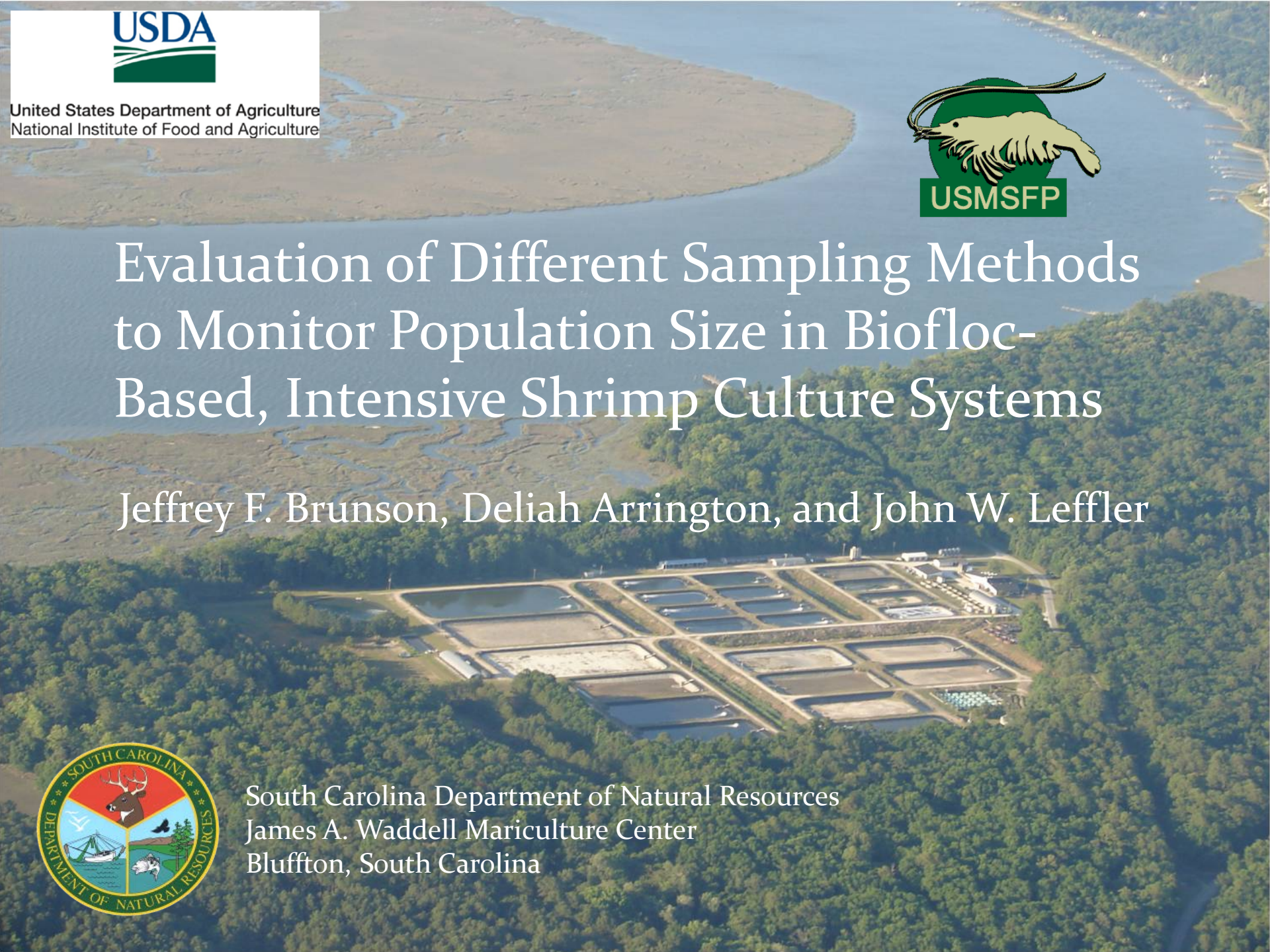
United States Department of Agriculture
National Institute of Food and Agriculture

USMSFP

Evaluation of Different Sampling Methods to Monitor Population Size in Biofloc-Based, Intensive Shrimp Culture Systems

