

Continued development of innovative hatchery technology for black grouper (*Mycteroperca bonaci*) including integrated multi-trophic aquaculture (IMTA) with oysters (*Crassostrea virginica*) and seaweed (*Asparagopsis taxiformis*)

By
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Chief Science & Research Officer
October 18, 2023

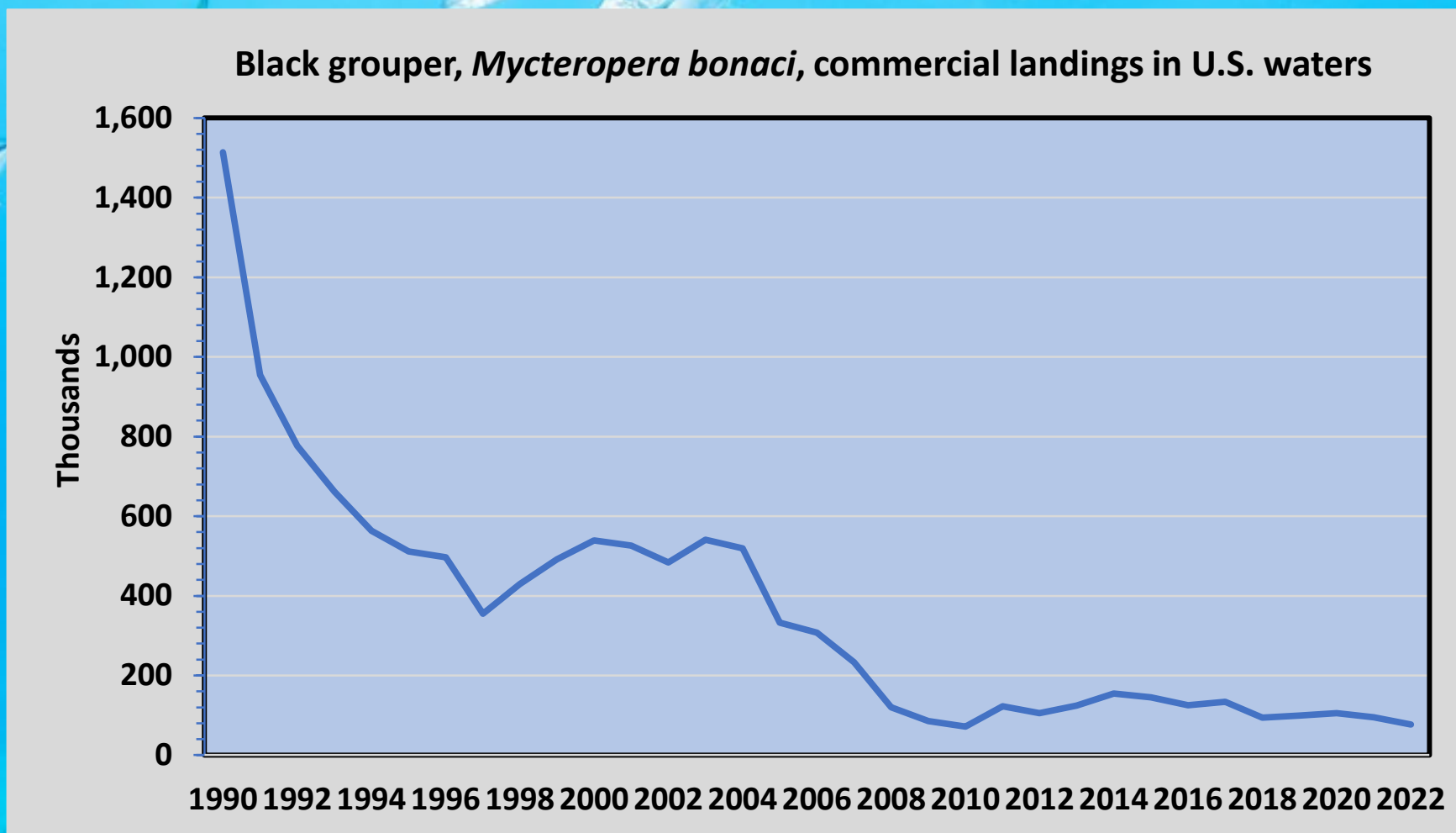
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Why *M. bonaci*?

- Populations have declined by 94% since 1990

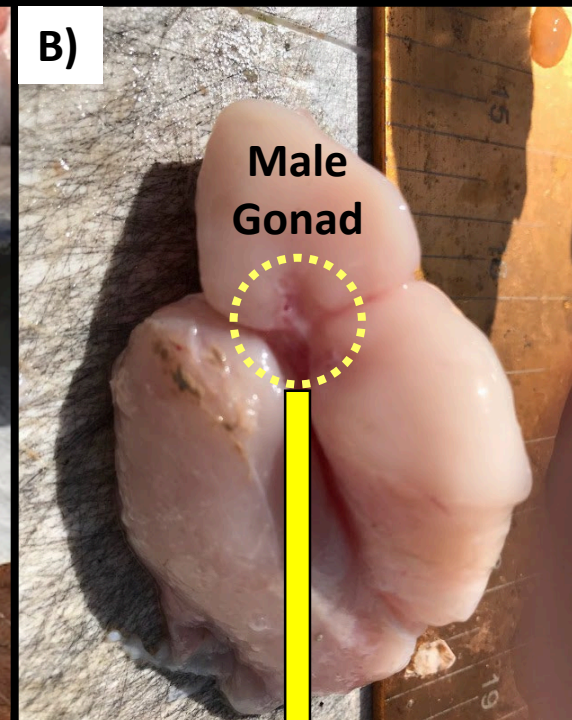
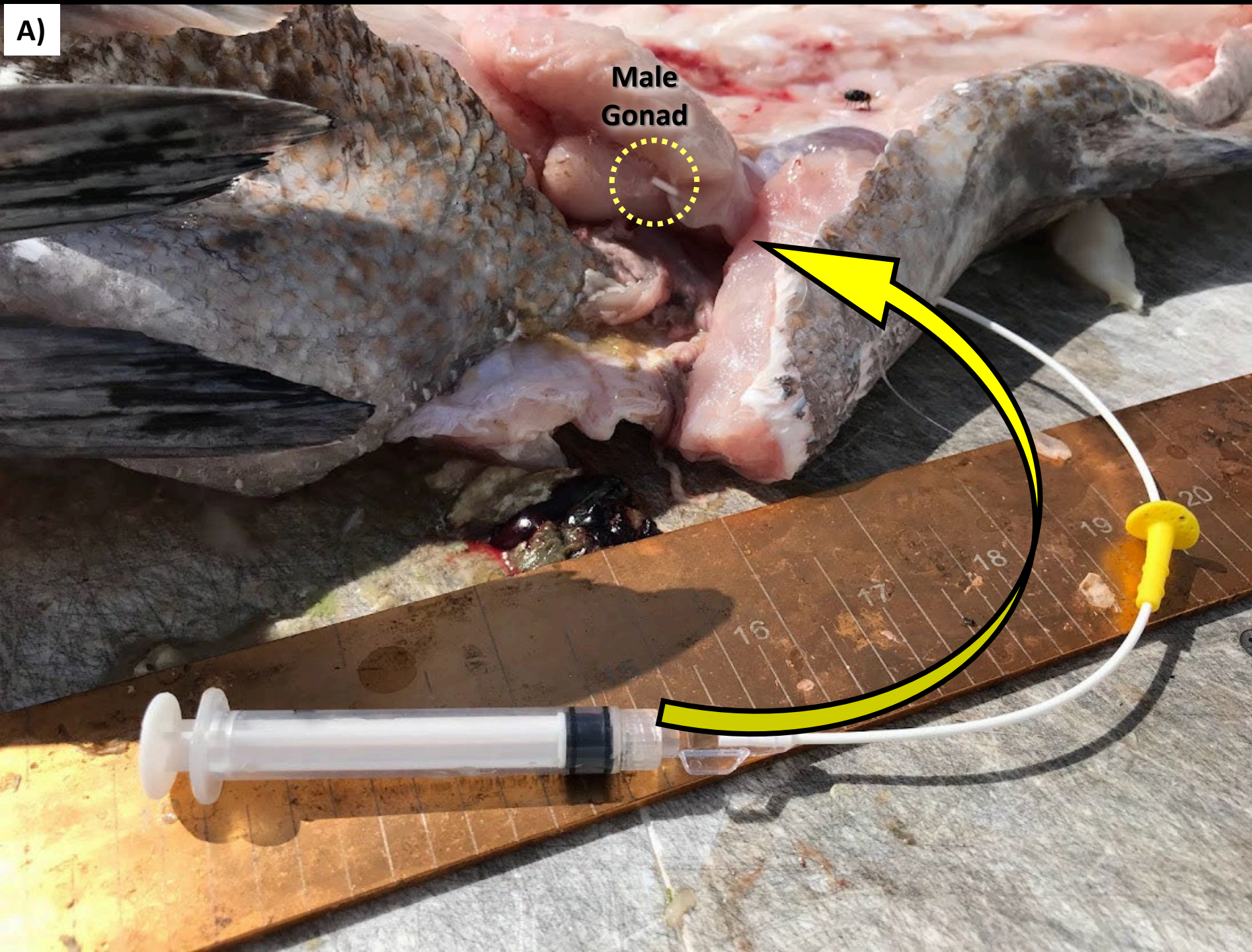


