

DECISION-SUPPORT TOOLS for Florida Clam Farmers

Leslie Sturmer

UF IFAS Shellfish Aquaculture Extension
Cedar Key, FL



Applied Projects

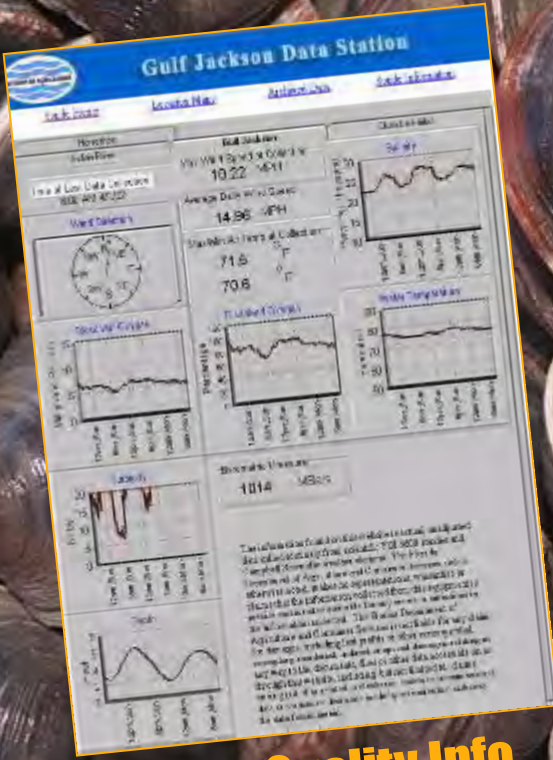
which allows growers to make informed and timely management decisions



Clam Tools
2010



Temperature
Data Loggers



Water Quality Info

What Do Clams Eat?

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Sea Grant
Florida
UNIVERSITY OF
FLORIDA

A guide to potential food sources for clams – marine phytoplankton and their spatial and seasonal distribution

Florida Shellfish Aquaculture Extension
PO Box 89
Cedar Key, FL 32625
352-543-5057
<http://shellfish.ifas.ufl.edu>

Water Quality Monitoring

- Collaborative project
 - University of Florida
 - FL Department of Agriculture and Consumer Services
- Partnership with USDA
 - Risk Management Agency
 - Funding renewed for 2010-12
- Allows for continued operation of remote sensing technologies in open-water clam farming

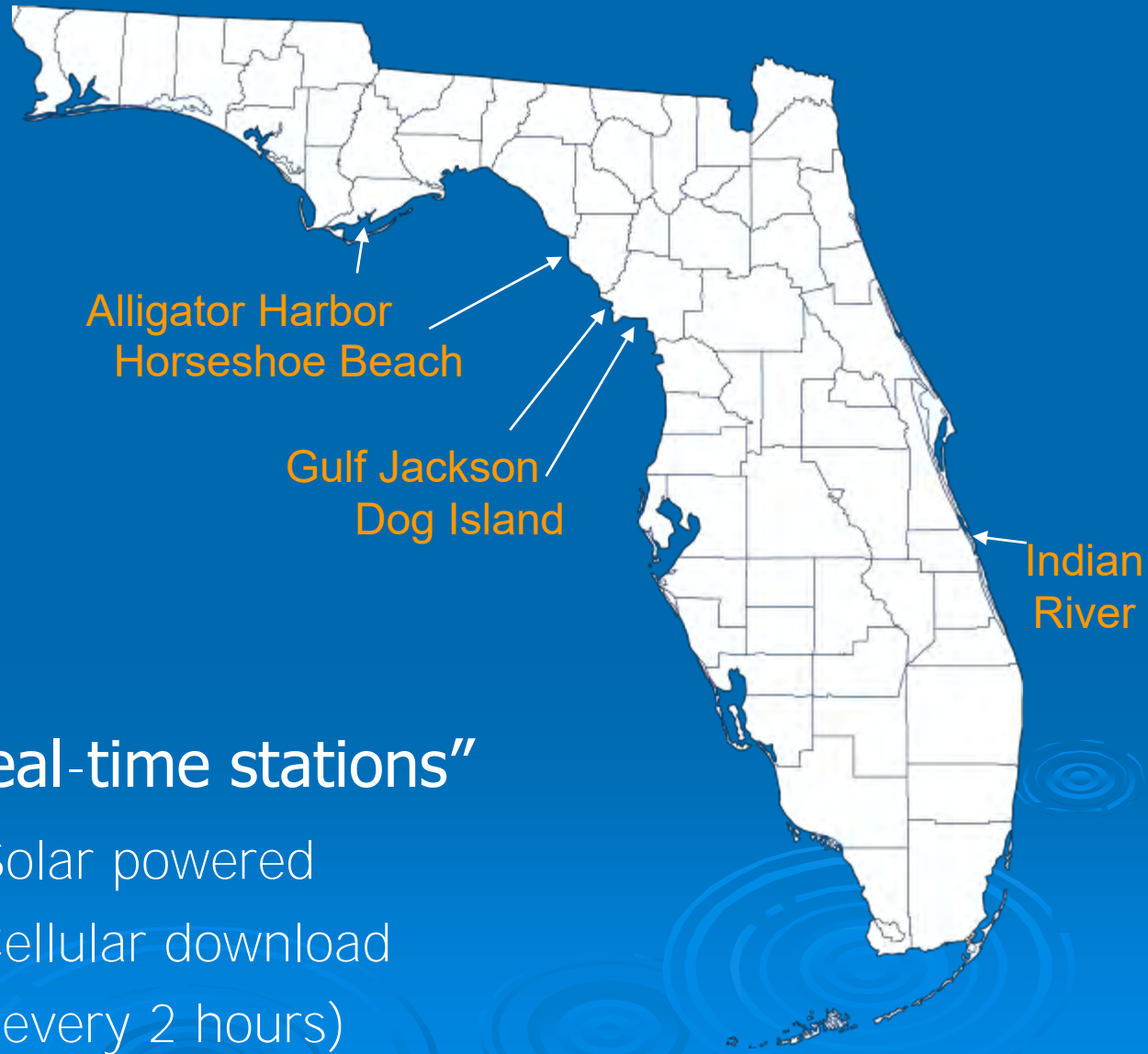


Monitoring Equipment

- Campbell Scientific Weather Stations
- YSI, Inc. Sondes 6600
- Continuous recording (every 30 minutes)
 - Water temperature
 - Salinity
 - Dissolved oxygen
 - Turbidity and depth
 - Air temperature
 - Wind speed and direction



