

Evaluation of grow-out gear on Eastern Oysters (*Crassostrea virginica*) in Georgia



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Table of Contents

Table of Tables	4
Abstract.....	5
Introduction.....	6
Study Sites	9
Skidaway River.....	10
Halfmoon/Wassaw Sound.....	10
Permits	11
Methods.....	12
Grow out	12
Survival.....	13
Condition Index	13
Results.....	14
Floating cages	14
Growth and appearance.....	14
Survival.....	19
Condition.....	21
Bottom cages.....	23
Growth and appearance.....	23
Survival.....	25
Condition.....	26
Floating and bottom cage comparison	27
Growth	27
Survival.....	29
Condition.....	30
Outreach.....	32
Grower meetings.....	32
Oyster Roast for a Reason.....	33
Oyster South.....	33
Landlocked and Symposium.....	33

Discussion.....	34
Growth	34
Survival.....	35
Condition.....	36
Management Implications.....	37
Literature Cited.....	38
Appendices.....	41
Appendix I – Permit application.....	41
Appendix II – Grower presentation	84
Appendix III - Gear observations	89
Floating Gear	89
Bottom Gear.....	90

Table of Figures

Figure 1. Location of Chatham County, GA (in red), and sample locations in the Skidaway River and Halfmoon River.....	9
Figure 2. Image of floating cages in the Skidaway River (left) and Halfmoon River (right).....	9
Figure 3. Growth (SH) of diploid and triploid oysters in floating cages in Halfmoon (Wassaw Sound) and Skidaway River, Chatham County, GA.....	15
Figure 4. Mean shell length (mm) of diploid and triploid oysters in floating cages at the Moon River and Skidaway River, Chatham County, GA.	16
Figure 5. Mean shell length (mm) of diploid and triploid oysters in floating cages at the Moon River and Skidaway River, Chatham County, GA.	16
Figure 6. Mean shell width (SW) of diploid and triploid oysters in floating cages at the Moon River and Skidaway River, Chatham County, GA.	17
Figure 7. Appearance of diploid oysters grown in floating cages in the Skidaway River (left) and Halfmoon (right), Chatham County, GA.	19
Figure 8. Appearance of triploid oysters grown in floating cages in the Skidaway River (left) and Halfmoon (right), Chatham County, GA.	19
Figure 9. Cumulative survival of diploid and triploid oyster in floating gear in the Skidaway River and Halfmoon River from May 2019 – February 2020, Chatham County, GA.	21
Figure 10. Condition of oyster meat in diploid oysters grown in floating cages in the Skidaway River (left) and Halfmoon (right), Chatham County, GA.	22
Figure 11. Condition of oyster meat in triploid oysters grown in floating cages in the Skidaway River (left) and Halfmoon (right), Chatham County, GA.	22
Figure 12. Condition index of diploid and triploid oysters in February 2020 from floating gear in the Skidaway River and Halfmoon River, Chatham County, GA.	23
Figure 13. Condition index of diploid and triploid oysters grown in bottom cages in the Skidaway River, Chatham County, GA.....	26
Figure 14. Appearance of triploid (left) and diploid (right) oysters grown in bottom cages in the Skidaway River, Chatham County, GA.....	27
Figure 15. Mean shell height diploid and triploid oysters grown in bottom and floating cages in the Skidaway River, Chatham County, GA.	28
Figure 16. Shell appearance and meat condition of triploid and diploid oysters from bottom cages in the Skidaway River, Chatham County, GA.....	31
Figure 17. Shell appearance and meat condition of triploid and diploid oysters from floating cages in the Skidaway River, Chatham County, GA.....	31

Table of Tables

Table 1. ANOVA results for shell height (SH), shell length (SL), and shell width (SW) by location, ploidy, and location*ploidy.	17
Table 2. Mean shell height (SH), shell length (SL), shell width (SW), fan ratio and cup ratio of diploid and triploid oysters in floating gear at the Skidaway River and Halfmoon River site, Chatham County, GA.....	18
Table 3. Monthly and cumulative survival of diploid and triploid oyster in floating gear in the Skidaway River and Halfmoon River, Chatham County, GA.	20
Table 4. Mean wet weight (g), wet shell weight (g), dry shell weight (g), wet tissue weight (g) and dry tissue weight (g) for diploid and triploid oyster in floating gear in the Skidaway River and Halfmoon River, Chatham County, GA.....	23
Table 5. Mean shell height, shell length, shell width, fan ratio and cup ratio for diploid and triploid oysters grown in sub-tidal bottom gear in the Skidaway River, Chatham County, GA.	24
Table 6. Monthly survival and cumulative survival of diploid and triploid oysters grown in sub-tidal bottom cages in the Skidaway River, Chatham County, GA.....	25
Table 7. Mean wet weight (g), shell weight (g), dry shell weight (g), wet tissue (g) and dry tissue (g) for diploid and triploid oysters grown in bottom cages in the Skidaway River, Chatham County, GA.....	26
Table 8. Mean shell height (mm) and standard error of diploid and triploid oysters grown in bottom and floating cages in the Skidaway River, Chatham County, GA.....	28
Table 9. ANOVA results for shell height by ploidy, cage location, and ploidy*cage for oysters grown in the Skidaway River, Chatham County, GA.....	28
Table 10. Tukeys multiple comparison results for shell height of oysters by ploidy and gear location in the Skidaway River, Chatham County, GA.	28
Table 11. Mean shell Length (SL) and standard error of diploid and triploid oysters grown in bottom and floating cages in the Skidaway River, Chatham County, GA.	29
Table 12. ANOVA results for shell length by ploidy, cage location, and ploidy*cage for oysters grown in the Skidaway River, Chatham County, GA.....	29
Table 13. Tukeys multiple comparison results for shell length of oysters by ploidy and gear location in the Skidaway River, Chatham County, GA.	29
Table 14. Monthly and cumulative survival of triploid (3n) and diploid (2n) oysters grown in bottom and floating cages in the Skidaway River, Chatham County, GA.	30

Abstract

From 2018-2020 we conducted an experimental field test of diploid and triploid eastern oysters (*Crassostrea virginica*) grown in floating cages (OysterGro[®]) and bottom cages (Chesapeake Bay Oyster Company) in Chatham County, Georgia. Oysters were deployed in 10 floating cages, five at Halfmoon River (Wassaw Sound) and five in the Skidaway River, and in five bottom cages, in the Skidaway River, in December 2018 with replicated bags in each ploidy assigned to each gear (n=15). Survival, growth and shell dimensions were monitored until February 2020. Condition indices were conducted at conclusion of the study. In terms of growth, triploid oysters significantly outperformed diploid oysters at both locations and within gear treatments. Between gear treatments floating cages outperformed bottom cages. Diploids had greater survival than triploid oysters at each location. Loss of triploid oysters occurred in middle to late summer 2019 when oysters were greater than 50.8 mm, which was not observed to the same extent with diploids. Survival in floating cages was considerably greater than survival in bottom cages which was extremely low. Shell dimensions were similar across ploidy from floating cages, but oyster in Halfmoon tended to have deeper cup than oysters in the Skidaway. Condition was highest in floating gear with diploids from at each site greater than triploids. Condition in bottom cages was greatest in triploids but both ploidies considerably lagged oysters in floating cages. This study illustrates the benefits and disadvantages of growing diploid and triploid oysters in floating, and bottom cages in Georgia. We conclude that oyster farmers would benefit from growing a mix of diploid and triploid oysters in floating cages to help mitigate summer survival, but that the scale survival will depend upon site and husbandry.

Introduction

It is estimated that world population will exceed 9 billion people by the middle of the 21st century and growth in aquaculture production is seen as an important component to meet the growing food demand. Production from aquaculture continues to grow and is projected to exceed capture production by 2030 (FAO 2018). Since 2000, aquaculture production has increased from 32.4 million tons to 80.3 million tons in 2016 while capture production has remained flat over the same period with 93.5 million tons and 90.9 million tons, respectively (FAO 2018). In 2016, the US consumed 16 pounds of seafood per person with the majority of the seafood from imports (NMFS 2018). Of the 16 pounds seafood consumed per person annually 5.8 pounds is estimated to be from shellfish and in 2016 oyster production in the United States was 36.6 million pounds with a value of \$192 million (NMFS 2018).

Along the east coast, the eastern oyster (*Crassostrea virginica*) is the primary oyster utilized in aquaculture and since the early 2000's there has been continued growth and development in eastern oyster aquaculture methods to increase production (Walton et al. 2013). To increase production there have been three areas identified, culture methods, husbandry methods (Mallet et al. 2013) and genetic improvements (Walton et al. 2013) which can be used independently or in combination. In 2017, 16 states along the Atlantic reported oyster landings and Georgia ranked last with only 32,580 pounds of meat harvested with a dock value of \$178,133.

Georgia's oyster industry is built upon wild harvest strategies of clustered oysters, where harvest is conducted "by hand" and is not cost-effective. The oyster industry in Georgia is unequipped to commercially compete in the present-day single oyster market based on existing

wild harvest methodologies and must develop single oyster aquaculture methods to expand and be viable. Previous research on intertidal bag-on-rack/bottom (similar to bottom cages) found that the fouling of oysters with unwanted biological organisms can be controlled by tidal placement (Moroney and Walker 1999), but the method is labor intensive and oysters can die from being covered with sifting sediments (Adams et al. 1994). Georgia's moderate climate, tidal conditions, salt marsh productivity, and abundance of phytoplankton, which allow wild oysters produce an preponderance of spat (baby oysters), Georgia has some of the highest wild oysters spat levels on the east coast with 10,000-20,000 m² (O'Beirn et al. 1996) and as high as 204,000 m² (Thoresen et al. 2005). To survive and grow, spat must attach to sedentary substrate, such as other mature oysters, and in Georgia, oysters provide the only substrate for spat to settle on. Therefore, wild oysters grow clumped together in clusters, which prevent them from developing into a larger size with a deeper cup. Although cluster oysters are perfect for oyster roasts, they cannot compete pricewise with large, deep-cupped, single oysters desired by restaurants and oyster bars, who shuck them and serve them on the half shell either raw or baked. Oysters that qualify for the half-shell market command a higher price (Bliss and Walker, 2012).

By comparison, single oyster aquaculture can be a potential source for jobs in coastal counties, which are economically depressed (GCRDC 2006) and for the Georgia industry to grow, adoption of culture, husbandry, and genetic techniques needs to be evaluated. Floating cages and bottom cages are successful methods for growing oysters since it keeps oysters above sediments. Bottom cages can still sediment up in areas with high sedimentation rates (Moroney and Walker 1999; Comeau et al. 2017) which can decrease survival and feeding efficiency (Comeau et al. 2017). Floating cages avoid sedimentation by being suspended at the surface of water where

phytoplankton are most abundant (Adams et al. 1991, Moroney and Walker 1999, Manley et al. 2009, Walton et al. 2013). The benefits of floating have led to its acceptance in other southeast states and within the last five years floating gear and water column gear has been permitted in North Carolina, South Carolina, Florida, and Alabama and South Carolina has seen a 25% increase in its oyster landings and 14 oyster farms in operation in 2018 (Davis 2016, Davis 2018).

In addition to gear, the use of triploid oysters has been a development that has helped increase oyster production within many areas. Triploid oysters have three sets of chromosomes whereas natural oysters are diploid with two sets of chromosomes. Triploid oysters are essentially sterile and since they do not undergo gametosis more energy is put into somatic tissue growth. This allows triploids to continue to grow at a faster rate during the spawning season when compared to diploid oysters and maintain meat quality (Allen and Downing 1986, Matthiessen and Davis 1992, Degremont et al. 2012). Triploids, do have drawbacks and performance benefits can be lost due environmental conditions such as salinity (Colden and Lipcius 2015) and most recently with increased mortality rates with warming waters in the spring and summer.

Given the paucity of information on oyster growth and survival for hatchery produced seed and industry standard aquaculture gear, this study was undertaken to evaluate the performance of triploid and diploid oysters grown in floating and bottom cages in Georgia to determine their impact upon growth and survival.

Study Sites

Two locations were chosen for this study in Chatham County (Figure 1), the Skidaway River (Figure 2) and the mouth of Halfmoon River (Figure 2). A third site, Groves Creek a tidal creek on the northeast side of Skidaway Island, was also selected but had to be excluded due to permitting conditions.

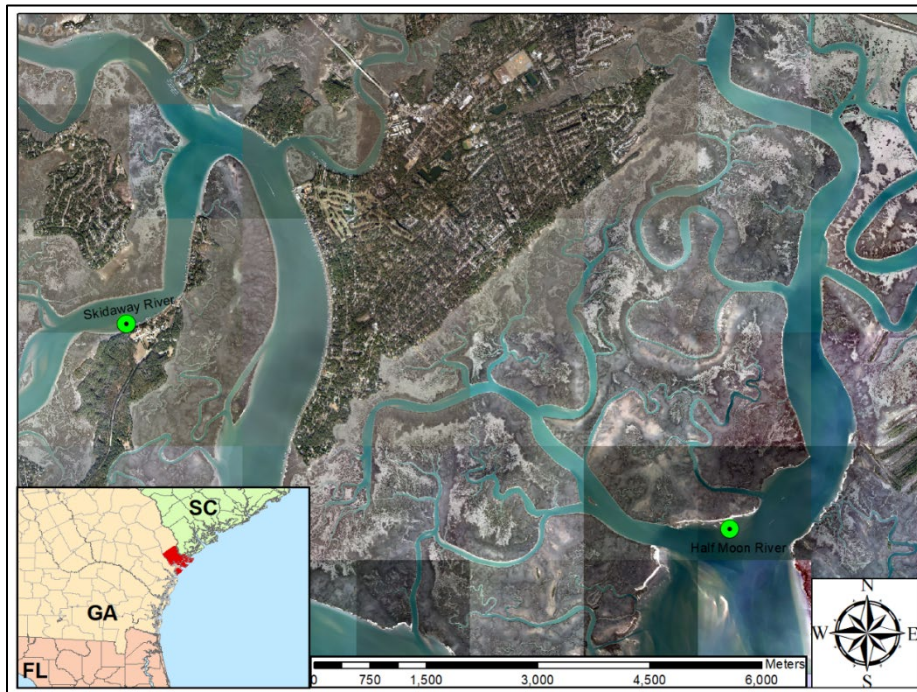


Figure 1. Location of Chatham County, GA (in red), and sample locations in the Skidaway River and Halfmoon River.



Figure 2. Image of floating cages in the Skidaway River (left) and Halfmoon River (right).

Skidaway River

The Skidaway River is 13.5 km long and has a salinity range of 10-34 PSU (Mathews *et al.*, 1980), semidiurnal tides with a tidal range of 2-3 m. The Skidaway River lies west of Skidaway Island within the Ogeechee Coastal watershed and connects the Wilmington River to the Vernon River. Water temperature in the estuary ranges from 8.5°C to 29.9°C with an average temperature of 21°C and depth at the 0.7 meters at mean low water. The Ogeechee Coastal watershed covers 409,929 ha, and the most abundant soils are Bohicket-Capers association, Bayboro loam, Blanden fine sandy loam, Bayboro clay loam, and Ellabelle loamy sand (USDA NRCS, 2006). The area is covered by 23.4% (95,820 ha) evergreen forest, 19.9% (81,630 ha) saltwater wetlands, 15.2% (62,491 ha) forested wetland, and 6.5% (26,514 ha) urban areas. The remaining 10.4% (42,802 ha) is comprised of clear-cut, row crop/pasture, deciduous forest, freshwater wetland, mixed forest, beach/dune/mud, and quarries/strip mines/rock, respectively.

Halfmoon/Wassaw Sound

Halfmoon River is a short tidal river that drains into Wassaw sound that opens directly to the Atlantic Ocean. The site was located in the Georgia Department of Natural Resources inshore artificial reef boundary and is within the approved shellfish growing area. Salinity values are more saline than the Skidaway site and with a range of 20 – 35 ppt and is typically >25 ppt (O’Beirn *et al.* 1995) and a temperature range of 6°C to 31°C with a depth of approximately 0.5 meters at mean low water. It also lies within the Ogeechee Coastal Watershed.

Permits

In 2017, the process on picking sites of experimentation began. Initially we selected three locations in Chatham County to select an area within a sound, a tidal river and a tidal creek to encompass the types of open water growing conditions typically found in the approved waters. We selected three locations; the Halfmoon fish habitat area in Wassaw sound, Skidaway River, and Groves Creek. In January 2018, a permit application was submitted to GA DNR and The Army Corps of Engineers (Appendix I). A site review of the three locations was held on February 15th at the Shellfish Research Lab and Marex/SG boat was used to take DNR and Army Corps of Engineer staff to each of the sites. In May 2018, permission was received from the state for installation of floating cages and bottom cages in the Skidaway River and floating cages in the Wassaw sound and the scientific collection permit for Marine Extension and Georgia Sea Grant was updated to reflect these changes. The Groves creek site was not permitted given reservations by GA DNR and Army Corps staff due to creek width and popularity for fishing. Once permission from the state was granted, the permit process with the Army Corps of Engineers under Nation Wide permit 48 could proceed. In September, permits for placing gear in the Skidaway River (SAS-2018-00244) and in the Halfmoon area in Wassaw Sound (SAS-2018-00245) were granted. With permission granted, final purchase of gear for anchoring and marking of sites was ordered. Full permit application is presented in appendix I.

Methods

Grow out

Oyster broodstock was brought into the hatchery in May 2018 and two spawns were conducted, one was a diploid spawn with Georgia brood stock and one was triploid spawn that was a cross between Louisiana tetraploids and Georgia diploids. Tetraploid germ plasm was used under agreement with 4C's (4Cs Breeding Technologies, Inc.) and underwent required disease testing for importation. Seed produced from both spawns were held at the Shellfish Research Laboratory until December 2018 and was sorted using standard sieves and diploid and triploid seed between 6-14 mm was retained for the study.

To evaluate oyster performance, five floating cages (OysterGro) were deployed in Wassaw and Skidaway River. Five bottom cages (Chesapeake Bay Oyster Company) were only deployed at the Skidaway River site and to compare with floating cages in the Skidaway River. To distribute seed equally into bags, three subsamples of 100 count diploid and 100 count triploid seed were weighed and averaged. Seed were then stocked by weight (g) to approximate a stocking density of 250 oysters per 4 mm vexar bags. Fifteen of the bags per treatment were filled with diploid oysters and the remaining fifteen were filled with triploid oysters. Once seed reached an average of 25.4 mm (1 inch), bags were restocked at a density of 150 oyster/bag

Stocked bags were placed in floating cages in December 2018 and floating cages were flipped every two weeks for 24 hours from December 2018-March 2019 and weekly for 24 hours from April 2019 -October 2019 and then biweekly from November 2019 – February 2020. Bottom cages were pulled up weekly, using an electrical winch and davit. If fouling was heavy a power

washer and/or trash pump was used on the boat to clean cages and bags, as needed. Growth and survival was evaluated on bi-monthly basis for seed. After oysters reached 26mm survival was estimated monthly and growth (SL, SW, SH) was measured bi-monthly. Oyster performance were compared using a one-way ANOVA to determine if ploidy, gear, and location influenced oyster growth. Appearance of oysters was evaluated using the cup ratio (SW/SH) and fan ratio of the oysters.

Survival

Survival was estimated bi-monthly for seed and monthly once oysters reach 26mm by counting the number of live oysters and dead oysters in each bag. Dead oysters were removed and live oysters were re-stocked without replacement. Monthly survival for each treatment was calculated by dividing the number live oysters by the total number (live + dead) oysters. To calculate cumulative survival Kaplan Meier (1958) estimates were used to determine survival over the duration of the study.

Condition Index

To determine oyster condition 15 diploid and triploid oysters from each site and treatment were collected at the end of the study. Oysters were collected, shells cleaned, and placed in the refrigerator up to 48 hours and then processed. Wet oyster weight was measured (in grams) using a Sartorius CP124S scale, if upper limit of the Sartorius was exceeded then a Denver Instrument XE-410D was used. Shell size metrics of each oyster were taken prior to shucking. Oysters were shucked and the soft tissue was placed in an aluminum weigh boat and tissue attached to the shells was scraped into the aluminum weigh boat and the shell was placed in labeled plastic weigh dish.

Soft tissue and shell was then weighed and weight of weight boats was removed to get tissue weight and shell weight. Oyster tissue was then placed in an oven at 80°C for 48 hours and then weighed to get dry tissue weight. Oyster shells were air dried for 48 hours and weighed to get dry shell weight. Condition index was calculated using the formula (Equation 1) derived by Abbe and Albright (2003).

