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**Virginia Shellfish Aquaculture Situation and Outlook Report :
Results of the 2015 Virginia Shellfish Aquaculture Crop Reporting
Survey**

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Virginia Shellfish Aquaculture Situation and Outlook Report

Results of the 2015 Virginia Shellfish
Aquaculture Crop Reporting Survey

April 2016

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The complete report can be found online at www.vims.edu/map/aquaculture
VIMS Marine Resource Report No. 2016-4

Photos: ©Karen Hudson, VIMS



Executive Summary

The hatchery-based shellfish aquaculture industry in Virginia continues to grow adding significant value to the Commonwealth's seafood marketplace. Today, watermen harvest both hard clams and oysters from the Commonwealth's public resources, albeit at rates diminished from historic levels. At the same time, Virginia's watermen-farmers, utilizing production from a land-based hatchery, are providing additional quantities of quality shellfish to consumers.

This survey, in its 10th year, is intended to continue annual assessments with which to gauge growth and inputs in Virginia's hatchery-based shellfish aquaculture industry. This report is based upon an industry survey completed during the first quarter of 2016.

While these trends are widely acknowledged, until this annual survey was initiated in 2006 there had been no consistent reporting of production and economic trends in Virginia's shellfish aquaculture industry. Periodic assessments are necessary to inform growers and related interests about the actual status and trends in the industry.

Highlights:

- 2015 farm gate value for Virginia shellfish aquaculture was \$48.3 million
 - \$32.3 million Hard Clams
 - \$16.0 million Oysters
- Virginia is 1st in the U.S. for hard clam production
- Virginia is 1st on the East Coast of the U.S. for Eastern oyster production
- Virginia shellfish aquaculture directly employs hundreds of Virginians
- Clams are the biggest contributor to Virginia's shellfish aquaculture economic value
- Oysters are the most rapidly developing sector of Virginia's shellfish aquaculture
- The majority of Virginia's shellfish production comes from a system of vertically integrated private hatcheries which are located on both the eastern and western shores



Methodology

A mail and Internet-based survey was developed to collect information from Virginia clam and oyster growers known to be active in the industry¹. Each year, the survey instrument is evaluated and revised based upon field testing (Appendices 1 & 2). Seventy-nine complete, useable surveys were returned via the Internet, mail, or fax, including responses from 15 clam growers, 66 intensive oyster growers, 7 extensive growers, 5 shellfish hatcheries, and 9 growers who cultured both molluscs. It is believed that the survey is representative of overall trends in 2015 and based on the majority of active commercial growers. For confidentiality reasons, the information collected is aggregated, and the total represents both the eastern and western shores of Virginia.

Summary of Findings

Virginia Oyster (*Crassostrea virginica*) Aquaculture

Historically the most common oyster “culture” technique in Virginia was the transplanting of wild harvested seed to leased growing grounds. Prior to the onslaught of diseases, the grower paid little attention to the grounds between the time seed was planted and the time mature oysters were harvested, some 2 or 3 years later. This culture is still practiced today; however, the results here do not include information on such oyster planting. The results in this report reflect the use of aquaculture practices adopted as a result of increased oyster disease and predation which utilize only hatchery produced seed and larvae.

There are two methods of hatchery-based oyster aquaculture production in Virginia: intensive culture (off bottom) and extensive culture (on bottom, or spat-on-shell). Both typically use genetically improved stocks and triploid, or “spawnless” oysters. Industry reports that the sterile triploid seed is more viable from a commercial standpoint, as the oysters grow faster and do not diminish in quality with seasonal spawning.

Intensive Culture (cultchless method using single seed)

Intensive culture uses cultchless, or single seed. This seed needs to be containerized for predator

protection. Containerization varies but generally consists of oysters deployed in bags within cages that sit approximately 12 inches off the bottom. Intensive oyster culture requires more labor in gear and product maintenance and is generally considered more expensive. However, the end result is a single, more uniform product that has the ability to obtain a higher price in the boxed and half shell markets.

Figure 1 shows a reported 135.6 million single oysters planted in 2015 which is a 27% increase from 2014 and right on target with grower expectations from the previous survey. The outlook for 2016 suggests a 14% increase in oysters planted by Virginia growers.

