

Development of Off-Bottom Oyster Farming Gear and Methods for the Northern Gulf of Mexico

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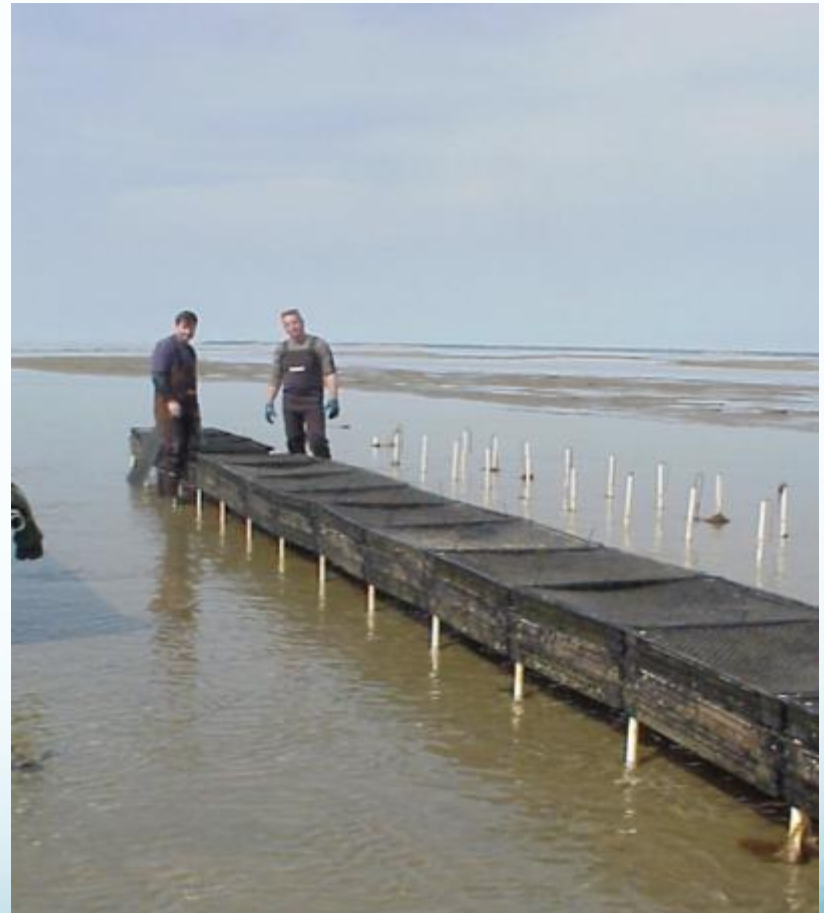


Overview of Today's Talk

- Introduction to Auburn University Shellfish Laboratory (AUSL)
- Why Off-Bottom Oyster Farming?
- Current Status in the Gulf of Mexico
- Development of Methods to Produce a High Quality Oyster
 - Types of Gear
 - Effects of Tumbling
 - Effects of Ploidy

My Background

- With Auburn University's Department of Fisheries & Allied Aquacultures and Alabama Cooperative Extension System since Jan. 2009
- Prior to working here, I worked as an Extension agent on Cape Cod, Massachusetts, working with shellfishermen, shellfish farmers and resource managers
- On the weekends, had a small oyster farm in Cape Cod Bay for 5 years
 - Produced Bees River oysters



Auburn University Shellfish Laboratory

- On Dauphin Island Sea Lab grounds
- Opened in 2003
- Able to spawn over 200 million oysters per year
 - Facilities could readily support other marine invertebrate culture
- Able to raise at least 40 million 2 mm oyster spat per year
- Resource for oystermen, resource managers, etc. – focused on applied research



AUSL People



Portersville Bay Oyster Farm Park



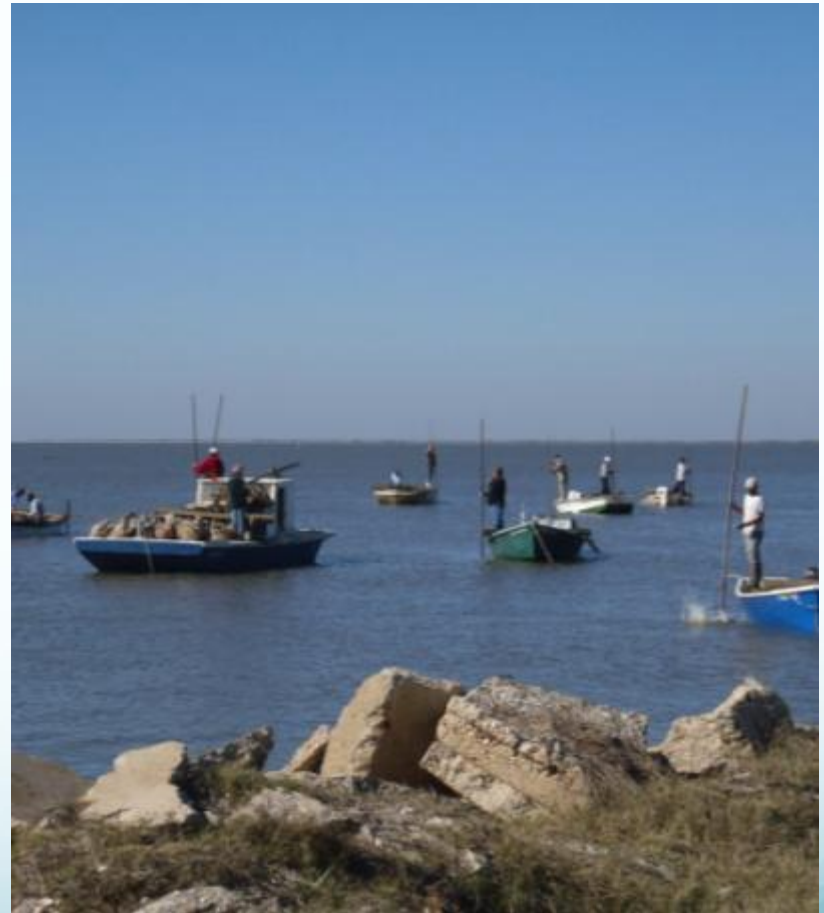
Photo credit: Sam St. John



Photo credit: Bill Daniels

Gulf of Mexico Oyster Industry

- In 2008, the U.S. eastern oyster industry (*Crassostrea virginica*) produced **over 23 million pounds of oysters, valued at almost \$82.5 million** (NMFS).
- By volume, the Gulf of Mexico dominated the harvest, accounting for **over 89% of the harvest**
- By value, however, the Gulf of Mexico obtained **73% of the total dollar value of the US harvest** (NMFS)



Primarily Commodity Market

- Focused on the commodity, shucked product market
- Gulf prices vary widely with supply
- In the shell, bought by weight or volume, not by the piece
- For the half shell market, top price might be about 15 cents per oyster



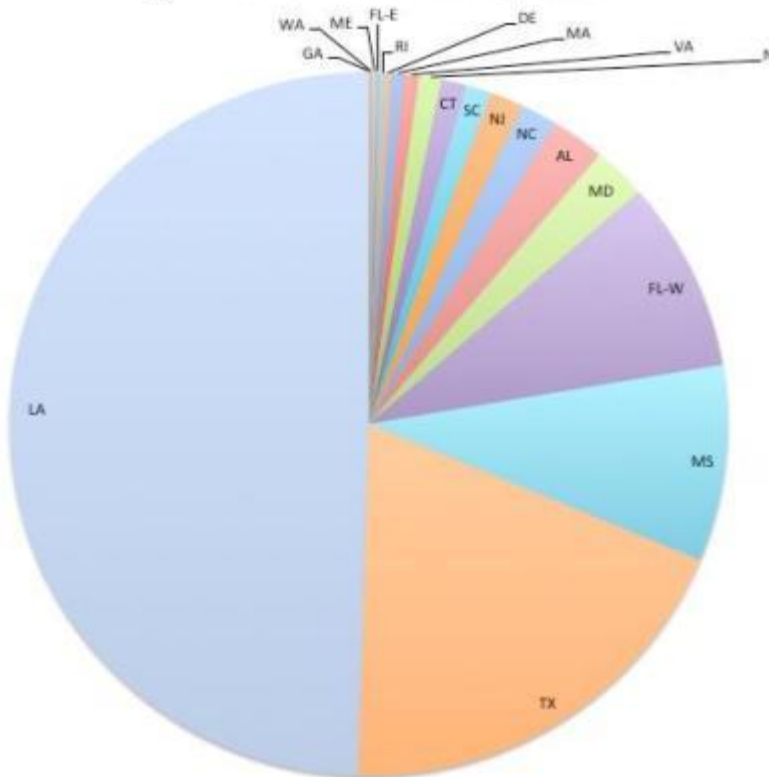
Credit: Scott Mowbray

Why Off-Bottom Oyster Farming?

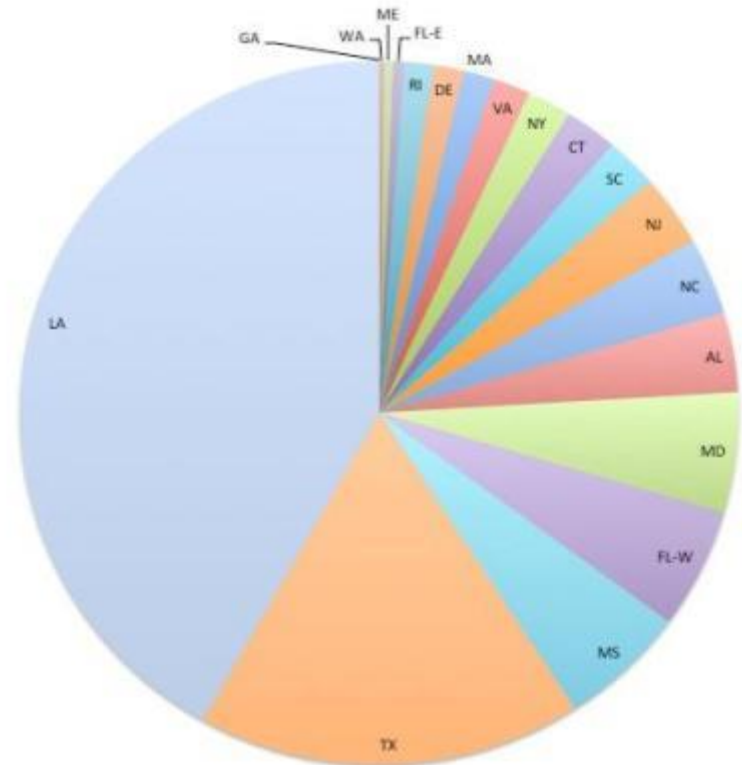
- Intended for the premium, high value niche markets
 - Primarily live, raw half-shell market that emphasizes quality
- Off-bottom farming has very high survival, allowing culture of bred lines and/or triploid oysters – which do not suffer from poor summer condition
- Branded oysters reduce variation in quality
- Not competition with shucked product or even less expensive sacks of oysters
 - Rather, adds high value niche product that could help overall perceptions
- Stability of income with possible limited season harvest