Data Source - National Marine Fisheries Service

Why *M. bonaci*?

- Populations have declined by 94% since 1990
- 2016 - Grouper fishery in the South Atlantic regulated (i.e. closed annually from Jan. 1 – April 31) <https://www.fisheries.noaa.gov/species/black-grouper>
- Economic impacts in the Florida Keys (e.g. fishers, restaurants, tourism, etc.)
- No hatcheries for any grouper species in the United States
- Grouper have a very complex reproductive strategy
- Recreational and commercial fishers regularly capture large male grouper
- But the gonads are not ripe during open season
- Concentrate on collecting milt during spawning season
- Resource for male gametes (i.e. cryopreservation)
- Focus only females in captivity
- Special systems for egg maturation



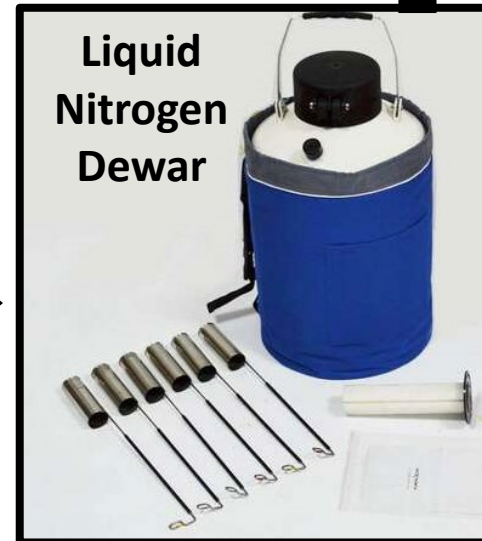
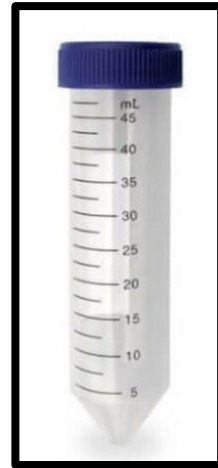


Grouper Sperm: Cryopreservation

Black Grouper Gonad



Syndel™
Fish
Sperm Freeze



-86° C Ultra-low freezer



Life Support Systems and Environmental Control

Water flow
→

Heater and Chiller



Ultraviolet Sterilizer



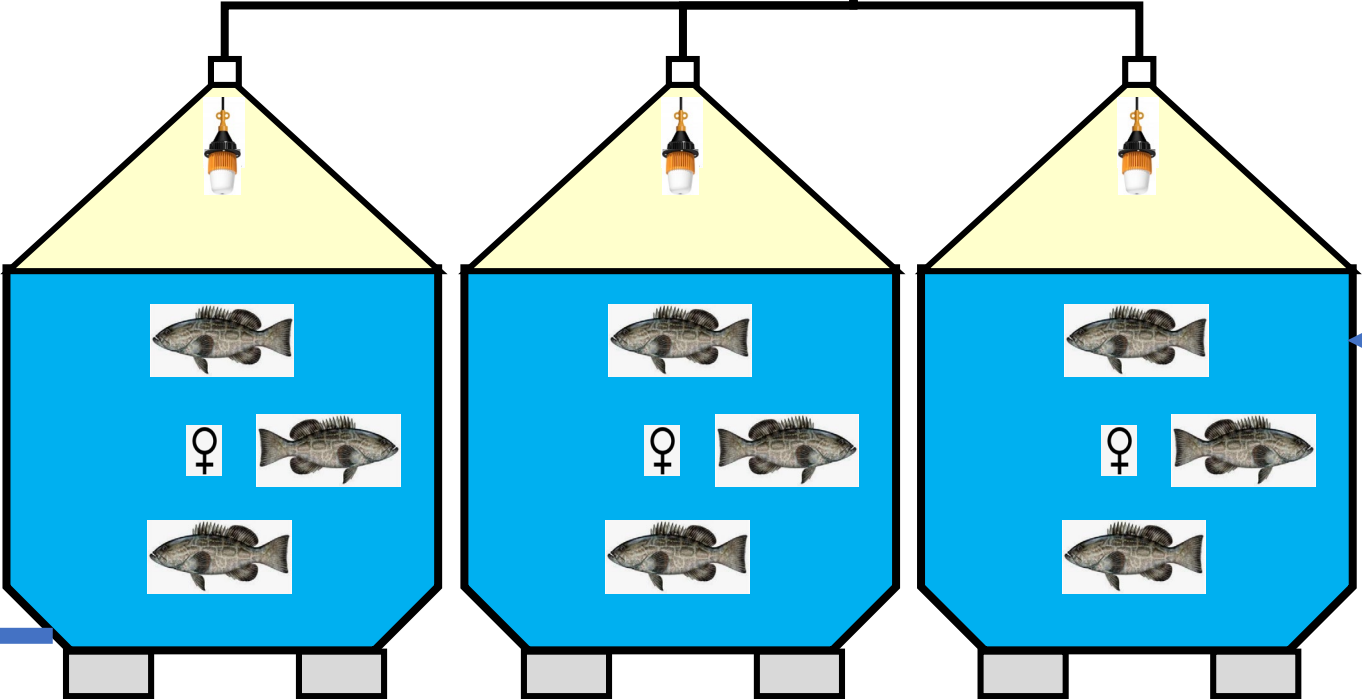
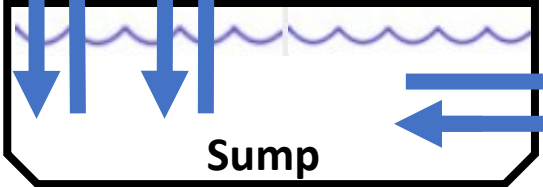
Photoperiod /Lunar Cycle



