Cleaning the Chesapeake Bay with Oysters

Determining Water Clearance Rates and Food Assimilation Efficiencies of the Native Oyster, *Crassostrea virginica*, and the Non-Native Oyster, *Crassostrea ariakensis*, and Implications for the Chesapeake Bay

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ABSTRACT

Water quality in the Chesapeake Bay, the largest estuary of the United States, is severely impaired. Chief pollutants are nutrients, silt, metals, and pathogens. Poor water quality affects health of fish and shellfish and diminishes recreational use of the Bay. A major reason for the problem is the drastic decline in the population of the native oyster, *Crassostrea virginica*, a keystone species and natural water purifier. Because efforts to restore the population of *C. virginica* will not produce results fast enough to meet national environmental goals for clean water, interest has turned to non-native oysters for bioremediation. The purpose of this study was three-fold: (1) Determine water clearance rates and food assimilation efficiencies of the diploid, native oyster, *Crassostrea virginica*, and the triploid, non-native oyster, *Crassostrea ariakensis*; (2) Develop a computer model showing how the triploid, non-native oyster could be used in aquaculture with the diploid, native oyster *in situ* to hasten clean-up of the Chesapeake Bay; and (3) Determine effect of ploidy on water clearance rates and food assimilation efficiencies of *C. ariakensis*. The study resulted from previous research that showed triploid *C. ariakensis* suppressed growth of diploid *C. virginica* in two rivers flowing into the Chesapeake Bay (Holt, 2001).

Water clearance rates and food assimilation efficiencies were determined by comparing particulate organic matter (POM) and particulate inorganic matter (PIM) ingested by oysters of the two species to POM and PIM ejected in their biodeposits (pseudofeces and feces). Samples of *C. virginica* (diploid), *C. ariakensis* (diploid), and *C. ariakensis* (triploid) were acclimated in water from the York River; weighed; put in feeding baskets; placed in circulating river water; and allowed to feed and produce

biodeposits over an extended time. Mean water clearance rate for diploid *C. virginica* (0.0121 l/hr g) was not statistically different from that of diploid *C. ariakensis* (0.00984 l/hr g) and triploid *C. ariakensis* (0.0103 l/hr g). Mean food assimilation efficiency of diploid *C. virginica* (69.7%) was significantly higher than that of diploid *C. ariakensis* (51.7%) and triploid *C. ariakensis* (49.8%). Mean water clearance rates and food assimilation efficiencies of diploid *C. ariakensis* were not significantly different from those of triploid *C. ariakensis*.

Using these data, a computer model was developed to calculate weights and percentages of *C. virginica* (diploid) growing in the natural environment and *C. ariakensis* (triploid) growing in controlled aquaculture needed to filter the Bay in any specified time. As an example, to clean the Bay in one year the model indicated that 681,829 kilograms of *C. virginica* or 1,124, 115 kilograms of *C. ariakensis* (triploid) would be needed. Additional calculations showed that at the present rate of harvesting *C. virginica* (i.e., 20,000 bushels in 2001 in Virginia alone), the native oyster is not likely to improve its health or increase its population. A risk assessment indicated low risk to the ecology of the Bay for growing triploid *C. ariakensis* in controlled aquaculture. A cost-to-benefit analysis showed a monetary return on investment of 54% after one year, with the most important benefits being non-quantifiable (e.g., improving water quality and helping to save *C. virginica* as a species).

This study is the first such research on the two species in waters of the Atlantic. It has important implications for improving water quality of the Chesapeake Bay, preserving the native oyster as a species, reviving a languishing oyster industry, meeting national environmental goals, and improving quality of life for citizens.

INTRODUCTION

Water quality in the Chesapeake Bay, the largest estuary of the United States, is severely impaired. Poor water quality affects health of fish and shellfish and diminishes recreational use of the Bay. Chief pollutants are nutrients, silt, metals, and pathogens (U. S. EPA, 1998). On a scale of 100, the Chesapeake Bay Foundation (1998) rates water clarity, a measure of nutrient and sediment contamination, at 15.

A major reason for the unhealthy status of the Bay is the demise of the native oyster, *C. virginica.* This keystone species ingests polluted water, digests microscopic floating plants, and removes sediments and pollutants suspended in the water. The present population of this natural water purifier is estimated at 2 percent of the population in the 1600s (Chesapeake Bay Foundation, 2000). Hargis and Haven (1988) attribute the demise primarily to over-harvesting. Newell (1988) believes that over-harvesting has reduced the quantity and quality of the broodstock, reduced habitat, deteriorated water quality, and caused ecological changes. Jensen and Travelstead (1992) attribute the decline to parasitic diseases, such as Dermo and MSX.