Getting a Bigger Piece of the Pie

Avg Annual Harvest 2000-2010, Pounds



Avg Annual Harvest 2000-2010, Dollars



Restaurant Menu in Nashville, February 2013

ASK YOUR SERVER ABOUT TODAY'S SELECTION.			
	SINGLE	1/2 DOZEN	DOZEN
X KUMAMOTO: Pacific Northwest, deep with fluted shell, buttery flavor with fruity finish.....	<input type="checkbox"/> \$4	<input type="checkbox"/> \$24	<input type="checkbox"/> \$45
FIRE LAKES: New Brunswick, medium depth cup, multi-creamy flavor with vegetable-like finish.....	<input type="checkbox"/> \$4	<input type="checkbox"/> \$24	<input type="checkbox"/> \$45
KUSSHI: British Columbia, tumbled while its raised, deep oyster with ultra clean flavor.....	<input type="checkbox"/> \$4	<input type="checkbox"/> \$24	<input type="checkbox"/> \$45
BRAS D'OR: Nova Scotia, deep cupped, delicately balanced, salty flavor with briny finish.....	<input type="checkbox"/> \$4	<input type="checkbox"/> \$24	<input type="checkbox"/> \$45
SHIGOKU: Willapa Bay, dense, cornucopia shaped, light, clean taste of cucumber and salt.....	<input type="checkbox"/> \$1.50	<input type="checkbox"/> \$19	<input type="checkbox"/> \$36
X BEAUSOLEIL: New Brunswick, deep cupped with extremely clean ocean flavor, finishes sweet.....	<input type="checkbox"/> \$1.50	<input type="checkbox"/> \$19	<input type="checkbox"/> \$36
FANNY BAY: British Columbia, flared cup, plump meat, copper undertones with hint of cucumber.....	<input type="checkbox"/> \$1.50	<input type="checkbox"/> \$19	<input type="checkbox"/> \$36
X WELLFLEET: Cape Cod, MA, plump meat, mild sweet flavor, briny with crisp, clean finish.....	<input type="checkbox"/> \$1	<input type="checkbox"/> \$17	<input type="checkbox"/> \$30
CHESAPEAKE: Virginia, medium bodied oyster, distinctive briny taste with sweet finish.....	<input type="checkbox"/> \$1	<input type="checkbox"/> \$17	<input type="checkbox"/> \$30
X BLUE POINT: Long Island, NY, rounded, pronounced cup, mildly salty with hint of pine.....	<input type="checkbox"/> \$1	<input type="checkbox"/> \$17	<input type="checkbox"/> \$30
NAKED BOY: Sanibel Bay, deep with extreme frills, light, briny flavor, hint of fruit and rhubarb.....	<input type="checkbox"/> \$1	<input type="checkbox"/> \$17	<input type="checkbox"/> \$30
HOOTENANNY: Pacific Northwest, deep cupped with fluted shell, hint of mineral and seaweed.....	<input type="checkbox"/> \$1	<input type="checkbox"/> \$17	<input type="checkbox"/> \$30
DEEP COVE: Prince Edward Island, deep cupped, medium salinity, clean, mild taste.....	<input type="checkbox"/> \$1	<input type="checkbox"/> \$17	<input type="checkbox"/> \$30
ELD INLET: Pacific Northwest, sweet, buttery texture, hints of watermelon rind with grassy finish.....	<input type="checkbox"/> \$1	<input type="checkbox"/> \$17	<input type="checkbox"/> \$30
X APALACHICOLA: Gulf Coast, fat, plump and light bodied with briny and sweet flavor.....	<input type="checkbox"/> \$1.50	<input type="checkbox"/> \$9	<input type="checkbox"/> \$18
BISTERS BUTTER: SALED WITH HOT PEPPERED COLLARDS, CORN & ANDOUILLE CREAM. ADD \$5 PER DOZEN			
GRANDMILLED OYSTERS: BQ OR LEMON HERE. ADD \$4 PER DOZEN			

Off-Bottom Oyster Farming is Not ...

- A public commercial fishery
- Traditional on-bottom oyster leasing
- Oyster restoration



How Does this Differ?

- Usually relies on hatchery-reared native seed
- Gear is used to protect oysters from predators, burial and other losses
 - Requires \$ investment
 - Requires time
 - Bottom cage, suspended, floating
- Can be established in areas where oysters on the bottom don't survive (high salinity, soupy bottom)



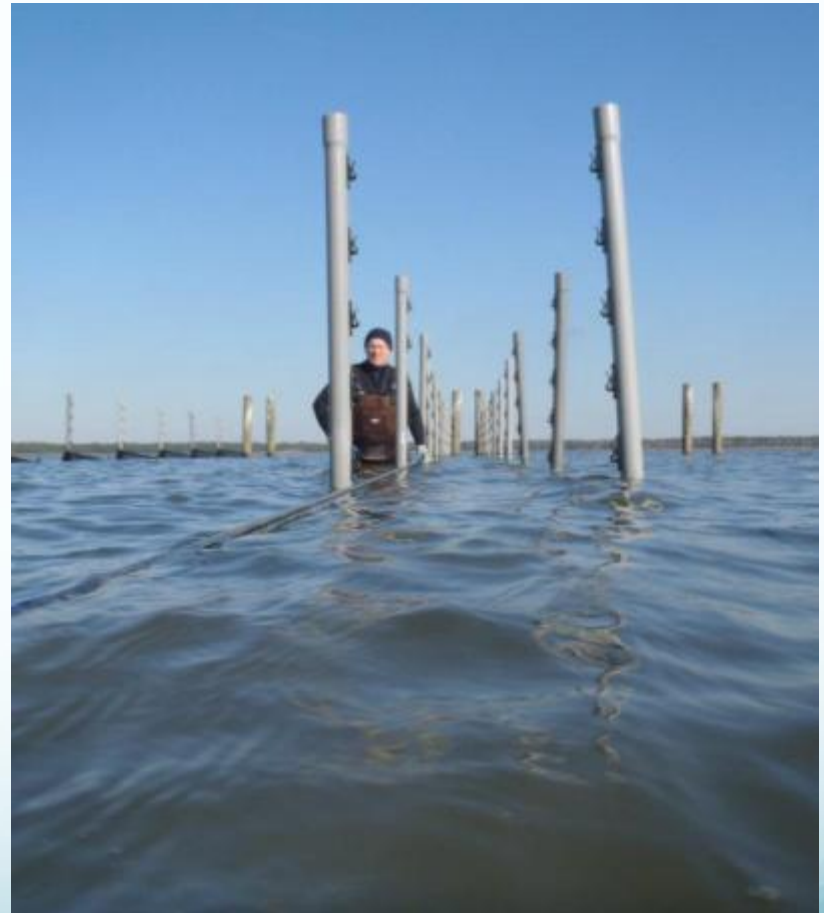
Why Farm instead of Bottom Plant?

- Can promote faster growth
 - Increases survival
 - Allows control of fouling
 - Improves shell shape and appearance
 - Increases product consistency
- But ...
 - Bottom planting can allow much higher production
 - Production cost per oyster is much lower



So Why Hasn't Off-Bottom Oyster Farming Already Become Established?

- Evaluated in Florida and Alabama in 1990's
- 'Biological success but economic failure'
- Specific hurdles
 - Heavy fouling & overset meant huge labor investments
 - Wholesale price was limited ('max 15 cents')
 - Limited production
 - Regulations & permits
 - Risk of hurricanes
 - Concerns about security

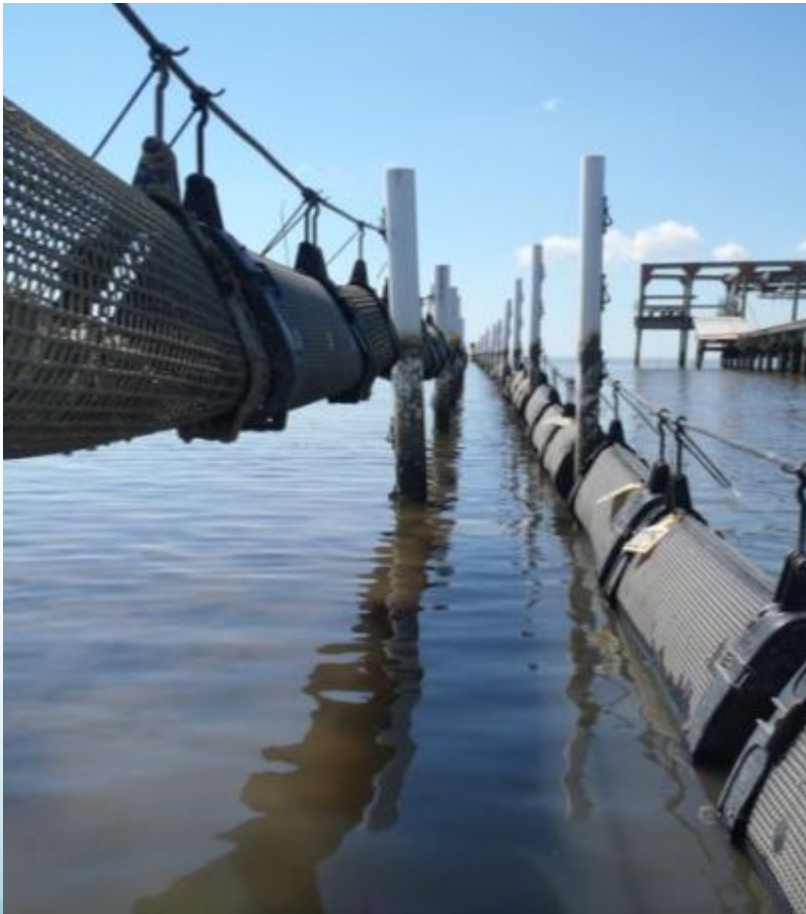


Problem of Fouling & Oversight

- In Alabama, collaboratively tested 4 types of gear, of which 3 control fouling through air drying
 - Australian long-lines
 - Floating cages
 - Floating bags
 - Bottom cages
- Needed to produce oysters that at most needed a rinse



Air Drying Takes Oysters Fully Out of Water



Standard Procedure?

