

Addressing Summer Mortalities of Cultured Hard Clams in Cedar Key

Friday April 19, 2024 @ UF/IFAS NCBS

Discussion by UF faculty to develop potential research response to summer mortalities, considering Cedar Key (CK) industry survey results as well as the limits of funding available (~\$55K awarded from Florida Sea Grant (FSG) as disaster response)

Agenda: Background presentations, intro of faculty present, group discussion

Intro by LS – reminder of Hurricane Idalia landfall in CK (10.9 ft storm surge); extreme conditions resulted in >80% crop loss, but notes significant mortalities were also being reported in July and August (high water temperature – 31 degrees clams stop growing, 32 stop filtering; historically there have always been chronic losses of adult clams reaching market size in Summer (20% of crop) but that percentage has been increasing (e.g., in 2022, reported crop loss of 30 – 35% in CK).

FSG has in response to the disaster asked the NSGO for funding to address grower concerns associated with storms and excessive heat (~60K)

Today will provide an overview of:

1. CK grower's feedback on the issue; survey hosted by Cedar Key Aquaculture Association was submitted to growers last month. Rose Cantwell, CKAA chair will give update.
2. Overview of water quality (WQ) conditions observed in CK last summer
3. Short summary of past projects performed in CK relevant to this topic

Reminder of industry importance and value to state of Florida:

From FDACS: 180 certified growers in CK, supports over 430 jobs, 90% of production comes out of CK, \$14.3 M dollar value in sales in FL (Botta et al 2021 – at least a \$29.3M economic impact)

4 active AUZs, 495 leases, CK production over past 7 years, 85 – 100 M clams sold out of CK.

Grower survey results from RC– 163 surveys distributed via email, 39 responded (24%) between March 13 - 29 2024; some highlights:

- Respondents avg number years farming = 19 years (range 2 - 30 y)
- 44% reported slower growth, 54% say about the same
- 83% reported worse clam mortalities over the past 5 y
- 95% reported that summer is the worst season for mortalities
- Pretty even distribution of responses across sizes of clams vulnerable to mortality (50 – 68%)

Conditions they ranked as most important to clam growth and survival included (in order): **salinity, temperature, oxygen, food availability, sediments, disease, fouling, predation, spawning.**

Industry respondents were asked to rank research and monitoring priorities/new initiatives they would like to see this summer, and provided some informative comments:

Top concerns included in comments: density, planting methods and locations, erosion (restoration area has changed salinities and movement of water – Pelican site is worse than it used to be), genetics

Faculty discuss project being led by Bill Pine, lead PI on the restoration project, note there has been lots of salinity monitoring by this group that have not noted a significant change, but also note there are many landscape changes that have occurred (demise of Derrick Key, Suwannee River flow influence, current wet regime)

Water Conditions and Data from long-term monitoring in CK presented by Natalie Anderson:

Temp and Sal monitoring stations (at Dog Island(DI) and Gulf Jackson(GJ)); sensor is 6 inches above the bottom and provides real-time data on temp and salinity

Take home message, 2023 was hot (hottest summer since 1956)

Also, June 2023 was the wettest since 1956, but July was the driest

Clams like 20 – 30 psu is preferred range

Very wet June made for lower salinities than July (note it is important to consider location of sensor as well as location of lease sites)

Leslie notes that winter/spring when Suwannee peaks, lower sals with lower temps are ok for clams, but these low sal conditions combined with high temps are deadly

These monitors provide important data that are used by many, including FSA we ask for these data annually as well as lots of growers who use data regularly.

Overview of relevant projects, CK specific:

Consistent WQ monitoring at both GJ and DI AUZ stations through time, these are real time data recorded every 30 minutes and posted every 2 hours (6 inches above the bottom), archived after QAQC and posted online and this goes back 20 years for Dog Island, a little less for GJ

Previous projects (results of these are available on [shellfish.ifas,ufl.edu](http://shellfish.ifas.ufl.edu) site or reach out directly to LS):

Temp monitoring: Deployed HOBOS on 17 leases in 2007; in 2008 – 2010 there were hobos on 33 – 39 leases