The Chesapeake Bay cannot be saved as a national ecological treasure unless its oyster population is restored (Chesapeake Bay Foundation, 2000). Since 1996, the Virginia Marine Resources Commission (VMRC) has been building artificial reefs and encouraging citizens to grow seed oysters for the reefs. The Virginia Institute of Marine Science (VIMS) has researched improved broodstock. Although the demise may have been arrested, VMRC recently concluded that these efforts alone will not meet the environmental goal of increasing the native oyster population tenfold by 2010. Attention has focused on non-native oysters as a means of improving water quality, reviving a

dying oyster industry, and allowing the native oyster time to re-build its population. In March 2002, the Virginia General Assembly passed a resolution supporting the introduction of *C. ariakensis* into the Bay in three years unless research shows that this should not be done. Similarly, in April 2002 the Maryland General Assembly passed an emergency bill requiring research on *C. ariakensis*.

BACKGROUND

For the Chesapeake Bay, much research has focused on *C. virginica,* but little has involved the Suminoe oyster, *C. ariakensis* (Calvo *et al*., 2000). *C. ariakensis* is naturally distributed from southern Japan along the south China coast through Southeast Asia to the western coast of the Indian subcontinent (Calvo *et al*., 2000). On the West Coast of the United States, *C. ariakensis* may have been introduced with shipments of *C. gigas* (Breese and Malouf, 1977).

As a first study, Calvo investigated the survivability, growth, and disease resistance of *C. ariakensis* in relationship to salinity in various waters of Virginica (Calvo *et al*., 2000). Holt (2001) conducted a study on competition between *C. virginica* and *C. ariakensis* in two rivers flowing into the Chesapeake Bay. This research showed that in the low-salinity river and the mid-salinity river, *C. ariakensis* suppressed the growth of *C. virginica* in competitive treatments (interspecific competition) and grew faster than *C. virginica* in control treatments. Moreover, this study showed that *C. ariakensis* had a higher survival rate than *C. virginica*. These findings raised three questions: (1) In waters of the Chesapeake Bay, does *C. ariakensis* grow faster in a wider range of salinities and survive better than *C. virginica* because it filters more water (i.e., has a higher water clearance rate) and /or metabolizes more of its food (i.e., has a higher food assimilation

rate)? (2) Could *C. ariakensis* be used with the native oyster to hasten clean up of the Chesapeake Bay? (3) Does ploidy of *C. ariakensis* make a difference in water clearance rates and food assimilation efficiencies?

HYPOTHESES AND PURPOSE

Based on research on competition between the two species (Holt, 2001), it was hypothesized that *C. ariakensis* would have a significantly higher water clearance rate than *C. virginica* (H1); *C. ariakensis* would have a significantly higher food assimilation efficiency than *C. virginica* (H2); and triploid and diploid *C. ariakensis* would not differ significantly in water clearance rates and food assimilation efficiencies (H3). The purpose of the research was three-fold: (1) Determine water clearance rates for *C. virginica* (diploid) and *C. ariakensis* (diploid and triploid); (2) Determine food assimilation efficiencies for *C. virginica* (diploid) and *C. ariakensis* (diploid and triploid); and (3) Use these data to develop a computer model to show how *C. ariakensis* could be used with *C. virginica* to hasten clean-up of the Chesapeake Bay.

DEFINITIONS

Water clearance rate is the volume of water filtered by an oyster per unit time. *Food assimilation efficiency* is a comparison of the amount of particulate organic matter ingested to that ejected in biodeposits. *Biodeposits* are *pseudofeces* and *feces.* *Pseudofeces* is particulate matter ingested by an oyster but quickly ejected. *Feces* is particulate matter ejected by an oyster after digestion of food.

METHODS AND MATERIALS

Water clearance rates and food assimilation efficiencies were determined by placing oysters of the two species in river water with naturally suspended particulate organic

matter (POM) and particulate inorganic matter (PIM), allowing them to feed for an extended time, and collecting their biodeposits (pseudofeces and feces). Water from the York River was used for the feeding environment. This river, which empties into the Chesapeake Bay at Yorktown, Virginia, was selected because of its salinity (about 20 parts per thousand) and its proximity to VIMS. Based on Calvo's (2000) research, this salinity should provide a favorable environment for both species. The percentages of POM and PIM were determined using Whatman glass filters and progressive heat treatments. The minimum percentage of POM to provide ample food for the oysters was set at 25% (Newell, 2001). If the analysis of POM and PIM showed a lower POM percentage, the POM was to be increased to at least 25% using algae. If the percent of POM was at 25% or higher, the river water was to be used without additional algae. A constant flow of the river water was maintained over the oysters throughout the 12 hours prior to the start of each experiment and during the experiment. The flow rate was equal to at least 10 liters per hour per oyster, which is the maximum water clearance rate documented for oysters (Newell, 2001).