- Desiccate oysters and gear weekly from mid-March to mid-November for 24 hours at a time
 - Reduced to overnight desiccation if air temperature exceeds about 95° F
- Desiccation for colder months dropped to every two weeks or so
 - Can be increased if problem seen (e.g., barnacle set)
- Oysters grown at about 150 per Vexar bag or 75-90 per long-line basket
- All these rules of thumb work for us BUT can be optimized AND need to be evaluated in new locations

Back of the Envelope Economics

- With current permits, 100,000 to 150,000 oysters can be harvested per acre per year
 - Survival has been very high but assume 100,000 make it to market
- Each acre requires ~ 0.5 FT person
 - Could be decreased with automating some tasks
- Each acre requires an initial investment of \$20,000 to \$30,000 in culture gear & system
 - Gear averages ~5 year usable life, for an amortized cost of \$4,000 to \$6,000 per acre per year
- Need to consider costs of permits, insurance, boat, grader, etc.
- Need to allow for seed production or higher seed costs
 - E.g., annual seed could be \$1,200-6,000 per acre per year
- Sold by piece at wholesale value of 35 to 50 cents
 - Annual gross of \$40,000 to \$50,000 per acre per year
 - Conservatively, net income of \$10,000-\$16,000 per acre per year
 - Production cost of ~20-25¢ per oyster

Very Early Stages of Industry

- Commercial oyster farms
 - 3 (6 acres) now established in Alabama with 1 more expecting to be fully permitted and harvesting this fall (+4 acres)
 - Multiple applications expected with new legislation in Alabama (HB 361)
 - Interest in oyster seed nursery operations
 - 1 in Louisiana, with permits pending for 1-2 more
 - Interest in oyster seed nursery operations
 - Opportunities in Florida?
 - Interest in Mississippi?
- Oyster farming 'parks' (enterprise zones) established in Alabama (40 acres) and Louisiana (25 acres)

Point aux Pins Oyster Farm & Mobile Oyster Company (AL)



OSAA Oyster Seed Nursery, Codon, AL



Caminada Bay Oyster Farm (LA)



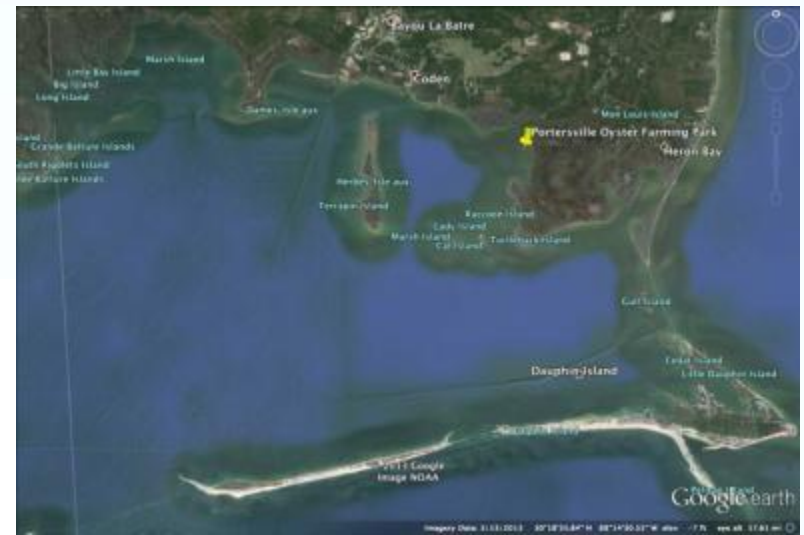
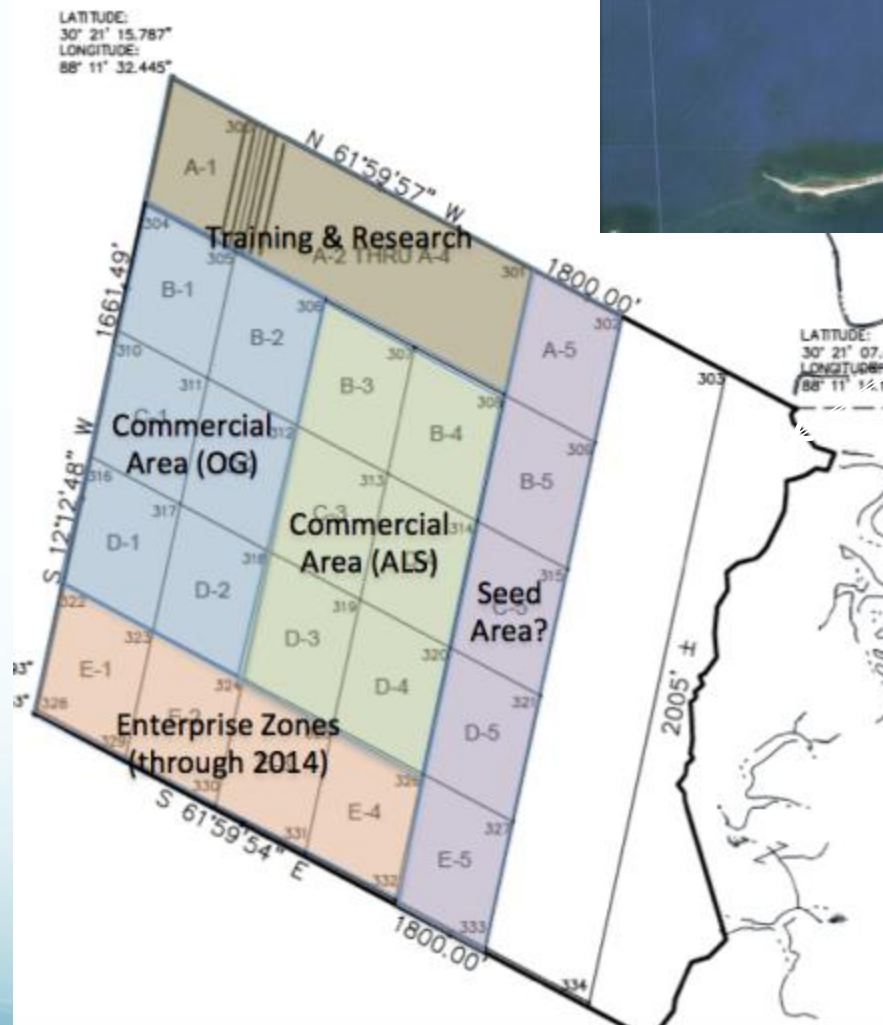
Some Bottom Planting of Seed



Portersville Bay Oyster Farming Park



Park Layout



Oyster Farmer Training Program

- Currently training 7 individuals as commercial oyster farmers
- Will train up to 9 more next year, with a total of up to 24 more acres in production at this one park



Development of Gear and Methods to Produce a High Quality Oyster

- Improving 'quality' of farmed oysters
 - Culture Methods
 - Courtney Coddington Ring (2012, M.Sc., effect of tumbling) – manuscript in prep.
 - Julie Davis (2013, M.Sc., gear orientation and stocking density) - manuscript in prep.
 - Jinglin Zhang with Dr. Yifen Wang – effect of exposure time on adductor muscles
 - Breeding – Initiated breeding program with Chris Andrikos and Dr. Eric Peatman to select for desirable shell shape
- Testing disease-resistant strains of oysters – Field test of 4 strains with Dr. Jerome LaPeyre (LSU) - manuscript in prep.
- Comparing diploid and triploid oyster performance - Walton, WC, FS Rikard, GI Chaplin, JE Davis, CR Arias & JE Supan. 2013. Effects of ploidy and gear on the performance of cultured oysters, *Crassostrea virginica*: Survival, growth, shape, condition index and vibrio abundances. Aquaculture.

Importance of Quality

- This was obvious as we started oyster farms in the Gulf of Mexico
- Generic Gulf oysters have huge variability in quality
- Arguably increasingly important to oyster farming industry



What Is Quality?

- Aspects of Quality
 - Taste
 - Smell
 - Shell Thickness
 - Shell Shape
 - Shell Size
 - Meat Condition, Plumpness
 - Shell Cleanliness
 - Food Safety
 - Consistency of Product in All of the Above



www.kusshioysters.com

Does Quality Matter?

- ‘Trash in the sack’ generates complaints from chefs, leaves consumers with very different impressions of a brand, and probably hurts repeat business
- With increase in US oyster aquaculture, quality can keep your product in the marketplace

Figure 1. Number of Oysters Planted by Virginia Aquaculturists

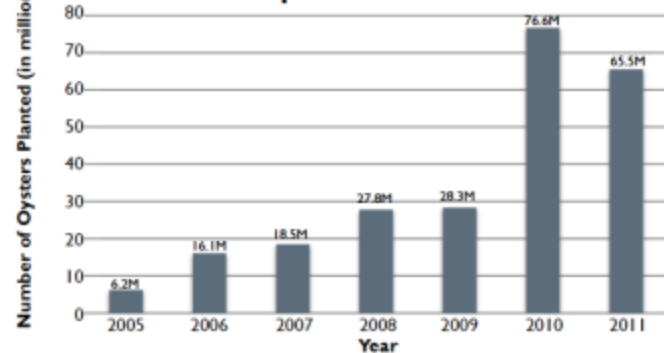
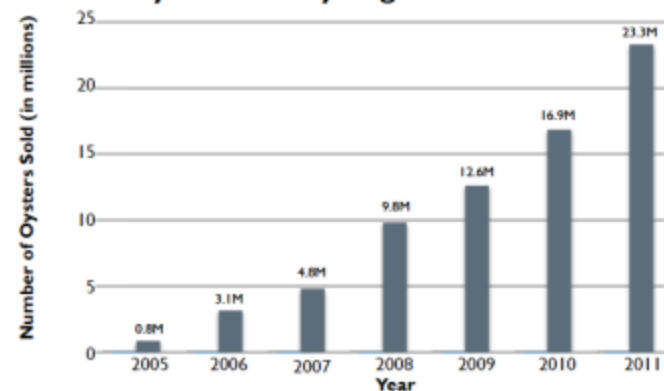


Figure 2. Number of Aquacultured Market Oysters Sold by Virginia Growers



Murray & Hudson, 2012

How Does a Grower Affect Quality?



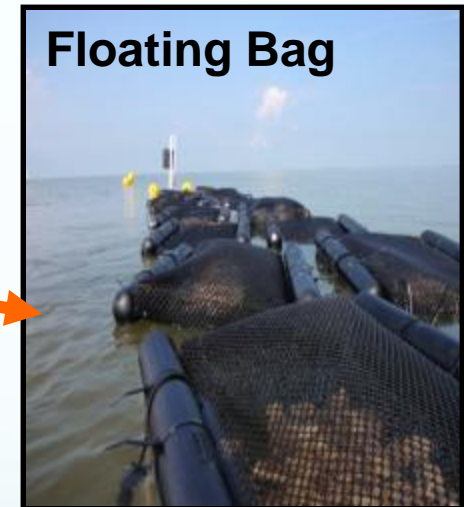
- Self-restricted harvest
 - E.g., fall & winter
- Cultivation methods
 - E.g., kusshi oysters
 - Gear type
 - Handling
 - Sorting
 - Inspection
- Breeding?

