SEA -TO- SCHOOL

Serving Cape Shark for Lunch at Cape Hatteras Secondary School

Sea Grant
North Carolina

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Find this report at ***go.ncsu.edu/STS_capeshark***.

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Introduction

Sea-to-school programs attempt to connect schools and fishermen with the aim of providing local seafood to the students while establishing new markets for the fishermen. Despite active farm-to-school programs, sea-to-school programs have yet to be established in North Carolina. In the winter of 2016-17, Cape Hatteras Secondary School (CHSS) in Dare County piloted the state's first sea-to-school program with the spiny dogfish, a species marketed more recently under the name cape shark. This white paper explores the context of farm-to-school and sea-to-school programs and the activities of CHSS, including a feasibility study that highlights lessons learned and opportunities for establishing sea-to-school programs within North Carolina.

Farm-to-school

Farm-to-school (FTS) programming supports experiential learning through farm visits, school gardens and nutrition education, in addition to local purchasing. FTS programs are mutually beneficial to farmers and schools. Students gain access to local foods while farmers gain access to new markets. By forging direct relationships with schools, small- and mid-size farms can supply a stable and reliable market. FTS efforts have the potential to improve the whole community on multiple fronts — strengthening regional economies, sharing local knowledge of cultural and environmental issues, and increasing community health.

School foodservice programs are a largely untapped market for many farmers. With more than 31 million school lunches served to children each day in 2012, commodity purchases by school foodservice operations are in the billions of dollars (USDA, 2017). The National School Lunch Program, a federally assisted meal program, operates in more than 100,000 public and nonprofit private schools, as well as in residential childcare centers.

Being primarily place-based in design, FTS programs often are motivated by strengthening regional food systems. Some provide students with experiential learning opportunities, such as farm visits, cooking classes and nutritional education, as well as science and hands-on experience in school gardens. The need for food security and desire to preserve rural culture offer further motivation for schools and farmers to participate in FTS programs, as well as impetus for families and community members to advocate for FTS policy support.

Studies evaluating the reasons for FTS participation by school foodservice professionals and farmers list concerns about the paucity of farms in communities and the quality of life associated with the existence of farms (Izumi et al., 2010a; Izumi et al., 2010b). FTS participants explain how their communities are embedded with the food produced in the region. Protecting traditional natural-resource-based jobs and the associated culture is a key motivator for FTS participation.

FTS programs also can contribute to a school's educational cross-curricular impact, particularly in nutrition and agriculture (Vallianatos et al., 2004). Farmers sometimes are invited to teach students about agriculture. Lessons associated with FTS programs are typically hands-on or "learning by doing," relating to where food comes from, how it is grown or caught,

and the value and enjoyment of eating fresh food. These lessons are sometimes incorporated into a curricular strategy that includes lessons about science, nutrition and the environment.

Sea-to-school

While FTS programs have been active in all 50 states, sea-to-school (STS) programs are less common and generally concentrated in New England (National Farm to School Network, 2017). North Coast Seafoods in Boston, Massachusetts, for example, has three local seafood products that it provides to schools in Massachusetts and Maine (Wilkinson and Foley, 2016). They define local seafood as sourced from the Gulf of Maine, ranging from Nova Scotia to Cape Cod. The product, *baked sole New England style*, is served in 3.6- or 4.5-ounce portions for $0.66 or $0.83 per portion, respectively. Other products include *salmon burger*, made with Atlantic redfish, and *coconut-crusted redfish*.

Other New England schools rely on a mix of national, regional and local seafood distributors and networks. Red's Best, a Boston-based seafood wholesaler, provides Harvard University Dining Services with local seafood by aggregating catch from a number of small boats, processing the fish and selling the "catch of the day" to Sysco, a large national company and one of Harvard's suppliers (FINE, 2016a). Seabrook School in Seabrook, New Hampshire, purchases its seafood directly through several local suppliers, such as the Yankee Fisherman's Cooperative based in Seabrook Harbor. The cooperative was founded in 1990 and comprises over 60 members who are ground — cod, pollock, haddock and flounder — fishermen, lobstermen, tuna fishermen and northern shrimpers (FINE, 2016b).