Station Locations



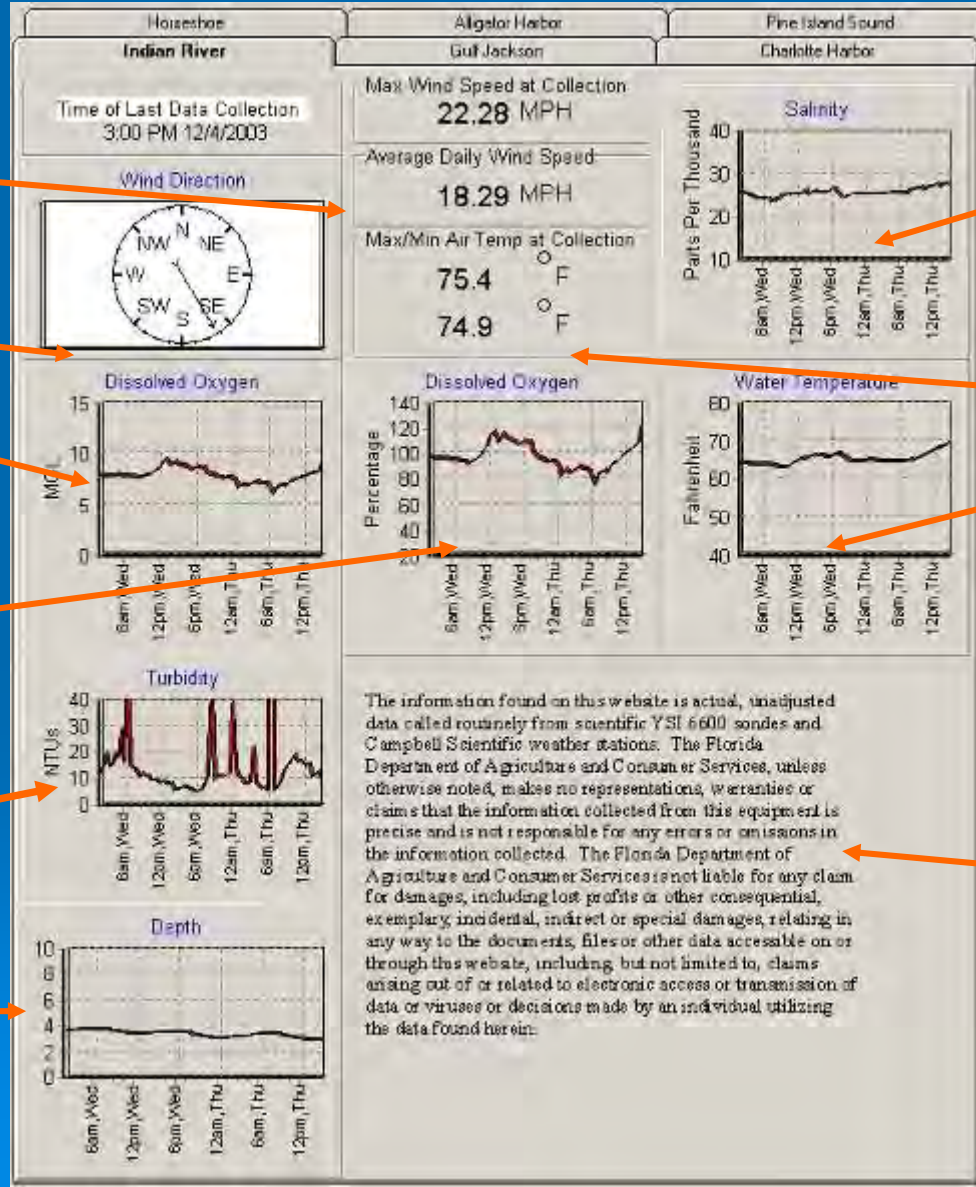
➤ "Real-time stations"

- Solar powered
- Cellular download (every 2 hours)



Uncorrected real-time data posted immediately

www.FloridaAquaculture.com



Wind speed

Wind direction

Dissolved O₂ (mg/L)

% Dissolved O₂

Turbidity (NTUs)

Depth (feet)

Salinity (ppt)

Air temperature

Water temperature (°F)

Disclaimer

Continuous database archived at <http://shellfish.ifas.ufl.edu>

➤ Continuous data base, 2002-10

- Proofed for sonde errors
- Archived and electronically posted at website
- Provided as “farmer friendly” monthly and annual graphs per station location

UF IFAS UNIVERSITY of FLORIDA Online Resource Guide for
Florida Shellfish Aquaculture

Home | Calendar | Contact an Expert

Archived Water Quality Information Alligator Harbor, Franklin County

2009

- [January 2009](#)
- [February 2009](#)
- [March 2009](#)
- [April 2009](#)

2008

- [January 2008](#)
- [February 2008](#)
- [March 2008](#)
- [April 2008](#)
- [May 2008](#)
- [June 2008](#)
- [July 2008](#)
- [August 2008](#)
- [September 2008](#)
- [October 2008](#)
- [November 2008](#)
- [December 2008](#)

2007

- [August 2007](#)
- [September 2007](#)
- [October 2007](#)
- [November 2007](#)
- [December 2007](#)

LIVE Water Quality Information (FDACS)

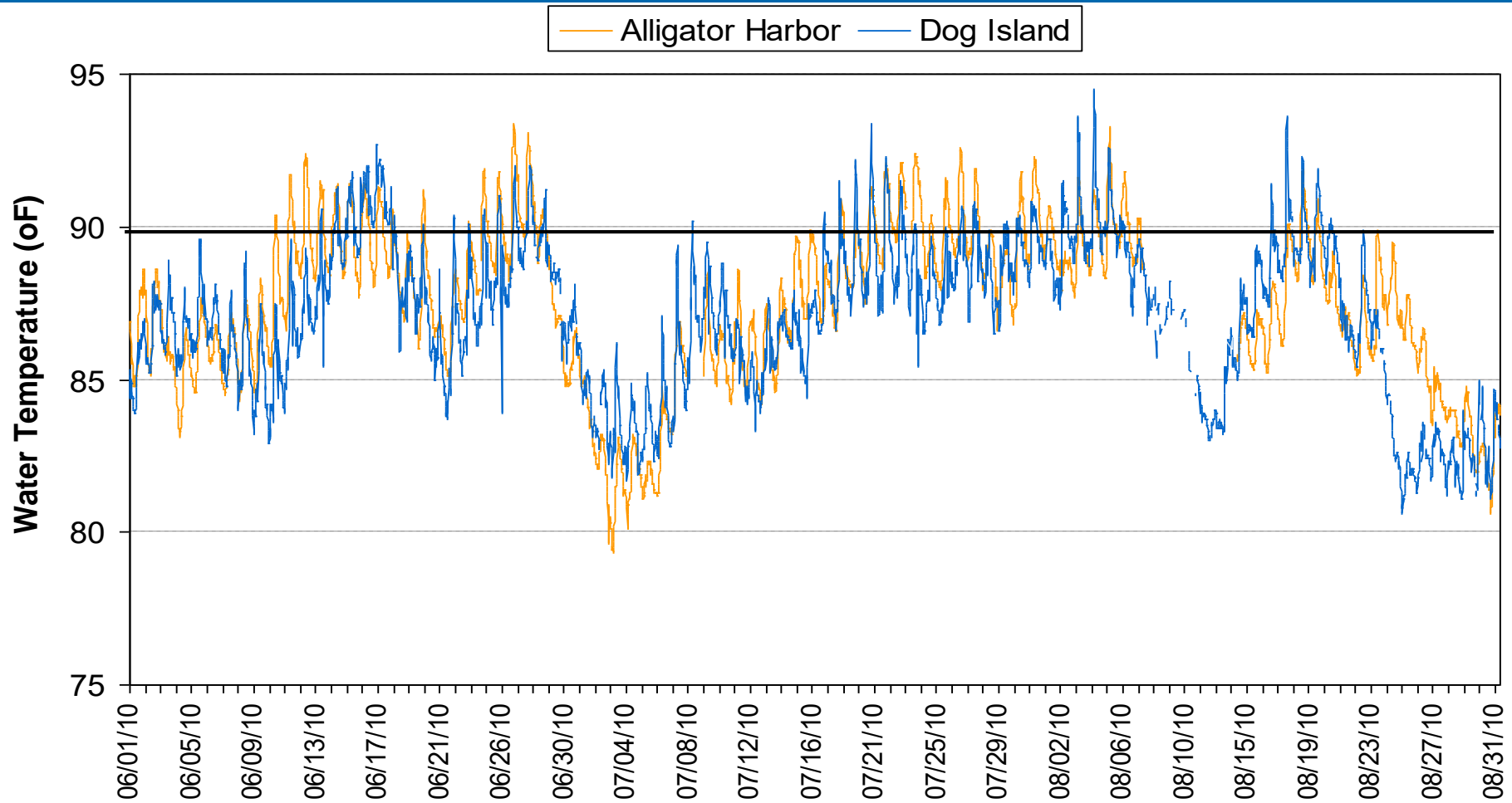
Archived Water Quality Information:

- [About Archives](#)
- [Alligator Harbor](#)
- [Body A](#)
- [Body F](#)
- [Dog Island](#)
- [Gulf Jackson](#)
- [Horseshoe Beach](#)
- [Indian River](#)
- [Pine Island](#)
- [Sandfly Key](#)

Monitoring Stations in Alligator Harbor (Franklin Co)

