Re-examination of the Feasibility study on one-year grow-out of triploid *Crassostrea ariakensis* 2007-2008

Virginia Seafood Council
76 Raleigh Road
Newport News, VA
23601

Project Completion Report
submitted to
The Virginia Fishery Resource Grant Program

VFRGP Award # 2007-05
June 2007-July 2008

Submitted July 10, 2008

Introduction

The Virginia Seafood Council has been involved in the study of *Crassostrea ariakensis* as a potential non-native product for the Chesapeake Bay since its inception in 2000. Since then, the Council has helped to organize and carry out several experiments using these oysters. Starting out with just a few thousand oysters per project, now in its 8th year working with this oyster the Virginia Seafood Council has completed another project with 700,000 oysters.

The first large scale project was conducted from 2003 to 2005 using 800,000 animals and 9 participants with the purpose of assessing the possibility of using *C. ariakensis* as an aquaculture oyster grown in bags and assessing its marketability. Results from this project were promising with fast growth and low mortality observed in *C. ariakensis* relative to the native oyster *Crassostrea virginica*. Markets were developed for the sale of *C. ariakensis* and its acceptance in these markets was generally good with some education of buyers necessary to inform them of differences between *C. ariakensis* and the *C. virginica* they were used to. This first large-scale project was an overall success with good grow-out by *C. ariakensis* and establishment of markets for the sale of this oyster.

The 2005-06 project deployed one million oysters between 10 industry sites. Once again the Council reported an overall success with all but two sites realizing a substantial profit.

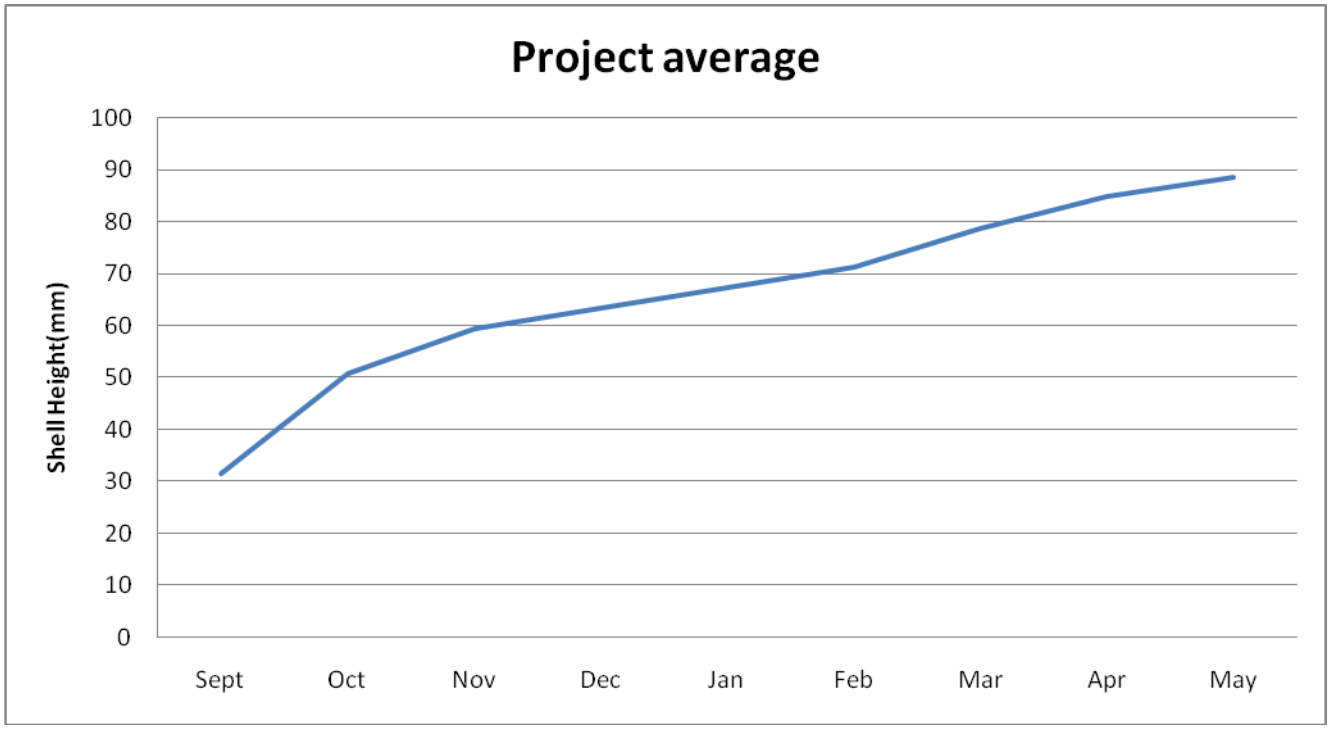
In the 2006 trials, 13 participants grew 100,000 triploid *C. ariakensis* and 10,000 triploid *C. virginica* per site using various contained aquaculture methods including Taylor floats, bags on racks, long-lined bags, and off-bottom cages. Participating sites were scattered around the Chesapeake Bay with four on the seaside eastern shore, one on the bayside eastern shore, two on the southern shore, and the remaining six on the western shore. Oysters were to be deployed at 20mm in length by June1 and grown to market size or for one year until June 1, 2007. Special permission was granted to deploy

some oysters at a smaller size to sites with the proper equipment. During the course of the project the project manager visited each site monthly to ensure bio-security measures were maintained, to track growth and mortality of both *C. ariakensis* and *C. virginica*, and to track cost and return of *C. ariakensis* aquaculture. Unfortunately, the one-year grow-out time frame was not realized as a result of permitting issues that delayed the project approximately 6 weeks. Deployment took place starting in the middle of July. Three deployments of C. ariakensis ensued. Therefore, results represented approximately a 10 ½ month grow-out timeframe.

Results – Biological

Grow-out performance of *C. ariakensis* continued to be exceptional at several sites. This year's averages for *C. ariakensis* were lessened due to a late deployment. Participants continued to gain valuable experience from the project. Figure 1 shows growth averages in millimeters for all sites for *C. ariakensis*.

Figure 1.



It should be noted that this growth data was recorded primarily for use in a mathematical model in place to reduce the risk of reproduction at any one site during the reproductive season and was therefore recorded for the first deployment of *C. ariakensis* at each different site once a month.

Measurements were taken on at least 100 oysters at each site from the general farm population. As a result this data is heavily influenced by the random harvest of the larger market size animals. Some growers chose to harvest throughout the project as the oysters reached market size, which is approximately 80 mm.

