

Monitoring Water Quality and *Trying to* Understand Climate Change Impacts to Cedar Key's Clam Culture Industry



Leslie Sturmer, Tracey Vlasak, Natalie Anderson

Shellfish Aquaculture Extension Program

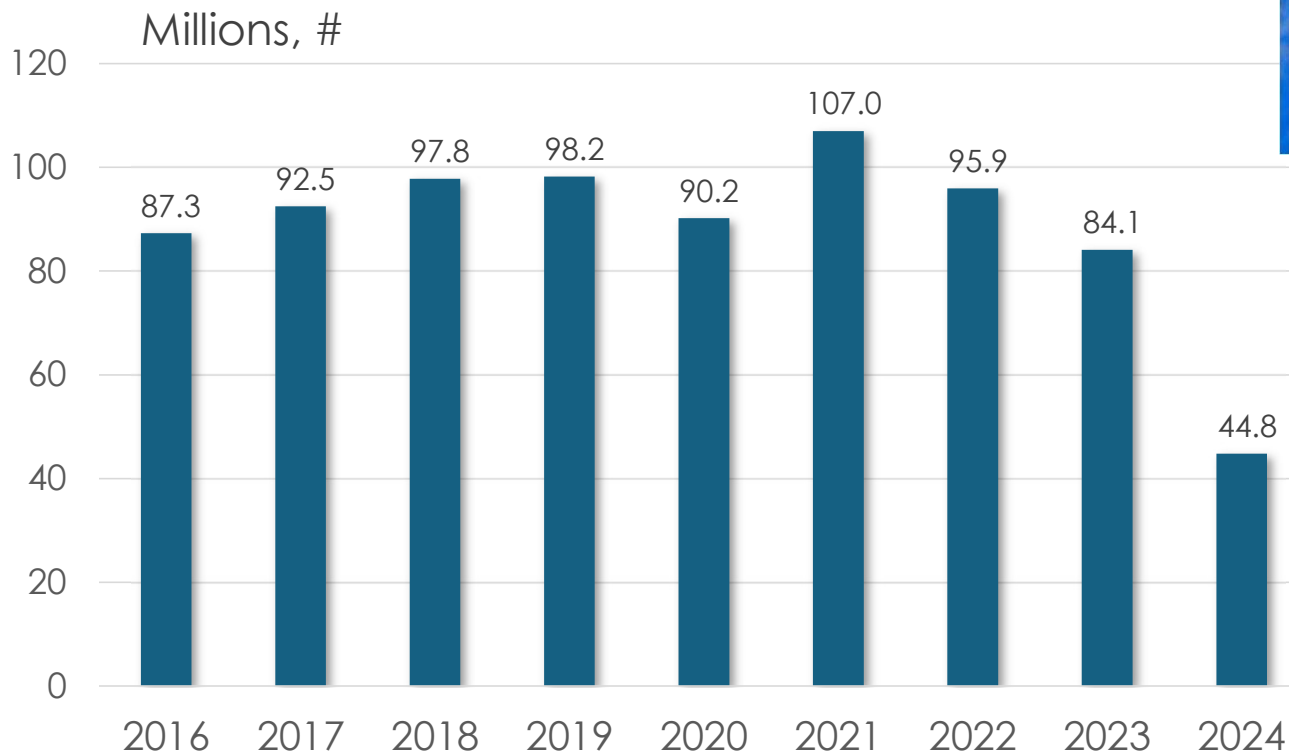
Cedar Key, Florida

UF | IFAS
UNIVERSITY of FLORIDA

Sea Grant
Florida

Cedar Key Clam Production 2016-2024

— FDACS internal data collected at primary shellfish wholesalers



- Seven-year average (2016-22) – 95.6 million clams
- 12% decline in 2023
- 53% decline in 2024
- Unprecedented challenges from weather and climate-related events

Climate Changes Impacting Cedar Key's Clam Culture Industry

Increased water temperatures

Increased tropical storms

Extreme variation in rainfall

Sea level rise / habitat loss

Data Sources

University of Florida

- Dog Island and Gulf Jackson Aquaculture Lease Areas
- Sensors: temp, salinity, dissolved oxygen, chlorophyll
- Collection interval: 30 mins
- Began monitoring in 2002
- shellfish.ifas.ufl.edu/water-quality-monitoring/

NOAA Tides and Currents

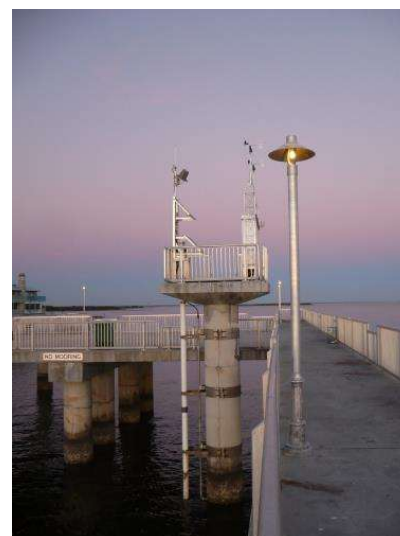
- Cedar Key Station ID: 87278520
- Sensors: air temp, water temp, wind, pressure
- Collection interval: 60 min
- tidesandcurrents.noaa.gov/physocean.html?id=8727520

NOAA National Weather Service

- Chiefland 5 ESE Station
- Climate summaries
- Records begin in 1956
- www.weather.gov/tbw/climatesummaries

NOAA National Hurricane Center

- Tropical storm summaries
 - Historical tracks from 1842
- <https://www.nhc.noaa.gov/index.shtml>

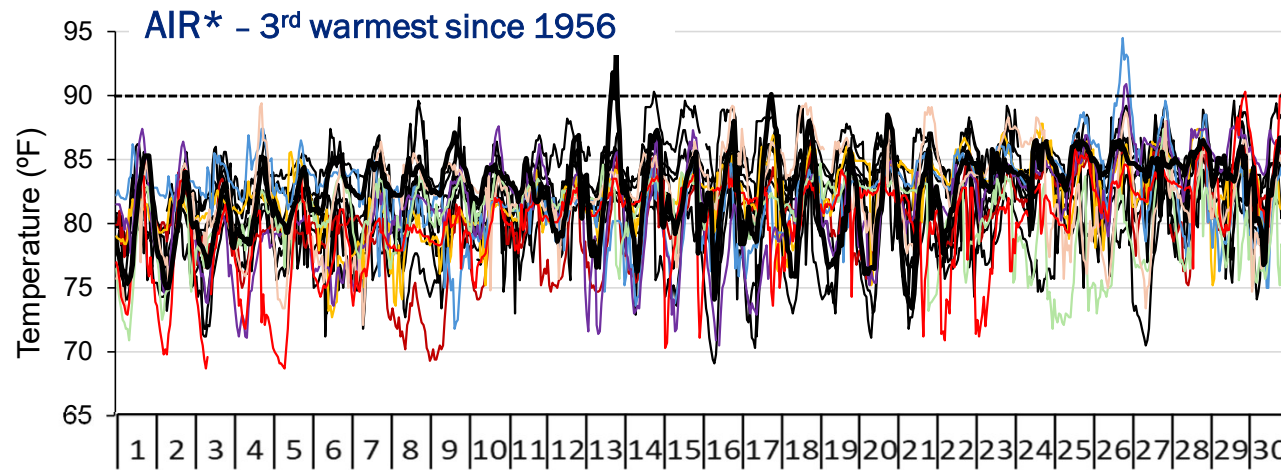
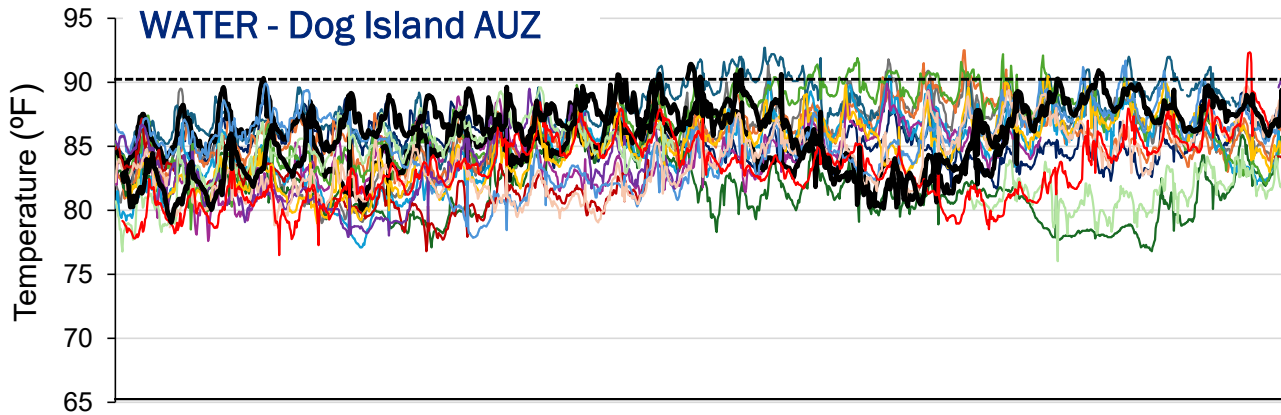