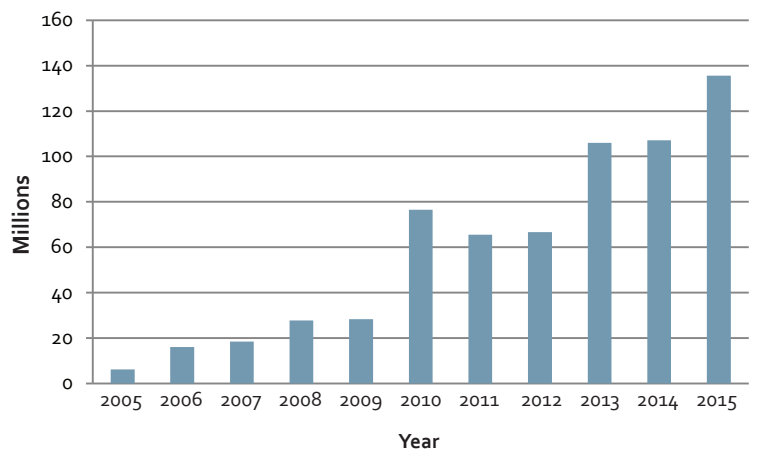
Oyster Sales and Prices

Eight of the 62 oyster survey responses indicated some sort of cooperative relationship to market, but most arrangements were similar to those with contractors - with no equity exchange, such as, providing seed². The 2015 results indi-

¹ Virginia Marine Resources Commission's Licensed Aquaculture Product Owners List.

² In 2013, the crop reporting survey was expanded to ask whether the grower has a “cooperative” agreement with a larger oyster producer who would likely report the sales numbers. This was due to reports of oyster cooperative arrangements and was an effort to reduce the potential for double counting oyster sales.

Figure 1. Number of Single Oysters Planted by Virginia Aquaculturists (millions)



cated the total number of market oysters sold by Virginia growers, subtracting the reported sales from those indicating involvement with a cooperative, was 35.4 million (Figure 2). This was a decrease of 11% from 2014 and is less than the 57 million cultured market oysters that growers had predicted for 2015 from the previous survey year. Survey respondents forecast a 32% increase which, if reached, would translate to nearly 47 million market oysters sold in 2016.

For the purposes of this report, oyster prices are not broken down as to market segment (i.e. primary wholesale, secondary wholesale, retail, etc.). Figure 3 shows a \$0.01 increase in the average price received for cultured oysters in 2015³. Trends in the percentage of single oysters sold into wholesale markets remain fairly consistent at greater than 94% for the last seven years. The percentage of single oysters sold out of state in 2015 was 62%. This export level has ranged between 56 % and 86% for the last six years.

Combining the overall sales of single, market oysters with the weighted average price per oyster, it is estimated that the total 2015 revenue for oyster aquaculturists (not including spat on shell production) was \$14.5 million, a slight decrease of less than \$1 million from 2014.

Extensive Culture - Spat-on-Shell

Extensive culture is also referred to as spat-on-shell. The primary advantage of spat-on-shell cultivation is that it requires less labor and fewer materials than single oyster cultivation, thereby making it a more economically feasible option for producing large quantities of oysters. Oyster eyed larvae is purchased from the hatchery and transported to the remote setting location. The eyed larvae are set in land-based tanks on bushels of clean oyster shells, referred to as cultch. The bushels of shell struck with larvae are planted directly on the bottom and harvested within two years. Because spat-on-shell cultivation produces oysters grown in clusters (similar to wild-caught oysters), the primary product is predominantly oysters for shucking rather than single oysters for half-shell consumption. For this reason, remote setting is not meant to take the place of single oyster culture, which produces consistent, high quality, half-shell oysters, but to complement it with a means of producing, on large scale, a local oyster for use by Virginia's oyster processors.

Figure 2. Number of Aquacultured Market Oysters Sold by Virginia Growers (millions)