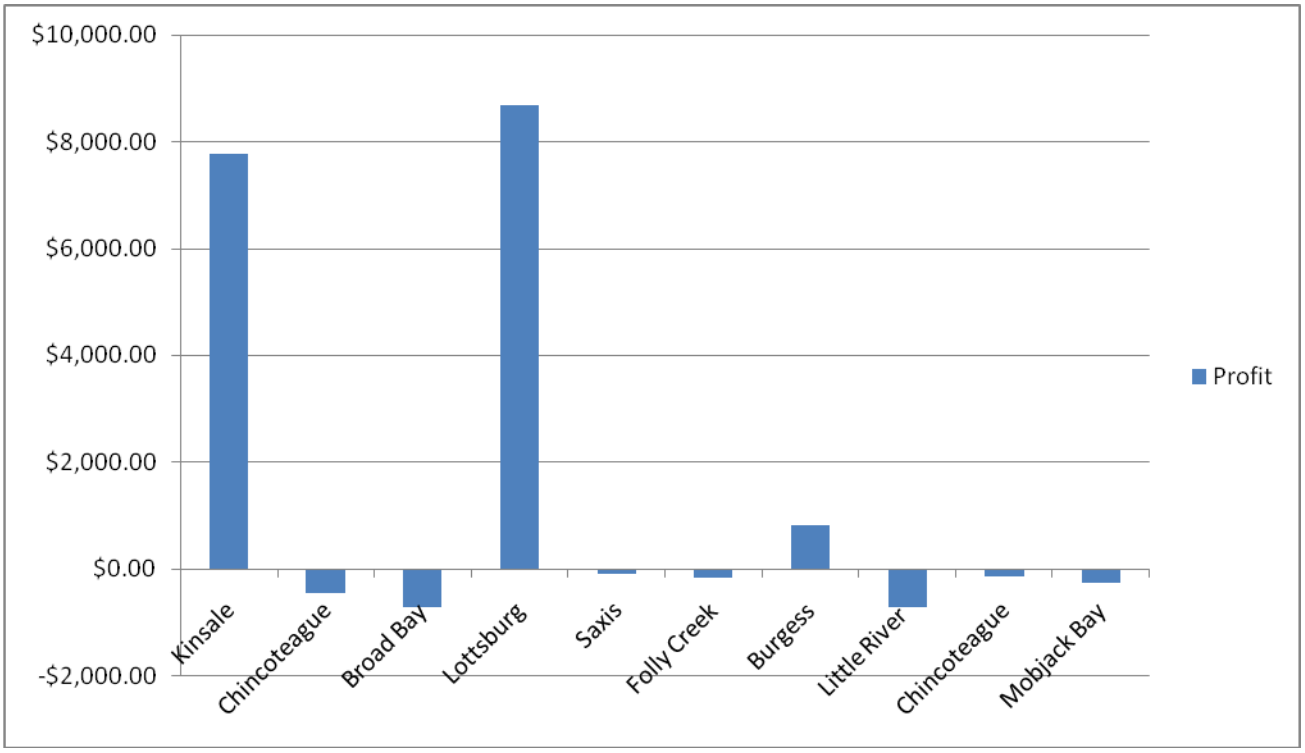
Mortality varied by site for *C. ariakensis*. One major mortality event occurred in September 2007 when two sites in the Little Wicomico River near Burgess, VA. A harmful algal bloom and/or low dissolved oxygen caused the mortality upwards of 70% at both sites. The detailed report of this event is included in the appendix. This event accounted for nearly all of the mortality at these sites. The site in Virginia Beach also experienced a mortality of approximately 30% while in the growers FLUPSY. The grower went out of town for a week and found the mortality when he returned.

Mortality of *C. ariakensis* was higher this year than in years past because of these factors mentioned above. More details will be given in the individual site reports (appendix III).

Results-Economic

Participants in this year's project were not as excited with the economic results as in years past. This is due in large part to the late deployment and reduced numbers of *C. ariakensis*. Profit ranged from $8,672 to a loss of $740. Figure 3 shows overall profit and loss across all sites.

Figure 3.



Although some growers nurseried their own *C. ariakensis*, some were nurseried by Council approved nurseries and therefore all nursery costs were left out of these cost and return calculations.

Table 1 shows the project's average investments, returns and profits. Total labor hours at each site were reduced in this project compared to last as a result of several growers choosing to stock oysters in units at low densities when deployed to avoid the additional labor of splitting oysters into more bags later. In some cases growers were able to leave oysters in their respective unit from the time of deployment to the time of harvest with only a few handlings for cleaning of the bags. Average cost for this year was nearly less than that of last year, however profits also decreased. The average number of oysters sold this year decreased due in large part to the lower numbers of oysters each grower received and the shortened growing period, as well as the mortality event in September. Supply costs include grow-out equipment such as bags, racks and cages as well as cable ties, rope, buoys and wire. Table 2 shows a breakdown of costs and returns at each site.

Table 1.

Average Cost and Return	
Labor Hours	102.8
Labor Cost	$1,028.00
Supply Cost	$81.00
Fuel Cost	$202.50
Total Cost	$1,311.50
Oysters sold	23285
Total revenue	$2,770.83
Profit	$1,459.33

Table 2.

	Kinsale	Chincoteague	Broad Bay	Lottsburg	Saxis	Folly Creek	Burgess	Little River	Chincoteague	Mobjack Bay
	Bevan's	Bowden	Chalmers	Cowart's	Drewer	Hammer	Harding	Lewis	Mason	Vigliotta
Labor Hours	65	127	100	65	250	96	125	75	100	25
Labor Cost	$650.00	$1,270.00	$1,000.00	$650.00	$2,500.00	$960.00	$1,250.00	$750.00	$1,000.00	$250.00
Supply Cost	$100.00	$50.00	$100.00	$100.00	$120.00	$100.00	$100.00	$100.00	$20.00	$20.00
Fuel Cost	$500.00	$60.00	$200.00	$500.00	$100.00	$250.00	$250.00	$125.00	$40.00	$0.00
Total Cost	$1,250.00	$1,380.00	$1,300.00	$1,250.00	$2,720.00	$1,310.00	$1,600.00	$975.00	$1,060.00	$270.00
Oysters sold	60,125	4,550	14,000	66,150	53,900	8,125	17,500	4,900	3,600	0
Total revenue	$9,018.75	$910.00	$560.00	$9,922.50	$2,622.00	$1,125.00	$2,400.00	$250.00	$900.00	$0.00
Profit	$7,768.75	-$470.00	-$740.00	$8,672.50	-$98.00	-$185.00	$800.00	-$725.00	-$160.00	-$270.00

Discussion

Returns for individual participants in this project ranged from a deficit of $470 to a profit of $8,672. As in years past growers who shucked all of their oysters yielded the highest profits. Several growers continued to sell their oysters on the half-shell market. It should be noted however that shucking *C. ariakensis* appears to be more practical because of the relatively short shelf life on the half shell. *C.* v*irginica* can live far longer in refrigeration than can *C. ariakensis*. This short shelf life makes shipping *C. ariakensis* alive difficult and therefore more appealing as a shucked product. All growers who chose to sell oysters on the half shell sold to individuals or businesses that planned on using the oysters very soon after the purchase.

As in past projects, deviations from traditional bagged oyster aquaculture practices that occurred in the 2007-08 project were stocking units with low numbers of oysters upon deployment. Traditionally in *C. virginica* aquaculture oysters were stocked at a standard volume of seed in each bag, grown until the bags filled, then the oysters were split out into 2 or more bags to allow more room for growth which works well for *C. virginica*. As a result of using low densities among units being the method of reducing spawning risk of rare diploids in these trials some participants decided that rather than splitting oysters into low densities prior to the onset of the reproductive season they would simply start their units out at low densities. Two advantages resulted from this deviation from traditional practices. One, labor hours were reduced as the tedious work of splitting had been effectively cut out of the process, and two *C. ariakensis* seemed to prefer having all the extra room in the bags when small and grew exceptionally well and noticeably better than *C. ariakensis* started at higher densities.

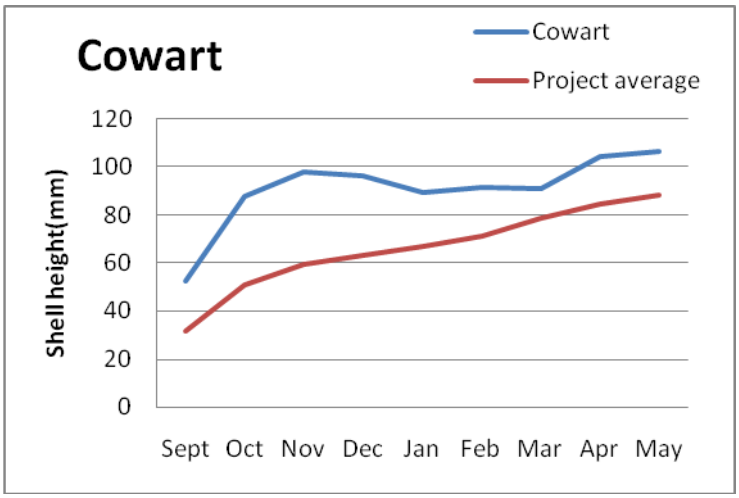
Grow-out performance of the 10,000 triploid *C. virginica* at each site, while not as fast as *C. ariakensis* was still strong. Participants of the project mentioned that they were impressed with the growth of the triploid *C. virginica* compared to diploid *C. virginica*, but still concerned about disease causing high mortality after a year or more. No grower reported selling any *C. virginica* in this year's project.