Continuous water quality database

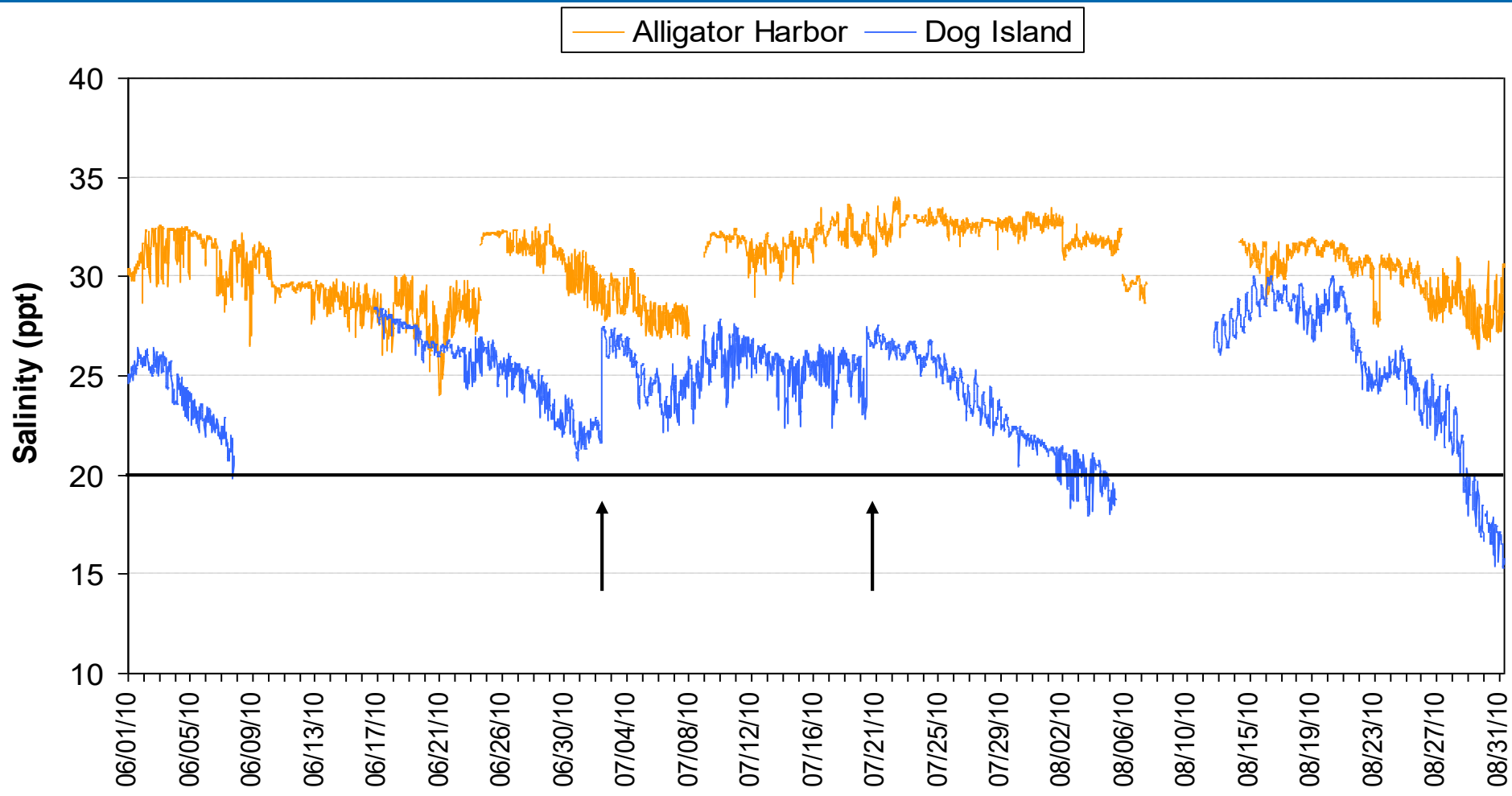
- Long-term data set is being developed
- Details in seasonal and annual variability being revealed



*Alligator Harbor (Franklin County) and Dog Island Lease Areas (Levy County)
June - August 2010*

Continuous water quality database

- Trends in environmental conditions in relation to clam production emerging



*Alligator Harbor (Franklin County) and Dog Island Lease Areas (Levy County)
June - August 2010*

Water quality fact sheets available at website: <http://edis.ifas.ufl.edu> FA151, FA152, CIR1500

UNIVERSITY of FLORIDA IFAS Extension edis FA150

The Role of Water Temperature in Hard Clam Aquaculture¹

Key Words: Leslie Sturmer, Elise Hoover

Introduction

The clam aquaculture industry has grown significantly in hard clam production in the state of Florida, primarily in the central and southern regions.

What is water temperature?

Temperature is the measurement of energy and it is related to the motion of molecules in a material. Many organisms are sensitive to temperature, and the amount of energy, dissolved oxygen, and salinity. Temperature is one of the most important factors that affect clam growth and survival. It affects the rate of metabolism, the rate of reproduction, and the rate of mortality. Temperature also affects the rate of disease transmission and the rate of mortality.

Temperature also plays an important role in determining the rate of food intake. Aquaculturists should be aware of the temperature requirements of the clam species they are raising.

UNIVERSITY of FLORIDA IFAS Extension edis CIR1500

The Role of Salinity in Hard Clam Aquaculture¹

Shirley Baker, Elise Hoover, and Leslie Sturmer

What is salinity?

Salinity is defined as the total concentration of dissolved salts in a solution. Salinity is measured in parts per thousand (ppt) or grams per liter (g/L). Salinity can be expressed in grams per liter (g/L) or parts per thousand (ppt). Salinity is an important factor in clam aquaculture because it affects the rate of metabolism, the rate of reproduction, and the rate of mortality. Salinity also affects the rate of disease transmission and the rate of mortality.

UNIVERSITY of FLORIDA IFAS Extension edis FA152

The Role of Dissolved Oxygen in Hard Clam Aquaculture¹

Key Words: Elise Hoover, Leslie Sturmer, and Shirley Baker

What is Dissolved Oxygen?

Oxygen is a chemical element and a colorless, odorless gas. It is the most abundant gas in the atmosphere. It is essential for the survival of most organisms. In water, oxygen is dissolved and is available to organisms. The amount of dissolved oxygen in water is affected by temperature, salinity, and the amount of oxygen that is added to the water.

How is Dissolved Oxygen Measured?

Dissolved oxygen can be measured by several methods. Unfortunately, measurement of dissolved oxygen requires special, often expensive, equipment. Winkler titration is the most inexpensive method to determine the amount of dissolved oxygen in water, but it is also the most sensitive and most labor-intensive. Oxygen electrodes and oxygen optodes (different types of oxygen meters) are fast and accurate, but they can be expensive.

Winkler Titration

A water sample is removed from the water body and preserved with chemicals that form a brown precipitate; the amount of precipitate is directly proportional to the volume of dissolved oxygen present in the water. A strong acid is added to convert the precipitate to dissolved iodine. Finally, a thiosulfate solution is slowly added until the brown-black iodine color disappears. The concentration of dissolved oxygen can be calculated from the volume of thiosulfate necessary to make all the iodine disappear.