From these previous projects, it was noted that temps at GJ station showed about a 2 degree difference (lower) than those temps recorded in bags; notes there is diurnal refuge

SEED project: FSG funded project to look at seed production and relationships with environmental factors at hatcheries and nurseries around the state – there were punctuated chemical composition and volatile organics assessments (1 – 2 times per year for 2 years) and values were within acceptable limits, same for herbicides and pesticides (but note these samples were only taken 1 – 2 times per year); also looked at phytoplankton composition through the year (monthly samples) – these data demonstrated that diatoms are important as well as seasonality in phytoplankton composition (across and within sites diversity)

Briefly mentioned “What do clams eat?” web based pictorial guide (Suwannee Sound and Indian River)

Clam Health projects: Introduction to Infectious Diseases in Hard Clams (no evidence of QPX); VIMS has helped with mortality event pathology in the past (Ryan Carnegie). John Robert’s vet intern at CVM was able to do an intensive study (2021-22) looking for neoplasia (devastating for shellfish in New England) – found in 1.7% of samples, but this is important because it appears this is a transmissible disease and could become a larger problem

Genetic diversity evaluation (most recent was 2014) Hargrove et al 2015 hatchery stocks v wild stocks

Soil studies - Todd Osborne and Mark Clark – soil mapping 2009 – 2010 to characterize the soil (elevation, organic matter and clay content) – investigating effects of intensive farming, are soil properties different (easement v. lease); Soil properties did not differ significantly in this project. Results could inform BMPs – fallow time recommendations.

Faculty introductions and discussion:

[Richard Baptiste](#): FAU HBOI – notes the historical loss of clams in IRL (also massive loss of seagrass in the IRL) wild stocks have dramatically diminished; no recruitment – lots of current restoration projects (millions of hard clams being planted on farms in IRL – not leading to recruitment in native pops); industry notes wild set every so often shows up, but very rare. Not a lot of research on what’s going on but a lot of restoration is going on. Perhaps some research angles where FAU can help: Genetic – broodstock selection in hatcheries? Can we help by providing some of the genetic expertise? Can we better describe what people are doing to the environment – they’ve done some research on pH and clams, they have microalgae lab space. Is there a way to get industry to collaborate with each other and get on the same page for benefit of entire industry. Notes that coral and sponges experiencing warm water mortality are being investigated as well, which may increase capacity.

Remembers big set of wild clams in the 1980s in the IRL, followed by excessive wild harvest (Bill Arnold’s work) and environmental degradation in 2000s

[John Roberts](#) – UF College of Vet Med – had start up money to do aquatic marine inverts (coral and shellfish); recent project included full body analysis/histo to look for neoplasia; much of this work done by Bryce Miller; but these samples all have matched DNA in the freezer; he has the capacity to look at an individual animal (586 individuals, transcriptome analysis over 13 months to see gene expression during the summer? Insight into metabolic processes? Development of a heat tolerant clam?)

Also investigating the spring mortality issue for oysters, using AI algorithm to read histos – pathology and tissue degradation (histology in shellfish)

Recent samples from CK (April 2024 sample from farmer) to investigate seed clam mortality and results ID that the event was not acute (clams were not eating for weeks)

Neoplasia is transmissible – impacting Cape Cod, Shirley Baker notes she has a book chapter coming out soon that discusses this issue – could get sequences from samples that are saved.

College of Vet Medicine is moving to AI with pathology and the work John has done on the oyster project – presented at NSA and it was well received – AI to read histos will allow for faster digestion of data

[Dave Chagaris](#) – UF NCBS, creating a marine model for Suwannee Sound ecosystem, clams are part of the model, temp, salinity, phytoplankton, etc. and mortality can inform that model

[Andy Kane](#) – UF Dept Env and Global Health, generally interested in environmental and community production, began with contaminants (aq toxicology and pathology) Bivalve health historically has focused on oysters, but relative to WQ, climate, harvest, disease – nutrients and productivity and comprehensive/additive impacts of stressors; *Notes it important to capture mortality in a more quantitative way to remove the anecdotal portion*

[Chris Vulpe](#) in Center for Env Health and Toxicology, College of Vet Med – Expertise includes molecular toxicology, a wide variety of systems including mollusks, focus is to understand mechanisms by which chemicals and contaminant in the environment lead to disease – recently became interested in shellfish mortality as it relates to environmental contaminants and stressors – molecular analysis/contaminant analysis – look for what you can't explain.