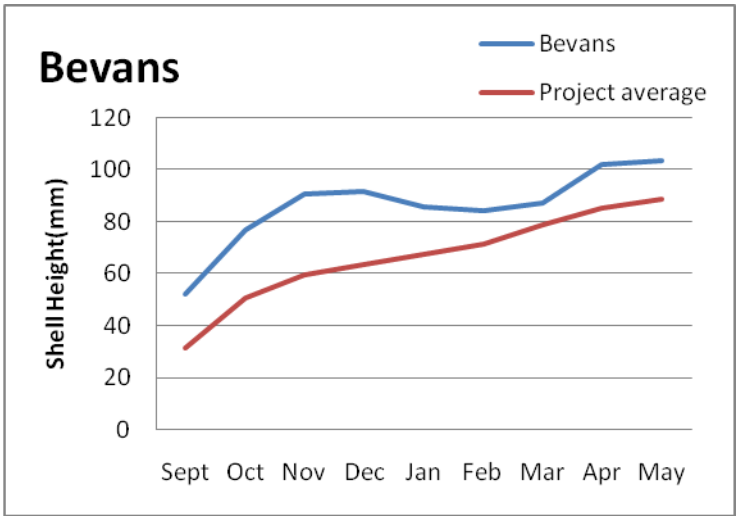
The 2007-08 project fell short of accomplishing it primary goal of growing triploid *C. ariakensis* to market size in a one-year time frame. However, the reason for this was a reduced time frame, and not due to *C. ariakensis* not being capable of reaching market size in 12 months.

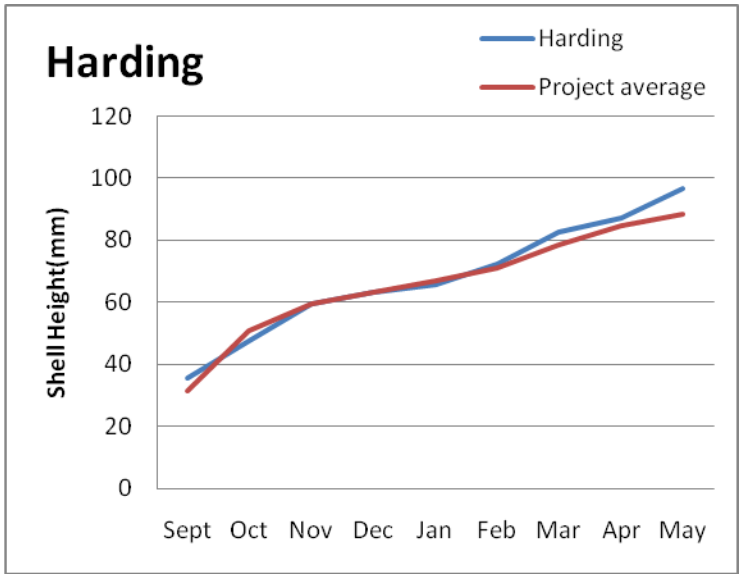
Keeping in mind that the first deployments of *C. ariakensis* were delayed nearly 2 months and the three significant mortality events, 33% of the oysters were marketed in roughly ten months. When you exclude the oysters lost in these mortality events the percentage of marketable oysters grows to nearly 50. Although the one year-time frame was not realized, it seems feasible that a relatively large number of *C. ariakensis* could be grown to market size in one year. Important factors that would lead to this successful end would include significant nursery capabilities to ensure a deployment in late spring to take advantage of cool water temperatures and high food content ideal for oyster growth, low stocking densities to ensure individuals are not food limited and due diligence paid to the animals by the growers. The Virginia Seafood Council continues to advocate for ongoing research regarding the use of triploid C. ariakensis as a complement to the native oyster industry.

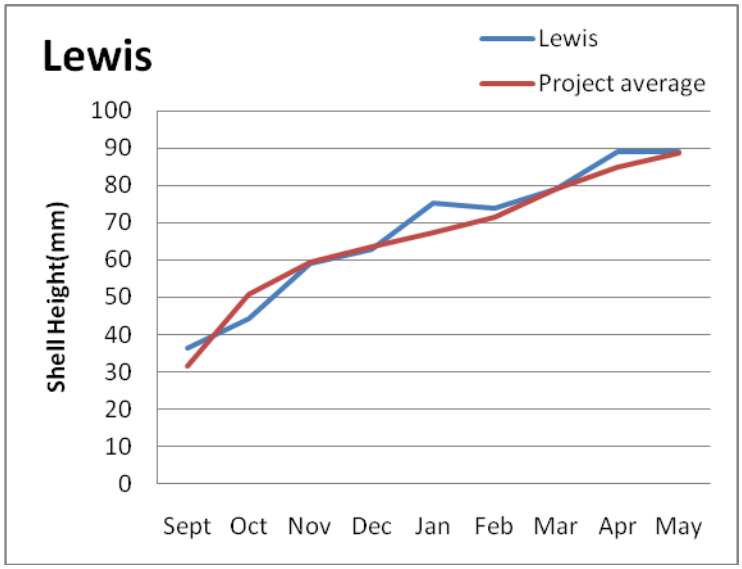
Appendix 1.