UNIVERSITY of FLORIDA IFAS Extension edis FA152

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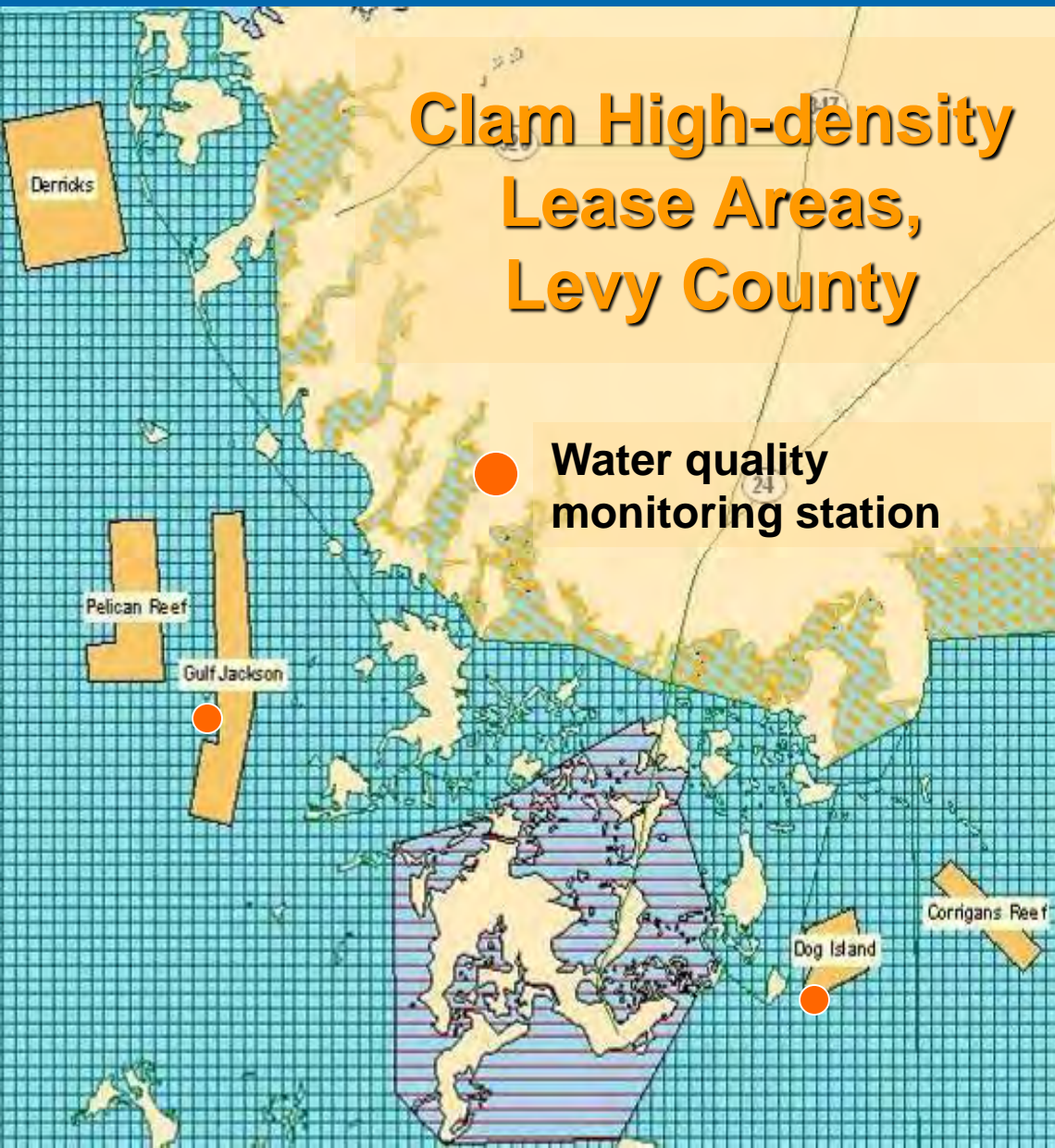
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- How measured
- Why variable
- How affects clam physiology
- What are signs of stress
- How affects clams
- How to manage crop in response to
 - Water temperature
 - Salinity
 - Dissolved oxygen

Water Temperature Monitoring



- Need to better understand water temperature during summer months and their affect on clam production
- Inexpensive data loggers distributed to participating growers provides detailed and broad coverage

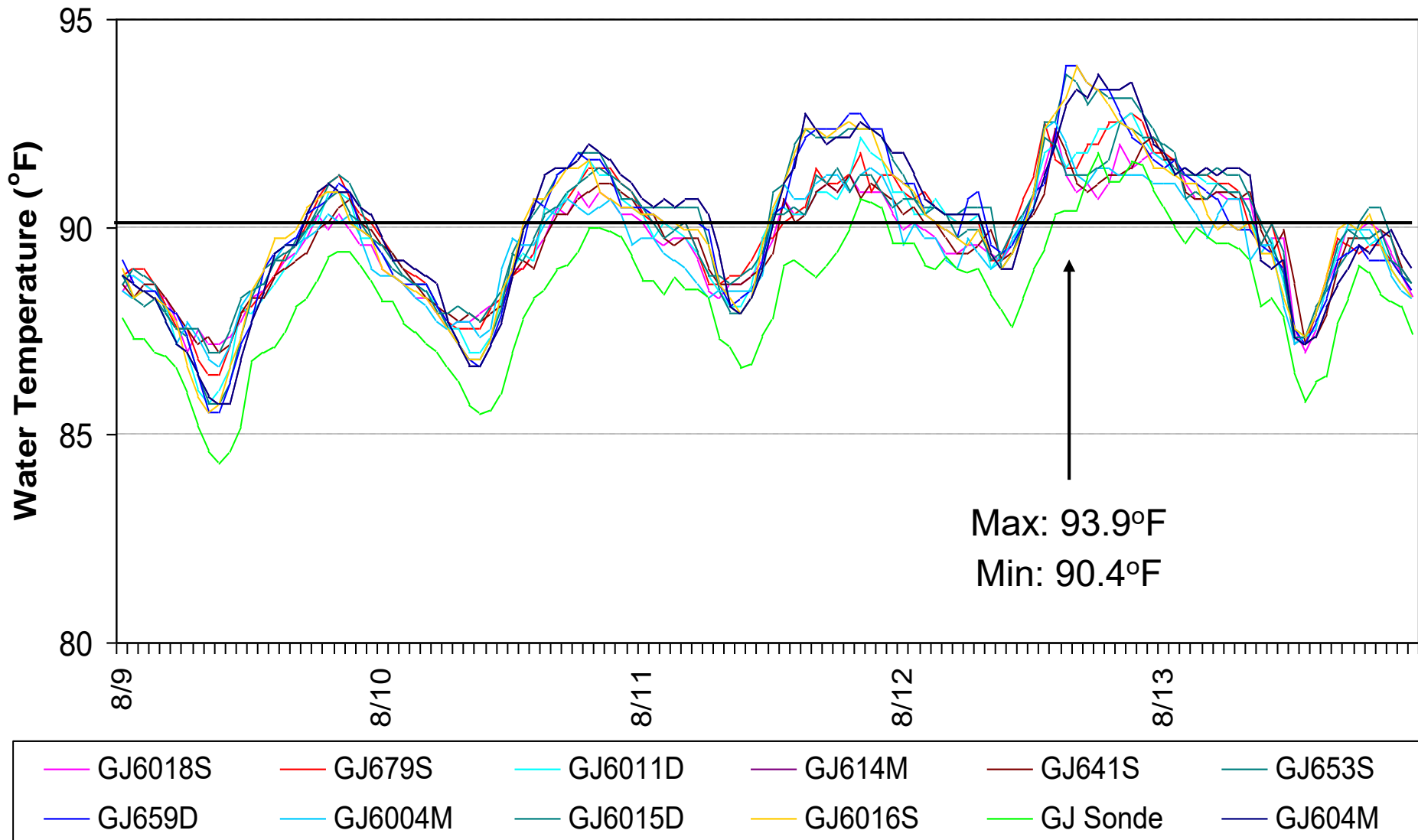
Water Temperature Monitoring

- Deployed by growers inside bags
 - 37 Levy County leases in 2009 - 18% coverage
 - 34 Levy County leases in 2010 - 16% coverage
 - 11 leases in 4 other counties in 2010
- Beginning to adequately describe temperature variability within and among lease areas
 - Water depth
 - Bottom configuration
 - Substrate characteristics
 - Tidal and wind current
 - Other parameters
- Develop site-specific planting and harvesting strategies



