



Closed-System Saltwater Aquarium as a Model of the Florida Keys Ecosystem: Real-Time Monitoring Applications

Broch E. Travis¹ and Anna Lee H. Travis, DPT, PhD (abd)²

¹PADI-Certified Divemaster, Marine Aquarist and System Designer, USAF Veteran

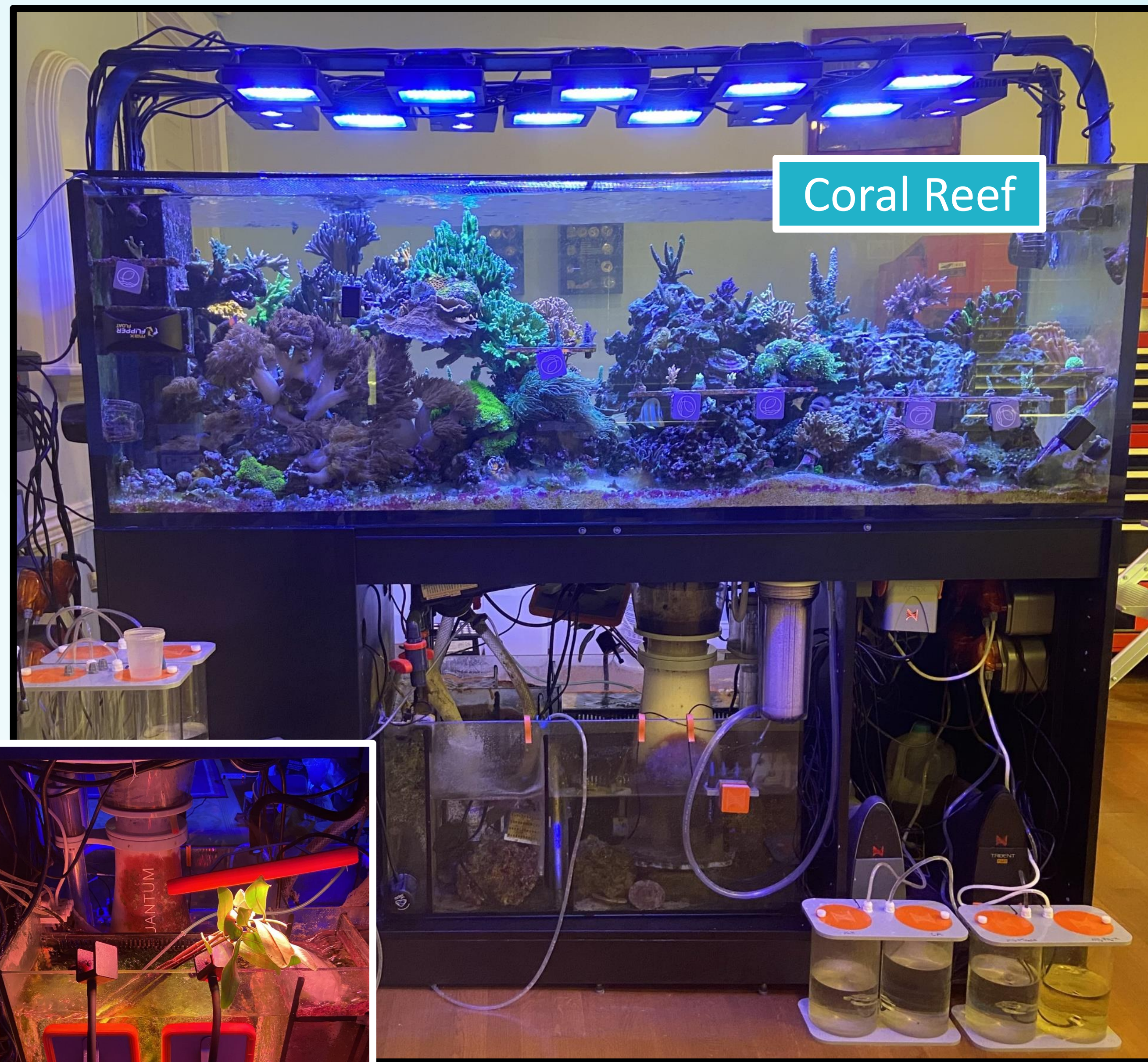
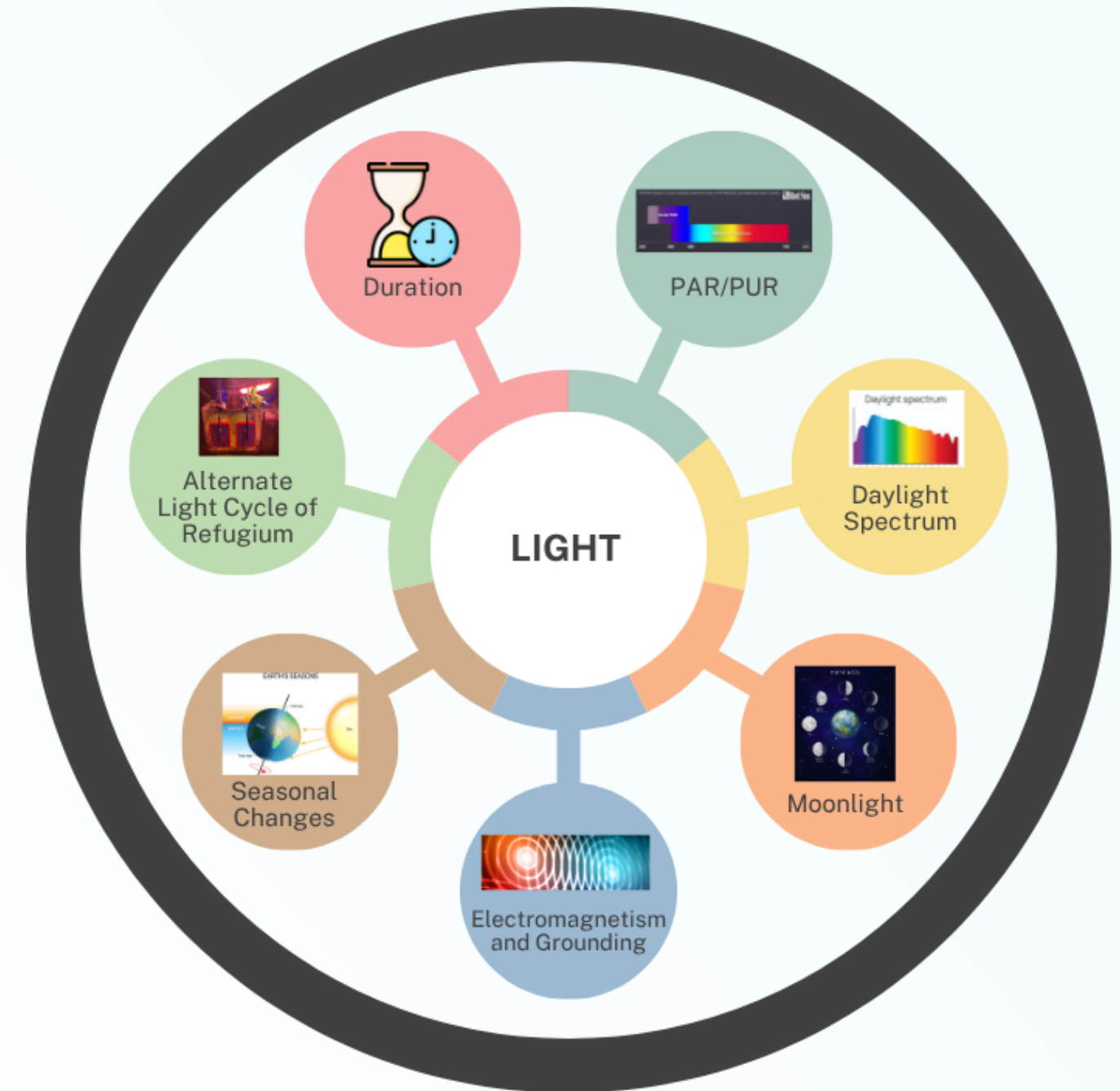
²Assistant Professor of Biology, Anderson University, SC