Redundant Pumps

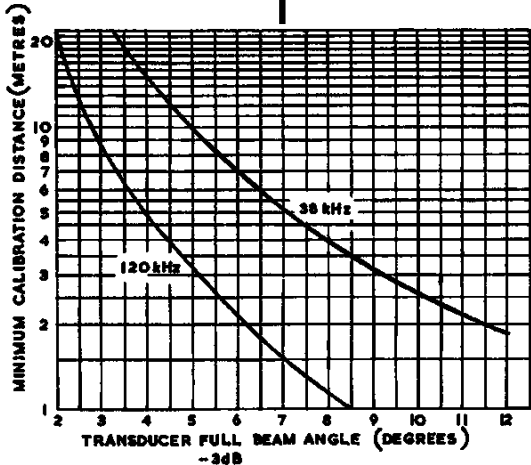
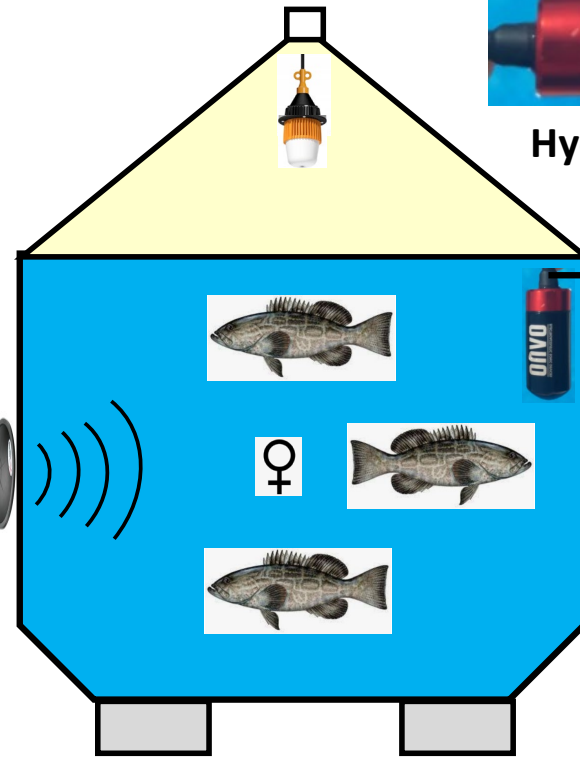
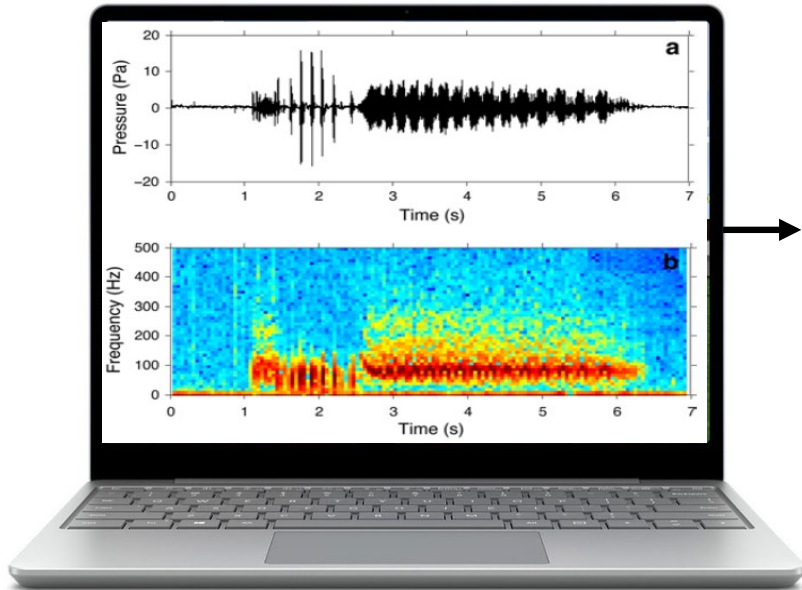


Sump



Acoustic Systems

Spawning Recordings



Fish Monitoring Systems

Underwater
IR camera



Ethernet switch



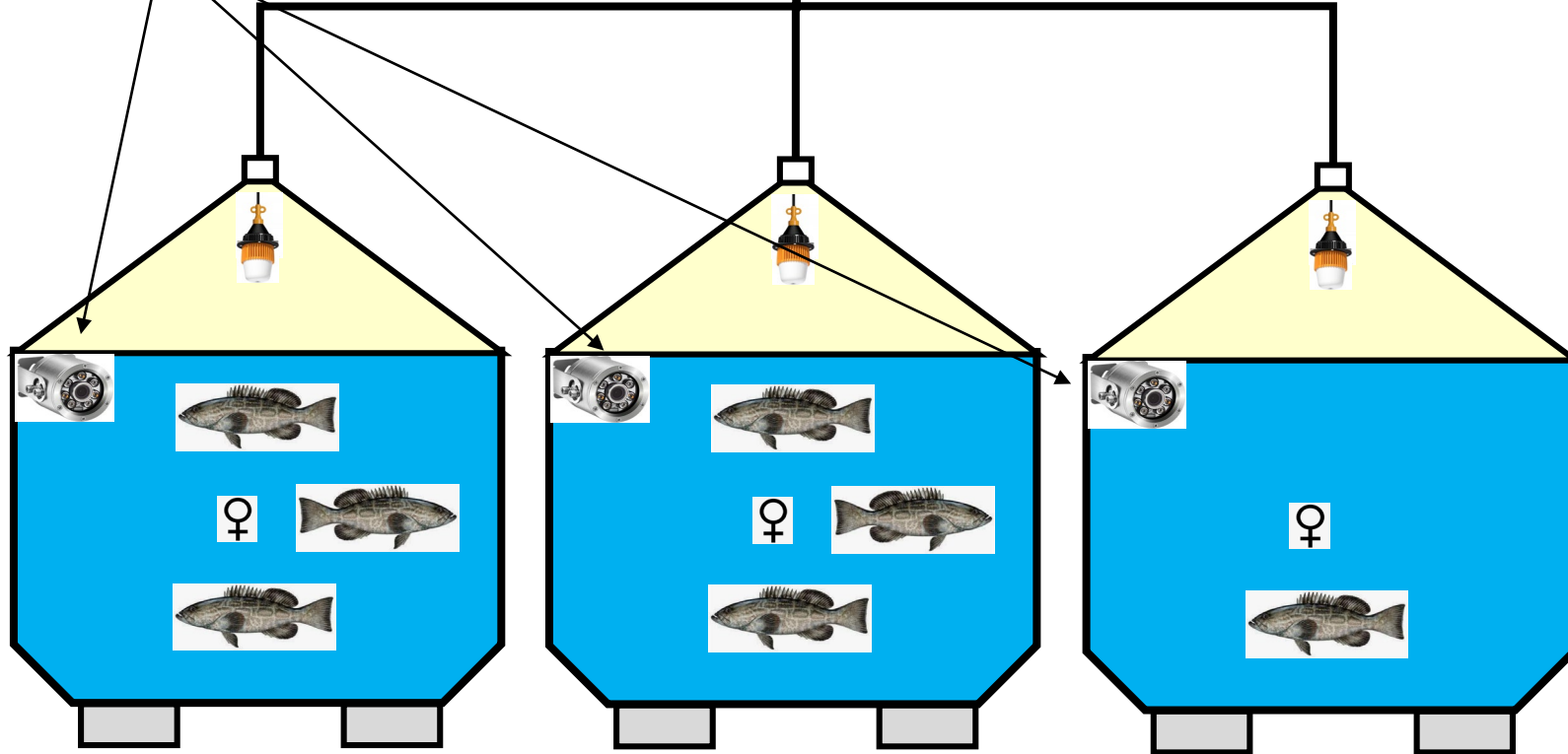
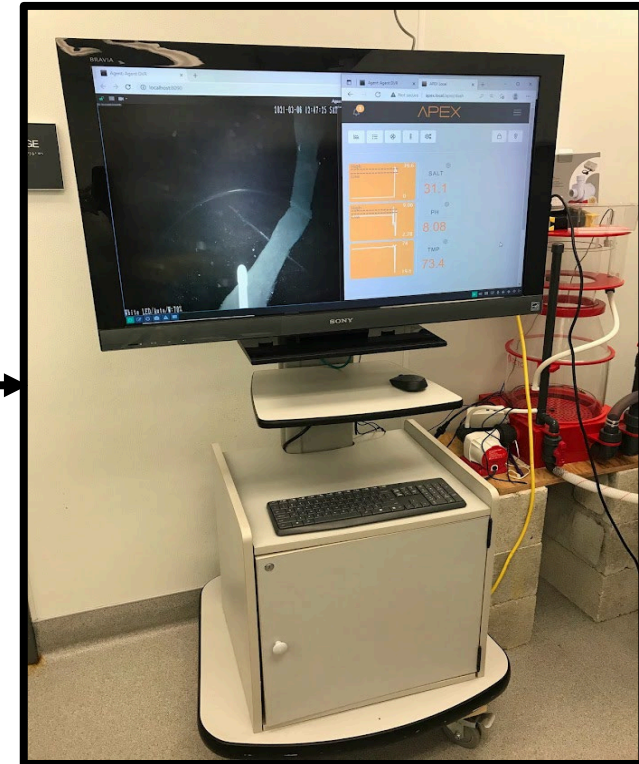
Laptop computer