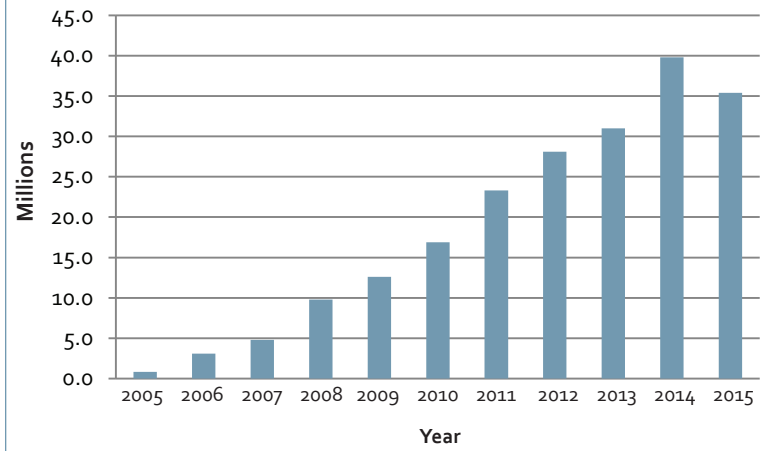
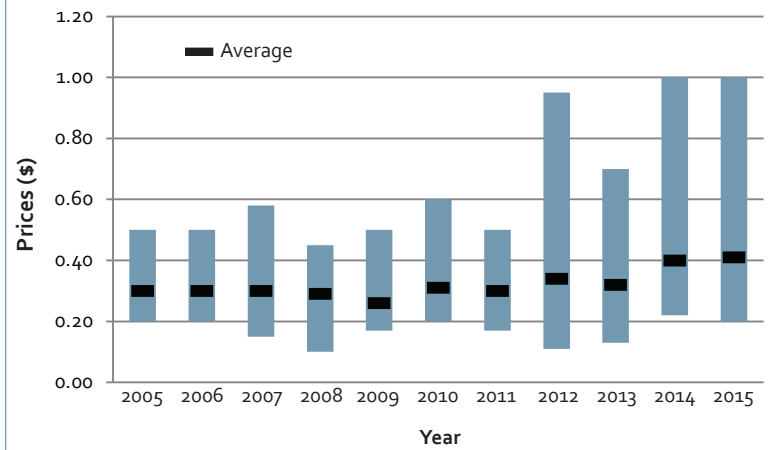


Figure 3. Oyster Prices reported by Virginia Growers



The spat-on-shell process has been enhanced since its start in 2008. Improvements in the quality of eyed larvae coming out of the hatcheries and optimized remote setting methods have cut in half the number of eyed larvae required per bushel of shell. While large-scale spat-on-shell cultivation has been used in Virginia for the last several years, federal monies had subsidized a large portion of this development which impeded relevant forecasting⁴. These subsidies are now gone, allowing for inclusion of industry trends. In 2015, growers reported planting 46,500 bushels, a 52% increase from 2014. The industry forecast for 2016 is to increase by 35%

³ During 2015 the median price was \$0.38 per market oyster, an increase of \$0.02 from 2014. The weighted average price across all growers was \$0.409 per market oyster in 2015, an increase of \$0.023 from 2014.

⁴ According to prior grower survey reports, the number of harvested bushels of spat-on-shell has continually increased from roughly 2,000 in 2009 to almost 13,000 in 2012 and over 38,000 bushels in 2014. These numbers include a mix of plantings funded by private investment and subsidized support.

to nearly 63,000 bushels. The industry's expansion depends on a consistent production of large quantities of eyed larvae, which can be problematic due to poor water quality.

Spat-on-Shell Sales and Prices

In 2015, growers reported harvesting 33,200 bushels of spat-on-shell which was a 13% decrease from 2014. Expectations for 2016 are for an increase of 59% to 53,000 harvested bushels of spat-on-shell. The average price per bushel was \$46 making the 2015 farm gate value for spat-on-shell \$1.5 million; an 11% decrease from 2014.

Oyster Hatcheries⁵

The vast majority of Virginia's production comes from a vertically integrated system with eight commercial shellfish hatcheries, of various scales, producing oyster seed and eyed larvae either planted by the hatchery owners themselves in their aquaculture operations, or sold to other Virginia growers.

Oyster Hatchery Sales

Since 2008, the expansion of large-scale spat-on-shell in Virginia has changed hatchery volume, as shown in Figure 4. Existing firms became active in purchasing not just cultchless seed, but large quantities of eyed larvae for spat-on-shell development. In 2015, hatcheries reported an increase from the prior year in sales of both the single seed and eyed larvae⁶. A total of 217 million single seed were sold in 2015, along with 2.6 billion eyed larvae. Triploid eyed larvae and seed were the source of the overwhelming majority of the oyster sales reported by hatcheries at 87% and 94%, respectively. In 2015 the average price of eyed larvae increased by 22% to \$313 per million.