North Coast Seafoods sells Baked Sole New England Style ***in 3.6- and 4.5-ounce portions. Courtesy North Coast Seafoods.***

North Carolina sea-to-school pilot program

A desire to support the fishing industry of Hatteras Island, located on the Outer Banks of North Carolina, inspired an effort to pilot the state's first STS program at Cape Hatteras Secondary School (CHSS). The main objective was to provide students with access to locally sourced marine protein. A CHSS foods course already educates students on the benefits of healthy eating, as well as on sustainable food sourcing and responsible production practices. How could local seafood fit in this ongoing educational effort?

In 2015, the N.C. Division of Marine Fisheries documented that North Carolina fishermen landed

Cape Hatteras Secondary School is located on Hatteras Island on the Outer Banks of North Carolina.

about 66 million pounds of 77 commercial fish species or groups of closely related species (NCDMF, 2016). Dare County had more seafood landings than any other county in North Carolina in 2015, with fishermen landing more than 18 million pounds of seafood (NCDMF, 2016). Hatteras Island in Dare County, where CHSS is located, was one of the most active seafood ports in the state, with fishermen landing more than 5 million pounds in 2015.

During the 2016-17 academic year, North Carolina schools purchased $1.07 million of locally sourced fruits and vegetables through the N.C. Department of Agriculture and Consumer Services' Farm to School Program (NCDACS, 2017a). Apples, strawberries, sweet potatoes and watermelons were the highest-value products purchased by total dollar amount. The program does not source protein locally because many state protein producers, like hog and poultry farmers, already are part of regional and national food distribution channels used by the schools (NCDACS, 2017b).

Recent FTS products served in Dare County schools were strawberries and sweet potatoes. Currently, the only seafood option for Dare County schools is Alaskan pollock, either as a 3.6-ounce fish portion or four, 1-ounce fish nuggets, with a cost per serving of $0.43 and $0.53, respectively.

Cape shark

The CHSS STS pilot program focused solely on the cape shark, *Squalus acanthias*. The North Carolina commercial cape shark fishery occurs from December to April, when cape shark is in greatest abundance in local waters. North Carolina's quota is 6.93 million pounds as of 2015 (NCDMF, 2015). Cape shark is considered an undervalued species in North Carolina: The fish has near-target population levels, yet no in-state markets exist (NOAA, 2017).

North Carolina consumers do not eat cape shark because of a lack of consumer recognition. Consumption of lesser-known species like cape shark could support the regional fishing industry as more popular finfish become inconsistently available due to harvest restrictions.

Cape shark, also known as spiny dogfish, is considered an undervalued commercial species in North Carolina. Photo by Doug Costa, NOAA Stellwagen Bank National Marine Sanctuary.

At the request of commercial fishermen, North Carolina Sea Grant conducted research to assess the degree of consumer acceptance for cape shark. The goal was to identify if this species might be a substitute for more popular species with inconsistent availability, such as grouper.

Sea Grant extension specialists partnered with restaurant chefs in three coastal locations to formulate a range of culinary preparations for cape shark. The goal was to learn the flavor profiles and cooking methods that best resonated with people who eat seafood — particularly local seafood. They chose restaurants because a majority of the seafood consumed in the United States is served in these places. The preliminary results showed that cape shark possesses desirable sensory characteristics similar to flounder across a range of cuisines and cooking methods.

If more consumers become aware of cape shark and find it an appealing seafood choice, demand might grow and prices may rise as a result. Currently, fishermen get little for the fish. In recent years, North Carolina wholesalers, also known as fish houses, have purchased cape shark for $0.11 to $0.22 per pound (Aiken, 2016). They then sell it almost exclusively to processors in New Bedford, Massachusetts, at roughly a 100-percent markup of $0.22 to $0.44 per pound.

North Carolina Sea Grant tested different preparations, such as chargrilled blackened cape shark fillet over pineapple salsa, to better understand consumer preferences. Photo by Vanda Lewis.

Finally, the processed product is sold overseas, reportedly at near $3 per pound, to meet European Union market demand, with countries in the Northeast Atlantic — Belgium, France, Germany, Ireland, Netherlands and United Kingdom — as the main importers (Dell'Apa et al., 2013). The exported product mainly is sold fresh, smoked or frozen, primarily in the form of fillets (Lack, 2006; Gasper, 2011).