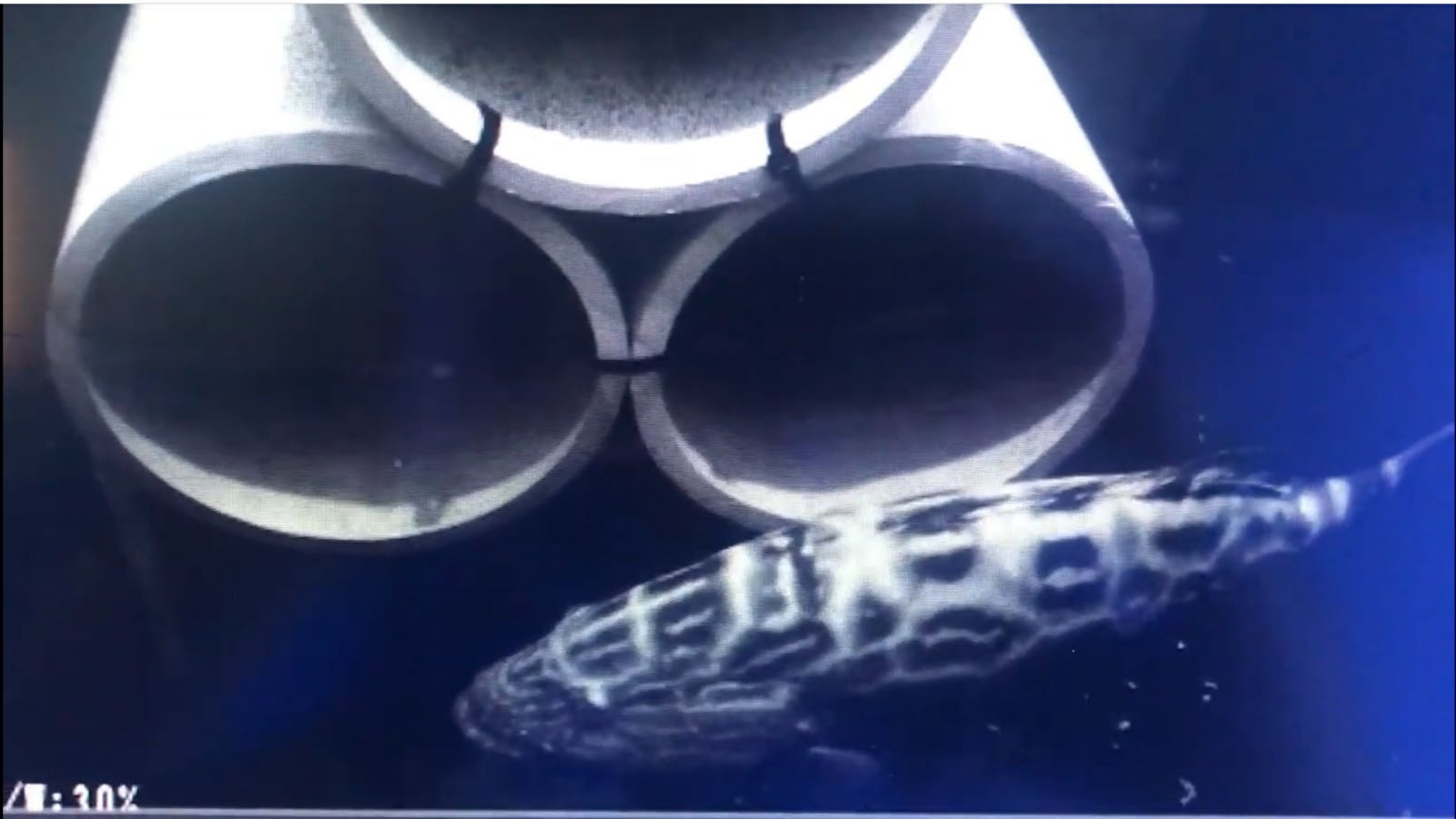


Crowd Sourcing

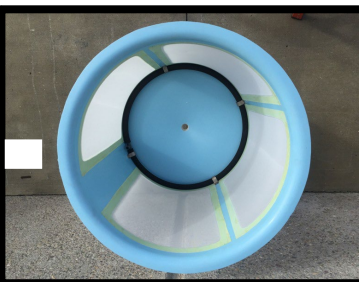


Lab Monitor



