North Carolina’s Shellfish Industry: Site Conditions and Economic Impacts

A statewide survey of shellfish leaseholders

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Shellfish aquaculture in North Carolina is a small, yet traditionally important industry to coastal communities, providing locally grown clams and oysters and supplemental income. Despite an increase in seafood demand, acreage under lease and total number of leases has remained relatively constant in recent years. This project examined the scope of the shellfish aquaculture industry in North Carolina. Factors surveyed included the production by species and culture method, sales of shellfish by species and size, market value of cultured product, seed sources, future production and constraints to production. Of the 228 surveys sent to North Carolina leaseholders, 22% were completed. Respondents reported operations of leased acreage ranging from 0.5 to 86 acres, 41% of which were located in Carteret County. Shellfish culture operations were in business for 15 years on average, with 19% of respondents’ income generated from shellfish culture activities. Clams and oysters were the dominant species of culture, with the majority producing both species. The top concerns of leaseholders were theft, hurricanes and water quality. A mixed response was received about the view of the industry in the future. Of the respondents, 42% thought the industry would grow in the next five years, 38% thought the industry would decline, and 20% felt the industry would remain stable. Substantial potential exists for current leaseholders to expand because most utilize extensive methods for shellfish production with relatively low yields. Modest increases on existing leases would provide a significant increase in shellfish production. Large-scale increases in North Carolina’s shellfish industry will likely require new operations that generate primary income. Assistance with siting new shellfish leases could reduce risks from theft and problematic water quality, and therefore should be included when considering how to best assist growth in the industry.

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North Carolina Shellfish Aquaculture

Shellfish aquaculture, specifically mollusks, accounts for two-thirds of U.S. marine aquaculture production (NOAA Aquaculture, 2009). U.S. mollusk production in 2007 totaled approximately $243 million from nearly 1,100 operations (USDA, 2009), providing a significant economic component to coastal areas. As the demand for a safe and sustainable seafood supply rises, so does the country's reliance on environmentally and economically sustainable aquaculture, for which shellfish production is well poised.

Shellfish aquaculture in North Carolina represents a small, yet traditionally important, industry to coastal counties. Using areas leased from the state, North Carolina's shellfish industry provides locally grown clams and oysters to consumers, and supplemental income to numerous families. Despite an increase in the demand for high-quality seafood, shellfish aquaculture in North Carolina remains a niche industry dominated by traditional fishing families. In 2007, 85 farms reported sales of cultured product, yet production from North Carolina represents only 1.1% of the total value for all shellfish produced along the East Coast (USDA, 2009).

The N.C. Division of Marine Fisheries, or NCDMF, reports that from 2006 to 2010, the average production of cultured clams was 5,000 bushels per year, while average production for cultured oysters was 9,600 bushels per year. In these years, cultured product for clams and oysters represented 10 percent of total landings for those species.

Despite efforts by individual growers and the N.C. Shellfish Growers Association, or NCSGA, to assist with aquaculture development, the acreage under lease and total number of leases have been relatively constant in recent years (Figure 1).

Current and potential new growers suggest several obstacles, including trouble identifying sites with long-term production potential, area closures due to declining water quality, regional and local moratoriums, uncertain operational and startup costs, and potential conflicts with other user groups. To date, these concerns have not been fully evaluated, in part because of the independent nature of the industry.

Expansion of the shellfish aquaculture industry would be timely in the current economic conditions, which are often more depressed in rural coastal communities. Shellfish aquaculture could be poised for expansion in these areas offering business diversity in the face of increased competition from seafood imports and additional regulations imposed on commercial fishing practices.

In addition, shellfish aquaculture technologies may be readily transferable to the commercial fishing sector because of the similarity in working environments. Shellfish aquaculture is suitable for part-time or full-time ventures with various levels of startup costs, providing additional income while maintaining commercial fishing activities. Also, cultured shellfish are highly marketable. Current growers receive, on average, higher prices than wild harvests and offer a year-round product that tends to be consistent in size and quality.

This project examined the current scope of the shellfish aquaculture industry in North Carolina. Factors surveyed included the total production by species and production methods used, sales of fresh shellfish by species and size, market value of cultured product, seed sources, future production and constraints to production.

![Figure 1. Recent history of shellfish leases in North Carolina.](image)

Methods

A four-part survey was developed to evaluate various aspects of North Carolina’s shellfish industry. Topics included lease and business information, clam production, oyster production, and outlook for the industry. A copy of the survey and electronic version of this report can be found online at [www.ncseagrant.org](http://www.ncseagrant.org). Participants could complete either a paper or an electronic survey. In January 2011, a total of 228 surveys were sent based on an overall list of North Carolina leaseholders from NCDMF. Participants were asked to complete the survey within three weeks. After the initial period, a reminder postcard was sent extending the deadline for an additional three weeks.
weeks. Survey data were summarized using descriptive statistics, where appropriate.

**Results**

Of the 228 surveys sent, 49 were completed, for a 22% response rate. All but one survey were completed by hand and returned via mail. The additional reminder postcard substantially increased returns following the initial deadline.

