# Pompano Culture in Recirculating Aquaculture Systems

HARBOR BRANCH

FLORIDA ATLANTIC UNIVERSITY

Funding Thanks to

FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES
DIVISION OF AQUACULTURE

Paul S. Wills

# Inland
# Recirculating Aquaculture Systems


USDA ARS

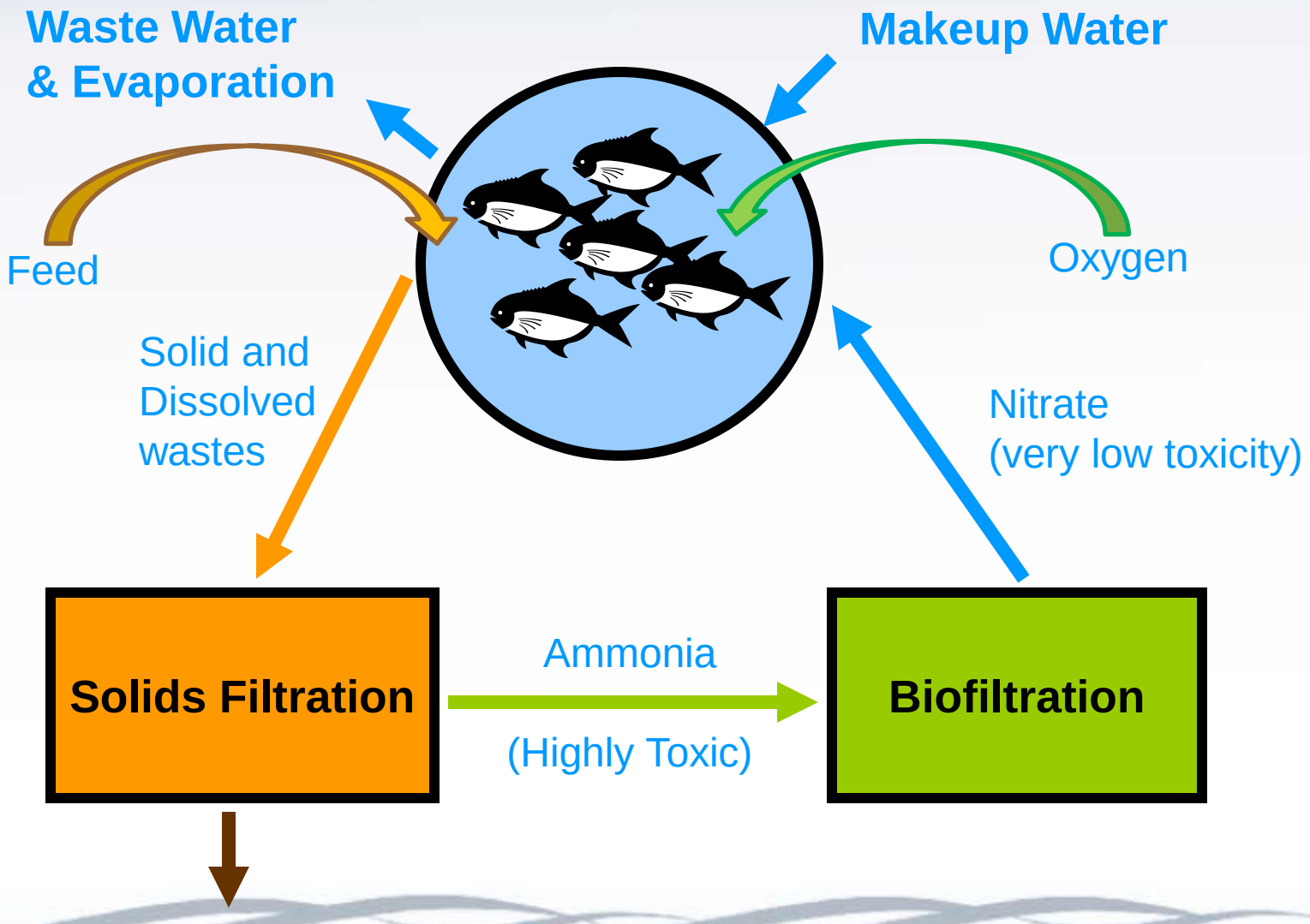
HARBOR BRANCH

FLORIDA ATLANTIC UNIVERSITY

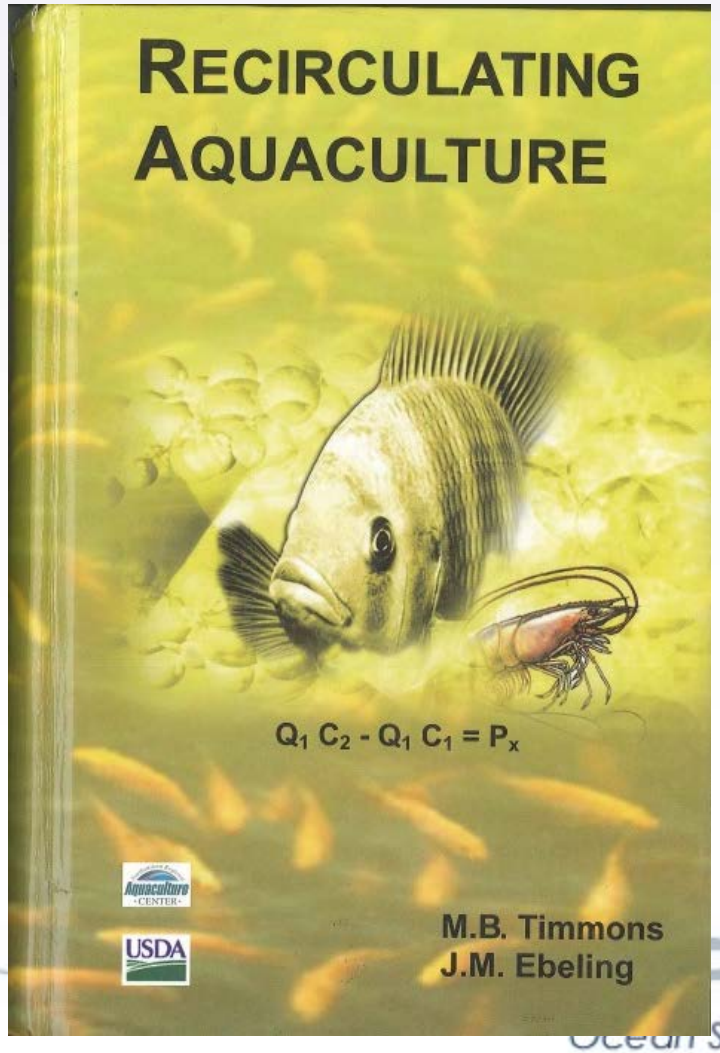
# Recirculating Aquaculture Systems (RAS)

- Year round growing season
- Reduced water consumption
- Reduced effluent discharge
- Intensive production
- Enhanced biosecurity
- Increased food safety
- Containment of escapees
- Environmental Sustainability