Leslie notes here that CK is well protected from industrial pollution; Chris notes legacy contaminants and potential resuspension in the water column.

[Andrew Ropicki](#) UF FRED/FSG Marine Economist– well acquainted with Florida's fisheries economics and may be able to assist from an economics standpoint; Adaptation/Economic assessment.

[Shirley Baker](#) UF SFFGS; has been at UF since 1999 working on shellfish – a bivalve physiologist – energy budgets, food and oxygen and env parameters and their impact on survival and growth –

Interested in how environmental conditions and effects on survival, metabolic rates;

Has a 2024 Sea Grant intern to build on previous study (metabolic rates of diploid and triploid clams and effect of temperature) – temp effects on behavior this summer

Mike notes that Salinity dynamics may be informative with Dave's model

[Angela Collins](#) – UF TAL/FSG Extension Scientist, can assist from an Extension perspective; currently working with industry in southwest Florida (where they also experience summer mortality events and very high temps); has multiple projects in conjunction with industry from hatchery, nursery and leases; notes ARC project that was recommended for funding this year (Hill, Tuckett and Collins – characterize current thermal landscape of Florida Aq) will allow lots of sensors to be deployed on individual leases; also working with the restoration efforts in SW Florida as led by All Clams on Deck (through GSI) and the A Billion Clams for Charlotte Harbor outplanting project

[Ashley Smyth](#) – UF TREC, coastal biogeochemist, she is interested in how nutrients move, has been working with industry here in FL as well as shellfish aq industry in VA for years.

[Ed Philips](#) – UF SFFGS, algal physiologist; recently completed project that assessed phytoplankton composition of water coming into hatcheries – notes problematic dinoflagellates, highest

concentrations 1 mg/l C (obviously these not as bad as IRL levels of 20 mg/l but still) Sampling once per month might not be enough

[Huiping Yang](#) – UF SFFGS, shellfish genetics expertise – has looked at heat and different response from *M. campechiensis*; transcriptomes from 2019; east coast clam hub consortia project using DNA/snp markers to relate to disease (and relationship to environmental parameters); phenotyping; next step is to combine genome selection and traditional phenotype to speed up the selection...hopefully doing genotyping soon but seeing that salinity is a top concern and then heat shock (low and high sal physiology, transcriptome, gill, blood cell function, etc.) Sample runs are very expensive – Jan 2025, post-doc in the lab has developed some sensitive markers for the ID of *campe*

Micro SNP markers large scale and high temp exposure correlation, genome selection submission, ARC proposal for low sal work was recommended for funding

[Sarah Hutchins](#) GSI – applied research to support FL shellfish industry and restoration efforts; ARC project looking at thermal tolerances of N and S hard clams and E oysters, acute thermal stress and diurnal cycles with high and low salinities – looking to do a follow up experiment that will dive more deeply into how salinities are affecting hard clams – spawned survivors at upper temps and hope that outplantings at CK do well (F1 heat shocked and growth and survival after stress);

Recent proposal in collaboration with VIMS looking at genetic markers for *M. campechiensis* to do more rapid assessments (this could inform development of hybrids)

[Susan Laramore](#) FAU HBOI, her lab brings expertise to seed health/histology/bacteriology – has existing upwellers, troughs, lab space; Notes that looking at things in combination is important; FAU can help with analysis and lab experimental capacity

[Ruth Francis-Floyd](#) UF College of Vet Med, Aquatic animal vet, Extension vet, sees her role as a facilitator to bring people together; Notes that historical protocols developed with Smolowitz and D Petty must be somewhere (John Roberts says he has it).

General Discussion

\$55K to do work this summer; form to be sent out next week for short proposal from interested faculty – this can include analysis of existing data, collect new data, etc. – these seed funds are not a lot but hopefully will allow us to learn some things this summer

Andy notes need for categorical response data and knowing the community – how would they weigh in on changing production practices

Group discusses density issue – planting density is obviously important, location on lease is also important;

Bottom planning without the bags would allow clams to bury deeper for thermal refuge – but not sure if that would outweigh the efficiency that clam bag method brings

But bottom plant allows clams to go deeper – perhaps an economics investigation (cost benefit of switching?); also notes that cover nets may be impacting clams ability to feed/etc.

