

Health Assessment of Clams Collected During the Summer at Lease Areas

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OBJECTIVE



To determine how the environment at two Cedar Key aquaculture use zones impacts clam health



**1. Document the presence of pathogens
(i.e. bacteria)**



**2. Document condition
(external & internal)**

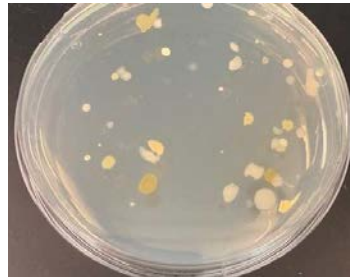
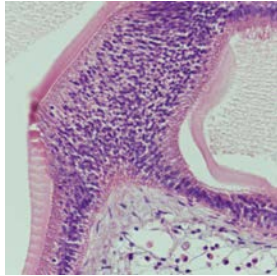


Correlate with changes in water quality



Correlate with location

Methods



Monthly collections (Jun, Jul, Aug, Oct)

2 sites (Dog Island, Gulf Jackson), 3 leases

- N=20 clams/lease (120/month)

Gross examination

- Measurements, external (shell, gaping), internal (mantle, meat, lesions)

Bacterial swabs of mantle

- Total counts (Marine agar), *Vibrio* counts (TCBS agar)

Histological examination

- Digestive tract condition, feeding, pathogens (parasites, bacteria) & tissue response

Results: Measurements (Growth)

- Size decreased from July to August at both locations
- Growth resumed by October

Location	July			August			October		
	Length	Width	*Weight	*Length	*Width	Weight	*Length	Width	*Weight
Gulf Jackson	48.9+2.0	26.5+1.2	32.4+5.3	37.3+8.8	26.4+3.1	35.2+11.3	52.7+4.2	27.9+1.9	41.5+10.6
Dog Island	50.3+2.6	26.4+0.9	38.0+4.7	46.1+10.3	33.8+9.6	38.9+12.2	48.6+5.1	25.6+2.7	*34.1+9.8



**Indicates that there was an environmental or disease issue that occurred between July and August*

Results: Gross Clinical Signs - External

Shell abnormalities - slight

- Chipping, deformed lips, brittle hinge

*Gaping - best external indicator of health

- Typically associated with environmental stress



Location	June		July		August		October	
	% affected		% affected		% affected		% affected	
	Siphon out	Gaping	Siphon out	Gaping	Siphon out	Gaping	Siphon out	Gaping
Gulf Jackson	1.7+2.8	← 0	7.5+10	45+7	15+0	10+0	0	0
Dog Island	0	0	1.7+2.8	22+20	2+3	18+20	0	0



Results: Gross Clinical Signs - Internal

Mantle condition (MC) – no change

- Retraction – common, usually slight
- Swelling - uncommon

*Physiological condition (PC) – *best internal indicator of clam health*

- Watery to fat meat (1-3)

Lesions – none seen



	June			July			August*			October*		
Location	% affected			% affected			% affected			% affected		
	MC-R	MC-S	PC-3	MC-R	MC-S	PC-3	MC-R	MC-S*	PC-3*	MC-R	MC-S	PC-3*
Gulf Jackson	15 + 13	5 + 5	42 + 20	33 + 25	0	23 + 3.5	35 + 0	15 + 0	0	35 + 0	0	20 + 0
Dog Island	33 + 10	5 + 5	28 + 3	33 + 21	7 + 7	23 + 8	28 + 6	3 + 3	8 + 3	33 + 24	12 + 12	40 + 13



Results: Total Mantle Bacterial Numbers

* Numbers indicate exposure levels and are not necessarily a reflection of the bacteria within the clam tissue (not quantitative).

Location	June		July		*August		October	
	Total (MA)		Total (MA)		Total (MA)		Total (MA)	
	#	% White	#	% White	#	% White	#	% White
Gulf Jackson	140 + 16	88 + 13	45 + 13	94.5 + 3	316 + 71	60 + 0	468 + 61	97.5 + 0
Dog Island	187 + 45*	92 + 8	*97 + 19	96.5 + 2	82 + 5	97 + 2	200 + 52	99.5 + 0.2