# Basic RAS Design



# Advanced RAS design and Operation




## HBOI-FAU ACTED Workshop:

"Recirculating Aquaculture Systems: Design, Engineering and Operation"

Instructors: Michael Timmons and Jim Ebeling

Dates: October 17-19, 2013

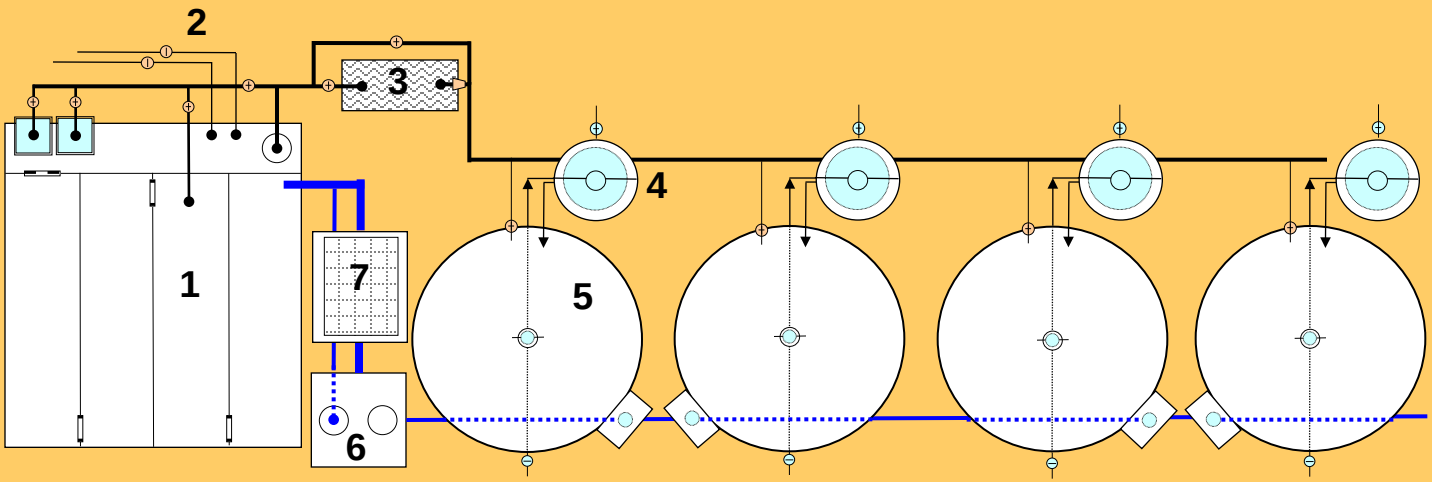
Cost: $450

Information: See Jill Sunderland
or, www.aquaculture-online.org
or, www.fau.edu/hboi
or, call 772-242-2506

# Basis of the Commercial System Design

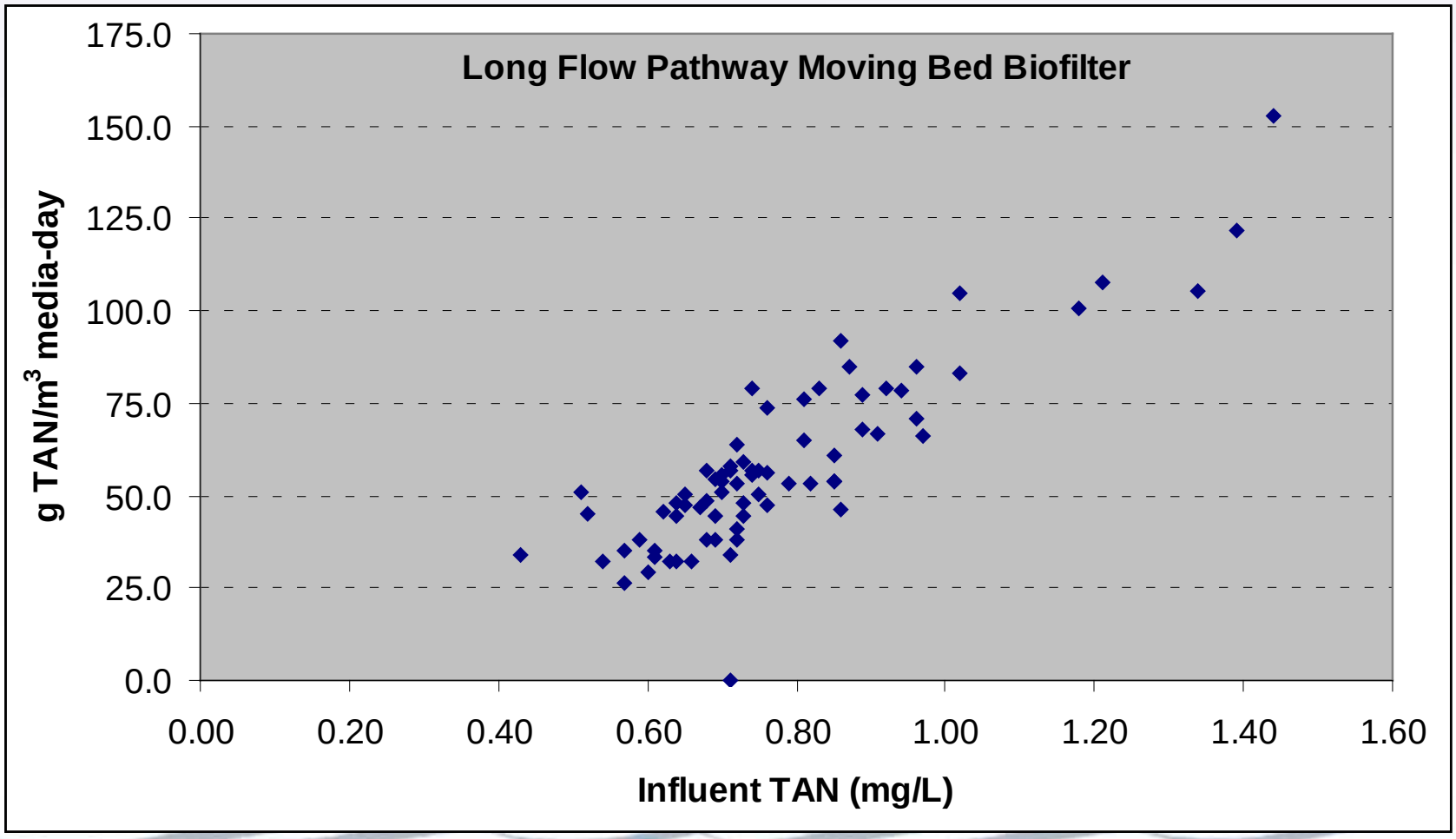
- Scaled up version of tested design developed jointly for USDA-ARS project and FL-FWCC marine hatchery program FMFEI
- System Tested with:
  - Red Drum up to ~90 Kg/$m^3$
  - Florida Pompano ~40 Kg/$m^3$