Suwannee River Water Management District

- Levy County
- Hydrologic Condition Reports
- Nexrad Monthly Rainfall Totals by County (inches)
- www.mysuwanneeriver.com/507/Water-Data-Portal

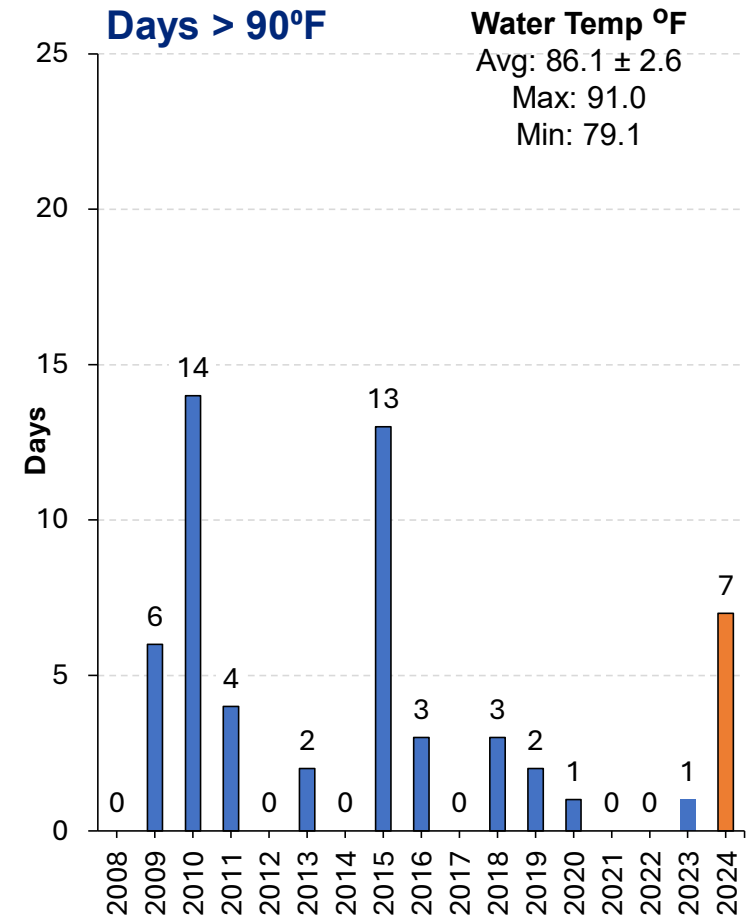


June 2024 Temperatures (°F)



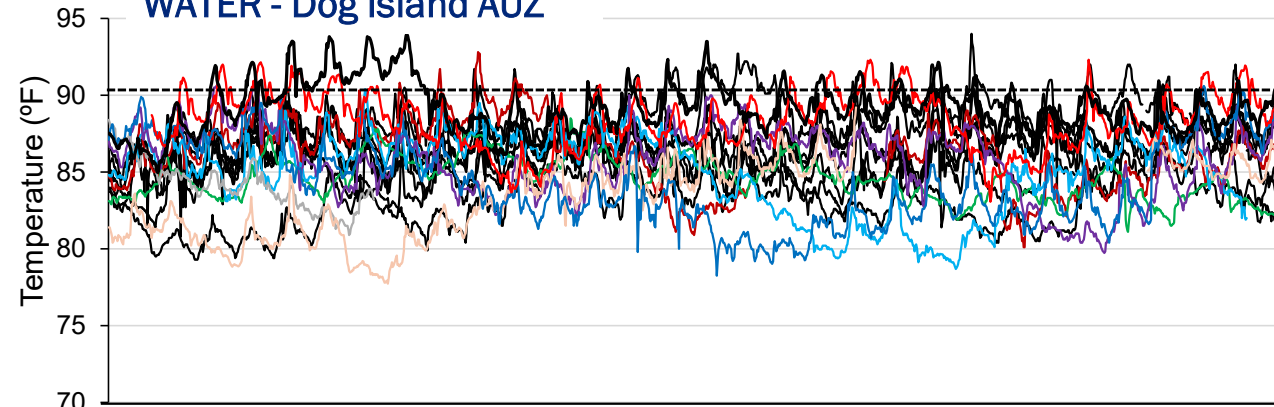
*Data unavailable for 2008-2009

2008 2009 2010 2011 2012 2013 2014 2015 2016
 2017 2018 2019 2020 2021 2022 2023 2024

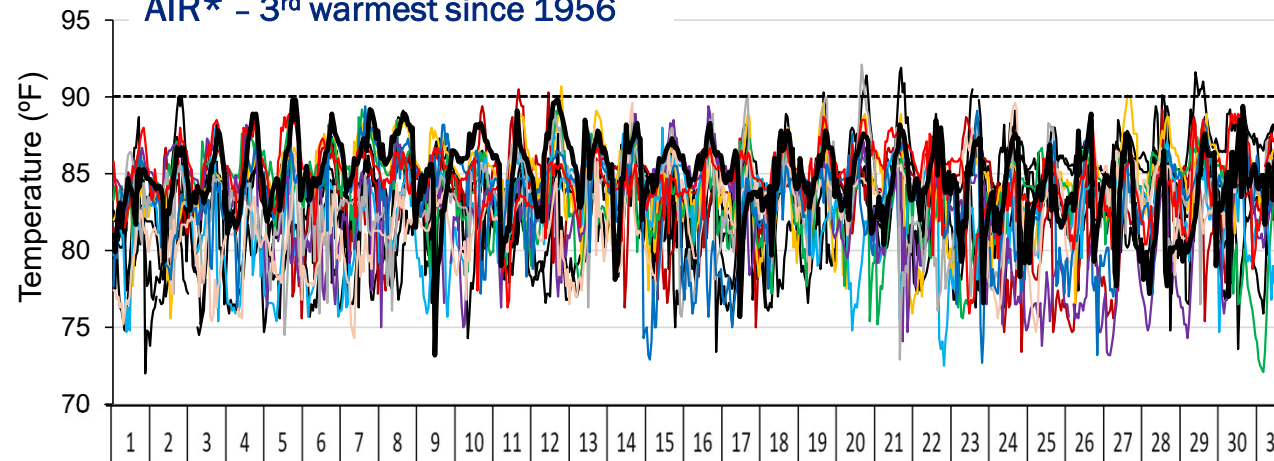


July 2024 Temperatures (°F)