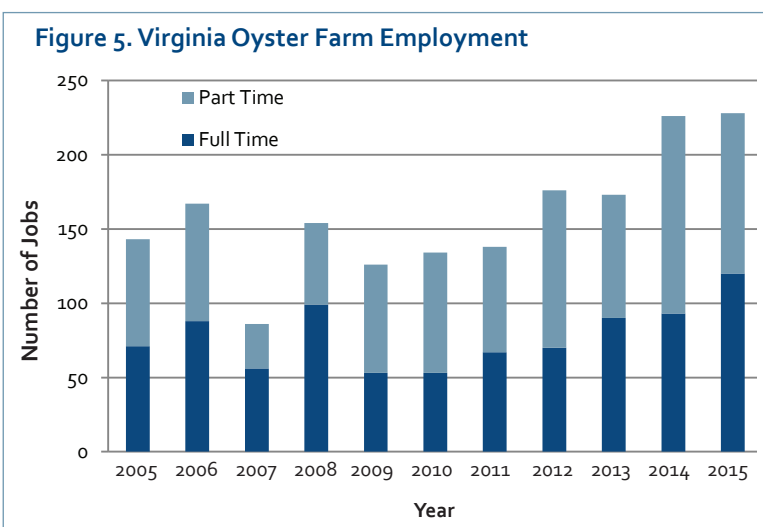
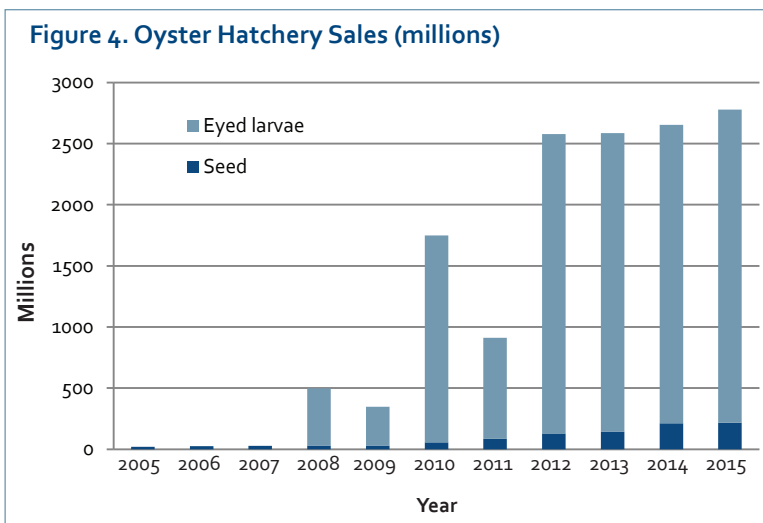
Good water quality remains a critical need for hatcheries. Water quality issues of unknown origin were reported by oyster hatcheries in 2009 and 2011 and show a clear impact on production as seen in Figure 4. Research is ongoing to understand the water quality parameters that negatively impact consistent production, with the goal of providing management tools to mitigate the issues.

Employment

Finally, as shown in Figure 5, employment associated with oyster aquaculture, which has remained varied over recent years, shows an increase in the number of full time and decrease in part time employment in 2015. The difficulty of estimating the time and labor associated with relatively small-scale aquaculture conducted in conjunction with other business lines makes estimates of oyster culture labor problematic at this point in industry development. In view of this fact, the trends in these employment figures should not be overly interpreted. There is consistent expectation that with successful development of both spat-on-shell and cultchless oyster aquaculture, additional employment will be required to meet the greatly expanded planting and production needs.

⁵The expansion of oyster hatchery infrastructure in 2009 prompted the addition of hatchery-specific survey questions in 2010. Hatchery questions were then relocated to a standalone survey sent directly to the shellfish hatcheries beginning in 2011 (Appendix 2).

⁶Over the last four years, Virginia hatcheries have reported selling a percentage of their total seed and eyed larvae production out-of-state. These sales support development of oyster aquaculture in surrounding states with limited, or no private hatchery capability of their own.



Hard Clam (*Mercenaria mercenaria*) Aquaculture

Clam aquaculture is a relatively mature aquaculture industry that has dominated over wild clam harvest in Virginia for more than a decade. Clams are not as low-salinity tolerant as oysters and thus the majority of clam production comes from the higher salinity areas on the eastern shore including both bayside and seaside. Clams burrow into the sediment which makes the production methods much different than oyster culture. There is one method for clam aquaculture in which beds are planted in plots and covered with mesh net for predator protection. Planting to harvest is a two year process; longer than in oyster aquaculture.