# LOW HEAD GROWOUT SYSTEM

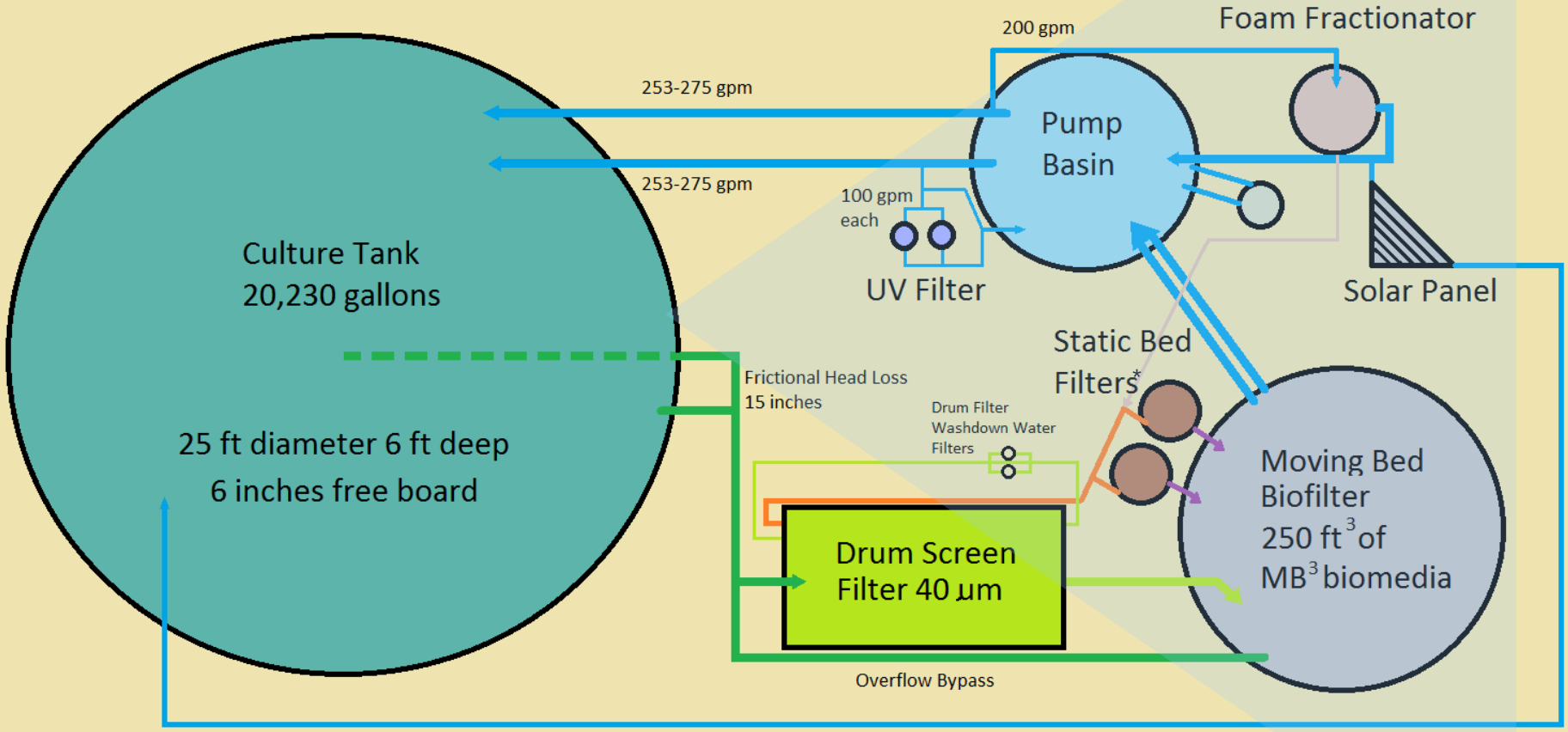



**1. Long flow pathway moving bed reactor with cross flow oxygenator, float valves, and propeller pump; 2. Incoming salt and freshwater lines with float valves and water meters; 3. UV sterilizer; 4. Torrus filters with 13ft$^3$ of MB3 floating plastic media; 5. Ten-foot diameter tanks w/ center sump and sidebox drain; 6. Diverter box; and 7. 60 micron drum filter.**