WATER - Dog Island AUZ



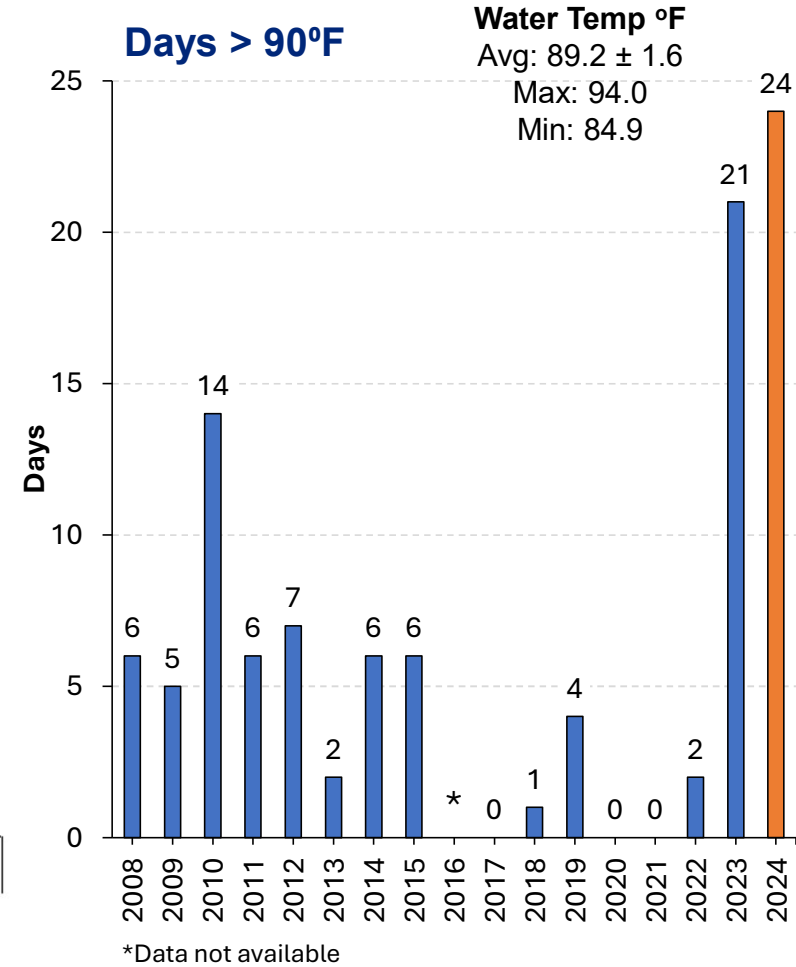
AIR* - 3rd warmest since 1956



*Data unavailable for 2008-2009

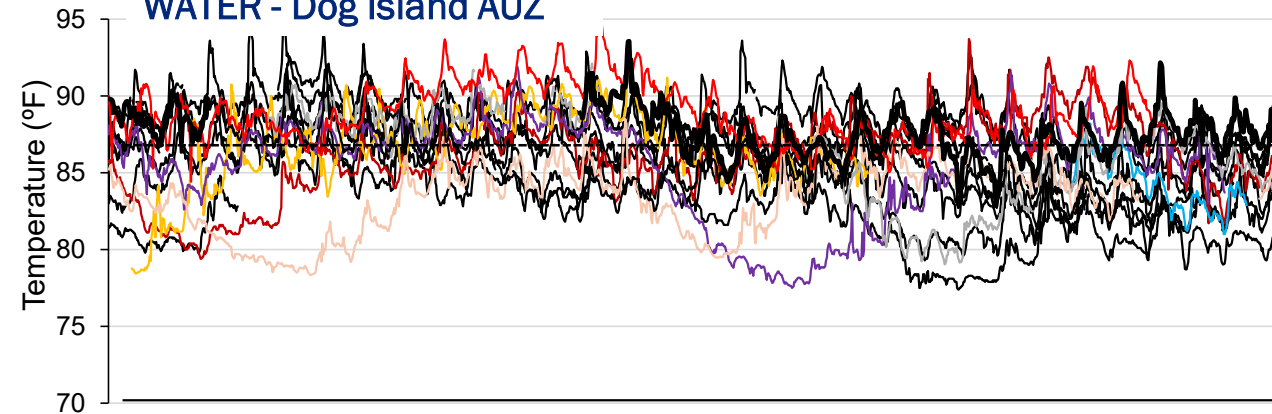
2008	2009	2010	2011	2012	2013	2014	2015	2016
2017	2018	2019	2020	2021	2022	2023	2024	

Days > 90°F

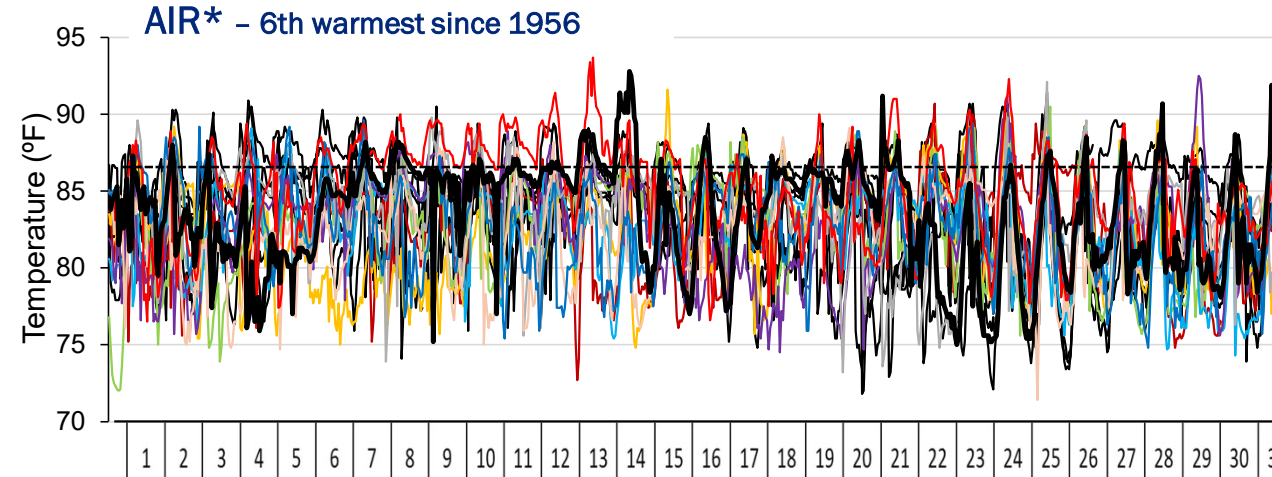


August 2024 Temperatures (°F)

