Proposal Title: PREDICTING OYSTER LEASE REINVESTMENT

Principal Investigator: John Supan, Ph.D.
Office of Sea Grant Development
Louisiana State University
Baton Rouge, LA 70803

Introduction

The reconciliation of oyster leasing with coastal restoration activities requires accurate data to establish fair and equitable estimates of lease value. A critical parameter necessary for determining lease value is the estimation of an oyster leaseholder's reinvestment that occurs during oyster farming operations.

Reinvestment is defined as the volume and characteristics of oyster dredge material returned to an oyster lease during or after the harvest of oysters for market. In Louisiana, oysters are typically harvested from leases using oyster dredges. The associated cultch material and seed oysters are returned to a lease for future capture of spatfall and/or growth. This procedure is one hallmark of good oyster farming practice that adds value to an oyster lease and helps maintain future profitability of oyster farming operations.

The goal of this project is to estimate the reinvestment of oyster farmers during normal harvesting of oyster leases for market. This analysis will greatly assist in the accurate estimate of fair market value of oyster leases in Louisiana.

Objectives:

(1) To measure: (a) the total volume and characteristics of oyster seed and cultch returned to an oyster lease; (b) the total volume of market-size oysters harvested from that lease; and, (c) dredge harvest time during a survey of five, separate, daily, oyster lease operations.

(2) To develop a prediction statistic of reinvestment per daily oyster harvest of oyster lease operations.

Methodology

Five oyster vessels working different oyster leases were boarded during February 2004 for daily surveys of oyster reinvestment. The sampled locations:lease numbers (and relative locations) were: Bay Courant:Lease # 292503 (west of Bayou Lafourche), Bayou Cholas:Lease #34525, Bay Black Shell:Lease #2835903, and Barataria Bay/Manila Village:Lease #2683798 (in the Barataria Cumulative Impact area), and Lake of Second Trees:Lease #33476 (east of the Mississippi River-west of the MRGO). Total volumes of harvested oysters and returned oyster seed/cultch were quantified using a metal basket representing a Louisiana sack measure (defined in Louisiana Revised Statute 56:440). Due to possible differences in volume measurement by individual oyster harvesting operations, the same metal baskets were used during all vessel surveys. As harvest proceeded, the following parameters were measured:

- Daily volume of harvested market-size oysters
- Daily volume of oyster seed and cultch material returned to the lease
- Three samples (five-gallon bucket) collected after 1, 2, and 3 dredging hours for later characterization of oyster seed (size classification) & cultch returned to the lease
- Daily dredging time

The harvest parameters and samples were taken real time from starboard and port dredges. Hand tally counters were used to keep record of volumes (sacks) harvested and reinvested. Reinvestment of oyster seed/cultch returned back to the lease occurred as per vessel operations: (a) either during harvest, when the appropriate dredge was retrieved, or (b) at another location on the lease at the end of harvest.

The samples were randomly taken from either dredge and taken to LSU for subsequent analyses. Each sample was washed free of mud and separated into three categories: Shell, oyster clusters (multiple oysters) with associated shell, and single oysters. Volume measurements (ml) of each category were determined using water displacement: the percent volume was determined by the formula: ml [per category]/∑ ml [all categories] x 100. The shell heights of all oysters per category were measured (mm) with a Vernier caliper.

Results

See Data Appendix

Data analyses

Harvest data

A plot of the harvested data indicated a possible linear relationship, with the Bay Courant data as a possible outlier. A simple linear regression was performed on sacks reinvested on sacks harvested in and attempt to develop a predictive model. The resulting regression model "A" had a poor fit (r^2=0.47) and precision (wide confidence intervals). When the Bay Courant outlier was removed from the data set, the "B" model fit ideally (r^2=0.97) with greater precision, providing a possibly accurate predictive model.

The harvest ratio (sacks reinvested:sacks harvested) resulting from the five sampled leases ranged from 1.8:1 to 3.8:1, with a mean of 2.7± 0.87. In this case, the removal of the Bay Courant data did not improve precision (standard error increased from 0.39 to 0.44) and made very little change in the mean ratio (0.2).

Sample data

Analyses of the harvest samples gave a telling characterization of how variable oyster reefs can be. The data analyses of the three replicate samples show high variability. Rarely did oyster size (mm) fit the test for normality, requiring a nonparametric analysis (Kruskal-Wallis test). The mean oyster size varied significantly ($P<0.05$) among three (Bayou Cholas, Bay Black Shell, Manila Village) of the five sampled reinvestments. This is likely due to sample size: larger numbers of oysters were in the Bay Courant and Lake of Second Trees samples. The size frequencies show a general domination by 25-50 mm oysters, a potential crop for next year. The percent volumes by category show the variability among leases. All but the Manila Village samples somewhat show an expected general trend: increasing percentage of shell and decreasing numbers of oysters after 1-2 hours of dredging.

Discussion

The mean ratio (2.7± 0.87) is the better predictor of sacks reinvested per sacks harvested over the linear regression model "B", since all data is included in the estimate. Regression "B" had an excellent fit (r^2=0.97), but the regression line did not intercept the origin (X & Y=0). It is not likely for dredging to harvest small numbers of sacks and not also contain additional volumes of oyster seed and cultch.

The outlying Bay Courant data in the harvest data plot may be in some way market driven. The Bay Courant effort was the only vessel of the five that were making sacks for shucking, while the other four vessels were being more selective for half-shell oysters.

Conclusions

Based on the five sampled leases and harvest operations, the mean ratio of 2.7± 0.87 may be used to predict the number of sacks reinvested per sacks harvested. Due to variability from lease location and the resulting natural oyster production, vessel and gear size, harvesting procedures and market conditions, this predictor may change with increased sampling.

All five locations had high natural oyster productivity and were fine examples of Louisiana oyster farms. During downward trends in wild seed production from the public seed grounds east of the Mississippi River, as currently exists, these naturally productive leases are critical to oyster farming operations and should be held in high regard during the assessment of fair market value. Yet, there are different kinds of leases in different environments to produce different kinds of oysters to address different market conditions.