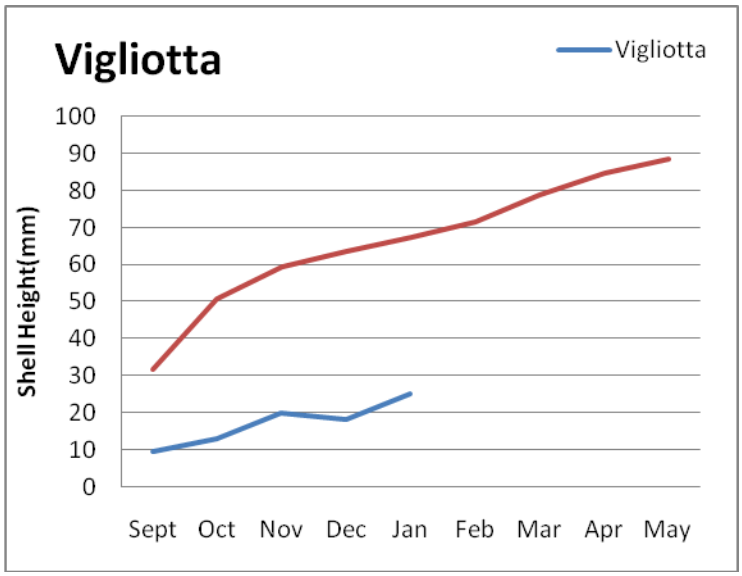
Site Specific Growth Data

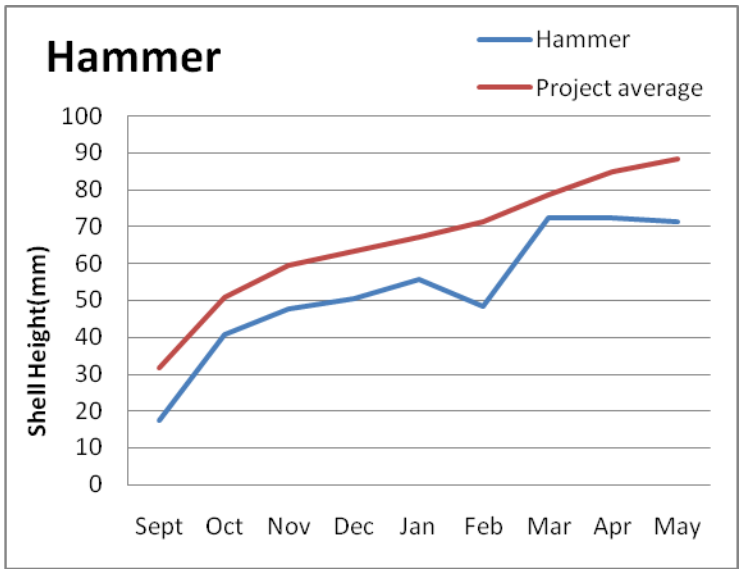


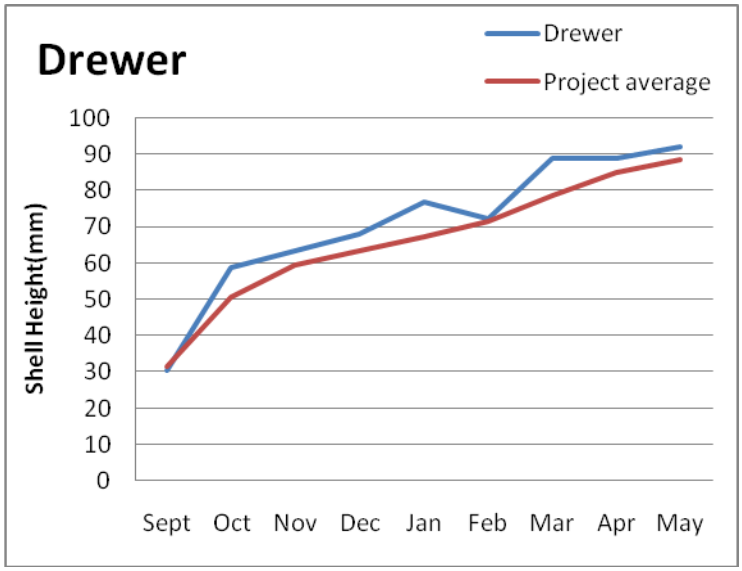


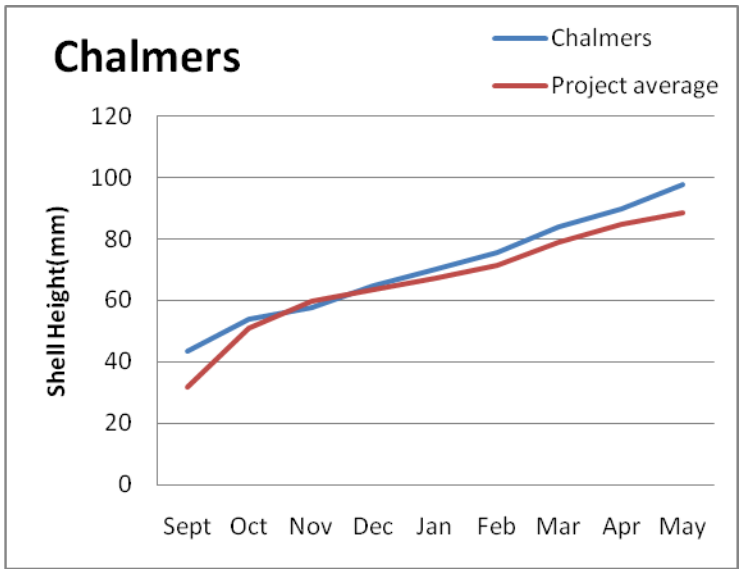


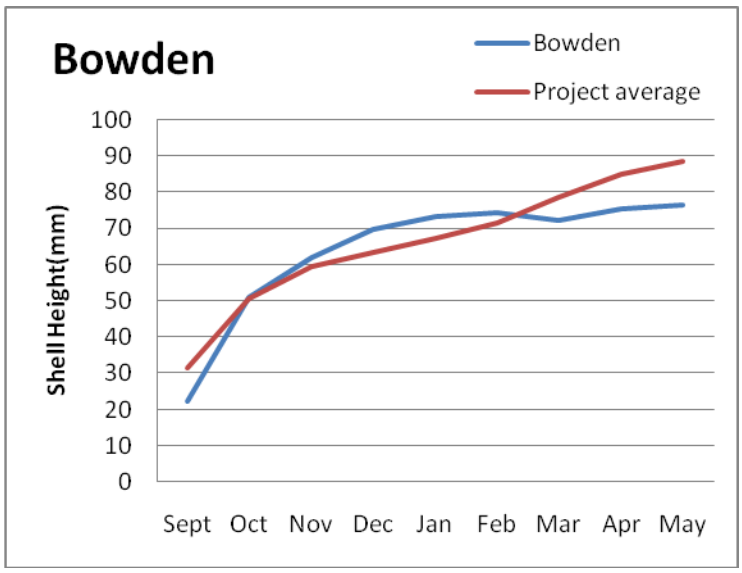

Lewis
Lewis
Project average
Shell Height(mm)
100
90
80
70
60
50
40
30
20
10
0
Sept
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May

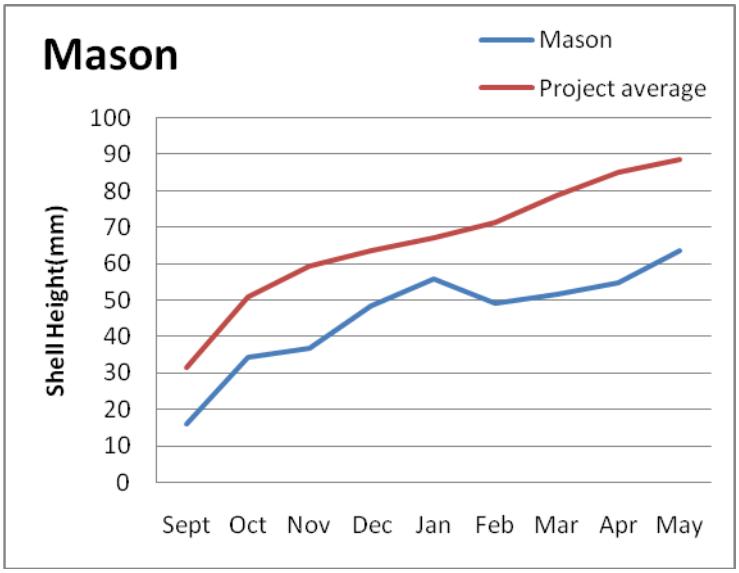

Vigliotta
Vigliotta
Shell Height(mm)
100
90
80
70
60
50
40
30
20
10
0
Sept
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May


Hammer
Hammer
Project average
Shell Height(mm)
100
90
80
70
60
50
40
30
20
10
0
Sept
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May


Drewer
Drewer
Project average
Shell Height(mm)
100
90
80
70
60
50
40
30
20
10
0
Sept
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May

