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Seafood Consumption Preferences and Attributes Influencing Awareness of South Carolina Aquaculture Products

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Abstract

Seafood consumers in South Carolina participated in an online survey describing their seafood preferences, consumption trends, and perceptions toward aquaculture products. Previous research assessing the market channels of seafood in South Carolina were compared to survey results. Respondents indicated that taste and quality were the most important factors considered when purchasing seafood, while production method, wild-caught or farm-raised, was the least important attribute. Respondents (68%) overwhelmingly believed that the majority of seafood

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they purchase in South Carolina is locally or domestically (United States) sourced. Shrimp and salmon were the most frequently purchased aquaculture products. Overall recognition of ecolabelling was below 40%.

Keywords: aquaculture, consumer survey, seafood consumption, supply chain, ecolabelling, South Carolina

Background

Food fish production from aquaculture currently accounts for 53% of the global supply of seafood and since 2016, consumption of seafood has increased 3.1% annually (United Nations Food and Agriculture Organization, 2018). In the United States, total seafood consumption has increased 25% from 1980 to 2018 (National Marine Fisheries Services, 2018), while the United States Department of Agriculture (USDA) estimates that more than 80% of seafood consumed in the United States is an imported product and is the top seafood importing country in the world (FAO, 2018; USDA, 2018). A majority of the seafood that is imported to the United States is farm raised, lending to the overall impact aquaculture has on the seafood supply chains in the United States (Shamshak et al., 2019). Due in part to the high volume of seafood imports since the 1970s, the United States currently faces an annual seafood trade deficit of $18 billion, with aquaculture products accounting for roughly half of that deficit (Bostock et al., 2010; Abolofia, Asche, and Wilen, 2017; Love et al., 2020).

Historically, U.S. aquaculture production constituted a double-digit share of the global market (e.g., 10% in 1951), but production has declined and only represented 1% of global output in 2016, as global expansion of aquaculture production dramatically increased (Garlock et al., 2020a). Marginal growth in gross production of U.S. aquaculture has been documented since 2010, with the situation being referred to as a "stagnation" of U.S. aquaculture (Hargreaves, 2017; van Senten and Engle, 2017). While U.S. domestic aquaculture production has seen slower growth as compared to consumer demand since 2000, aquaculture products are now comparable in market price to wild-caught seafood, meaning a higher return on investment for aquaculture producers (Asche, Bjørndal, and Young, 2001; Verbeke et al., 2007). The National Aquaculture Plan, established by the U.S. Congress in 1980, seeks identification of "the economic, physical, legal, institutional, and social constraints that inhibit the development of aquaculture in the United States" (p. 3). More recently, an Executive Order promoting American seafood competitiveness and economic growth was signed on May 7, 2020. and outlines the expansion of sustainable U.S. production through more efficient and predictable aquaculture permitting, among other considerations (Exec. Order 13921, 3 C.F.R., 2020). It is in this vein that bridging the gap between consumers' knowledge regarding seafood and their purchasing habits continues to be an objective of many state and federal agencies in addressing the production deficit that the United States is facing.

Introduction

The U.S. aquaculture industry appreciably contributes to domestic seafood consumption, but despite recent increases, still lags behind worldwide production (Thong and Solgaard, 2017; Garlock et al., 2020b) and is unable to satisfy the demands of U.S. markets (Carlucci et al., 2014; Love et al., 2020). Barriers to increasing the gross aquaculture production in the United States, with barriers being defined as factors inhibiting the expansion of aquaculture operations, vary depending on suitable water quality, local infrastructure, labor, and the presence of existing markets (Tango-Lowy and Robertson, 2005; Gibbs, 2009). Some of the potential reasons for the stagnation of gross aquaculture production in the United States include the small-scale nature of

many aquaculture operations, production taking place in public waters, social opposition across a wide range of stakeholders, and the complex processes behind leasing and permitting as key reasons for the underutilization of aquaculture production in the United States. (Whitmarsh and Palmieri, 2009; Knapp and Rubino, 2016; Risius, Janssen, and Hamm, 2017). In terms of shellfish mariculture operations, regulatory costs remain a major barrier. A survey of producers on the West Coast of the United States who collectively made up 74% of the region's gross shellfish mariculture production found that regulatory costs associated with permitting make up 29% of the firm's operational costs (van Senten et al., 2020).

Research focused on consumer preferences for and perceptions of seafood products has focused on the attributes consumers consider when making purchasing decisions, segmenting the demographic and nondemographic factors that influence these decisions (Chu et al., 2010; Roheim, Sudhakaran, and Durham, 2012; Flaherty et al., 2019; Bouchard et al., 2021). A systemic literature review by Carlucci et al. (2014) identified numerous factors influencing global fish consumption, including the high cost of seafood products, concerns about health risks, adversity to preparing seafood, and concerns over fish stock abundances, among others. A survey investigating the perceptions of aquaculture products in the northeastern United States found that aquaculture products were perceived to be of higher food quality and safety than comparable wild-harvested seafood products (Gall and O'Dierno, 1993). Respondents from the same survey perceived aquaculture products to be more expensive than wild-harvested products (Gall and O'Dierno, 1993).