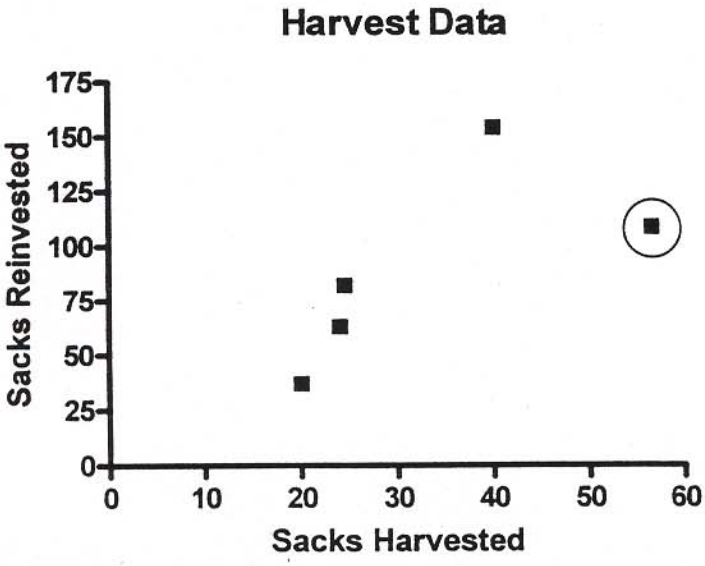
Acknowledgements

This study was conducted with the cooperation of Captains Tracy Collins, Jules Melancon, Peter Vujnovich, Jr., Ralph Pausina, Sam and Anthony Slavich, and the crews of the M/V Capt. Wilbert, Miss Melanie, and the Capt. Pete. Appreciation is extended to Ms. Carolyn Kass Falgout for donating the two Louisiana sack measures (baskets) used for this study. Funding was provided by the Louisiana Oyster Task Force and the Louisiana Department of Natural Resources.

DATA APPENDIX

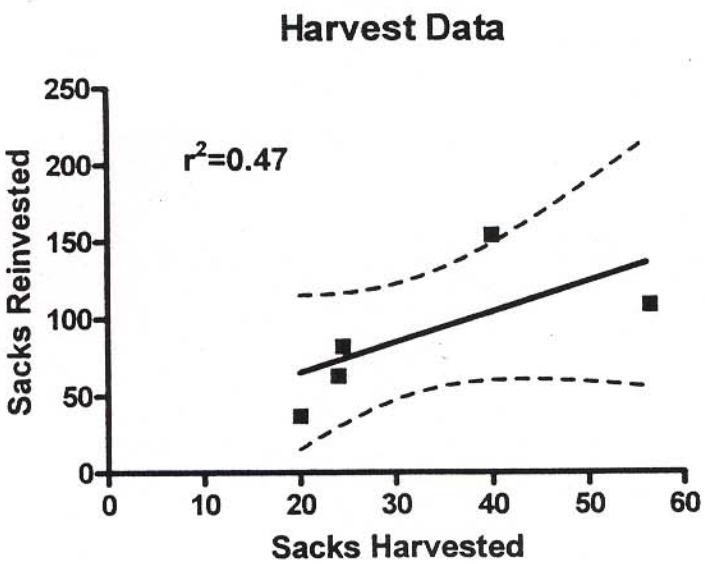
HARVEST DATA ANALYSIS

Plot of harvest data. Bay Courant data identified as outlier (circled).

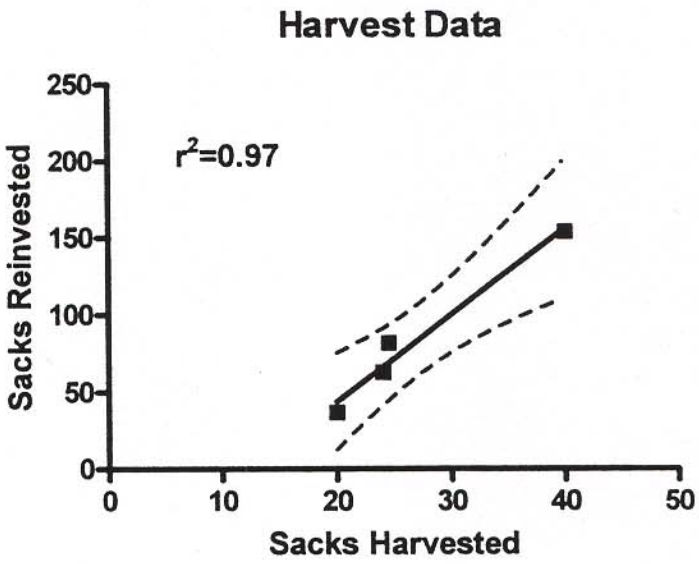


Simple linear regression of sacks reinvested on sacks harvested with 95% confidence bands. A=With Bay Courant data. B=without Bay Courant data.

A



B



Harvest ratio statistics. A=Without Bay Courant data. B=With Bay Courant data.

	A	B
Number of values	4	5
Minimum	1.8	1.8
Maximum	3.8	3.8
Mean	2.9	2.7
Std. Deviation	0.87	0.87
Std. Error	0.44	0.39
Lower 95% CI of mean	1.5	1.7
Upper 95% CI of mean	4.3	3.8
Sum	11.7	13.6