Are we selecting through hatcheries and culture methods for animals that are easy to spawn and influencing crop by planting individuals that spawn so easy (e.g., are they spending energy on spawning and not growth and resilience)

Leslie reminds group of FARMS project – oyster farm monitoring as a model

Could we do something similar where we provide seed to growers; sentinel clams...holistic approach this summer?

Density dependence/Carrying Capacity – stocking density and survival results – repeat those projects that have been done before and compare to past results

Huiping's work at Dog Island leases (50% survival) Heat challenge 1150 – 1200 per bag

Ed – potential to examine phytoplankton gradient as you move across the lease/food availability/chl (discussion related to how the clams on the edges of leases often do better than those in the center)

[Ray Grizzle](#)'s work on measuring chlorophyll across leases using fluorimeters.

Paper with Kal Knickerbocker FDACS in Alligator Harbor AUZ (source and sinks for nutrients) Ammonia concentrations shift with flow – Note dead clams add to ammonia and exacerbate nutrient increase.

Chris asks whether it is possible that herbicides are killing the food source – exposure to herbicides is episodic and can really be accelerated by weather events; one-off sampling may not be very informative, should increase assessment frequency of chemicals present.

Continual monitoring of phytoplankton is important – Leslie notes that chlorophyll probes are to be added to the 2 stations in existence – is chl a good proxy or should there be more repeated sampling for species composition; remote probes may still provide useful info (deploy upstream and downstream during the full tidal cycle to see if there is a consistent gradient – spot checks and grabs would involve enormous cost and manpower)

Higher deposition of organic matter could lead to higher metabolic rates and low DO and be exacerbated by summertime temps (sediment tubes - @Ashley Smyth to measure sedimentation rates?)

Sediments are fluid inshore; tide, wind, precipitation events can all influence this

Redox potential might be informative (are there any newer, more reliable probes out there?)

Richard asked about the unusual Pyrodinium bloom in the IRL (Sebastian area) last summer? Did Ed do anything to assess this? Group notes that [Malcolm McFarland](#) at HBOI or [Kate Hubbard](#) at FWC/FWRI might be able to provide most recent info

There is expertise on carrying capacity and models as they may relate to shellfish; VIMS researcher [Mark Brush](#)

Leslie mentioned she is part of a project proposal to do genetics work to have hatcheries provide broodstock to get a genetic health assessment for the east coast (NSGO request for funding)

Genetic breeding would be an enormous benefit to the industry – Huiping will continue to seek funding to help with this – group notes we need to have industry buy in to evaluate success in the field; Shallow water stock on east coast – in the NSGO proposal.

Increase water quality monitoring (assess flow situation – Dave Kaplan or Matt Richardson that have done comprehensive analysis on the data from Bill Pine’s project – noted no diffs in sal, except during periods of high flow – frequency data, but either way there is not a strong signal)

Angela working developing on a mechanism with Adrienne at FSAA for farmers to report observations (simple online, app or web-based reporting– representative growers, look at [PCSGA](#) as example?)

What is the value of health assessments during the critical period when clams are dying and do this across density treatments? (Leslie notes that funds can only go out for payments for services or purchase of supplies and equipment).

Industry buy-in and response rate – are there long term records they might be willing to share? but getting them to participate through time will be key

Pilot study to assess lower density planting success? (e.g. does increased survival from low density plantings outweigh mortality in higher density bags?)

What about shelf life? How is shelf life being impacted in summer; ways to improve shelf life.

Chris reminds group of New President’s strategic initiatives funding opportunity – aquaculture fits well within that umbrella and a strategic initiative; call for proposals is due in 2 weeks but these are short, undetailed proposals (1 page) 750K – 2 M over 3 years, potential opportunity to apply and receive funding (iterative process, no downside!) Mike noted they have tried before (twice) for broader aquaculture funding through one of these; but interested in industry buy-in and fiscal contributions.