Empirical surveys documenting consumers' preferences for and perceptions of seafood have sought to elucidate the patterns associated with a higher affinity for seafood and aquaculture products and attributes considered when making seafood purchases, such as labelling associated with locality and sustainability (Chu et al., 2010; Thapa, Dey, and Engle, 2015; Carlucci et al., 2017). A metric that is commonly collected in seafood consumer surveys is the frequency of seafood purchases among consumers (Gall and O'Dierno, 1993; Hicks, Pivarnik, and McDermott, 2008; Davidson et al., 2012). In the northeastern United States, higher frequency of seafood purchases for in-home consumption was associated with older age groups, residence in urban or suburban areas, and participation in recreational fishing activities (Herrmann et al., 1994). Following the findings of Herrmann et al. (1998) regarding population segments of recreational anglers having higher frequency of seafood consumption, Perkinson et al. (2020) investigated seafood consumption patterns of recreational anglers in Charleston and Berkeley counties in South Carolina and found that more than 25% of respondents ate seafood twice a week or more.

Labelling schemes of seafood products and consumers' perceptions of where seafood is sourced continue to be a focus of consumer survey research. Specifically, surveys seek to extract empirical evidence on the impact labelling and other attributes have on consumer decision making. Bouchard et al. (2021) surveyed consumers across the U.S. East Coast and found that those who more frequently sought out labelled seafood products, such as being farm raised or regional identification, were more informed about aquaculture practices, older, and generally had a more positive attitude toward aquaculture products. However, consumers in Hawaii reported a higher affinity for wild-caught-identified seafood products (Davidson et al., 2012), while Fonner and

Sylvia (2015) found that consumers in Oregon had a higher willingness to pay for seafood that displayed eco-labelling and was marketed as locally sourced.

Aquaculture along the southeastern U.S. coast is largely concentrated on shellfish mariculture production, specifically of Eastern Oyster *Crassostrea virginica*, with the exception of Florida where 98% of shellfish mariculture production is Hard Clams *Mercenaria* (USDA-NASS, 2013). The need for feedback from seafood consumers on what products they purchase, where they purchase them, and the demand for alternative seafood options is evident as fledgling aquaculture operations have difficulty establishing themselves (Gibbs, 2009; Whitmarsh and Palmieri, 2009; Brayden et al., 2018). In this study, we investigated South Carolina coastal and inland consumer perceptions of local aquaculture seafood and their respective consumption across a variety of species and market outlets. The South Carolina aquaculture industry is embryonic: In 2018, the South Caroline aquaculture sector was valued at slightly more than $4 million with 24 farms, which is a loss of eight farms and 14% in revenue since 2013 (USDA-NASS, 2018). In South Carolina, the number of freshwater aquaculture farms specializing in the production of catfish and tilapia has declined 20% since 2013, while the number of mariculture operations has increased 40% (USDA-NASS, 2018). This increase is largely occurring on farms involved in the off-bottom shellfish production of oysters (USDA-NASS, 2018).

Evaluating the demand for seafood and aquaculture products in South Carolina has been documented previously in a comprehensive economic impact report conducted in 2008 on the market channels for seafood products in South Carolina and the breakdown of sales of imported and exported products (Henry, Rhodes, and Eades, 2008). Henry, Rhodes, and Eades (2008) provide vital information on the trends of local aquaculture production and accessibility of local aquaculture products to in-state distributors. For our purposes, we used the per capita consumption values of various seafood products from this report as a baseline for seafood consumption in South Carolina. Using data collected by Henry, Rhodes, and Eades (2008) as a baseline, our objective was to update our understanding of seafood consumption trends through empirical sampling of seafood consumers in South Carolina.

Materials and Methods

Survey

The perceptions and consumption of seafood in South Carolina focusing on aquaculture-produced species were evaluated utilizing the validated survey instrument, Qualtrics. Questions on the survey were pretested by select South Carolina residents, Clemson Extension, and South Carolina Sea Grant Consortium personnel and revised as necessary. Surveys were distributed to random households across all of the 46 counties in South Carolina. Surveys consisted of screening, lifestyle, shopping preference, and demographic questions. Screening questions were used to limit participants to the targeted population: South Carolina residents 18 years of age or older who consumed seafood. For simplicity, both marine and freshwater species were lumped under the term "seafood." A total of 1,947 respondents from all 46 counties in South Carolina matched screening criteria. Survey participants were queried about household consumption and their perceptions of

wild and raised seafood. Data on species, market outlets, and season preferences also were collected. A major portion of the survey inquired about consumers' perceptions of aquaculture in general and South Carolina's fledgling aquaculture industry specifically.

Respondents were asked to choose up to three most frequently consumed seafood products from a provided list. This list was comprehensive but not exhaustive; therefore, seafood products representative of certain localities may not be represented among the choices available. To account for choices not represented, the survey included an "other" option as a choice. Of note, canned tuna in this survey is not differentiated among fresh, frozen, and prepared products, which has been differentiated in similar surveys (Gall and O'Dierno, 1993). Shellfish options listed in the survey included bivalves, such as clams, oysters, and mussels, and crustaceans, such as crab and shrimp. Shellfish products in this survey were not differentiated between being consumed cooked or raw, as is the case with clams and oysters on the half-shell (Murray and D'Anna, 2015). To address the current gap in knowledge regarding intrastate travel relating to seafood consumption, we collected data on seafood preferences of inland residents who indicated they had traveled to a coastal county and purchased seafood.