BAY COURANT: LEASE #292503

Harvest Data

Dredge time (hrs)	5
Sacks harvested	56.5
Sacks reinvested	108.5
Ratio	1.9:1

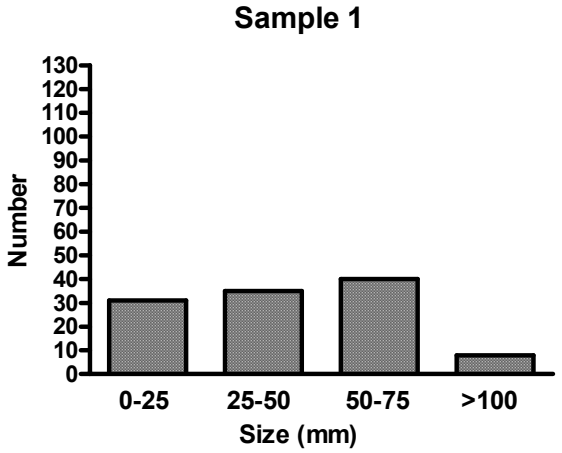
Statistics

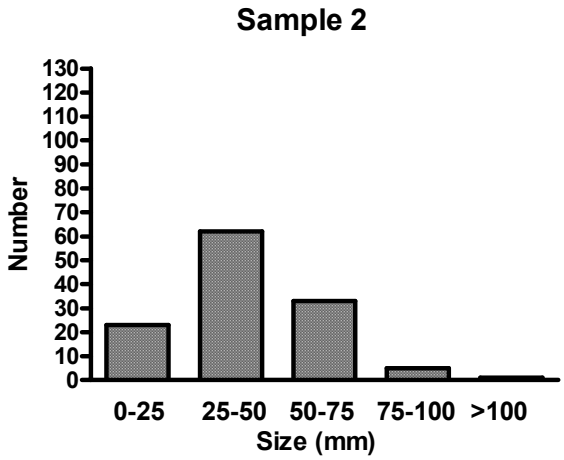
	Samples		
	1	2	3
Number of oysters	114	124	91
Minimum (mm)	6.5	11.9	8.7
Maximum (mm)	92.3	107.7	441.7
Mean (mm)	43.7	41.6	48.1
Std. Deviation (mm)	21.2	18.2	45.7
Std. Error	1.99	1.64	4.79
Lower 95% CI of mean	39.8	38.6	38.6
Upper 95% CI of mean	47.7	44.9	57.6
KS normality test			
KS distance	0.1021	0.08652	0.2432
P value	0.0053	0.0235	P<0.0001
Passed normality test (alpha=0.05)?	No	No	No
P value summary	**	*	***

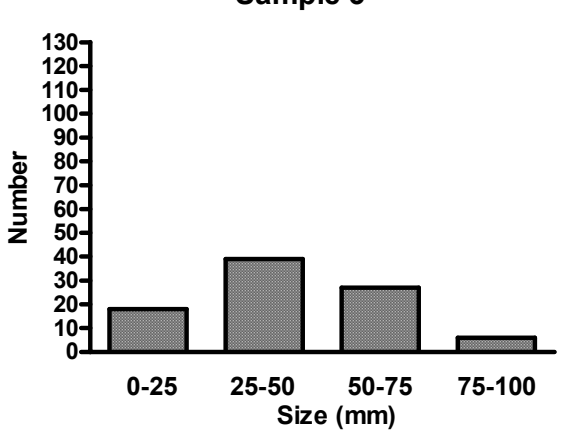
Kruskal-Wallis test

P value	0.5515
Exact or approximate P value?	Gaussian Approximation
P value summary	ns
Do the medians vary signif. (P < 0.05)	No
Number of groups	3
Kruskal-Wallis statistic	1.19