Equation 1. Condition index formula.

$$[(\text{dry tissue weight}) / (\text{whole wet weight} - \text{dry shell weight})] * 100$$

Results

Floating cages

Growth and appearance

Oysters at the Skidaway site grew larger than oysters at the Halfmoon River site. Shell height of Skidaway diploids were 84.9mm and growing an average of 4.9mm/month while SH of triploids averaged 98.3mm with a mean growth rate of 5.9mm/month. Oysters at Halfmoon River grew slower with diploids reaching 69.9mm with a mean growth at 3.5 mm/month while SH of triploids reached 81.6mm and averaged 4.6 mm/month growth rate.

Oysters of each ploidy reached the minimum harvest size of 52 mm (2 inches) between June 2019 and September 2019. All oysters, except diploid oysters at Halfmoon, reached 76.2 mm (3 inches) between September 2019 and January 2020 (Figure 3), while diploids from Halfmoon had not reached 76mm by February 2020. Overall, the mean shell height (SH) of diploids was 77.4 mm (\pm SE) which was significantly different from triploids which had a mean SH of 89.9 mm (\pm SE). The trend observed with SH was also detected in shell length (SL) and shell width (SW) and bi-monthly metrics for each ploidy and site are in Figures 4-6.

ANOVA detected that at time of harvest, the SH, SL, and SW were significant difference between diploid and triploids and that there were significant difference between sites, but that there was no interaction detected between site*ploidy (Table 1). This indicates that at both sites triploid oysters were significantly larger than diploid oysters and that oysters at the Skidaway River site were significantly larger than oysters at the Moon River site.

The appearance of oysters was very similar between diploid and triploid oysters at each location and had no to little fouling (Figures 7-8). The mean cup ratio was greatest at the Halfmoon site with both diploid and triploid oysters having a ratio of 0.37, but triploids at HM had a greater fan ratio of 0.70 compared to the 0.64 ratio for diploids. At the Skidaway site cup ratio was 0.30 for diploid and 0.29 for triploids and the fan ratio was 0.64 for diploid and 0.67 for triploids (Table 2).

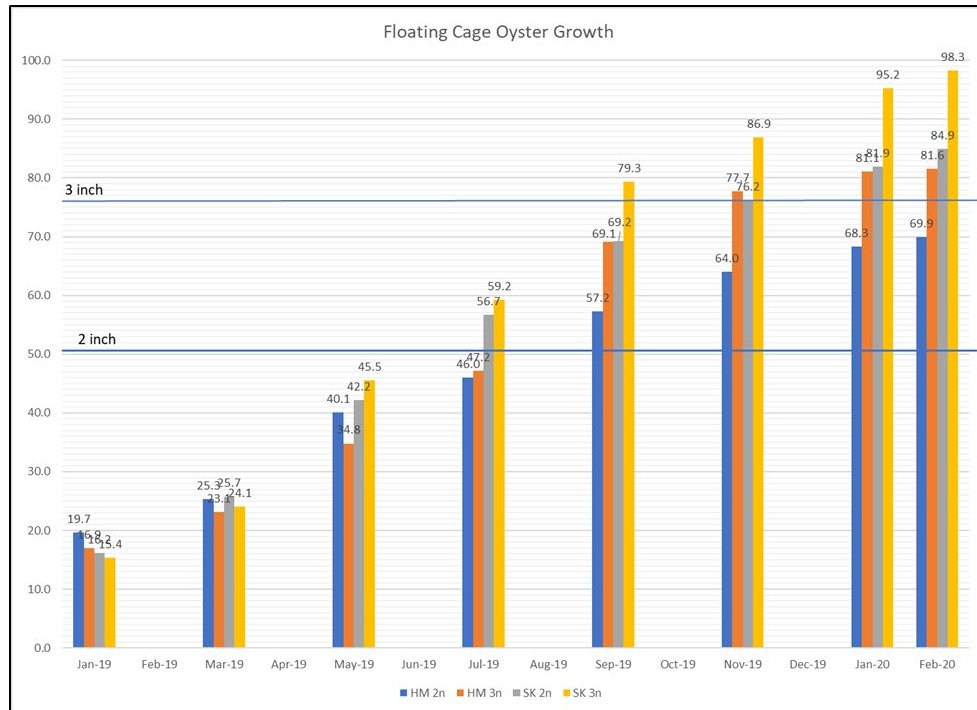


Figure 3. Growth (SH) of diploid and triploid oysters in floating cages in Halfmoon (Wassaw Sound) and Skidaway River, Chatham County, GA.

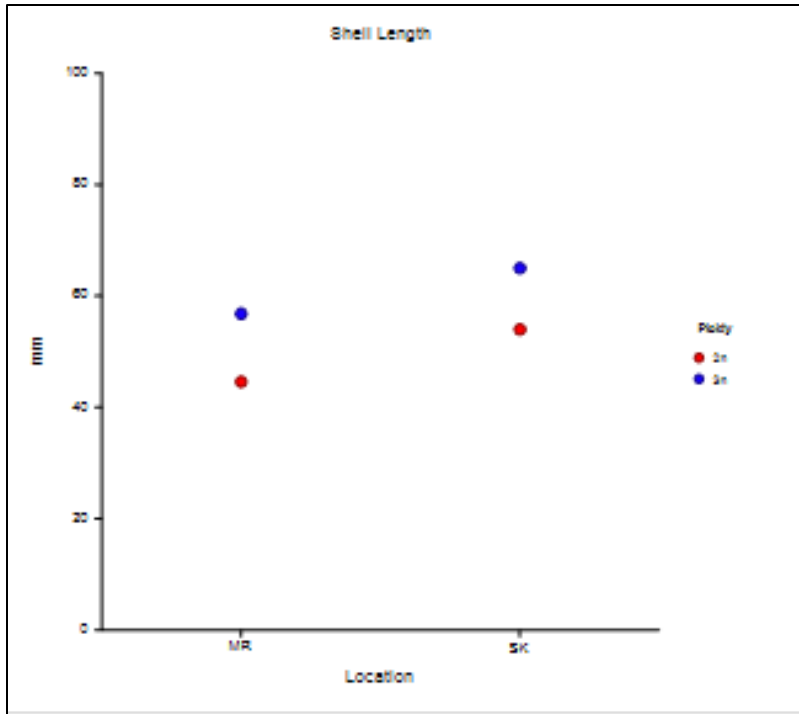


Figure 4. Mean shell length (mm) of diploid and triploid oysters in floating cages at the Moon River and Skidaway River, Chatham County, GA.

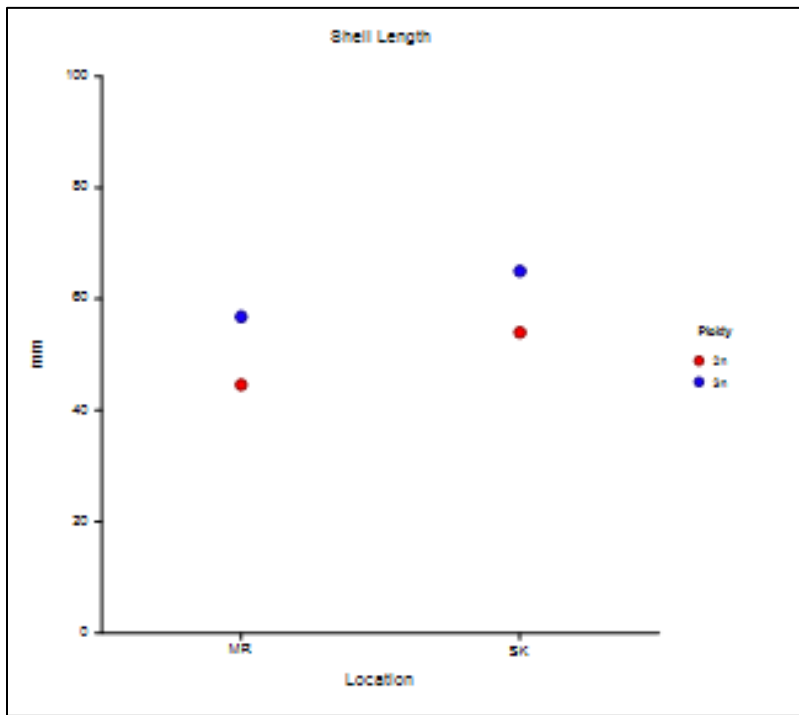


Figure 5. Mean shell length (mm) of diploid and triploid oysters in floating cages at the Moon River and Skidaway River, Chatham County, GA.

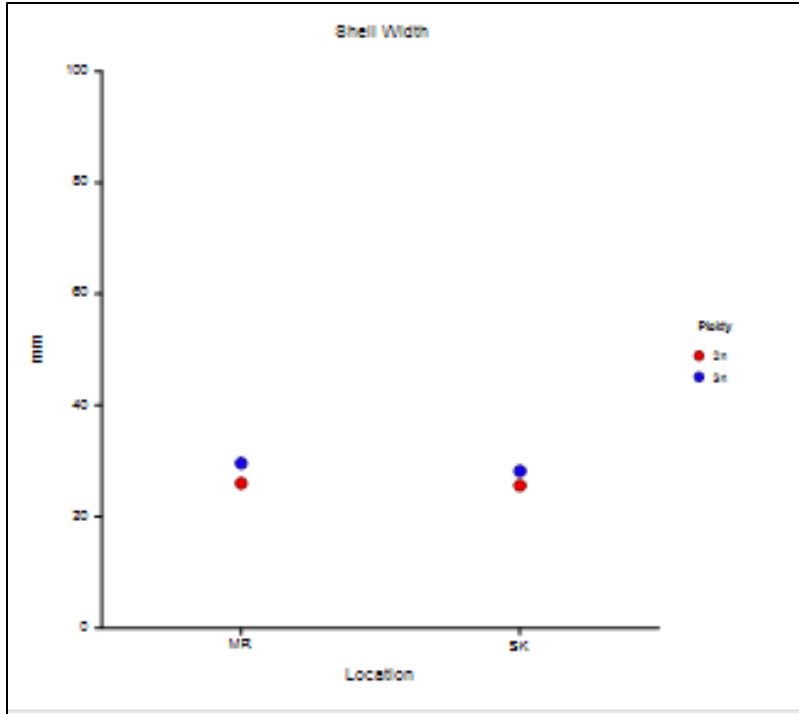


Figure 6. Mean shell width (SW) of diploid and triploid oysters in floating cages at the Moon River and Skidaway River, Chatham County, GA.

Table 1. ANOVA results for shell height (SH), shell length (SL), and shell width (SW) by location, ploidy, and location*ploidy.

Shell Height (SH)	DF	F-Ratio	P-value
Location (SK & HM)	1	367.82	< 0.0001
Ploidy (2n & 3n)	1	228.86	< 0.0001
Location*Ploidy	1	1.02	0.31
Shell Height (SL)	DF	F-Ratio	P-value
Location (SK & HM)	1	291.84	< 0.0001
Ploidy (2n & 3n)	1	513.80	< 0.0001
Location*Ploidy	1	1.51	0.22
Shell Height (SW)	DF	F-Ratio	P-value
Location (SK & HM)	1	9.52	0.0022
Ploidy (2n & 3n)	1	123.13	< 0.0001
Location*Ploidy	1	3.11	0.078

Table 2. Mean shell height (SH), shell length (SL), shell width (SW), fan ratio and cup ratio of diploid and triploid oysters in floating gear at the Skidaway River and Halfmoon River site, Chatham County, GA.

Row Labels	Mean SH (mm)	Mean SL (mm)	Mean SW (mm)	Mean Fan ratio	Mean cup ratio
MR					
2n					
2019					
Jan	19.7				
Mar	25.3				
May	40.1	28.4	12.3	0.71	0.31
Jul	46.0	31.4	16.4	0.68	0.36
Sep	57.2	35.9	21.5	0.63	0.38
Nov	64.0	40.8	22.8	0.64	0.36
2020					
Jan	68.3	44.0	25.3	0.64	0.37
Feb	69.9	44.5	26.0	0.64	0.37
<hr/>					
3n					
2019					
Jan	16.9				
Mar	23.1				
May	34.8	27.4	12.4	0.79	0.36
Jul	47.2	38.0	18.1	0.81	0.38
Sep	69.1	50.3	24.3	0.73	0.35
Nov	77.7	54.4	27.2	0.70	0.35
2020					
Jan	81.1	56.8	28.5	0.70	0.35
Feb	81.6	56.8	29.6	0.70	0.37
<hr/>					
SK					
2n					
2019					
Jan	16.2				
Mar	25.7				
May	42.2	31.1	11.7	0.74	0.28
Jul	56.7	39.8	17.1	0.70	0.30
Sep	69.2	41.8	21.0	0.61	0.30
Nov	76.2	46.4	22.8	0.61	0.30
2020					
Jan	81.9	51.9	25.0	0.64	0.31
Feb	84.9	54.0	25.7	0.64	0.30
<hr/>					
3n					
2019					
Jan	15.4				
Mar	24.1				
May	45.5	33.3	14.2	0.74	0.32
Jul	59.2	45.0	19.3	0.76	0.33
Sep	79.3	51.8	23.3	0.66	0.30
Nov	86.9	56.7	25.4	0.66	0.29
2020					
Jan	95.2	62.5	27.5	0.66	0.29
Feb	98.3	65.0	28.2	0.67	0.29



Figure 7. Appearance of diploid oysters grown in floating cages in the Skidaway River (left) and Halfmoon (right), Chatham County, GA.

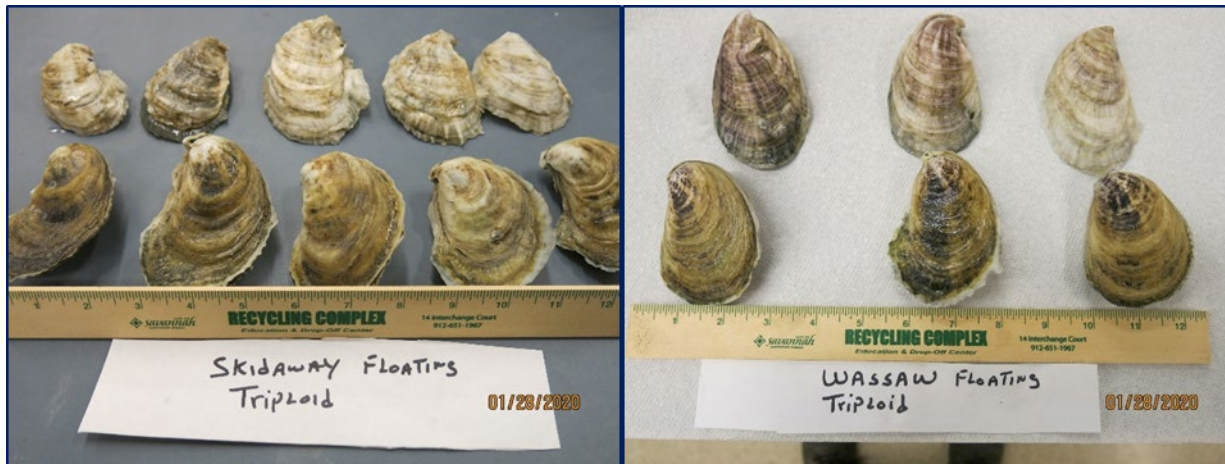


Figure 8. Appearance of triploid oysters grown in floating cages in the Skidaway River (left) and Halfmoon (right), Chatham County, GA.

Survival

Survival of diploid and triploid oysters (Figure 9) was similar from December 2018 through May 2019 with monthly survival ranging between 99.3% - 99.8% and cumulative survival between 98.6% - 98.9% in May 2019 (Table 3). From July through February monthly survival varied by ploidy and location. Highest cumulative survival was observed with diploid oysters in Halfmoon with a survival of 84.2%, triploids in Halfmoon had 69.8%, followed by diploids in Skidaway

River with 69.7%, and lowest survival was observed with triploids in the Skidaway River with 32.3% (Table 3).

When examining survival of oyster to when they reached minimum commercial harvest size of 50.8 mm (2 inches) we found that triploids in Skidaway River reached market size in July 2019 and had a survival rate 94.4%. Diploids in the Skidaway River also reached 50.8mm by July with 96.9%. Triploid oysters at Halfmoon reached 50.8mm by September and with 76.2% survival and diploids at Halfmoon also reach 50.8mm in September with 88.9% survival. Mortality was greatest in late summer between July and September and then started to decline in fall (Table 3).

Table 3. Monthly and cumulative survival of diploid and triploid oyster in floating gear in the Skidaway River and Halfmoon River, Chatham County, GA.

Date	Monthly Survival				Cumulative Survival			
	Halfmoon		Skidaway River		Halfmoon		Skidaway River	
	2n	3n	2n	3n	2n	3n	2n	3n
Dec-18	100%	100%	100%	100%	100.0%	100.0%	100.0%	100.0%
Jan-19	99.6%	99.8%	99.2%	99.1%	99.6%	99.8%	99.2%	99.1%
Feb-19								
Mar-19	99.8%	99.3%	99.8%	100.0%	99.5%	99.1%	99.0%	99.1%
Apr-19								
May-19	99.6%	99.5%	99.9%	99.8%	99.1%	98.6%	98.8%	98.9%
Jun-19								
Jul-19	96.5%	87.8%	98.0%	95.4%	95.6%	86.5%	96.9%	94.4%
Aug-19	97.7%	95.8%	96.8%	82.9%	93.4%	82.9%	93.8%	78.2%
Sep-19	95.3%	92.0%	80.3%	56.5%	88.9%	76.2%	75.3%	44.2%
Oct-19	98.5%	95.6%	96.7%	86.6%	87.6%	72.8%	72.8%	38.3%
Nov-19	97.9%	96.6%	97.0%	86.5%	85.8%	70.4%	70.6%	33.2%
Dec-19	99.8%	99.8%	99.8%	99.6%	85.6%	70.2%	70.5%	33.0%
Jan-20	98.6%	99.5%	98.9%	98.7%	84.4%	69.8%	69.7%	32.6%
Feb-20	99.8%	99.9%	99.9%	99.0%	84.2%	69.8%	69.7%	32.3%

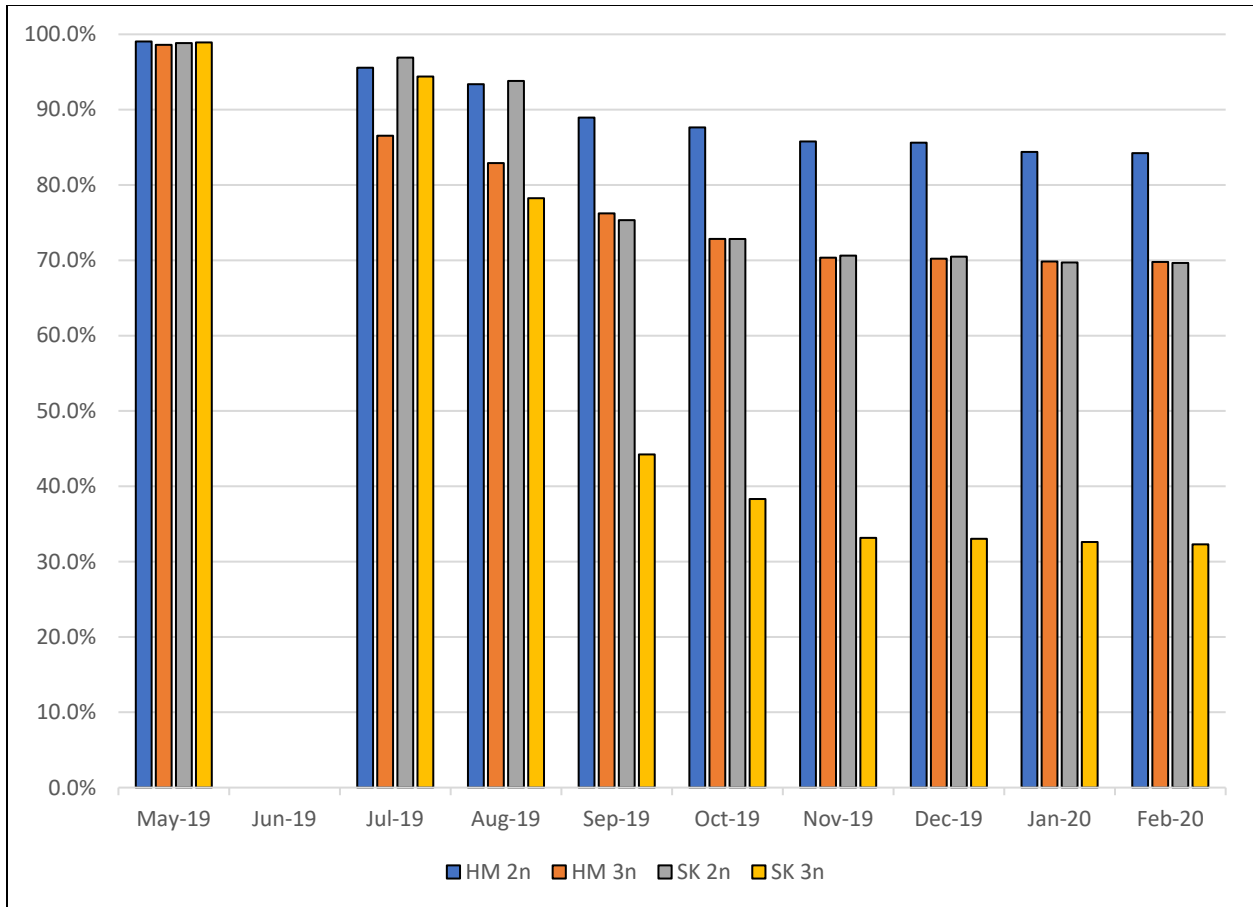


Figure 9. Cumulative survival of diploid and triploid oyster in floating gear in the Skidaway River and Halfmoon River from May 2019 – February 2020, Chatham County, GA.