Test of Effects of Gear and Tumbling (Coddington 2011)

- Number of oyster farmers indicated that tumbling in a mechanical sorter improved oyster quality (more cupped and less fouled)
- Conducted two experiments in seed's second summer
 - Gear (4 types) x Tumbling (3 treatments)
 - In floating bags, Frequency of Handling (4 frequencies from seasonally to weekly) x Tumbling (3 treatments)



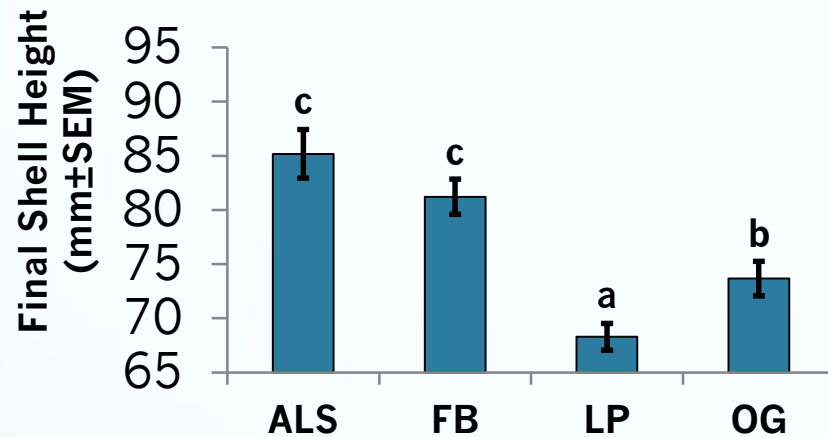
Grow-Out Gear



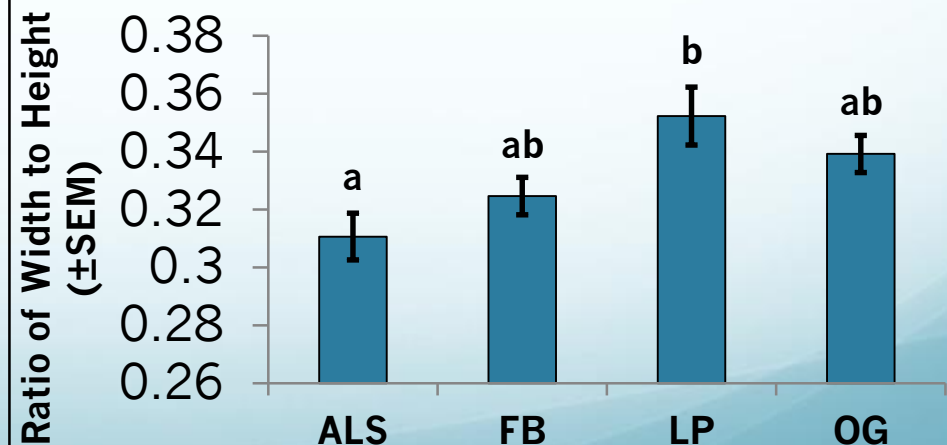
Photos: Bill Walton, Courtney Coddington, & Julie Davis

Effects of Gear Type on Cup

Effect of Gear on Shell Height

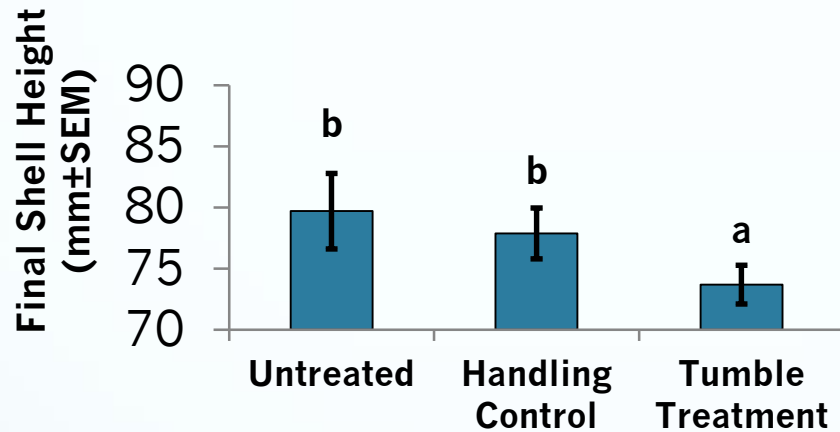


Effect of Gear on Cup Shape

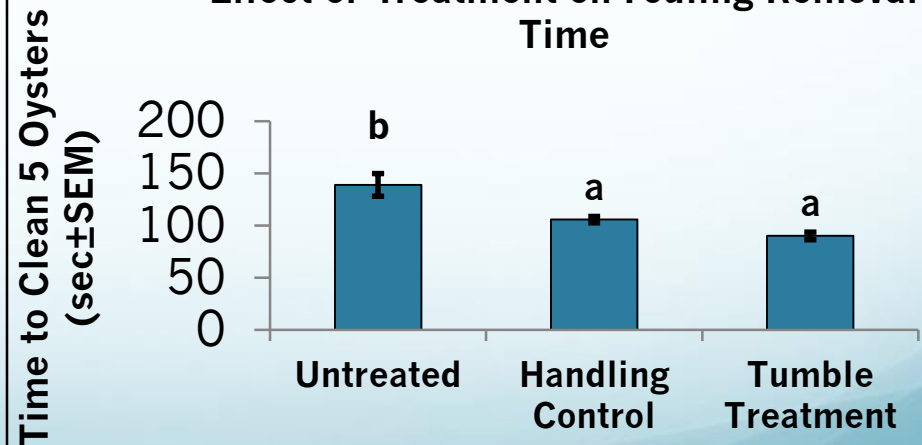


Effects of Tumbling on Fouling

Effect of Treatment on Shell Height



Effect of Treatment on Fouling Removal Time



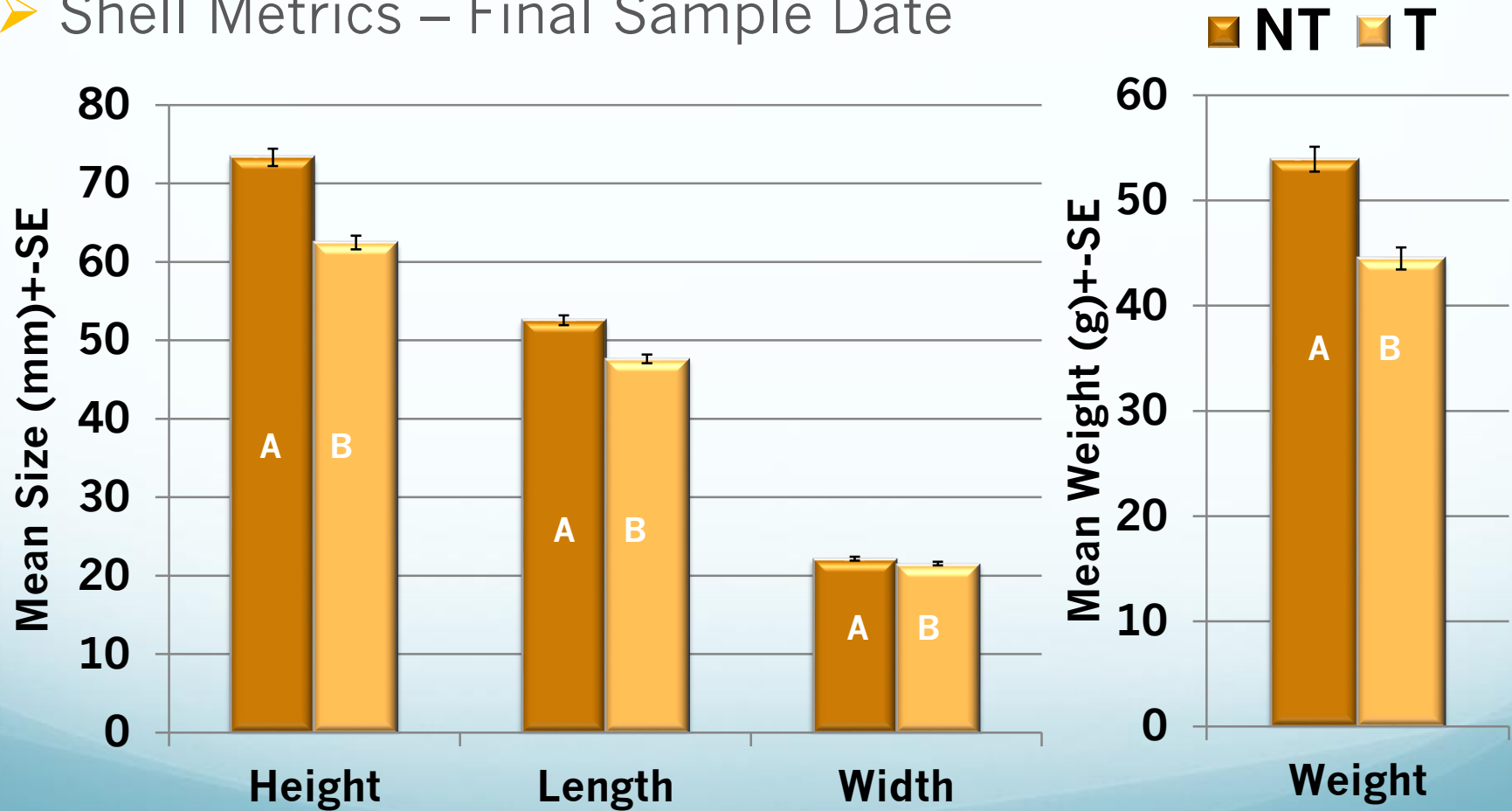
What If Tumbling Started Earlier?

- Follow Up Experiment: Monthly Tumbling from 3 months after spawn to 9 months
- Tumbling occurred monthly