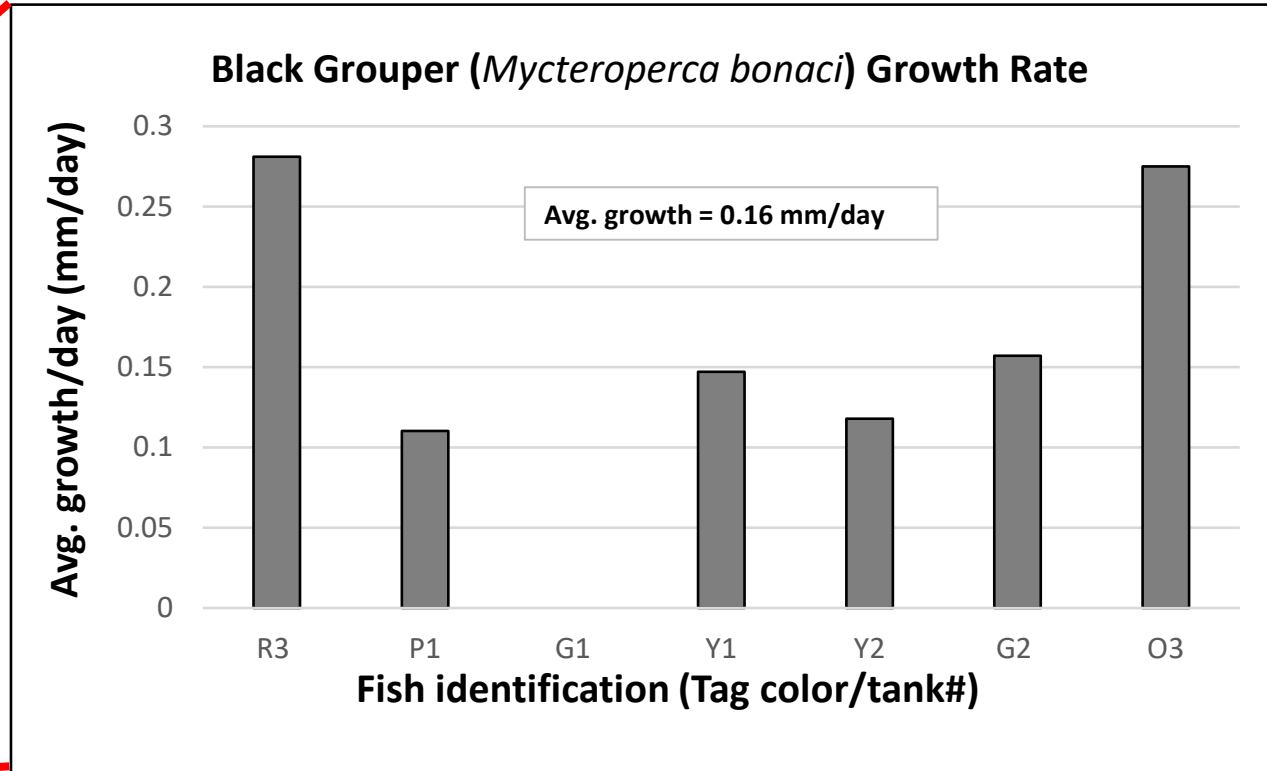
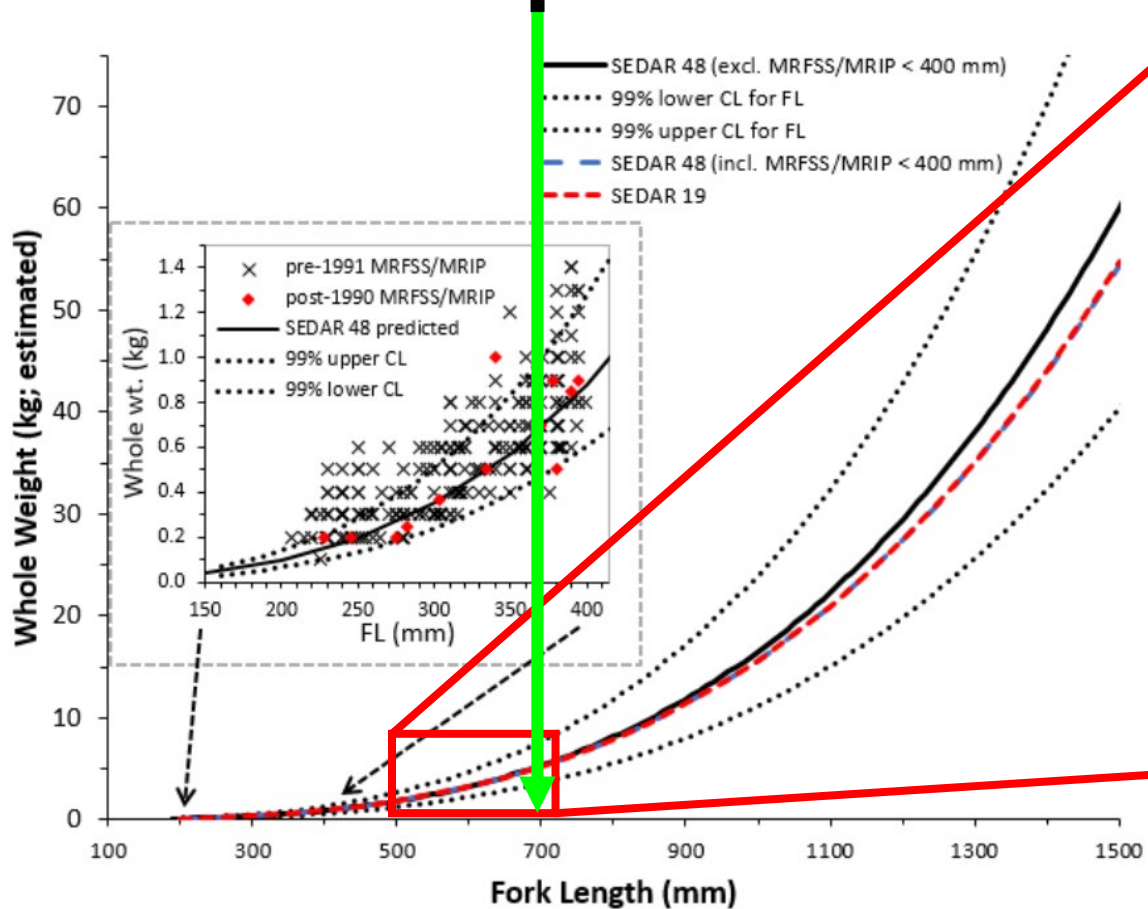
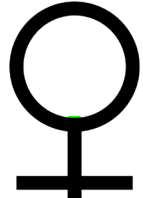