Based on previous economic assessments compiled by the authors, Virginia continues to lead the nation in the production of cultured hard clams. As depicted in Figure 6, clam growers reported a 7% increase in seed plantings during 2015 to a total of 526 million clams. The industry outlook for 2016 predicts an increase of 2% to 537 million individual clams planted.

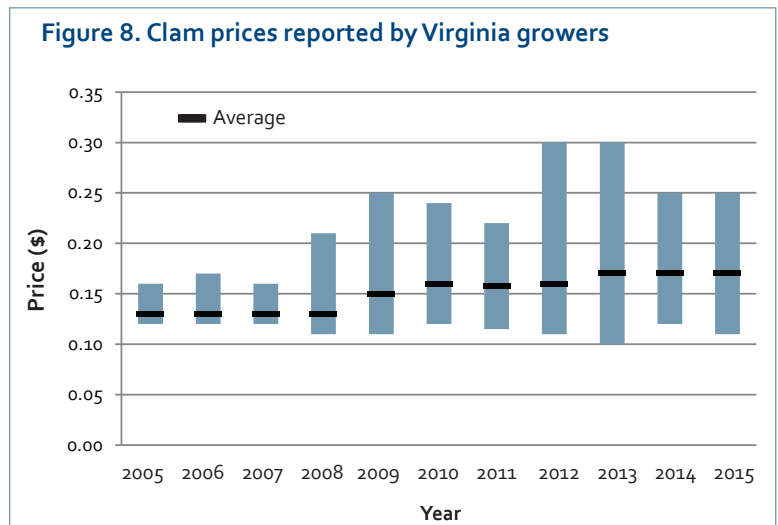
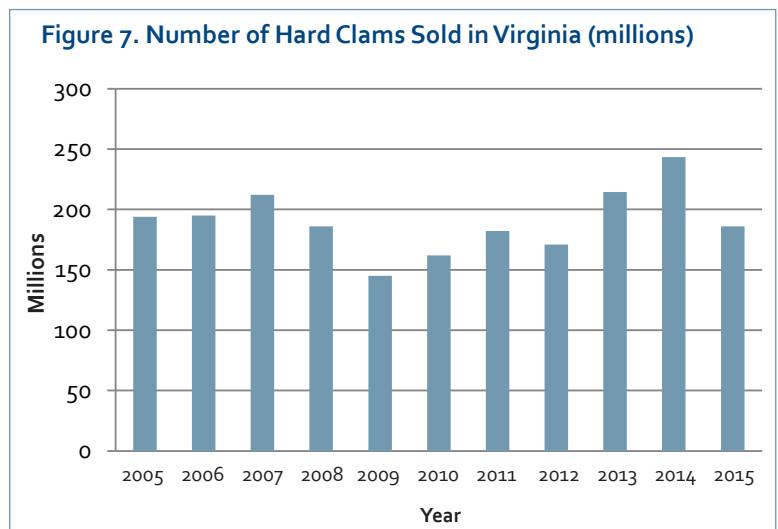
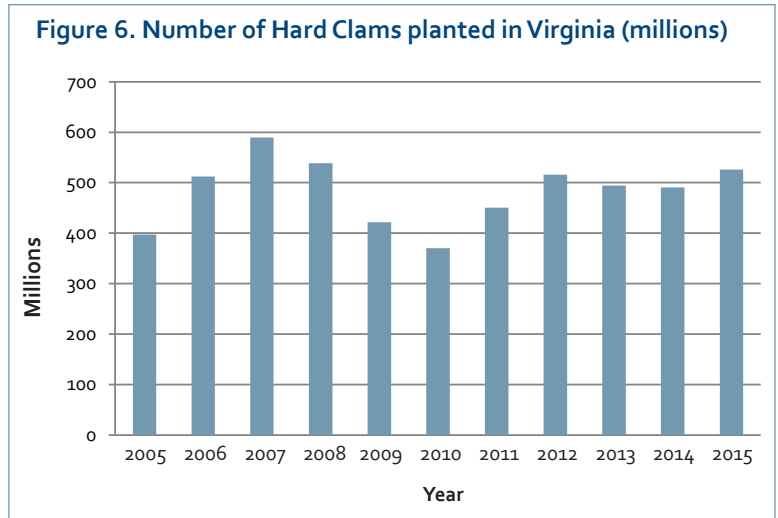
Clam Sales and Prices

The 2015 crop reporting survey reflects a 24% decrease from the all-time high of 243 million market clams sold in the previous year, as shown in Figure 7. Based on the overall sales and the weighted average price per market clam, it is estimated that total revenue for hard clam aquaculturists in 2015 was \$32.3 million—a decrease of 17%, or \$6.5 million, from the prior year.