Effect on Shell Metrics

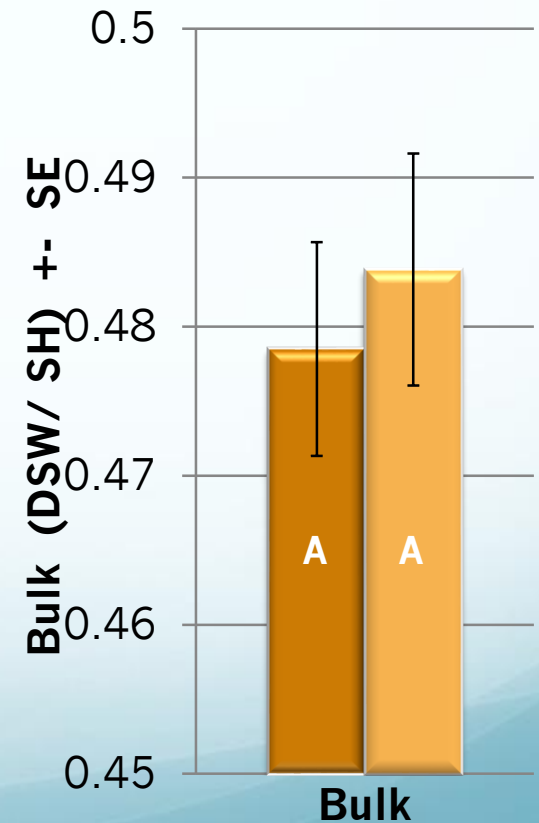
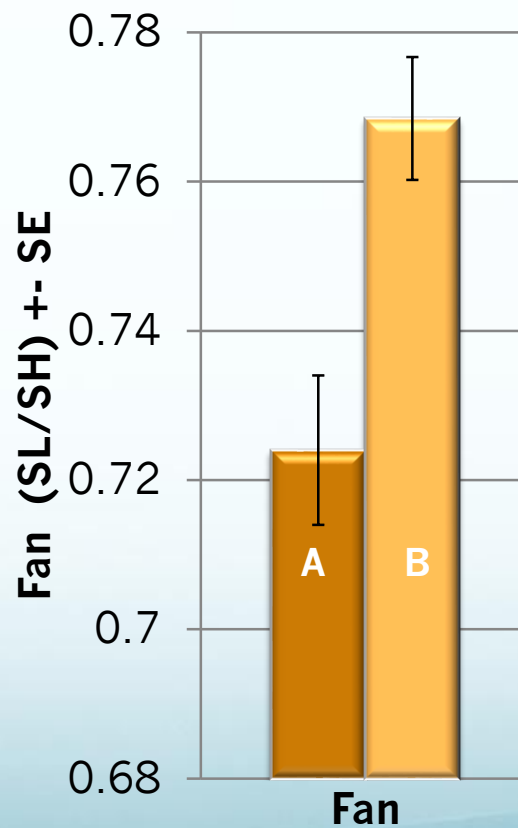
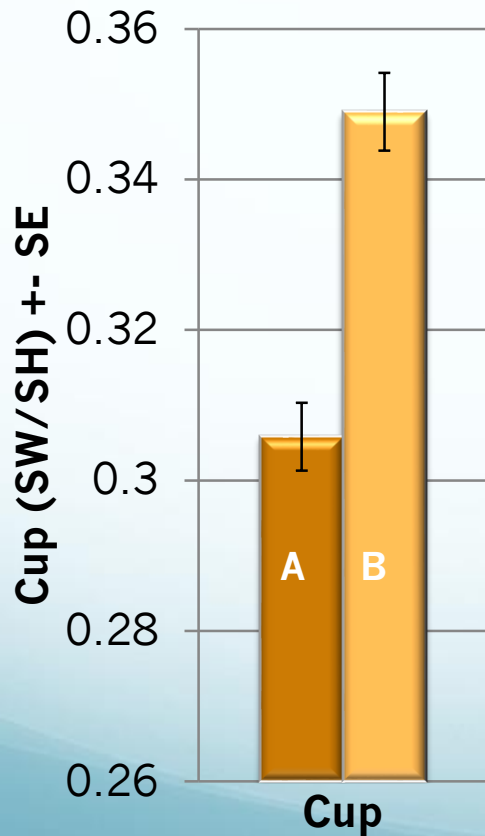
➤ Shell Metrics – Final Sample Date



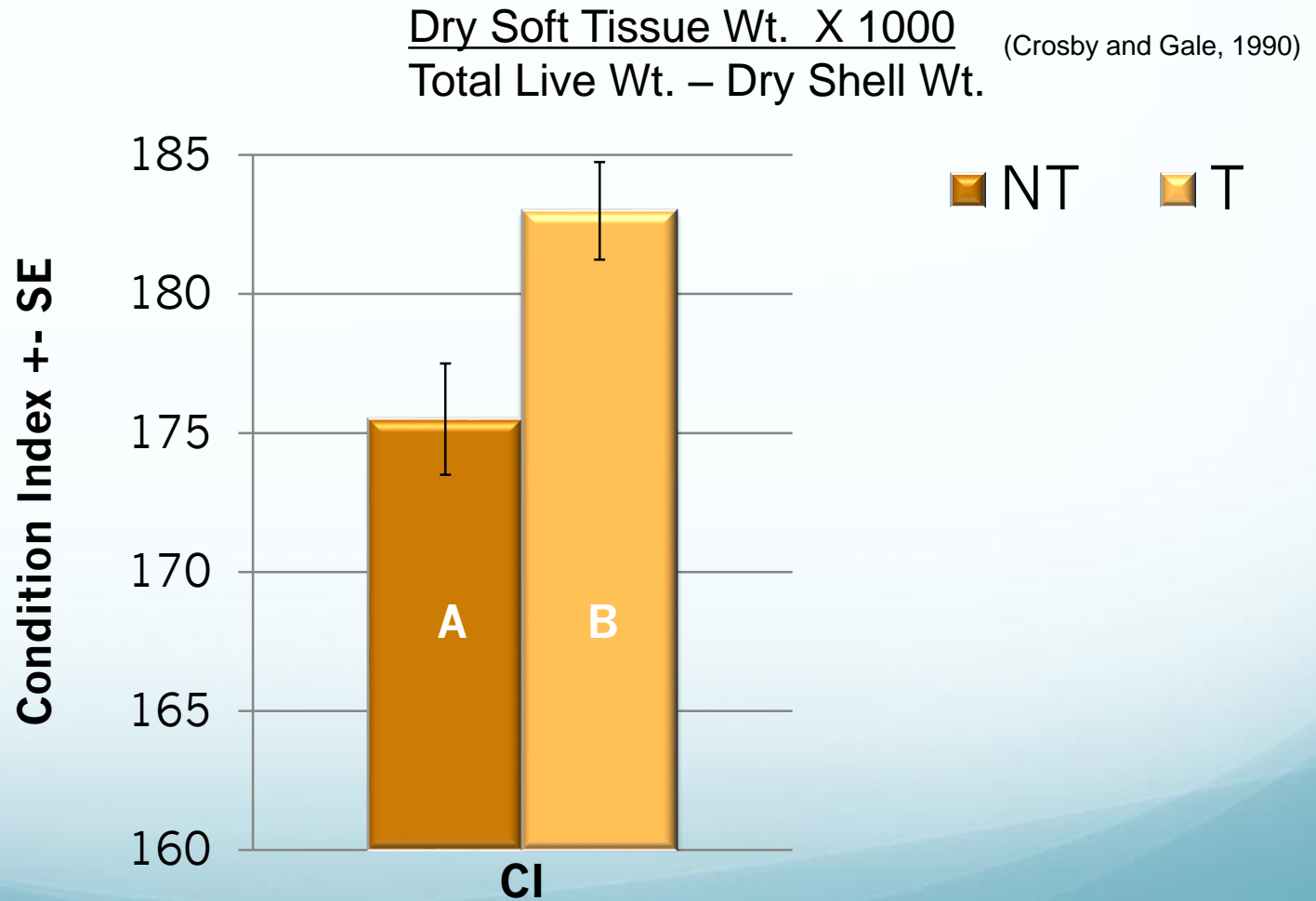
Effect on Shell Shape

➤ Shell Shape – Final Sample Date

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Effect on Condition Index



Bottom Line?

- Significant differences among gear types in quality of oysters produced
- Tumbling, especially in the first year, positively affects cup shape, fan shape, and condition index – but does impose a growth penalty

Use of Triploidy to Improve Success of Oyster Farming

- Triploids commonly used elsewhere in oyster aquaculture and agriculture
- Prior studies have shown that triploid oysters typically grow faster than diploids, particularly under favorable growing conditions
- Does performance of triploids depend upon culture gear?



Photo: Bill Walton

Broodstock Selection & Nursery Method

- Half sibling diploid and triploid oysters produced May 2010 at the Auburn University Shellfish Lab, Dauphin Island, AL
- Larvae and juveniles raised in identical systems until May 2011
- Deployed into 4 commercial gear types ($n \geq 3$)

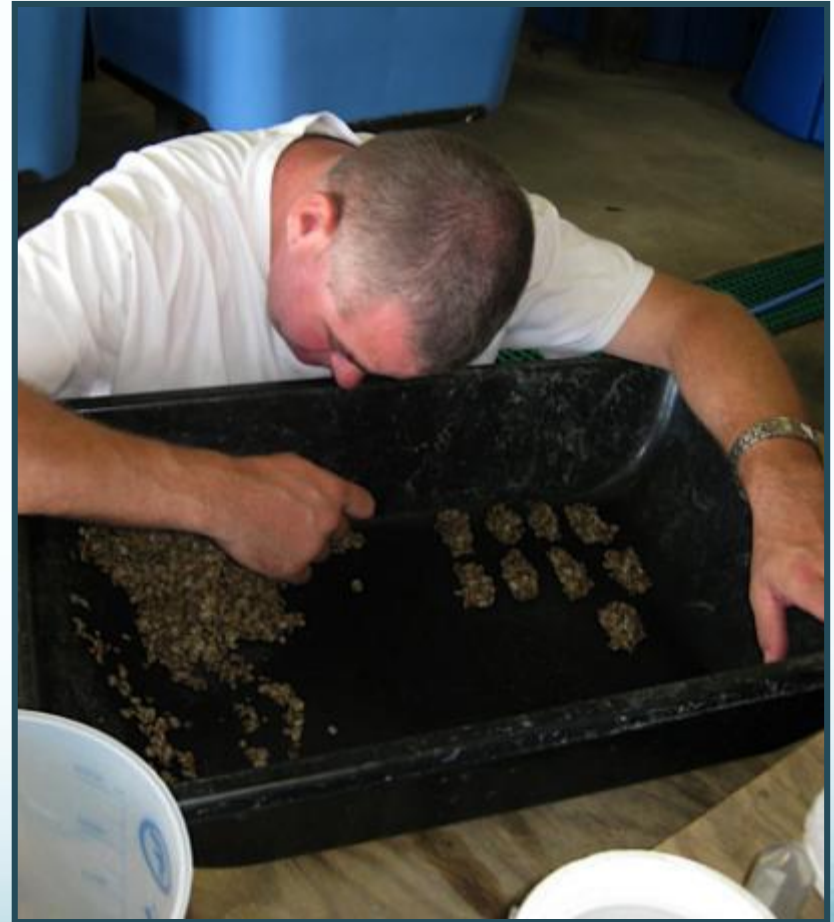
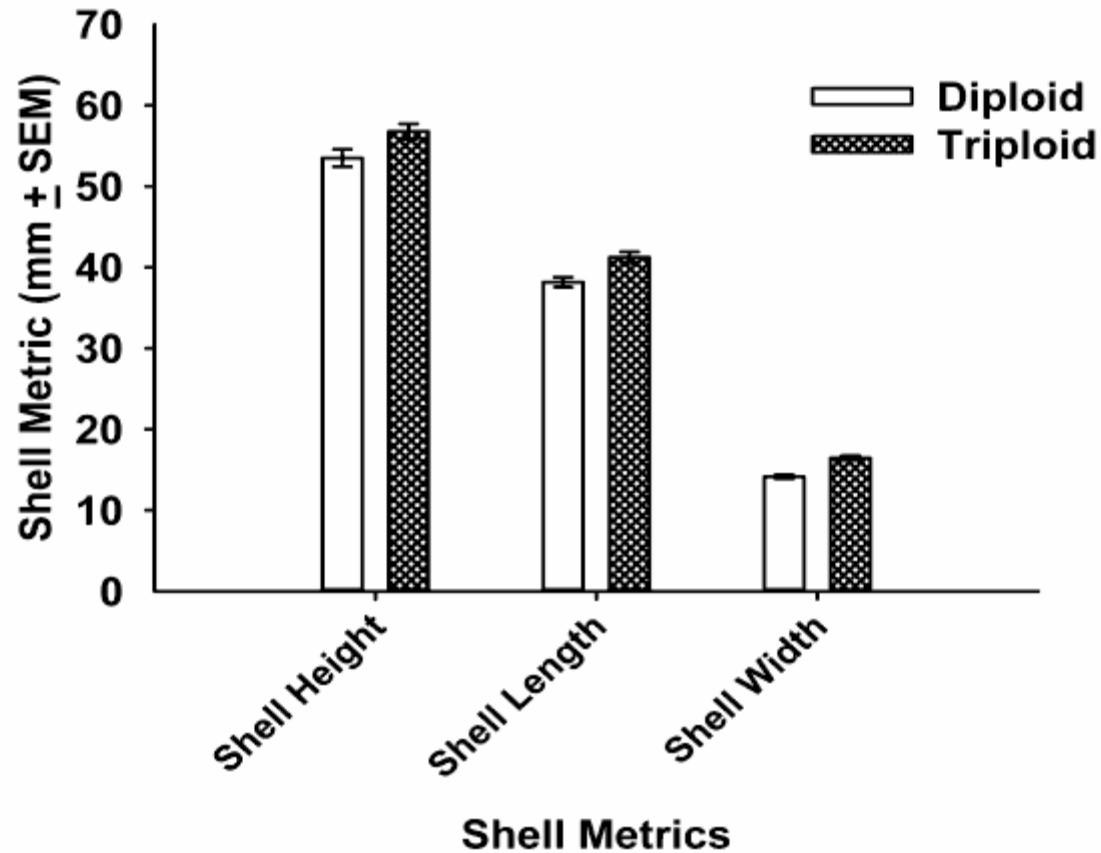
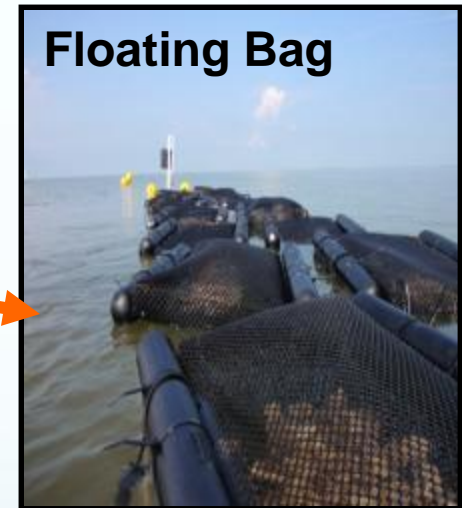