Sensory evaluation of cape shark tacos

In fall 2016, CHSS students in the foods courses were tasked with creating cape shark recipes that would appeal to their peers and rely on ingredients already available in the school cafeteria. The students wanted to create a seafood preparation that would have universal appeal. They decided on fish tacos using blackened, baked cape shark.

Students used herbs and spices from the cafeteria to create a homemade blackening seasoning, as well as a mild, homemade salsa. They also used 8-inch, store-bought flour tortillas. At the project onset, students experimented several times with frozen cape shark from New Bedford, Massachusetts, as fresh North Carolina cape shark was not in season.

After refining the recipe, the students conducted a sensory evaluation of the fish tacos among the

Evan Ferguson (center), the marketing and foods teacher at Cape Hatteras Secondary School, and her students developed a taco recipe incorporating cape shark. Courtesy Cape Hatteras Secondary School.

school population using fresh cape shark supplied by Wanchese Fish Company. A total of 219 students and staff were surveyed to determine whether they would participate in the sensory evaluation. Only those who enjoyed eating seafood could participate. Out of the 219 potential participants, 60 students and staff were chosen for the sensory panel. While the survey showed 67 percent of respondents liked fish, some students could not participate because of class conflicts or failure to submit permission slips.

Participants rated the sensory attributes of flavor, texture, aroma and appearance of the tortillas, baked fish, salsa and the assembled cape shark tacos. A hedonic scale, which measures food preferences, was used, where a score of "7" equals excellent, "6" equals very good, "5" equals good, "4" equals fair, "3" equals poor, "2" equals very poor and "1" equals unacceptable. A total score of five for each sensory attribute was the threshold of acceptability. Scores of four or lower indicated deficiencies requiring a reformulation.

Approximately 97 percent of the respondents rated the flavor of the baked fish as good or better (**Table 1**). Similarly, 97 percent of the respondents rated the appearance of the baked fish as good or better. Approximately 80 percent of the respondents rated the texture of the baked fish as good to excellent, and 87 percent rated the aroma of the baked fish as good to excellent. Finally, 93 percent, 91 percent, 99 percent and 100 percent of the respondents rated the flavor, texture, aroma and appearance, respectively, of the assembled fish taco as good or better.

Respondents also could elect to write comments about individual components and the overall tacos (**Table 2**). About 17 percent of the respondents left comments about the fish, while approximately 7 percent left comments about the salsa and the overall taco. The 10 comments about the fish ranged from negative to positive. Some respondents found the fish bland and recommended additional seasoning. The four comments about the salsa were negative. All four comments about the overall tacos were positive.

A foods student assembles a cape shark taco for testing. Courtesy Cape Hatteras Secondary School.