Water clearance rate (CR) was calculated using the biodeposition method described by Iglesias *et al.* (1998). This method uses the fact that oysters ingest inorganic matter with food (organic matter). They eject inorganic matter as pseudofeces, or it goes through their digestive system and comes out unaffected in their feces. The organic matter is digested, or it comes out in the feces. Water clearance rate was calculated as follows:

$$CR = IFR/PIM$$

where IFR is the rate that inorganic matter moves through the oyster, i.e., the rate of inorganic matter filtration (mg/hour), and PIM is the concentration of particulate inorganic matter in the water supply (mg/l).

Food assimilation efficiency (AE) was determined using the ratio method of Conover (1966). By this method, AE is defined as percentage of utilization (U') and was calculated as

$$U' = ((F' - E')/(1-E')\ (F')) \times 100$$

where F' is the ash-free dry weight : dry weight ratio (fraction of organic matter) in the ingested food and E' is the same ratio in a representative sample of feces.

The independent variables were species and ploidy of oysters. The dependent variables were water clearance rate and food assimilation efficiency. Control variables were particulate matter in the river water, temperature of the river water, flow rate of the river water over the oysters, salinity, other water characteristics, and light in the feeding trough. Protocol of VIMS for research on non-natives was followed. Specific procedures are given in Table 1. The experimental apparatus is shown in Figure 1.

Table 1

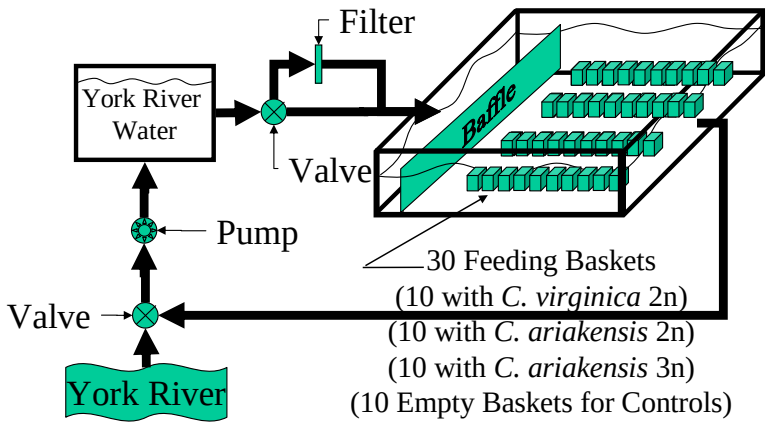
Specific Procedures

- **Select diploid *C. virginica*, diploid *C. ariakensis*, and triploid *C. ariakensis* with shell heights ranging from 12 mm to 50 mm from populations of healthy oysters.**
- **Acclimate oysters in York River water at 20^0C for 14 days.**
- **Set up experimental apparatus; bring York River water to 20^0C.**
- **Heat Whatman Glass Filters for the PIM/POM analyses at 80^0C for 12 hours; cool and weigh. Prepare ammonium formate rinse solution.**
- **Twelve hours before experiment, determine PIM and POM in river water. Repeat at six and zero hours before test. POM should equal at least 25% of total particulate matter.**
- **At twelve hours before experiment, clean and weight oysters.**
- **Place each oyster in a feeding basket. Place basket with oyster in feeding trough. Adjust flow of river water to at least 10 liters/hour/oyster.**

- **At zero hours before experiment, gently transfer each oyster to a clean feeding basket and return basket and oyster to feeding trough. Put empty feeding baskets in the feeding trough as controls. Ensure water flow equals at least 10 liters/hour/oyster.**
- **At end of experiment, gently lift each oyster from its feeding basket. Rinse the oyster with the rinse solution, collecting the rinse in the feeding basket. Transfer the rinse solution and the oyster's biodeposits to a weighed glass filter. Return the oyster to the acclimation trough. Transfer any sediment in each control basket to a weighted glass filter.**
- **Rinse the biodeposits on the filters with rinse solution. Heat filters at 80^{0}C for at least 12 hours; cool and weigh filters. Heat filters at 475^{0}C for 3 hours. Cool and weigh.**
- **Calculate CR and AE. Perform statistical analyses of data.**

Using Microsoft's Excel statistical software, wet weights of oysters were correlated with water clearance rates. Mean water clearance rates and food assimilation efficiencies of *C. virginica* (diploid) were compared to those of *C. ariakensis* (diploid and triploid) using the Student's t-test. Similarly, the mean water clearance rates and food assimilation efficiencies of *C. ariakensis* (diploid) were compared to those of *C. ariakensis* (triploid). Nie *et al*. (1975) describe the statistical tests.