Abstract

This project presents a mixed-reef saltwater aquarium as a microscale model for the Florida Keys ecosystem, integrating coral reef, seagrass and mangrove analogs to simulate its broad ecology. In this 230-gallon system, corals and live rock provide basic reef structure, while macroalgae and mangrove seedlings simulate nutrient cycling and coastal stabilization. Fish, invertebrates, and microbial communities illustrate parallel trophic linkages, supported by a regulated light cycle and real-time monitoring of water quality. Periodic testing and DNA sequencing add insight into microbial and eukaryotic disease dynamics, while observations of acoustic, electromagnetic and redox influences highlight broader ecological connections. This model bridges innovative aquarium management with citizen science and provides a platform for closed-system ecological research relevant to Florida Keys conservation.

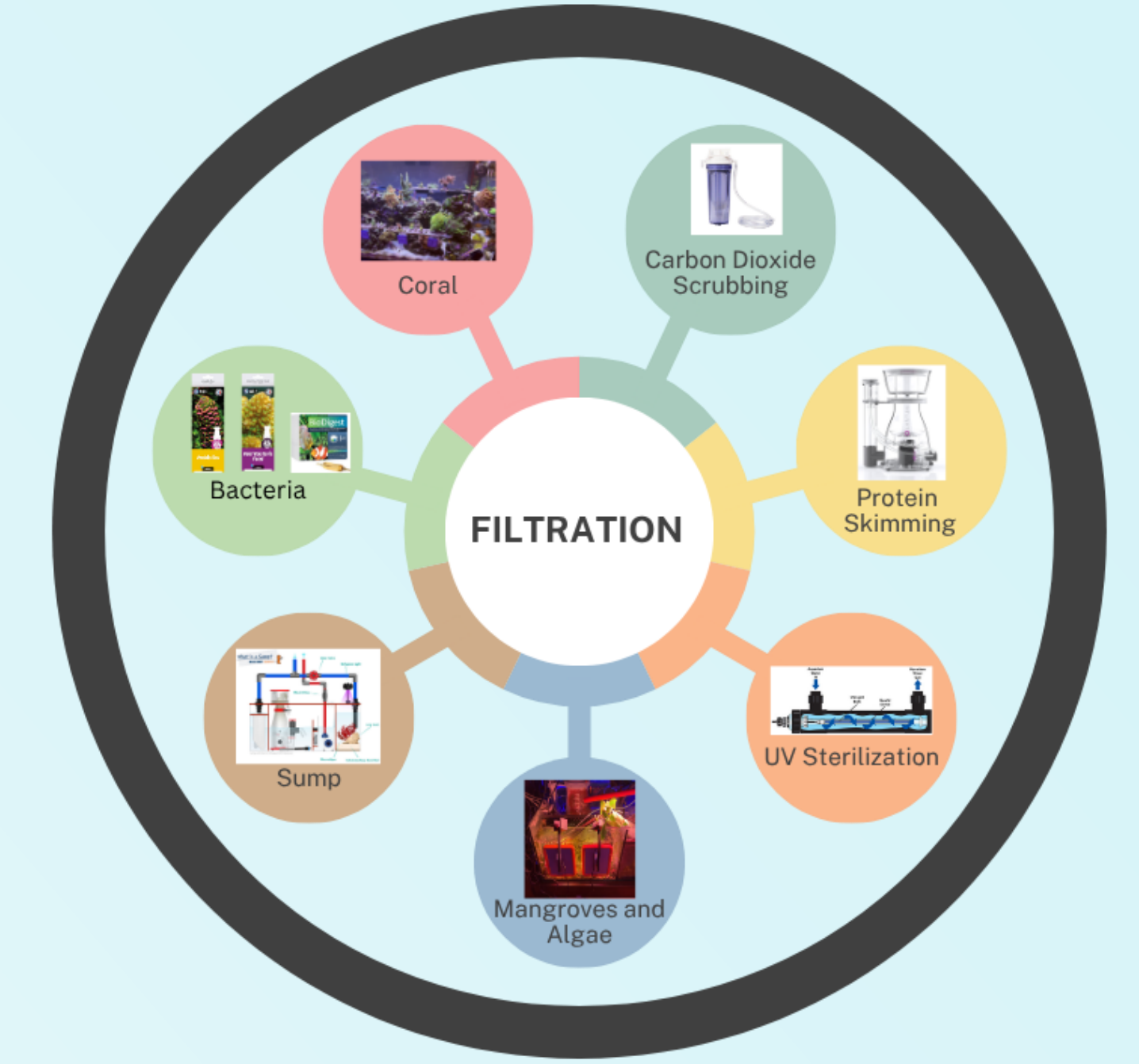
System Components and Habitat Analogs



Coral Reef



Seagrass Bed and Mangrove Forest



Import

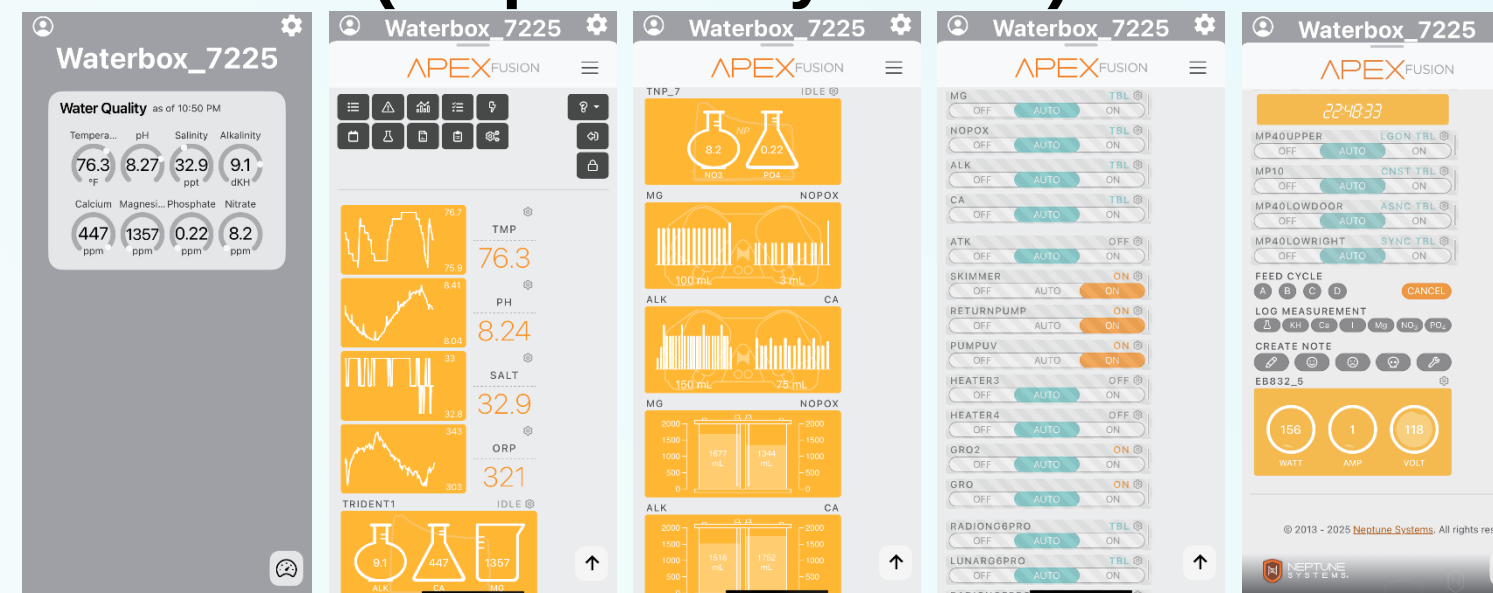
- Food Web
 - Dry
 - Wet
 - Live
 - Algae
 - Bacteria Food
 - Trophic Linkages
- Daylight/Moonlight
 - Spectrum
 - Duration
 - Intensity
- Chemicals
 - Elements: Major, Minor, Trace
 - Nitrogen/Phosphate
 - Probiotics
 - Hydrogen Peroxide
 - STN-X/RTN-X

Export

- Protein Skimming
- CO₂ Scrubbing
- Refugium
 - Mangroves
 - Chaetomorpha
 - Dark Areas
 - Diverse Compartments
- UV Filtration/Sterilization
- Flow (Program med Tides)
- Water Changes
- Bacteria/Bio-balls
- Substrate
- Activated Carbon