TABLE 1. Sensory evaluation results for the cape shark taco

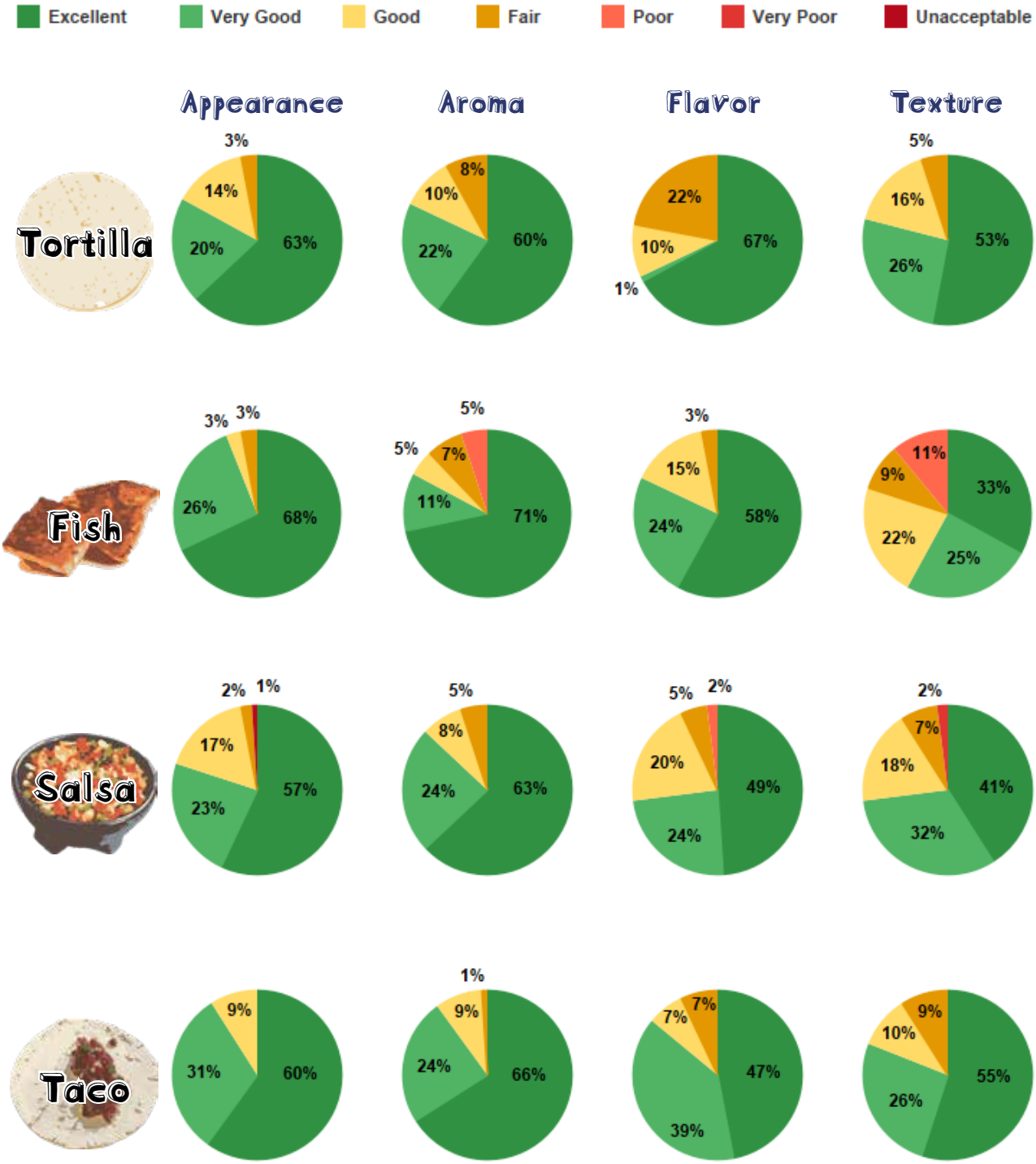

TABLE 2. Comments made by students and staff about the cape shark tacos and individual components

	"Like flounder, snapper, or bass but flakier." "The fish was a little bland but overall it was amazing." "Delicious! I loved the blackened seasoning, loved the tenderness as well." "More seasoning, needs to be crispy on the outside." "Bland. Pretty low on my list of preferred fish." "I don't care for dog shark too much. Too mushy and flavorless." "Fish sauce is too lemony. Fish itself didn't have too much flavor." "Seasoning needs to be stronger." "Too much lemon."
	"Needed just a bit more salt and cilantro in salsa, but that may not be economical for cafeteria." "Too much salsa." "More salsa flavor. More of a fine, soft chopped salsa." "It was good, the salsa was kind of drippy."
	"I would eat it every day." "Colorful and healthy. A lunch you can feel good about eating." "I would buy this off the cafeteria menu." "I would recommend this to a friend."

Cross-curricular cape shark lessons

Apart from determining the feasibility of incorporating cape shark into the CHSS cafeteria offerings, the project also included cross-curricular science, technology, engineering, art and math lessons. Art students created cape shark sculptures, math students evaluated trends in the cape shark population and biology students dissected cape shark. The foods students developed social media messages and websites to raise public awareness of the project and they presented findings about their recipe to the Dare County Board of Education.




Clockwise from top left: Biology students dissected cape shark. • Art students created cape shark sculptures. • The students developed a homemade blackening seasoning, as well as a mild salsa for the taco recipe. • The art sculptures were showcased around the school. Courtesy Cape Hatteras Secondary School.