Figure 1. Experimental Apparatus



RESULTS

The concentrations of POM and PIM in the York River water supply stayed essentially constant during the three trials. The average percentage of POM in the particulate matter during Trials 1 and 2, conducted in January 2002, was 33%. The

average percentage of PIM was 67%. During Trial 3, conducted in March 2002, the average percentage of POM in the particulate matter was 52% and the average percentage of PIM was 48%. The percentage of POM in each trial was greater than the required 25%, indicating that the oysters had an ample food supply prior to and during the trials.

Trial 1 involved 5 *C. virginica* (diploid); 5 *C. ariakensis* (diploid); and 5 *C. ariakensis* (triploid). This trial spanned 5 hours. Biodeposits were taken at 5 hours into the experiment. During this trial, oysters filtered water and produced biodeposits.

Trial 2 involved the same oysters as Trial 1. At the end of Trial 1, oysters were transferred into clean feeding baskets. During Trial 2, some of the oysters did not produce significant biodeposits. The movement to clean feeding baskets after Trial 1 may have traumatized the animals.

Trial 3 involved the same oysters as Trial 1, plus 5 additional *C. virginica* (diploid), 5 *C. ariakensis* (diploid), and 5 *C. ariakensis* (triploid). To accommodate laboratory scheduling, Trial 3 covered 8 hours, not 5. Biodeposits were collected at the end of 8 hours. The oysters were not disturbed during this trial.

For the three trials, mean water clearance rates are given in Figure 2. Mean food assimilation efficiencies are given in Figure 3. Figures 4, 5, and 6 show the relationships of water clearance rates with wet weights. The correlation coefficients, 0.87 for *C. virginica*, 0.96 for *C. ariakensis* (diploid), and 0.98 for *C. ariakensis* (triploid), were all statistically significant at the 95% confidence level. Results of the Student's t-test, together with information on significance at the 95 % confidence level, are given in Table 2 for mean clearance rates and Table 3 for mean food assimilation efficiencies.

CONCLUSIONS

Figure 2. Mean Clearance Rates

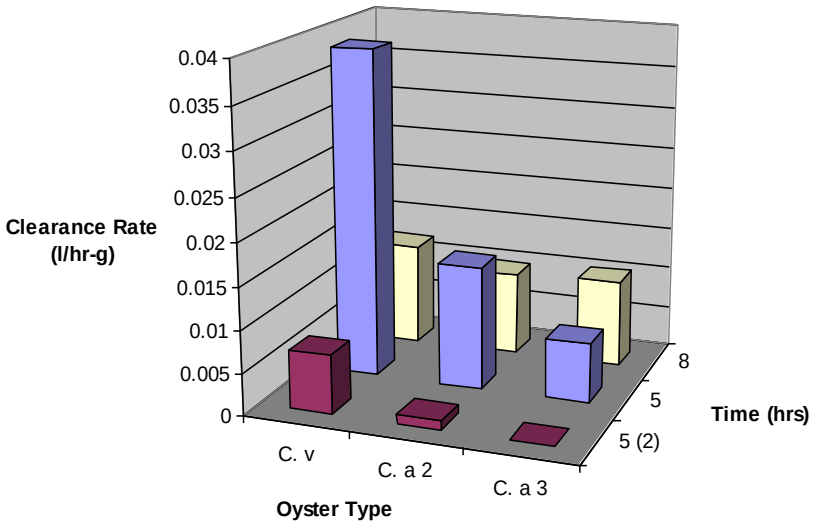
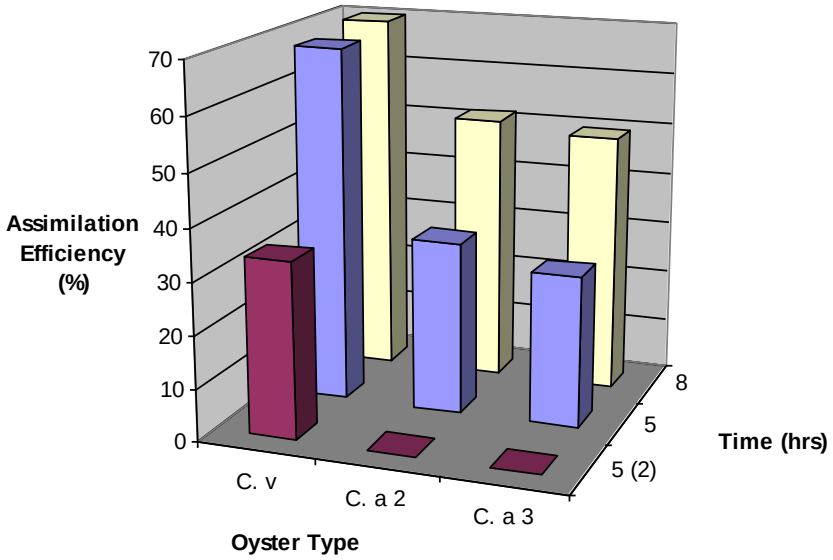