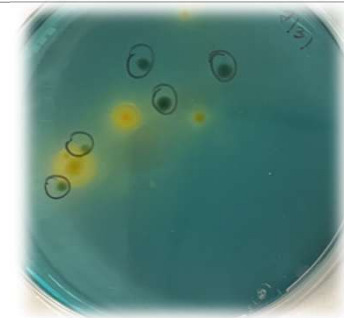
Location	June		July		*August		*October	
	Col types	C T _{≥4}	Col types	C T _{≥4}	Col types	C T _{≥4}	Col types	C T _{≥4}
Gulf Jackson	5.3 + 0.6	8 + 1.7	3.5 + 0.7	1 + 1.4	5 + 0	4 + 0	6 + 0	10 + 0
Dog Island	4.3 + 0.6	*4.3 + 2.9	3.3 + 0.6	0.3 + 0.6	4 + 2	2 + 1.3	3 + 0	0 + 0



- ❖ Decreased bacterial diversity in July
- ❖ Location difference in Aug & Oct

Results: Vibrio Mantle Numbers

Location	June	July	*August	*October
	Vibrio	Vibrio	Vibrio	Vibrio
Gulf Jackson	26 + 11	9 + 5.3	1.2 + 0.7	53.5 + 29.5
Dog Island	17 + 7	6.7 + 1.8	12.4 + 5	25 + 6.7

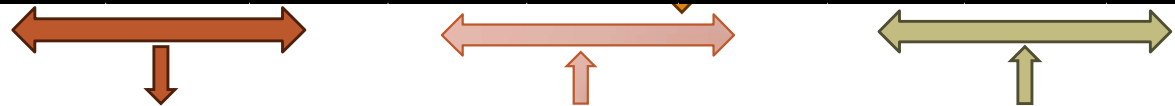


Location	June		*July		*August		October	
	Vibrio		Vibrio		Vibrio		Vibrio	
	% Yellow	%Green	% Yellow	%Green	% Yellow	%Green	% Yellow	%Green
Gulf Jackson	82 + 14.5	18 + 14.5	82 + 13	18 + 14	61 + 0	39 + 0	86 + 0	14 + 0
Dog Island	72 + 12	28 + 12	43 + 14	57 + 14	76 + 8	24 + 8	82 + 2	18 + 1

Vibrio counts are lower in July and August, but the percentage of pathogenic Vibrio's increased

Histology Results: Physiological Condition

Location	June			July			August			October		
	% affected		Scale 0-4	% affected		Scale 0-4	% affected		Scale 0-4	% affected		Scale 0-4
	Feeding	Tiss Deg	DT Atrophy	Feeding	Tiss Deg	DT Atrophy	Feeding	Tiss Deg	DT Atrophy	Feeding	Tiss Deg	DT Atrophy
Gulf Jackson	67 + 12	12 + 16	0.4 + 0.1	42 + 0%	48 + 18	2.1 + 0.1	60 + 0	40 + 0	1.4 + 0	90 + 0	10 + 0	0.24 + 0
Dog Island	56 + 11	*18 + 32	*0.7 + 0.5	*58 + 29	*43 + 38	*1.7 + 1.4	82 + 13	20 + 15	0.5 + 0.2	98 + 3	7 + 6	0.04 + 0.04



*One site at DI had significantly less issues than the other two sites in June & July

*Digestive tubule atrophy (0=good, 4=poor) is generally associated with environmental change (WQ, food source)
Tissue degradation can be associated with either environmental change or pathogens*