Nutrition analysis of cape shark

A nutrition analysis of cape shark indicates the calories, fat, cholesterol, sodium, protein and omega-3s found in a 3.5-ounce serving of raw cape shark (**Table 3**). Cape shark would be an acceptable protein choice, when served with a balanced meal, according to federal school-nutrition standards.

Seafood is viewed as a low-calorie protein source. While a 3.5-ounce serving of raw cape shark contains 130 calories, the final caloric content will vary depending on how the fish is cooked. The CHSS students baked the cape shark for the fish tacos and added no additional oils or fats apart from the non-stick oil spray used to coat the aluminum foil-lined pan. Hence, the expected final calorie content of the baked fish would be similar to raw cape shark.

Generally, seafood also is low in total and saturated fat. Most fish and shellfish contain less than 5 percent total fat, and even the fattiest fish, such as mackerel, have no more than 15 percent fat (Seafood Health Facts, 2017). A 3.5-ounce portion of raw cape shark contains only 4.5 percent total fat, which again, can fluctuate depending on the cooking method.

The human body cannot produce omega-3 fatty acids, yet they are needed for healthy development. Hence,

Table 3. Nutrition analysis of a 3.5-ounce serving of raw cape shark

Calories	130
Fat calories	41
Total fat	4.5 grams
Saturated fat	0.9 grams
Cholesterol	51 mg
Sodium	79 mg
Protein	20.9 grams
Omega-3	0.9 grams

(Seafood Business, 2009)

omega-3s must be obtained through diet. Research suggests omega-3 fatty acids — eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) — may reduce the incidence of heart disease. The American Heart Association recommends 1,000 milligrams of combined EPA/DHA per day for patients with coronary heart disease (Seafood Health Facts, 2017). A 3.5-ounce serving of raw cape shark contains 0.9 grams, making it a good source of omega-3 fatty acids.

Mercury, a toxic metallic element, can bioaccumulate in fish tissue. Therefore, fish can represent a major dietary source of mercury to humans. Tissue analysis of cape shark is limited (Adams and McMichael, 2013). The N.C. Department of Health and Human Services recommends that only one meal of shark be eaten per week (NCDHHS, 2017).

Hazard Analysis and Critical Control Point monitoring

North Carolina Sea Grant conducted a safety evaluation of cape shark handled in a commercial setting. Hazard Analysis and Critical Control Point (HACCP) monitoring is a federally mandated program food handlers and manufacturers use to prevent, eliminate or reduce potential health risks in food. To ensure the safety of fish and fishery products, the U.S. Food and Drug Administration (FDA) issued its seafood HACCP regulation in 1995 (Nash and Green, 1998; Nash and Green, 1999).

A HACCP food-safety program is designed to reduce four kinds of hazards that are reasonably likely to occur and would cause illness or injury to consumers:

- **Biological**: disease-causing bacteria, viruses and parasites;
- **Chemical**: environmental toxins, aquaculture drugs, toxic compounds and decomposition (histamine);
- **Physical**: metal, glass or wood fragments; and
- **Allergens**: milk, eggs, fish, crustacean shellfish, tree nuts, peanuts, wheat and soybeans.

The *FDA Fish and Fishery Products Hazards and Controls Guidance* is the standard resource for conducting hazard analyses and devising seafood HACCP plans. An assessment of process vulnerabilities during a hazard analysis must account for methods of storage and distribution and how the seafood will be consumed — raw or cooked — by an end user. Hazards inherent in seafood and the manner in which it is processed also are evaluated.

For the frozen New Bedford cape shark product, Sea Grant determined the vacuum-packed fillets should be distributed to and stored frozen at CHSS. The product should be fully cooked for consumption. The analysis showed that cape shark possessed no hazards with regard to parasites, natural toxins, histamine, environmental chemicals or aquaculture drugs. While all raw seafood potentially contains pathogenic

bacteria, cooking fillets to an internal temperature of 145 degrees Fahrenheit for 15 seconds would negate the biological hazard (National Restaurant Association, 2013).