Broodstock Systems



Egg Harvester

M. bonaci growth in captivity



Hormone Study

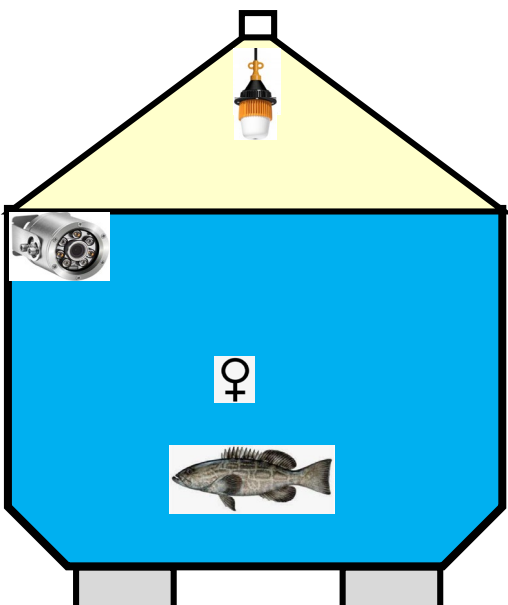
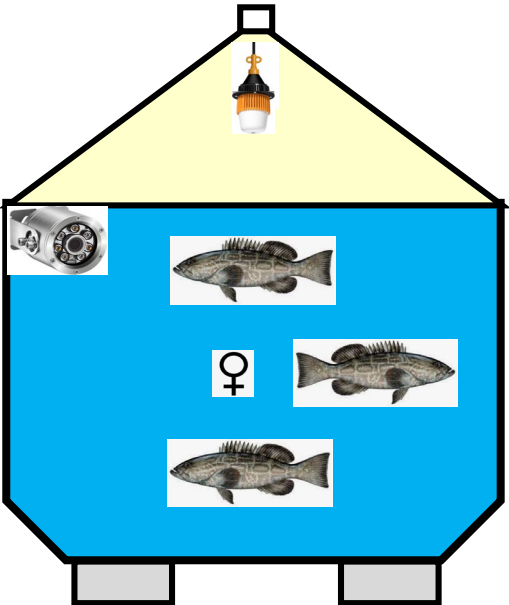
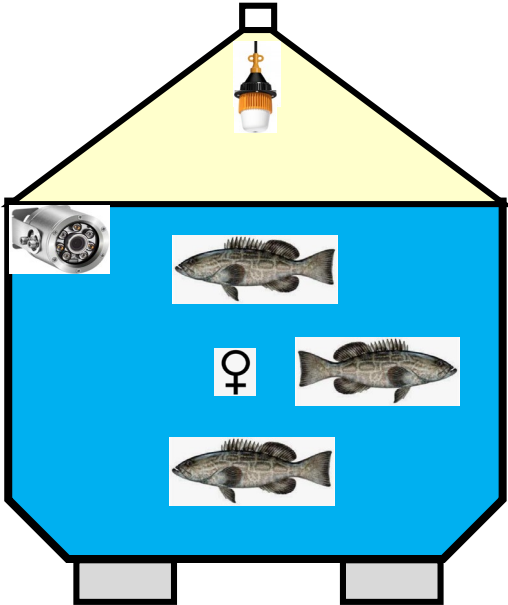
Injectable GnRH



GnRH Implant

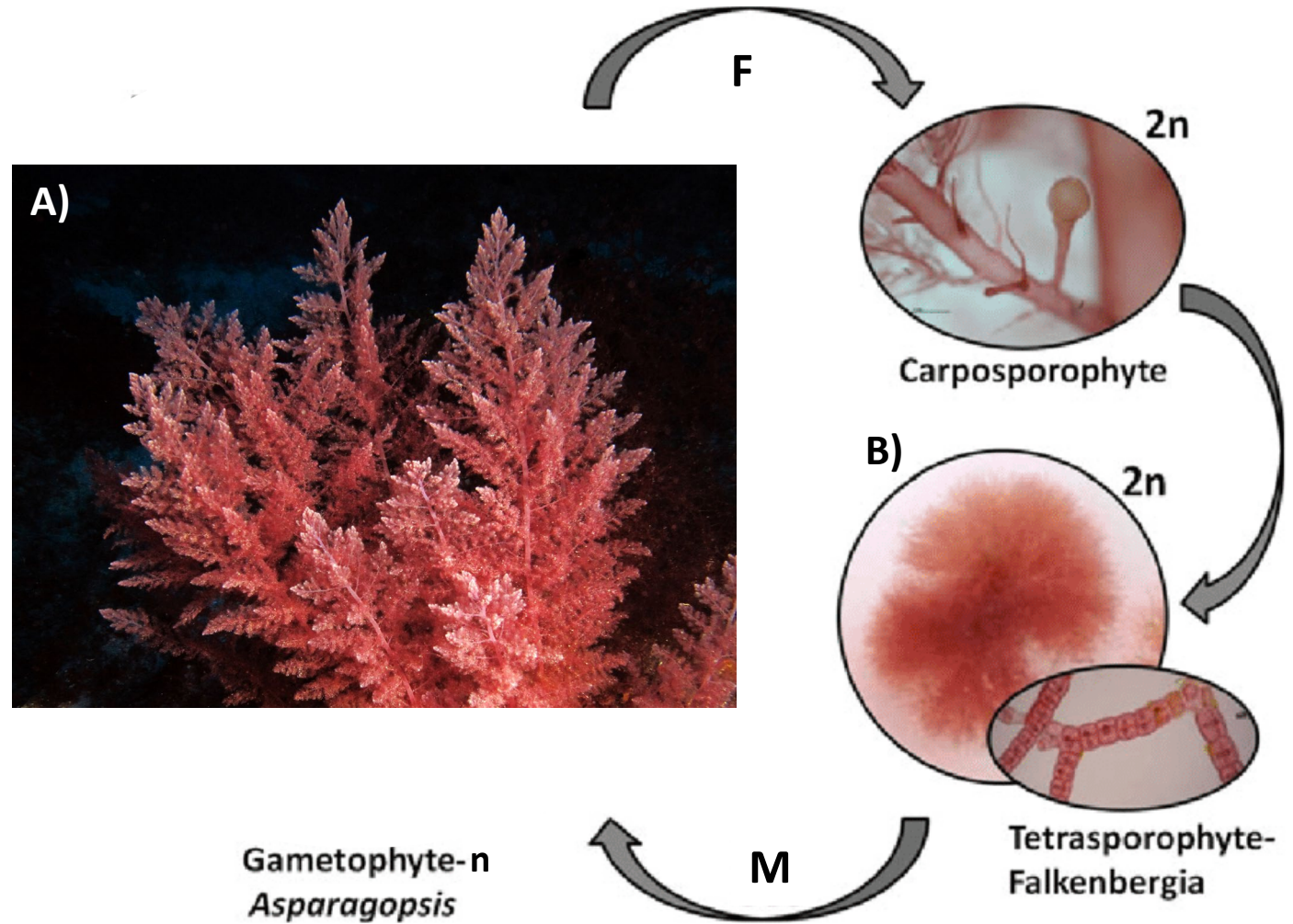


Control
(No Hormone)



Seaweed Update: *Asparagopsis taxiformis*

- The current system requires weekly water changes around 30%.
- Macroalgae are excellent at nutrient absorption.
- **Why *A. taxiformis*?**
 - Evidence of local distribution in the Florida Keys
 - Red macroalgae shown to reduce methane production by ruminants up to 98%.
 - Connections with local organic cattle farming operations.
- *A. taxiformis* has been challenging to locate.