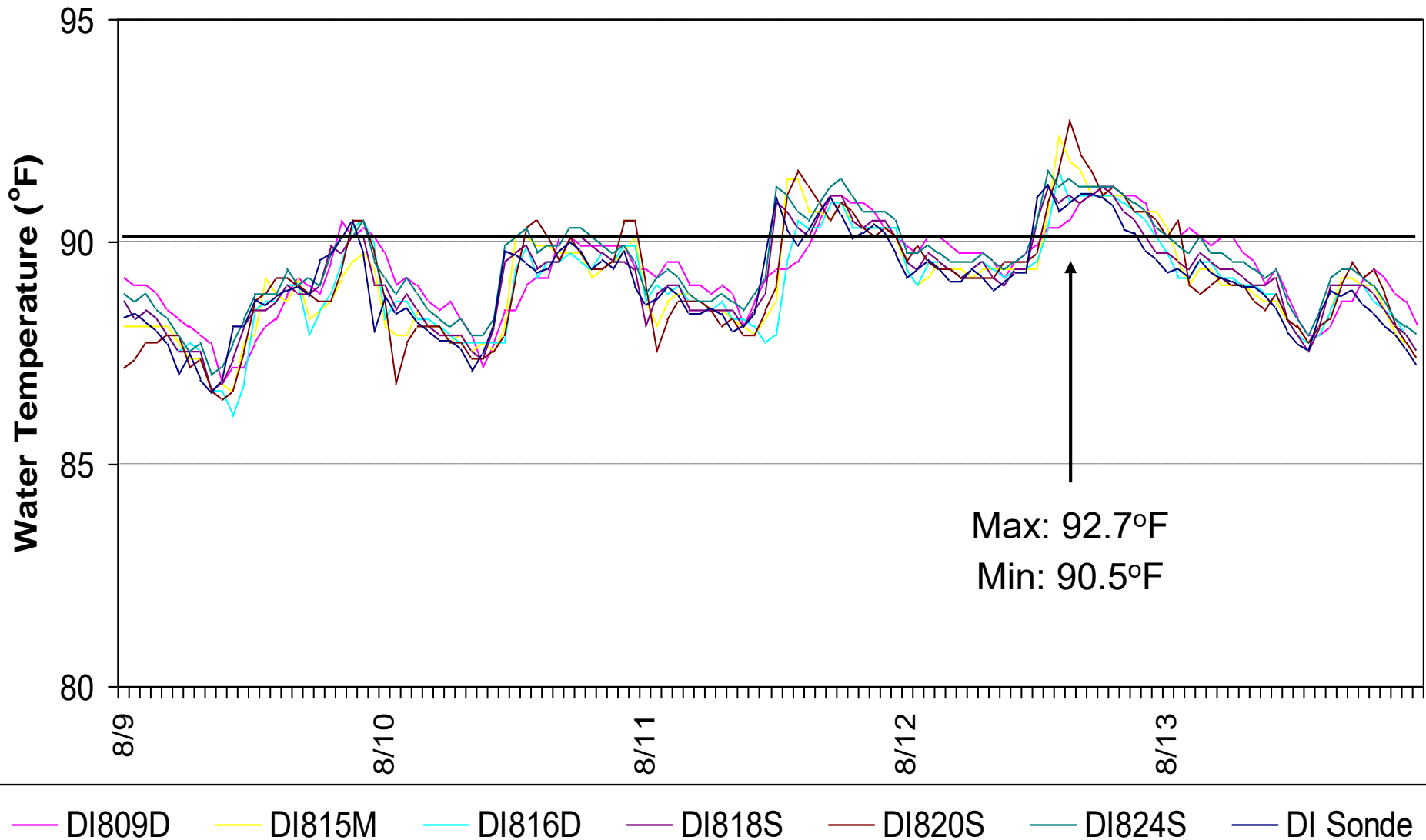
*HOBO® Pendant
Temperature Data Logger
(2.3 x 1.3 x 0.9 inches)*

Gulf Jackson, Cedar Key Leases (n=12) August 9-13, 2009

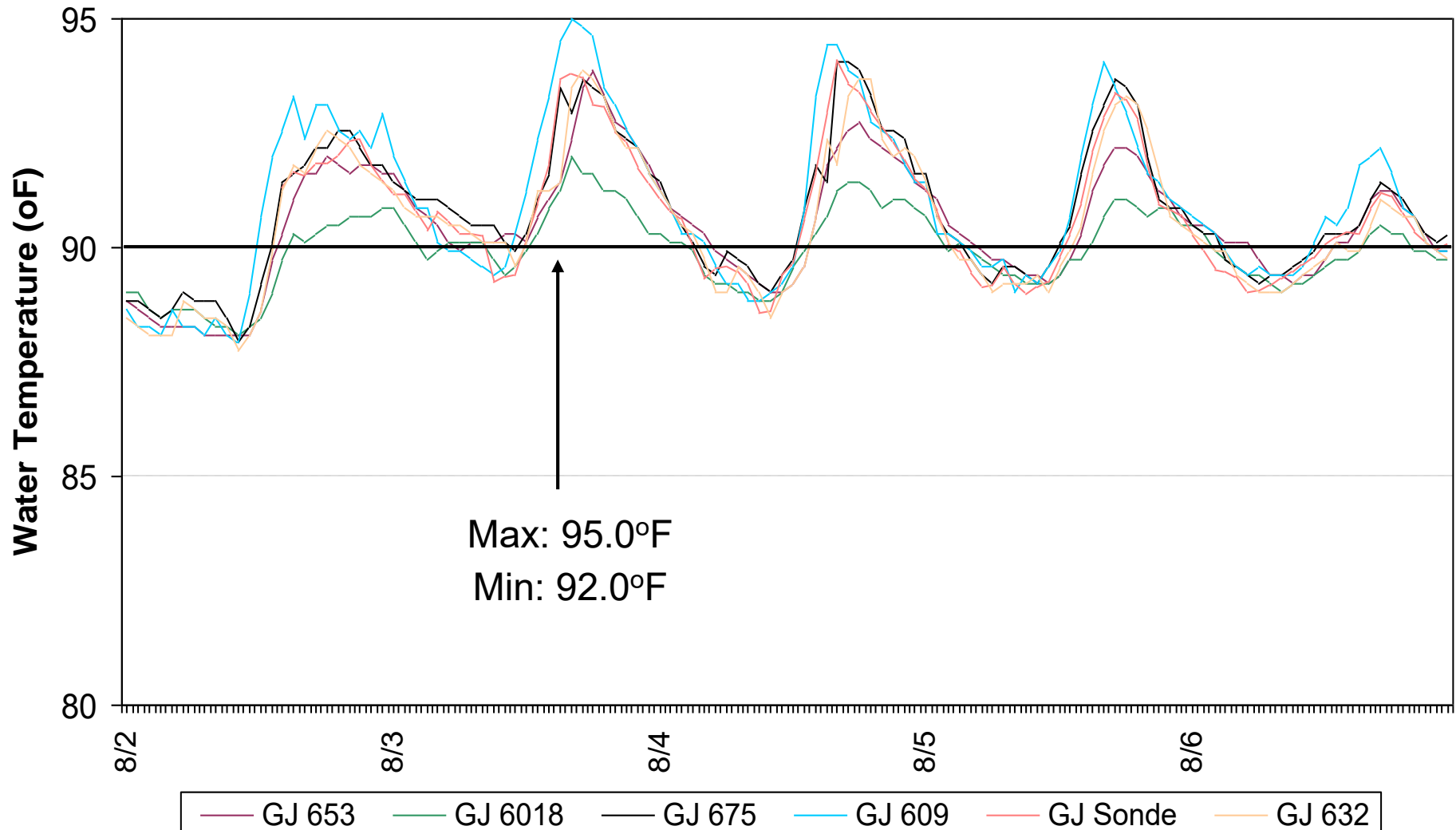


Dog Island, Cedar Key Leases (n=7)

