIMITED AWARENESS OF ADVISORIES AMONG PUBLIC AUDIENCES CAN INHIBIT BEHAVIOR CHANGE

NC Fish Forum participants identified many barriers to understanding FCAs and to ensuring that they promote the health-protective behaviors they are designed to encourage. This discussion largely aligned with prior literature on the subject (see *Introduction*), e.g., lower awareness among minority populations and a failure to reach the most vulnerable populations, mistrust of advisories and the government agencies that provide them, and the disconnect between awareness of the health risks described by FCAs and subsequent behavior change.

Additional challenges identified in the forum included the varied ways that fishermen perceive the risks associated with fish consumption. For example, participants noted that some fishermen rely on lived experience when considering long-term health consequences (e.g. saying "I haven't gotten sick before, and I've been fishing here for years,", as reported by (Gray et al. 2016a). Others over-estimated risk. For example, a local government participant noted an example of a fisherman being unsure if it was safe to touch fish due to a local FCA. Further, participants noted that subsistence fish consumers depend on fish as a key source of protein, which may outweigh their perceptions of any potential health risks from consumption.

2 COORDINATION AND COLLABORATION AMONG PARTICIPATING AGENCIES IS LIMITED

As noted above, in NC, environmental, health, and wildlife agencies at state and local levels are involved in FCA development and communication. *NC Fish Forum* participants discussed how the lack of coordination among these agencies and other stakeholders has hindered the communication of FCAs. For example, NC Wildlife Resource Commission field staff reported that fishermen ask them questions about the FCA process. These staff are not experts on the FCA setting process, and sometimes feel unequipped to answer these questions from the public. NCDHHS staff members noted that the agency has developed a protocol for setting FCAs, which if shared more broadly could help other agencies answer procedural questions.

Participants also noted that there is not currently a "one-stop-shop" online that provides accessible information on FCAs in NC. Some suggested that the lack of such a resource limited awareness and communication of FCAs. Further, a lack of Spanish-language materials was identified as a barrier to communicating advisory information to subsistence fish consumers. Another participant commented that FCAs and the processes for setting them can vary across state lines, which causes confusion for people who fish in more than one state, a common occurrence in river basins that border North and South Carolina.

3 RESOURCES TO SUPPORT ADVISORY DEVELOPMENT AND COMMUNICATION ARE LIMITED

NC Fish Forum participants spoke at length about the limited resources available for FCAs, noting that every phase of the advisory setting process (including tissue collection, testing, data analysis, and outreach) is underfunded, understaffed, and under-resourced. Even considering opportunities to leverage research, fish tissue collection, and communications efforts led by local universities, this under-allocation of resources was thought unlikely to be addressed in the near term. For instance, although participants heard from staff in New Hanover, Wake, and Mecklenburg Counties about successful local efforts to share information with fishermen, they noted that these counties had more resources relative to other counties, meaning that their approaches likely could not be replicated without new funding.

Participants also commented that fish tissue sampling and testing is usually quite expensive, especially for classes of chemicals that contain many individual compounds (e.g. PCBs and PFAS). For example, one participant noted that their organization recently spent $28,000 to analyze 12 samples for PCBs, mercury, selenium, and arsenic. Additional costs may include collecting fish samples and testing other parameters, which would increase overall sampling and testing costs.

Other participants noted that NCDHHS does have dedicated staff, resources to conduct FCA assessments, and additional resources available through a cooperative agreement between NCDHHS and the federal Agency for Toxic Substances and Disease Registry, but these are limited to work done around hazardous waste sites.

4 THE NARROW FOCUS OF MOST ADVISORIES LIMITS UNDERSTANDING OF KEY MESSAGES

FCAs are in some ways narrow; they describe the risks associated with specific fish species, chemicals, and water bodies. This focus enables advisories to be established using a relatively small number of fish tissue samples, which reduces the costs of collection and testing. Yet some *NC Fish Forum* participants noted that this narrow focus limits the broader understanding of FCAs. For example, FCAs do not consider or communicate about relative risk based on age or size of fish. A participant noted that some fishermen follow their own informal rule for limiting exposure to contaminants that "the smaller you eat, the better you are." However, size limits set by WRC (usually a minimum length) may conflict with these informal norms by mandating fishermen only keep larger, mature fish. The same participant noted that in at least one NC lake, fish larger than a certain length are considered contaminated with PCBs, yet the FCA at this lake is not based on size. Participants from NCDHHS noted that size could be considered in setting FCAs, but that approach would require collecting and testing a greater number of samples, which would raise costs.