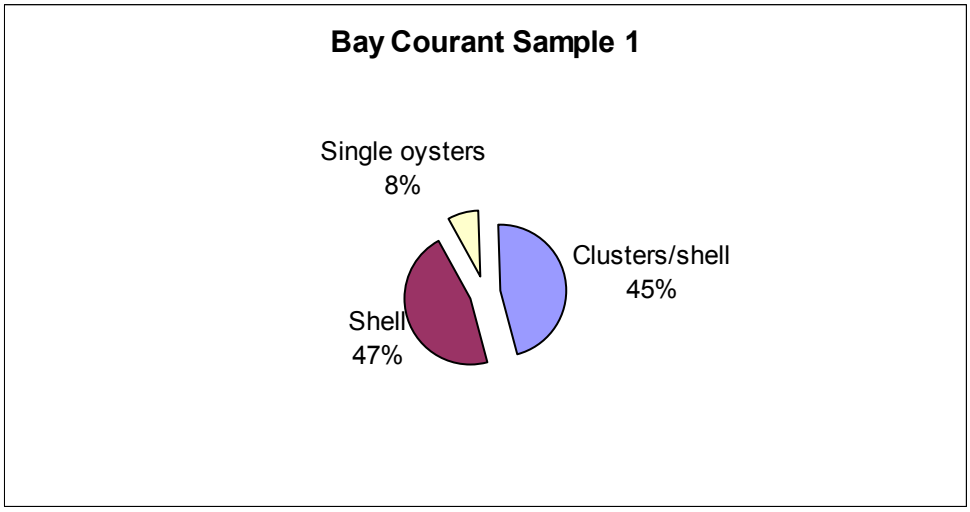
Bay Courant Size Frequencies

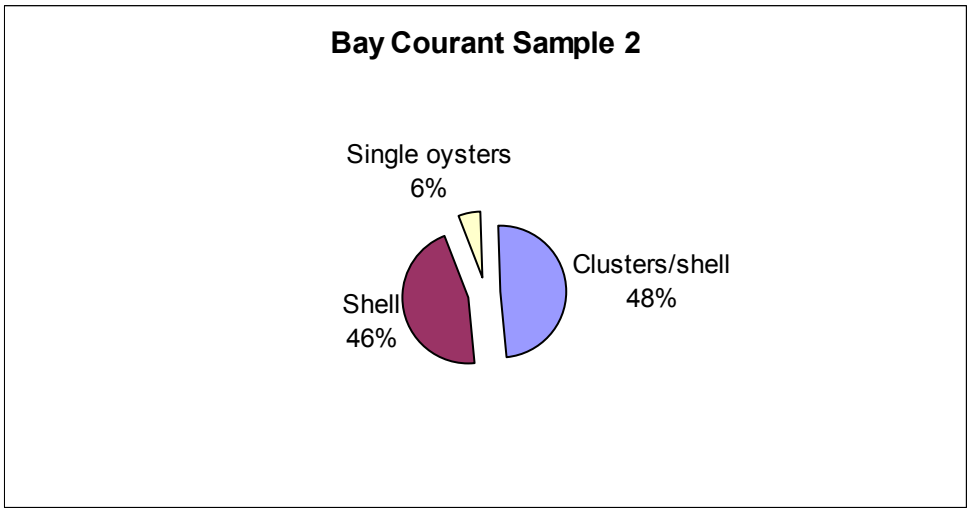


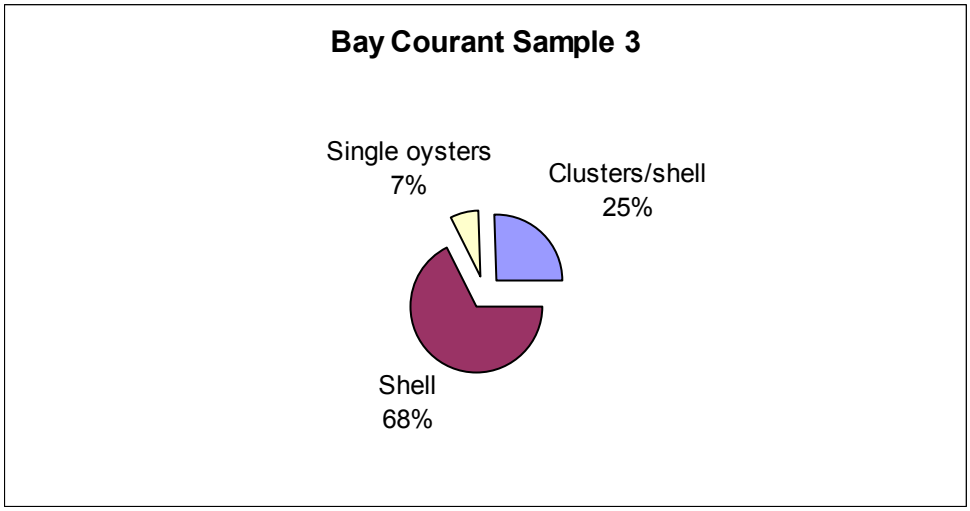




BAY COURANT: LEASE #292503







BAYOU CHOLAS: LEASE #34525

Harvest Data

Dredge time (hrs)	5
Sacks harvested	24.5
Sacks reinvested	82
Ratio	3.3:1

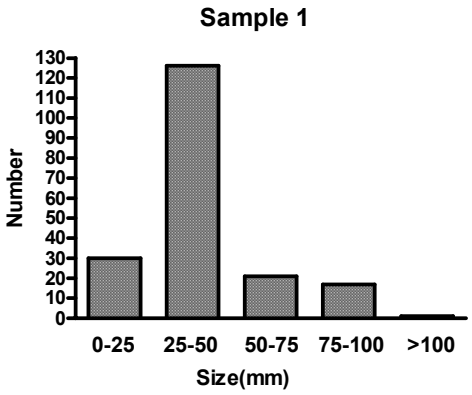
Statistics

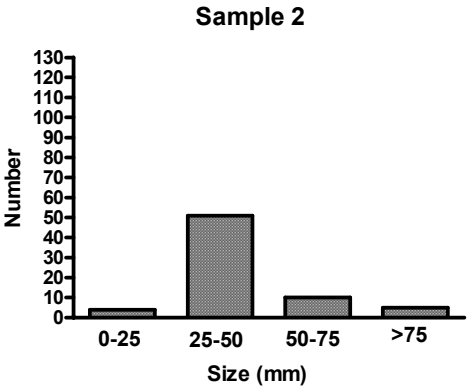
	Samples		
	1	2	3
Number of oysters	195	70	120
Minimum (mm)	6.40	14.2	5.40
Maximum (mm)	108	87.7	101
Mean (mm)	40.6	42.3	50.7
Std. Deviation (mm)	19.1	14.8	19.7
Std. Error	1.37	1.77	1.79
Lower 95% CI of mean	38.0	38.7	47.1
Upper 95% CI of mean	43.3	45.8	54.3
KS normality test			
KS distance	0.167	0.161	0.119
P value	P<0.0001	0.0001	0.0003
Passed normality test (alpha=0.05)?	No	No	No
P value summary	***	***	***

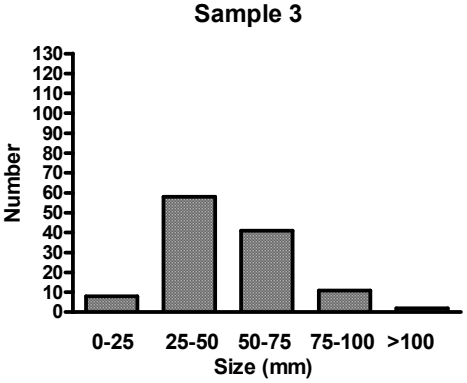
Kruskal-Wallis test

P value	P<0.0001
Exact or approximate P value?	Gaussian Approximation
P value summary	***
Do the medians vary signif. (P < 0.05)	Yes
Number of groups	3
Kruskal-Wallis statistic	25.9