Condition

The condition of oysters (Figures 10 and 11) was evaluated in February 2020 and was greatest in diploids at both sites, which had a condition index of 14.77 and 10.07 for Halfmoon and Skidaway River, respectively. While triploids had a condition index of 9.75 in Skidaway and 9.49 at Halfmoon (Figure 12). Even though triploids were larger and had more dry tissue weight than diploids (Table 4), the ratio of dry meat to dry shell was greater for diploids which was 4.9% and 4.6% for Skidaway and Halfmoon, correspondingly and was 3.8% and 3.7% for triploids in the Skidaway and Halfmoon, respectively.



Figure 10. Condition of oyster meat in diploid oysters grown in floating cages in the Skidaway River (left) and Halfmoon (right), Chatham County, GA.



Figure 11. Condition of oyster meat in triploid oysters grown in floating cages in the Skidaway River (left) and Halfmoon (right), Chatham County, GA.

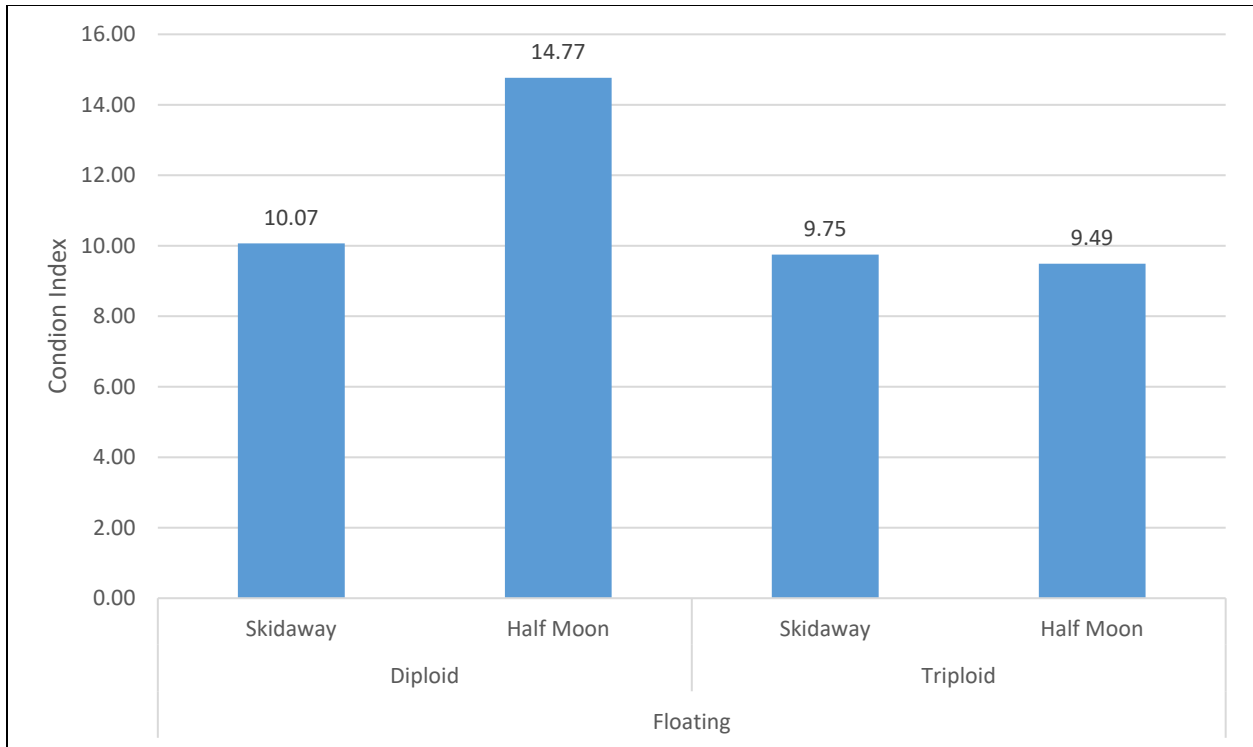


Figure 12. Condition index of diploid and triploid oysters in February 2020 from floating gear in the Skidaway River and Halfmoon River, Chatham County, GA.

Table 4. Mean wet weight (g), wet shell weight (g), dry shell weight (g), wet tissue weight (g) and dry tissue weight (g) for diploid and triploid oyster in floating gear in the Skidaway River and Halfmoon River, Chatham County, GA.

Row Labels	Mean Wet Weight	Mean Wet Shell	Mean Dry Shell	Mean Wet Tissue	Mean Dry Tissue
Diploid					
Skidaway	66.40	43.66	44.56	18.75	2.19
Halfmoon	51.58	39.93	39.14	14.45	1.80
Triploid					
Skidaway	96.59	71.44	69.74	23.01	2.62
Halfmoon	92.43	67.65	66.30	21.78	2.48

Bottom cages

Growth and appearance

Triploid oysters were larger with mean SH of 89.6mm and a mean growth rate of 4.69 mm/month than diploids with a mean SH of 82.3mm which grew an average of 4.0 mm/month. Growth was significantly different for SH, SL, and SW (Table 5) with triploids being of greater

size in each category. The appearance of oysters was similar, but once again triploids had a greater fan ratio 0.67 than diploids with a ratio of 0.64 and greater cup ratio of 0.43 than diploids which had a mean ratio of 0.37 (Table 5). ANOVA detected that there was a difference between diploid and triploid oysters at the site.

The appearance of oysters was very similar between diploid and triploid and had no to little fouling (Figure 13), unlike the cages and bags. The mean cup ratio was greatest in triploid oysters with a ratio of 0.43 compared to the 0.37 for diploids. The same trend was observed with fan ratio with triploids having 0.67 compared to 0.64 ratio for diploids.

Table 5. Mean shell height, shell length, shell width, fan ratio and cup ratio for diploid and triploid oysters grown in subtidal bottom gear in the Skidaway River, Chatham County, GA.

Row Labels	Mean SH (mm)	Mean SL (mm)	Mean SW (mm)	Mean Fan ratio	Mean cup
SK					
2n					
2019					
Jan	22.2				
Mar	28.5				
Apr					
May	39.1	29.7	11.1	0.76	0.28
Jul	51.8	36.1	15.9	0.70	0.31
Aug					
Sep	61.9	37.8	18.1	0.62	0.37
Oct					
Nov	71.2	43.7	20.1	0.62	0.36
2020					
Jan	78.8	51.0	22.3	0.65	0.42
Mar	82.3	52.5	23.1	0.64	0.37
3n					
2019					
Jan	19.2				
Feb					
Mar	23.9				
Apr					
May	43.9	33.0	11.8	0.76	0.27
Jul	52.5	38.9	16.8	0.75	0.32
Aug					
Sep	65.3	42.4	18.5	0.66	0.46
Oct					
Nov	75.9	48.0	21.3	0.64	0.44
2020					
Jan	85.4	56.0	23.4	0.66	0.50
Mar	89.6	59.2	25.2	0.67	0.43



Figure 13. Appearance of triploid (left) and diploid (right) oysters in bottom cages in the Skidaway River, Chatham County, Georgia.

Survival

Survival of diploid and triploid oysters was similar throughout the entire study. Monthly survival ranged from 54.1%-99.3% for diploids and 41.0%-99.6% triploids with lowest survival occurring in August for diploids and September for triploids. Cumulative survival was low for both ploidies at 10% for triploids and 11% for diploids (Table 6).

Table 6. Monthly survival and cumulative survival of diploid and triploid oysters grown in sub-tidal bottom cages in the Skidaway River, Chatham County, GA.

Month	2n				3n			
	Live	Dead	Survival Monthly	Cumulative	Live	Dead	Survival Monthly	Cumulative
Jan	622.0	119.0	83.9%		584.0	34.0	94.5%	
Feb					231.0	1.0	99.6%	94%
Mar	622.0	7.0	98.9%	83%	482.0	14.0	97.2%	91%
Apr	576.0	62.0	90.3%	75%	482.0	120.0	80.1%	73%
May	521.0	101.0	83.8%	63%	493.0	20.0	96.1%	70%
Jul	1028.0	378.0	73.1%	46%	1062.0	409.0	72.2%	51%
Aug	233.0	198.0	54.1%	25%	230.0	58.0	79.9%	41%
Sep	709.0	408.0	63.5%	16%	510.0	734.0	41.0%	17%
Oct	274.0	41.0	87.0%	14%	122.0	22.0	84.7%	14%
Nov	537.0	137.0	79.7%	11%	341.0	154.0	68.9%	10%
Jan	447.0	5.0	98.9%	11%	431.0	6.0	98.6%	10%
Mar	401.0	3.0	99.3%	11%	383.0	2.0	99.5%	10%

Condition

The condition of oysters was conducted in February 2020 and was greatest in triploids which had an index of 8.93 and diploids had an index of 6.21 (Figure 14). Overall triploids had more meat than diploids (Figure 15), and the ratio of dry meat to dry shell was greatest in triploids with 3.7% compared to the 3.2% in diploids (Table 7).

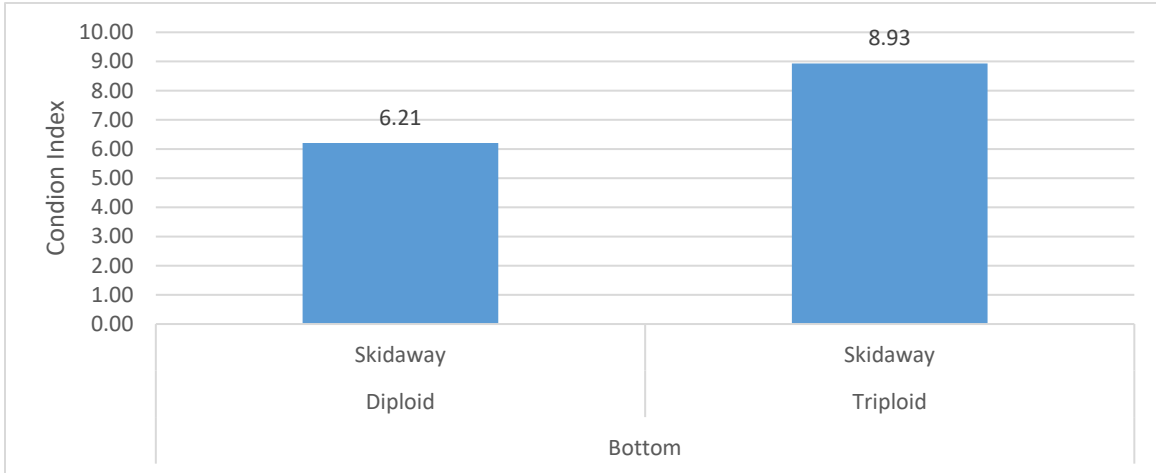


Figure 14. Condition index of diploid and triploid oysters grown in bottom cages in the Skidaway River, Chatham County, GA.

Table 7. Mean wet weight (g), shell weight (g), dry shell weight (g), wet tissue (g) and dry tissue (g) for diploid and triploid oysters grown in bottom cages in the Skidaway River, Chatham County, GA

Row Labels	Mean Wet Weight	Mean Wet Shell	Mean Dry Shell	Mean Wet Tissue	Mean Dry Tissue
Bottom					
Diploid					
Skidaway	49.97	34.41	33.16	13.86	1.07
Triploid					
Skidaway	69.18	50.63	48.85	16.99	1.81

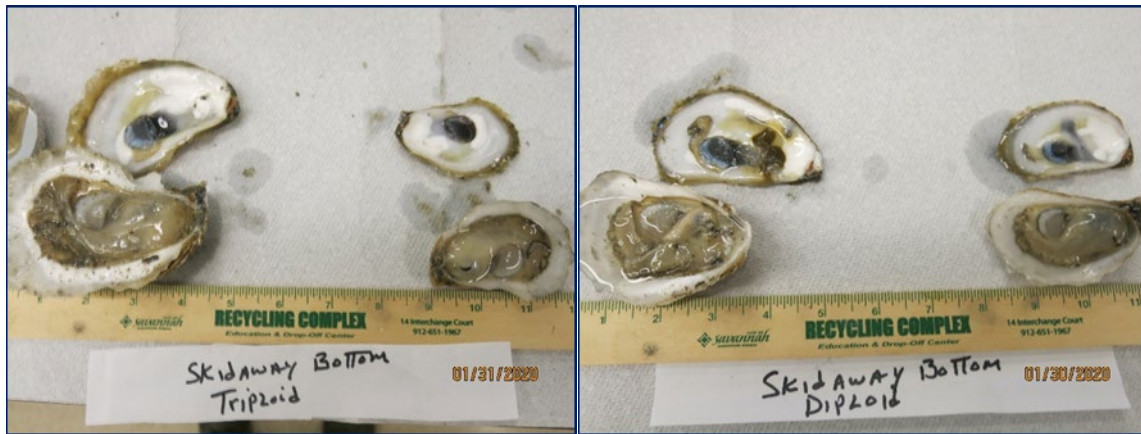


Figure 15. Appearance of triploid (left) and diploid (right) oysters grown in bottom cages in the Skidaway River, Chatham County, GA.

Floating and bottom cage comparison

Growth

Skidaway River oysters grown in floating cages were used to compare to oysters grown in bottom cages to avoid complications from site characteristics of oysters from Halfmoon. Shell height of triploid and diploid oysters in the Skidaway River were larger in floating cages than bottom cages with triploids in both treatments larger than diploids (Table 8 and Figure 16). ANOVA found that oysters grown in floating cages were significantly larger than bottom cages ($p=0.015$), triploid oysters were larger than diploids ($p<0.0001$), and there was an interactive effect between cage*ploidy ($p=0.02$) (Table 9). Tukeys multiple comparison test indicated triploid in floating cages were significantly larger than all other treatments (Table 10). Results for SL and SW were similar to those of SH and in all cases, triploids were larger than diploids, oysters in floating cages were larger than bottom cages, and ploidy*cage found that triploids in floating cages were larger than all other treatments (Tables 11-13).

Table 8. Mean shell height (mm) and standard error of diploid and triploid oysters grown in bottom and floating cages in the Skidaway River, Chatham County, GA.

Term	Count	Mean	Standard Error
2n,Bottom	30	84.72	1.977029
2n,Floating	75	84.928	1.250383
3n,Bottom	24	90.02084	2.210386
3n,Floating	75	98.27467	1.250383

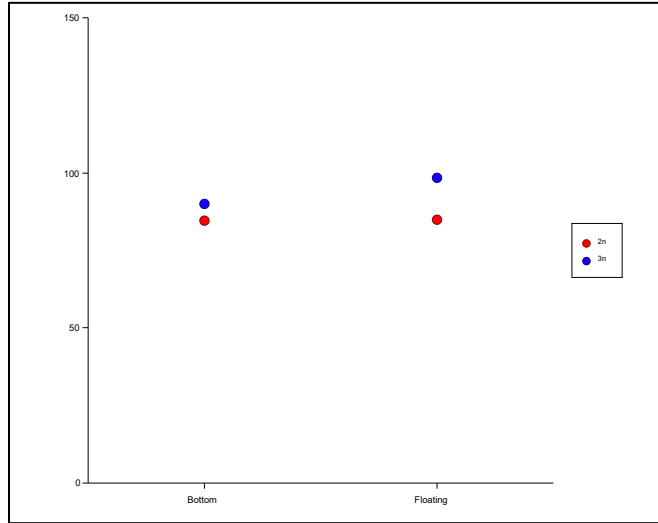


Figure 16. Mean shell height diploid and triploid oysters grown in bottom and floating cages in the Skidaway River, Chatham County, GA.

Table 9. ANOVA results for shell height by ploidy, cage location, and ploidy*cage for oysters grown in the Skidaway River, Chatham County, GA.

Source	DF	Sum of Squares	Mean Square	F-Ratio	P-Value	Power (Alpha=0.05)
A: Ploidy	1	3420.288	3420.288	29.17	0.000000*	0.999681
B: Cage	1	704.2881	704.2881	6.01	0.015114*	0.684042
AB	1	636.742	636.742	5.43	0.020788*	0.640255
S	200	23451.86	117.2593			
Total (Adjusted)	203	31319.67				
Total	204					

Table 10. Tukeys multiple comparison results for shell height of oysters by ploidy and gear location in the Skidaway River, Chatham County, GA.

Group	Count	Mean	Different From Groups
2n,Bottom	30	84.72	(3n,Floating)
2n,Floating	75	84.928	(3n,Floating)
3n,Bottom	24	90.02084	(3n,Floating)
3n,Floating	75	98.27467	(2n,Bottom), (2n,Floating), (3n,Bottom)

Table 11. Mean shell Length (SL) and standard error of diploid and triploid oysters grown in bottom and floating cages in the Skidaway River, Chatham County, GA.

Term	Count	Mean	Standard Error
2n,Bottom	30	54.30667	1.175613
2n,Floating	75	53.968	0.7435229
3n,Bottom	24	58.14167	1.314375
3n,Floating	75	65.01466	0.7435229

Table 12. ANOVA results for shell length by ploidy, cage location, and ploidy*cage for oysters grown in the Skidaway River, Chatham County, GA.

Source	DF	Sum of Squares	Mean Square	F-Ratio	P-Value	Power (Alpha=0.05)
A: Ploidy	1	2178.334	2178.334	52.54	0.000000*	1.000000
B: Cage	1	419.9755	419.9755	10.13	0.001692*	0.886352
AB	1	511.5555	511.5555	12.34	0.000549*	0.937689
S	200	8292.395	41.46197			
Total (Adjusted)	203	13545.49				
Total	204					

Table 13. Tukeys multiple comparison results for shell length of oysters by ploidy and gear location in the Skidaway River, Chatham County, GA.

Group	Count	Mean	Different From Groups
2n,Bottom	30	54.30667	(3n,Floating)
2n,Floating	75	53.968	(3n,Bottom), (3n,Floating)
3n,Bottom	24	58.14167	(2n,Floating), (3n,Floating)
3n,Floating	75	65.01466	(2n,Bottom), (2n,Floating), (3n,Bottom)

Survival

Survival of oysters in floating gear was greater than that in bottom gear (Table 14). Cumulative survival in floating gear in the Skidaway was 69.7% for diploids and 32.3% triploids compared to 10.7% and 9.5% for diploids and triploids in bottom gear, respectively.

Table 14. Monthly and cumulative survival of triploid (3n) and diploid (2n) oysters grown in bottom and floating cages in the Skidaway River, Chatham County, GA.