Developing FCAs for emerging contaminants poses additional challenges since chemical structure, bioavailability, health effects, and geography are all generally unknown. Participants who were dealing with emerging contaminants such as PFAS in their communities noted that the uncertainties around these chemicals meant that the FCA process moved more slowly compared to other pollutants. A government participant discussed the difficulty with crafting simple and direct messages for the public, while also conveying the scientific nuance and uncertainty that underpin advisories for emerging contaminants like PFAS.

3.2 OPPORTUNITIES

NC Fish Forum participants identified **five opportunity areas** for developing and communicating FCAs where collaboration could leverage available resources. These span stakeholder engagement, policy development, and outreach.

1: SUSTAIN NC STAKEHOLDER GROUP FOCUSED ON IMPROVING ADVISORIES

Many participants expressed enthusiasm for continuing conversations and strategic planning among the assembled group to improve advisory implementation across the state. Participants supported the idea of the academic institutions (UNC-CEHS, NCSU CHHE, and Duke SRC) continuing to serve as conveners. However, they suggested that the group extend invitations to other stakeholders not represented at the Forum, including people who are subsistence fish consumers.

2: IDENTIFY KEY PLAYERS WORKING ON FCAS IN VARIOUS AGENCIES & DESCRIBE ROLES AND BANDWIDTH

To facilitate resource sharing and limit duplication of effort, participants wanted a better understanding of who was assigned to develop and implement FCAs within state agencies, including staff members with the following responsibilities: (a) FCA-related planning and decisions, (b) fish tissue sampling and testing, (c) risk assessment and FCA setting, and (d) communication and implementation of FCAs. In addition, although the Wildlife Resource Commission does not have a specific role in FCA development and communication, participants also expressed the importance of empowering WRC staff members who interact with fishermen and residents so that they can address questions and concerns about FCAs. Because WRC staff interact directly with those targeted by FCA communications, efforts made to share knowledge and involve them more in the FCA process can help improve communication and compliance with FCAs.

3: ACTIVELY ENGAGE LOCAL GOVERNMENT STAFF EARLIER IN FCA PLANNING AND COMMUNICATIONS

Local government participants voiced a desire to be included earlier and more regularly in FCA discussions in their regions. They wanted to engage with, and provide input to, state agencies and other stakeholders on FCAs, in order to better protect the health of communities they serve. However, their interest in more frequent dialogue did not equate to a desire for additional responsibilities associated with FCAs.

4: EXPLORE POTENTIAL FOR POLICY & REGULATORY CHANGES TO OFFSET FCA COSTS & PROTECT HEALTH

Some participants suggested including requirements for fish tissue collection and testing as part of NPDES (National Pollutant Discharge Elimination System) permit language to support FCAs and help offset the high costs. This approach would put the burden on NPDES permittees—those who ostensibly benefit from discharging their pollutants into water bodies—instead of local governments or communities who likely experience fewer direct benefits and more adverse impacts from permitted discharges. Participants also discussed ways that the WRC might take FCAs into account when setting creel (daily catch) limits for a given fish species. This approach could enhance understanding and awareness of FCAs among fishermen and fish consumers. More work is needed to explore these potential policy changes.

5: CREATE TOOLKITS TO FACILITATE ADVISORY COMMUNICATION

Participants suggested that academic partners and state agency staff work together to create toolkits to support local governments in creating materials and outreach infrastructure to effectively communicate FCAs to fish consumers and the public. One recommendation was to develop standard templates that local governments could easily adapt for specific locations and advisories, providing "grab and go" signage, brochures, messaging, etc. They suggested that such a toolkit could also include best practices for reaching vulnerable populations and using social marketing to focus communications on promoting desired behavior change.