Respondents were also asked to select up to three of the most commonly purchased farm-raised seafood products, in addition to the three most desired farm-raised seafood produced in South Carolina, assuming these products were available. The option "none" was included among the choices as a proxy for respondents who would not purchase farm-raised seafood products in any capacity. The objective of this question was to assess the market potential of local aquaculture products based on possible consumer demand. Other sections in the survey included asking respondents their three most frequently visited market outlets for purchasing seafood, familiarity with seafood certification labelling, the importance of attributes when making seafood purchases, and which sources of information about seafood are preferred.

One of the primary limitations of this study revolved around respondents' demographics. Utilizing online survey platforms is a cost-minimization strategy for data collection, but is inherently limited by selection biases of survey companies (Wright, 2006). Primarily, two selection biases occur. Online survey companies may not be able to recruit participants representative of the general population, and as such, may not be able to meet target demographic groups to ensure a representative sample population. Secondly, online surveys eliminate households without access to the internet. Based on the estimates from the American Community Survey (U.S. Census Bureau, 2019), 81.6% of households have broadband internet access. It is assumed that the exclusion of the population of households without internet may result in a geographic and socioeconomic sample bias at a minimum.

Results

Sociodemographic Data of Survey Respondents

Survey respondents resided in each county across South Carolina (f) and tended to be younger, well educated, and long-term state residents. A majority, 72%, resided in non-coastal counties,

with the seven most populous counties contributing 12% (Greenville), 9% (Charleston), 8% (Richland), 8% (Horry), 6% (Spartanburg), 6% (Lexington), and 5% (York) of all surveys collected. Sociodemographic data of survey respondents were weighted according to American Community Survey 1-year estimates to accurately report various sociodemographic characteristics of our sample population (U.S. Census Bureau, 2019). The average age of respondents was just under 44 years old, and a majority, 69%, were female (Table 1). Household income in 2019 was just under $65,000, and education level was 15.3 years, equaling between 3 to 4 years of postsecondary education. Households typically consisted of four family members including adults and were South Carolina residents for just under 19 years, highlighting that a majority of survey participants were long-term residents of the state.

Table 1. Sociodemographic Data of Survey Respondents

Variable	Definition	Obs.	Sample Average	Std. Dev.	Min.	Max.	State Average[c]
Respondent location	1 if inland, 0 if coastal county	1947	0.72	0.31	0	1	0.71
Gender	1 if male, 0 if female	1947	0.31	0.27	0	1	0.48
Age[a]	Average age in years	1947	43.6	15.82	18	100	39.9[d]
Income[a]	Average 2019 household income	1947	$65,000	$56,000	0	>$500,000	$56,277
Education[b]	Education in years	1947	15.34	1.98	9	19	13.46
Household members	Including survey respondent	1947	3.00	1.78	0	9	2.54
Residency[a]	Years residing in SC	1947	18.93	10.05	0	50	--
Race and ethnicity	Native American or Alaskan Native	15	0.008	--	--	--	0.004
	Asian	25	0.013	--	--	--	0.017
	Black or African American	393	0.2	--	--	--	0.26
	Hispanic or Latino	43	0.022	--	--	--	0.058
	Native Hawaiian or Pacific Islander	2	0.001	--	--	--	0.001
	White or Caucasian	1446	0.74	--	--	--	0.66
	Other	28	0.014	--	--	--	0.001
Employment	Employed	1208	0.62	--	--	--	0.58
	Unemployed	158	0.08	--	--	--	0.03
	Not in labor force	581	0.3	--	--	--	0.4