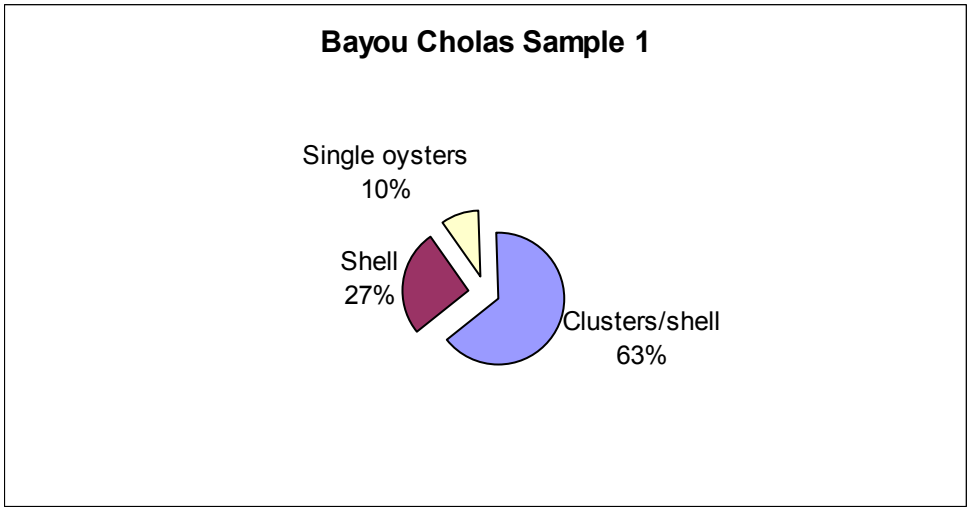
Bayou Cholas Size Frequencies

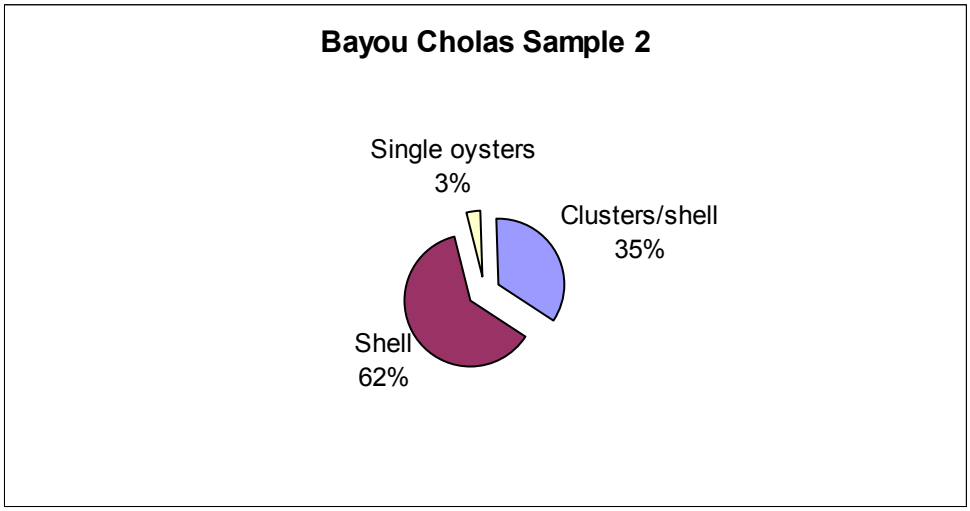


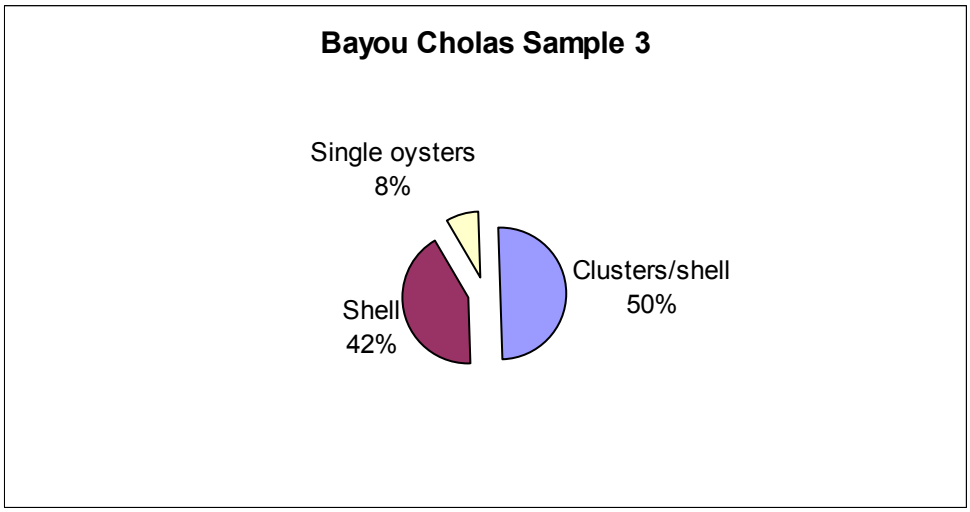




BAYOU CHOLAS: LEASE #34525







BAY BLACK SHELL: LEASE #2835903

Harvest Data

Dredge time (hrs)	4
Sacks harvested	24
Sacks reinvested	63
Ratio	2.6:1

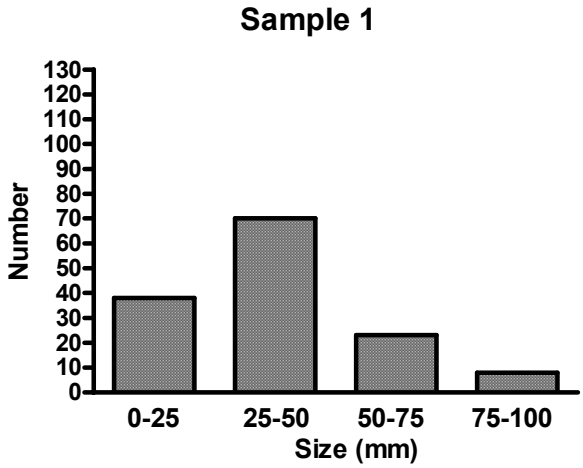
Statistics

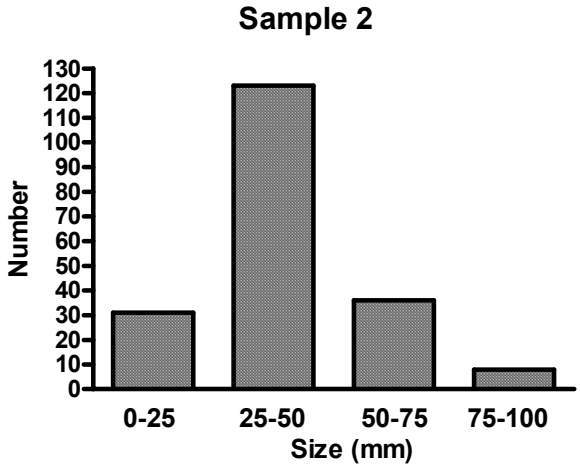
	Samples		
	1	2	3
Number of oysters	139	198	84
Minimum (mm)	6.9	12.8	18.1
Maximum (mm)	92.0	99.6	98.6
Mean (mm)	37.5	39.8	46.0
Std. Deviation (mm)	18.5	15.3	17.1
Std. Error	1.57	1.09	1.86
Lower 95% CI of mean	34.4	37.7	42.3
Upper 95% CI of mean	40.6	42.0	49.7
KS normality test			
KS distance	0.110	0.0955	0.141
P value	0.0003	0.0002	0.0003
Passed normality test (alpha=0.05)?	No	No	No
P value summary	***	***	***

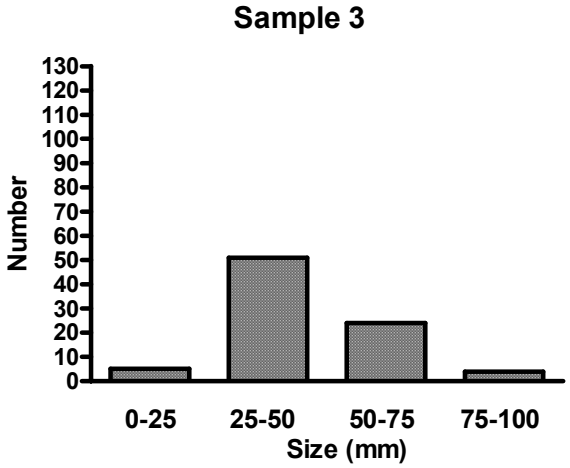
Kruskal-Wallis test

P value	0.0003
Exact or approximate P value?	Gaussian Approximation
P value summary	***
Do the medians vary signif. (P < 0.05)	yes
Number of groups	3
Kruskal-Wallis statistic	16.5