4. DISCUSSION

NC Fish Forum participants generally agreed that communicating FCAs in NC would be improved by better communication among key agencies and other stakeholders. They asserted that such communication would greatly improve effectiveness of FCAs by more efficiently sharing resources and enhancing understanding among fishermen and subsistence fish consumers. Yet they also noted differing perspectives, constraints, and tensions that might hinder improved communication and coordination if not resolved. Below, the authors of this paper highlight certain potential barriers to collaboration and communication among FCA stakeholders.

Differing perspectives on where to act

As noted above, some participants wanted FCA processes to include greater emphasis on source water protection. They felt that identifying the sources of pollution and regulating those discharges would more comprehensively protect human health and the environment. State agency representatives agreed with the need for effective pollution control, but also noted that mercury, PCBs, and other legacy pollutants are already in the environment and in fish, meaning that source water protection on its own would not fully address the issue.

Tension between perceived benefits and risks of fishing and fish consumption

The WRC and fishing organizations promote outdoor recreation and fishing, and place little emphasis on fishing for food and associated health considerations. This creates tension with the messaging of public health agencies, who primarily focus on fish consumption. In addition, public health agencies both promote fish protein as a healthy dietary choice, and at the same time acknowledge and communicate the health concerns from mercury and other contaminants in fish.

Tension between clear communication and scientific accuracy

Participants consistently noted that the tension between accuracy and the need to engage the public could bring about disagreements among stakeholders. Specifically, agency staff and researchers concerned with accurately describing fish consumption risks in their full context may disagree with public health professionals and communicators who disseminate messages to the public. Participants noted that the latter group might find that including extensive technical information could hinder the effectiveness of their communication efforts.

Organizational constraints

Although participants were in broad agreement regarding the value of a well-maintained and easy-to-navigate online portal for FCA information, efforts to improve the NCDHHS FCA webpage may be constrained by budgetary and other resource limitations. For this reason, an FCA online portal hosted by NCDHHS may not align with this vision nor meet the needs of non-governmental stakeholders.

4.1 LIMITATIONS

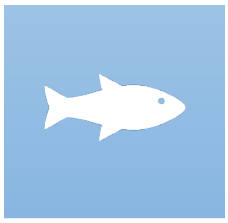
Some key stakeholders were not able to attend the *NC Fish Forum* to share their perspectives, e.g., state agency staff who collect fish tissue for analysis, and people who consider themselves part of a subsistence fishing population. Subsistence fishermen are an important audience for fish consumption advisories due to the potential for consumption of large quantities of contaminated fish species. Although they were not represented, members of the convening team have engaged extensively with members of subsistence fishing communities (Gray et al. *in review*; Cape Fear River Watch 2019). Participants of the forum also opted in and were not randomly selected, which may have led to a bias towards individuals who have the capacity, support, and interest to attend such a discussion.

5. RECOMMENDATIONS

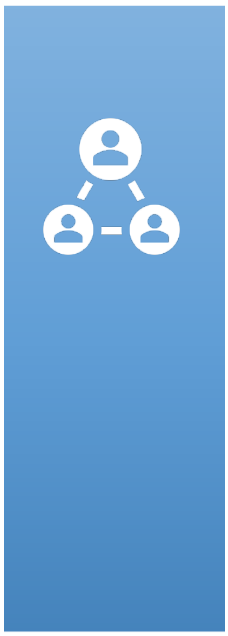
In this section, we outline a vision for improved FCA development and communication based on the discussion and recommendations of the *NC Fish Forum* participants. We follow with recommendations that represent concrete actions that could begin to improve the processes behind FCA creation and communication in NC.

5.1 VISION FOR THE FUTURE

Our ultimate vision is that fewer people—particularly those who are most vulnerable to harmful health effects, such as children and pregnant women—eat unhealthy amounts of contaminated fish. The following foundational elements of this vision increase the likelihood that we achieve it.



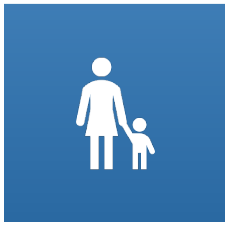
FCA procedures should be clearly communicated and widely available. The procedures for fish collection, testing, and establishing advisories (e.g. which fish to collect, sampling and analysis costs, risk assessment process) should be easily accessible and transparent, especially to local government agencies. This approach would enable local governments with concerns about fish safety to efficiently use their resources to evaluate the need for and inform development of an FCA.