Figure 8 displays the survey findings regarding relative prices received for market clams. The average price reported per market clam at the farm gate was \$0.17 during 2015; the same as the previous two years. Trends in the percentage of market clams sold into wholesale markets have remained in the range of 94% to 99% for the last seven years. During 2015, 85% of market clams were sold out of state. This export level has remained between 85% and 93% for the last five years.

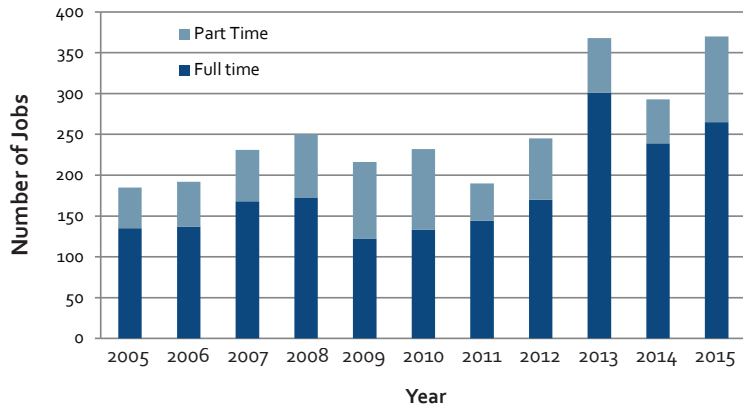
Clam Hatcheries

Clam seed production and sales have remained stable for the last several years as well as the reported average price of clam seed. Industry sources indicate much of the hatchery capacity is dedicated to producing seed for the hatchery



owner's own planting. Essentially, all of the seed produced is planted in Virginia. This vertically integrated system with eventual sales to many out-of-state consumers adds important economic development to local coastal communities.

Figure 9. Virginia Clam Farm Employment



Employment

Figure 9 demonstrates an increase in both full time and part time employment in 2015. However, as noted above, the employment situation for all shellfish aquaculture is complicated by the diversity of the firms involved. The vast majority of the clam production is conducted by relatively large vertically integrated companies; these companies often contract with self-employed grower cooperatives, which, as with oysters, complicate the estimates of labor involved in this industry.

Given the ambiguity of reporting labor used for both oyster and clam culture noted above, it is useful as a benchmark to review the economic impact model developed for Virginia shellfish aquaculture for the 2012 growing year. The IMPLAN model used for that assessment estimates that just under one (0.9) full time equivalent (FTE) is needed to produce \$100,000 of cultured shellfish output. Based upon this model, 435 FTEs would be needed to produce the 2015 estimated output of \$48.3 million; a decrease of 9% over the 2014 estimate of 480 FTEs. These figures do not represent the indirect and induced employment multipliers.

Virginia Shellfish Grower Situation & Outlook Survey 2016

Welcome

Thank you for taking a few minutes to complete the following commercial aquaculture survey. This survey is meant to capture private ground activity that originates from a land-based hatchery. If you do not participate in hatchery-based culture, please disregard.

With your help, Virginia's past annual surveys have shown how useful timely information is for the shellfish aquaculture industry. Such information is vital to understanding the importance of Virginia's growing aquaculture business to the economy, and in turn the importance of clean water, reasonable land use and tax policies, access to financial capital and the like to shellfish growers.

All information provided will be held in the strictest of confidence and used only when combined with all of those providing information on their individual operations.

Not all questions may apply to your situation. Please answer all that do. The more accurate the information provided, the better the characterization of the Virginia aquaculture industry.

Please complete the survey by February 12, 2016.

If you have any questions or would like to discuss, please contact us at:

Thomas J. Murray
Marine Business Specialist
Phone 804-684-7190
Fax: 804-684-7161

Karen Hudson
Aquaculture Specialist
Phone: 804-684-7742
Fax: 804-684-7161

You can also file online by accessing <https://www.surveymonkey.com/r/shellfishsurvey2016>

If filing online, please note your answers can be saved if you exit the survey before completion. You can then return at a later time to finish the survey.