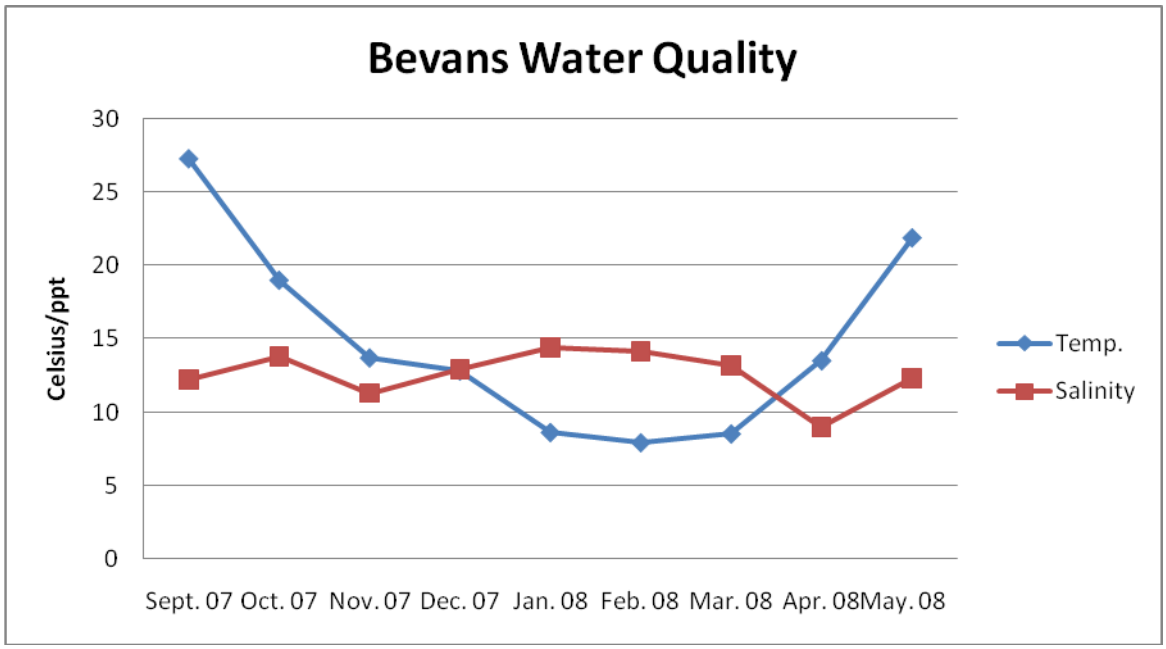

Chalmers
Chalmers
Project average
Shell Height(mm)
120
100
80
60
40
20
0
Sept
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May

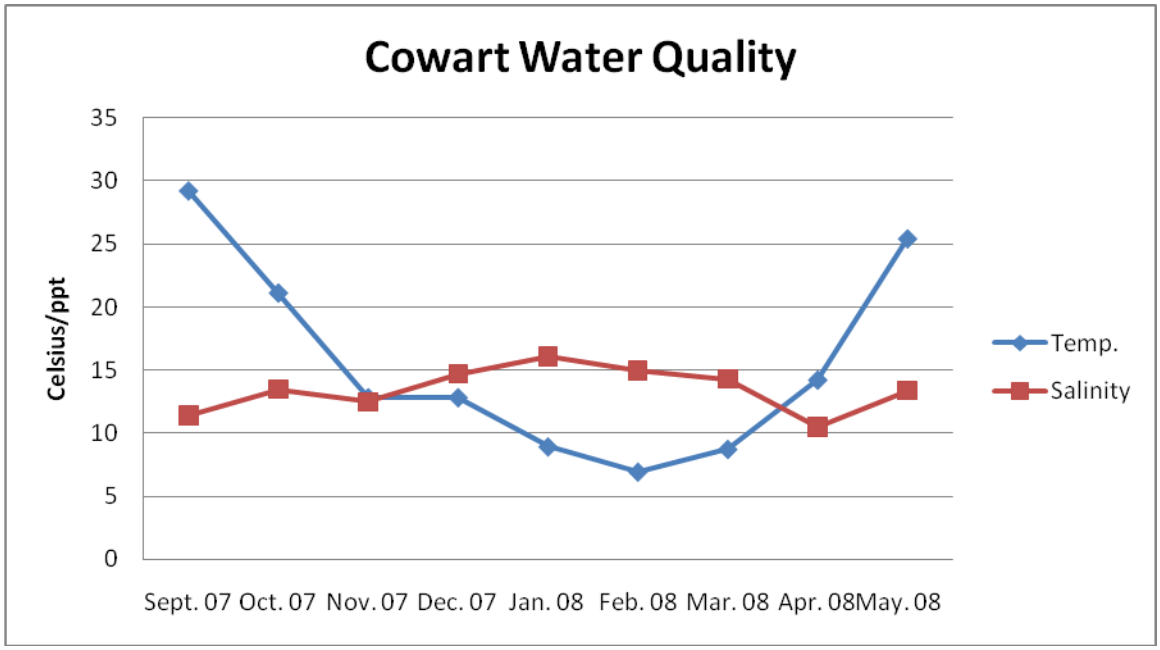

Bowden
Bowden
Project average
Shell Height(mm)
100
90
80
70
60
50
40
30
20
10
0
Sept
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May

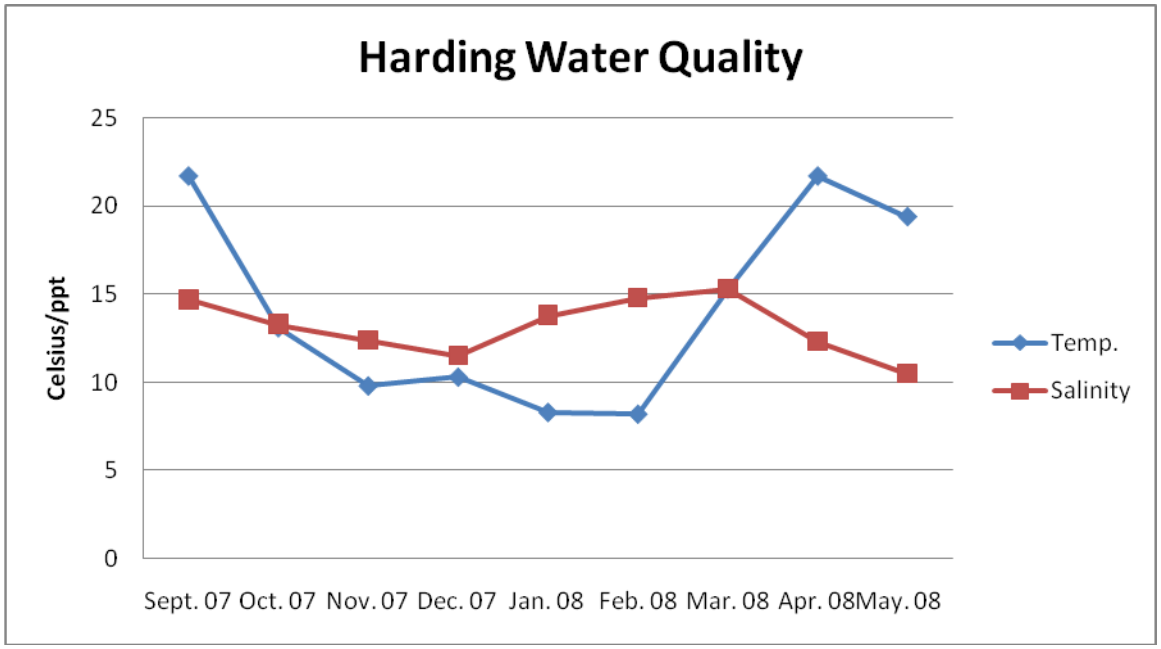

Mason
Mason
Project average
Shell Height(mm)
100
90
80
70
60
50
40
30
20
10
0
Sept
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May