Date	Monthly				Cumulative Survival			
	Bottom 2n	Bottom 3n	Floating 2n	Floating 3n	Bottom 2n	Bottom 3n	Floating 2n	Floating 3n
Dec-18	100%	100%	100%	100%	100.0%	100.0%	100.0%	100.0%
Jan-19	83.9%	94.5%	99.2%	99.1%	83.9%	94.5%	99.2%	99.1%
Feb-19		99.6%				94.1%		
Mar-19	98.9%	97.2%	99.8%	100.0%	83.0%	91.5%	99.0%	99.1%
Apr-19	90.3%	80.1%			74.9%	73.3%		
May-19	83.8%	96.1%	99.9%	99.8%	62.8%	70.4%	98.8%	98.9%
Jun-19								
Jul-19	73.1%	72.2%	98.0%	95.4%	45.9%	50.8%	96.9%	94.4%
Aug-19	54.1%	79.9%	96.8%	82.9%	24.8%	40.6%	93.8%	78.2%
Sep-19	63.5%	41.0%	80.3%	56.5%	15.7%	16.7%	75.3%	44.2%
Oct-19	87.0%	84.7%	96.7%	86.6%	13.7%	14.1%	72.8%	38.3%
Nov-19	79.7%	68.9%	97.0%	86.5%	10.9%	9.7%	70.6%	33.2%
Dec-19			99.8%	99.6%			70.5%	33.0%
Jan-20	98.9%	98.6%	98.9%	98.7%	10.8%	9.6%	69.7%	32.6%
Feb-20	99.3%	99.5%	99.9%	99.0%	10.7%	9.5%	69.7%	32.3%

Condition

The condition of oysters overall was better in oyster held in floating gear. Diploids in floating gear had the highest index of 10.07 while triploids had a condition index of 9.75. Inversely to floating cages, diploids in bottom cages had the lowest condition observed with 6.21 while triploids had an index of 8.93. The ratio of dry meat to dry shell was greater for diploids which was 4.9% and 3.8% for triploids in floating cages while for bottom cages the ratio of dry meat to dry shell was greatest in triploids with 3.7% compared to the 3.2% in diploids. When comparing the look of the inside of the shell the appearance of mud blisters (yellow/brown nacre) was more pronounced in oysters from bottom cages and was almost nonexistent in oysters in floating cages (Figures 17 and 18).

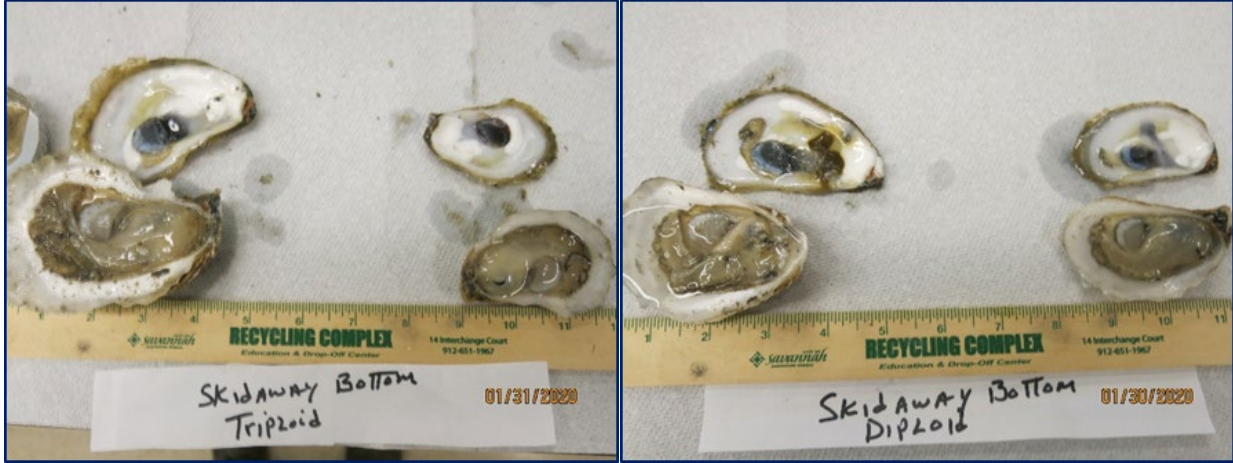


Figure 17. Shell appearance and meat condition of triploid and diploid oysters from bottom cages in the Skidaway River, Chatham County, GA

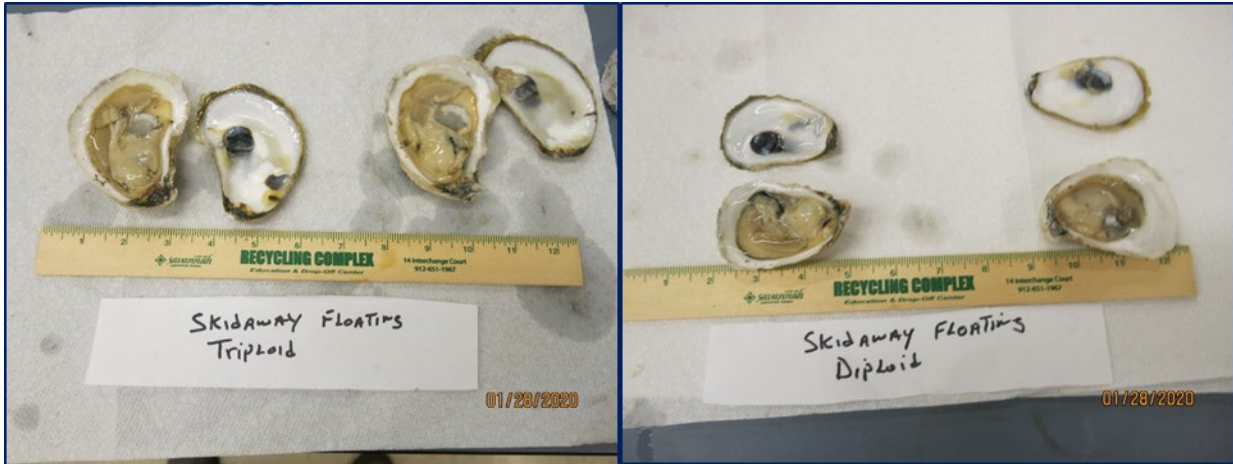


Figure 18. Shell appearance and meat condition of triploid and diploid oysters from floating cages in the Skidaway River, Chatham County, GA

Outreach

Grower meetings

In September 2018, a grower meeting was held at the Shellfish Research Laboratory to show current lease holders floating oyster cages. The meeting was attended by five growers that viewed floating cages, utilized for another research project, and a cage demonstration was held. Growers got a chance to handle the gear, discuss the gear, and ask questions about the upcoming research.

On September 20, 2019 a meeting was held and was attended by three growers. Other growers had planned to attend but after the meeting was scheduled they were unable to attend. Participating growers were taken to both study sites, Halfmoon and Skidaway River and were shown diploid and triploid oysters from the project and gear demonstration. Growers were able to handle oysters and the gear and ask questions about our observations up to then. Most questions had to do with ploidy, oyster condition, and growth. Growers were excited by the growth observed in the floating cages but were not impressed with the oysters in the sub-tidal bottom cages.

A final wrap-up meeting was held on March 16, 2020 with growers at the Shellfish Lab. Five growers were able to attend in person or connect via Zoom, two growers that could not attend received a copy of the presentation via e-mail. Results of the study were presented and discussed and a copy of the presentation is located in Appendix II. We were able to discuss the growth and survival of both triploid and diploid oysters in floating and bottom cages, and answer any questions that they had. In addition to the results, we also discussed the status of the hatchery and spawning plans for the upcoming summer. Growers also had questions about the lottery and possible sites,

which we recommended they direct to GA Coastal Resources Division. Additional items discussed were the seed workshop and gear information collected at the recent Oyster South Symposium to keep growers informed of what is happening within the industry as Georgia gets ready to expand its industry.

Oyster Roast for a Reason

The annual oyster roast for Marine Extension and Georgia Sea Grant was held on November 17, 2019 on Skidaway. This roast provided the opportunity to serve Georgia oysters on the half shell to participants and talk about the current research taking place with the floating gear in the Skidaway River visible to guest. Guest were supportive of the research, wanting to see the industry grow and appreciated being able to see how oyster were grown. Many local chefs and members of Oyster South, and Auburn University we able to come and help support the work taking place in Georgia.

Oyster South

Landlocked and Symposium

In addition to grower meetings, Georgia oysters were part of the Landlocked 3 in Atlanta, GA on October 20, 2019 and UGA staff were able to attend and assist E.L. McIntosh and Son and answer questions participants had about oysters in Georgia. There was great interest in Georgia oysters from guests and they were excited to hear about the current research and legislative changes. An update on the Georgia industry was also given at the Oyster South Symposium in Wilmington, NC on February 21, 2020.

Discussion

Growth

In general, growth was good in floating gear and bottom gear for triploid and diploid oysters. Our results support research from other studies (Walton et al. 2013.) that show that triploid oysters grow faster than diploid oysters. It was observed that diploids and triploids grow differently based on site and that diploids grown in the Skidaway River in floating gear grew at the same rate as triploids in floating gear at Halfmoon. This indicates that site plays an important role in the growth of oysters. It is believed that the slower growth rate at Halfmoon is a response to the high energy that is observed with this location being adjacent to Wassaw Sound. Wave energy and fetch data was not collected, and therefore could not be analyzed, but is a component that needs to be analyzed in future research. The different growth rates based on site characteristics indicates that as leases using floating cages come into production that growers will need to pay attention to their growth rates to establish when oysters will reach harvest size.

Within this study, triploid and diploid oysters in the Skidaway River reached harvest size in July 2019 and in Halfmoon both ploidies reached harvest size by September 2019. By September 2019, triploid oysters in the Skidaway had grown past 76.2mm (3 inches) which puts them out of the ideal harvest size of 57.5-69.85 (2.25-2.75 inches) (Rackley personal communication). Similarly, diploids from the Skidaway and triploids Halfmoon reached 76.2 mm by November 2019, just two months into the open season. Diploids in Halfmoon remained under 3 inches for the duration of the study. This indicates that unless closed season harvest (summer harvest) is approved then the full benefit of growing oysters, regardless of ploidy, cannot be realized if oysters

are not able to be harvested at their ideal size. Growth in sub-tidal bottom cages was also good, but since only one site was tested, it is not possible to draw any conclusions upon their use in Georgia. Intertidal oyster cages also have good growth (Bliss and Manley 2017) but intertidal oysters will not meet the standards for summer harvest and remain an open season (October-May) methods, whereas sub-tidal bottom cages would be approved for summer harvest.

This research indicates that time of year when seed is received will have an impact upon production in addition to site. Oyster seed for this study were spawned in late summer and set out in early December and research by Kirk (2019) found that triploid oysters spawned in early May and grown at Halfmoon, in floating gear, that oysters reached or were close to 50.4mm in March, which would allow harvest size to be reached prior to summer.

The appearance of oysters grown in both locations and both types of gear produced harvestable oysters. All oysters had a cup ratio greater than the 0.25 threshold which is considered desirable by oyster consumers (Brake et al. 2003), but the cup ratio was greater at the Halfmoon site which is most likely a response to the high energy, wave action, observed at that site. The cup ratio between diploid and triploid at each site in floating gear was similar, but the cup ratio in triploids in bottom gear was notably larger than diploids in bottom gear. The fan ratio was also good and similar for all oysters.

Survival

Cumulative survival of oysters to harvest size of 52mm was above 80% at both sites and for both ploidies. Triploid oysters at the Skidaway River had a dramatic decrease in survival after reaching harvest size that saw survival drop to 38.3% by October when oyster season opens. This loss of oysters is tremendous and could be mitigated through approval of summer harvest

regulations. Summer loss in triploids has been observed in other locations that have observed a spike in triploid summer mortality spiked in summer when compared to diploids (Cheney et al. 2000) and more recently triploid die offs have been observed in Gulf of Mexico (Walton pers. comm.) and in South Carolina (Huelteen pers. comm). With high loss observed in triploids in the Skidaway River this needs to be further examined to determine the potential impact in Georgia. The remainder of the oysters from both sites had good survival throughout the season remain above 68% which is comparable to other studies (Walton et al. 2013, Kirk 2019) with diploids in Halfmoon having the greatest survival at 84.2%. Sites closer to the sound seem to provide better survival of diploid and triploid oysters and is an aspect that needs further examination.

Survival in sub-tidal bottom cages was terrible and by conclusion of the study about 10% of the oysters of both ploidies survived. Monthly survival was lower than floating cages each month throughout the study and it was common for cages to be tumbled, stuck in the sediment, or covered in soft fouling. With only one study location, we cannot state if the survival we observed in bottom cages is indicative of the gear or the site. Additional sites need to be examined that would examine sediment type and cage fouling. Past studies by Walker (1998) with blood arks found difference in the amount of soft fouling which was greater in the Skidaway River than in House Creek, which is adjacent to Wassaw Sound.

Condition

The condition of oysters in floating cages was better than oysters in bottom cages and the best condition observed was in diploids from Halfmoon that was considerably higher than oysters from all other treatments and locations. It must be noted that condition was evaluated in the winter, when oyster condition is highest in Georgia and needs to be evaluated throughout the entire growing

season to determine the effect of gear and ploidy upon condition. Triploids are noted for having better condition during the spawning season, but for oysters grown in floating gear where food is abundant, it is quite possible that with the productive waters in Georgia that diploid oysters would have good condition as well. Summer condition studies of oysters in Georgia have been conducted on wild oysters and needs to be evaluated for both diploid and triploid oysters grown for aquaculture.

Management Implications

The growth of the oyster industry in Georgia is in its infancy and this study indicates that site and oyster ploidy can have an effect upon the production of a lease. Based on this study floating cages were easier to use than bottom cages (Appendix III), survival was better in floating cages than bottom cages, diploid had better survival than triploids, but that triploids had faster growth to market size. Therefore, it would be beneficial to structure a lease using floating gear and to grow both diploid and triploid oysters and work with hatcheries to receive seed in spring/early summer and in late summer/early fall. Closed season harvest regulations must be established for both diploid and triploid oysters to avoid potential oyster loss during the summer months. As the industry continues to transform and grow, it is important that a dynamic strategy be adopted so that state regulations and industry needs can be addressed in timely manner and be based upon relevant research.

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Appendices

Appendix I – Permit application

Description of gear and sites for experimental permit for testing
OysterGro floating cages and Bottom cages for oyster
aquaculture in Georgia.

Submitted By:

Thomas Bliss

University of Georgia
Marine Extension and Georgia Sea Grant
Shellfish Research Laboratory
20 Ocean Science Circle
Savannah, GA 31411

February 2018

Table of Contents

Description of Gear, Buoys, and Floats 2

 Floating cages..... 2

 Anchoring for floating cages..... 2

 Bottom cages..... 4

 Buoys..... 4

 Bottom Cage Floats..... 4

Site Descriptions 5

 Site 1: Skidaway River – Skidaway Island 5

 Site 2: Half Moon Fish Area – Wassaw Sound..... 6

 Site 3: Groves Creek – Skidaway Island..... 7

DESCRIPTION OF GEAR, BUOYS, AND FLOATS

Below are the descriptions of three locations for the use of floating OysterGro cages and bottom cages in Chatham county. The three locations include a tidal river, tidal sound, and tidal creek that are representative of estuarine waters found along the entire coast. Site 1 is in the Skidaway River, Site 2 is in Wassaw sound, and Site 3 is in Groves Creek on the Wilmington River side of Skidaway Island.

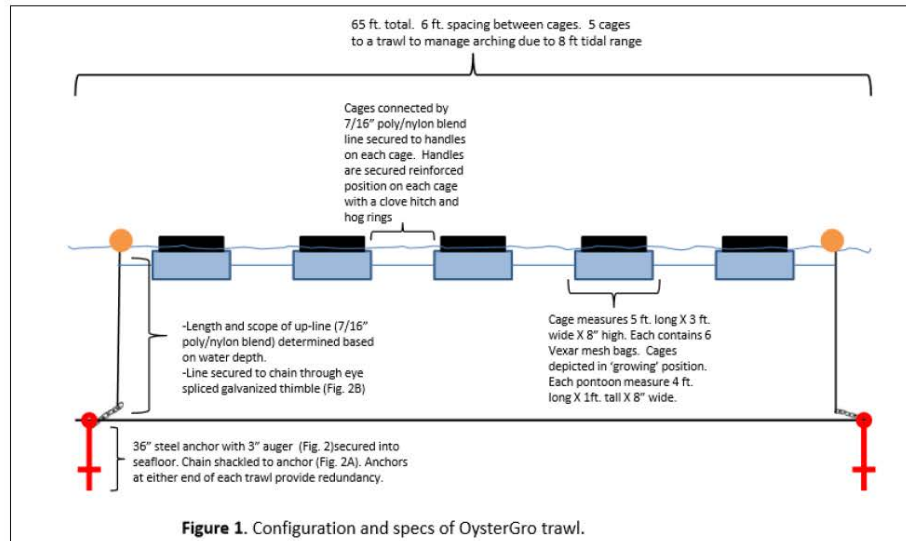
The dimensions of the floating OysterGro cages and bottom cages are listed below, followed by a description of each of the proposed sites for the cages.

FLOATING CAGES

- The dimensions of the OysterGro (cage + floats) is 60" long x 36" wide x 20" high. The cage by itself is 60"x36"x8" and holds 6 Vexar bags. The floats by themselves are 48" long x 8" wide x 12" high and there are 2 per cage.
- One string of gear will be 60ft long (5 cages at 65" long and 72" between each cage)
- Four 2" pvc pipes will be placed at the corners of the run to give a visual for boaters. Pvc will be cut to be 2ft higher than MHHW at the site. A sign will be attached on the two channel side poles with the wording "UGA Marine Extension Experimental Research Project – Boating obstruction floating and bottom gear present"

ANCHORING FOR FLOATING CAGES

Details on the the anchoring are shown below in Figures 1 and 2, but each string (5 cages) would be anchored using four 3ft steel auger anchors (2 at each end of the 5 cage run), four 3ft pieces of chain, and ½ inch diameter poly dacron rope will connect cages to anchors and to each other. In the event of a storm we would fill floats with water and sink cages as depicted in Figure 3.



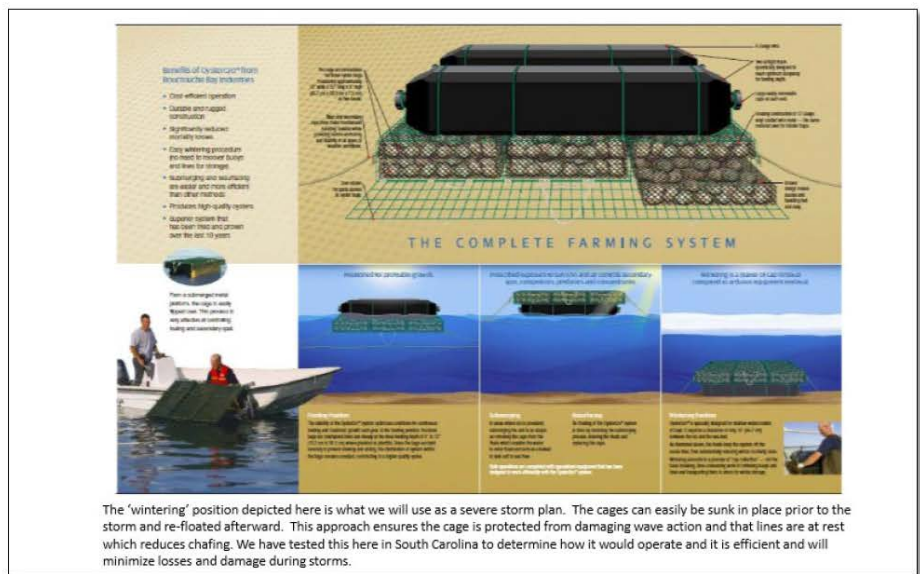
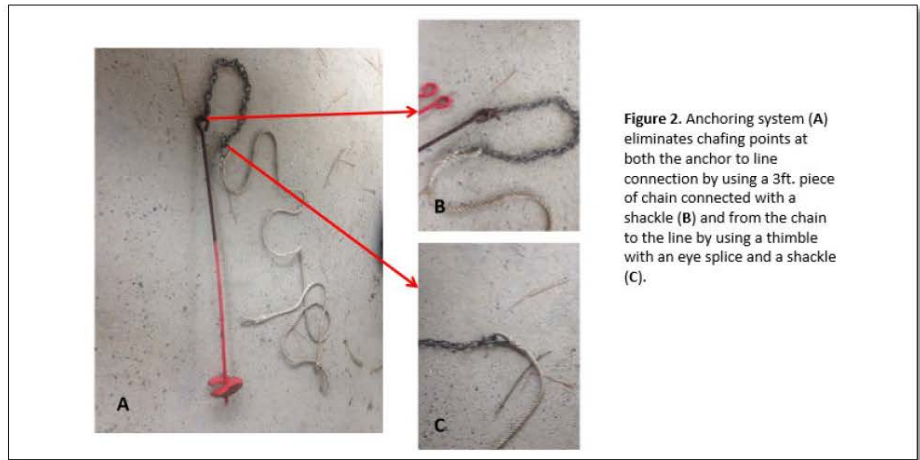


Figure 3. Diagram depicting sinking of OysterGro cages to be used during a storm event.