Lessons learned

During fall 2016, the CHSS foods students experimented with cape shark processed in New Bedford, Massachusetts, because the species was not available then from North Carolina waters. The product was received frozen and with the bloodline, or the dark flesh, excised. Despite no bloodline, the students found the Massachusetts-sourced product to be stronger — "fishier" — in flavor compared to locally sourced fresh product. Off-flavors might have been a result of post-harvest handling.

Aside from the bloodline, cape shark has white-colored meat with an appearance and texture reminiscent of flounder. While the bloodline and the immediate surrounding area of meat can be eaten, it tends to develop strong, unpalatable off-flavors as a fish ages. The bloodline contains enzymes that facilitate the spoilage process. To enhance the eating experience, processors or chefs opt to trim bloodlines from their fish carcasses. Thus, the students removed the bloodline prior to preparing the fresh fish for the sensory evaluation.

When North Carolina fishermen began harvesting cape shark in the winter, a Hatteras processor delivered fillets to the students with the bloodline intact. At a usable-meat yield of 20 percent, the Hatteras processor could meet the school's maximum price point of $2.12 per pound — $0.53 per four, 1-ounce nuggets — of filleted fish.

However, the student chefs did not like the strong, "fishy" flavor of the meat that was in contact with the bloodline, so they decided to remove this dark flesh from the fillets. With the bloodline trimmed out, yields of usable meat decreased to between 10 and 15 percent. Within this yield range, the processor could not meet the school's price ceiling for fresh product and still make a profit.

New England processors have developed specialized manufacturing capabilities to use nearly all of the parts of the fish: belly flaps, fins, cartilage and even the remaining carcass for organic fertilizer. While there is the potential for this in North Carolina, the processing capability does not presently exist in the state.

Another constraint on the Hatteras processor was the student chefs' preference for fresh over frozen North Carolina cape shark. The inconsistent availability of cape shark during winter 2017 proved an impediment to sourcing. Unseasonably warm weather made the species scarce, and local fishermen focused on other, higher-value finfish. Freezing is the only method of stocking a fish long-term, particularly when its presence in local waters is highly variable.

Many consumers believe fresh seafood is of higher quality than frozen. Properly frozen seafood, once thawed, should exhibit the same ideal sensory characteristics of fresh-caught seafood.

The key to preserving the quality — and safety — of fresh seafood post-harvest is to pack it in ice to keep the temperature at, or near, 32 degrees Fahrenheit, which retards enzymatic and bacterial decomposition. Well-iced seafood, typically, has a shelf life of five to seven days. Long-term storage requires freezing, and the quality of seafood is best maintained when it is frozen quickly, either cryogenically, using liquid carbon dioxide or nitrogen, or with forced-air convection — blast freezing. The worst approach is to freeze seafood in a chamber having minimal or no air movement, such as in a home or standard school freezer.

Dare County schools rely on national food distributors, such as Sysco, to fulfill their foodservice needs. Preferred vendors provide year-round access to a large variety of competitively priced, packaged and processed products that satisfy their clients' specifications (Newbold, 2017). These wholesale distributors offer one-stop shopping for food and nonfood items, as well as streamlined service. School foodservice professionals cite the additional administrative time needed to identify farmers and fishermen, negotiate terms, and coordinate deliveries as a significant barrier to procuring local food (Berkenkamp, 2006; Izumi et al., 2006). The Dare County schools foodservice director also voiced concern about the potential for additional work.

Many school foodservice programs, including Dare County schools, typically buy heat-and-serve meals and no longer have the equipment or labor to handle whole, unprocessed foodstuff. Farmers and fishermen may not have the production capability to pack or process their product to meet these specifications. The CHSS cafeteria's food preparation generally is limited to reheating frozen products. While the CHSS foods students' recipe could be recreated in the cafeteria with available equipment, the effort could be an additional burden to cafeteria staff.

The STS pilot program highlights the need for schools and local processors to start a dialogue about custom-processing local seafood so schools' specifications can be met *profitably* by local producers.

The availability of processed seafood is critical in high-volume foodservice environments like schools. Having access to processing facilities, freezing and storage is very important for the vendors to make sure a product like cape shark can be available year-round and served in a school with limited preparation. In Dare County, seafood-processing companies have access to volume and manufacturing resources, as well as the ability to purchase equipment and hire labor, if opportunities to service the county's school system are profitable.