Figure 3. Mean Food Assimilation Efficiencies



Based on Trial 3, in which all oysters were actively feeding and producing biodeposits, five conclusions were drawn. The POM was sufficient throughout the experiment to provide ample food. At the 95% confidence level, there was a significant, positive correlation between water clearance rates of *C. virginica* (diploid), *C. ariakensis* (diploid), and *C. ariakensis* (triploid) with their respective wet weights. The water clearance rates of *C. virginica* (diploid) and *C. ariakensis* (diploid and triploid) were not significantly different at the 95% confidence level. *C. virginica* (diploid) had a significantly higher food assimilation

Figure 4. Clearance Rate vs. Weight of Oyster
***C. virginica* (diploid)**

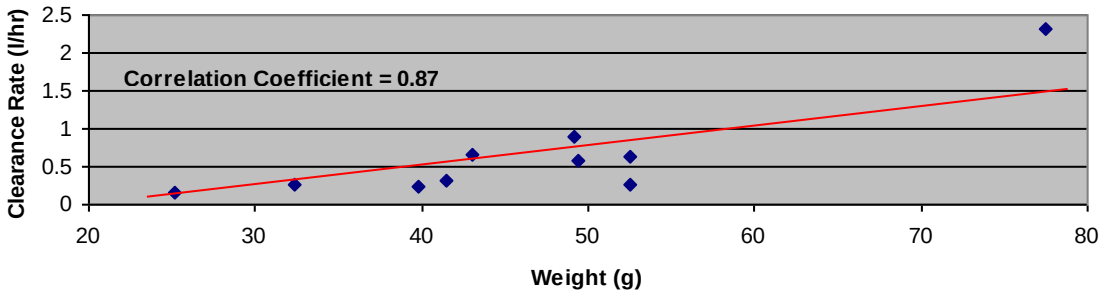


Figure 5. Clearance Rate vs. Weight of Oyster
***C. ariakensis* (diploid)**

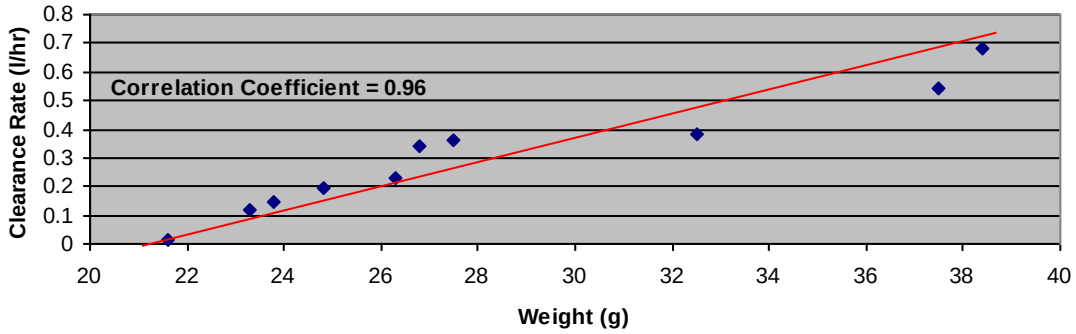


Figure 6. Clearance Rate vs. Weight of Oyster
***C. ariakensis* (triploid)**

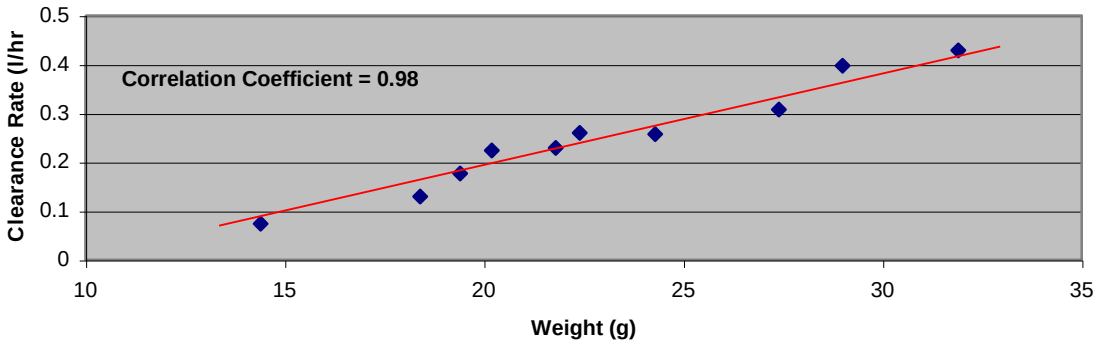


Table 2. MEAN CLEARANCE RATES

Species/Ploidy	Mean Clearance Rate (liters/hr-g)			Student's t-values And Significance at 95% Confidence Level					
	Trial			Trial					
	1 5 Hrs.	2 5 Hrs	3 8Hrs.	1 5 Hrs. t-value	sig (Y/N)	2 5 Hrs. t-value	sig (Y/N)	3 8 Hrs. t-value	sig (Y/N)
C. virginica (diploid)	0.0339	0.00691	0.0121	2.01	N	1.68	N	1.02	N
C. ariakensis (diploid)	0.0146	0.00105	0.00984						
C. virginica (diploid)	0.0388	0.00691	0.0121	2.71	Y	2.02	N	0.78	N
C. ariakensis (triploid)	0.00707	0.00105	0.0103						
C. ariakensis (diploid)	0.0146	0.00105	0.00984	3.45	Y	0.44	N	0.25	N
C. ariakensis (triploid)	0.00707	0.00109	0.0103						

Table 3. MEAN FOOD ASSIMILATION EFFICIENCIES

Species/Ploidy	Mean Assimilation Efficiency(%)			Student's t-values and Significance at 95% Confidence Level					
	Trial			Trial					
	1 5 Hrs.	2 5 Hrs.	3 8 Hrs.	1 5 Hrs. t-value	sig (Y/N)	2 5 Hrs. t-value	sig (Y/N)	3 8 Hrs. t-value	sig (Y/N)
C. virginica (diploid)	68.1	33.7	69.7	5.22	Y	2.54	Y	2.45	Y
C. ariakensis (diploid)	40.0	71.0	51.7						
C. virginica (diploid)	68.1	33.7	69.7	5.22	Y	NA		3.15	Y
C. ariakensis (triploid)	28.9	(0)	49.8						
C. ariakensis (diploid)	40.0	71.0	51.7	6.93	Y	NA		0.24	N
C. ariakensis (triploid)	28.9	(0)	49.8						

Note: For sample size of 5, t-value of 2.13 required for significance at 95% confidence level; for sample size of 10, t-value of 1.83 required for significance at 95% confidence level.