BOTTOM CAGES

Bottom cages are not anchored, but sit directly on the bottom and are held in place by the sediment.

- The dimensions of the bottom cage (cage + feet) is 60" long x 36" wide x 16" high (Figure 4). The cage by itself is 60"x36"x8" and holds 6 Vexar bags. The feet by themselves are 48" long x 8" wide x 8" high and there are 3 per cage.
- Bridal made of 1/2 inch braided poly line will be attached to each cage and one buoy held with 1/4 inch diameter poly rope will be attached to allow to lift cage with on board davit.

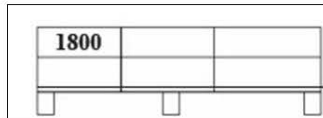


Figure 4. Drawing of Bottom cages for oyster aquaculture (Chesapeake Bay Oyster Company).

BUOYS

To mark the sites in the Skidaway River and Groves Creek we propose to use two Sur Marker Buoy 49" x 10" that are labeled with either "Hazard Area" or "Danger" with one buoy anchored each end of the line cages. Buoys will be anchored using the same 3ft auger anchor used for anchoring floating OysterGro cages.



BOTTOM CAGE FLOATS

Bottom cages will be marked using criteria following guidelines for commercial crab traps which states "All commercial crab traps must have an attached float of a color other than green that is visible from a distance of 100 feet in clear weather at slack tide. Each float must be marked with the identification number assigned by the department. Markings must be at least one inch (1") in height, of contrasting color to the float, and readable from left to right." Instead of an identification number floats would be marked with UGA.

SITE DESCRIPTIONS

SITE 1: SKIDAWAY RIVER – SKIDAWAY ISLAND

This site is 0.1 acres in size and is adjacent to the University of Georgia Campus on Skidaway Island (Figure 5) and we are requesting a string of 30 floating cages and 5 bottom cages. Five of the floating cages will be for use in research and 25 cages will be used as a nursery for holding of hatchery seed. It is approximately 150 m long and 7m wide and is in-line with existing fixed docks on the property. Buoys, as described above, will be used to mark the start and end of the line. The depth of the site is 0.7m at MLLW (Table 1). The location is 33m channel ward of the lower spartina edge and the Skidaway river at this location is 480m wide (lower spartina edge to lower spartina edge). The channel depth is 1.3-4m deep at MLLW and is approximately 290m wide (Table 1). Center of polygon is 31.989, -81.026.

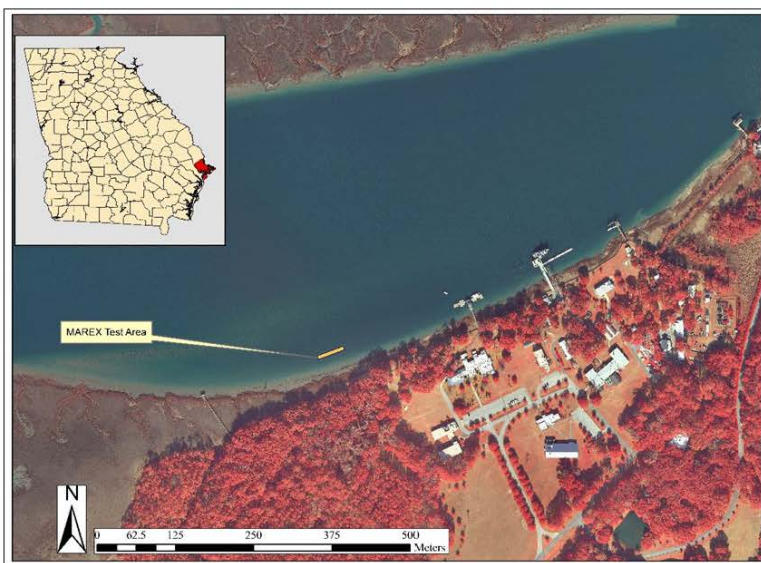


Figure 5. Proposed location (orange rectangle) for placement of floating and bottom cages in the Skidaway River.

Table 1. Depth of water at MLLW in the Skidaway River with Latitude and Longitude

Latitude	Longitude	Depth (m) MLLW	
31 59.298	-81 01.571	-1.5	
31 59.323	-81 01.591	0.7	Proposed site
31 59.362	-81 01.625	0.2	
31 59.381	-81 01.626	1.3	
31 59.427	-81 01.592	3.4	
31 59.472	-81 01.590	4.0	
31 59.509	-81 01.687	3.4	
31 59.525	-81 01.698	1.3	
31 59.527	-81 01.698	0.7	
31 59.545	-81 01.701	-1.5	

SITE 2: HALF MOON FISH AREA – WASSAW SOUND

This site is located in the Half Moon Fish habitat area (Figure 6). This area has already been approved for 16 floating cages (blue line) (Figure 6) and we are asking for permission to add an additional 5 floating for this experiment. Buoys would not be used at this site since the area is marked by four pilings as a restricted boating area. The depth within the fish habitat area is around 0.5m at MLLW and the center coordinate of the fish habitat area is 31.963, -80.941.

After talking with Dominic Guadagnoli, it was recommended that bottom cages not be deployed in the fish habitat zone, therefore we ask permission to deploy the five bottom cages in waters adjacent to the fish habitat area following State guidelines used for commercial crab traps which states “Commercial crab traps may not be placed within 100 feet of a dock of another person. Also, crab traps may not be placed or set in a legally marked channel.” and that “All commercial crab traps must have an attached float of a color other than green that is visible from a distance of 100 feet in clear weather at slack tide. Each float must be marked with the identification number assigned by the department. Markings must be at least one inch (1”) in height, of contrasting color to the float, and readable from left to right.” (GA DNR Coastal Resources Division Commercial Saltwater Fishing Regulations 2017 <http://coastalgadnr.org/sites/default/files/crd/CommFish/2017CRDCommercialRegsWEBformat.pdf>) Instead of an identification number floats would be marked with letters UGA.



Figure 6. Half moon fish habitat area

SITE 3: GROVES CREEK – SKIDAWAY ISLAND

This site will be located on Groves Creek on the northeast end of Skidaway Island. The marsh and surrounding upland is state property under the authority of the University System of Georgia. The 5 floating cages and five bottom cages will be placed within the polygon below (Figure 7). The ends of the line will be marked with buoys, described above, and bottom cages will be marked with commercial crab floats, described above. The depth of Groves Creek was measured along 3 transects within the polygon (Figure 7). The channel width, measured from spartina edge to spartina edge is ~42 m at the north, middle, and south. At MLLW the channel edge is about 5m or less in from the spartina edge on each side and depth and at MLLW the channel is 32m wide at along each transect. The profile of the depth along each transect is listed below in Table 2. Floating and bottom cages will be set within 3-6 meters of the MLW line, the channel word edge of polygon is 9 meters (28% of the channel) from the MLW mark to allow for cage movement. This will leave 72% of channel open at MLLW. The coordinates of the middle of the polygon in figure 7 is 31.974, -81.024.

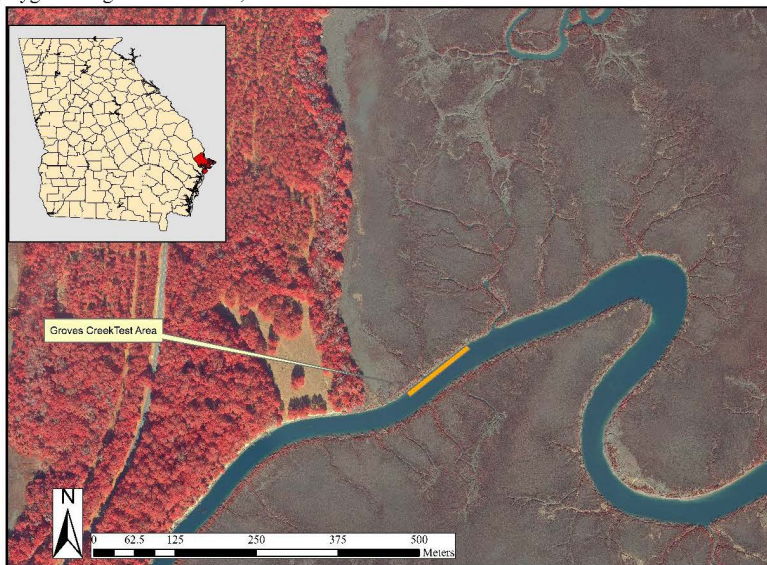


Figure 7. Proposed location (orange rectangle) in Groves Creek for placement of floating and bottom cages.

Table 2. Channel depth and distance from spartina edge in Groves Creek in proposed area for floating and bottom cages.

Distance (Meters)	Depth (Meters) transect 1	Depth (meters) transect 2
3	0.5	0.5
6	2.5	2
16 (midway)	3.5	3
6	1.5	2
3	0.5	0.5



Research Requirements and Application

November 2017

Purpose:

To evaluate and provide appropriate authorization for research projects conducted in the state's jurisdictional areas for the public's interest.

Research Proposal Procedure:

A written proposal is required for all research projects within the State's jurisdiction. This proposal should include the following:

- Applicant and contact information
 - Principal Investigator, student (if applicable)
- Academic sponsor
- Objectives of the project
- Methods including sampling design
- Brief synopsis
- Map, including lat/long of project. If exact coordinates unknown, provide general area coordinates.
- Literature cited section
- Funding sources (including agency and grant)
- Time frame of the project
- Structural components that will be placed in jurisdiction (i.e. what equipment will be left in the field during the course of the project)
- Coordinates of structures
- Number and frequency of people accessing the site
- Likely impacts of the project to the site
- Listing of all local, state, and/or federal authorizations received or being sought, if applicable
- Qualifications of the PI or project advisors (team) to conduct the research. This should be a resume or CV with summary or similar work

All information above should be included in order for staff to have a completed proposal for review. Please note, additional information may be required depending on project type and/or location. Any changes to the scope of the proposal (including project goals, objectives, or placement of structures) after authorization will need to be re-evaluated by CRD.

Please submit all above information to Sheldon Leiker at sheldon.leiker@dnr.ga.gov.



Research Application Form

Application Title: Evaluation of grow-out gear on Eastern Oyster (*Crassostrea virginica*) in Georgia

Principal Investigator: Thomas Bliss - University of Georgia Marine Extension and Georgia Sea Grant

Student Researcher: _____

Academic Sponsor: Georgia Department of Natural Resources - Coastal Resources Division

Mailing Address: 20 Ocean Science Circle
Savannah, GA 31411

E-mail Address: tbliss@uga.edu **Phone Number:** 912-598-2348

Project Location: Skidaway River, Half Moon FHA Wassaw Sound, Groves Creek; Chatham County

GPS Coordinates: 31.989, -81.026; 31.963, -80.941; 31.974, -81.024

Expected Start Date: March 1, 2018 **Expected End Date:** March 31, 2020

Upon completion of research, Applicants are subject to the following Post Research Requirements:

- Provide DNR a copy of all data collected, with the understanding that DNR will not publish the data without the consent of the researcher, upon request
- Provide DNR a digital copy of any research poster produced by the student, upon request
- Provide DNR a written report of the results, upon request
- Provide DNR a copy of any published materials
- DNR CRD should be properly acknowledged in any publications
- Removal of all project related materials at the end of the project

Principle Investigator's Signature

Date

Student Researcher's Signature

Date

**U.S. ARMY CORPS OF ENGINEERS, SAVANNAH DISTRICT
2017 PRE-CONSTRUCTION NOTIFICATION (PCN)
FOR USE OF CERTAIN NATIONWIDE PERMITS (NWP)**

USE OF NWP NUMBER 48 Date _____

APPLICANT/PROPERTY OWNER University System of Georgia

Phone(hm/bus) 404-962-3155 FAX 404-962-3188 E-Mail jim.james@usg.edu

Address 270 Washington St. SW City Atlanta State GA Zip Code 30334

AGENT/CONSULTANT Thomas Bliss

Phone(hm/bus) 912-598-2348 FAX 912-598-2399 E-Mail tbliss@uga.edu

Address 20 Ocean Science Circle City Savannah State GA Zip Code 31411

PROJECT LOCATION/ADDRESS 20 Ocean Science Circle

City Savannah County Chatham Subdivision _____ Lot _____

Latitude 31.974 Longitude -81.024 Hydrologic Map Cataloging Unit 03060204

Nearest Named Stream, River or Other Waterbody Groves Creek

EXISTING SITE CONDITIONS Site Description attached. Site is adjacent to the University of Georgia Skidaway Campus.

PROJECT DESCRIPTION Request to place 5 floating cages (OysterGro's) and 5 bottom cages to evaluate for oyster aquaculture

MEASURES TAKEN TO AVOIDANCE/MINIMIZE IMPACTS TO WATER OF U.S.
Site is located in Groves Creek and hazard markings will be used used to increase visibility.

APPENDIX B

PROJECT AREA AND IMPACT INFORMATION

	PROJECT AREA		IMPACTS TO US WATERS	
	ACRES	LINEAR FEET	ACRES	LINEAR FEET
TOTAL PROJECT AREA	0.25	N/A	N/A	N/A
UPLAND	0	N/A	N/A	N/A
WETLAND	0	N/A	0	N/A
OPEN WATER	0.25	N/A	0.25	N/A
PERENNIAL STREAM				
INTERMITTENT STREAM				
EPHEMERAL STREAM				
MAN-MADE DITCHES				

MAPS, DRAWINGS AND OTHER INFORMATION. Include information to address answers provided.

1. PCN submitted to the Georgia EPD? (RC A and Appendix A) Yes No
2. PCN submitted to the Georgia CRD? (RC A and Appendix A) Yes No
3. Is the project on or adjacent to a state water, where buffer variance is required? Yes No
4. Is the project within 10 miles of a 303(d) listed stream? Yes No
5. Is the project located in or adjacent to a trout stream? Yes No
6. Is there a water quality management plan for the project site? Yes No
7. Is a copy of the FWS Initial Project Scoping (IPaC) attached to the PCN? (GC 18) Yes No
<http://ecos.fws.gov/ipac/>
8. Are oysters located within the project area? Yes No
9. Are cultural resources located on or near the project site? (GC 20(c)) Yes No
<http://www.nr.nps.gov/>
10. Is compensatory mitigation required? (GC 32(b)(6), GC 23 & RCs H.1–H.5) Yes No
11. Are culverts proposed in streams or wetlands? (RC C.4 and E.1-8) Yes No
12. Is in-stream/wetland storm water management proposed? (RC C.5) Yes No
13. Is the project phased, with future wetland/stream impacts planned? Yes No
14. Have authorized wetland/stream impacts occurred on the project site? Yes No
15. Have unauthorized wetland/stream impacts occurred on the project site? Yes No
16. Is the project located within 5 miles of an airport? Yes No

IMPORTANT NOTES:

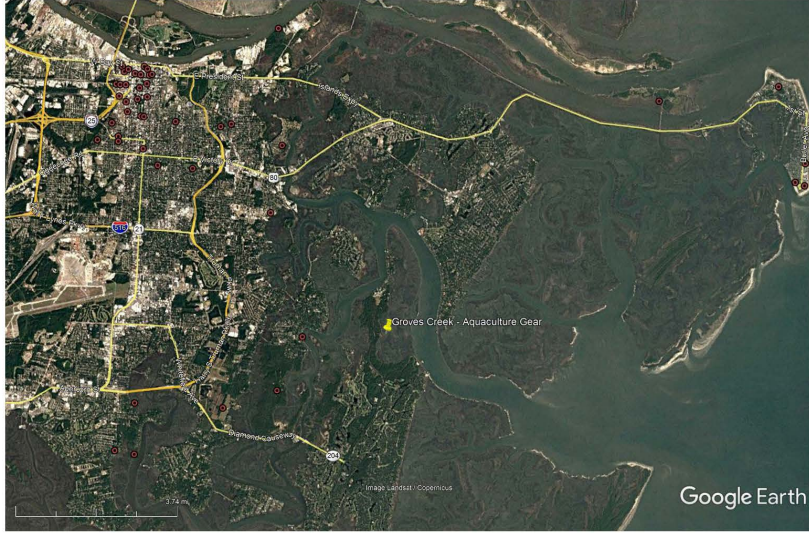
1. For a PCN to be complete for processing, information required at NWP General Condition (GC) 32(b) and Savannah District 2017 NWP Regional Conditions C must be included.
2. All maps and drawings that are attached to this PCN must be submitted on 8 ½ X 11-inch paper. Supplemental maps and drawings larger than 8 ½ X 11 may also be submitted for clarity.

National Register of Historic Places in Chatham County, GA

Reference	State	County	City	Resource	Address	Listed	Resource
85001787	GEORGIA	Chatham	Savannah	Ardley Park-Chatham Crescent Historic District	Roughly bounded by Ardley Pk., Chatham Crescent, Bull St., Baldwin Pk. and Ardmore	19850815	DISTRICT
73000614	GEORGIA	Chatham	Savannah	Bethesda Home for Boys	S of Savannah at Ferguson Ave. and Bethesda Rd.	19730912	DISTRICT
01000035	GEORGIA	Chatham	Savannah	Bonaventure Cemetery	Bonaventure Rd., 1 mi. N of US 80	20010202	DISTRICT
10000273	GEORGIA	Chatham	Tybee Island	Carbo House, The	9 Tyborea St.	20100521	BUILDING
76000610	GEORGIA	Chatham	Savannah	Central of Georgia Depot and Trainshed	W. Broad and Liberty Sts.	19761208	DISTRICT
78000970	GEORGIA	Chatham	Savannah	Central of Georgia Railroad Savannah Shops and Terminal Facilities	W. Broad St. and Railroad Ave.	19780602	DISTRICT
70000199	GEORGIA	Chatham	Savannah	Central of Georgia Railway Company Shop Property	Between W. Jones St. and Louisville Rd.	19700305	DISTRICT
84000934	GEORGIA	Chatham	Savannah	Charity Hospital	644 W. 36th St.	19850502	BUILDING
86003746	GEORGIA	Chatham	Savannah	CSS GEORGIA (Ironclad)	Address Restricted	19870210	SITE
98000028	GEORGIA	Chatham	Savannah	Cuyler-Brownville Historic District	Roughly bounded by Anderson Ln., W. 31st St., Montgomery St., Victory Dr., Ogeechee Rd., and Hopkins St.	19980213	DISTRICT
99000554	GEORGIA	Chatham	Savannah	Daffin Park--Parkside Place Historic District	Bounded by Victory Dr., Waters Ave., Bee St. and 51st Street Ln.	19990512	DISTRICT
72000374	GEORGIA	Chatham	Savannah	Davenport, Isaiah, House	324 E. State St.	19720922	BUILDING
13000626	GEORGIA	Chatham	Savannah	Dreyton Arms Apartments	102 E. Liberty St.	20130106	BUILDING
91000158	GEORGIA	Chatham	Savannah	Drouillard--Maupas House	2422 Abercorn St.	19910513	BUILDING
08000711	GEORGIA	Chatham	Tybee Island	Dutton-Walker Raised Tybee Cottage	1416 7th Ave.	20080724	BUILDING
02001292	GEORGIA	Chatham	Savannah	Eastside Historic District	Roughly bounded by E. Broad, Cedar, Gwinnett and Anderson Sts.	20021107	DISTRICT
09000491	GEORGIA	Chatham	Savannah	Eureka Club--Farr's Point	2326 E. Blvd.	20090708	BUILDING
09000184	GEORGIA	Chatham	Savannah	Fairway Oaks--Greenview Historic District	Bounded approx. by DeBonne Dr., Waters Ave., Truman Pkwy., and Casey Canal, and the Live Oaks Golf Course	20090531	DISTRICT
74000663	GEORGIA	Chatham	Savannah	Federal Building and U.S. Courthouse	Wright Sq.	19740607	BUILDING
78000971	GEORGIA	Chatham	Savannah	First Bryan Baptist Church	575 W. Bryan St.	19780522	BUILDING
70000200	GEORGIA	Chatham	Savannah	Fort James Jackson	Islands Expwy.	19700218	BUILDING
66000064	GEORGIA	Chatham	Savannah	Fort Pulaski National Monument	17 mi. W of Savannah, Cockspar Island	19660105	DISTRICT
82002393	GEORGIA	Chatham	Tybee Island	Fort Screven Historic District	Tilton, Butler, Van Horn, Railroad and Alger Aves., and Pulaski Rd.	19820525	DISTRICT
01000741	GEORGIA	Chatham	Savannah	Gordonston Historic District	Roughly bounded by Skidaway Rd., Goebel Ave., Gwinnett St., and Pennsylvania Ave.	20011011	DISTRICT
74000664	GEORGIA	Chatham	Savannah	Green-Meldrum House	Macon and Bull Sts.	19740121	BUILDING
81000197	GEORGIA	Chatham	Savannah	Hill Hall at Savannah State College	Savannah State College campus	19810423	BUILDING
77000413	GEORGIA	Chatham	Savannah	Hodgson, W. B., Hall	501 Whitaker St.	19770325	BUILDING