WATER - Dog Island AUZ



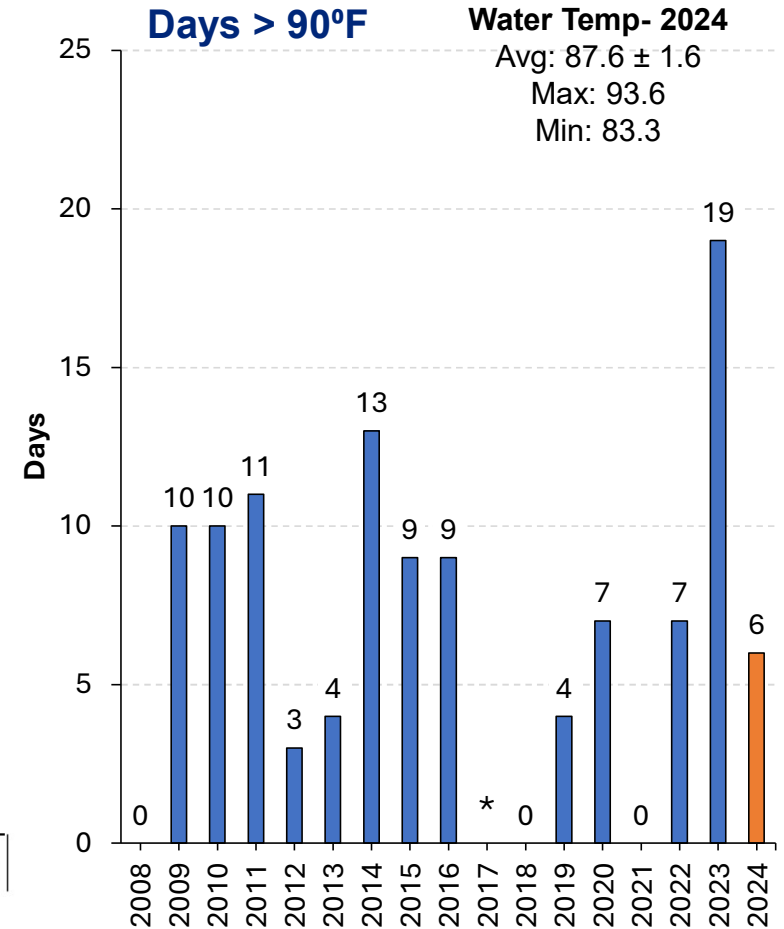
AIR* - 6th warmest since 1956



*Data unavailable for 2008-2009

2008 2009 2010 2011 2012 2013 2014 2015 2016
 2017 2018 2019 2020 2021 2022 2023 2024

Days > 90°F



Water Temp- 2024

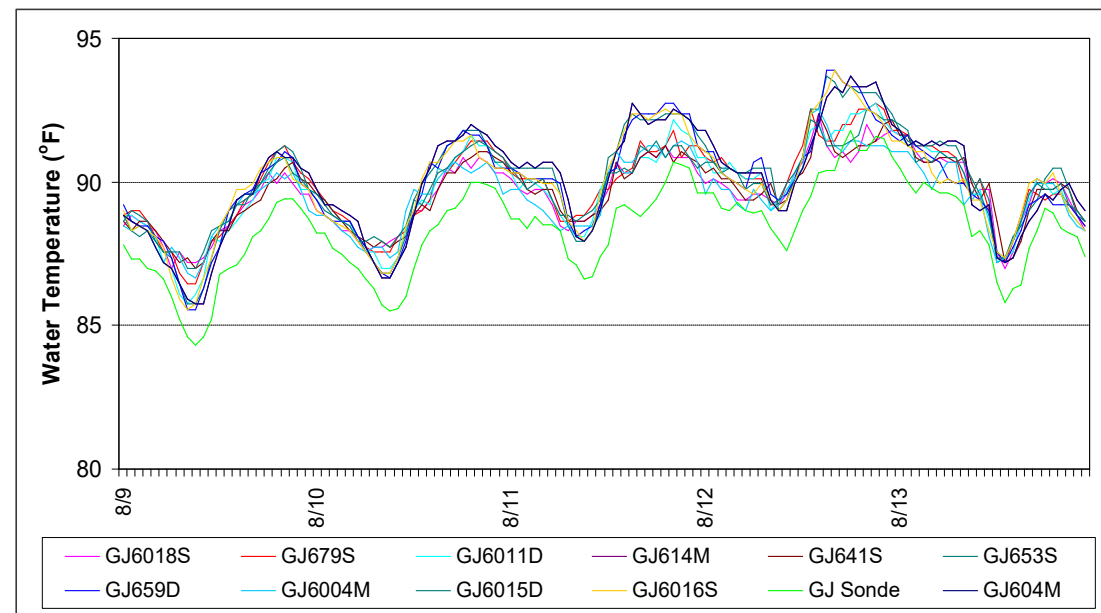
Avg: 87.6 ± 1.6
 Max: 93.6
 Min: 83.3

*Data not available

Monitoring Water Temperatures at Multiple Leases during Summer



- Describe temperature variability within and among lease areas
- 2007-10 - Loggers provided to growers to deploy inside bags at Cedar Key leases
 - 17 leases in 2007 (8% coverage)
 - 33-39 leases in 2008-10 (16-20%)
- Summer 2024 - Loggers provided to clam growers at Dog Island and Gulf Jackson
 - Lost due to Hurricane Helene
- 2025 - Loggers available to growers as part of a statewide monitoring project
 - Contact Angela Collins, abcollins@ufl.edu, (914) 704-8434



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



SOURCE: NOAA

PAUL HORN / Inside Climate News

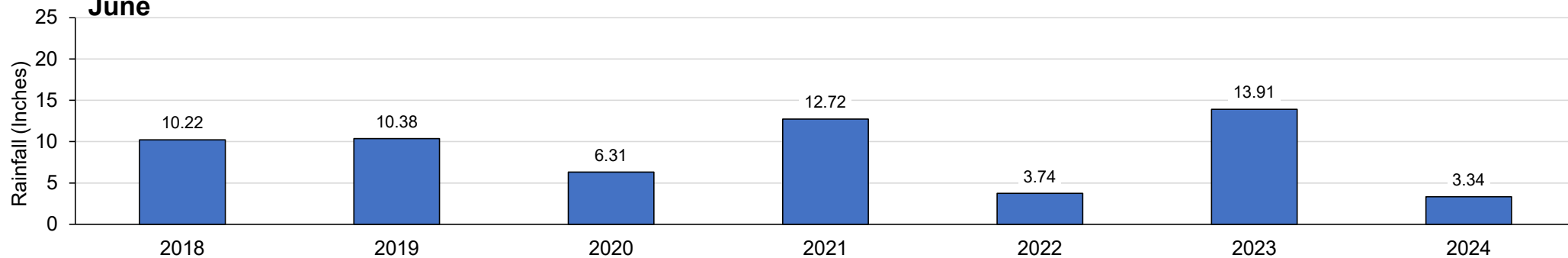
Tropical Systems

- **Hurricane Idalia**
 - August 30, 2023
 - Category 3 storm
 - 10.9' (3.26 m) MLLW tidal surge
- **Hurricane Debby**
 - August 5, 2024
 - Category 1 storm
 - 6.0' (1.83 m) MLLW tidal surge
- **Hurricane Helene**
 - September 27, 2024
 - Category 4 storm
 - 13.1' (3.99 m) MLLW tidal surge

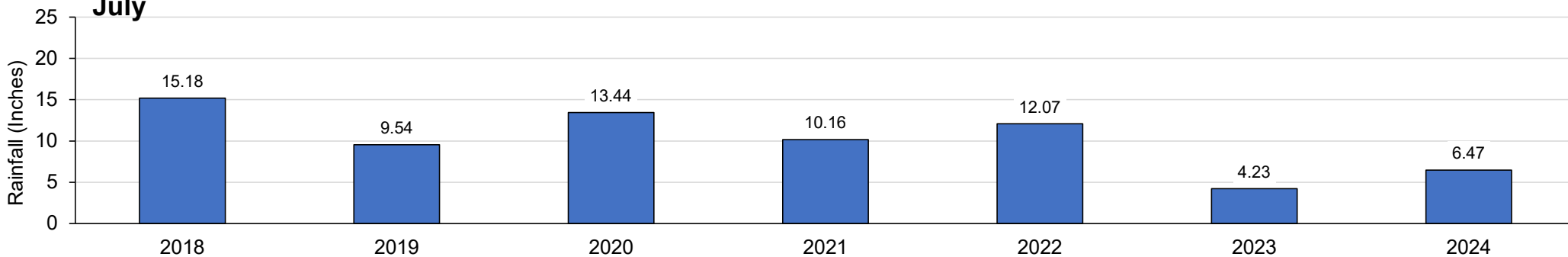
*World Weather Attribution researchers concluded with "high confidence" that **Hurricane Helene** was made worse by climate change.*