# BIOFILTER VOLUMETRIC NITRIFICATION RATES



# Commercial System Design



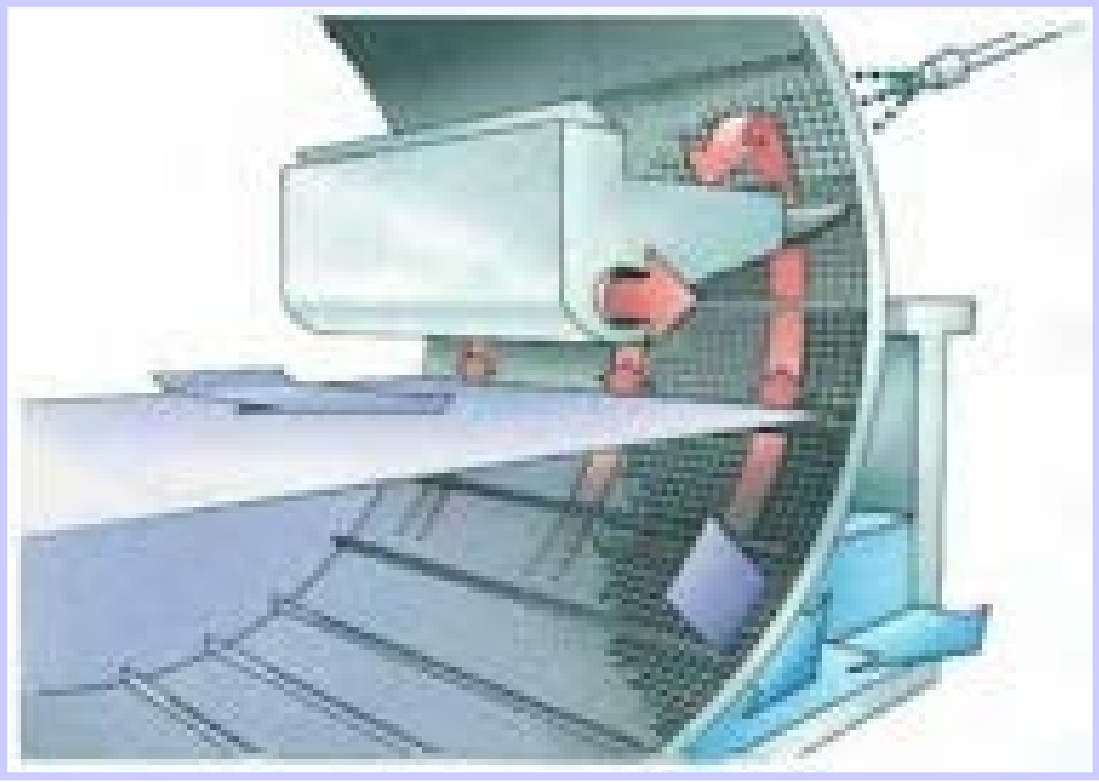

Not to scale

* Static Bed filters each contain 8 ft$^3$ of MB$^3$ biomedia

# Panorama of Filtration System

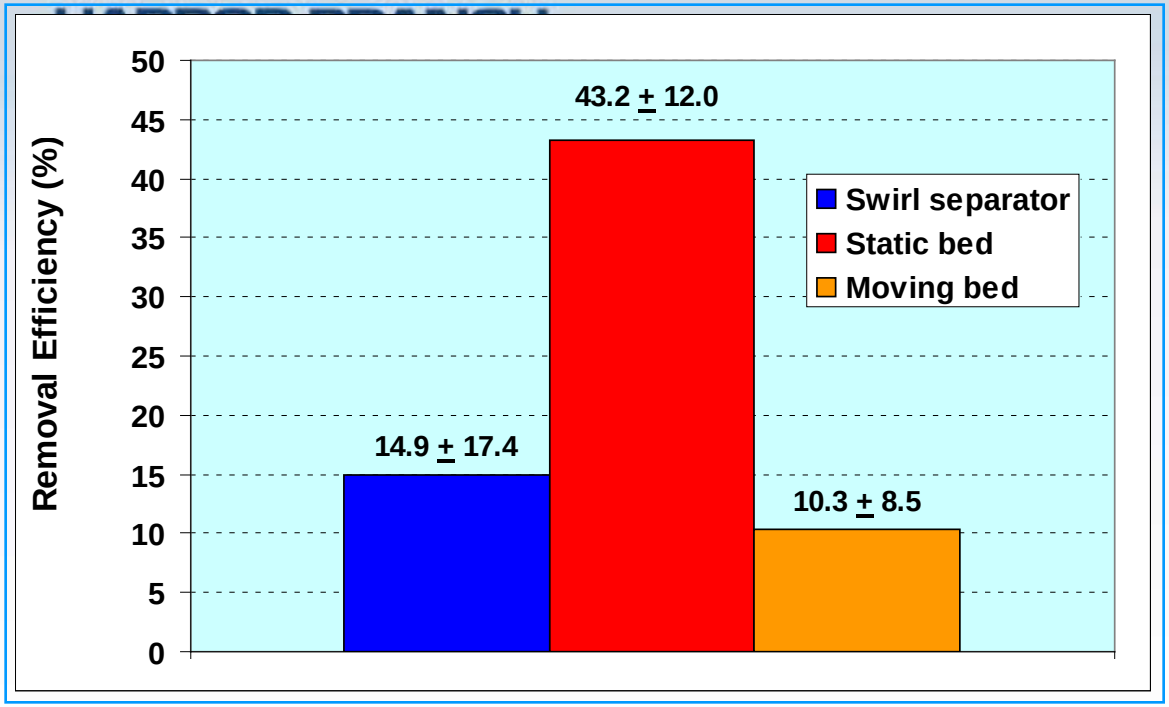
# Drum Screen Filter


# Microscreen Cleaning Process



# Waste Water Recapture

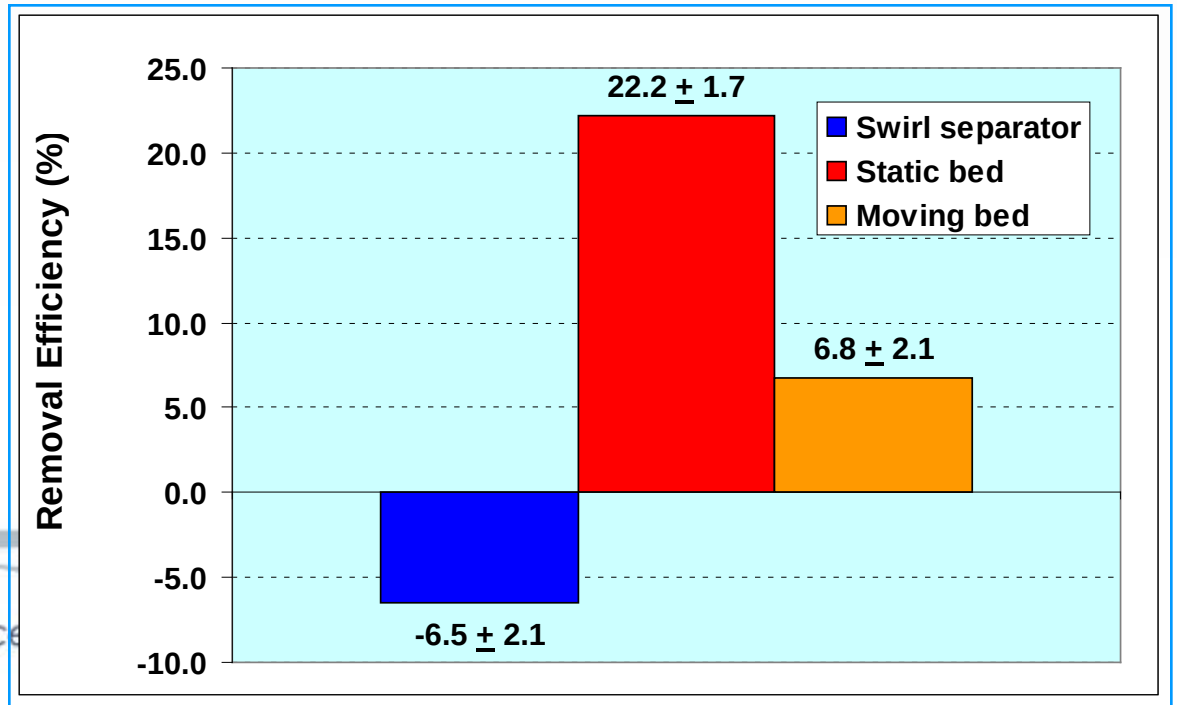
- We used a Static Bed Filter to separate solids from Drum Screen Filter Waste stream
  - Concentrates solids prior to discharge
  - Recaptures significant component of water used for wash down of drum screen
  - Each contains 8 $Ft^3$ $MB^3$ Media