Photo: Bill Walton

Initial Shell Metrics



Grow-Out Gear



Photos: Bill Walton, Courtney Coddington, & Julie Davis

Sampling

- Ploidy (2) x Gear (4) design
- August and October 2011 (5 oysters from each basket)
- Response variables included:
 - Shell metrics, dry shell weight, dry tissue weight, condition index, survival, abundance of *Vibrio vulnificus* and *V. parahaemolyticus*



Photo: Bill Walton

Results

- 1) Only two significant Ploidy x Gear interactions were observed
 - 1) Dry tissue weight
 - 2) August condition index
- 2) Single factor effects are presented for:
 - 1) Ploidy effects
 - 2) Gear effects

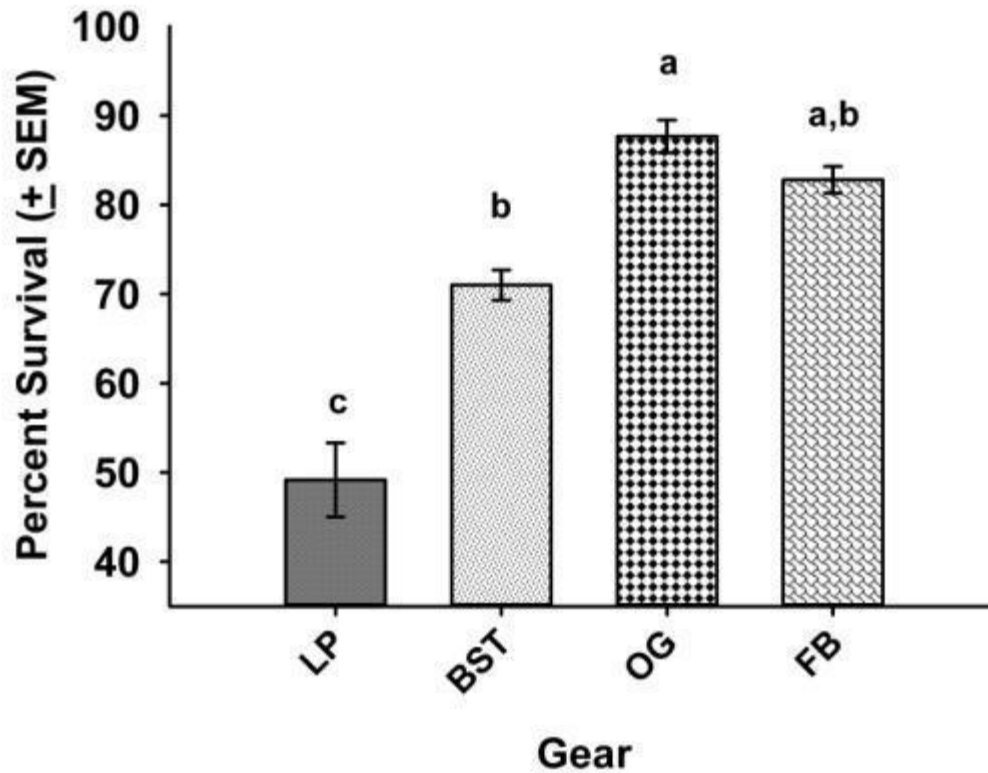


Photo: Julie Davis

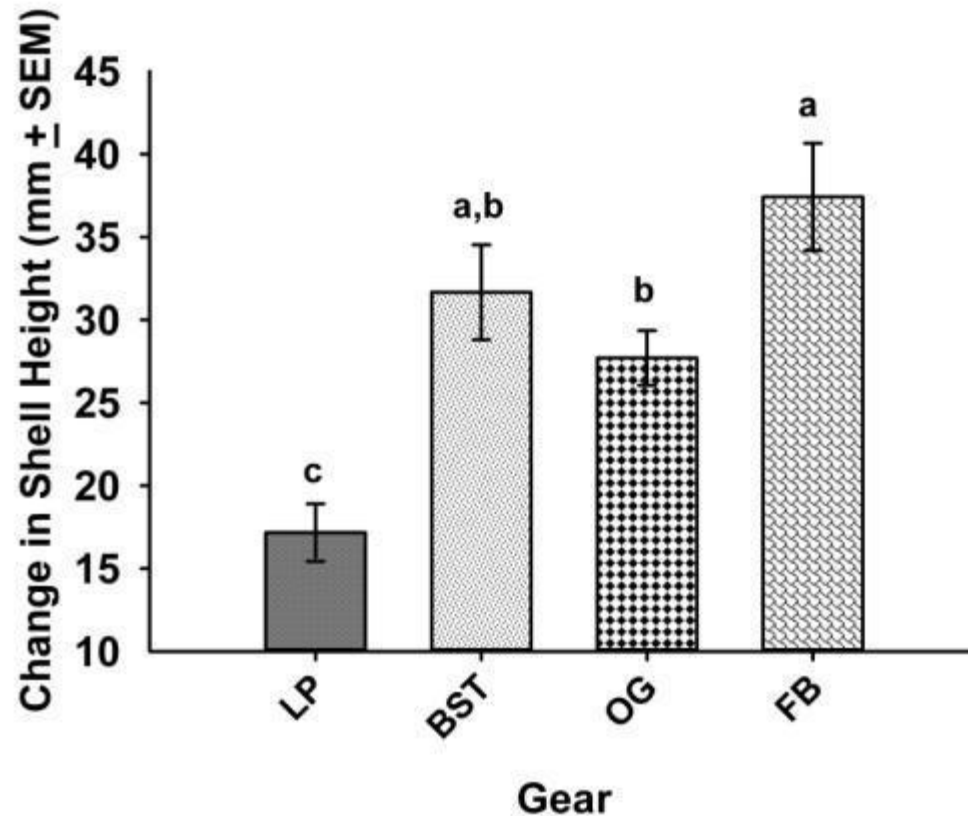
Effects of Gear



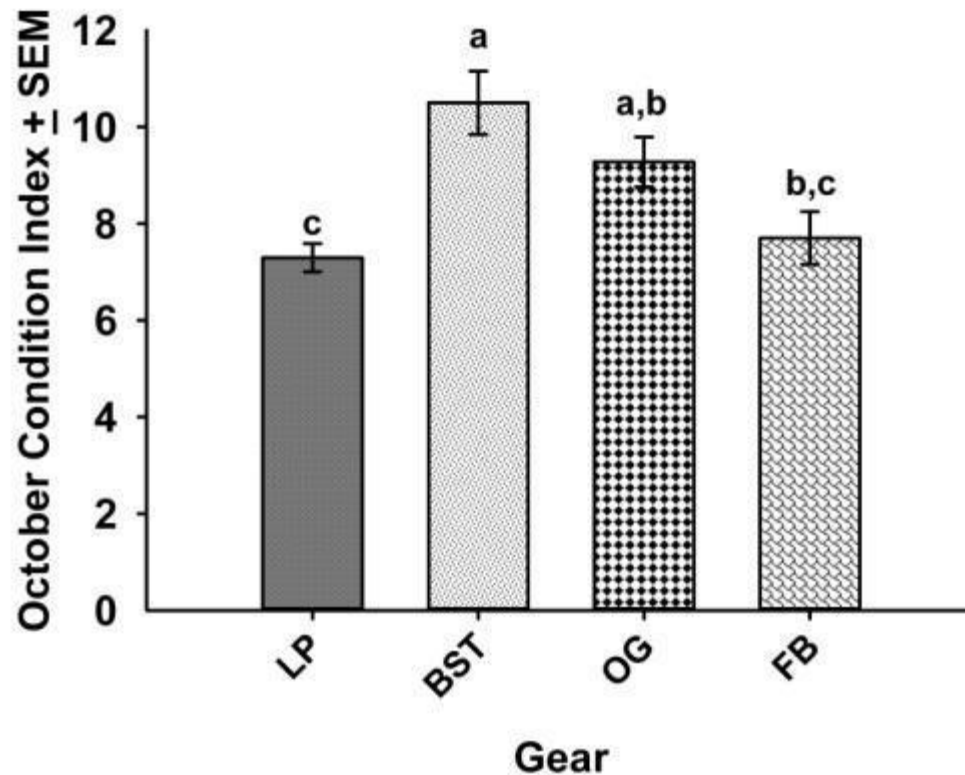
Effect of Gear on Survival



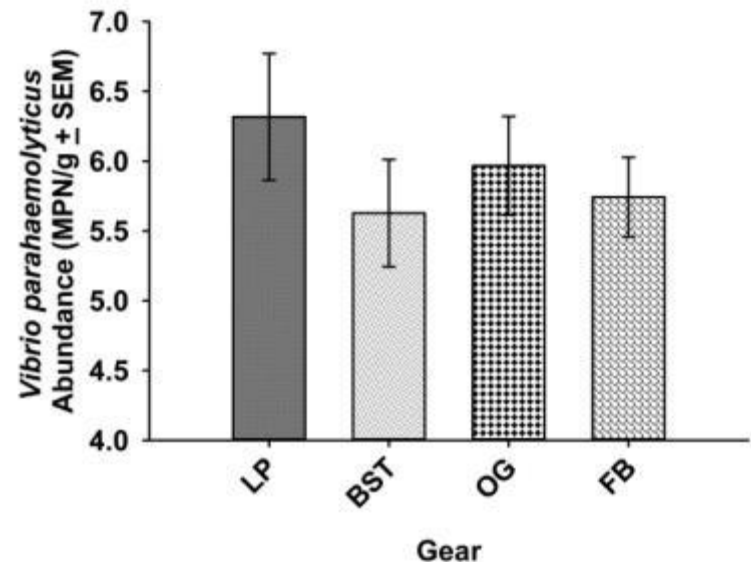
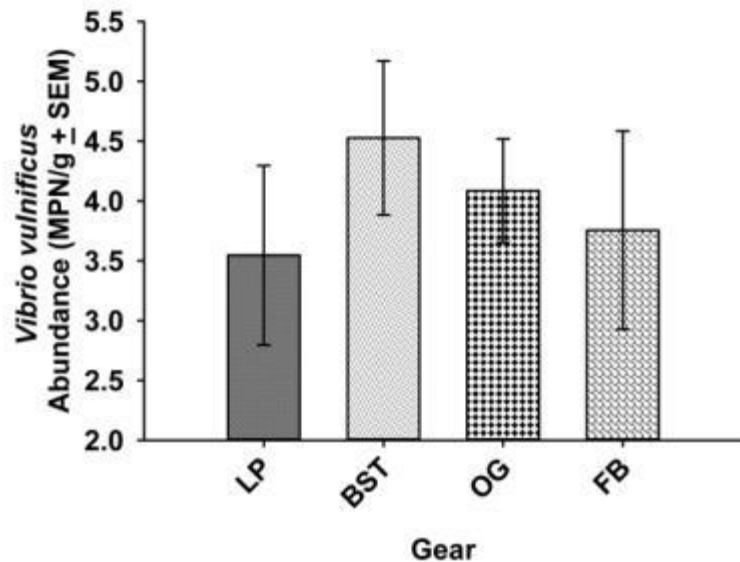
Effect of Gear on Change in Shell Height



Effect of Gear on October Condition Index



Lack of Effect of Gear on *Vibrio* Species Abundances



Effects of Ploidy

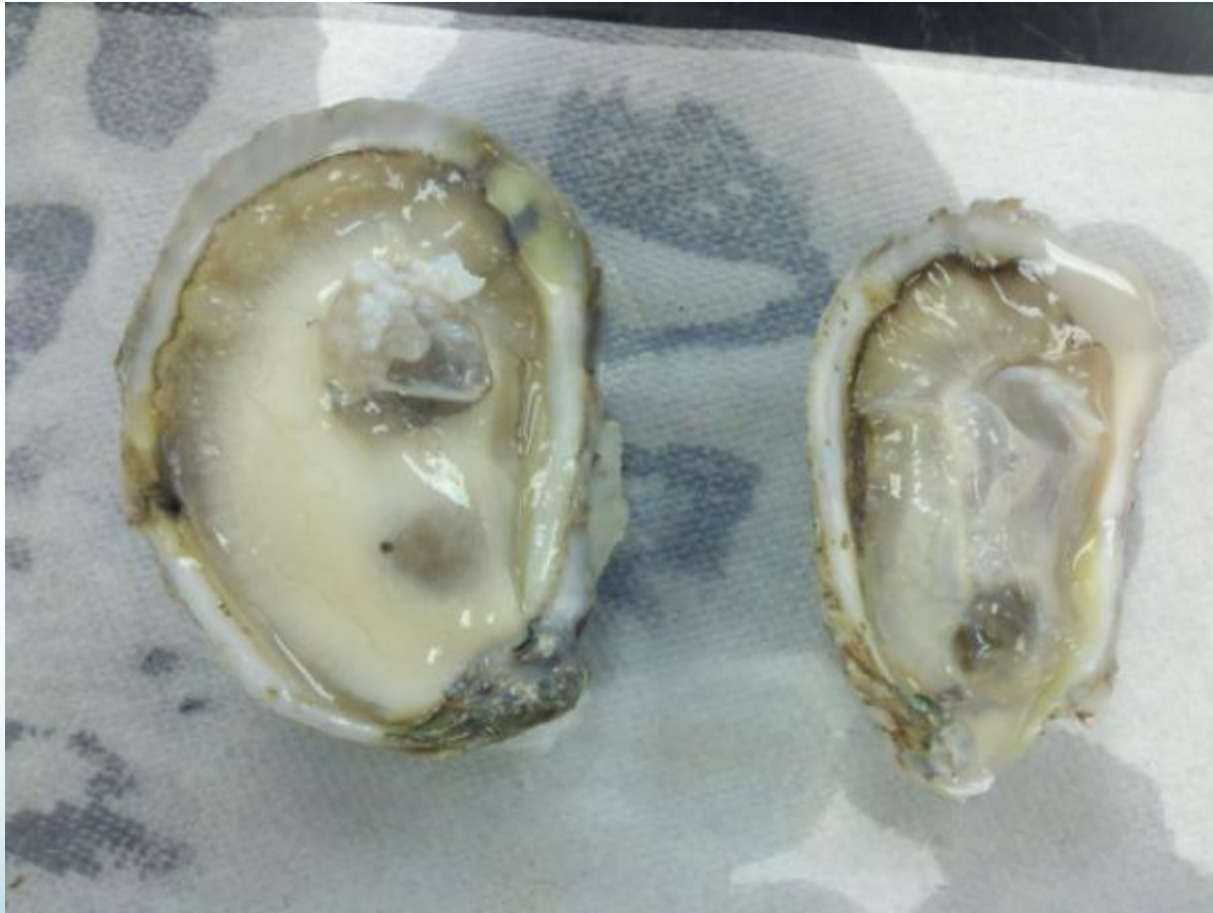
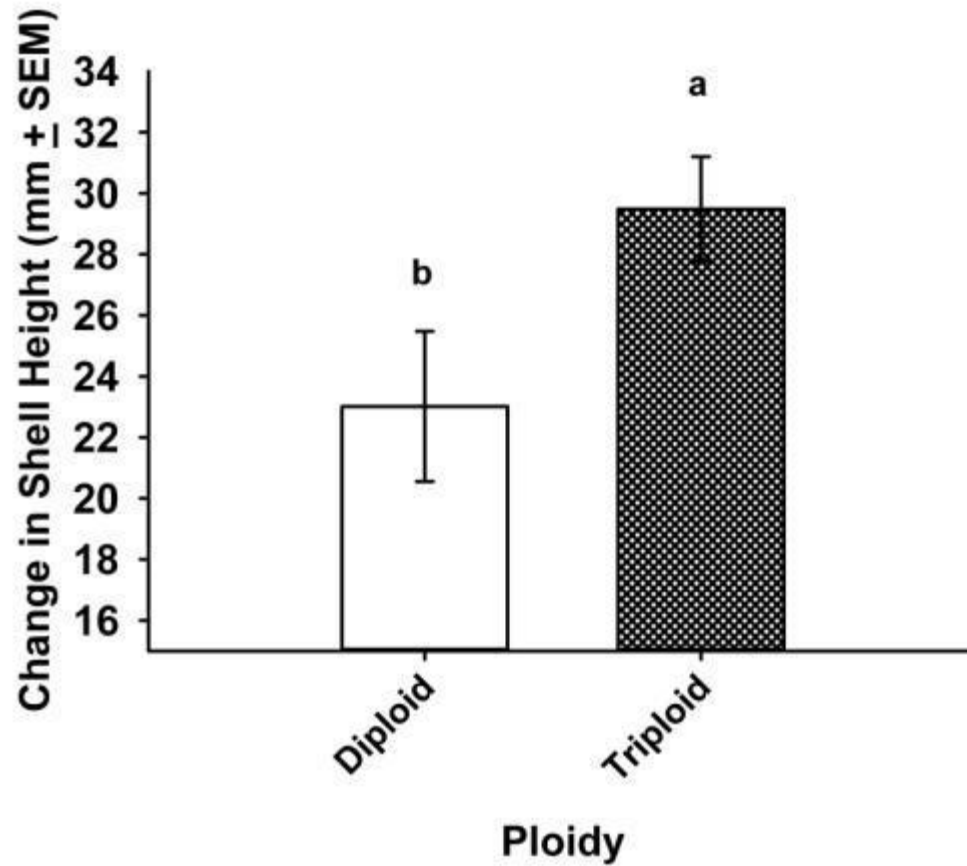
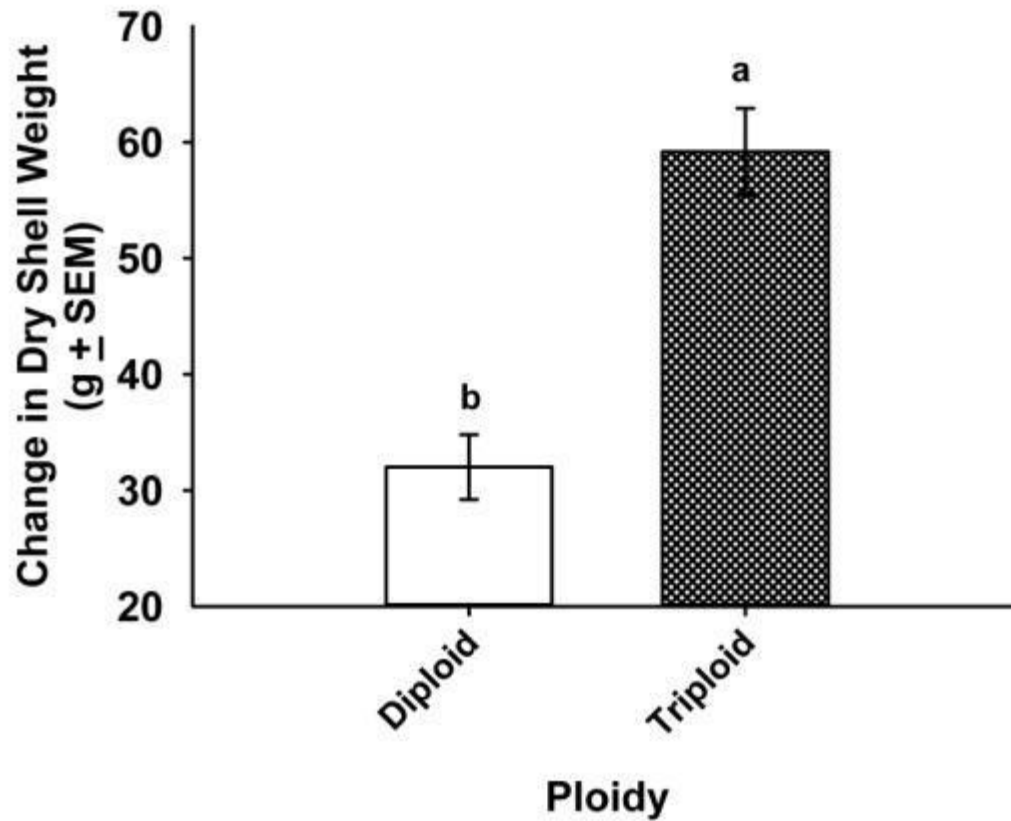