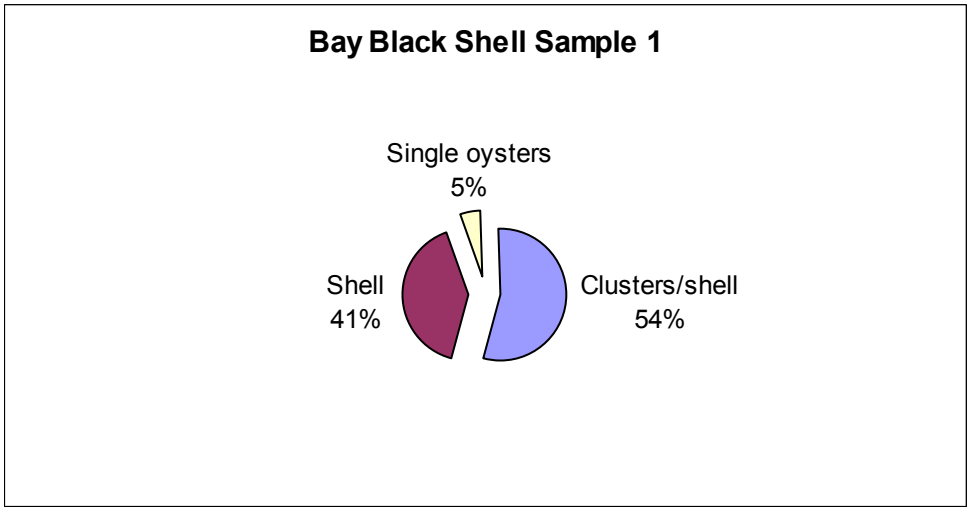
Bay Black Shell Size Frequencies

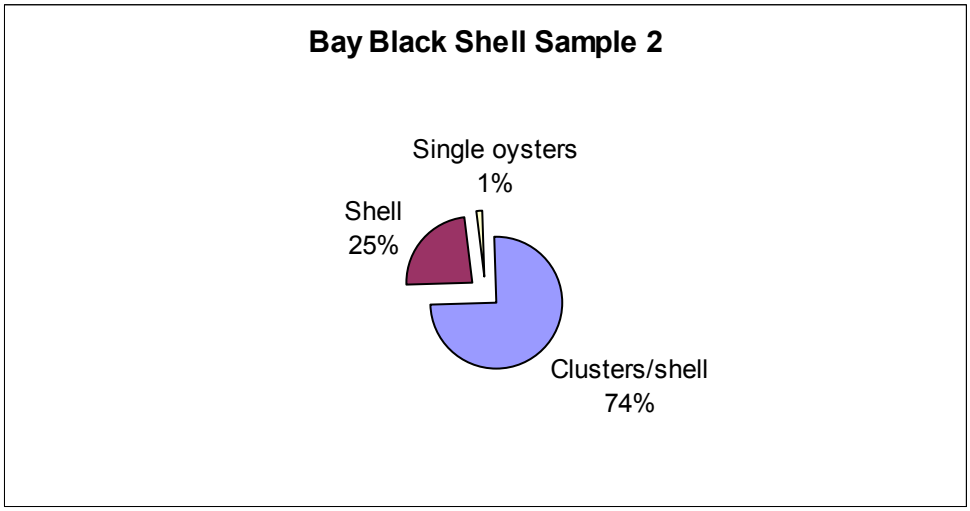


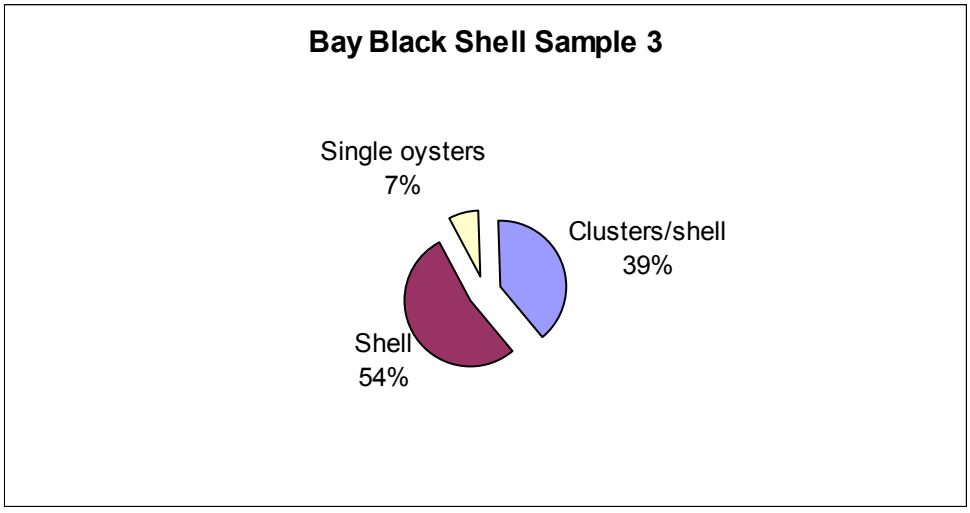




BAY BLACK SHELL: LEASE #2835903







MANILA VILLAGE: LEASE #2683798

Harvest Data

Dredge time (hrs)	7
Sacks harvested	20
Sacks reinvested	37
Ratio	1.85:1

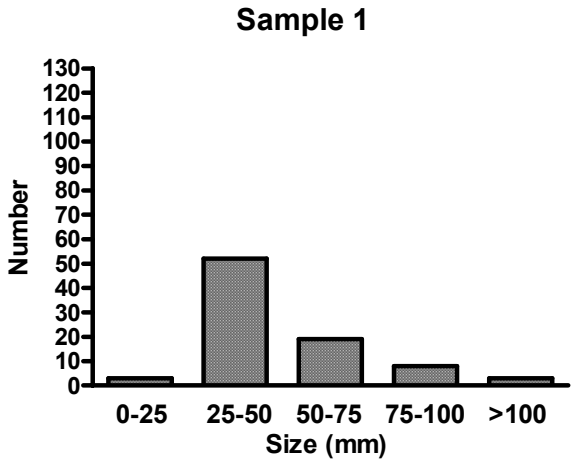
Statistics

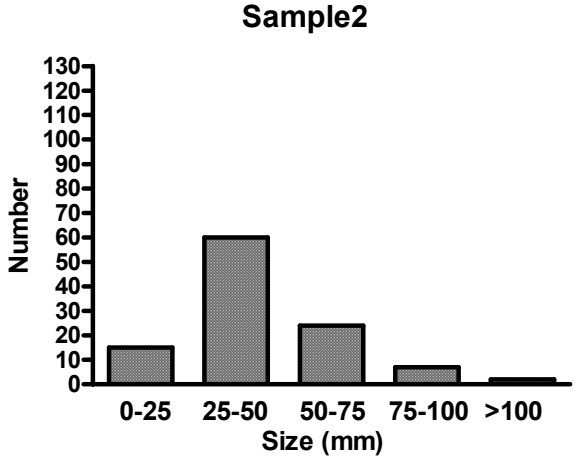
	Samples		
	1	2	3
Number of oysters	85	108	87
Minimum (mm)	10	14.4	14.1
Maximum (mm)	122	121	101
Mean (mm)	48.2	43.9	51.8
Std. Deviation (mm)	20.4	20.3	19.2
Std. Error	2.21	1.95	2.06
Lower 95% CI of mean	43.8	40.0	47.7
Upper 95% CI of mean	52.6	47.7	55.9
KS normality test			
KS distance	0.145	0.131	0.128
P value	0.0001	P<0.0001	0.0013
Passed normality test (alpha=0.05)?	No	No	No
P value summary	***	***	**

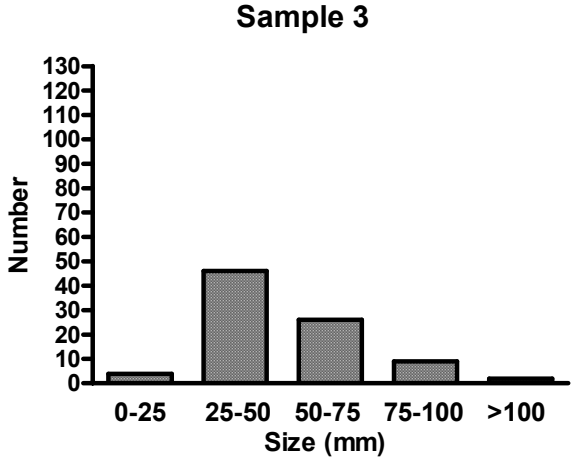
Kruskal-Wallis test

P value	0.0035
Exact or approximate P value?	Gaussian Approximation
P value summary	**