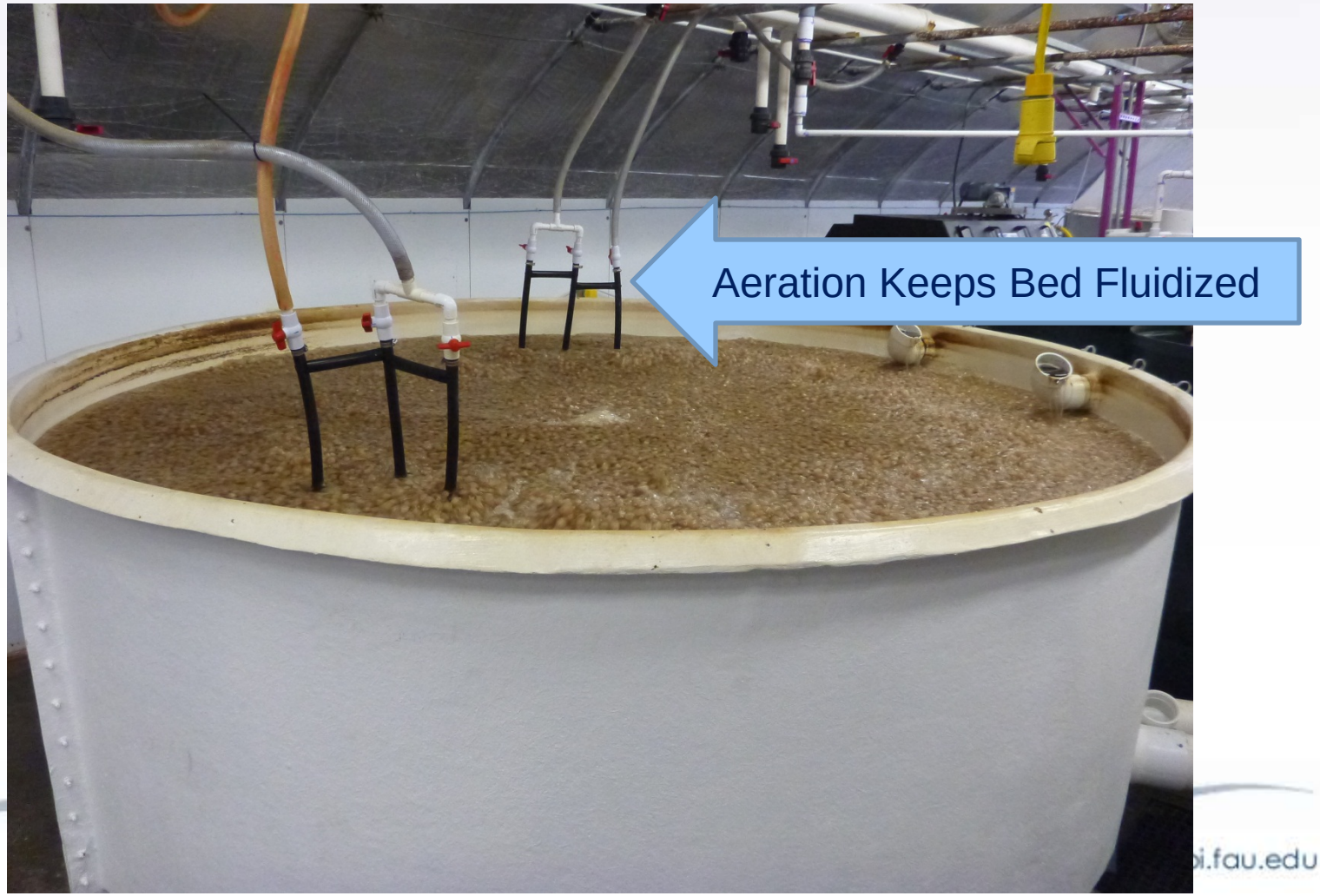

## Solids removal efficiency

$RE = (TSS_{IN}-TSS_{OUT}) / TSS_{IN}$

## Solids removal efficiency (< 50 microns)



# Moving Bed Biofilter (250 $ft^3$ $MB^3$ Biomedia)




Minimum Dose Desired

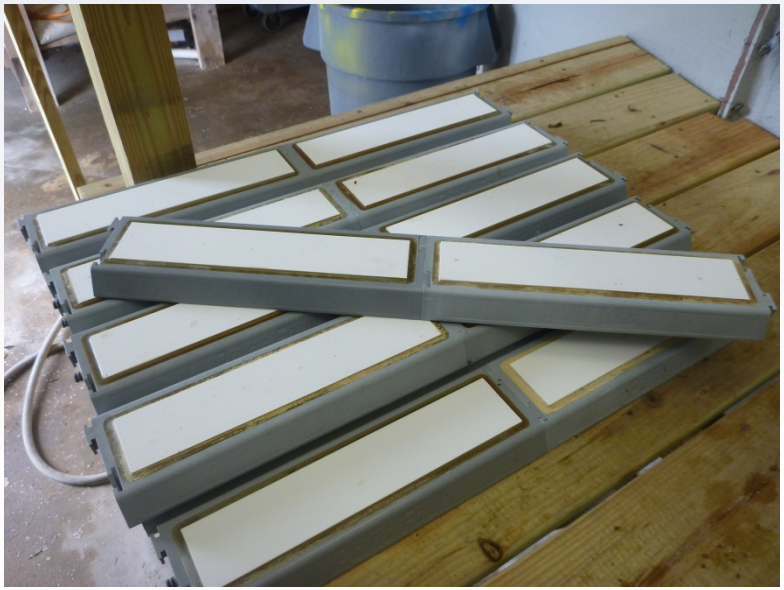
30,000 uW sec/cm$^2$

The two units delivering

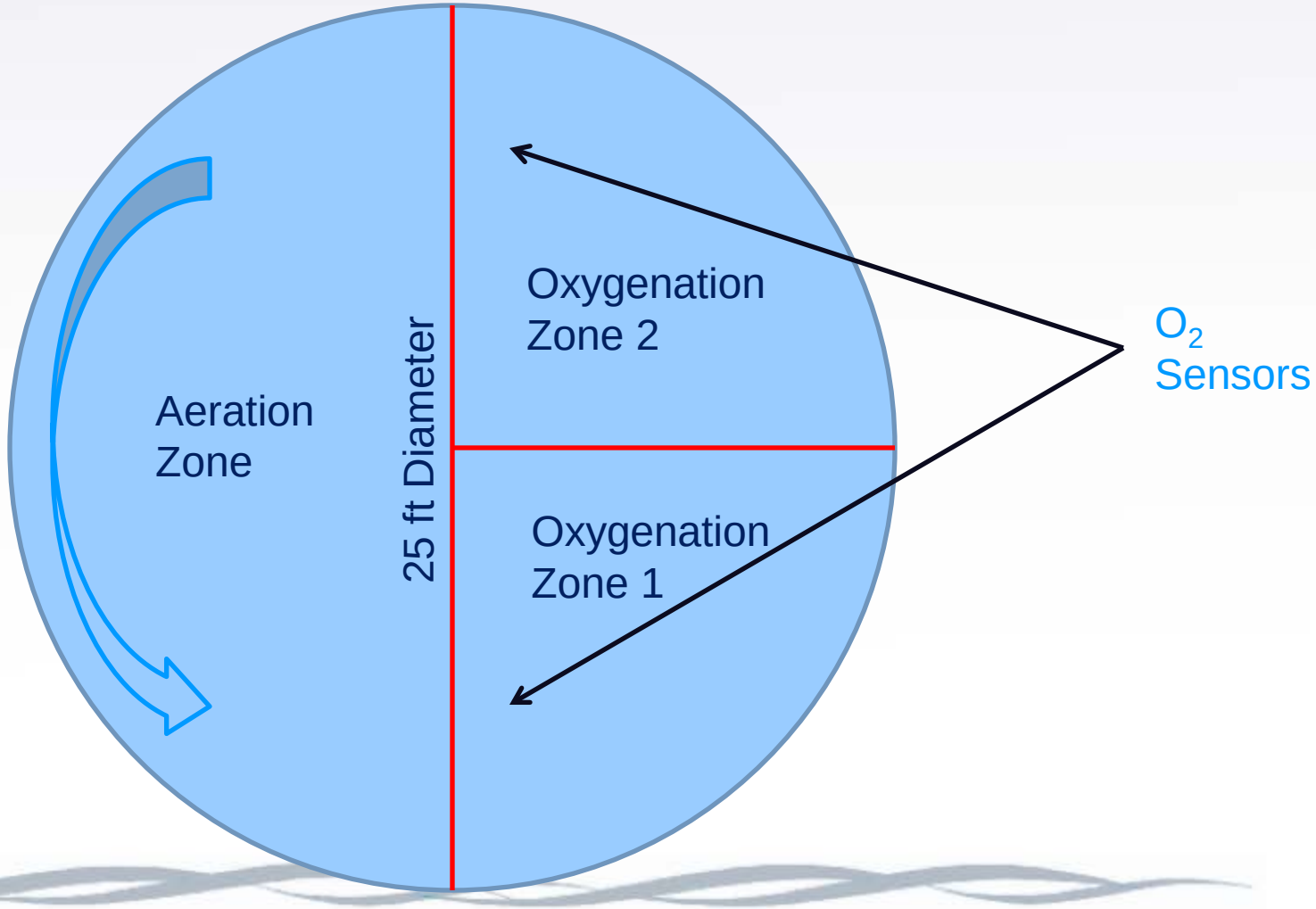
~150,000 uW sec/cm$^2$

# Tank Cover

# Aeration and Oxygenation




# Aeration and Oxygenation



# Backup Systems

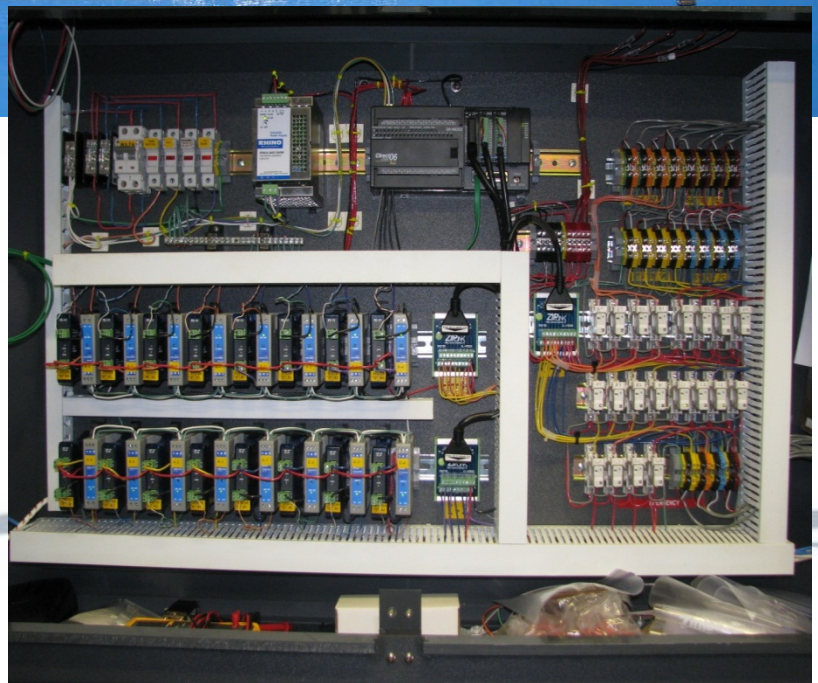
- Systems designed to combat “Murphys Law”
  - “If anything can go wrong it will”