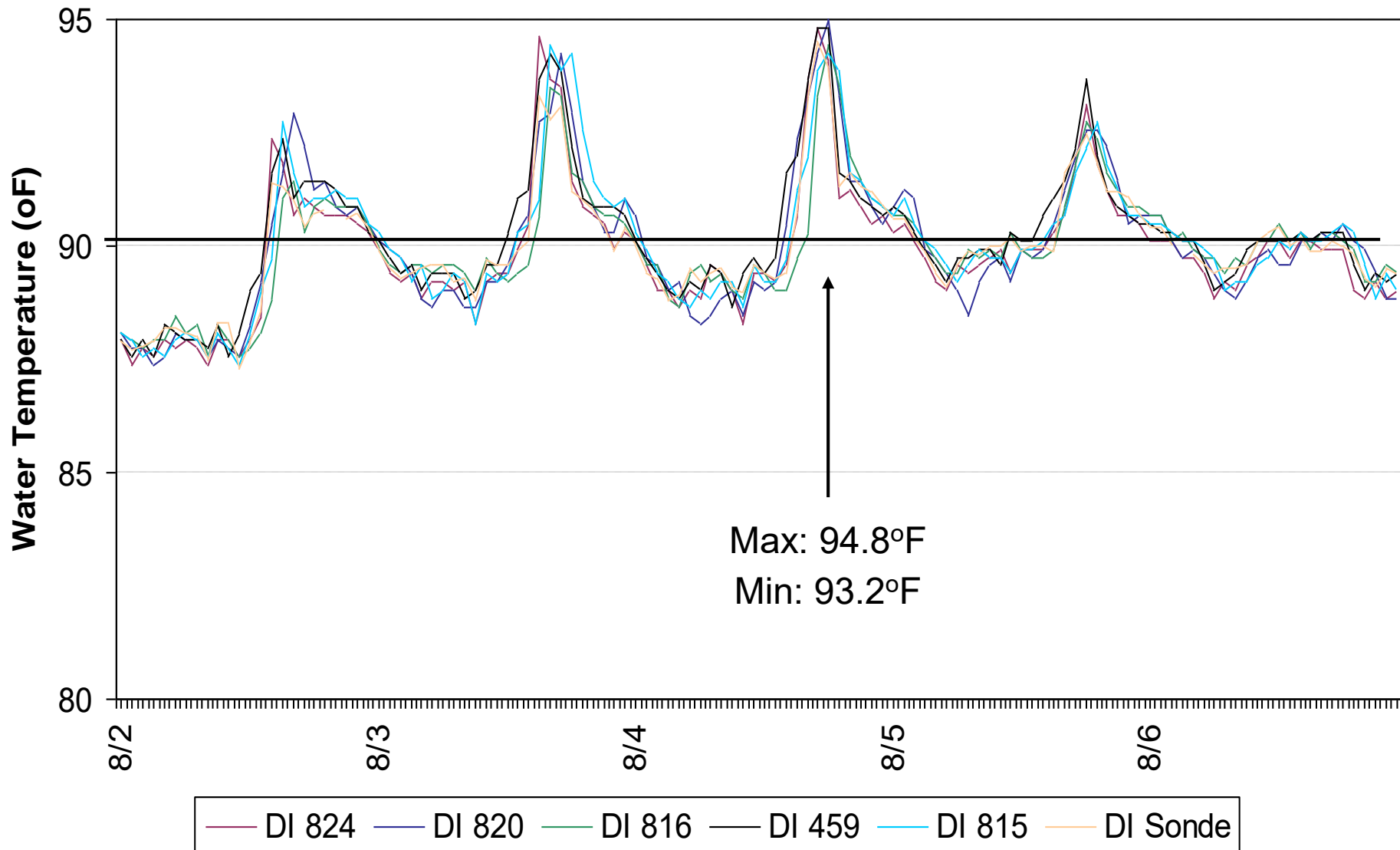
August 9-13, 2009



Gulf Jackson, Cedar Key Leases (n=6) August 2-6, 2010

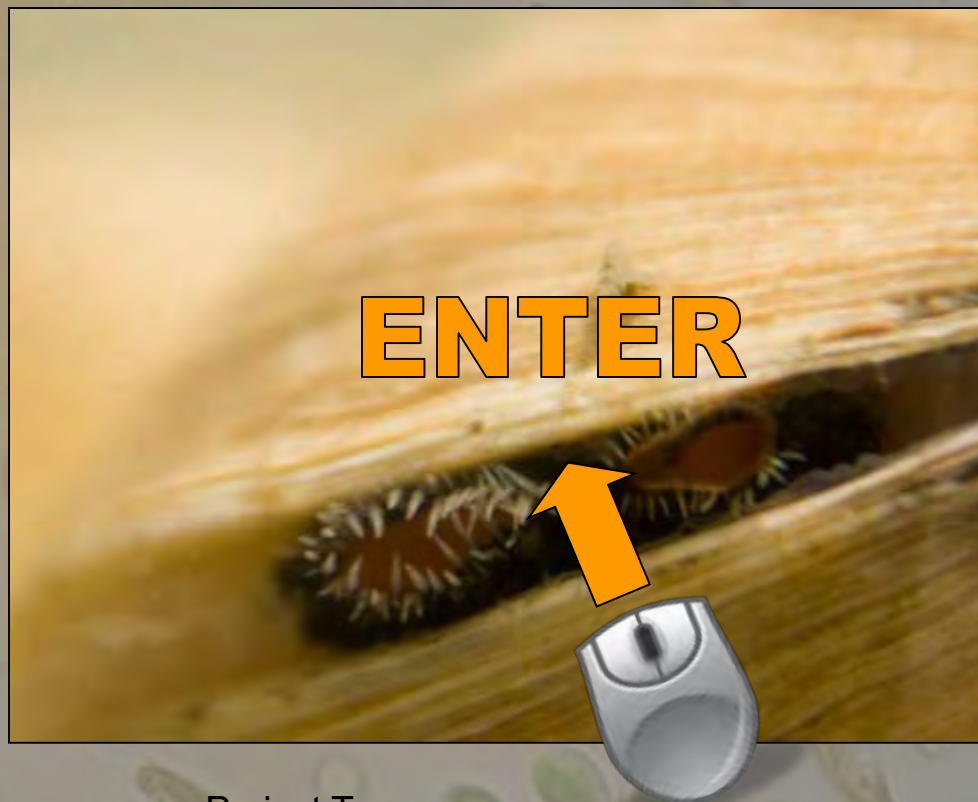


Dog Island, Cedar Key Leases (n=6) August 2-6, 2010



What's do Clams Eat?

- Pictorial guide assists clam farmers in identifying
 - Potential food sources
 - Spatial and seasonal distribution of food
 - Whether food is good (nutritious) or bad (noxious or harmful) for clams
- Focuses on 2 regions of FL
 - Suwannee Sound
 - Indian River
- Data collected from prior UF phytoplankton studies
 - US EPA, USDA
 - FL Water Management Districts



Project Team:

- Ed Philips, Nikki Dix, Shirley Baker
UF SFRC Fisheries and Aquatic Sciences
- Leslie Sturmer, UF Cooperative Extension
- Kevin Hulen, UF Biological Sciences

Quantity of Clam Food

FOOD FOR CLAMS: MEASURES OF QUANTITY

[READ ABOUT FOOD QUALITY](#)

Introduction > Sampling Methods > Food Quality

Microscopic counting of phytoplankton (a method is expensive and time-consuming) to measure food availability is by estimating the amount of chlorophyll contained in all algal cells and then extract the pigment and measure it with a spectrophotometer (a device that measures the amount of light absorbed by a substance).

Chlorophyll a concentrations are widely used to define eutrophication (i.e., growth of algae) in aquatic ecosystems (oligotrophic, moderately eutrophic, or hypereutrophic) environments where rather than low nutrient levels, they are roughly defined as 5, 10, and 20 $\mu\text{g/L}$ thresholds since their mean values in unflushed ecosystems these boundary levels might be exceeded.

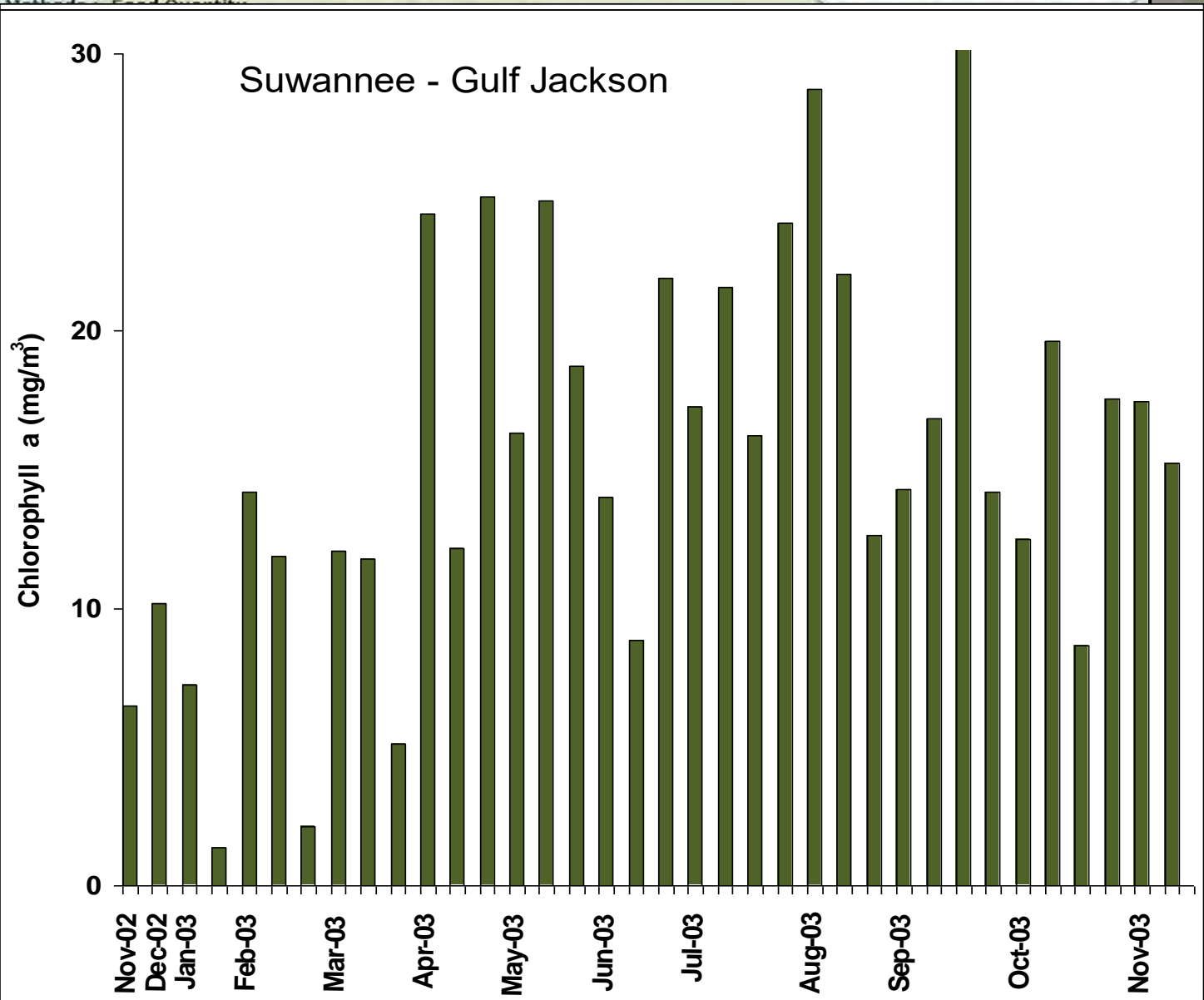
Many scientists view eutrophication as a complex phenomenon on the specific issues under consideration. For example, the effects of eutrophication involved are not harmful, but the effects are due to reduced water clarity and oxygen depletion.