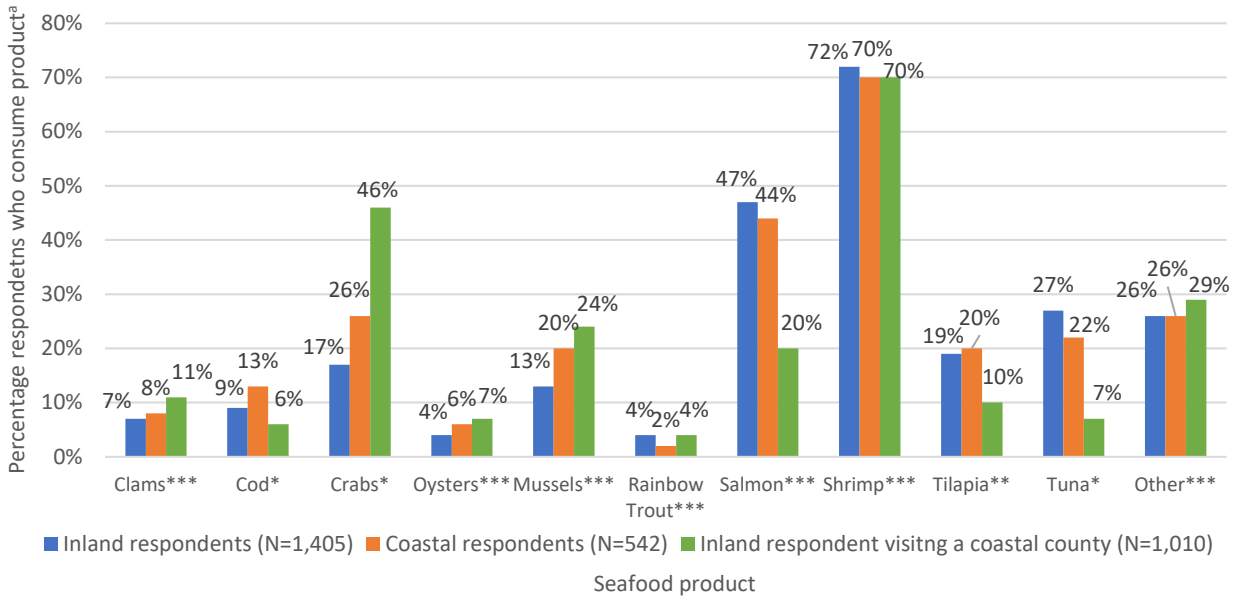
[a]Values are represented by using median values from categorical choices in the survey.
[b]Values are represented by categorical choices, starting with "Some High School" and increasing to a "Graduate Degree."
[c]State level values are based on 2019 ACS 1-year estimates.
[d]Age at the state level is based on individuals of 25 years or old.

Seafood Consumption

The frequency and seasonality of seafood consumption varied in South Carolina (Table 2; Figure 2). Home consumption of seafood occurred twice a month in a majority of households (Table 2). Restaurant seafood consumption only occurred once a month, but in a greater percentage of households (Table 2). While most species were consumed equally across seasons, oyster, crab, and shrimp consumption varied seasonally (Figure 2). Oyster consumption increased during winter months and crab and shrimp consumption increased during summer months (Figure 2). Consumption of crab species, such as the blue crab, is higher among coastal residents than their inland counterparts, while inland residents who traveled to the coast and purchased crabs had the highest rate of reported consumption among respondents (Figure 3).

Table 2. Summary of Respondent Seafood Consumption Frequency

Variable	Average Per Capita Frequency of Consumption	
Frequency of Seafood Purchases	**Prepared at Home (%)**	**Prepared at Restaurants (%)**
Several times per week	18.2	8.8
Weekly	22.7	12.8
Bi-weekly	21.8	20.8
Monthly	37.3	57.6

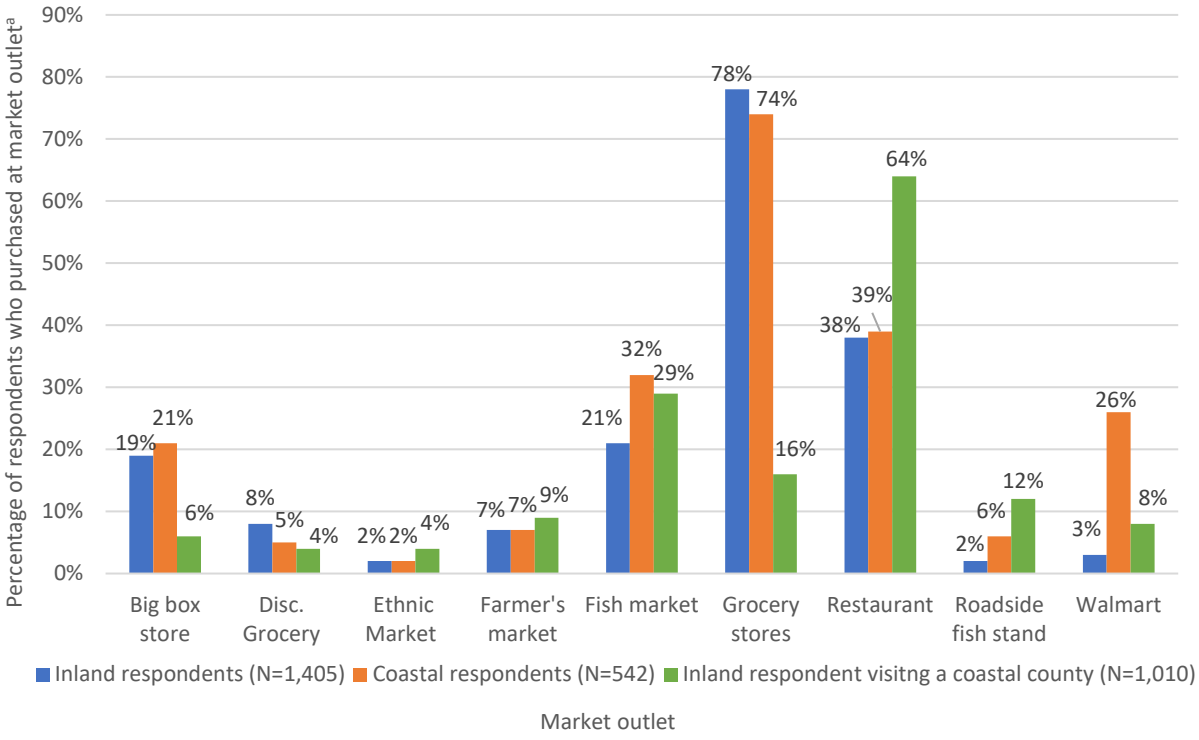


*Wild-caught seafood only
***Both wild-caught and farm-raised seafood
[a]Up to three seafood products could be selected