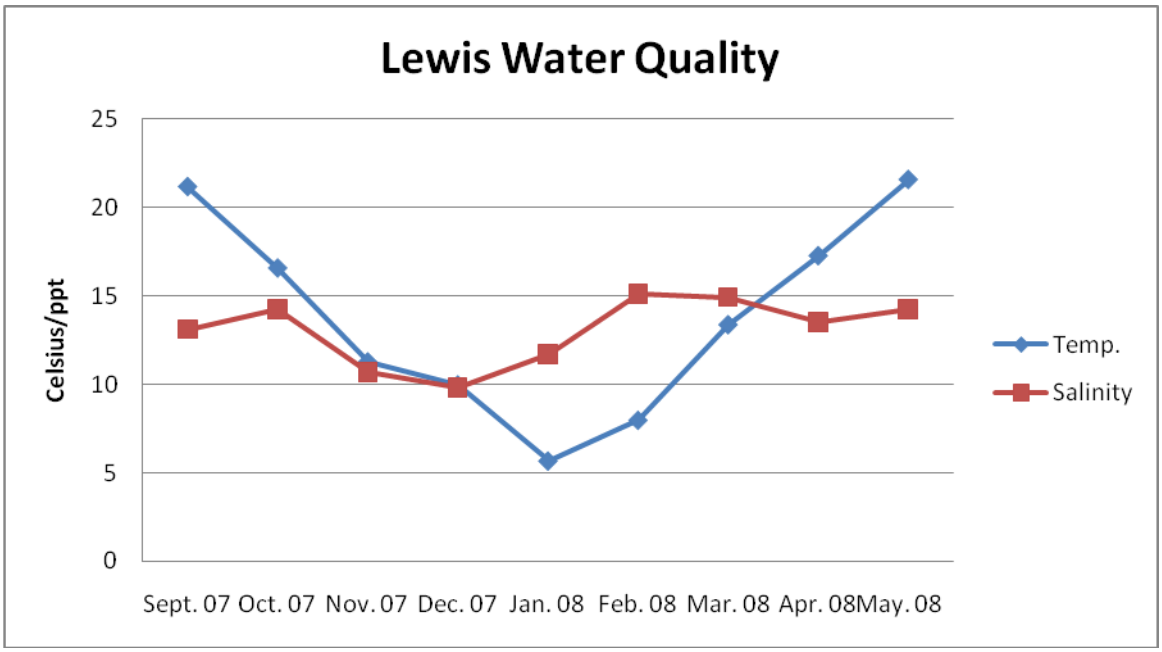
Appendix 2.