Asparagopsis taxiformis (Delile) Trevisan de Saint-Léon ↗

Family: Bonnemaisoniaceae

[*Asparagopsis delilei* Montagne, [more](#)]



Resources

Internal Resources

- [937 occurrences](#)
- [Taxonomic Tree](#)

External Resources

- [Flora of North America](#)
- [Google Images](#)
- [Google Search Engine](#)
- [International Plant Names Index](#)
- [NCBI - National Center for Biotechnology Information](#)
- [W3Tropicos](#)



[Open Interactive Map](#)

Map

Satellite

Asparagopsis taxiformis Locations in the Florida Keys

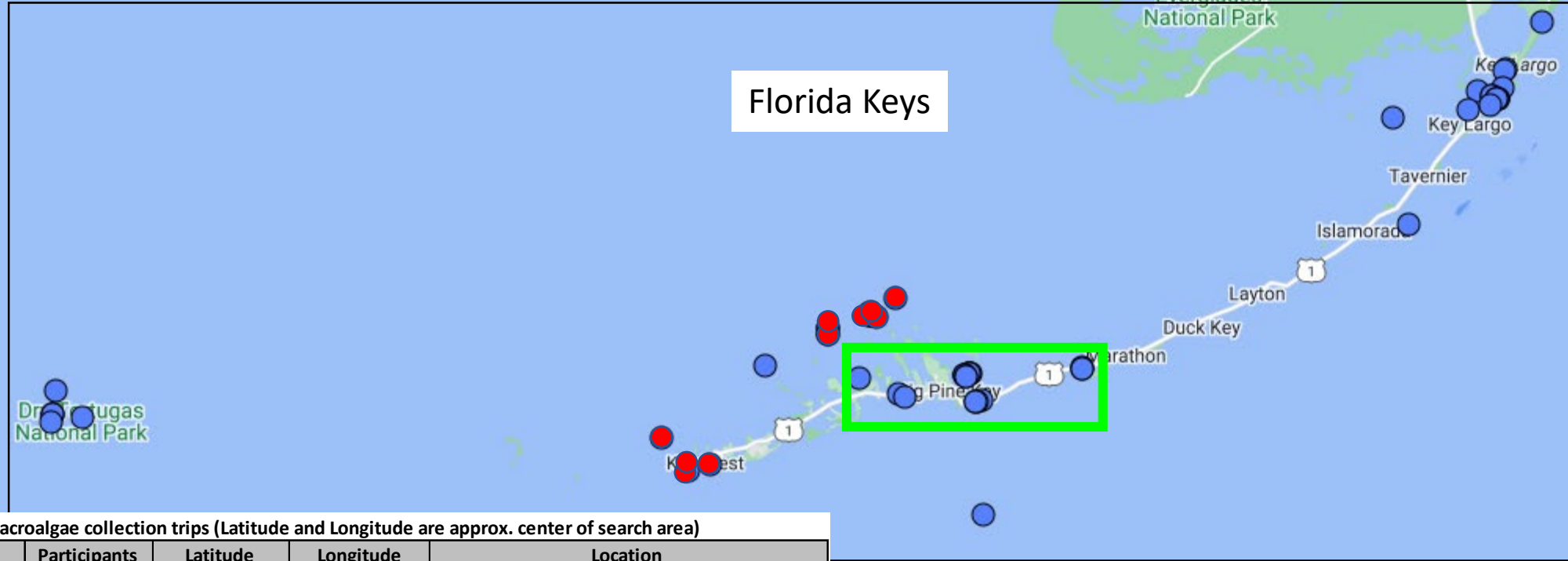


Table 1. Macroalgae collection trips (Latitude and Longitude are approx. center of search area)

Date	Participants	Latitude	Longitude	Location
6/10/2023	PI, RA, C, V	24° 32' 45" N	81° 47' 02" W	Whitestreet Pier, Key West, FL
6/17/2023	PI, RA, C, V	24° 32' 45" N	81° 47' 02" W	Whitestreet Pier, Key West, FL
6/23/2023	PI, RA, C, V	24° 38' 10" N	81° 53' 09" W	Northwest Channel Jetty (West), Key West, FL
6/30/2023	PI, RA, V	24° 34' 00" N	81° 44' 50" W	Cow Key Channel (South), Key West, FL
7/7/2023	PI, V	24° 47' 44" N	81° 29' 30" W	Content Key (Northside), Monroe County, FL

PI = Principal Investigator

RA = Research Assistant

C = Project Coordinator

V = Volunteer

Expert help to confirm *A. taxiformis*?

ECOLOGY AND WATER QUALITY

Dr. Brian LaPointe

- Research Faculty
- Florida Atlantic University
- Harbor Branch Oceanographic Institute



Principal Investigator

Brian E. Lapointe, Ph.D.

Research Professor

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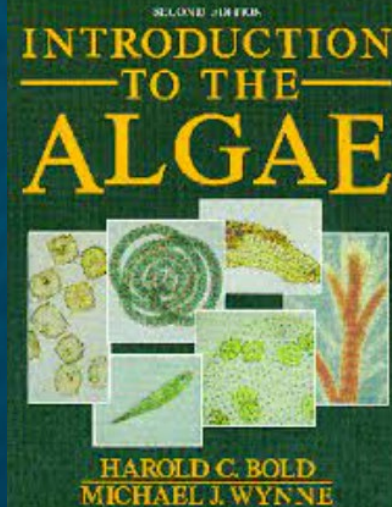
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[Publications](#) | [Website](#)

Dr. Michael Wynne

- Professor Emeritus
- University of Michigan
- Ecology and Evolutionary Biology
- Co-authored “Introduction to the Algae”

Michael J. Wynne
Professor and Curator of Algae



In the meantime: *Ulva sp.* and *Chaetomorpha sp.*?



Ulva sp.



Chaetomorpha sp.

Bivalve Update: Eastern Oyster *Crassostrea virginica*

- Originally proposed *C. virginica* as an IMTA bivalve to remove waste particles produced by *M. bonaci*
- Source for oyster spat is Great Florida Shellfish Company <https://thegreatfloridashellfishcompany.com/>
- Received about 1000 oyster spat in July 2023
- Counted and weighed and placed into a quarantine tank
- Fed with *Nannochloropsis*, *Isochrysis*, and Rotigrow™
- Immediate problems with pH drops
- System has finally stabilized and spat are growing nicely