Figure 2. Seafood Product Choices by Season among Survey Respondent

Market Outlet

Grocery stores were the market outlet of choice (82%) for the majority of seafood purchased for in-home consumption. The segment of inland residents who indicated they had purchased seafood while visiting a coastal county were also asked to provide the three market outlets where they purchased seafood on the coast. The purpose of this question was to compare purchasing behavior among respondents purchasing seafood near their residence as opposed to when they visit coastal communities. Among coastal and inland respondents purchasing seafood near their residence, more than 70% revealed they purchased seafood from grocery stores (Figure 3). A majority of inland respondents visiting a coastal county (64%) purchased seafood at restaurants, and the proportion of inland respondents visiting a coastal county who purchased seafood at grocery stores fell to 16%. Respondents reported average monthly spending of $76.00 on seafood products across all market outlets, and nearly 56% of seafood purchased was cooked as opposed to raw.



[a]Up to three market outlets could be selected.

Figure 3. Choices of Market Outlet among Survey Respondents

Labelling

We found that 47% of respondents have purchased seafood labeled as farm raised, 44% had not, and 9% indicated they did not know whether they had purchased seafood that was labeled as farm raised (Table 3). Survey respondents (68%) believed that the majority of the seafood they purchase is sourced either locally or domestically to the United States. When respondents were asked whether they recognized any labeling signifying their seafood was farm raised in South Carolina,

only 38% had any awareness of labeling for local farm-raised seafood. Table 4 reports respondent results related to seafood source recognition and labeling, including recognition of the Best Aquaculture Practices (BAP) label and the Marine Stewardship Council (MSC) and Aquaculture Stewardship Council (ASC) ecolabels. Table 4 shows that 57% of respondents recognized farm-raised seafood products labels, while a much smaller group of respondents recognized BAP, ASC, and MSC.

Table 3. Summary of Consumer Purchasing Attributes Data

Variable	Definition	Average of Respondents
Seafood preparation	1=cooked, 0=uncooked	0.56
Location of consumption	1=in-home, 0=restaurant	0.64
Seafood purchased for in-home (%)	Grocery stores	82.0
	Other sources	15.0
	I did buy seafood for in-home	3.0
Purchases of seafood labelled as farm-raised (%)	Yes	47.0%
	No	9.0%
	I do not know	44.0%
SC consumer perception of where the majority of seafood is sourced (%)	Locally (SC)	39.0%
	Domestically (besides SC)	29.0%
	Imported internationally	18.0%
	I do not know	14.0%

Table 4. Summary of Ecolabels for Seafood and Aquaculture Products

Variable	Definition	Average of Respondents
Recognition of aquaculture labelling organizations		
Label specifying seafood is farm raised	(1 = Yes, 0 = No)	0.57
Certified SC Seafood[a]	(1 = Yes, 0 = No)	0.38
Best Aquaculture Practices (BAP)	(1 = Yes, 0 = No)	0.29
Marine Stewardship Council	(1 = Yes, 0 = No)	0.37
Aquaculture Stewardship Council	(1 = Yes, 0 = No)	0.32

[a]As of 2019, the South Carolina Department of Agriculture created the South Carolina Certified Seafood Program including aquaculture products.

Seafood Attributes

Taste, quality, and cost were the three most important decision-making criteria for purchasing seafood. Conversely, cooking time and whether the seafood product is farm raised were found to be the least important factors when purchasing seafood. Table 5 highlights that respondents were satisfied overall with the quality and variety of seafood at both grocery stores and restaurants. Respondents were familiar with the differences between farm-raised and wild-caught seafood production methods; however, they were unfamiliar with the actual species that were farm raised in South Carolina. Finally, we found that consumers were very likely to purchase local aquaculture products as evidenced by a score of 4.1 on a 5-point Likert scale (1 = very unlikely, 5 = very likely).

Table 5. Summary of Consumers' Perceptions toward Seafood and Marketing Characteristics

Variable	Definition	Obs.	Scale	Std. Dev.	Min.	Max.
Attributes for purchasing seafood	5 = very important 1 = very unimportant	1947				
Cooking time			3.5	1.14	1	5
Cost/price			4.1	0.91	1	5
Farmed-raised			3.3	0.98	1	5
Location of production			3.7	0.95	1	5
Quality and/or freshness			4.6	0.81	1	5
Supporting local aquaculture			3.7	0.93	1	5
Sustainability			4.1	0.93	1	5
Taste			3.5	0.77	1	5
Market outlet satisfaction	5 = very important 1 = very unimportant	1947				
Quality at grocery stores			3.8	0.80	1	5
Quality at restaurants			4.0	0.78	1	5
Variety at grocery stores			3.6	0.9	1	5
Variety at restaurants			3.9	0.88	1	5
Familiarity with aquaculture products	5 = very familiar 1 = very unfamiliar					
Difference between wild and farm-raised seafood			3.6	1.11	1	5
Types of farm-raised seafood commonly produced in SC			2.8	1.12	1	5
Purchasing SC aquaculture products	5 = very likely 1 = very unlikely		4.1	0.96	1	5

Table 5 (continued).