Virginia Shellfish Grower Situation & Outlook Survey 2016

Commercial Clam Aquaculture

1. Do you aquaculture clams? Yes No
2. Do you have a clam hatchery? Yes No
3. Do you "re-sell" seed? Yes No
Do you grow small seed to a larger size for resale to another grower(s)
4. Do you have a "cooperative" agreement with a larger clam producer who will likely be reporting these numbers? Yes No
5. Do you purchase hard clam crop insurance? Yes No

6. 2015 Commercial Clam Aquaculture

- a) # Clams planted
- b) % Seed purchased
- c) Ave. price of seed purchased
- d) # Seed sold
- i. % seed sold out-of-state
- e) # Market (non-seed) sold
- i. % wholesale
- ii. % retail
- iii. % market clams sold out-of-state
- f) Ave. price per market clam
- i. Avg. price wholesale
- ii. Ave. price retail
- g) # Full-time help
- h) # Part-time help

Virginia Shellfish Grower Situation & Outlook Survey 2016

Commercial Clam Aquaculture

7. 2016 ESTIMATED Commercial Clam Aquaculture

- a) # Clams planted
- b) % Seed purchased
- c) Ave. price of seed purchased
- d) # Seed sold
 - i. % seed sold out-of-state
- e) # Market (non-seed) sold
 - i. % wholesale
 - ii. % retail
 - iii. % market clams sold out-of-state
- f) Ave. price per market clam
 - i. Avg. price wholesale
 - ii. Ave. price retail
- g) # Full-time help
- h) # Part-time help

8. Comments or Explanatory Notes on 2015 and 2016 Clam Aquaculture:

Virginia Shellfish Grower Situation & Outlook Survey 2016

Commercial Oyster Aquaculture

This section covers two methods of commercial oyster culture: spat-on-shell and single oysters. Each method has its own series of questions.

9. Do you aquaculture oysters? Yes No

10. Do you aquaculture spat-on-shell oysters Yes No

Do you participate in the setting, planting, and/or harvesting of spat-on-shell?

Note: Some of you may purchase eyed larvae for setting single seed. Do not include this activity in the spat-on-shell section. It can be included in the cultchless oyster section.

Virginia Shellfish Grower Situation & Outlook Survey 2016

Commercial Spat-on Shell Oyster Aquaculture

*Please report only oyster production which originated from an onshore hatchery.
This does NOT include “natural strike” product moved to private ground.
This does NOT include larvae purchased for setting single seed.

11. 2015 Commercial Spat-on-Shell Oyster Aquaculture

- a) # Eyed-larvae used
- i. % Diploid
- ii. % Triploid
- b) % Eyed-larvae purchased from out-of-state
- c) # Bushels spat-on-shell planted
- d) # Bushels “market-size” spat-on-shell harvested/sold
- e) Ave. price received per bushel of “market-size” spat-on-shell

12. 2016 ESTIMATED Commercial Spat-on-Shell Oyster Aquaculture

- a) # Eyed-larvae used
- i. % Diploid
- ii. % Triploid
- b) % Eyed-larvae purchased from out-of-state
- c) # Bushels spat-on-shell planted
- d) # Bushels “market-size” spat-on-shell harvested/sold
- e) Ave. price received per bushel of “market-size” spat-on-shell

13. Comments or Explanatory Notes on 2015 & 2016 Commercial Spat-on-Shell Oyster Aquaculture:

Virginia Shellfish Grower Situation & Outlook Survey 2016

Commercial Oyster Aquaculture

14. Do you aquaculture cultchless (single) oysters? Yes No

15. Do you re-sell oyster seed? Yes No

Do you set larvae for single seed and/or grow small seed to a larger size for resale to another grower(s)

16. Do you have a "cooperative" agreement with a larger producer who will likely report your numbers of planted and sold? (This does NOT include selling to a wholesaler)

Yes No

Cultchless (single) Oyster Aquaculture

*Please report only commercial oyster production which originated from an onshore hatchery.