Cedar Key Forestry Tower Rainfall Totals, 2018-24

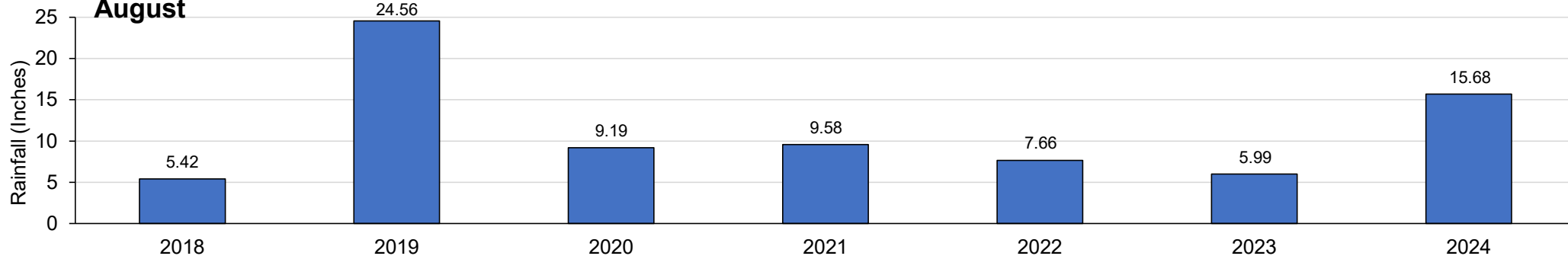
June



July

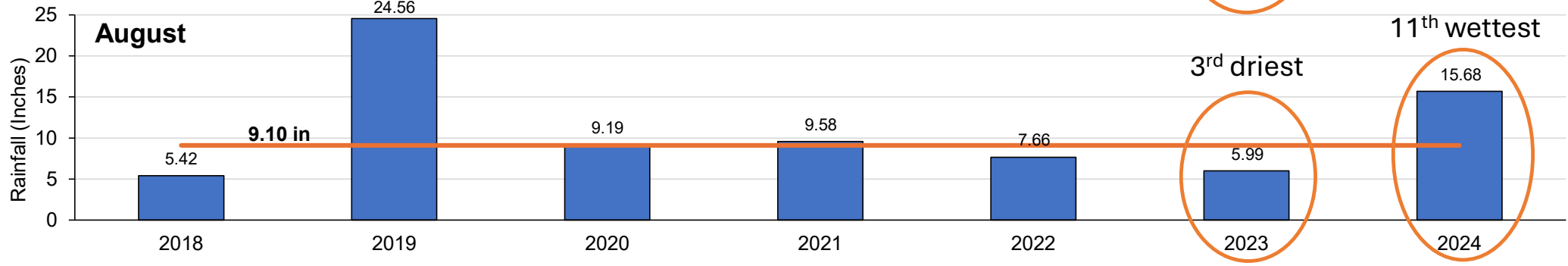
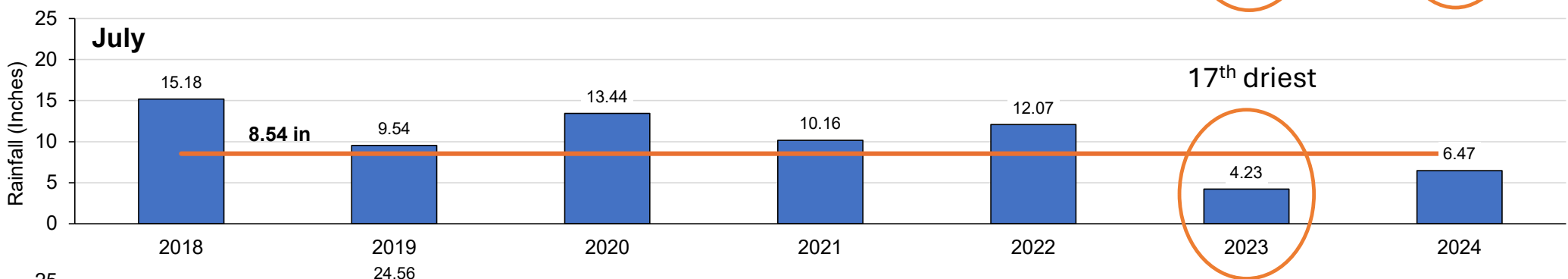
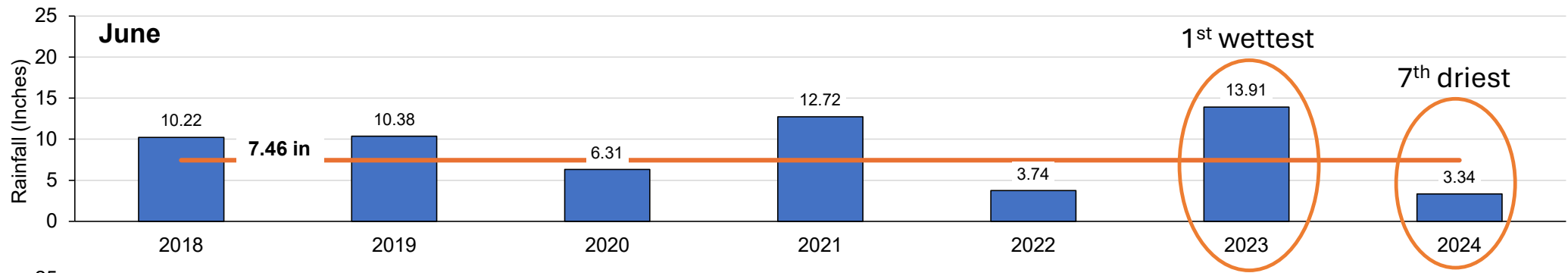


August



Cedar Key Forestry Tower Rainfall Totals

Average Monthly Rainfall*
*Based on PRISM LT81 monthly rainfall averages by county (1927-2023)