Variable	Definition	Obs.	Scale	Std. Dev.	Min.	Max.
Information sources	5 = very frequently 1 = very infrequently					
Fisherperson			3.0	1.24	1	5
Friends			3.3	1.09	1	5
Locals			3.3	1.12	1	5
Online review			3.2	1.20	1	5
Restaurant staff			3.3	1.09	1	5
Seafood retailer			3.2	1.12	1	5

Information Sources

Respondents utilized local knowledge, friends, and restaurant staff most frequently for information regarding aquaculture and seafood products, while seafood websites and fisherpersons were the least frequently used sources (Table 5). Respondents preferred to use or receive information about aquaculture products from academia, followed by state agencies, nongovernmental organizations, federal agencies, and lastly, private organizations (Table 6).

Table 6. Summary of Consumers' Preference for Information Regarding Aquaculture Products

Variable	Average of Respondents
Consumer preference for obtaining information on aquaculture products	
Academia (e.g., Clemson University)	38.0%
State agencies (e.g., South Carolina Sea Grant Consortium)	24.0%
Non-governmental organizations (e.g., The Nature Conservancy)	15.0%
Federal agencies (e.g. NOAA)	14.0%
Private organizations	6.0%

Discussion

In this study, we investigated South Carolinians' seafood consumption and their perception(s) of buying and consuming aquaculture products from South Carolina. This research is valuable in that it informs producers and aquaculture industry stakeholders about consumers' demands and preferences. Comparing national and statewide trends of seafood consumption provides evidence of the potential market for aquaculture products in South Carolina, along with opportunities to enhance consumers' awareness of locally produced seafood in the state.

Our results found that salmon, particularly Atlantic salmon, is the most widely consumed aquaculture product, followed by shrimp. According to the National Marine Fisheries Service (2018), Atlantic salmon was the most widely consumed aquaculture product, while farm-raised shrimp was the second most consumed aquaculture product. The most consumed seafood products,

regardless of production method, among U.S. consumers are shrimp and salmon, ranking first and second, respectively (National Marine Fisheries Service, 2018; USDA-NASS, 2018). Our results follow global consumption trends of farm-raised seafood products, with the proportion of respondents in our survey reporting they consumed farm-raised shrimp (71%), Atlantic salmon (46%), tilapia (20%), and catfish (16%), which are also the four most valuable farm-raised fish species by revenue behind carp species (FAO, 2020). Regarding seafood production from recirculating aquaculture systems (RAS), South Carolina has 11 RAS facilities; however, these systems do not currently support the cultivation of shrimp, which is the most desired aquaculture product among respondents (USDA-NASS, 2018). Also, mussels and salmon cannot be feasibly cultivated in South Carolina.

Consumers may choose more frequent consumption of seafood at home given the higher cost of purchasing seafood at restaurants. This is an important signal to producers that the market for home seafood consumption is an important one for additional development and marketing as the industry grows (Hicks, Pivarnik, and McDermott, 2008). A majority of respondents purchased seafood two or more times per month for in-home consumption and once a month at restaurants. A similar trend in restaurant purchases was observed by Hicks, Pivarnik, and McDermott (2008), with respondents reporting two or fewer monthly seafood purchases at restaurants, while in-home purchases took place several times per week.

Understanding the relationship of seafood purchases in the home and at market outlets was of particular importance in our survey, as limited estimates exist for this type of consumer behavior in South Carolina. A majority (56%) of seafood purchased by respondents was cooked. This value is slightly higher than the findings by Cheng and Capps (1988), who found that less than 50% of seafood purchased by Americans was already cooked. Over the last 30 years, seafood preparation at market outlets has increased with more offerings of already prepared seafood available to consumers, particularly frozen and already cooked products (Thapa, Dey, and Engle, 2015). Interestingly, our findings showed that 64% of seafood consumption in South Carolina happens at home, as compared to outside the home or at a restaurant. Respondents purchased 36% of their seafood from restaurants, which is well below the findings of other similar studies regarding seafood consumption (Risius, Janssen, and Hamm, 2017; Brayden et al., 2018).

Similar studies found overall out-of-home seafood consumption as high as 65% (Love et al., 2020). Richards (2020) estimated that in South Carolina, an excess of 80% of farm-raised oysters are sold directly to restaurants where they are marketed as half-shell quality, which further explains the demand for out-of-home consumption of certain aquaculture products. A similar study by Zhang et al. (2004) on at-home and away-from-home consumption of seafood in the United States found that only 46% of respondents purchased seafood at restaurants, much lower than expected. Some studies in other U.S. locations have found that respondents purchased up to 80% of the seafood they consume at restaurants (Thapa, Dey, and Engle, 2015; Thong and Solgaard, 2017). Seafood purchases at roadside fish stands or directly from fishermen themselves were greatest among inland respondents visiting a coastal county (12%). This result is a sign that South Carolina residents potentially prefer freshly caught seafood sold directly from harvesters when they are visiting the coast. Additionally, inland respondents' seafood purchases at fish markets decreased

by 8% when compared to home location purchase versus visiting a coastal county. This finding revealed that there may be more limited availability of fresh seafood in inland counties and that seafood markets in South Carolina are predominantly distributed throughout coastal counties where a majority of locally sourced seafood products are purchased and consumed. This also could highlight that consumers may not be aware of where local seafood markets are located in their communities and may represent a source of educational and/or market opportunities.