- Therefore managers must:
  - Anticipate
  - Plan
  - Train
  - Respond
    - (an automatic system that “cries wolf” can derail this necessary task)

# Backup Systems

- Generators
- Automatic oxygen system

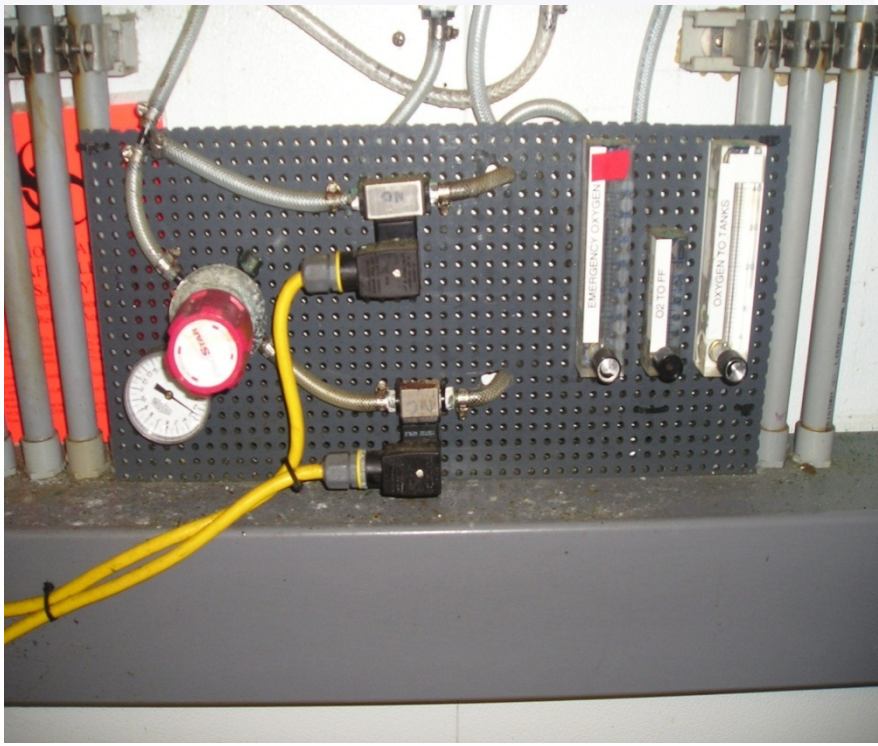
# Generators

- Must have disconnect switch and meet other local requirements

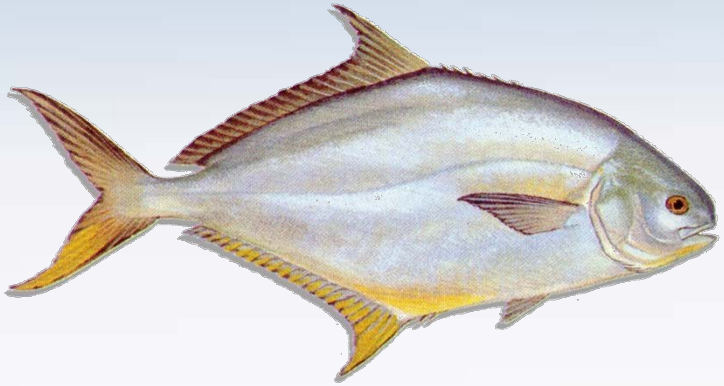


# Automatic Oxygen System

- Opens oxygen flow to tanks regardless of monitoring systems or other backup systems if the power turns off
- Must use Normally Open Solenoid Valves for failsafe system
  - Normally open ➔ closed when power applied