Monitor

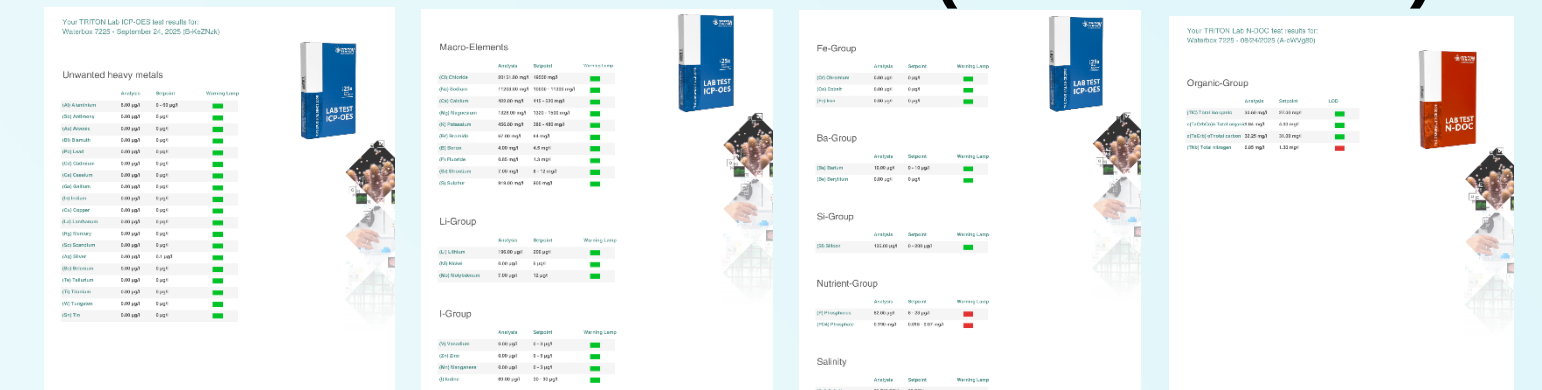
- APEX (Neptune Systems)



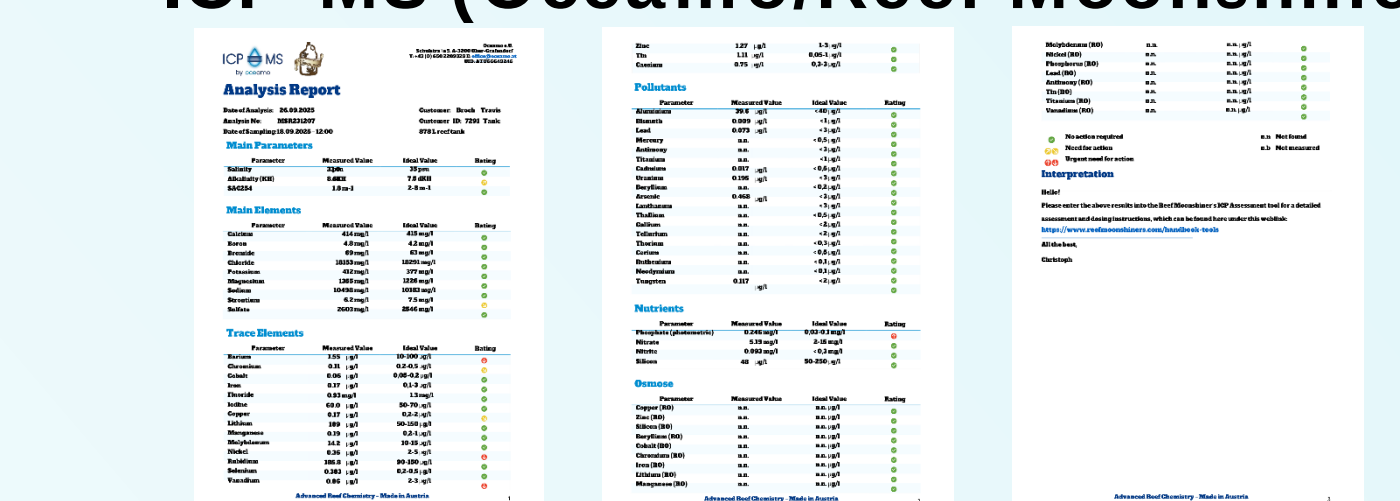
- Integration/Testing
- Visual Inspection
- Mobius/MXM
- Organismal Behavior
- Nutrient Monitoring
- Ion Monitoring
- Whole House Generator
- CALIBRATION

Test

- ICP-OES and N-DOC (Trident Labs)



- ICP-MS (Oceamo/Reef Moonshiners)



- Microbiome/Tank DNA (Aquabiomics)



- Trident: ALK, Calcium, Magnesium
- Trident NP: Nitrogen, Phosphate
- Probes: Salinity, pH, Temperature, ORP/Redox
- Optical Sensors (Auto-Top Off)
- REDUNDANCIES

System Dynamics and Flow

- Water Changes with Salts and RODI
- Refugium (Breeding Microorganisms that Feed System)
- Biodiversity (Fish, Invertebrates, Isopods, Amphipods, Copepods, Phytoplankton, Protozoa, Bacteria, Viruses)
- Carbon-Dosing (NO₃PO₄-X)
- Pumps: Return, UV, Circulating



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