efficiency than *C. ariakensis* (diploid and triploid) at the 95% confidence level. The food assimilation efficiencies of *C. ariakensis* (diploid) and *C. ariakensis* (triploid) were not significantly different at the 95% confidence level. The hypotheses that *C. ariakensis* would have a higher clearance rate and a higher food assimilation efficiency were not supported. The more robust growth of *C. ariakensis* observed in Holt's (2001) competition study was not explained by clearance rates or food assimilation efficiencies. Ploidy of *C. ariakensis* did not make a difference in clearance rates or food assimilation efficiencies, suggesting that either diploid or triploid *C. ariakensis* would be equally effective at bioremediation.

COMPUTER MODEL FOR CLEANING THE CHESAPEAKE BAY WITH OYSTERS

Using Microsoft's Excel software and specially written macros, a computer model was developed to calculate the weight of *C. virginica* (diploid) and *C. ariakensis* (triploid) needed to clean the Chesapeake Bay in a given time period. This model is described in Table 4.

Table 4.
Computer Model for Cleaning the Chesapeake Bay with Oysters

To clean the Chesapeake Bay with *C. virginica* (diploid) only:

1. **Assume that the hypothetical reef is populated only by *C. virginica* (diploid) growing in the natural environment of the Chesapeake Bay; that the *C. virginica* on the reef have the same average wet weight as *C. virginica* used in this experiment; and that the *C. virginica* on the reef will have a water clearance rate and food assimilation efficiency as determined in this experiment (Trial 3).**
2. **Use a survivability rate of 99.0% for *C. virginica* (Holt, 2001). Use the volume of the Chesapeake Bay as determined by Cronin (5×10^{10} liters) (1971).**
3. **Calculate the weight of *C. virginica* needed to clean the Bay in one year as:**

   Weight (kg) = 5×10^{10} liters/8760 hours x CR (liters/hr g) x AE x Survivability Rate x 1000 g/kg
4. **Determine weight of *C. virginica* (diploid) required to filter the Chesapeake Bay for other time periods by varying time in the formula.**

To clean the Chesapeake Bay with *C. ariakensis* (triploid) only:

1. **Assume that the hypothetical reef is populated only by *C. ariakensis* (triploid) growing in controlled aquaculture; that the *C. ariakensis* (triploid) will have the same average wet weight as *C. ariakensis* in this experiment; and that the *C. ariakensis* will have a water clearance rate and food assimilation efficiency as determined in this experiment (Trial 3).**
2. **Use a survivability rate of 99.8 % for *C. ariakensis* (Holt, 2001). Use the volume of the Chesapeake Bay as determined by Cronin (5×10^{10} liters) (1971).**
3. **Calculate the weight of *C. ariakensis* needed to clean the Bay in one year as:**