State agencies, universities, and other stakeholders should engage and consult with local governments early and throughout the process of establishing FCAs. Local government departments, such as Health, Parks and Recreation, Stormwater and others, perform vital work in their communities that are related to and can inform advisories. The ways in which local government agencies can be involved in the setting and implementation of FCAs include:

- Identifying potential concerns related to fish consumption and water pollution
- Spreading the word about how to safely consume fish, which may include creating educational materials and signage
- Monitoring and enforcing any fishing restrictions.

Local departments know their communities and can meaningfully contribute to better public health outcomes when they are empowered to advocate for fish testing and promote safe fish consumption. Other FCA stakeholders can support these efforts by forming active partnerships with local governments to better share resources and expertise.



FCA outreach efforts should prioritize vulnerable populations. After FCAs are established, communication efforts should prioritize identifying and reaching the most at-risk groups so that they can make informed decisions about their health. This approach requires creating understandable and culturally appropriate materials that reach key audiences, including fish consumers, fishermen, people who do not speak English, and other groups that can be challenging to communicate with.

5.2 ACTION STEPS TO ACHIEVE THIS VISION

NC Fish Forum participants generally agreed that they would like the stakeholder group to continue convening and expand participants to include subsistence fishermen/consumers, if possible. Below is a list of action items recommended by participants for the convening group to carry out.

CONTINUE TO CONVENE NC FISH FORUM STAKEHOLDER GROUP.

The convening academic partners: Duke SRP, NCSU CHHE, and UNC-CEHS, should organize regular meetings. These academic partners are charged with seeking input from all stakeholders to set agendas and identify specific issues to address, such as facilitating effective cross-agency communication among NCDHHS, NCDEQ, and WRC. Forum participants also suggested that active engagement of subsistence fishermen/consumers, and representatives from WRC who regularly interact with fishermen, would contribute to more robust and representative discussion. Models from community engaged research provide insight into how to convene a diverse and relevant group and support its functioning over time (Finn and Collman 2016).

CLEARLY DESCRIBE ROLES OF THE VARIOUS STAKEHOLDERS.

This effort to describe stakeholder roles began during the forum, where the functions of state and local government in the FCA process were discussed. Participants learned from the experiences of county health departments and other local agencies at the forum who are tasked with communicating fish consumption advisories and interacting with fishermen and fish consumers. Participants also suggested that universities could leverage their resources in support of FCA development and communication (Figure 3). Opportunities for more active participation by these stakeholders include the following: (a) collect and analyze more fish tissue data, (b) use expertise in communications and social science research to assist local governments with implementing effective outreach, (c) help state agencies develop and support user-friendly web resources, and (d) leverage research resources and national networks of community engagement specialists to support these efforts. Moving forward, the group should continue to refine the roles of all stakeholders in order to leverage existing resources, avoid duplication of effort, and improve channels of communication. This can help to achieve our future vision.

DEVELOP TEMPLATES AND OTHER RESOURCES TO SUPPORT LOCAL COMMUNICATION & OUTREACH.

Due to limited resources, some local governments struggle to develop effective advisory materials for reaching fishermen and public audiences. Academic partners could help to address this gap by developing templates for impactful communication materials that are grounded in peer-reviewed literature and best practices. In addition, academic partners have the bandwidth and resources to create these materials and strategies. Participants suggested the best means to deliver this content in a timely and responsive manner would be a website that can serve as the "one-stop-shop" for information on fish consumption advisories in NC. NCSU CHHE has already developed a website with information on pollutants in fish, a searchable table of water bodies with FCAs, recommendations on which fish to eat and serving size, and an interactive map (NCSU CHHE and NC Cooperative Extension 2018). "NC Healthy Homes," developed by the Center for Environmental Health and Susceptibility at UNC Chapel Hill, is another example of a centralized website that provides public health educational resources to local governments (UNC CEHS 2020).