HARBOR BRANCH
FLORIDA ATLANTIC UNIVERSITY



# Broodstock Conditioning and Spawning System USDA-ARS/HBOI-FAU Design

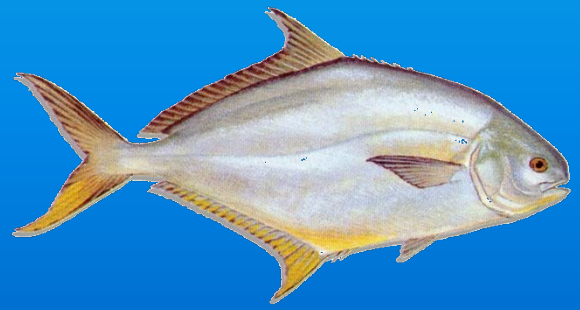
USDA ARS

HARBOR BRANCH
FLORIDA ATLANTIC UNIVERSITY

# Broodstock Profile

## Florida Pompano

Weight: 0.7 – 2.3 kg
Mature age: 1- 3 yrs
Temp: 18 – 30 C
Salinity: 5 – 36 ppt

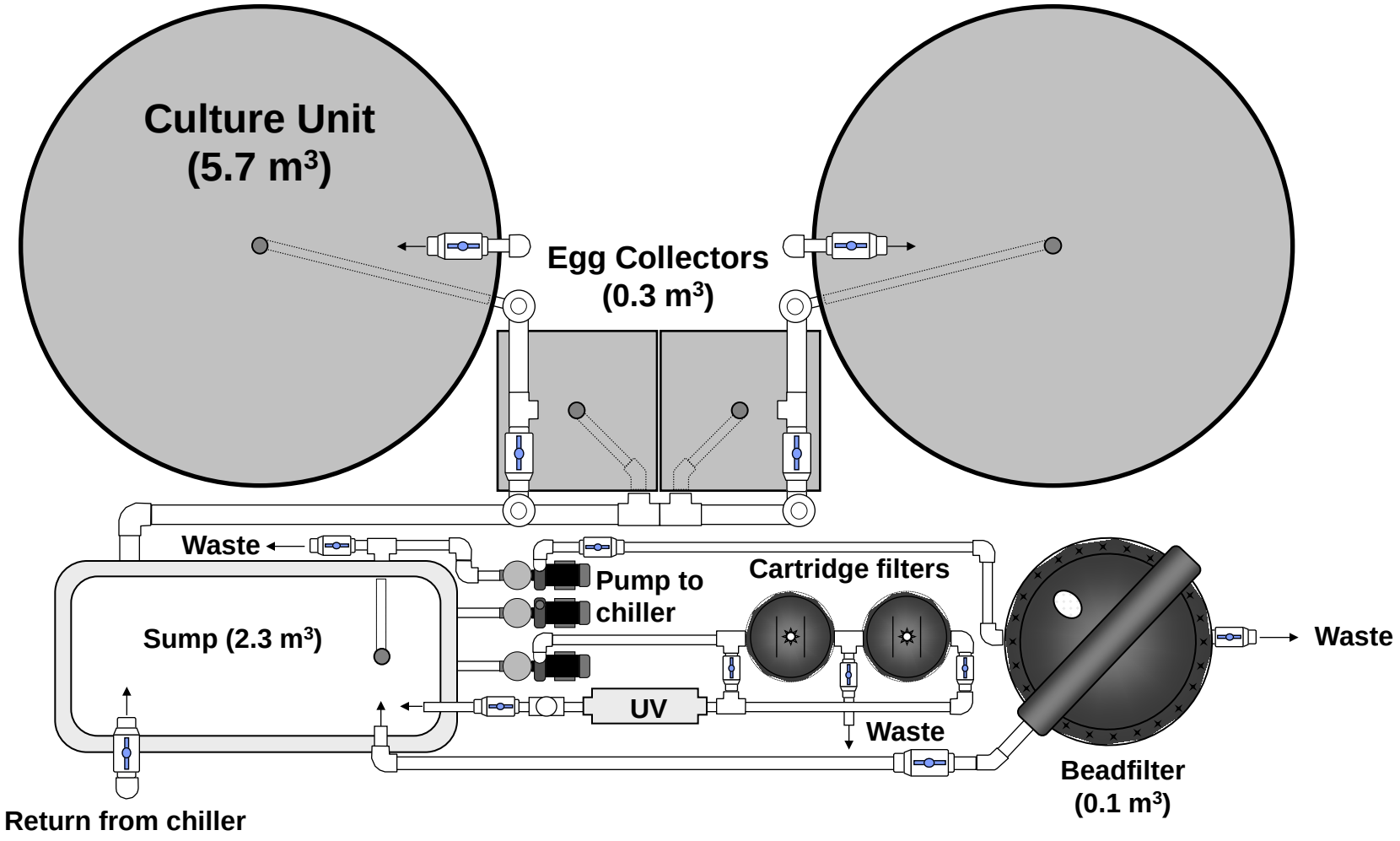


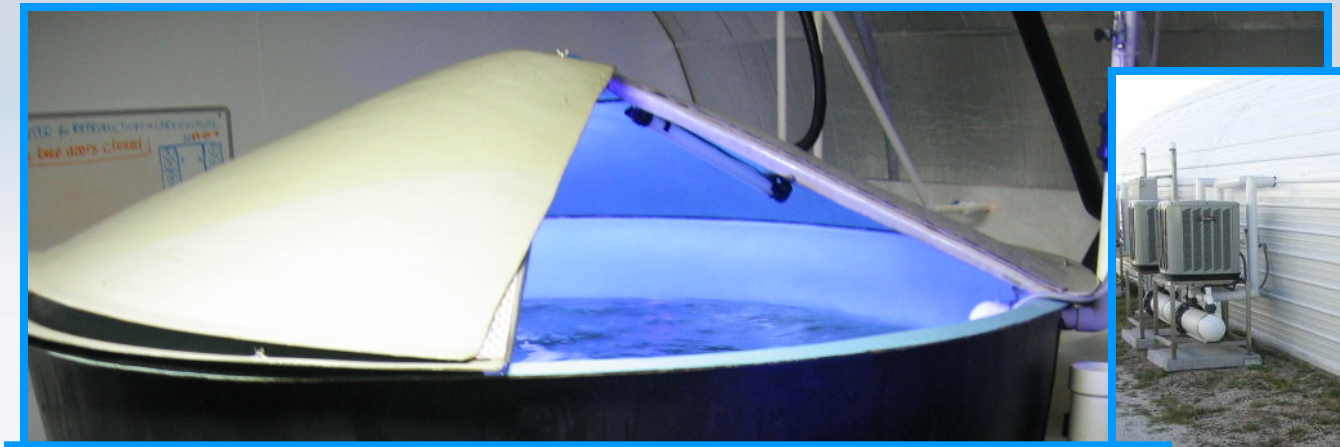
HARBOR BRANCH
FLORIDA ATLANTIC UNIVERSITY