84003874	GEORGIA	Chatham	Savannah	Isle of Hope Historic District	Roughly bounded by Skidaway River, Parkersburg Rd., Island, Cormis, and Noble Glen Dr.	19840907	DISTRICT
08000441	GEORGIA	Chatham	Tybee Island	Johanson, J. Herbert and Julia, Raised Tybee Cottage	1306 Jones Ave.	20080521	BUILDING
83000187	GEORGIA	Chatham	Savannah	Louise Grove-North Cemetery	W. Anderson St.	19830804	SITE
78000972	GEORGIA	Chatham	Savannah	Louise Grove-South Cemetery	37th St.	19780906	SITE
79000704	GEORGIA	Chatham	Savannah	Lebanon Plantation	SW of Savannah	19791129	BUILDING
66000276	GEORGIA	Chatham	Savannah	Low, Juliette Gordon, Historic District	10 Oglethorpe Ave., E., 330 Drayton St., 329 Abercorn St.	19660105	DISTRICT
77000414	GEORGIA	Chatham	Savannah	Maisie Common School House	207 E. Gordon St.	19770413	BUILDING
08000713	GEORGIA	Chatham	Tybee Island	Morgan-He Cottage	703 2nd Ave.	20080724	BUILDING
75000375	GEORGIA	Chatham	Fort Wentworth	Mulberry Grove Site	Address Restricted	19750717	SITE
08000349	GEORGIA	Chatham	Tybee Island	Mulherin--Rigdon Raised Tybee Cottage	14 8th Pl.	20080429	BUILDING
01000854	GEORGIA	Chatham	Savannah	New Ogeechee Missionary Baptist Church	751 Chevis Rd.	20010808	BUILDING
78000969	GEORGIA	Chatham	Nicholsonville	Nicholsonville Baptist Church	White Bluff Rd.	19780522	BUILDING
96000468	GEORGIA	Chatham	Savannah	Ossabaw Island	7 mi. S of Savannah, bounded by the Atlantic Ocean, Bear R., Ogeechee R., and St. Catherine's Sound	19960506	DISTRICT
76000611	GEORGIA	Chatham	Savannah	Owens-Thomas House	124 Abercorn St.	19760511	BUILDING
10000604	GEORGIA	Chatham	Tybee Island	Rourke, James and Odessa, Jr., Raised Tybee Cottage	702 14th St	20100923	BUILDING
97000614	GEORGIA	Chatham	Chatham	Savannah and Ogeechee Canal	Roughly along I-95, between the Savannah and Ogeechee R.	19970811	DISTRICT
66000277	GEORGIA	Chatham	Savannah	Savannah Historic District	Bounded by E. Broad, Gwinnett, and W. Broad Sts. and the Savannah River	19661113	DISTRICT
74000665	GEORGIA	Chatham	Savannah	Savannah Victorian Historic District	Roughly bounded by Gwinnett, Price, Anderson, and Montgomery Sts.	19741211	DISTRICT
82002392	GEORGIA	Chatham	Savannah	Savannah Victorian Historic District (Boundary Inquest)	Bounded by Gwinnett, Anderson and 31st Sk.	19820520	DISTRICT
70000201	GEORGIA	Chatham	Savannah	Scarborough, William, House	41 W. Broad St.	19700622	BUILDING
03000286	GEORGIA	Chatham	Tybee Island	Sea View Apartments	7 18th St.	20030422	BUILDING
83000188	GEORGIA	Chatham	Savannah	Slotin Building	101 W. Broad St.	19830324	BUILDING
82002391	GEORGIA	Chatham	Burroughs	St. Bartholomew's Church	Cheves Rd.	19820617	BUILDING
84000959	GEORGIA	Chatham	Savannah	St. Philip AME Church	613 W. Broad St.	19840802	BUILDING
71000271	GEORGIA	Chatham	Savannah	Sturges, Oliver, House	27 Abercorn St.	19710714	BUILDING
76000612	GEORGIA	Chatham	Savannah	Telfair Academy	121 Burnard St.	19760511	BUILDING
97000613	GEORGIA	Chatham	Savannah	Thomas Square Streetcar Historic District	Roughly bounded by Anderson Ln., 42nd St., Victory Dr., E. Broad St., and Martin Luther King, Jr. Blvd.	19970729	DISTRICT
90000492	GEORGIA	Chatham	Savannah	Two Pierpont Circle	2 Pierpont Cir.	19900404	BUILDING
99000928	GEORGIA	Chatham	Tybee Island	Tybee Island Back River Historic District	Along Chatham Ave., from Tybee River to Venetian Dr.	19990805	DISTRICT

98000971	GEORGIA	Chatham	Tybee Island	Tybee Island Strand Cottages Historic District	Along Butler Ave., between 12 St. and 14th St.	19990402	DISTRICT
74000666	GEORGIA	Chatham	Savannah	U.S. Customhouse	1-3 E. Bay St.	19740529	BUILDING
00000714	GEORGIA	Chatham	Vernonburg	Vernonburg Historic District	Dancy Ave., Rockwell Ave. and S. Rockwell Ave.	20000622	DISTRICT
77000415	GEORGIA	Chatham	Savannah	Wild Heron	15 mi. SW of Savannah off U.S. 17	19771216	BUILDING
73000615	GEORGIA	Chatham	Savannah	Wormsloe Plantation	Isle of Hope and Long Island	19730426	DISTRICT



Proposed aquaculture site location marked in yellow, National Register of Historic Sites Marked in Red.



United States Department of the Interior

FISH AND WILDLIFE SERVICE
Georgia Ecological Services Field Office
105 Westpark Drive
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Athens, GA 30606-3175
Phone: (706) 613-9493 Fax: (706) 613-6059



In Reply Refer To:
Consultation Code: 04EG1000-2018-SLI-1118
Event Code: 04EG1000-2018-E-01647
Project Name: Groves Creek - Directed project

February 16, 2018

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

This list identifies threatened, endangered, proposed and candidate species, as well as critical habitat, that may be affected by your proposed project. This list may change before your project is completed. Under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this list should be verified after 90 days. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation.

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*). Projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html).

Wind energy projects should follow the wind energy guidelines <http://www.fws.gov/windenergy/> for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts of communication towers on migratory birds can be found under the "Bird Hazards" tab at: www.fws.gov/migratorybirds.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Georgia Ecological Services Field Office

105 Westpark Drive
Westpark Center Suite D
Athens, GA 30606-3175
(706) 613-9493

Project Summary

Consultation Code: 04EG1000-2018-SLI-1118

Event Code: 04EG1000-2018-E-01647

Project Name: Groves Creek - Directed project

Project Type: ** OTHER **

Project Description: Evaluation of aquaculture gear on the growth and survival of oysters.

Project Location:

Approximate location of the project can be viewed in Google Maps: <https://www.google.com/maps/place/31.974406900332987N81.02372496816525W>



Counties: Chatham, GA

Endangered Species Act Species

There is a total of 14 threatened, endangered, or candidate species on this species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

Mammals

NAME	STATUS
West Indian Manatee <i>Trichechus manatus</i> There is final critical habitat for this species. Your location is outside the critical habitat. <i>This species is also protected by the Marine Mammal Protection Act, and may have additional consultation requirements.</i> Species profile: https://ecos.fws.gov/ecp/species/4469	Threatened

Birds

NAME	STATUS
Piping Plover <i>Charadrius melodus</i> Population: [Atlantic Coast and Northern Great Plains populations] - Wherever found, except those areas where listed as endangered. There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6039	Threatened
Piping Plover <i>Charadrius melodus</i> Population: [Great Lakes watershed DPS] - Great Lakes, watershed in States of IL, IN, MI, MN, NY, OH, PA, and WI and Canada (Ont.) There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6039	Endangered
Red Knot <i>Calidris canutus rufa</i> No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1864	Threatened
Red-cockaded Woodpecker <i>Picoides borealis</i> No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/7614	Endangered
Wood Stork <i>Mycteria americana</i> Population: AL, FL, GA, MS, NC, SC No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8477	Threatened

Reptiles

NAME	STATUS
Eastern Indigo Snake <i>Drymarchon corais couperi</i> No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/646	Threatened
Gopher Tortoise <i>Gopherus polyphemus</i> Population: eastern No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6994	Candidate
Green Sea Turtle <i>Chelonia mydas</i> Population: North Atlantic DPS No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6199	Threatened
Kemp's Ridley Sea Turtle <i>Lepidochelys kempii</i> There is proposed critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/5523	Endangered
Leatherback Sea Turtle <i>Dermochelys coriacea</i> There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1493	Endangered
Loggerhead Sea Turtle <i>Caretta caretta</i> Population: Northwest Atlantic Ocean DPS There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1110	Threatened

Amphibians

NAME	STATUS
Frosted Flatwoods Salamander <i>Ambystoma cingulatum</i> There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/4981	Threatened

Flowering Plants

NAME	STATUS
Pondberry <i>Lindera melissifolia</i> No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1279	Endangered

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.



STATE OF GEORGIA

REVOCABLE LICENSE REQUEST FOR THE USE OF TIDAL WATERBOTTOMS

APPLICANTS NAME(S): University System of Georgia

MAILING ADDRESS: 270 Washington St.SW, Atlanta, GA, 30334
(Street) (City) (State) (Zip)

PROJECT ADDRESS/LOCATION: Skidaway Island, 31.974, -81.024

COUNTY: Chatham WATERWAY: Groves Creek DATE: 2/28/2018

LOT, BLOCK & SUBDIVISION NAME FROM DEED: _____

Georgia Department of Natural Resources
Coastal Resources Division
One Conservation Way
Brunswick, Georgia 31520-8687

I am requesting that I be granted a revocable license from the State of Georgia to encroach on the beds of tidewaters, which are state owned property. Attached hereto and made a part of this request is a copy of the plans and description of the project that will be the subject of such a license. I certify that all information submitted is true and correct to the best of my knowledge and understand that willful misrepresentation or falsification is punishable by law.

I understand that if permission from the State is granted, it will be a revocable license and will not constitute a license coupled with an interest. I acknowledge that this revocable license does not resolve any actual or potential disputes regarding the ownership of, or rights in, or over the property upon which the subject project is proposed, and shall not be construed as recognizing or denying any such rights or interests. I acknowledge that such a license would relate only to the property interests of the State and would not obviate the necessity of obtaining any other State license, permit or authorization required by State law. I recognize that I waive my right of expectation of privacy and I do not have the permission of the State of Georgia to proceed with such project until the Commissioner of DNR or his/her designee has signed a copy of this request.

Sincerely,

By: _____
(Applicant), title if applicable

By: _____
(Applicant), title if applicable

The State of Georgia hereby grants you a revocable license not coupled with an interest as provided in your request. This area may now or in the future be utilized by boats employing power drawn nets under the provisions for commercial or sport bait shrimping. In its occupancy and use of the premises, licensee shall not discriminate against any person on the basis of race, gender, color, national origin, religion, age, or disability. This covenant by licensee may be enforced by termination of this license, by injunction, and by any other remedy available at law to the Department. The project proposed for this license must be constructed and completed within **the specified timeframe associated with the authorization and/or transmittal letter associated with this revocable license** and must be maintained in serviceable condition. Otherwise, action will be initiated to revoke this license and all structures must be removed immediately at the licensee's expense.

STATE OF GEORGIA
Office of the Governor

By: _____
For: Mark Williams, Commissioner-DNR

Date: _____

**U.S. ARMY CORPS OF ENGINEERS, SAVANNAH DISTRICT
2017 PRE-CONSTRUCTION NOTIFICATION (PCN)
FOR USE OF CERTAIN NATIONWIDE PERMITS (NWP)**

USE OF NWP NUMBER 48 Date _____

APPLICANT/PROPERTY OWNER University System of Georgia

Phone(hm/bus) 404-962-3155 FAX 404-962-3188 E-Mail jim.james@usg.edu

Address 270 Washington St. SW City Atlanta State GA Zip Code 30334

AGENT/CONSULTANT Thomas Bliss

Phone(hm/bus) 912-598-2348 FAX 912-598-2399 E-Mail tbliss@uga.edu

Address 20 Ocean Science Circle City Savannah State GA Zip Code 31411

PROJECT LOCATION/ADDRESS 20 Ocean Science Circle

City Savannah County Chatham Subdivision _____ Lot _____

Latitude 31.974 Longitude -81.024 Hydrologic Map Cataloging Unit 03060204

Nearest Named Stream, River or Other Waterbody Groves Creek

EXISTING SITE CONDITIONS Site Description attached. Site is adjacent to the University of Georgia Skidaway Campus.

PROJECT DESCRIPTION Request to place 5 floating cages (OysterGro's) and 5 bottom cages to evaluate for oyster aquaculture

MEASURES TAKEN TO AVOIDANCE/MINIMIZE IMPACTS TO WATER OF U.S.
Site is located in Groves Creek and hazard markings will be used used to increase visibility.

APPENDIX B

PROJECT AREA AND IMPACT INFORMATION

	PROJECT AREA		IMPACTS TO US WATERS	
	ACRES	LINEAR FEET	ACRES	LINEAR FEET
TOTAL PROJECT AREA	0.25	N/A	N/A	N/A
UPLAND	0	N/A	N/A	N/A
WETLAND	0	N/A	0	N/A
OPEN WATER	0.25	N/A	0.25	N/A
PERENNIAL STREAM				
INTERMITTENT STREAM				
EPHEMERAL STREAM				
MAN-MADE DITCHES				

MAPS, DRAWINGS AND OTHER INFORMATION. Include information to address answers provided.

1. PCN submitted to the Georgia EPD? (RC A and Appendix A) Yes No
2. PCN submitted to the Georgia CRD? (RC A and Appendix A) Yes No
3. Is the project on or adjacent to a state water, where buffer variance is required? Yes No
4. Is the project within 10 miles of a 303(d) listed stream? Yes No
5. Is the project located in or adjacent to a trout stream? Yes No
6. Is there a water quality management plan for the project site? Yes No
7. Is a copy of the FWS Initial Project Scoping (IPaC) attached to the PCN? (GC 18) Yes No
<http://ecos.fws.gov/ipac/>
8. Are oysters located within the project area? Yes No
9. Are cultural resources located on or near the project site? (GC 20(c)) Yes No
<http://www.nr.nps.gov/>
10. Is compensatory mitigation required? (GC 32(b)(6), GC 23 & RCs H.1–H.5) Yes No
11. Are culverts proposed in streams or wetlands? (RC C.4 and E.1-8) Yes No
12. Is in-stream/wetland storm water management proposed? (RC C.5) Yes No
13. Is the project phased, with future wetland/stream impacts planned? Yes No
14. Have authorized wetland/stream impacts occurred on the project site? Yes No
15. Have unauthorized wetland/stream impacts occurred on the project site? Yes No
16. Is the project located within 5 miles of an airport? Yes No

IMPORTANT NOTES:

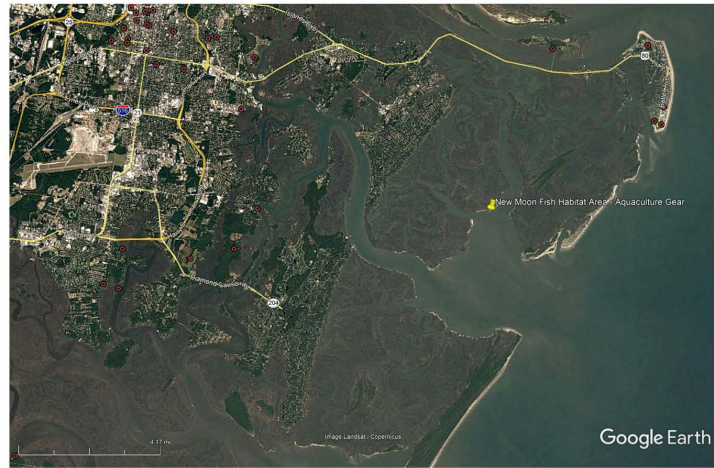
1. For a PCN to be complete for processing, information required at NWP General Condition (GC) 32(b) and Savannah District 2017 NWP Regional Conditions C must be included.
2. All maps and drawings that are attached to this PCN must be submitted on 8 ½ X 11-inch paper. Supplemental maps and drawings larger than 8 ½ X 11 may also be submitted for clarity.

National Register of Historic Places in Chatham County, GA

Reference	State	County	City	Resource	Address	Listed	Resource
85001787	GEORGIA	Chatham	Savannah	Ardley Park-Chatham Crescent Historic District	Roughly bounded by Ardley Pk., Chatham Crescent, Bull St., Baldwin Pl. and Ardmore	19830815	DISTRICT
73000614	GEORGIA	Chatham	Savannah	Bethesda Home for Boys	S of Savannah at Ferguson Ave. and Bethesda Rd.	19730912	DISTRICT
01000035	GEORGIA	Chatham	Savannah	Bonaventure Cemetery	Bonaventure Rd., 1 mi. N of US 80	20010202	DISTRICT
10000273	GEORGIA	Chatham	Tybee Island	Carbo House, The	9 Tybrius St.	20100521	BUILDING
76000610	GEORGIA	Chatham	Savannah	Central of Georgia Depot and Trainshed	W. Broad and Liberty Sts.	19761208	DISTRICT
78000970	GEORGIA	Chatham	Savannah	Central of Georgia Railroad: Savannah Shops and Terminal Facilities	W. Broad St. and Railroad Ave.	19780602	DISTRICT
70000199	GEORGIA	Chatham	Savannah	Central of Georgia Railway Company Shop Property	Between W. Jones St. and Louisville Rd.	19780305	DISTRICT
85000934	GEORGIA	Chatham	Savannah	Charity Hospital	644 W. 36th St.	19830502	BUILDING
86003746	GEORGIA	Chatham	Savannah	CSS GEORGIA (Ironclad)	Address Restricted	19870210	SITE
98000028	GEORGIA	Chatham	Savannah	Cuyler-Brownville Historic District	Roughly bounded by Anderson Ln., W. 31st St., Montgomery St., Victory Dr., Ogeechee Rd., and Hopkins St.	19980213	DISTRICT
99000554	GEORGIA	Chatham	Savannah	Daffin Park-Parkside Place Historic District	Bounded by Victory Dr., Waters Ave., Bee St. and 51st Street Ln.	19990512	DISTRICT
72000374	GEORGIA	Chatham	Savannah	Davenport, Isaiah, House	324 E. State St.	19720922	BUILDING
13000826	GEORGIA	Chatham	Savannah	Drayton Arms Apartments	102 E. Liberty St.	20131016	BUILDING
91000558	GEORGIA	Chatham	Savannah	Drossillard-Maupas House	2422 Abercorn St.	19910513	BUILDING
08000711	GEORGIA	Chatham	Tybee Island	Dutton-Walker Raised Tybee Cottage	1416 7th Ave.	20080724	BUILDING
02001292	GEORGIA	Chatham	Savannah	Eastside Historic District	Roughly bounded by E. Broad, Cedar, Gwinnett and Anderson Sts.	20021107	DISTRICT
09000491	GEORGIA	Chatham	Savannah	Eureka Club-Harris Point	2326 E. Blvd.	20090708	BUILDING
09000184	GEORGIA	Chatham	Savannah	Fairway Oaks-Greenview Historic District	Bounded approx. by DeLenne Dr., Waters Ave., Truman Pkwy., and Casey Canal, and the Live Oaks Golf Course	20090331	DISTRICT
74000663	GEORGIA	Chatham	Savannah	Federal Building and U.S. Courthouse	Wright Sq.	19740607	BUILDING
78000971	GEORGIA	Chatham	Savannah	First Bryan Baptist Church	575 W. Bryan St.	19780522	BUILDING
70000200	GEORGIA	Chatham	Savannah	Fort James Jackson	Islands Expwy.	19700218	BUILDING
66000664	GEORGIA	Chatham	Savannah	Fort Pulaski National Monument	17 mi. W of Savannah, Cocker Island	19661015	DISTRICT
82002393	GEORGIA	Chatham	Tybee Island	Fort Screven Historic District	Tilton, Butler, Van Horn, Railroad and Alger Aves., and Pulaski Rd.	19820525	DISTRICT
01000741	GEORGIA	Chatham	Savannah	Gordonston Historic District	Roughly bounded by Skidaway Rd., Goebel Ave., Gwinnett St., and Pennsylvania Ave.	20011011	DISTRICT
74000664	GEORGIA	Chatham	Savannah	Green-Meldrim House	Macon and Bull Sts.	19740121	BUILDING