5.2 ACTION STEPS TO ACHIEVE THIS VISION

ENGAGE WITH HARD-TO-REACH AND AT-RISK POPULATIONS SUCH AS SUBSISTENCE FISH CONSUMERS.

Engaging vulnerable populations can be a challenge, and even well designed and creative communication materials require a deliberate strategy for reaching those most in need of public health messaging. Effective approaches typically start by collaborating with those who you seek to reach, and by identifying and partnering with their trusted messengers. In this case, an iterative process, where fishermen, fish consumers, and other stakeholders provide feedback on messaging and channels of communications could inform future engagement efforts and refine best practices. Lessons learned and effective strategies can be shared through the stakeholder group and other public health and local government networks.

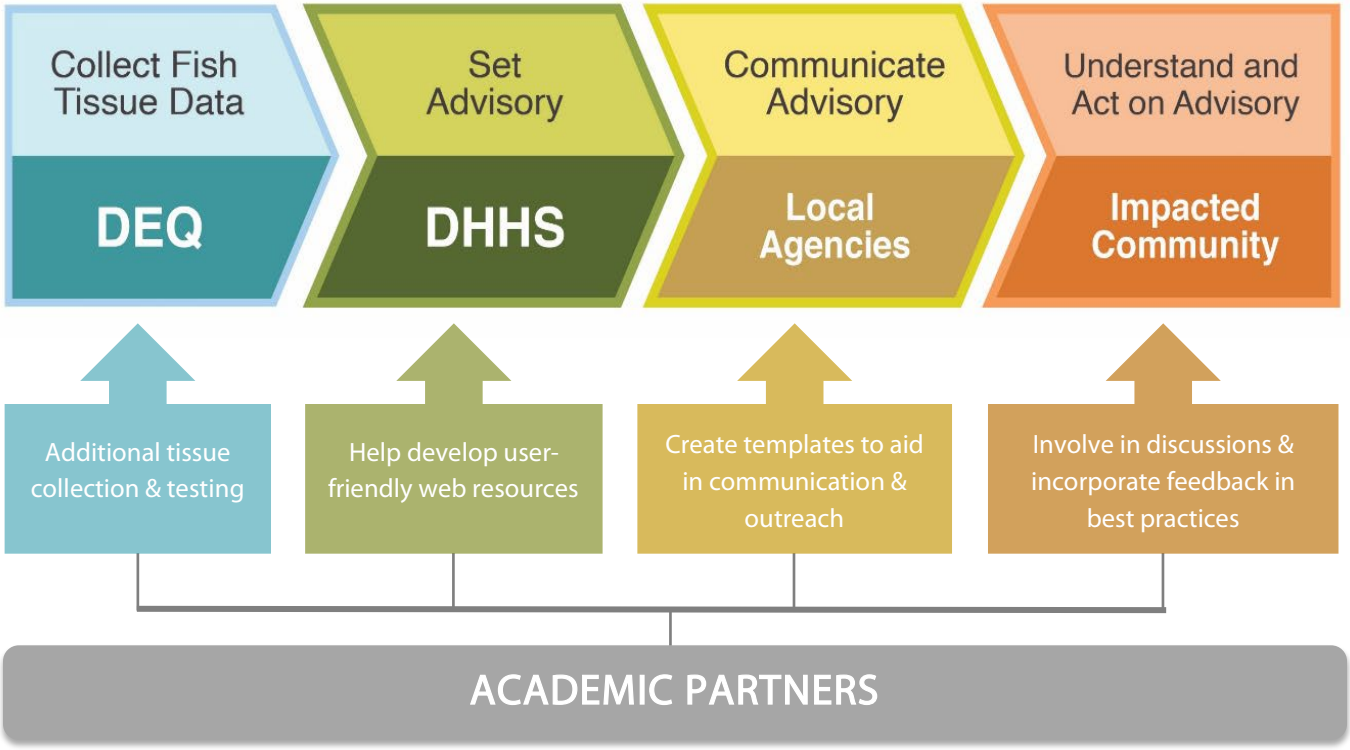


Figure 3. Diagram of fish consumption advisory process in North Carolina, revised to include roles for academic partners.

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