17. 2015 Commercial Single Oyster Aquaculture

- a) # Oyster seed planted
- i. % diploid
- ii. % triploid
- b) Avg. price of triploid seed purchased (\$ per 1,000)
- c) % Planted seed purchased from out-of-state
- d) # Seed sold
- i. % seed sold out-of-state
- ii. Avg. price of seed sold (\$ per 1,000)
- e) # Market (non- seed) oysters sold
- i. % wholesale
- ii. % retail
- iii. % market oysters sold out-of-state
- f) Avg. price per market oyster (\$ per piece)
- i. Avg. price wholesale
- ii. Avg. price retail
- g) # Full-time help
- h) # Part-time help

Virginia Shellfish Grower Situation & Outlook Survey 2016

Commercial Cultchless (single) Oyster Aquaculture

18. 2016 ESTIMATED Commercial Single Oyster Aquaculture

- a) # Oyster seed planted
- i. % diploid
- ii. % triploid
- b) Avg. price of triploid seed purchased (\$ per 1,000)
- c) % Planted seed purchased from out-of-state
- d) # Seed sold
- i. % seed sold out-of-state
- ii. Avg. price of seed sold (\$ per 1,000)
- e) # Market (non- seed) oysters sold
- i. % wholesale
- ii. % retail
- iii. % market oysters sold out-of-state
- f) Avg. price per market oyster (\$ per piece)
- i. Avg. price wholesale
- ii. Avg. price retail
- g) # Full-time help
- h) # Part-time help

19. Comments or Explanatory Notes on 2015 & 2016 Commercial Single Oyster Aquaculture:

Virginia Shellfish Grower Situation & Outlook Survey 2016

Thank You

20. Please provide any comments on the shellfish aquaculture industry situation.

21. Would you like to receive a copy of the overall report when completed?

If yes, please fill out the contact information below

Yes

No

22. Contact Information (Optional)

***At a minimum, please provide the zip code to inform the region where production is occurring**

Name

Company

Address

City, State, Zip

Telephone

Email

Thank you for completing the Virginia Shellfish Grower Situation and Outlook Survey.

Virginia Shellfish Hatchery Situation & Outlook Survey 2016

Welcome

Thank you for taking a few minutes to complete the following commercial shellfish hatchery survey. With your help, Virginia's past annual surveys have shown how useful timely information is for the shellfish aquaculture industry. Such information is vital to understanding the importance of Virginia's growing aquaculture business to the economy, and in turn the importance of clean water, reasonable land use and tax policies, access to financial capital and the like to shellfish hatcheries and growers.

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Not all questions may apply to your situation. Please answer all that do. The more accurate the information provided, the better the characterization of the Virginia aquaculture industry.

Please complete the survey by February 12, 2016.

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Karen Hudson
Aquaculture Specialist
Phone: 804-684-7742
Fax: 804-684-7161

You can also file online by accessing <https://www.surveymonkey.com/r/hatcherysurvey2016>
If filing online, please note your answers can be saved if you exit the survey before completion.
You can then return at a later time to finish the survey.



Virginia Shellfish Hatchery Situation & Outlook Survey 2016

Shellfish Hatchery Production

1. 2015 Clam and Oyster Hatchery Production

- a) # Clam seed produced
- b) # Clam seed sold
 - i. % Clam seed sold out-of-state
- c) # Oyster eyed larvae produced
- d) # Oyster eyed larvae sold
 - i. % diploid
 - ii. % triploid
 - iii. % Oyster eyed larvae sold out-of-state
- e) Ave price per million oyster eyed larvae sold
 - i. Ave. price diploid
 - ii. Ave. price triploid
- f) # Single oyster seed produced
- g) # Single oyster seed sold
 - i. % diploid
 - ii. % triploid
 - iii. % single seed sold out-of-state
- h) # Full-time help
- i) # Part-time help

Virginia Shellfish Hatchery Situation & Outlook Survey 2016

2. 2016 *ESTIMATED* Clam and Oyster Hatchery Production

Please indicate any changes in production, sales and employment expected for 2016. If no changes are expected, please write "same".

3. Comments or Explanatory Notes on 2015 & 2016 Commercial Shellfish Hatchery:

4. Please provide any comments on the shellfish hatchery situation.

Thank You

5. Contact Information (Optional)

Name

Address

City, State, Zip

Telephone

Email

Thank you for completing the Virginia Shellfish Hatchery Situation and Outlook Survey.

The complete report can be found online at www.vims.edu/map/aquaculture

VIMS Marine Resource Report No. 2016-4