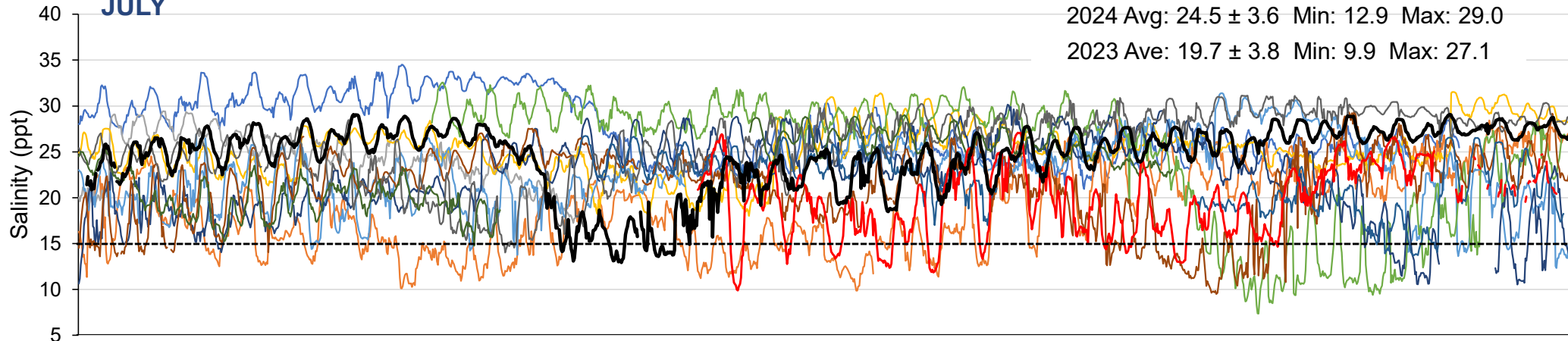


2024 Salinity – Gulf Jackson AUZ

JULY

2024 Avg: 24.5 ± 3.6 Min: 12.9 Max: 29.0

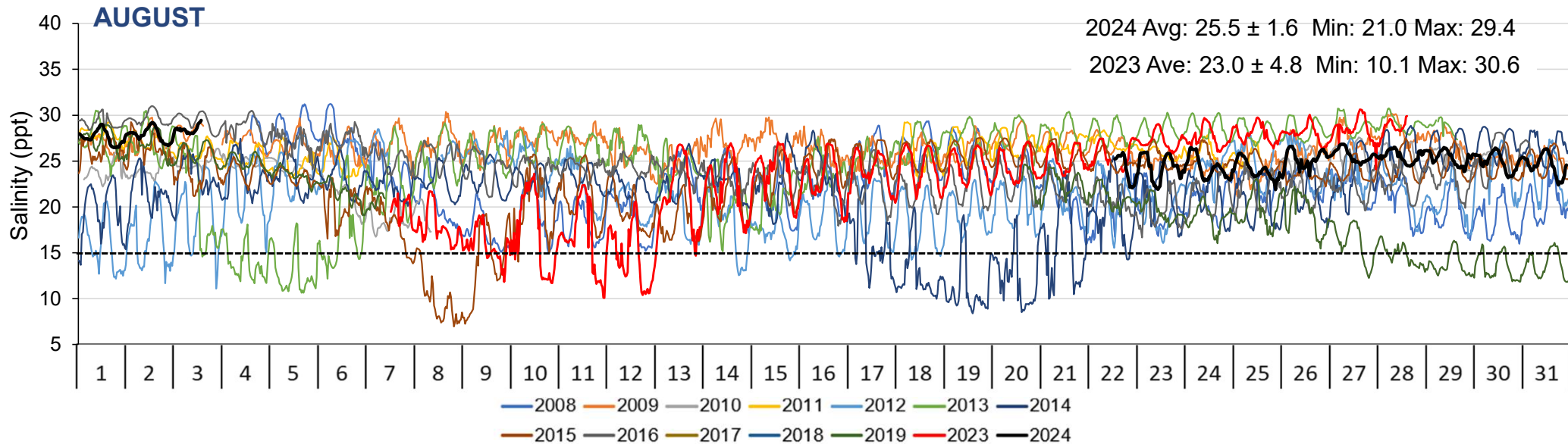
2023 Ave: 19.7 ± 3.8 Min: 9.9 Max: 27.1



AUGUST

2024 Avg: 25.5 ± 1.6 Min: 21.0 Max: 29.4

2023 Ave: 23.0 ± 4.8 Min: 10.1 Max: 30.6

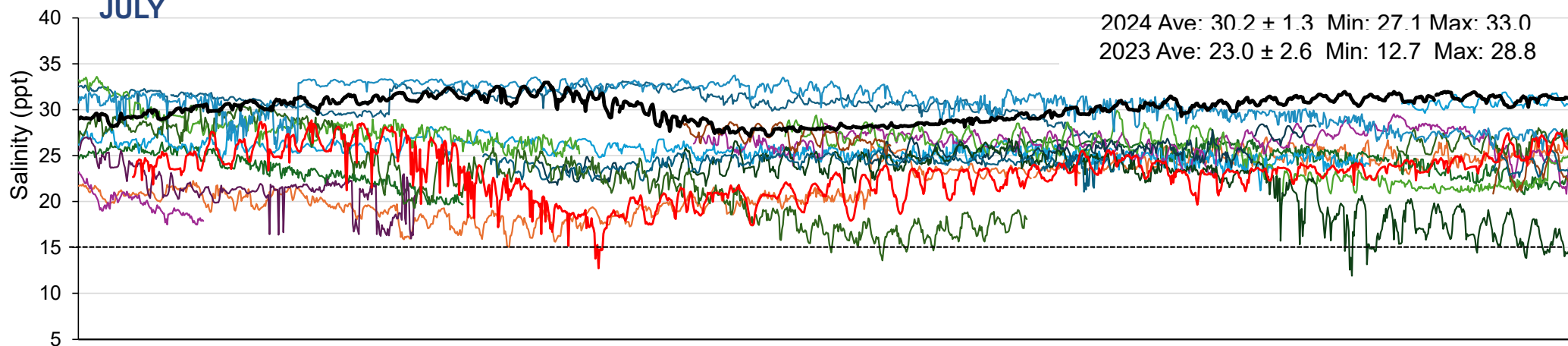


2024 Salinity – Dog Island AUZ

JULY

2024 Ave: 30.2 ± 1.3 Min: 27.1 Max: 33.0

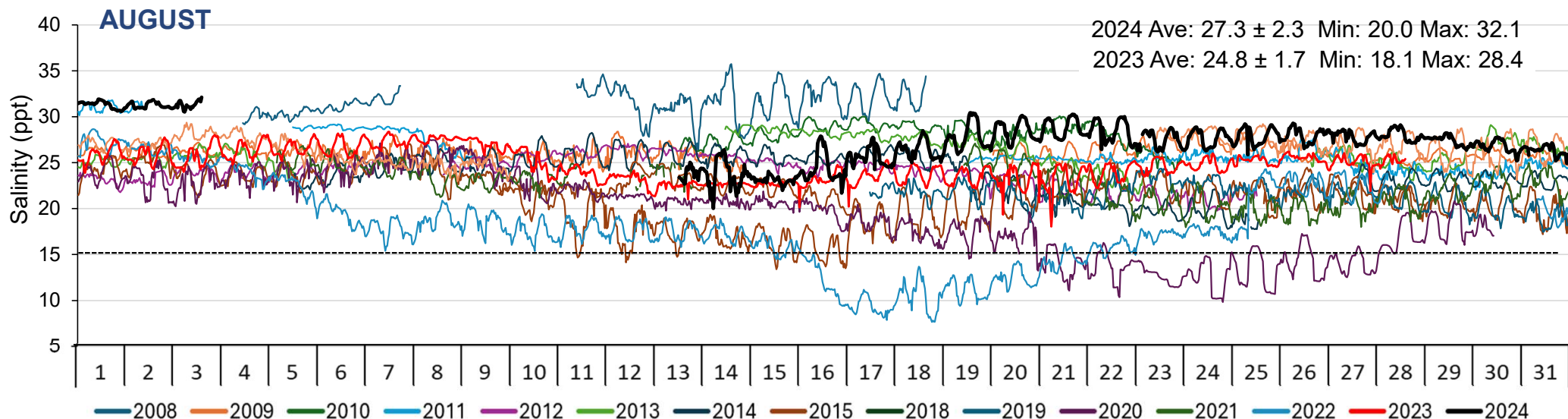
2023 Ave: 23.0 ± 2.6 Min: 12.7 Max: 28.8