Chlorophyll a Patterns

Below you will find graphs showing the average monthly chlorophyll a concentration in the Indian River Lagoon and the Gulf of Mexico Sound regions of Florida. The concentration can change depending on the season.

Indian River Lagoon

Average Monthly Chlorophyll a Concentration



Quality of Clam Food

FOOD FOR CLAMS: MEASURES OF QUALITY

RESOURCES

Introduction > Sampling

The amount of phytoplankton is then identifying and counting species (and how many) to estimate of total phytoplankton as a measure of food available.

Microscope counts are used to estimate the potential quality of the food. More nutritious or more diverse environmental conditions

Phytoplankton Biovolume

Below you will find graphs for various regions of Florida. Each graph shows the amount of phytoplankton measured in units of biovolume (10⁶ μm³/mL) depending on the range of months.

Indian River Lagoon

Phytoplankton Biovolume

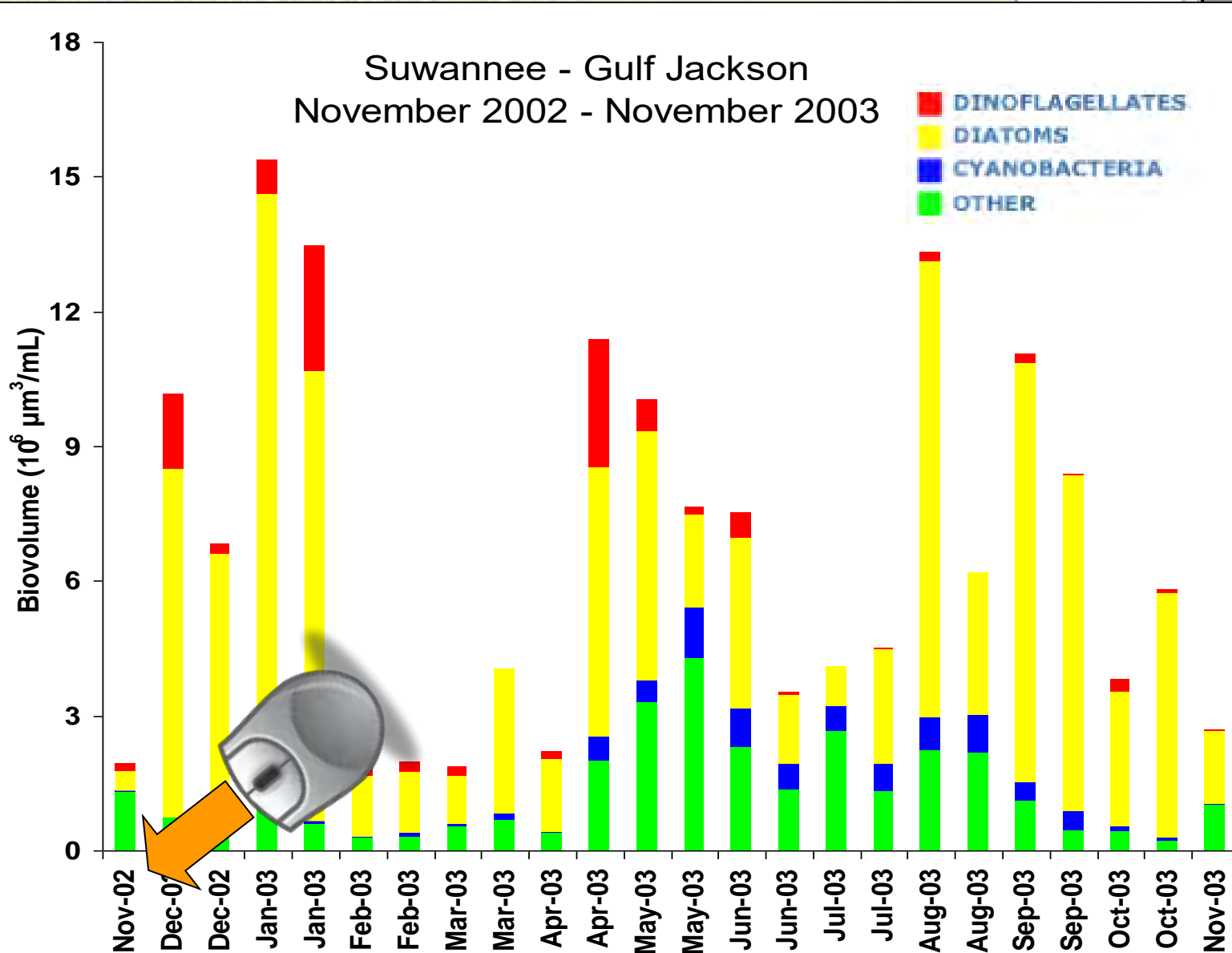
Phytoplankton Biovolume

Phytoplankton Biovolume

Major Algal Groups

Click below for descriptions

■ DINOFLAGELLATES



Algal Group Pages

ALGAL GROUP: DIATOMS

[Introduction](#) > [Sampling Methods](#) > [Food Quantity](#) > [Food Quality](#) > [Diatoms](#)

(5 – 200 µm cell size)

Diatoms are among the most common and widely distributed microscopic marine algae. They are the dominant algal group in most of Florida's coastal waters and can form major blooms. They have cell walls composed of silica. In other words, diatoms live in glass houses, which often take on beautiful shapes. Diatoms have traditionally been classified based on their shape and size. Circular, centric diatoms (such as *Paralia sulcata*) have radial symmetry and live mostly in the water column, while oblong, pennate diatoms (such as *Nitzschia spp.*) exhibit lateral symmetry. Some pennate diatoms are planktonic (i.e., live in the water column), but many reside on the seafloor or attached to surfaces, except when water turbulence stirs them up into the water column.

Diatoms store food in the form of lipids (fats), which makes them nutritious food for clams. Lipid concentrations in diatoms can be very high, up to 70% of dry weight, which helps decrease their rate of sinking. In fact, some species of diatoms have been studied for their ability to produce nutritionally beneficial lipids, such as omega-3-fatty acids, for human consumption as a means of lowering bad cholesterol. Other ways diatoms maintain their position in the water column include the increase of surface area through the production of **spines** or formation of **colonies**. In seawater, diatoms can increase their buoyancy by exchanging heavy ions with lighter ions in the surrounding water.

Species with long, rigid spines can cause physical harm to the gills of fish and may be difficult for clams to filter. A few species of pennate diatoms (e.g., some species of *Pseudo-nitzschia spp.*) have been known to produce the neurotoxin domoic acid, which is associated with Amnesiac Shellfish Poisoning (ASP). ASP can affect human and aquatic animal health, although confirmed cases of ASP have not yet been reported along the peninsular coast of Florida.