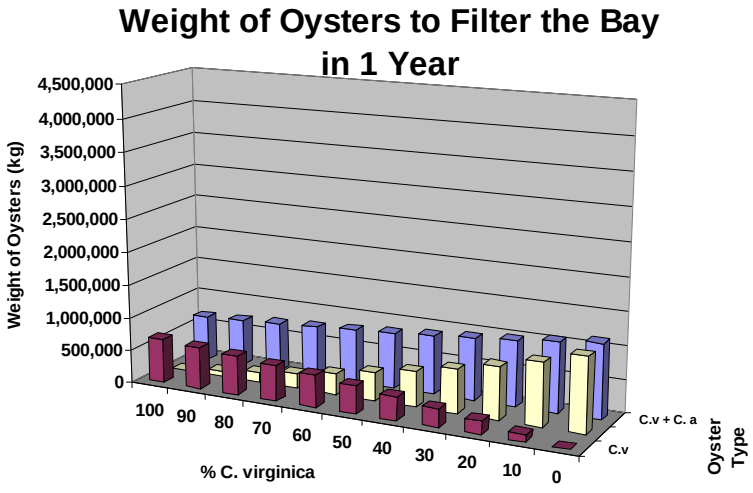
   Weight (kg) = 5×10^{10} liters/8760 hours x CR (liters/hr g) x AE x Survivability Rate x 1000 g/kg
4. **Determine weight of *C. ariakensis* (triploid) required to filter the Chesapeake Bay for other time periods by varying time in the formula.**

To clean the Bay with varying percentages of *C. virginica* (diploid) and *C. ariakensis* (triploid).

1. **Combine the equations above.**
2. **Specify the percentage of each species to be used.**

Output data for cleaning the Bay in 1, 0.5, and 0.25 years are given in Figures 7, 8, and 9, respectively. As an example, Figure 7 shows that to clean the Bay in 1 year requires 681,829 kilograms of *C. virginica* or 1,124,115 kilograms of *C. ariakensis* (triploid).

Figure 7.



ADDITIONAL CALCULATIONS AND CONCLUSIONS

As shown in Table 5, the number of bushels of *C. virginica* needed to clean the Bay in one year is 24,703. According to the General Assembly of Virginia (2002) about 20,000 bushels of *C. virginica* were harvested in Virginia in 2001. Comparing these quantities suggests that at the present rate of harvesting, *C. virginica* is not likely to significantly improve its health or increase its population.

Figure 8.

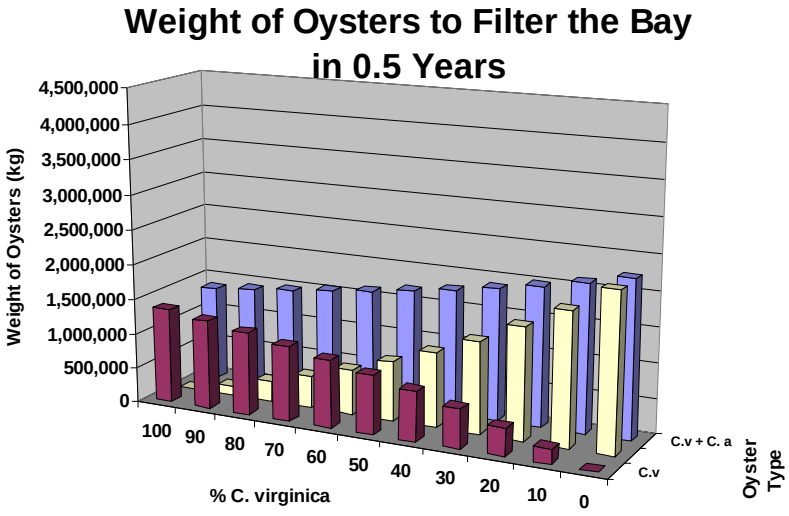
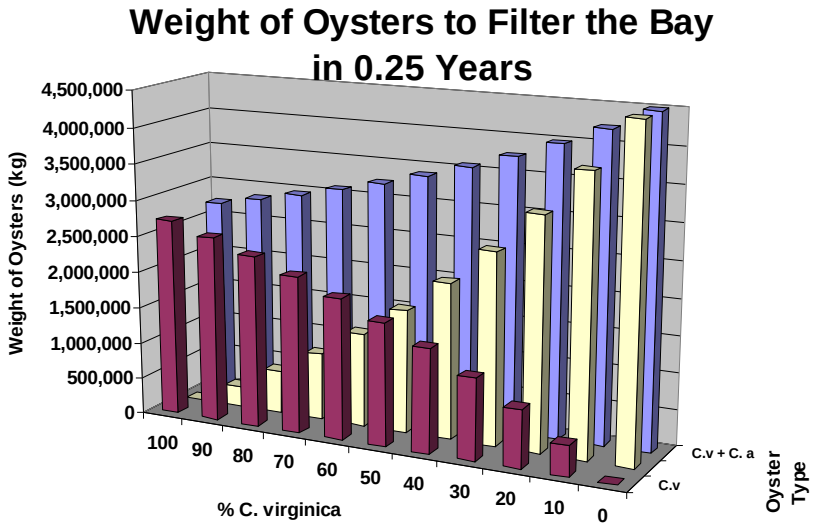


Figure 9.