AUGUST

2024 Ave: 27.3 ± 2.3 Min: 20.0 Max: 32.1

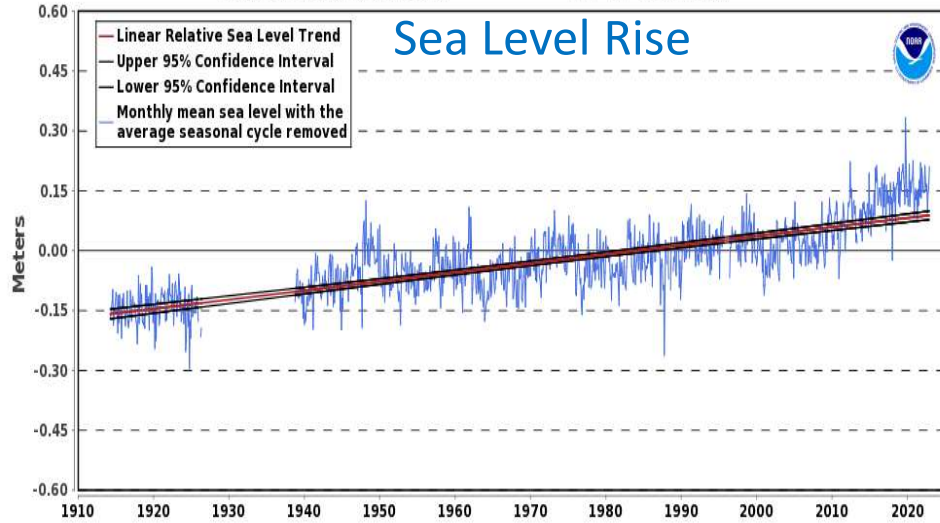
2023 Ave: 24.8 ± 1.7 Min: 18.1 Max: 28.4



8727520 Cedar Key, Florida

2.27 +/- 0.18 mm/yr

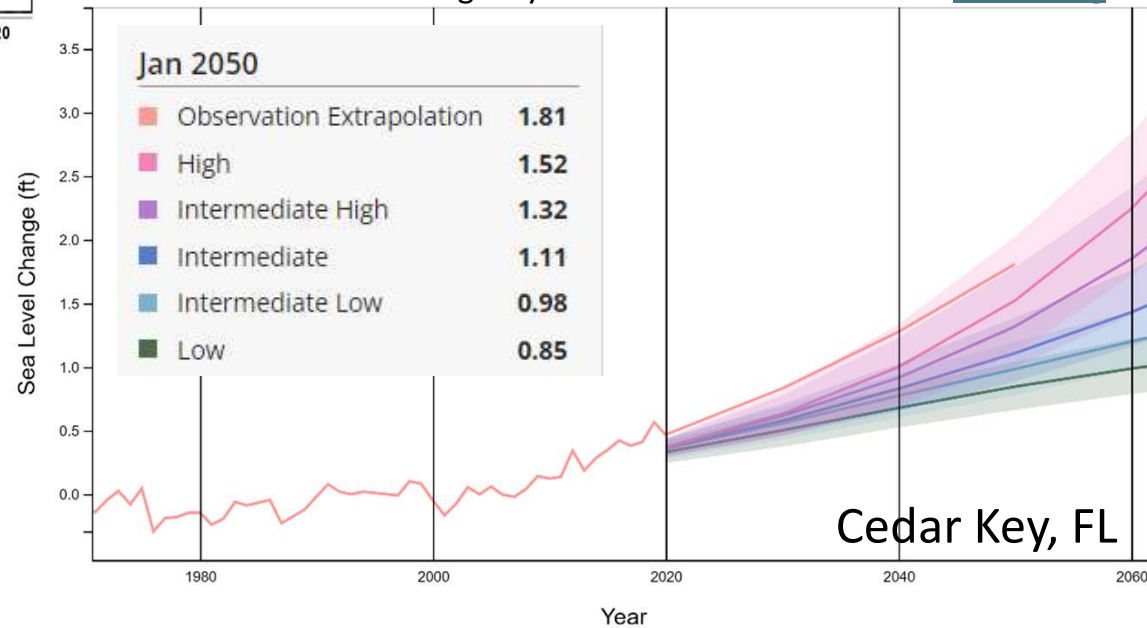
Sea Level Rise



Sea Level Rise in Cedar Key

- 4th fastest SLR acceleration in the USA (NOAA)
- 30 cm (11.8 inches) rise over past century
- Extrapolation of observed sea level trends outpaces the extreme high scenario models

Interagency Sea Level Rise Scenario Tool localslr.org





Rapid degradation of oyster reef habitat in 30 years



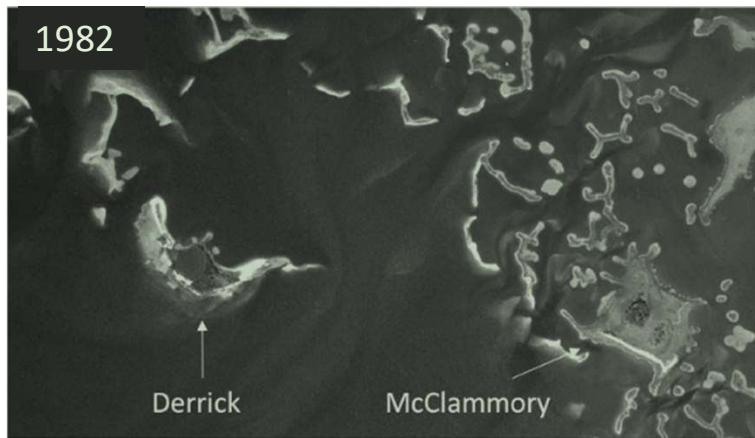
Coastal Habitat Changes

- Through aerial photography in 2011 documented
 - 88% loss of offshore reefs
 - 61% loss of nearshore reefs
 - 50% loss of inshore reefs over a 30-year period
- Reefs existed for over 3,000 years

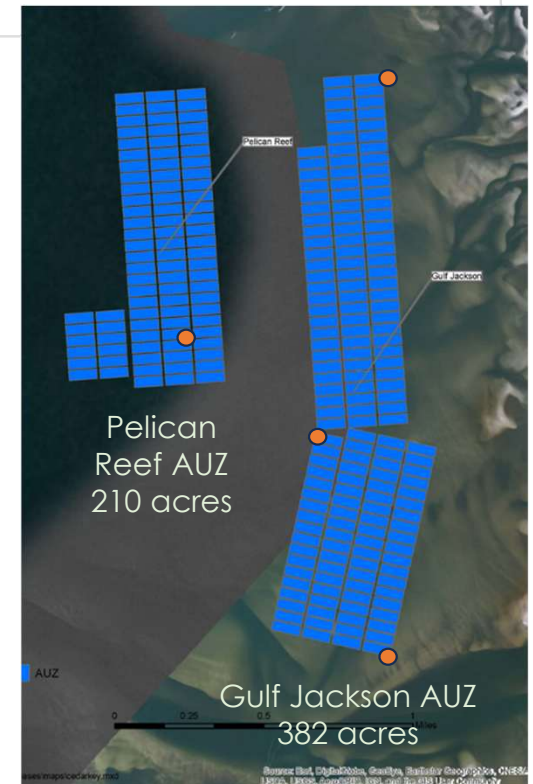
Seavey et al. 2011. Decadal Changes in Oyster Reefs in the Big Bend of Florida's Gulf Coast. *Ecosphere* 2:114

Coastal Landscape Changes

- Loss of inshore coastal islands over similar time frame
- Altered hydrology / flow of Suwannee River discharge
- Growers report variable salinities and unreliable clam production at PR & GJ lease areas over past few years