Farmer cooperatives and seafood wholesalers ultimately may serve as a critical link between producers and fishermen, respectively. From the farmers' perspective, consistently low-volume sales and logistical issues associated with the timing of deliveries, the availability of storage or refrigeration space in school foodservice kitchens or warehouses, and the presence or absence of loading docks are key challenges to participating in FTS programs (Izumi et al., 2010b). Those same barriers exist from fishermen's perspectives. These issues are magnified when decentralized delivery of product to multiple school buildings is required. Thus, expanding the scope of the pilot program to multiple Dare County schools would require additional logistical support or the use of a wholesaler that can aggregate and distribute volume to local customers.

Finally, maintaining a passion and demand for local seafood products, especially if they become more regular offerings, could prove difficult if student engagement is not consistent from year to year. Continued education about the importance of local seafood to the students' communities would likely be needed to keep the program viable.

Opportunities

There was strong interest in eating local seafood, according to feedback from CHSS students and staff. Sensory-evaluation participants indicated they were excited to be served fresh, local seafood and to help the local fishermen and economy. Direct outreach to students by their peers and

teachers — and established relationships among local fishermen and CHSS staff — made a big difference in interest and level of awareness of the importance of eating local seafood.

The cape shark project demonstrated coastal students' interest in an STS program. Students and staff were eager to explore ways to incorporate local seafood into their school's lunch menu. This is an educational opportunity to help students learn more about, and develop an appreciation for, the biology and nutrition of commercial species and the challenges fishermen face when bringing local seafood to the public.

Despite the challenges with cape shark, Hatteras fishermen still indicated an interest in providing local seafood to area schools. By engaging local fishermen and processors, as well as larger distributors in the STS conversation, new business configurations have the potential to emerge. In other FTS programs, early sales often were limited, but the volume and variety of products sold to schools increased over the years (Izumi et al., 2010a). The higher volume of sales was due, in part, to new opportunities that emerged once relationships between farmers and school foodservice professionals were established.

Ultimately, to be successful, FTS and STS programs must develop partnerships that benefit the school and the local farmer or fisherman. Established programs involve motivated school foodservice directors who can balance cost, nutrition and student participation, as well as local farmers and fishermen with interests in serving new markets.

In addition, heat-and-serve food items may require additional processing to accommodate the school cafeterias' capabilities to prepare meals. More discussion is needed among individual schools and school systems with processors to find mutually beneficial arrangements to use local seafood. Success in the STS arena in North Carolina may depend on supply-chain innovations, including aggregation and distribution, as well as custom processing and packaging by processors. Success also could require third-party food distributors to add value and accommodate school needs.

Finally, economic studies should be conducted to determine the types of seafood that school systems can afford, and the cost of value addition (such as processing, packaging and distribution) for a heat-and-serve cooking environment. North Carolina Sea Grant's expertise in marine education, economics, and seafood processing and safety is needed and available to guide development of North Carolina STS programs.

References

Adams, D.H. and R.H. McMichael. 1999. Mercury levels in four species of sharks from the Atlantic coast of Florida. *Fishery Bulletin-National Oceanic and Atmospheric Administration* 97: 372-379.

Aiken, J. 2016. Personal interview with North Carolina seafood processor on July 21, 2016.

Berkenkamp, J. 2006. Making the Farm/School Connection: Opportunities and Barriers to Greater Use of Locally-grown Produce in Public Schools. *Leopold Center Pubs and Papers*. 153.

Dell'Apa, A., Johnson, J.C., Kimmel, D.G., and R.A. Rulifson. 2013. The international trade and fishery management of spiny dogfish: A social network approach. *Ocean & Coastal Management* 80: 65–72.

Farm to Institution New England (FINE). 2016a. Sea to campus case study – Harvard University. http://www.farmtoinstitution.org/sites/default/files/imce/uploads/Seafood%20Case%20Study_Harvard_0.pdf, accessed 5/2/2017.