81000197	GEORGIA	Chatham	Savannah	Hill Hall at Savannah State College	Savannah State College campus	19810423	BUILDING
77000413	GEORGIA	Chatham	Savannah	Hodgson, W. B., Hall	501 Whitaker St.	19770325	BUILDING
84003874	GEORGIA	Chatham	Savannah	Isle of Hope Historic District	Roughly bounded by Skidaway River, Parkersburg Rd., Island, Cornus, and Noble Glen Drs.	19840907	DISTRICT
08000441	GEORGIA	Chatham	Tybee Island	Jolmon, J. Herbert and Julia, Raised Tybee Cottage	1306 Jones Ave.	20080521	BUILDING
83000187	GEORGIA	Chatham	Savannah	Laurel Grove-North Cemetery	W. Anderson St.	19830804	SITE
78000972	GEORGIA	Chatham	Savannah	Laurel Grove-South Cemetery	37th St.	19780906	SITE
79000704	GEORGIA	Chatham	Savannah	Lebanon Plantation	SW of Savannah	19791129	BUILDING
66000276	GEORGIA	Chatham	Savannah	Low, Fajette Gordon, Historic District	10 Oglethorpe Ave., E., 330 Drayton St., 329 Abercorn St.	19661015	DISTRICT
77000414	GEORGIA	Chatham	Savannah	Massie Common School House	207 E. Gordon St.	19770413	BUILDING
08000713	GEORGIA	Chatham	Tybee Island	Morgan-Ille Cottage	703 2nd Ave.	20080724	BUILDING
75000575	GEORGIA	Chatham	Fort Wentworth	Mulberry Grove Site	Address Restricted	19750717	SITE
08000349	GEORGIA	Chatham	Tybee Island	Mulherin-Righton Raised Tybee Cottage	14 8th Pl.	20080429	BUILDING
01000854	GEORGIA	Chatham	Savannah	New Ogeechee Missionary Baptist Church	751 Chevis Rd.	20010808	BUILDING
78000969	GEORGIA	Chatham	Nicholsonville	Nicholsonville Baptist Church	White Bluff Rd.	19780522	BUILDING
96000168	GEORGIA	Chatham	Savannah	Osabaw Island	7 mi. S of Savannah, bounded by the Atlantic Ocean, Bear R., Ogeechee R., and St. Catherine's Sound	19960506	DISTRICT
76000611	GEORGIA	Chatham	Savannah	Owens-Thomas House	124 Abercorn St.	19760511	BUILDING
10000604	GEORGIA	Chatham	Tybee Island	Rourke, James and Odessa, Jr., Raised Tybee Cottage	702 14th St	20100923	BUILDING
97000614	GEORGIA	Chatham	Chatham	Savannah and Ogeechee Canal	Roughly along I-95, between the Savannah and Ogeechee Rs.	19970811	DISTRICT
66000277	GEORGIA	Chatham	Savannah	Savannah Historic District	Bounded by E. Broad, Gwinnett, and W. Broad Sts. and the Savannah River	19661113	DISTRICT
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82002392	GEORGIA	Chatham	Savannah	Savannah Victorian Historic District (Boundary Increase)	Bounded by Gwinnett, Anderson and 31st Sts.	19820520	DISTRICT
70000201	GEORGIA	Chatham	Savannah	Scarborough, William, House	41 W. Broad St.	19700622	BUILDING
03000286	GEORGIA	Chatham	Tybee Island	Sea View Apartments	7 18th St.	20030422	BUILDING
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82002391	GEORGIA	Chatham	Burroughs	St. Bartholomew's Church	Cheves Rd.	19820617	BUILDING
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90000492	GEORGIA	Chatham	Savannah	Two Pierpont Circle	2 Pierpont Cir.	19900404	BUILDING
99000928	GEORGIA	Chatham	Tybee Island	Tybee Island Back River Historic District	Along Chatham Ave., from Tybee River to Venetian Dr.	19990805	DISTRICT
98000971	GEORGIA	Chatham	Tybee Island	Tybee Island Strand Cottages Historic District	Along Butler Ave., between 12 St. and 14th St.	19990402	DISTRICT
74000666	GEORGIA	Chatham	Savannah	U.S. Customhouse	1--3 E. Bay St.	19740529	BUILDING
00000714	GEORGIA	Chatham	Vernonburg	Vernonburg Historic District	Dancy Ave., Rockwell Ave. and S. Rockwell Ave.	20000622	DISTRICT
77000415	GEORGIA	Chatham	Savannah	Wild Heron	15 mi. SW of Savannah off U.S. 17	19771216	BUILDING
73000615	GEORGIA	Chatham	Savannah	Wormsloe Plantation	Isle of Hope and Long Island	19730426	DISTRICT



Proposed aquaculture site location marked in yellow, National Register of Historic Sites Marked in Red.



United States Department of the Interior

FISH AND WILDLIFE SERVICE
Georgia Ecological Services Field Office
105 Westpark Drive
Westpark Center Suite D
Athens, GA 30606-3175
Phone: (706) 613-9493 Fax: (706) 613-6059



In Reply Refer To: February 16, 2018
Consultation Code: 04EG1000-2018-SLI-1119
Event Code: 04EG1000-2018-E-01649
Project Name: Half Moon River FHA - Directed project

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

This list identifies threatened, endangered, proposed and candidate species, as well as critical habitat, that may be affected by your proposed project. This list may change before your project is completed. Under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this list should be verified after 90 days. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation.

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Wind energy projects should follow the wind energy guidelines <http://www.fws.gov/windenergy/> for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts of communication towers on migratory birds can be found under the "Bird Hazards" tab at: www.fws.gov/migratorybirds.

Attachment(s):

- Official Species List

Official Species List

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This species list is provided by:

Georgia Ecological Services Field Office

105 Westpark Drive
Westpark Center Suite D
Athens, GA 30606-3175
(706) 613-9493

Project Summary

Consultation Code: 04EG1000-2018-SLI-1119

Event Code: 04EG1000-2018-E-01649

Project Name: Half Moon River FHA - Directed project

Project Type: ** OTHER **

Project Description: Evaluation of aquaculture gear on the growth and survival of oysters.

Project Location:

Approximate location of the project can be viewed in Google Maps: <https://www.google.com/maps/place/31.963363180094824N80.94158287615275W>



Counties: Chatham, GA

Endangered Species Act Species

There is a total of 14 threatened, endangered, or candidate species on this species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

Mammals

NAME	STATUS
<p>West Indian Manatee <i>Trichechus manatus</i></p> <p>There is final critical habitat for this species. Your location is outside the critical habitat. This species is also protected by the Marine Mammal Protection Act, and may have additional consultation requirements. Species profile: https://ecos.fws.gov/ecp/species/4469</p>	Threatened

Birds

NAME	STATUS
<p>Piping Plover <i>Charadrius melodus</i></p> <p>Population: [Great Lakes watershed DPS] - Great Lakes, watershed in States of IL, IN, MI, MN, NY, OH, PA, and WI and Canada (Ont.) There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6039</p>	Endangered
<p>Piping Plover <i>Charadrius melodus</i></p> <p>Population: [Atlantic Coast and Northern Great Plains populations] - Wherever found, except those areas where listed as endangered. There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6039</p>	Threatened
<p>Red Knot <i>Calidris canutus rufa</i></p> <p>No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1864</p>	Threatened
<p>Red-cockaded Woodpecker <i>Picoides borealis</i></p> <p>No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/7614</p>	Endangered
<p>Wood Stork <i>Mycteria americana</i></p> <p>Population: AL, FL, GA, MS, NC, SC No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8477</p>	Threatened

Reptiles

NAME	STATUS
Eastern Indigo Snake <i>Drymarchon corais couperi</i> No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/646	Threatened
Gopher Tortoise <i>Gopherus polyphemus</i> Population: eastern No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6994	Candidate
Green Sea Turtle <i>Chelonia mydas</i> Population: North Atlantic DPS No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6199	Threatened
Kemp's Ridley Sea Turtle <i>Lepidochelys kempii</i> There is proposed critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/5523	Endangered
Leatherback Sea Turtle <i>Dermochelys coriacea</i> There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1493	Endangered
Loggerhead Sea Turtle <i>Caretta caretta</i> Population: Northwest Atlantic Ocean DPS There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1110	Threatened

Amphibians

NAME	STATUS
Frosted Flatwoods Salamander <i>Ambystoma cingulatum</i> There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/4981	Threatened

Flowering Plants

NAME	STATUS
Pondberry <i>Lindera melissifolia</i> No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1279	Endangered

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.



STATE OF GEORGIA

REVOCABLE LICENSE REQUEST FOR THE USE OF TIDAL WATERBOTTOMS

APPLICANTS NAME(S): University System of Georgia

MAILING ADDRESS: 270 Washington St.SW, Atlanta, GA, 30334
(Street) (City) (State) (Zip)

PROJECT ADDRESS/LOCATION: Skidaway Island, 31.974, -81.024

COUNTY: Chatham WATERWAY: Groves Creek DATE: 2/28/2018

LOT, BLOCK & SUBDIVISION NAME FROM DEED: _____

Georgia Department of Natural Resources
Coastal Resources Division
One Conservation Way
Brunswick, Georgia 31520-8687

I am requesting that I be granted a revocable license from the State of Georgia to encroach on the beds of tidewaters, which are state owned property. Attached hereto and made a part of this request is a copy of the plans and description of the project that will be the subject of such a license. I certify that all information submitted is true and correct to the best of my knowledge and understand that willful misrepresentation or falsification is punishable by law.

I understand that if permission from the State is granted, it will be a revocable license and will not constitute a license coupled with an interest. I acknowledge that this revocable license does not resolve any actual or potential disputes regarding the ownership of, or rights in, or over the property upon which the subject project is proposed, and shall not be construed as recognizing or denying any such rights or interests. I acknowledge that such a license would relate only to the property interests of the State and would not obviate the necessity of obtaining any other State license, permit or authorization required by State law. I recognize that I waive my right of expectation of privacy and I do not have the permission of the State of Georgia to proceed with such project until the Commissioner of DNR or his/her designee has signed a copy of this request.

Sincerely,

By: _____
(Applicant), title if applicable

By: _____
(Applicant), title if applicable

The State of Georgia hereby grants you a revocable license not coupled with an interest as provided in your request. This area may now or in the future be utilized by boats employing power drawn nets under the provisions for commercial or sport bait shrimping. In its occupancy and use of the premises, licensee shall not discriminate against any person on the basis of race, gender, color, national origin, religion, age, or disability. This covenant by licensee may be enforced by termination of this license, by injunction, and by any other remedy available at law to the Department. The project proposed for this license must be constructed and completed within **the specified timeframe associated with the authorization and/or transmittal letter associated with this revocable license** and must be maintained in serviceable condition. Otherwise, action will be initiated to revoke this license and all structures must be removed immediately at the licensee's expense.

STATE OF GEORGIA
Office of the Governor

By: _____
For: Mark Williams, Commissioner-DNR

Date: _____

**U.S. ARMY CORPS OF ENGINEERS, SAVANNAH DISTRICT
2017 PRE-CONSTRUCTION NOTIFICATION (PCN)
FOR USE OF CERTAIN NATIONWIDE PERMITS (NWP)**

USE OF NWP NUMBER 48 Date _____

APPLICANT/PROPERTY OWNER University System of Georgia

Phone(hm/bus) 404-962-3155 FAX 404-962-3188 E-Mail jim.james@usg.edu

Address 270 Washington St. SW City Atlanta State GA Zip Code 30334

AGENT/CONSULTANT Thomas Bliss

Phone(hm/bus) 912-598-2348 FAX 912-598-2399 E-Mail tbliss@uga.edu

Address 20 Ocean Science Circle City Savannah State GA Zip Code 31411

PROJECT LOCATION/ADDRESS 20 Ocean Science Circle

City Savannah County Chatham Subdivision _____ Lot _____

Latitude 31.974 Longitude -81.024 Hydrologic Map Cataloging Unit 03060204

Nearest Named Stream, River or Other Waterbody Groves Creek

EXISTING SITE CONDITIONS Site Description attached. Site is adjacent to the University of Georgia Skidaway Campus.

PROJECT DESCRIPTION Request to place 5 floating cages (OysterGro's) and 5 bottom cages to evaluate for oyster aquaculture

MEASURES TAKEN TO AVOIDANCE/MINIMIZE IMPACTS TO WATER OF U.S.
Site is located in Groves Creek and hazard markings will be used used to increase visibility.

APPENDIX B

PROJECT AREA AND IMPACT INFORMATION

	PROJECT AREA		IMPACTS TO US WATERS	
	ACRES	LINEAR FEET	ACRES	LINEAR FEET
TOTAL PROJECT AREA	0.25	N/A	N/A	N/A
UPLAND	0	N/A	N/A	N/A
WETLAND	0	N/A	0	N/A
OPEN WATER	0.25	N/A	0.25	N/A
PERENNIAL STREAM				
INTERMITTENT STREAM				
EPHEMERAL STREAM				
MAN-MADE DITCHES				

MAPS, DRAWINGS AND OTHER INFORMATION. Include information to address answers provided.

1. PCN submitted to the Georgia EPD? (RC A and Appendix A) Yes No
2. PCN submitted to the Georgia CRD? (RC A and Appendix A) Yes No
3. Is the project on or adjacent to a state water, where buffer variance is required? Yes No
4. Is the project within 10 miles of a 303(d) listed stream? Yes No
5. Is the project located in or adjacent to a trout stream? Yes No
6. Is there a water quality management plan for the project site? Yes No
7. Is a copy of the FWS Initial Project Scoping (IPaC) attached to the PCN? (GC 18) Yes No
<http://ecos.fws.gov/ipac/>
8. Are oysters located within the project area? Yes No
9. Are cultural resources located on or near the project site? (GC 20(c)) Yes No
<http://www.nr.nps.gov/>
10. Is compensatory mitigation required? (GC 32(b)(6), GC 23 & RCs H.1–H.5) Yes No
11. Are culverts proposed in streams or wetlands? (RC C.4 and E.1-8) Yes No
12. Is in-stream/wetland storm water management proposed? (RC C.5) Yes No
13. Is the project phased, with future wetland/stream impacts planned? Yes No
14. Have authorized wetland/stream impacts occurred on the project site? Yes No
15. Have unauthorized wetland/stream impacts occurred on the project site? Yes No
16. Is the project located within 5 miles of an airport? Yes No

IMPORTANT NOTES:

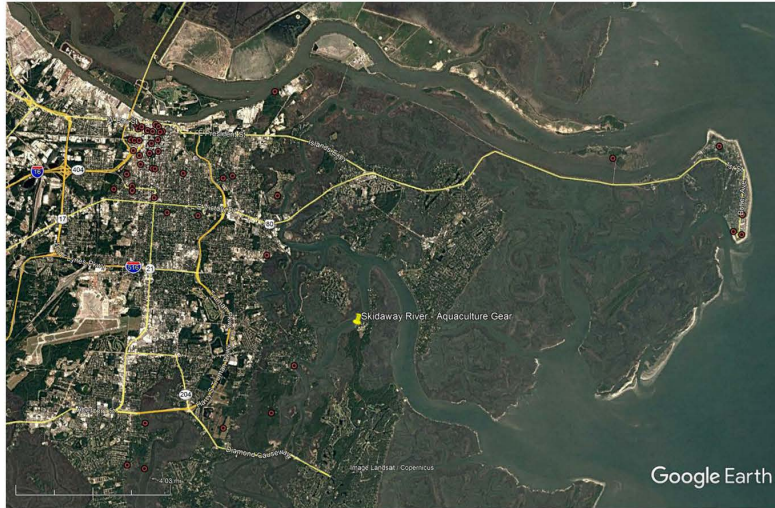
1. For a PCN to be complete for processing, information required at NWP General Condition (GC) 32(b) and Savannah District 2017 NWP Regional Conditions C must be included.
2. All maps and drawings that are attached to this PCN must be submitted on 8 ½ X 11-inch paper. Supplemental maps and drawings larger than 8 ½ X 11 may also be submitted for clarity.

National Register of Historic Place Chatham County, GA

Reference	State	County	City	Resource	Address	Listed	Resource
8501787	GEORGIA	Chatham	Savannah	Ardley Park-Chatham Crescent Historic District	Roughly bounded by Ardley Pk., Chatham Crescent, Bull St., Baldwin Pk. and Ardmore	19850815	DISTRICT
73000614	GEORGIA	Chatham	Savannah	Bethesda Home for Boys	S of Savannah at Ferguson Ave. and Bethesda Rd.	19730912	DISTRICT
01000035	GEORGIA	Chatham	Savannah	Bonaventure Cemetery	Bonaventure Rd., 1 mi. N of US 80	20010202	DISTRICT
10000273	GEORGIA	Chatham	Tybee Island	Carbo House, The	9 Tybrisa St.	20100521	BUILDING
76000610	GEORGIA	Chatham	Savannah	Central of Georgia Depot and Trainshed	W. Broad and Liberty Sts.	19761208	DISTRICT
78000970	GEORGIA	Chatham	Savannah	Central of Georgia Railroad Savannah Shops and Terminal Facilities	W. Broad St. and Railroad Ave.	19780602	DISTRICT
70000199	GEORGIA	Chatham	Savannah	Central of Georgia Railway Company Shop Property	Between W. Jones St. and Louisville Rd.	19700305	DISTRICT
85000934	GEORGIA	Chatham	Savannah	Charity Hospital	644 W. 36th St.	19850502	BUILDING
86003746	GEORGIA	Chatham	Savannah	CSS GEORGIA (ironclad)	Address Restricted	19870210	SITE
98000028	GEORGIA	Chatham	Savannah	Cuyler-Brownville Historic District	Roughly bounded by Anderson Ln., W. 31st St., Montgomery St., Victory Dr., Ogeechee Rd., and Franklin St.	19980213	DISTRICT
99000554	GEORGIA	Chatham	Savannah	Daffin Park-Parkside Place Historic District	Bounded by Victory Dr., Waters Ave., Bee St. and 51st Street Ln.	19990512	DISTRICT
72000374	GEORGIA	Chatham	Savannah	Davenport, Isiah, House	324 E. State St.	19720922	BUILDING
13000826	GEORGIA	Chatham	Savannah	Drayton Arms Apartments	102 E. Liberty St.	20131016	BUILDING
91000558	GEORGIA	Chatham	Savannah	Drouillard-Maupus House	2422 Abercorn St.	19910513	BUILDING
08000711	GEORGIA	Chatham	Tybee Island	Dutton-Waller Raised Tybee Cottage	1416 7th Ave.	20080724	BUILDING
02001292	GEORGIA	Chatham	Savannah	Eastside Historic District	Roughly bounded by E. Broad, Cedar, Gwinnett and Anderson Sts.	20021107	DISTRICT
09000491	GEORGIA	Chatham	Savannah	Eureka Club--Farr's Point	2326 E. Blvd.	20090708	BUILDING
09000184	GEORGIA	Chatham	Savannah	Fairway Oaks-Greenview Historic District	Bounded approx. by DeHenne Dr., Waters Ave., Truman Pkwy., and Casey Canal, and the Live Oaks Golf Course	20090331	DISTRICT
74000663	GEORGIA	Chatham	Savannah	Federal Building and U.S. Courthouse	Wright Sq.	19740607	BUILDING
78000971	GEORGIA	Chatham	Savannah	First Bryan Baptist Church	575 W. Bryan St.	19780522	BUILDING
70000200	GEORGIA	Chatham	Savannah	Fort James Jackson	Islands Expwy.	19700218	BUILDING
66000064	GEORGIA	Chatham	Savannah	Fort Pulaski National Monument	17 mi. W of Savannah, Cockspear Island	19661015	DISTRICT
82002393	GEORGIA	Chatham	Tybee Island	Fort Screven Historic District	Tilton, Butler, Van Horn, Railroad and Alger Aves., and Pulaski Rd.	19820525	DISTRICT
01000741	GEORGIA	Chatham	Savannah	Gordonston Historic District	Roughly bounded by Skidaway Rd., Goebel Ave., Gwinnett St., and Pennsylvania Ave.	20011011	DISTRICT
74000664	GEORGIA	Chatham	Savannah	Green-Meldrim House	Macon and Bull Sts.	19740121	BUILDING
81000197	GEORGIA	Chatham	Savannah	Hill Hall at Savannah State College	Savannah State College campus	19810423	BUILDING
77000413	GEORGIA	Chatham	Savannah	Hodgson, W. B., Hall	501 Whitaker St.	19770325	BUILDING