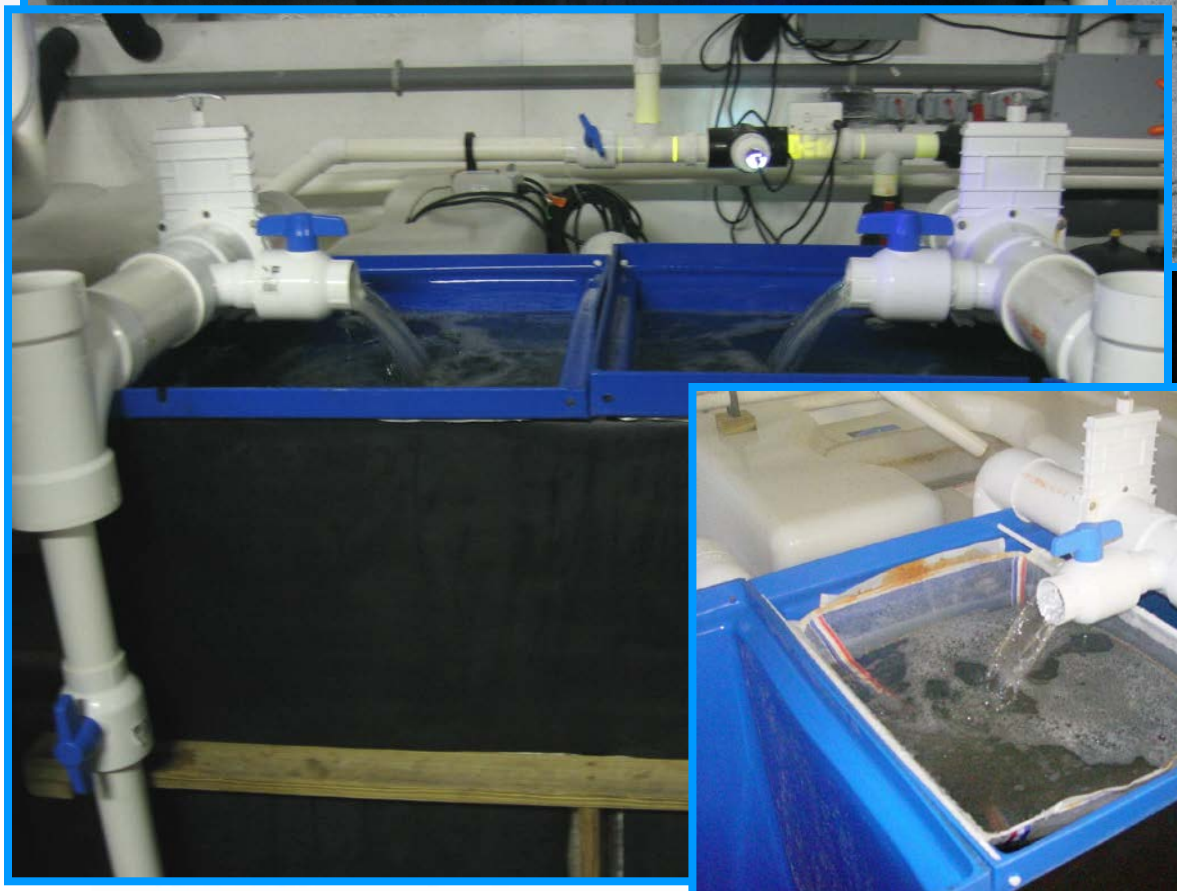
# Water Quality Management Parameters

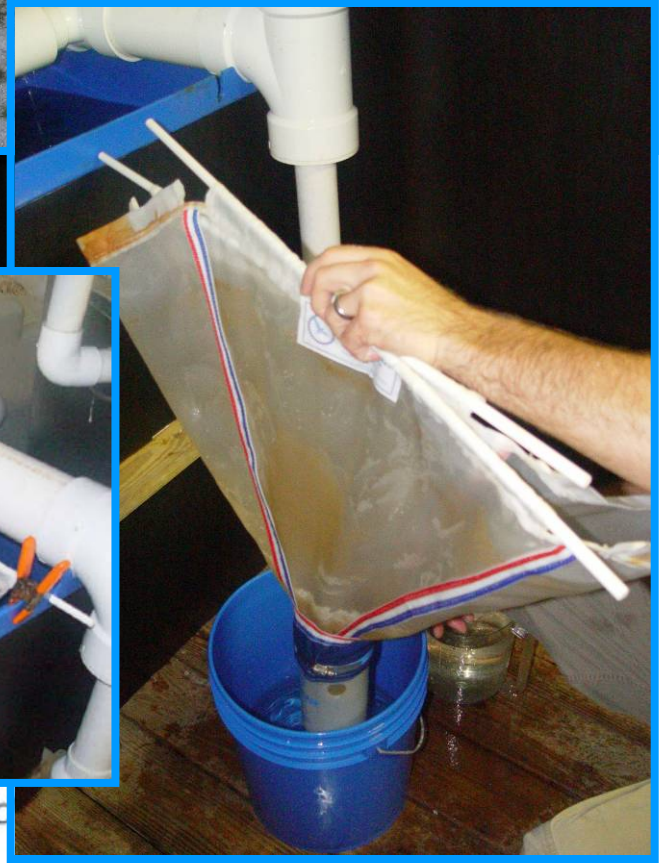
| Parameter | Target Level |
|---|---|
| Temperature | 16 – 30 C |
| pH | 7.6 – 8.2 |
| Dissolved oxygen | ≥ 5 mg/L |
| Alkalinity | ≥ 200 mg/L |
| Ammonia | ≤ 1 mg/L |
| Nitrite | ≤ 2 mg/L |
| Total dissolved solids | ≤ 5 mg/L |

# Broodstock Conditioning System











Ocean Science for a Better World

# Larviculture System

# Nursery System

# Limitations of RAS Technology

- Waste products from the fish must be treated before discharge
  - This is much easier than in other aquaculture systems such as open ocean net-pens
- No one has ever achieved 100% recirculation due to water needed for removing waste products and lost to evaporation

WASTES !!!!!

# WASTES!!! WHAT?! WASTE !!!!!

- What are they?
  - Uneaten feed and other Solids
  - Liquid Excretions
- One Characteristic of these “Wastes” is that they contain quite a bit of nutrient
  - (esp., Nitrogen, Phosphorus)
- So, why not USE nutrients instead of discharging them?

# The Answer: Integrated Multi-Trophic Aquaculture (IMTA)

## Turn Wastes into Resources

The Next Generation in Recirculating System Design

IMTA = Integrated Multi-trophic Aquaculture Systems

HARBOR BRANCH
FLORIDA ATLANTIC UNIVERSITY

# Prototype Land Based HBOI-IMTA Funded Through Aquaculture SLP