Farm to Institution New England (FINE). 2016b. Sea to campus case study – Seabrook School. www.farmtoinstitution.org/sites/default/files/imce/uploads/Seafood%20Case%20Study_Seabrook%20School.pdf, accessed 5/2/2017.

Gasper, J.R. 2011. Policy and market analysis of world dogfish fisheries and an evaluation of the feasibility of a dogfish fishery in waters of Alaska, USA. [Dissertation] University of Alaska, Fairbanks, Alaska. Publication Number: 3497719. 215pp.

Izumi, B.T., Alaimo, K., and M.W. Hamm. 2010a. Farm-to-school programs: Perspectives of school food service professionals. *Nutrition Education and Behavior* 42 (2): 83-91.

Izumi, B.T., Wright, D.W., and M.W. Hamm. 2010b. Market diversification and social benefits: Motivations of farmers participating in farm to school programs. *Rural Studies* 26: 374-382.

Izumi, B.T., Rostant, O.S., Moss, M.J., and M.W. Hamm. 2006. Results from the 2004 Michigan farm-to-school survey. *School Health* 76 (5): 169-174.

Lack, M. 2006. Conservation of spiny dogfish (*Squalus acanthias*): A role for CITES? TRAFFIC International, Cambridge, UK. 49 pp. www.traffic.org/species-reports/traffic_species_fish5.pdf, accessed 5/20/17.

Nash, B. and D. Green. 1999. Hazard analysis and critical control point monitoring: Model safety plans for small seafood dealers, packers and processors. North Carolina Sea Grant, UNC-SG-99-01, page 1.

Nash, B. and D. Green. 1998. A self-guide to hazard analysis and critical control point inspection for small seafood dealers, packers and processors. North Carolina Sea Grant, UNC-SG-98-05, pages 3-5.

National Farm to School Network. 2017. Our network. www.farmtoschool.org/our-network, accessed 5/3/2017.

National Oceanic and Atmospheric Administration. 2017. Atlantic spiny dogfish. www.fishwatch.gov/profiles/atlantic-spiny-dogfish, accessed 6/15/17.

National Restaurant Association. 2013. ServSafe manager 6th Edition. Page 6.10.

N.C. Department of Agriculture and Consumer Services. 2017a. NC farm to school total produce sales 2017-2017 school year. www.ncfarmtoschool.com/htm/about/documents/2016-2017NCFarmtoSchoolTotalProduceSales5-1-2017.pdf, accessed 5/8/17.

N.C. Department of Agriculture and Consumer Services. 2017b. Personal communication with NCDACS marketing specialist Heather Barnes on 5/2/17.

N.C. Department of Health and Human Services. 2017. Mercury. epi.publichealth.nc.gov/oee/mercury/safefish.html, accessed 6/15/2017.

N.C. Division of Marine Fisheries. 2016. 2016 License-statistics annual report. portal.ncdenr.org/web/mf/commercial-fishing-annual-reports, accessed 5/8/17.

N.C. Division of Marine Fisheries. 2015. Spiny dogfish – 2015. portal.ncdenr.org/web/mf/29-spiny-dogfish-ssr-2015, accessed 5/8/2017.

Newbold, V. 2017. Personal interview with Sysco seafood specialist on May 2, 2017.

Seafood Business, eds. 2009. Seafood Handbook: The Comprehensive Guide to Sourcing, Buying and Preparation. 2009. John Wiley & Sons, Inc.

Seafood Health Facts. 2017. Seafood nutrition overview. www.seafoodhealthfacts.org/seafood-nutrition/healthcare-professionals/seafood-nutrition-overview, accessed 5/15/2017.

U.S. Department of Agriculture. 2017. National school lunch program. www.fns.usda.gov/sites/default/files/cn/NSLPFactSheet.pdf, accessed 5/8/2017.

Vallianatos, M., Gottlieb, R., and M.A. Haase. 2004. Farm-to-school: Strategies for urban health, combating sprawl and establishing a community food systems approach. *Planning Education and Research* 23: 414-423.

Wilkinson, A. and K. Foley. 2016. Building students' ownership: Sea-to-School. www.massfarmtoschool.org/presentations/sea-to-school.ppt, accessed 10/25/2017.

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