Do the medians vary signif. (P < 0.05)	yes
Number of groups	3
Kruskal-Wallis statistic	11.3

Manila Village Size Frequencies

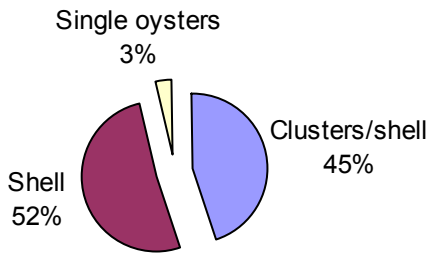




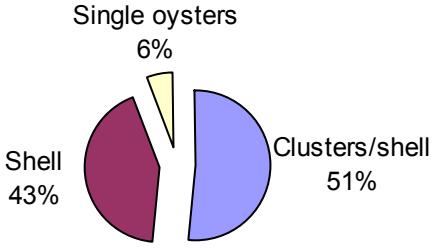


MANILA VILLAGE: LEASE #2683798

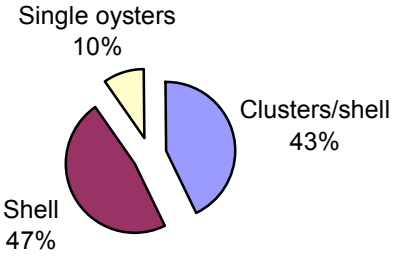
Manila Village Sample 1



Manila Village Sample 2



Manila Village Sample 3



LAKE OF SECOND TREES: LEASE #33476

Harvest Data

Dredge time (hrs)	7
Sacks harvested	40
Sacks reinvested	154
Ratio	3.8:1

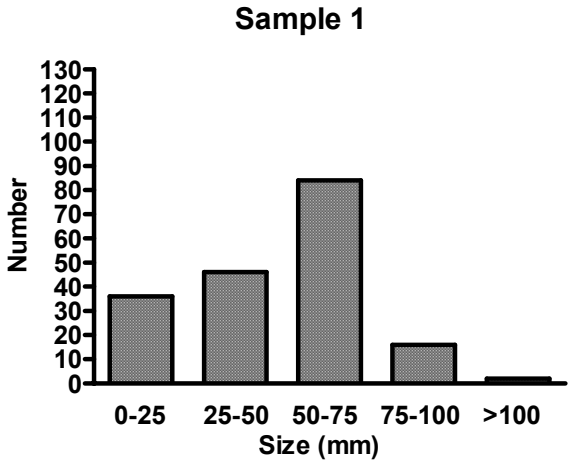
Statistics

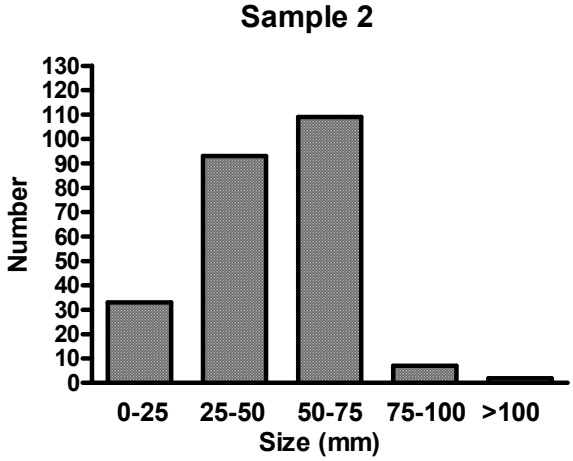
	Samples		
	1	2	3
Number of oysters	184	244	127
Minimum (mm)	8.1	6.5	7.3
Maximum (mm)	108	123	138
Mean (mm)	48.8	47.8	49.6
Std. Deviation (mm)	21.9	17.8	21.2
Std. Error	1.61	1.14	1.88
Lower 95% CI of mean	45.6	45.6	45.9
Upper 95% CI of mean	52.0	50.1	53.4
KS normality test			
KS distance	0.0994	0.0521	0.0600
P value	0.0001	P > 0.10	P > 0.10
Passed normality test (alpha=0.05)?	No	Yes	Yes
P value summary	***	ns	ns