Our survey instrument also included a component focused on intrastate travel by inland residents to coastal counties who purchased seafood while visiting the coast. The purpose of this distinction was to investigate which seafood products are more desired by visitors of coastal counties as opposed to the inland counties in which they reside, and at which market outlets inland residents visiting the coast are more likely to purchase seafood. We compared per capita seafood consumption among inland and coastal South Carolina residents to the values found in Henry, Rhodes, and Eades's (2008) study with the same eight coastal counties used to compare per capita consumption of seafood in South Carolina. Henry, Rhodes, and Eades (2008) found that fish accounts for 53% of seafood consumption, while shellfish comprised 47% of seafood consumption for both coastal and inland residents in 2006 (Table 7). Our survey showed similar results for inland county residents' consumption of fish (54%) and shellfish (46%) but differs with respect to coastal county residents' consumption of shellfish, which is higher than Henry, Rhodes, and Eades's (2008) estimates. These results may be attributed to the increase in shellfish mariculture production in South Carolina over the last 15 years (Jodice and Norman, 2020). The decline in grocery store seafood purchases when inland residents visit the coast highlights the relative importance that consumers place on purchasing seafood at market outlets other than grocery stores, such as at restaurants, seafood markets, and roadside fish stands.

Table 7. Percentage of Per Capita Seafood Consumption in South Carolina

Variable	**Source**	**Per Capita seafood consumption (%)**	
Respondent location		**Fish**	**Shellfish**[c]
Inland[a]		53%	47%
Coastal	*Henry et al., 2008*[b]	53%	47%
Inland		49%	51%
Coastal	Our survey, 2020	54%	46%

[a]Coastal counties in South Carolina include Beaufort, Berkeley, Charleston, Colleton, Dorchester, Georgetown, Jaspar and Horry.
[b]Per capita consumption by seafood type is derived from National Marine Fisheries Service database (2008).
[c]Shelllfish in our survey included clams, crabs, mussels, oysters, and shrimp.

Similar studies have found clear distinctions in the purchasing patterns of tourists and residents of coastal counties. For instance, Jodice and Norman (2020) and Tango-Lowy and Robertson (2005) found that the main attributes of seafood consumption, such as quality, taste, and price, typically differ little between geographic areas, while other attributes, such as preferred production method (i.e., wild caught versus farm raised) and origin, can vary widely between coastal and inland communities. Coastal and inland residents' differences may be related to the interactions that coastal residents have with aquaculture growers, resulting in a better understanding of the effects

of aquaculture on coastal ecosystems and a greater potential for supporting producers by purchasing locally (Hilborn et al., 2018).

Seasonality also had an effect on seafood consumption trends in our survey, particularly with shellfish. The increase in consumption of oysters in winter months can be attributed partly to consumers' concern about eating oysters during summer months when water temperature is higher, which can increase the risk of shellfish poisoning due to pathogens such as *Vibrio spp.* (Børresen, 2009). Fishery closures also contribute to trends in local seafood consumption, with no seasonal closure of crab species in South Carolina, while the fall white shrimp commercial fishery is open from September to December, and consumption of shrimp is consistently high throughout the year (South Carolina Department of Natural Resources, 2019). However, higher consumption rates of crab species commonly sold in South Carolina, such as blue crabs, were observed in the summer. This finding alludes to the demand-driven nature of blue crab purchases among tourists in the summer months, when the majority of blue crabs are sold in South Carolina, rather than the effect of harvesting effort, as a majority of landings take place from September to May (Henry, Rhodes, and Eades, 2008; South Carolina Department of Natural Resources, 2019; Jodice and Norman, 2020). Similar consumption trends between inland and coastal respondents were observed with salmon, with 47% and 44% of respondents, respectively, indicating they purchased salmon, while only 20% of inland respondents visiting the coast purchased salmon. Lower consumption of salmon by coastal tourists might be attributed to the relatively homogenous distribution of salmon, both farm raised and wild caught, across the state, and therefore may be less desired than other locally caught seafood sold in coastal counties (Henry, Rhodes, and Eades, 2008).