84003874	GEORGIA	Chatham	Savannah	Isle of Hope Historic District	Roughly bounded by Skidaway River, Parkersburg Rd., Island, Cornus, and Noble Glen Dr.	19840907	DISTRICT
08000441	GEORGIA	Chatham	Tybee Island	Johnson, J. Herbert and Julia, Raised Tybee Cottage	1306 Jones Ave.	20080521	BUILDING
83000187	GEORGIA	Chatham	Savannah	Laurel Grove-North Cemetery	W. Anderson St.	19830804	SITE
78000972	GEORGIA	Chatham	Savannah	Laurel Grove-South Cemetery	37th St.	19780906	SITE
79000704	GEORGIA	Chatham	Savannah	Lebanon Plantation	SW of Savannah	19791129	BUILDING
66000276	GEORGIA	Chatham	Savannah	Low, Juliette Gordon, Historic District	10 Oglethorpe Ave., E., 330 Drayton St., 329 Abercorn St.	19661015	DISTRICT
77000414	GEORGIA	Chatham	Savannah	Maestri Common School House	207 E. Gordon St.	19770413	BUILDING
08000713	GEORGIA	Chatham	Tybee Island	Morgan-Ille Cottage	703 2nd Ave.	20080724	BUILDING
75000375	GEORGIA	Chatham	Port Wentworth	Mulberry Grove Site	Address Restricted	19750717	SITE
08000349	GEORGIA	Chatham	Tybee Island	Mullerin-Righton Raised Tybee Cottage	14 8th Pl.	20080429	BUILDING
01000854	GEORGIA	Chatham	Savannah	New Ogeechee Missionary Baptist Church	751 Chevis Rd.	20010808	BUILDING
78000969	GEORGIA	Chatham	Nicholsonville	Nicholsonville Baptist Church	White Bluff Rd.	19780522	BUILDING
98000468	GEORGIA	Chatham	Savannah	Ossabaw Island	7 mi. S of Savannah, bounded by the Atlantic Ocean, Bear R., Ogeechee R., and St. Catherine's Sound	19960506	DISTRICT
76000611	GEORGIA	Chatham	Savannah	Owens-Thomas House	124 Abercorn St.	19760511	BUILDING
10000804	GEORGIA	Chatham	Tybee Island	Rourke, James and Odessa, Jr., Raised Tybee Cottage	702 14th St.	20100923	BUILDING
97000814	GEORGIA	Chatham	Chatham	Savannah and Ogeechee Canal	Roughly along I-95, between the Savannah and Ogeechee Rs.	19970811	DISTRICT
66000277	GEORGIA	Chatham	Savannah	Savannah Historic District	Bounded by E. Broad, Gwinnett, and W. Broad Sts. and the Savannah River	19661113	DISTRICT
74000665	GEORGIA	Chatham	Savannah	Savannah Victorian Historic District	Roughly bounded by Gwinnett, Price, Anderson, and Montgomery Sts.	19741211	DISTRICT
82002392	GEORGIA	Chatham	Savannah	Savannah Victorian Historic District (Boundary Increase)	Bounded by Gwinnett, Anderson and 31st Sts.	19820520	DISTRICT
70000201	GEORGIA	Chatham	Savannah	Scarborough, William, House	41 W. Broad St.	19700622	BUILDING
03000286	GEORGIA	Chatham	Tybee Island	Sea View Apartments	7 18th St.	20090422	BUILDING
83000188	GEORGIA	Chatham	Savannah	Sletin Building	101 W. Broad St.	19830324	BUILDING
82002391	GEORGIA	Chatham	Burroughs	St. Bartholomew's Church	Cheves Rd.	19820617	BUILDING
84000959	GEORGIA	Chatham	Savannah	St. Philip AME Church	613 W. Broad St.	19840802	BUILDING
71000271	GEORGIA	Chatham	Savannah	Sturges, Oliver, House	27 Abercorn St.	19710714	BUILDING
76000612	GEORGIA	Chatham	Savannah	Telfair Academy	121 Barnard St.	19760511	BUILDING
97000813	GEORGIA	Chatham	Savannah	Thomas Square Streetcar Historic District	Roughly bounded by Anderson Ln., 42nd St., Victory Dr., E. Broad St., and Martin Luther King, Jr. Blvd.	19970729	DISTRICT
99000492	GEORGIA	Chatham	Savannah	Two Pierpont Circle	2 Pierpont Cir.	19900404	BUILDING
99000928	GEORGIA	Chatham	Tybee Island	Tybee Island Back River Historic District	Along Chatham Ave., from Tybee River to Venetian Dr.	19990805	DISTRICT

98000971	GEORGIA	Chatham	Tybee Island	Tybee Island Strand Cottages Historic District	Along Butler Ave., between 12 St. and 14th St.	19990402	DISTRICT
74000666	GEORGIA	Chatham	Savannah	U.S. Customhouse	1-3 E. Bay St.	19740529	BUILDING
00000714	GEORGIA	Chatham	Vernonburg	Vernonburg Historic District	Dancy Ave., Rockwell Ave. and S. Rockwell Ave.	20000622	DISTRICT
77000415	GEORGIA	Chatham	Savannah	Wild Heron	15 mi. SW of Savannah off U.S. 17	19771216	BUILDING
73000615	GEORGIA	Chatham	Savannah	Wormsloe Plantation	Isle of Hope and Long Island	19730426	DISTRICT



Proposed commercial shellfish nursery marked in yellow, National Register of Historic Sites Marked in Red.



United States Department of the Interior

FISH AND WILDLIFE SERVICE
Georgia Ecological Services Field Office
105 Westpark Drive
Westpark Center Suite D
Athens, GA 30606-3175
Phone: (706) 613-9493 Fax: (706) 613-6059



In Reply Refer To:
Consultation Code: 04EG1000-2018-SLI-1117
Event Code: 04EG1000-2018-E-01645
Project Name: Skidaway - Directed project

February 16, 2018

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

This list identifies threatened, endangered, proposed and candidate species, as well as critical habitat, that may be affected by your proposed project. This list may change before your project is completed. Under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this list should be verified after 90 days. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation.

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*). Projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html).

Wind energy projects should follow the wind energy guidelines <http://www.fws.gov/windenergy/> for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts of communication towers on migratory birds can be found under the "Bird Hazards" tab at: www.fws.gov/migratorybirds.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Georgia Ecological Services Field Office

105 Westpark Drive
Westpark Center Suite D
Athens, GA 30606-3175
(706) 613-9493

Project Summary

Consultation Code: 04EG1000-2018-SLI-1117

Event Code: 04EG1000-2018-E-01645

Project Name: Skidaway - Directed project

Project Type: ** OTHER **

Project Description: Project to evaluate aquaculture gear on the growth and survival of oysters.

Project Location:

Approximate location of the project can be viewed in Google Maps: <https://www.google.com/maps/place/31.98864220511819N81.02574073305396W>



Counties: Chatham, GA

Endangered Species Act Species

There is a total of 14 threatened, endangered, or candidate species on this species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

Mammals

NAME	STATUS
<p>West Indian Manatee <i>Trichechus manatus</i></p> <p>There is final critical habitat for this species. Your location is outside the critical habitat. This species is also protected by the Marine Mammal Protection Act, and may have additional consultation requirements. Species profile: https://ecos.fws.gov/ecp/species/4469</p>	Threatened

Birds

NAME	STATUS
<p>Piping Plover <i>Charadrius melodus</i></p> <p>Population: [Great Lakes watershed DPS] - Great Lakes, watershed in States of IL, IN, MI, MN, NY, OH, PA, and WI and Canada (Ont.) There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6039</p>	Endangered
<p>Piping Plover <i>Charadrius melodus</i></p> <p>Population: [Atlantic Coast and Northern Great Plains populations] - Wherever found, except those areas where listed as endangered. There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6039</p>	Threatened
<p>Red Knot <i>Calidris canutus rufa</i></p> <p>No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1864</p>	Threatened
<p>Red-cockaded Woodpecker <i>Picoides borealis</i></p> <p>No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/7614</p>	Endangered
<p>Wood Stork <i>Mycteria americana</i></p> <p>Population: AL, FL, GA, MS, NC, SC No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8477</p>	Threatened

Reptiles

NAME	STATUS
Eastern Indigo Snake <i>Drymarchon corais couperi</i> No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/646	Threatened
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Green Sea Turtle <i>Chelonia mydas</i> Population: North Atlantic DPS No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6199	Threatened
Kemp's Ridley Sea Turtle <i>Lepidochelys kempii</i> There is proposed critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/5523	Endangered
Leatherback Sea Turtle <i>Dermochelys coriacea</i> There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1493	Endangered
Loggerhead Sea Turtle <i>Caretta caretta</i> Population: Northwest Atlantic Ocean DPS There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1110	Threatened

Amphibians

NAME	STATUS
Frosted Flatwoods Salamander <i>Ambystoma cingulatum</i> There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/4981	Threatened

Flowering Plants

NAME	STATUS
Pondberry <i>Lindera melissifolia</i> No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1279	Endangered

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.



STATE OF GEORGIA

REVOCABLE LICENSE REQUEST FOR THE USE OF TIDAL WATERBOTTOMS

APPLICANTS NAME(S): University System of Georgia

MAILING ADDRESS: 270 Washington St.SW, Atlanta, GA, 30334
(Street) (City) (State) (Zip)

PROJECT ADDRESS/LOCATION: Skidaway Island, 31.974, -81.024

COUNTY: Chatham WATERWAY: Groves Creek DATE: 2/28/2018

LOT, BLOCK & SUBDIVISION NAME FROM DEED: _____

Georgia Department of Natural Resources
Coastal Resources Division
One Conservation Way
Brunswick, Georgia 31520-8687

I am requesting that I be granted a revocable license from the State of Georgia to encroach on the beds of tidewaters, which are state owned property. Attached hereto and made a part of this request is a copy of the plans and description of the project that will be the subject of such a license. I certify that all information submitted is true and correct to the best of my knowledge and understand that willful misrepresentation or falsification is punishable by law.

I understand that if permission from the State is granted, it will be a revocable license and will not constitute a license coupled with an interest. I acknowledge that this revocable license does not resolve any actual or potential disputes regarding the ownership of, or rights in, or over the property upon which the subject project is proposed, and shall not be construed as recognizing or denying any such rights or interests. I acknowledge that such a license would relate only to the property interests of the State and would not obviate the necessity of obtaining any other State license, permit or authorization required by State law. I recognize that I waive my right of expectation of privacy and I do not have the permission of the State of Georgia to proceed with such project until the Commissioner of DNR or his/her designee has signed a copy of this request.

Sincerely,

By: _____
(Applicant), title if applicable

By: _____
(Applicant), title if applicable

The State of Georgia hereby grants you a revocable license not coupled with an interest as provided in your request. This area may now or in the future be utilized by boats employing power drawn nets under the provisions for commercial or sport bait shrimping. In its occupancy and use of the premises, licensee shall not discriminate against any person on the basis of race, gender, color, national origin, religion, age, or disability. This covenant by licensee may be enforced by termination of this license, by injunction, and by any other remedy available at law to the Department. The project proposed for this license must be constructed and completed within **the specified timeframe associated with the authorization and/or transmittal letter associated with this revocable license** and must be maintained in serviceable condition. Otherwise, action will be initiated to revoke this license and all structures must be removed immediately at the licensee's expense.


STATE OF GEORGIA
Office of the Governor

By: _____
For: Mark Williams, Commissioner-DNR



Date: _____

Appendix II – Grower presentation

Eastern Oyster Aquaculture Update




A photograph showing four orange mesh baskets filled with oysters, arranged on a wooden dock. A person's legs and feet are visible on the right side of the frame. The background shows a body of water and a boat.



 Marine Extension and
Georgia Sea Grant
UNIVERSITY OF GEORGIA |  marex.uga.edu

Study Sites

Wassaw Sound (Half Moon)
Skidaway River



Two side-by-side photographs showing oyster aquaculture sites. The left photo shows a wide view of a body of water with several oyster racks in the distance. The right photo shows a closer view of a line of oyster racks in the water, with a person visible in the background.

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Seed/Spat

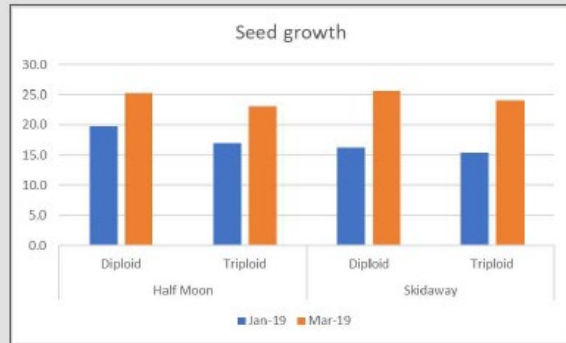
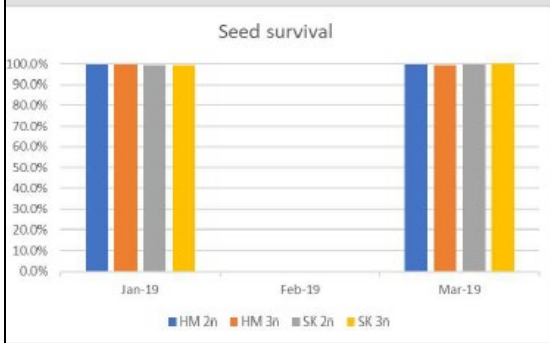


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Seed Survival



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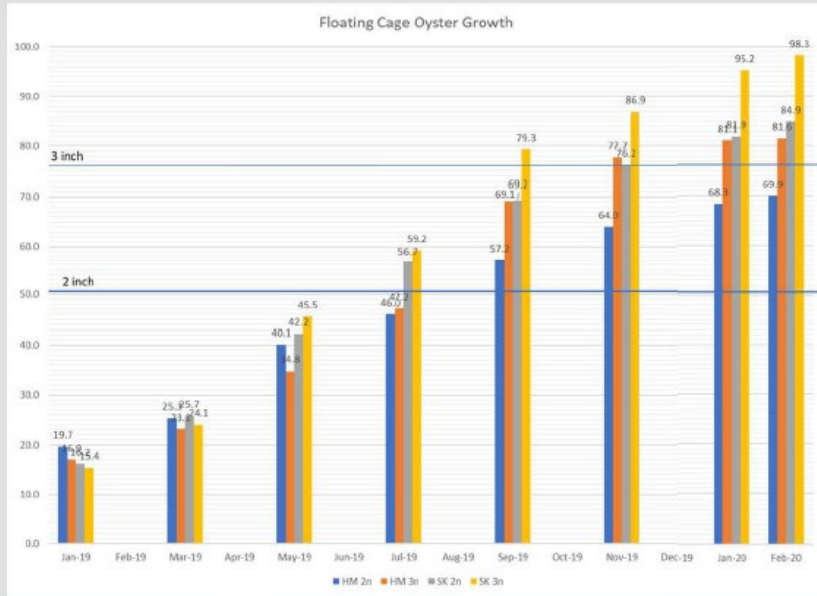
Harvest



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Skidaway River - Floating

Skidaway	Diploid		Triploid	
	Size	Survival	Size	Survival
Dec	6.0	100%	6.0	100%
Jan	16.2	99%	15.4	99%
Mar	25.7	99%	24.1	99%
May	42.2	99%	45.5	99%
Jul	56.7	97%	59.2	94%
Aug		94%		78%
Sep	69.2	75%	79.3	44%
Oct		73%		38%
Nov	76.2	71%	86.9	33%
Dec		70%		33%
Jan	81.9	70%	95.2	33%
Feb	84.9	70%	98.3	32%



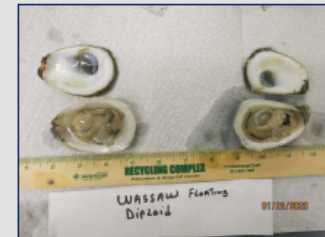
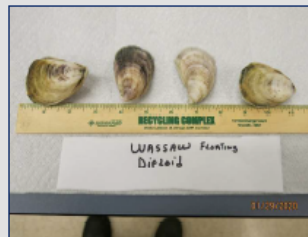
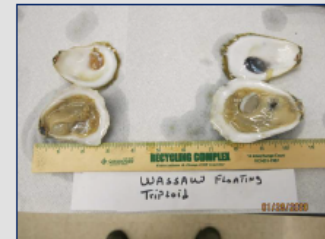
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Wassaw Sound - Floating

Half Moon	Diploid		Triploid	
	Size	Survival	Size	Survival
Dec	6.0	100%	6.0	100%
Jan	19.7	100%	16.9	100%
Mar	25.3	99%	23.1	99%
May	40.1	99%	34.8	99%
Jul	46.0	96%	47.2	87%
Aug		93%		83%
Sep	57.2	89%	69.1	76%
Oct		88%		73%
Nov	64.0	86%	77.7	70%
Dec		86%		70%
Jan	68.3	84%	81.1	70%
Feb	69.9	84%	81.6	70%



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Skidaway River - Bottom

SK	Diploid	Triploid
Bottom		
2018		
Dec	6.0	6.0
2019		
Jan	22.2	19.2
Feb		
Mar	28.5	23.9
Apr		
May	39.1	43.9
Jul	51.8	52.5
Aug		
Sep	61.9	65.3
Oct		
Nov	71.2	75.9
2020		
Jan	78.8	85.4
Mar	82.3	89.6
Survival	11%	10%



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Appendix III - Gear observations

Floating Gear

Floating gear was very strait forward to use and these are some observations from use over this period.

1. **Anchoring** – was done at an extremely low tide to allow us to sink auger anchors by hand with anchor chain and rope already attached. and Check anchors after severe weather.
2. **Connecting ropes** – ropes used to attach cages together can chafe, check on ropes with when flipping cages. A section of old garden hose slipped over the rope at the chafe point will eliminate the problem.
3. **Pontoon Floats** – keep an eye on wire connecting floats to the cage. It can become loose after severe weather. Check float caps to keep floats from filling with water, but do not over tighten.
4. **Flipping** – is strait forward and can easily be done from a boat or in water when oysters are less than 1 inch. Once oysters are larger cages are heavy, especially if fouled, and becomes more difficult to flip from a boat. Toward the end of the project, the davit was used to facilitate flipping.
5. **Sinking before storms** – minimum of two people per cage needed and must has to be done when in the water to ensure that the cage to be sunk when cage sinks that it lands pontoon side down. Be careful not to lose caps to pontoons when removing.
6. **Refloating after a storm** – use of davit was very helpful. Required one person to swim down and connect davit line to one end of the cage. Davit was then used to raise cage up allowing water to drain by displacement and then were re-capped. Bring spare caps.
7. **Fouling** – is handled by flipping cages up to dry and by periodic cleaning with power washer. If using a power washer, Use it do after the drying period and not before to keep from increasing oyster mortality.
8. **Cage** – Make sure all cage doors are facing the same direction during initial deployment.

Bottom Gear

Bottom gear sub-tidally was easy to deploy but here are some observations if using this gear.

1. **Anchoring** – no anchoring required, just a standard crab trap line and float was used
2. **Floating line** – check line to ensure not chafing when bringing up
3. **Davit** – is necessary to raise cages efficiently, doing by hand is very difficult especially as oysters increase in size and cages become fouled
4. **Fouling** – is controlled by bring and cage onto boat and cleaning with a power washer. Cages in the Skidaway River fouled very quickly with soft fouling and had to be cleaned quite regularly
5. **Sediment control** – Done by lifting cage to the surface and shaking by hand in the water to remove sediment. Lifting the cage to the surface to drag it through the water with the boat also works.
6. **Storms** – cages were left on bottom, no additional work was required. In strong storms cages at times got pushed by the tides and would have increased sediment in the bags.
7. **Harness** – When tying rope to the four corners of the cage to make the cage's harness, make sure the harness is short enough to allow the cage to clear the top of the gunnel before the harness bottoms-out on the davit pulley.