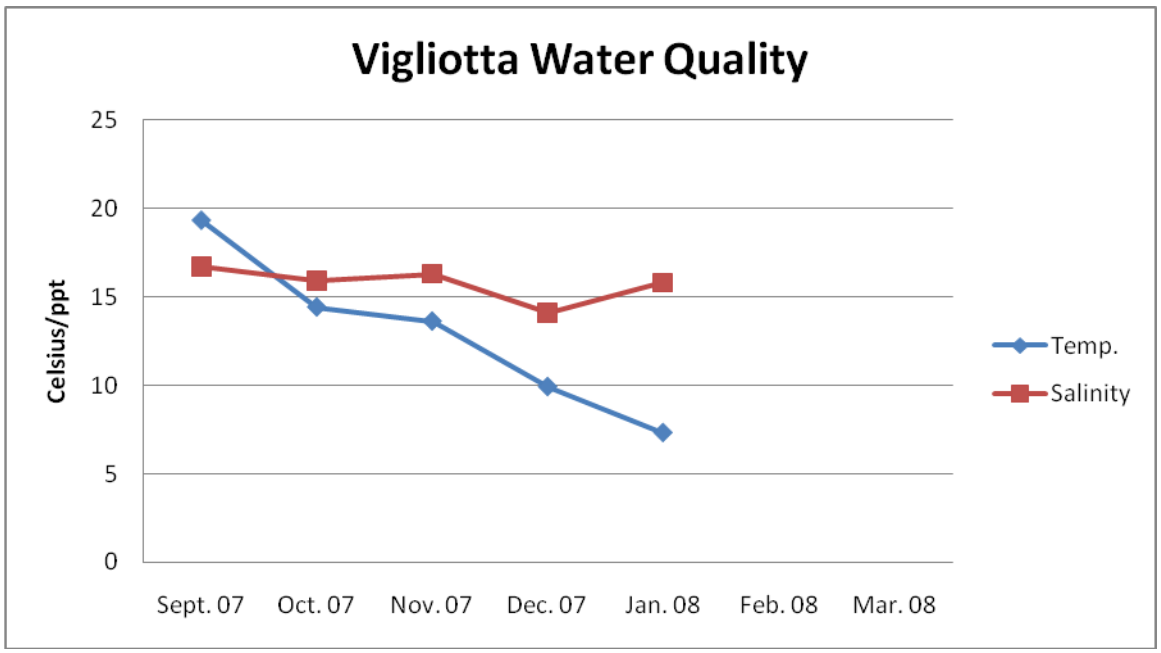
Water Quality

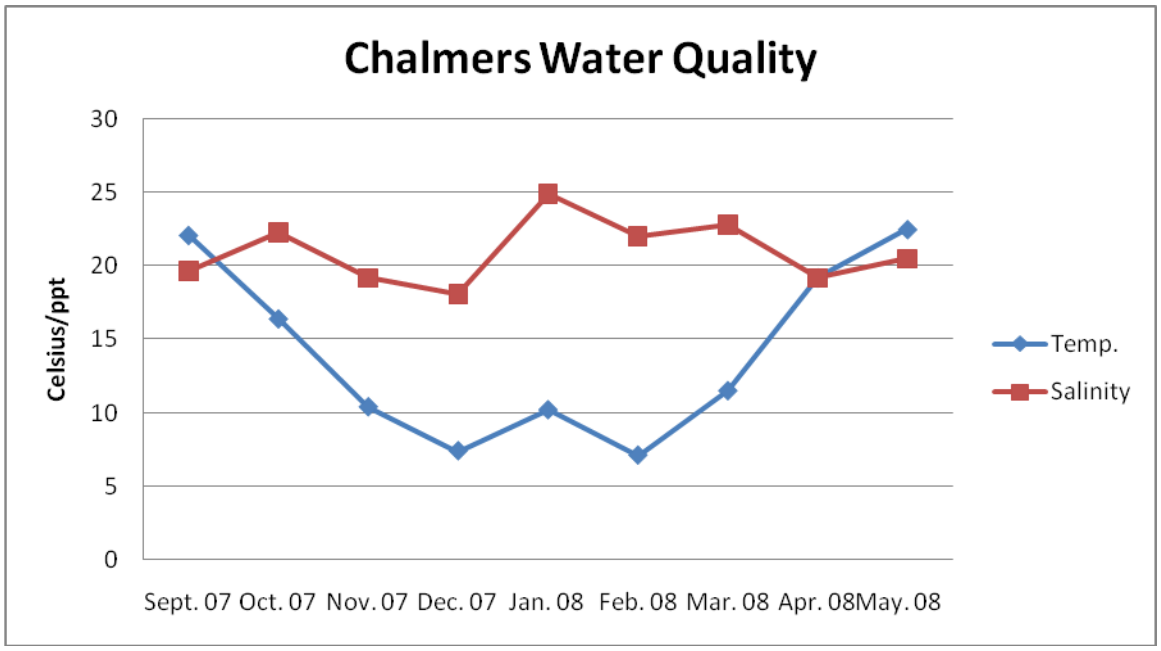


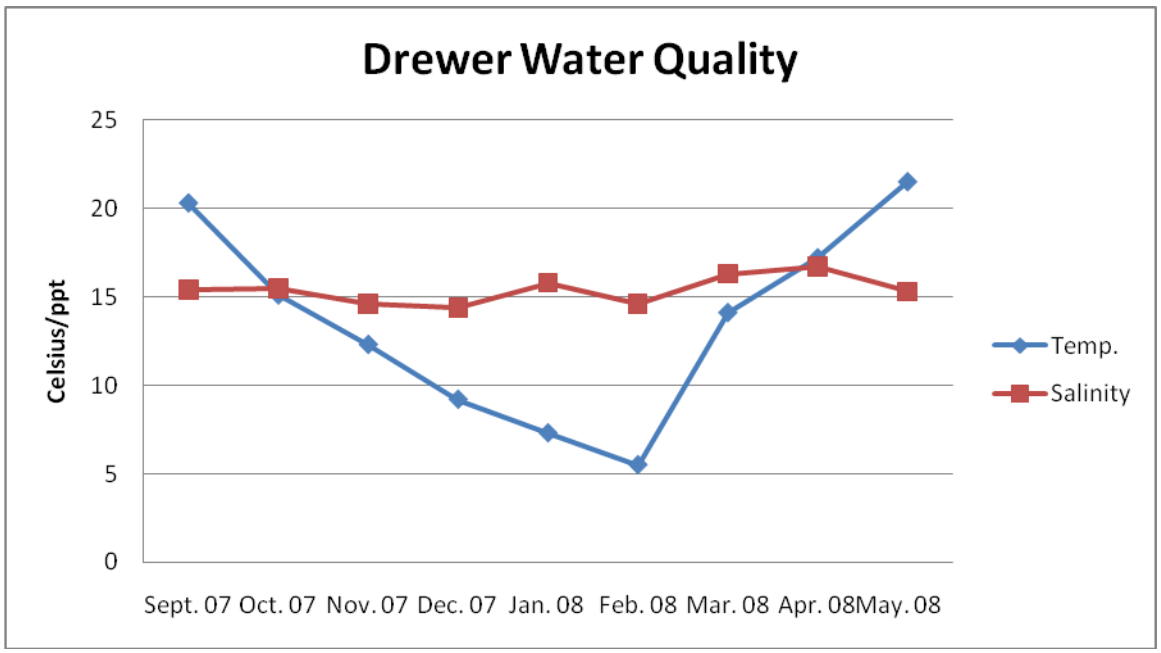


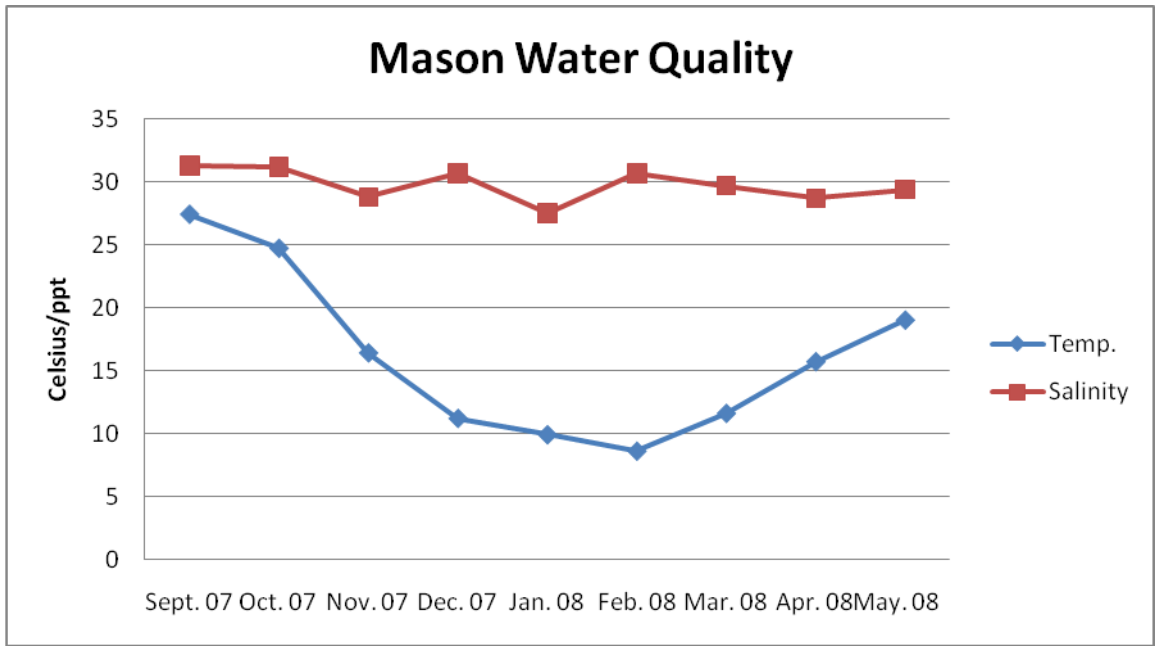

Harding Water Quality
25
20
15
10
5
0
Celsius/ppt
Sept. 07
Oct. 07
Nov. 07
Dec. 07
Jan. 08
Feb. 08
Mar. 08
Apr. 08
May. 08
Temp.
Salinity

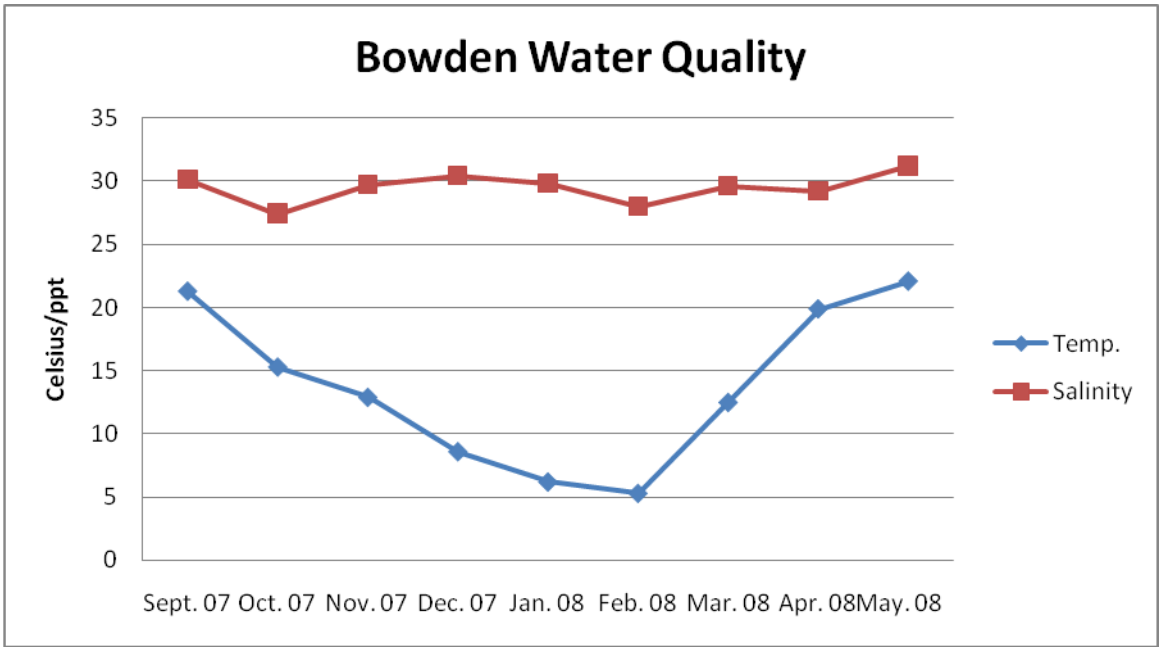

Lewis Water Quality
25
20
15
10
5
0
Celsius/ppt
Sept. 07
Oct. 07
Nov. 07
Dec. 07
Jan. 08
Feb. 08
Mar. 08
Apr. 08
May. 08
Temp.
Salinity