In South Carolina, the production method (i.e., capture fisheries and aquaculture) and locality of seafood are important considerations in valuation and willingness to pay (WTP). For example, in a study evaluating WTP of wild and farmed salmon, salmon labelled "wild-caught" on average sold for $15.62 per pound, whereas salmon labeled as "farm-raised" sold on average for $6.31 per pound (Bostock et al., 2010). This pattern illustrates consumers' potential preference for "wild-caught" seafood and the related market opportunities. The opposite valuation trend is observed for shellfish, specifically with farm-raised oysters where consumers preferred farm-raised oysters over wild-caught counterparts (Kecinski et al., 2017). Preference for local seafood and aquaculture products is a reoccurring interest that consumers have continued to show when making food purchases (Grebitus, Lusk, and Nayga, 2013; Chen et al., 2017). Similar studies along the Atlantic Coast have found that the proximity of oyster cultivation to consumers affects their willingness to pay for local products (Li, Ahsanuzzaman, and Messer, 2019). Jodice and Norman (2020) found that South Carolina residents' ratings of importance for the attributes "environmentally sustainable," "wild-caught," and "harvested locally" were significantly higher than tourist ratings for the same attributes. In future studies, it will be important to examine how proximity to local aquaculture production may impact residents' willingness to pay for locally harvested products.

Education and outreach continue to be instrumental in growing awareness of the domestic aquaculture industry with consumers who would otherwise overlook the source and production method of the seafood they consume. Respondents (68%) overwhelmingly believed that seafood purchased in South Carolina is either locally sourced or a domestic product of the United States.

the National Marine Fisheries Service (2018) reports that less than 20% of the seafood Americans consume is a domestic product. These results are in line with other studies that highlight the common misconception consumers have about the source of the seafood they purchase (Barrington et al,, 2010; Carlucci et al., 2017). Consumer awareness gaps appear even around the region that certain species are produced; for example, 94% of Atlantic salmon and more than 90% of various species of tropical shrimp (*Penaeid spp.*) are imported and are often misunderstood by consumers as being domestic products (National Marine Fisheries Service, 2018). Consumers' ability to access information regarding aquaculture products and the practices used in the industry has had a significant influence on awareness and acceptance of these products in states with strong aquaculture associations and university-based aquaculture extension programs. They have also served as a catalyst for more financially constrained aquaculture enterprises (Swann and Morris, 2001).

As of this study, the South Carolina Department of Agriculture, in conjunction with the South Carolina Seafood Alliance and the South Carolina Department of Natural Resources, has developed the South Carolina Certified Seafood Program, which is designed to help consumers easily identify locally sourced seafood (South Carolina Department of Agriculture, 2019). This program is available to wholesale dealers, distributors, retailers, and both aquaculture and shellfish mariculture permit holders, certifying that their grown or landed seafood is a product of South Carolina. This certification label includes South Carolina-certified grown seafood, which incorporates locally wild-caught seafood such as shrimp from the family *Penaeidae* and various finfish species commonly caught in South Carolina (South Carolina Department of Natural Resources, 2019). Market outlets sometimes use the terms "locally-sourced" or "farm-raised" as a label on seafood, signifying that the product is either farm raised or that the product is locally sourced. Our results showed that only 38% of respondents indicated they had purchased seafood with the South Carolina Certified Seafood label, signaling that this particular labeling is still relatively new in its implementation among locally sourced seafood and aquaculture products.

Research has shown that education and outreach of coastal mariculture practices and promoting additional market outlets, such as farmers' markets and oyster trails, continue to be effective steps in promoting local, farm-raised seafood products for which consumers are willing to pay a premium (Davidson et al., 2012; Fonner and Sylvia, 2015; Li, Ahsanuzzaman, and Messer, 2019; Kim et al., 2020). South Carolina has recently developed its own form of oyster trail known as the "Lowcountry oyster trail," which may be a valuable resource for introducing the role of mariculture in the region and building environmental and economic support in coastal communities. As mariculture continues to grow in both production and accessibility along coastal counties in South Carolina, the need for targeted surveys of rural communities where aquaculture is taking place is necessary to determine how preferences for aquaculture products may change in contrast to more urban areas of the state. Additional research exploring the preferences for and perceptions of aquaculture products among rural, urban, and underrepresented groups is imperative to better channel marketing opportunities for producers who plan to grow their markets.

Conclusion

This study is the first to elucidate South Carolina seafood consumers' perceptions of aquaculture products and the seafood industry as a whole through empirical reporting. Our survey findings on the preference for South Carolina aquaculture products is in line with the national preference for species including shrimp and salmon, the two most readily available aquaculture products on the market (FAO, 2018). Taste, quality, and/or freshness, and price were found to be the most important attributes when purchasing seafood, which mirrors the most important factors in consumer seafood purchasing found in other studies (Grebitus, Lusk, and Nayga, 2013; Chen et al., 2017).

Our findings about respondents' perceptions of the source of seafood and aquaculture products are important for the larger research stream. While the Certified South Carolina Seafood Program is still in its infancy, it currently has 11 organizational members and is growing annually (Jodice and Norman, 2020). Regulating seafood labeling-related fraud continues to be an important objective in South Carolina and beyond, and a study on national seafood labeling found that 33% of seafood tested for its origin was inaccurately labeled, showing that a significant proportion of U.S. seafood could be geographically misrepresented (Warner et al., 2012).

In conclusion, this research provides valuable information to the broad set of stakeholders interested in aquaculture production in South Carolina. Our results highlight there is great potential for growth of this industry, and consumers are eager to purchase local South Carolina seafood products. Increasing awareness about the economic and environmental benefits of shellfish mariculture in South Carolina and how this industry could benefit our rural communities by being an engine of local entrepreneurship is an area of research and outreach that should be pursued in subsequent studies.

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