**General Operations**

Depending on the operation, a shellfish producer in North Carolina may utilize a single lease, or combine production from multiple leases. Survey respondents indicated that total leased area for their operations ranged from 0.5 to 86.5 acres (Figure 2).

A majority of respondents, 54%, produced shellfish on 5 acres or less, followed by 27% between 5 and 10 acres. Most of the survey respondents held leases in Carteret County (41%), followed by Pender, Onslow and Hyde counties, all with 18% (Figure 3). Leases exist in other counties of the state, however, completed surveys were not obtained from those areas.

These shellfish leases were part of businesses operating for various lengths of time. Some were new and had been open for only a year, while others were operating on areas that had been leased for more than 100 years (Figure 4). Of the leaseholders surveyed, 23% had been in operation between 16 and 20 years. This was followed by businesses in operation for 1 to 5, 6 to 10, and 11 to 15 years, each representing 21%.

In general, the majority of leaseholders generated less than a third of their income from shellfish culture activities, with most obtaining 5% or less of total earnings from this work (Figure 5). Additional income for leaseholders originated from commercial fishing, shore-based employment or some other source, and ranged from 38 to 47% of their income (Figure 6).

While attempts have been made at culturing a variety of species, the shellfish culture industry in North Carolina is dominated by clams and oysters. Survey respondents reported clam production alone on 27% of leases, oyster production alone on 31% of leases, and both clam and oyster production on 41% of leases (Figure 7). A small group (2%) also reported scallop, clams and oyster production.

Because techniques for shellfish culture vary by species, the survey was further divided into subsections for each species.
Clam Production

Clam aquaculture in North Carolina consists of all three phases of production: hatchery (not included in this survey), or spawning of broodstock; nursery rearing, or growing small seed to a larger size prior to planting on the bottom; and growout to market size. All use on-bottom culture methods.

One-quarter of survey respondents reared seed during the nursery phase, while 71% cultured clams during growout. Seed purchases were mainly from in-state suppliers (70%), with 23% of respondents purchasing seed from outside the state. Some operations (7%) purchased seed from both in- and out-of-state sources. After final growout, 99% of seed produced by the responding leaseholders was sold to in-state buyers.

Prior to sale, clams are commonly graded into several categories, three of which are most often used in the North Carolina industry: littlenecks, cherrystones and chowders. These three grades are sold both wholesale and retail. Survey results for average pricing of individual grades are shown in Figure 8 for wholesale and Figure 9 for retail sales.

Across all grades, wholesale prices for clams averaged 12.5 cents per clam, and ranged from 9 to 20 cents per clam. Average wholesale pricing was greatest for littlenecks (13.8 cents per clam), followed by cherrystones at 13 cents per clam and chowders at 10.8 cents per clam. Retail pricing of North Carolina cultured clams for all grades averaged 17.7 cents per clam, and ranged from 16 to 19.7 cents. Average retail pricing for individual grades followed a similar pattern — 19.7, 18 and 16 cents per clam for littlenecks, cherrystones and chowders, respectively.

Oyster Production

Oyster aquaculture in North Carolina relies on extensive and intensive culture methods, and includes all phases of production, hatchery (not included in the survey), nursery and growout.

Extensive methods rely on wild oyster larvae or small juveniles and have reduced financial input, labor, and risk. Extensive methods result in lower oyster yields. Intensive oyster production utilizes oyster larvae or seed purchased from a hatchery, and cultured at higher densities. Intensive production requires higher upfront costs, increases labor, and risk, but offers the potential for higher yields and greater profit.

Based on survey responses, most oysters grown on North Carolina leases originated from planting cultch — shell material placed on the bottom to act as attachment points for spat and relaying juvenile oysters from closed waters under permit (Figure 10). Relayed oysters are transferred to leased bottom, for growout to market size.
Eighty percent of respondents planted cultch to collect wild oyster larvae, while 69% participated in the oyster relay program. A small group (5%) of oyster growers purchased larvae and set their own seed, a process by which oyster larvae are placed into closed tanks with micro-cultch, or small fragments of shells for the larval oysters to attach. Because most culturists responding to the survey used extensive culture methods (cultch planting and oyster relay), bottom planting is the preferred growout method. However, other methods for oyster growout have been and are being used on North Carolina leases. Figure 11 shows the various growout methods previously tried, and those currently being used.

Leaseholders responding to the survey indicated that all growout methods listed have been tested previously to some degree. However, not all are currently being used. Float bags, the newest growout method in North Carolina, were used by 57% of respondents previously, and 67% are currently using them. Bottom cages had been tested by 40% of the survey respondents, all of whom no longer use the technique. The rack-and-bag method was tested by 14% of the survey respondents, and is currently being used by 29%. The chub system is currently used by 14% of respondents.

Cultured oyster sales in North Carolina are different from clams. There are no true grades for oysters. Rather, oysters are sold by the bushel or on an individual basis once they reach the legal size for North Carolina, which is 3 inches. Bushels of oysters include both clustered (multiple attached oysters) and individual or single oysters. Based on survey responses, the per bushel price for oysters grown on North Carolina leases averaged $32, and ranged from $25 to $38 (Figure 12). Prices for individual oysters averaged 35 cents per oyster and ranged from 30 to 45 cents (Figure 13).