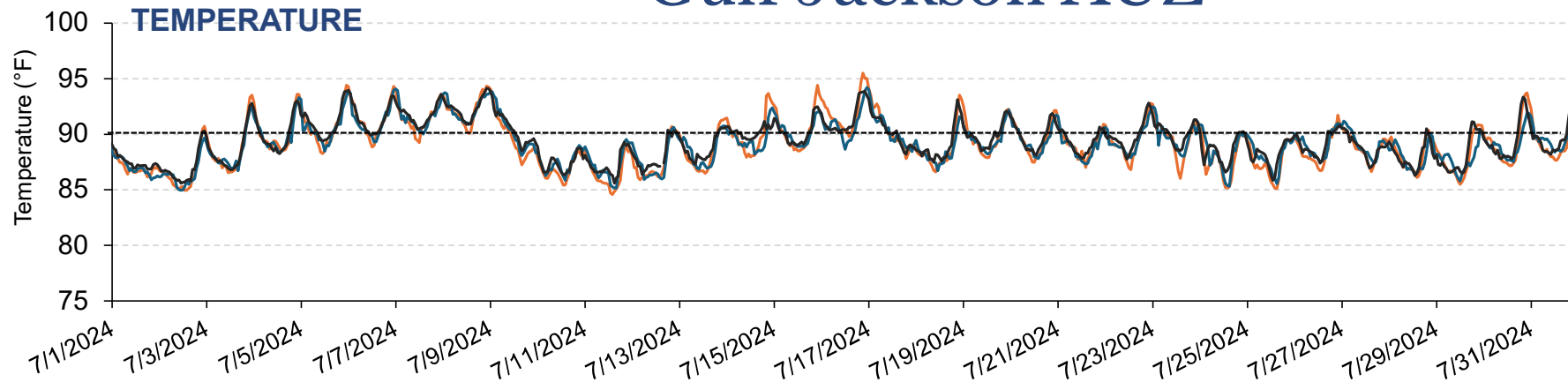


Derrick Key – 100% loss
McClammory Key – 32% loss



Vitae et al. 2020. Loss of Coastal Islands Along Florida's Big Bend Region. Estuaries and Coasts
<https://doi.org/10.1007/s12237-020-00811-3>

July 2024 Temperature (°F) and Salinity (ppt) - Gulf Jackson AUZ

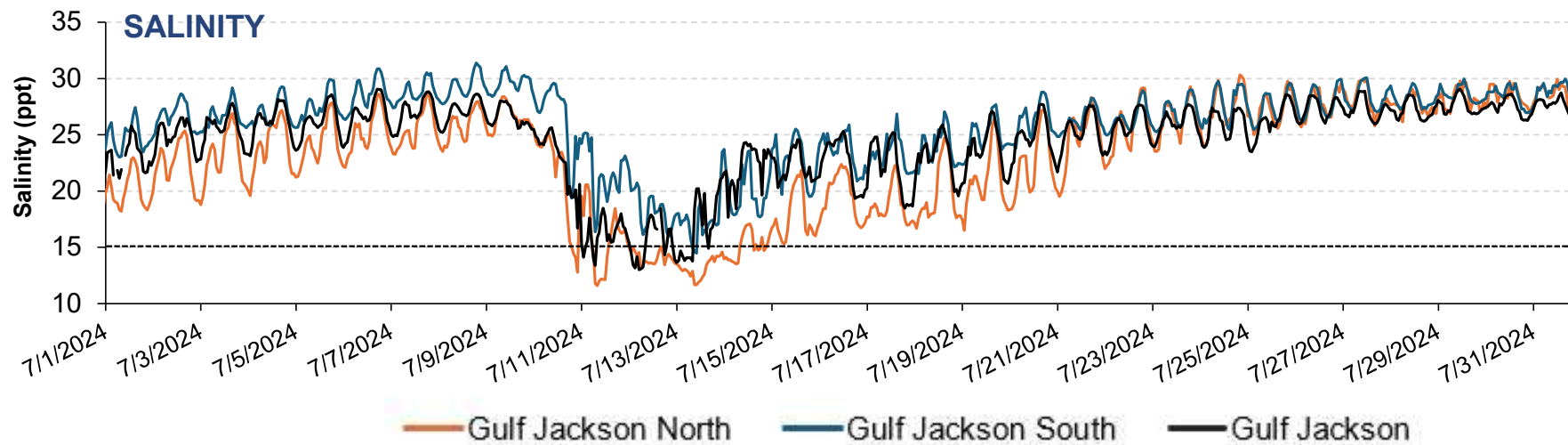


**Ave Temp
(°F)**

GJ-N: 89.1

GJ: 89.4

GJ-S: 89.2



**Ave Salinity
(ppt)**

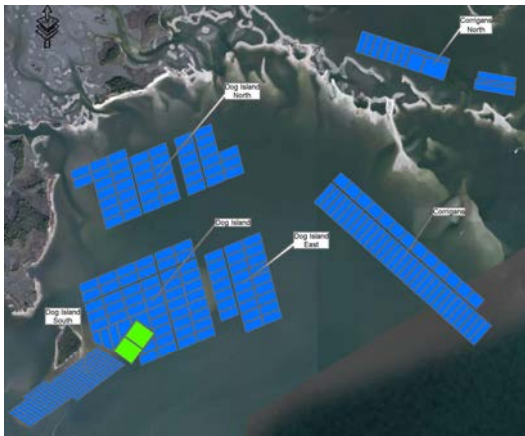
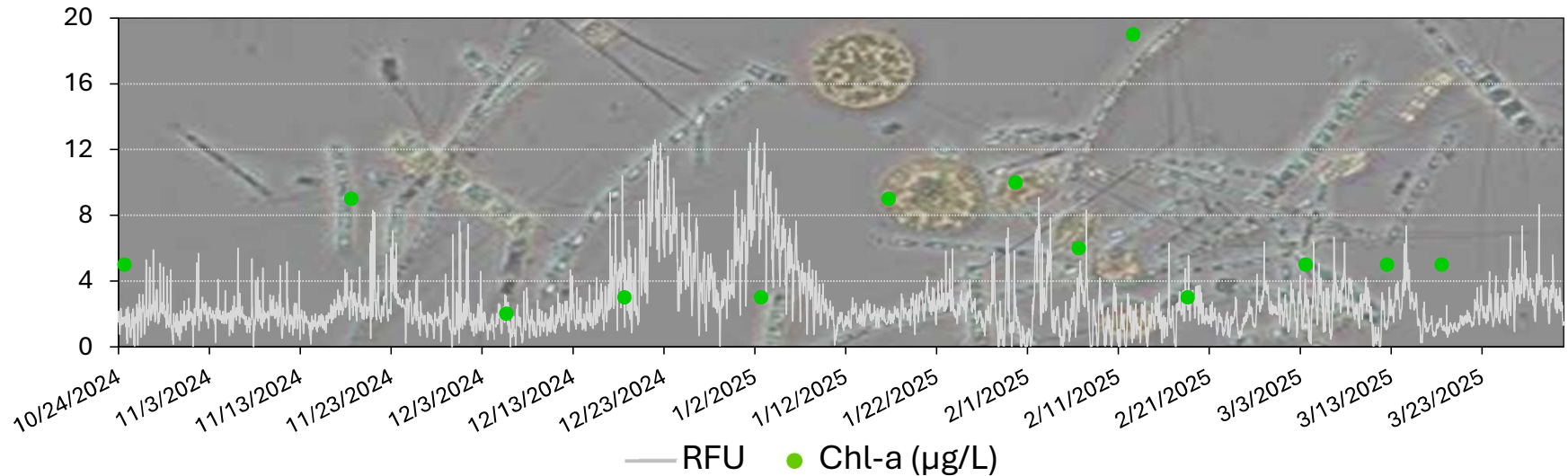
GJ-N: 23.1

GJ: 24.5

GJ-S: 25.9

What's New?

Monitoring Phytoplankton: Fluorescence (RFU) versus Chlorophyll-a Concentration ($\mu\text{g/L}$)



Ecosystem Modeling of AUZs

- Understand carrying capacity of water body supporting Dog Island and Corrigan's Reef AUZs
- Identify controlling parameters and interactions of water quality and clam production

Looking Ahead: Sustaining Cedar Key's Shellfish Aquaculture Future



Challenges Acknowledged

Responses by Industry,
Researchers, Extension Agents

Need for Resources, Support,
Collaboration, Innovation