Eastern Oyster *Crassostrea virginica*



Also Known As

American oyster, Atlantic oyster, American cupped oyster, Virginia oyster

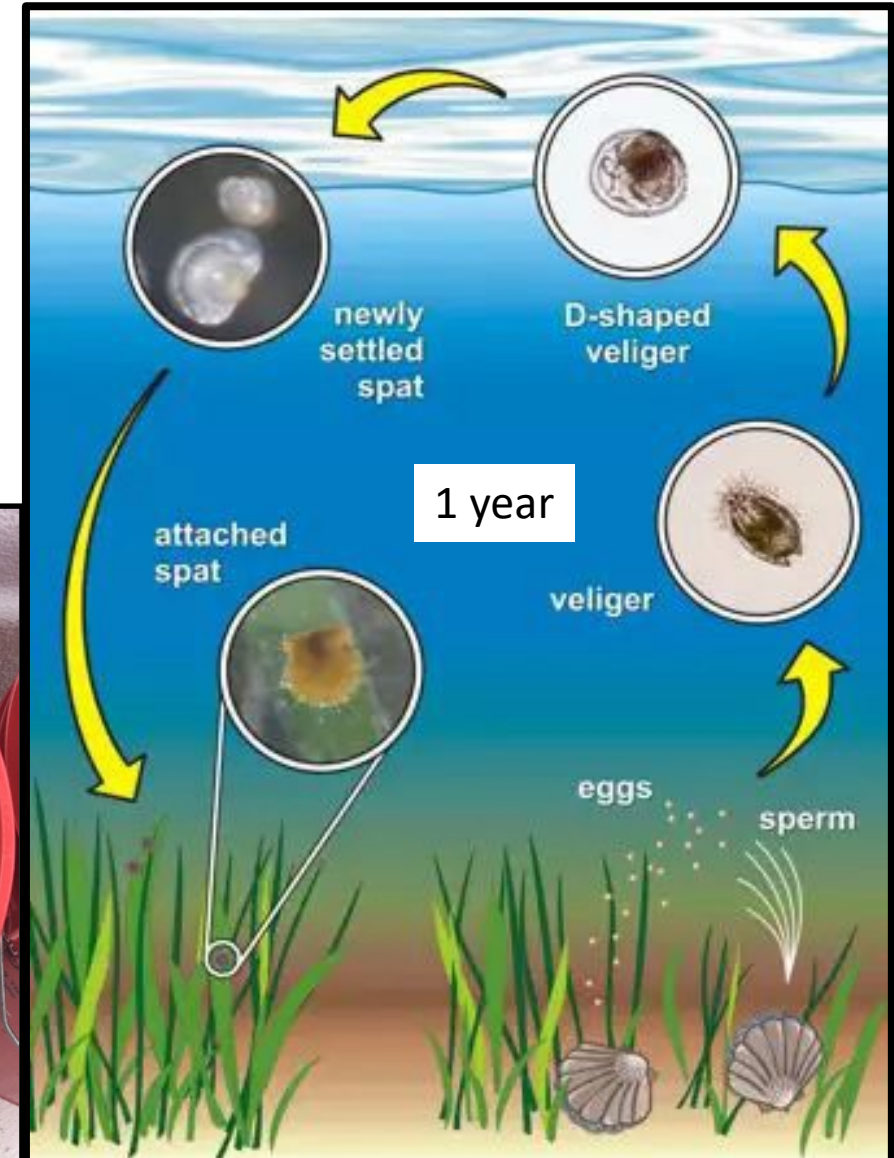
Quick Facts

LENGTH	Average 3–5 inches in length; can grow up to 8 inches
LIFESPAN	Up to 20 years
REGION	New England/Mid-Atlantic, Southeast

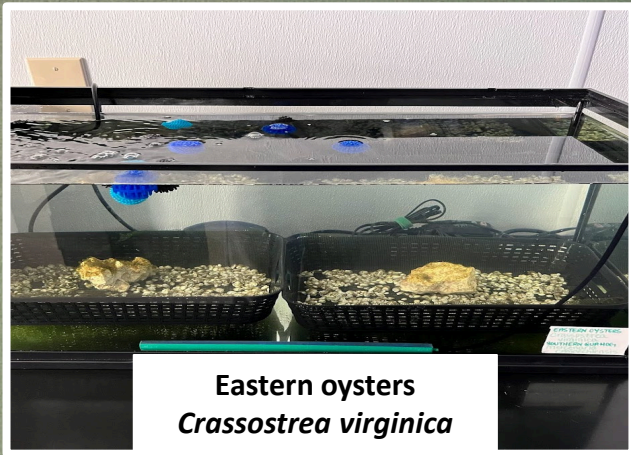


Bivalve Update: Florida Bay scallops *Argopecten irradians*

- Opportunity to study the Florida Bay Scallop
- Good filter-feeder
- Short life-cycle (about 1 yr in Florida)
- Probably not a viable candidate



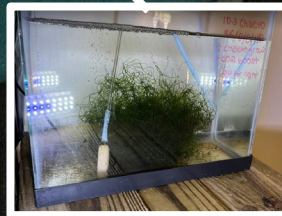
IMTA System Design



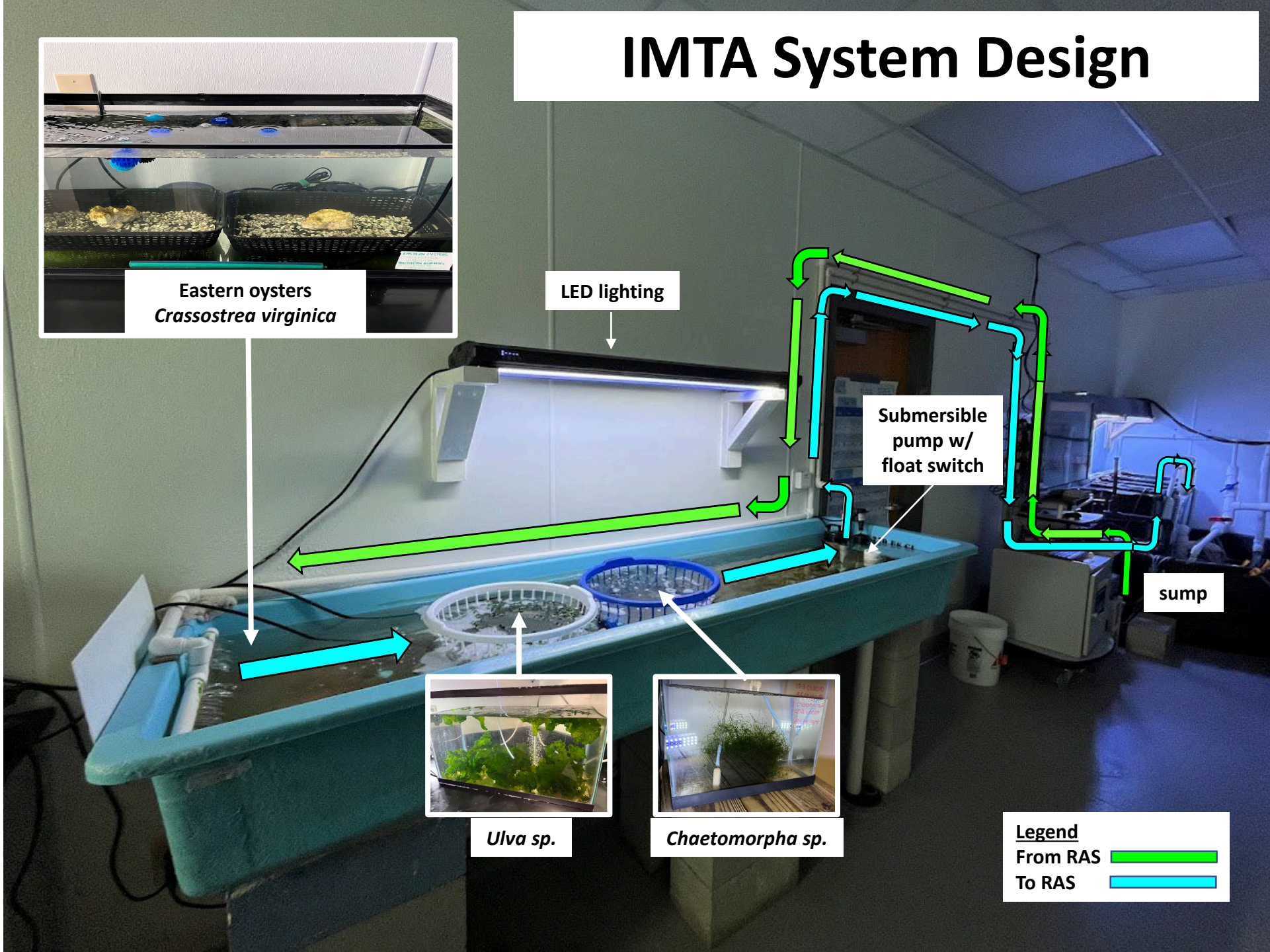
LED lighting

Submersible pump w/
float switch

sump



Legend
From RAS 
To RAS 



Questions?

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Logo by Piper Flowers
CFK Marine Research Assistant

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- Caeley Flowers
- STEM Technician
- Cody Moore

STEM Ambassadors

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 - Kaitlyn Stumbar
- Volunteers
- Daniel Widell
 - Leah Eve

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