Industry Outlook

Survey recipients also responded to questions regarding the current condition and future of the shellfish industry. The top concerns of leaseholders, in decreasing order, were theft, hurricanes and water quality, with 38%, 31% and 27% of respondents stating they were very concerned about each issue (Figure 14).

User conflict, marketing and climate issues were of least concern for respondents. Leaseholders indicated declining water quality was the greatest reason for lack of individual expansion (Figure 15). Other key factors included regulation, marketing, and lack of loans or grants.

Leaseholders were divided on their views of the future for North Carolina shellfish culture. About 42% of respondents thought the industry would grow in the next five years, while 38% thought the industry would decline (Figure 16). Twenty percent of respondents suggested the industry would be stable over the next five years.
The North Carolina shellfish industry historically has been a small but stable industry, characteristics that appear to apply to the current industry. Based on survey respondents, the majority of leases were 10 acres or less in size, with production from those leases representing a fraction of a leaseholder’s income. The majority of income for leaseholders was generated from shore-based employment and commercial fishing.

Despite the relatively small size of individual operations, a significant number, 57%, have been in business for more than 10 years, an indicator of industry stability. The ability to generate secondary income has likely benefited the small-scale nature of the industry. Furthermore, many of the shellfish growers responding to the survey utilized labor-saving methods for clam and oyster production.

For clam production, 71% planted seed on the bottom for growout, while only 25% used nursery-rearing methods that are more intensive.

Similarly, oyster production was dominated by growers who relied on wild oyster larval settlement on their leases, as well as those who relayed small oysters from closed areas to their leases. Both methods require significantly less labor than remote-setting techniques, conducted by only 5% of respondents. The combination of smaller leases and labor-saving methods for production has supported the stability of the industry and helped maintain its part-time nature.

Similar to other industries reliant on the environment, concerns exist for the future of the shellfish culture industry in North Carolina. These concerns include theft on leases, hurricane impacts and deteriorating water quality. Theft on leases can be addressed only through law

Discussion

Molluscan shellfish culture represents two-thirds of all marine aquaculture in North Carolina (NOAA Aquaculture, 2009). Various-sized operations on the East and West coasts of the United States grow clams, oysters and mussels. Along the East Coast, significant growth of the industry is occurring in Virginia (Murray and Hudson, 2011), and is expected to increase similarly in Maryland.
enforcement. Regulations already exist barring the illegal removal of shellfish from leases. However, North Carolina does not have planned aquaculture zones and many leases are not within view of the leaseholder’s waterfront property, hence sufficient oversight is not possible at all times. More efficient methods to prevent poaching will be needed for the industry to expand.

Impacts from hurricanes can be significant, particularly in the case of off-bottom culture, and onshore hatcheries or nurseries. Unfortunately, few options are available for leaseholders once the lease has been established. Selecting sheltered locations as appropriate facility sites represents the best option to minimize hurricane risks.

Deteriorating water quality can impact existing and potential leaseholders. Temporary closures, such as those following heavy rains, can hamper the timing for harvest. Long-term problems, such as from nearby developments, can permanently close all or parts of a lease. To some degree, as with hurricanes, water quality is out of the control of leaseholders. The best way to address poor water quality is to site an operation far from areas with closed waters nearby. Similar to the risks with hurricanes, proper siting can minimize water quality problems over the long term.

The concerns for the industry are perhaps one reason for the divergence of opinion on the future of the shellfish culture industry. Forty-two percent of respondents felt the industry would grow within the next five years, 38% felt that it would decline, and 20% thought the industry would remain the same.

Positive signs for the shellfish culture industry include growing demand and stable pricing. Wholesale pricing for hard clams (all groups) averaged 12.5 cents per clam, while retail pricing averaged 17.7 cents per clam (all grades). Oysters averaged $32 per bushel, while individual oysters averaged 35 cents per oyster.

The problems noted likely contributed to several respondents indicating that the industry would decline. While price and overall operation economics will dictate the growth or decline of the industry, the major concerns described by current leaseholders will provide a framework for directing efforts to assist in industry development. Specifically, addressing issues with theft, and deteriorating water quality — perhaps by developing methods to better locate new facilities — will ultimately assist interested, but concerned, growers.

Conclusion
Increasing demands for safe and sustainable seafood, and stable prices for cultured shellfish products provide opportunities for future shellfish aquaculture development in North Carolina. Addressing issues of theft and deteriorating water quality will assist growth, as long as the economics of production are maintained.

Substantial potential exists for current leaseholders to expand. The results of this survey indicate that the vast majority of leaseholders utilize extensive methods for shellfish production with relatively low yields. Modest increases on existing leases would provide a significant increase in shellfish production to the state, without additional leases. However, large-scale increases in North Carolina’s shellfish industry will likely begin with new operations in which income generated from the business is a primary source rather than a supplemental one. Assistance with siting new shellfish leases could reduce risks from theft and problematic water quality, and therefore should be considered among growth options in the industry.

References


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