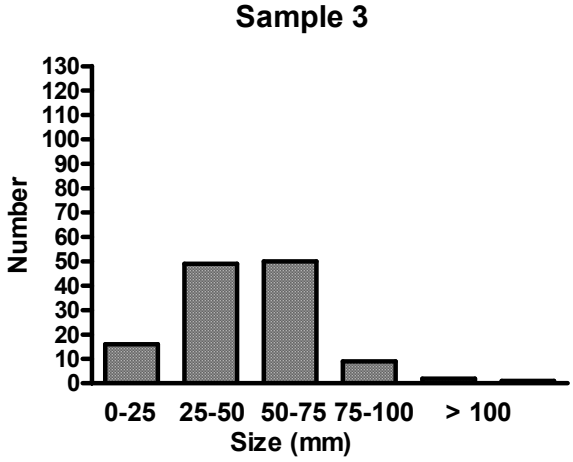
Kruskal-Wallis test

P value	0.6419
Exact or approximate P value?	Gaussian Approximation
P value summary	ns
Do the medians vary signif. (P < 0.05)	No
Number of groups	3
Kruskal-Wallis statistic	0.887

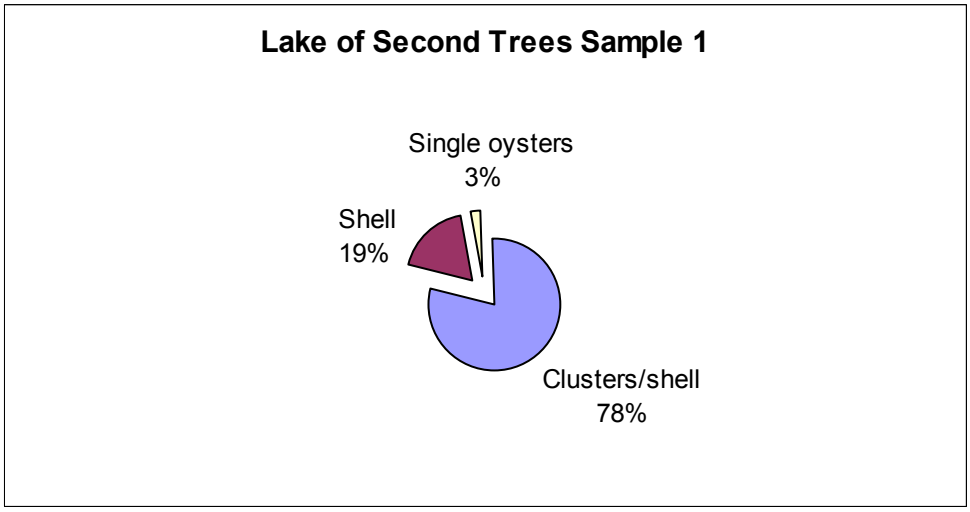
Lake of Second Trees Size Frequencies

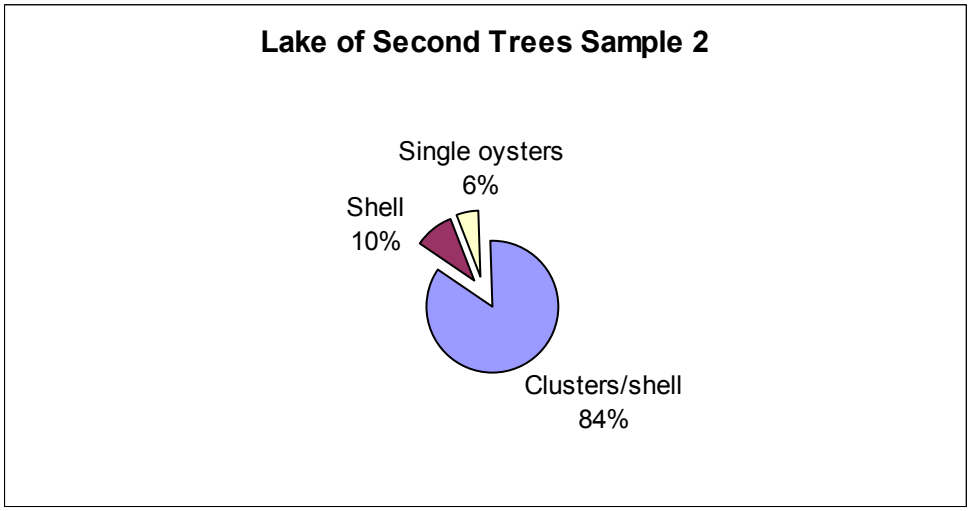


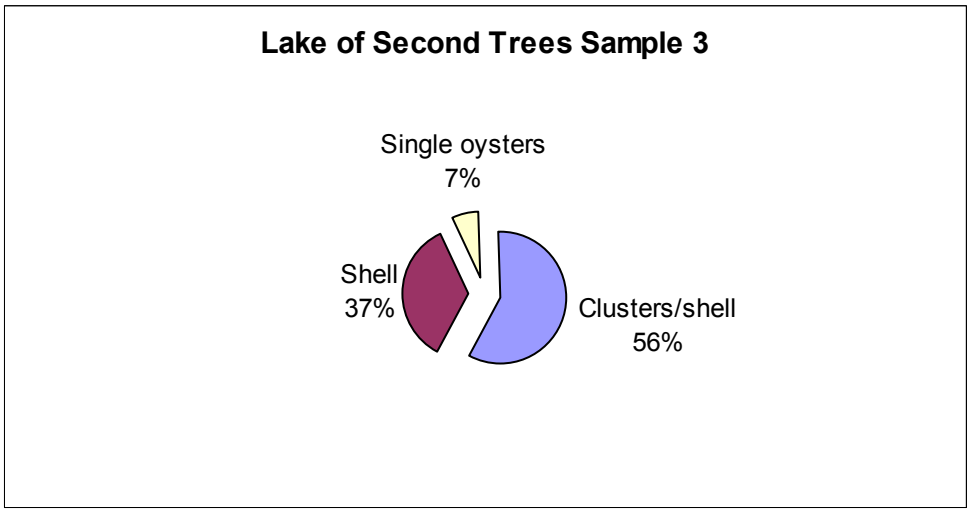




LAKE OF SECOND TREES: LEASE #33476







Five Reinvestment Sampling Leases

LDWF Oyster Leases
Leases of Interest

N

5 0 5 Miles

5 0 5 Kilometers

Data Source:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Coastal Restoration Field Station
Baton Rouge, LA
Source of Oyster Information:
Louisiana Department of Wildlife & Fisheries
Oyster Survey Section, New Orleans, LA
Data are current as of November 2003

Image Source:
2002 Thematic Mapper Imagery
Map Date: February 20, 2004
Map ID: USGS-NWRC 2004-11-0201