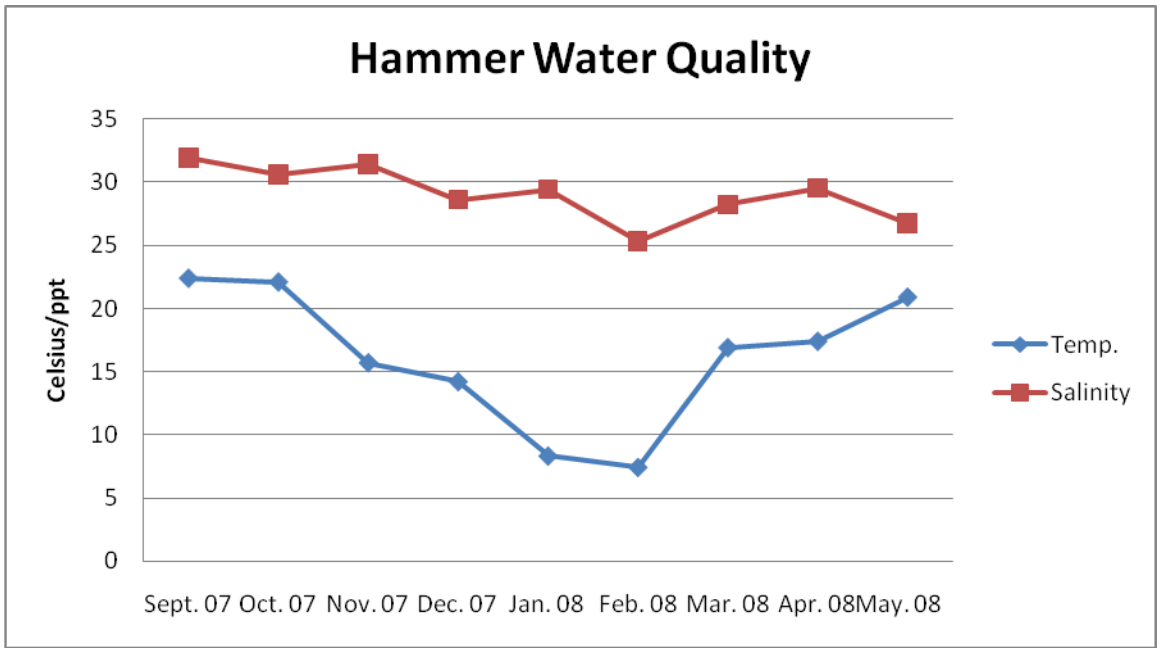

Vigliotta Water Quality
Celsius/ppt
25
20
15
10
5
0
Sept. 07
Oct. 07
Nov. 07
Dec. 07
Jan. 08
Feb. 08
Mar. 08
Temp.
Salinity


Chalmers Water Quality
Celsius/ppt
30
25
20
15
10
5
0
Sept. 07
Oct. 07
Nov. 07
Dec. 07
Jan. 08
Feb. 08
Mar. 08
Apr. 08
May. 08
Temp.
Salinity


Drewer Water Quality
25
20
15
10
5
0
Celsius/ppt
Sept. 07
Oct. 07
Nov. 07
Dec. 07
Jan. 08
Feb. 08
Mar. 08
Apr. 08
May. 08
Temp.
Salinity


Mason Water Quality
35
30
25
20
15
10
5
0
Celsius/ppt
Sept. 07
Oct. 07
Nov. 07
Dec. 07
Jan. 08
Feb. 08
Mar. 08
Apr. 08
May. 08
Temp.
Salinity


Bowden Water Quality
Celsius/ppt
35
30
25
20
15
10
5
0
Sept. 07 Oct. 07 Nov. 07 Dec. 07 Jan. 08 Feb. 08 Mar. 08 Apr. 08 May. 08
Temp.
Salinity


Hammer Water Quality
Celsius/ppt
35
30
25
20
15
10
5
0
Sept. 07 Oct. 07 Nov. 07 Dec. 07 Jan. 08 Feb. 08 Mar. 08 Apr. 08 May. 08
Temp.
Salinity

Appendix 3.

Mortality Event Report

This report details the mortality events of *Crassostrea ariakensis* at two sites in the Little Wicomico River near Burgess, VA. In summary, we have not determined the cause of the mortality, but have ruled out several factors. The following will be a synopsis of the events leading up to the mortality and actions taken after the mortality was observed.

120,000 *C. ariakensis* were delivered to Purcell's Seafood from the upweller system at VIMS on July 23, 2007. These oysters measured between 2 and 4 millimeters and were put into a FLUPSY at Purcell's. Since there was plenty of room in the FLUPSY by the time the oysters were deployed we can rule out overcrowding as a cause of mortality. August 21, 2007 the oysters were deployed into cages and put overboard. 60,000 of these oysters were deployed by Purcell's Seafood and 60,000 were deployed by Little River Seafood. No significant mortality was reported at this time by either grower.

September 10, 2007 I was making a routine site visit to Little River Seafood to collect growth data on the oysters. Oysters here are grown in an off bottom cage system, however to adhere to biosecurity protocols they were still being held in smaller mesh bags (3/8 inch) within the cages. As soon as I pulled the first bag out of the cage I could hear a lot of empty shells rattling around. A quick count estimated mortality at 50%. We also opened several other bags and they all exhibited similar mortality. The remaining living oysters had an average shell height of just over 36 mm. I estimate the shell height of the empty shells to be between 25 and 30 mm. The water temperature was 28.4° C and salinity was 16.1 ppt. The grower pulled all cages the next day and estimated 70% mortality.

September 11, 2007 I visited Purcell's Seafood. I informed Rich of the situation at Little River Seafood and he thought that it might have been caused by black mud suffocating the oysters. We ruled this out soon after because Rich's oysters were on sandy bottom and exhibited the same mortality. This is when I realized that we could have a serious situation and I collected a sample of about 50 oysters for the pathology lab at VIMS. The living oysters had an average shell height of 35.6 mm. The estimated shell height of the empty shells was similar to Little River Seafood's at around 25-30 mm. The water temperature was 28° C and salinity was 18 ppt. We also looked at several cages of *C. virginica* less than a ¼ mile away. There was no mortality observed in any of these cages. These oysters had been in the same FLUPSY and were deployed the same day as the *C. ariakensis*.

The sample was taken to the pathology lab at VIMS the morning of September 12, 2007. Karen Hudson and I spoke to the technicians in the lab about the samples and what needed to be done. We all agreed on the tests to be done and were told that results would be available in 7-10 days. Results were given to us on September 25, 2007. Oysters were examined for all known oyster diseases and parasites. Two very light infections of *Perkinsus marinus* were found. It seems very unlikely that the mortality event can be attributed to any pathological ailment.

Unfortunately no water samples were taken and dissolved oxygen content is unknown. Recent conversations with Rich Harding have brought some new information to my attention. It seems that within the 3 week window between deployment of the oysters and the observed mortality several crab fishermen had told him they had been pulling up crab pots with all the crabs dead. There have also been reports of mortality in *C. virginica* by people who grow oysters off of their docks in the area.

With the information available to us at this point I think that we can confidently rule out several possible causes. First, husbandry of the oysters seems not an issue. These growers have been involved in oyster aquaculture for many years and have not had past issues related to husbandry. Second, pathology reports from VIMS came back negative for any serious infections in the oysters. Third, crab predation can be ruled out because I did not observe any of the normal shell deformations usually caused by crabs. Fourth, because of the lack of rain we have experienced all summer I don't think there is any possibility of the salinity dropping below critical levels. This leaves us with two possible situations which could be tied up into one: a harmful algal bloom and/or low dissolved oxygen are the most likely culprits.