Common Species

Below you will find a list of example species. When you click on a species in the list, you will find a biographical sketch with information about what the species looks like, where and how often we found it in our study (see [Sampling Methods](#) for sampling dates and locations), and the potential "good" and "bad" effects on clams. Most species have the potential to **harm** clams if they form dense blooms; however, the "good" and "bad" categories on this page refer to the acceptability of individual cells as food items.

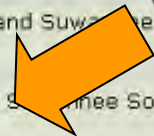
Amphiprora cf. Found in: Indian River and Suwannee Sound
Site(s): Sebastian: DE, GJ, PI, HB, PR

Bellerochea horologicalis Found in: Suwannee Sound
Site(s): DE, GJ, PI, HB, PR

Cerataulina pelagica Found in: Indian River and Suwannee Sound
Site(s): Sebastian: DE, GJ, PI, HB, PR

Chaetoceros spp. Found in: Indian River and Suwannee Sound
Site(s): Sebastian: DE, GJ, PI, HB, PR, SR

Dactyliosolen fragilissimus Found in: Indian River and Suwannee Sound
Site(s): Sebastian: DE, GJ, PI, HB, PR



Algal Species Pages

ALGAL GROUP: **DIATOMS**

BIOGRAPHICAL SKETCH: ***Chaetoceros* spp.**

Description

Cylindrical cells (appear rectangular), 4-84 μm wide, single or chains, spines (setae) at corners.

Where we found it

Indian River



Suwannee Sound - Gulf Jackson, Pine Island, Horseshoe Beach, Pelican Reef, Suwannee River

Frequency of occurrence

Indian River - 34% in 116 samples taken

Suwannee Sound - 44% in 120 samples taken

What are effects on clams?

 GOOD  BAD

Why is it good? Acceptable food item for clams.

Why is it bad? Some species have long silica spines that can damage bivalve gills.

Ecological considerations

A major bloom-former. Blooms can occur any time of year, but are most common in fall and spring. Resting spores are common.



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What Do Clams Eat?



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marine phytoplankton and their spatial
and seasonal distribution

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<http://shellfish.ifas.ufl.edu>

Available as a CD-ROM
and web-based linked to
<http://shellfish.ifas.ufl.edu>



What's going on in 2011?

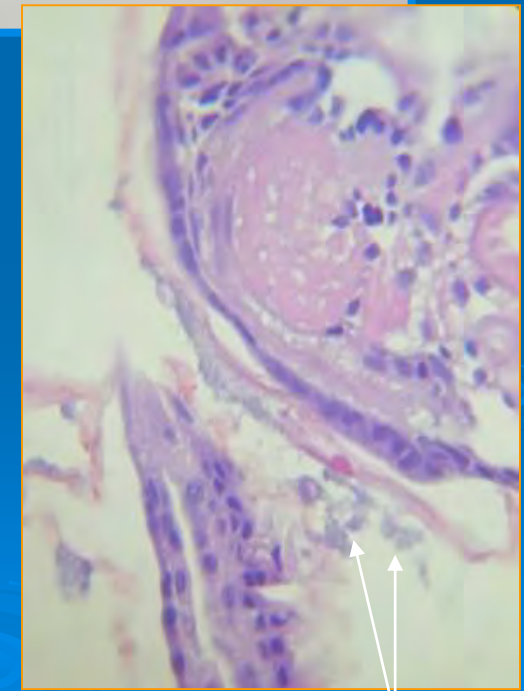
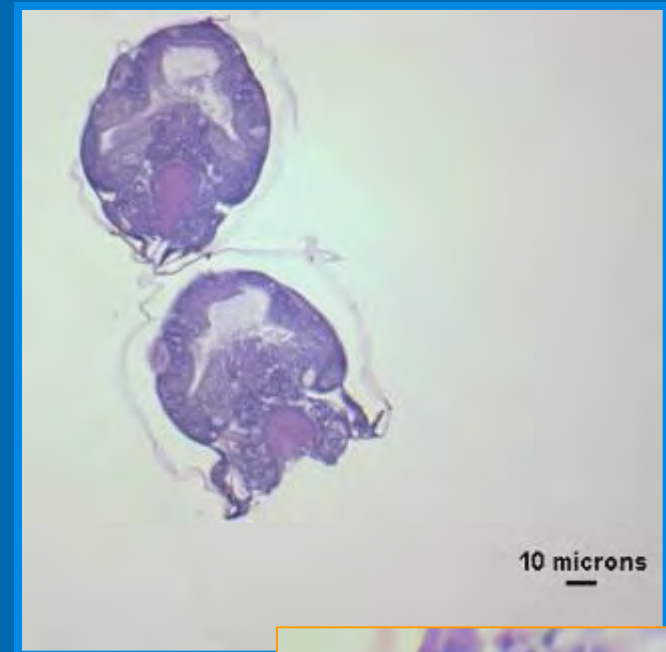
- Growers reports from 2010 will be sent soon
- **RETURN LOGGERS!**
- More data loggers to be deployed by growers at leases throughout the state
- Clam health and diagnostic testing



Dr. Denise Petty, DVM

Diagnostic Testing

- Testing includes:
 - Water quality parameter analysis
 - Bacterial cultures of algal stocks, water, and larvae
 - Histology of larvae and adult stocks
 - Identification of phytoplankton (Susan Badylak or Mary Cichra)



Bacteria

Act quickly when mortalities occur!

- Animals should be collected for diagnostic testing as soon as mortality is observed.

Timing is critical!

- The primary problem may resolve before a sample of animals is collected. Often, these animals are the survivors and tests will be negative.
- Many larvae are required to run a variety of tests; be generous.

Clam health fact sheet

available at <http://edis.ifas.ufl.edu>, FA125

Introduction to Infectious Diseases in Hard Clams¹

Shirley Baker, Denise Petty, Ruth Francis-Floyd, Roy Yanong, Leslin Stumar²

Introduction

The aquaculture of hard clams (*Meretrix mercenaria*) in Florida is a relatively young industry that has grown very rapidly over the past several years. Hard clams have notably few infectious diseases, compared to other bivalve molluscs, and to date no significant problems due to infectious diseases have been observed in cultured clams from Florida waters. There is a growing concern, however, that disease-causing agents may appear as production densities increase. Information provided in this document is intended to familiarize clam growers with common clam diseases.

Gross Signs of Disease in Hard Clams

Gross signs of infectious disease in juvenile or adult hard clams may go unnoticed because clams are infertile, that is, living buried in the sediment. However, most diseased or stressed individuals will rise to the sediment surface. Additional signs of infectious disease in clams may include gaping (inability to hold the valves closed); shell deformities or chipping of the shell margin; deposits or blisters

on the inner surfaces of shells; excess mucus production; watery meats; dark, pale, or discolored meats; lesions or ulcers of the mantle, adductor muscle, or foot; or retracted and/or swollen mantle edges. These signs are not necessarily indications of infectious disease; they may also be associated with noninfectious diseases and adverse environmental conditions.

Types of Clam Diseases and Pests

Pathogens can potentially affect all life stages of hard clams. Organisms of particular concern include QPX (Quahog Parasite Unknown), which has caused significant mortality of cultured clams in northeastern states, and *Perkinsus* spp., an oyster disease which clams are known to carry, though they do not get sick. Other potential pathogens of *M. mercenaria* include common bacteria in the environment, such as *Chlamydiales* and *Rickettsiales*. It should be noted that none of these diseases affect humans.

QPX

QPX, short for Quahog Parasite Unknown, is the only significant pathogen of hard clams. Significant

- Gross signs of disease in clams
- Types of clam diseases and pests
 - QPX, a "slime-net" protist
 - *Perkinsus* spp. (Dermo)
 - Chlamydiales
 - Rickettsiales
 - Pest metazoans
 - Granulomas
- Significance in Florida

Thank You!

A sunset scene over a body of water. The sun is low on the horizon, creating a bright, golden glow and a long, shimmering reflection on the water's surface. The sky is filled with soft, orange and yellow clouds. In the foreground, the silhouettes of wooden structures, possibly a pier or dock, are visible against the bright light of the setting sun. The overall mood is peaceful and serene.

For further information,
contact Leslie Sturmer
at **LNST@ufl.edu**
or visit the website:
<http://shellfish.ifas.ufl.edu>