Photo: Julie Davis

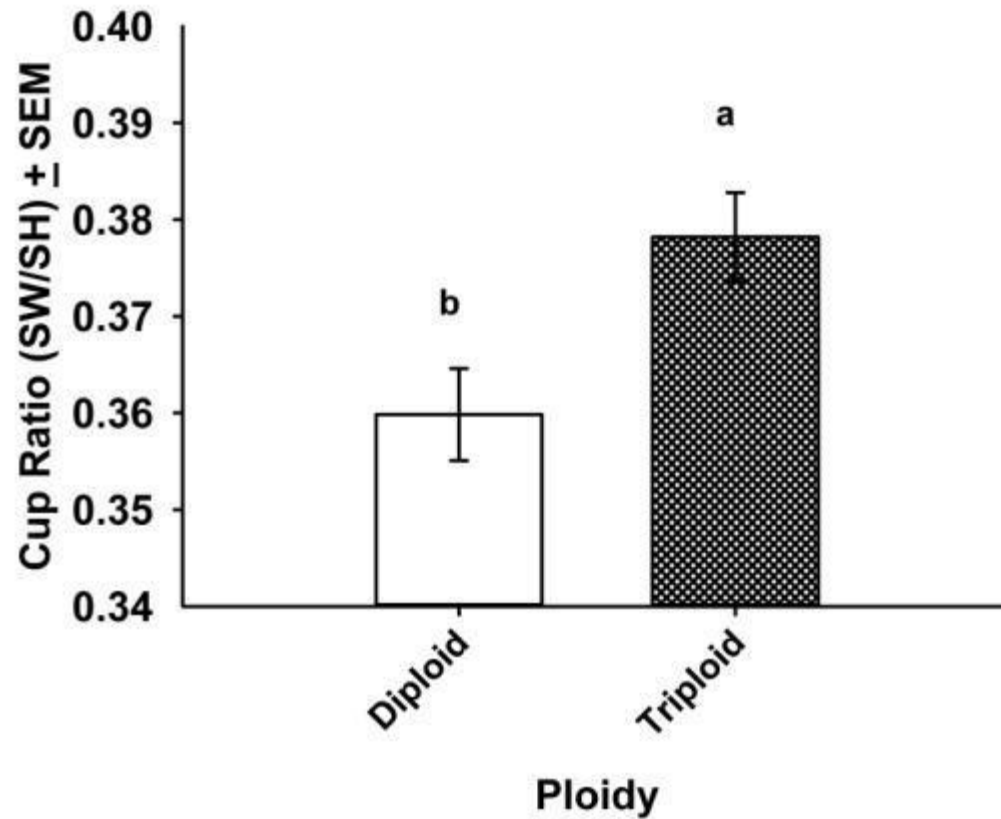
Effect of Ploidy on Change in Shell Height



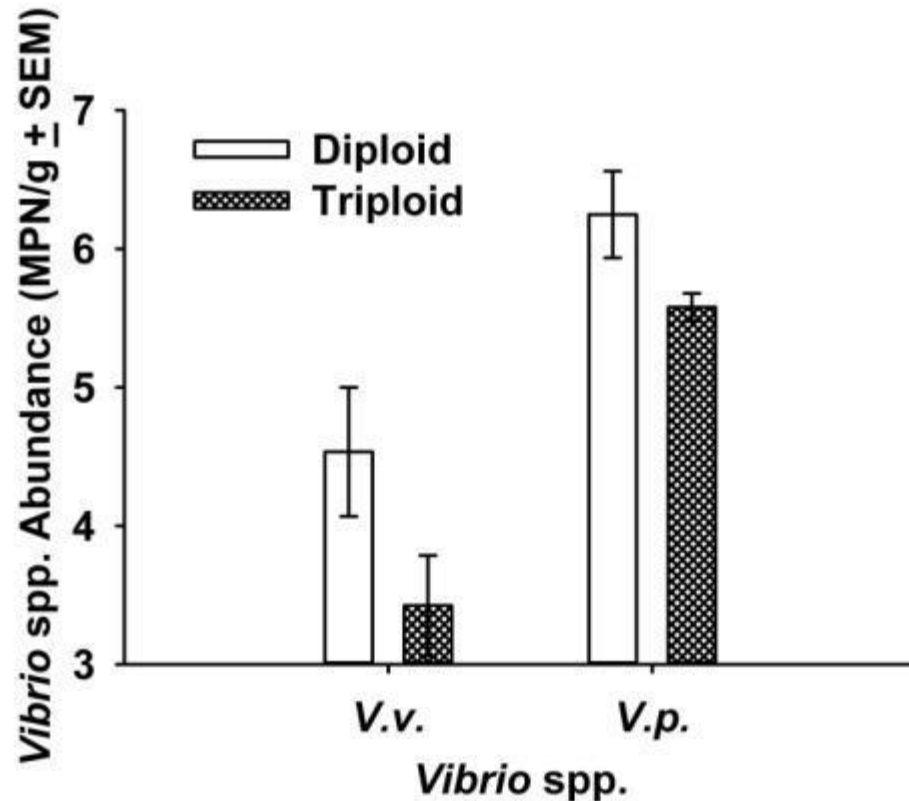
Effect of Ploidy on Change in Dry Shell Weight



Effect of Ploidy on Cup Ratio



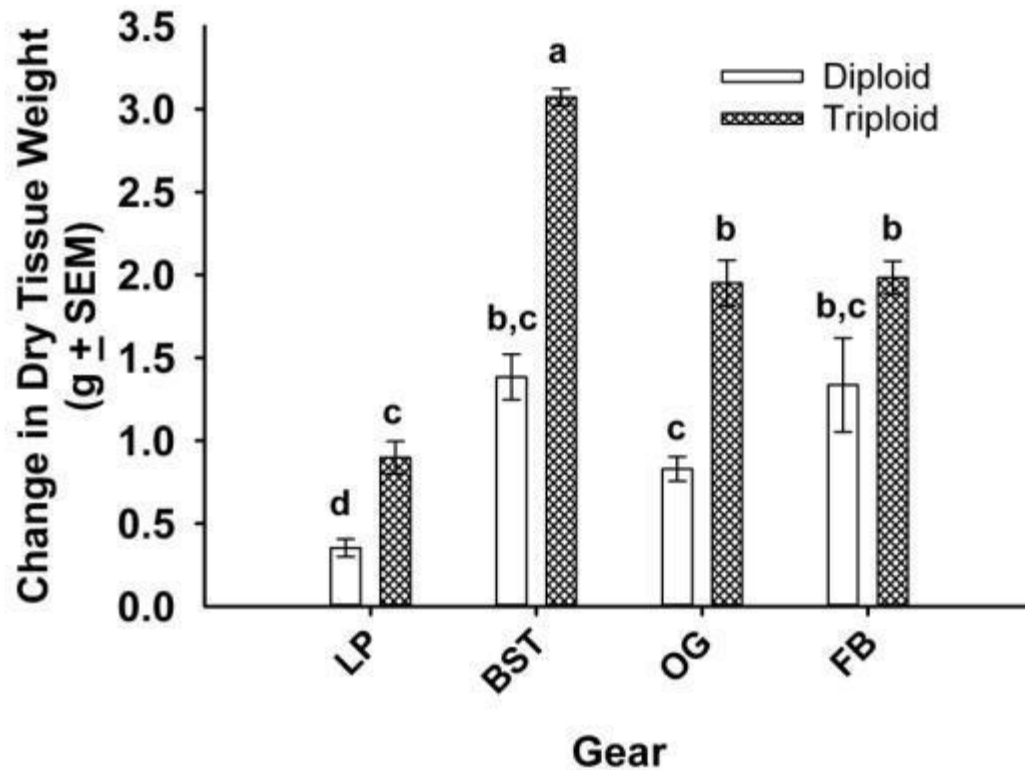
Lack of Effect of Ploidy on *Vibrio* Species Abundances



Effects of Ploidy x Gear Interactions



Change in Dry Tissue Weight



Bottom Line?

- Triploids performed better in all measures of growth and in some cases quality
- Gear affected oyster growth, survival and quality with clear disadvantage to the bottom cages

Questions



Several Related Extension Publications

- Walton, WC, JE Davis & JE Supan. In Press. Off-Bottom Culture of Oysters in the Gulf of Mexico. **Southern Regional Aquaculture Center**. 8 pp.
- Walton, B, JE Davis, G Chaplin, FS Rikard, DL Swann & T Hanson. 2012. Gulf Coast Off-Bottom Oyster Farming Gear Types: Floating Bags. **Mississippi-Alabama Sea Grant Consortium Publication #12-013-04**. 2 pp.
- Davis, JE, B Walton, G Chaplin, FS Rikard, DL Swann & T Hanson. 2012. Gulf Coast Off-Bottom Oyster Farming Gear Types: Floating Cage System. **Mississippi-Alabama Sea Grant Consortium Publication #12-013-03**. 2 pp.
- Walton, B, JE Davis, G Chaplin, FS Rikard, DL Swann & T Hanson. 2012. Gulf Coast Off-Bottom Oyster Farming Gear Types: Bottom Cages. **Mississippi-Alabama Sea Grant Consortium Publication #12-013-02**. 2 pp.
- Davis, JE, B Walton, G Chaplin, FS Rikard, DL Swann & T Hanson. 2012. Gulf Coast Off-Bottom Oyster Farming Gear Types: Adjustable Long-line System. **Mississippi-Alabama Sea Grant Consortium Publication #12-013-01**. 2 pp.
- Walton, WC, JE Davis, GI Chaplin, FS Rikard, TR Hanson, PJ Waters & DL Swann. 2012. Off-bottom oyster farming. **Alabama Cooperative Extension Timely Information/Mississippi-Alabama Sea Grant Consortium Publication #12-024**. 8 pp.