As shown in Table 6, the ecological risk of growing sterile, triploid *C. ariakensis* in controlled aquaculture for one year is low. The cost-to-benefit analysis shows a monetary return on investment of 54%, with the most important benefits (e.g., improving water quality in the Bay) being non-quantifiable.

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Table 5.
Bushels of *C. virginica* to Clean the Chesapeake Bay in One Year Versus the Bushels of *C. virginica* Harvested

Estimated Number: 600 mature oysters/bushel
From experimental data: Average wet weight of *C. virginica (C. v)* = 46 g
600 oysters * 46 g/oyster * 1 kg/1000 g = 27.6 kg/ bushel
From the model output data: 681,829 kg of *C. v* are needed to clean the Chesapeake Bay in one year or 681,829 kg * 1 bushel/27.6 kg = 24,703 bushels
From Virginia General Assembly House Joint Resolution No. 164: 20,000 bushels of oysters were harvested in Virginia in 2001.
Conclusion: With the present harvesting rate, it is unlikely that *C. v* can recover its health and increase its population.

Table 6.
Use of *C. ariakensis* in Aquaculture

Ecological Risk Assessment: Low, given *C. ariakensis (C. a)* are sterile, confined in bags secured in trays, and harvested after one year.
Estimated Costs
Bushels of *C. a* needed to clean the Chesapeake Bay in one year:
Estimated number: 600 mature oysters/bushel
From experimental data: Average weight of *C. a* = 23 g
600 oysters/bushel * 23 g/oyster * 1kg/1000g = 13.8 kg/bushel
From model output data: 1,124,115 kg of *C. a* needed to clean the Chesapeake Bay in one year or 1,124,115 kg * 1 bushel/13.8 kg = 81,458 bushels
or 81,458 bushels * 600 oysters/bushel = 48,874,800 oysters

Triploid spat	**$30/1000 oysters * 48,874,800 oysters =**	**$1,466,244**
Trays	**$10/tray * 1 tray/1000 oysters * 48,874,800 oysters =**	**$488,748**
Bags	**$5/bag * 2 bags/1000 oysters * 48,874,800 oysters =**	**$488,748**
Labor	**$10/hr * 8 hrs/1000 oysters * 48,874,800 oysters =**	**$3,909.984**
Total		**$6,353,724**

Estimated Return
Estimated revenue: $10/pint of shucked oysters
Estimated number: 50 oysters/pint

$10/pint * 1 pint/50 oysters * 48,874,800 oysters =	**$9,774,960**
$9,774,960 - $6,353,724 =	**$3,421,236**
Return on Investment: $3,421,236/$6,353,724 x 100 =	**54%**

These calculations suggest that aquaculture of sterile *C. ariakensis* would hasten the clean-up of the Chesapeake Bay, help save *C. virginica* as a species, provide oysters for commerce, and improve quality of life for citizens who use the Bay. If these results are supported by replication, *C. ariakensis* may present a win-win solution to the urgent problem of the Chesapeake Bay. The use of C. ariakensis as a bioremediator of polluted estuaries worldwide may also prove beneficial.

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SUMMARY

Water quality in the Chesapeake Bay, the largest estuary of the United States, is severely impaired. Chief pollutants are nutrients, silt, metals, and pathogens. Poor water quality affects health of fish and shellfish and diminishes recreational use of the Bay. A major reason for the problem is the drastic decline in the population of the native oyster, *Crassostrea virginica*, a keystone species and natural water purifier. To meet national environmental goals for clean water, interest has turned to non-native oysters, especially the Suminoe oyster, *Crassostrea ariakensis,* for bioremediation. This study demonstrates how the Chesapeake Bay could be cleaned using the native oyster growing in the natural environment and sterile *Crassostrea ariakensis*, growing in controlled aquaculture. Using experimentally determined water clearance rates and food assimilation efficiencies for the two species, a computer model was developed to calculate weights and percentages of each species needed to clean the Bay in any specified time. The model output was used to show that with the present rate of harvesting *C. virginica*, the native oyster will not likely recover its health or increase its population. A cost-to-benefit analysis and risk assessment suggested that use of *C. ariakensis* may present a win-win solution to the problems of the Chesapeake Bay.