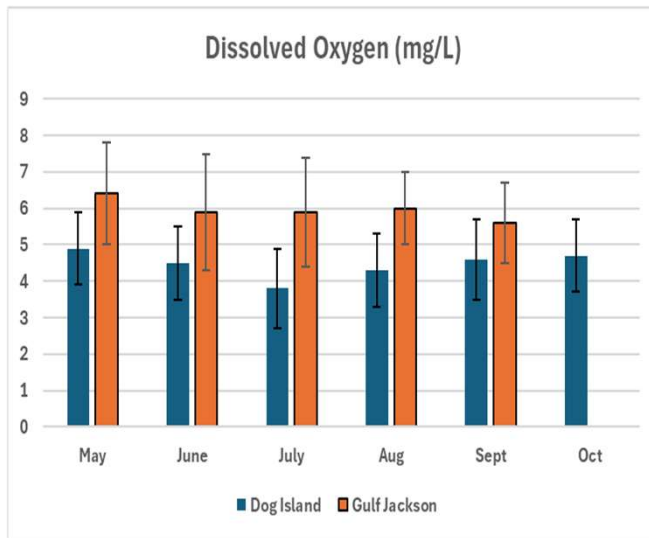
Histology Results: Pathogens

Location	June			July			August			October		
	% affected			% affected			% affected			% affected		
	Parasites	Bacteria	Heme Inf	Parasites	Bacteria*	Heme Inf	Parasites	Bacteria	Heme Inf	Parasites*	Bacteria	Heme Inf
Gulf Jackson	47 + 18	2 + 3	17 + 17*	30 + 0	40 + 7	*62 + 39	30 + 0	20 + 0	65 + 0	50 + 0	0 + 0	20 + 0
Dog Island	*25 + 13	5 + 5	27 + 15	*33 + 18	*14 + 13	*42 + 33	32 + 10	12 + 3	32 + 8	23 + 10	3.3 + 3	13 + 10

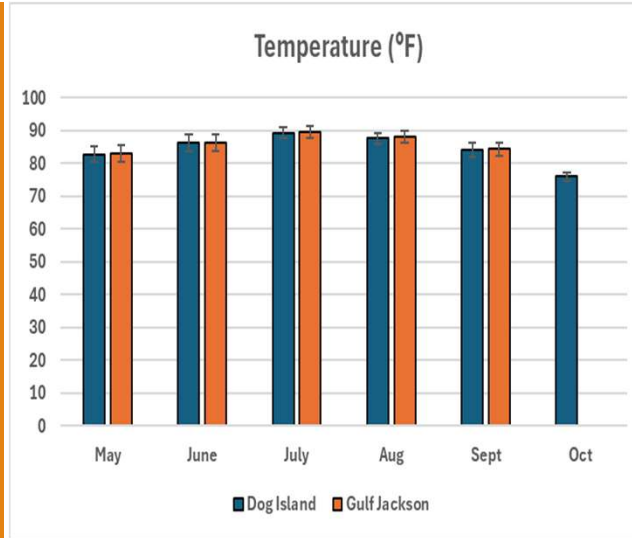


- Although ¼ to ½ of clams had parasites in their tissues, numbers were low (1-5, avg 2) = *no real problem!*
- Bacteria populations in tissues increased in July
 - Hemocyte infiltration followed a similar pattern

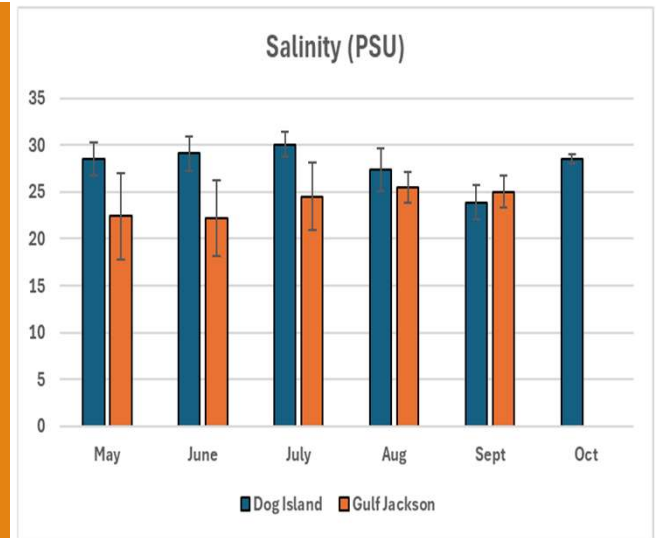
Although bacterial numbers were low in July & August, diversity decreased & the percent of pathogenic Vibrios increased. This was especially evident at GJ and indicates a change in the environment



Optimal = ≥ 5 mg/L



Optimal = 60-80°F



Optimal = 20-30 PPT

Gaping is a typical response to environmental stress

Environmental Conditions

Clam Health Summary

- Decreased drastically in July
 - Decreased survival Aug & Oct
- No smoking gun
 - Bacterial diversity dropped
 - Bacterial pathogens increased
- Temperature played a role
- Unknown environmental factors
 - Plankton diversity change?
 - Nutrient change?

	June		July		August		October	
	GJ	DI	GJ	DI	GJ	DI	GJ	DI
Growth								
Gaping								
Phys Con								
Bac count								
Bac Div								
Bac Path								
Tiss Deg								
Dig Atrop								
Survival	43	57	60	64	25	53	5	35
Temp								
DO								
Sal								