Jeffrey F. Brunson, Deliah Arrington, and John W. Leffler



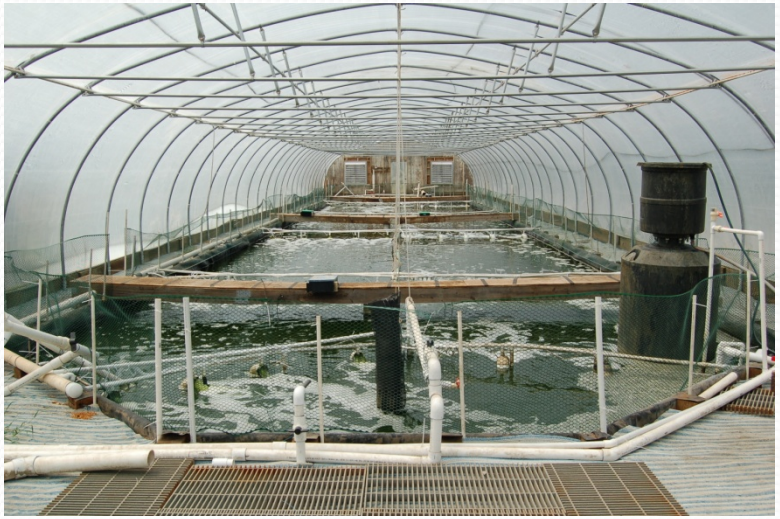
South Carolina Department of Natural Resources
James A. Waddell Mariculture Center
Bluffton, South Carolina

Population Assessment

- Efficient feeding strategy
  - Reduce feed costs
  - Improve water quality
  - Reduce solid waste disposal or treatment
- Better predict crop size
  - Marketing
  - Satisfied customers
- Increased profitability $$$
- **How many shrimp do I need to feed?**

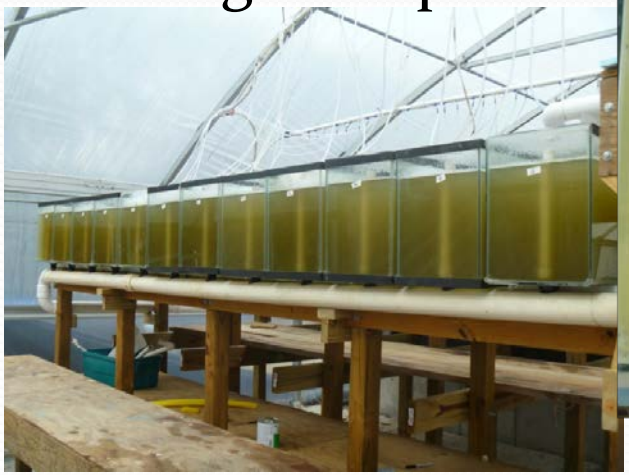
Population Estimation

- In-situ
  - Cast nets
  - Feeding trays
  - Standard mortality curve
  - Side-scan sonar
- Raceway advantages and limitations
  - Shrimp are more confined
  - Space constraints



Sampling Methods

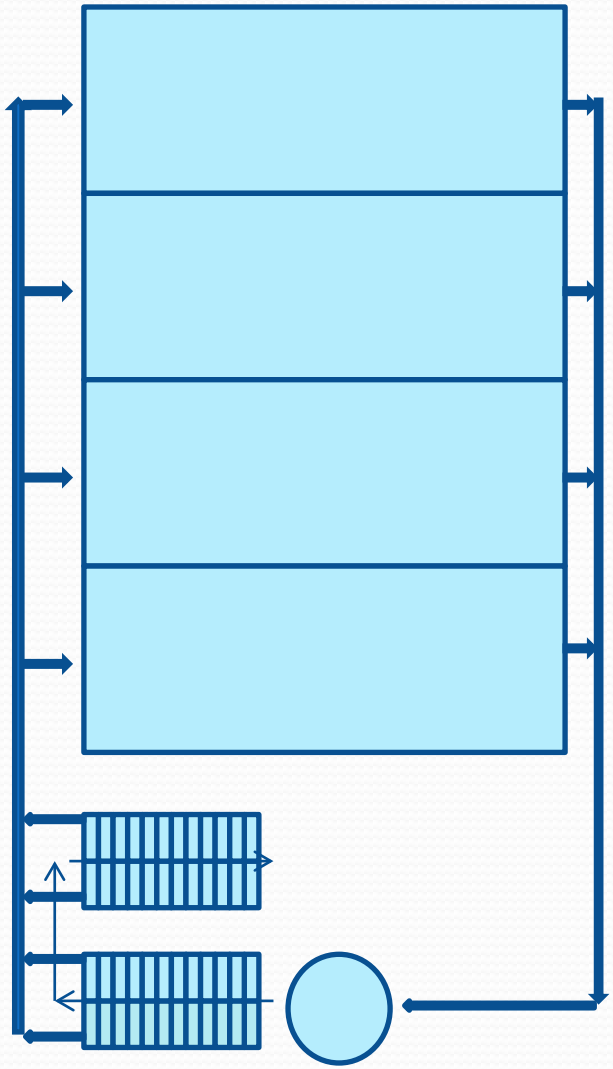
60 L glass aquaria



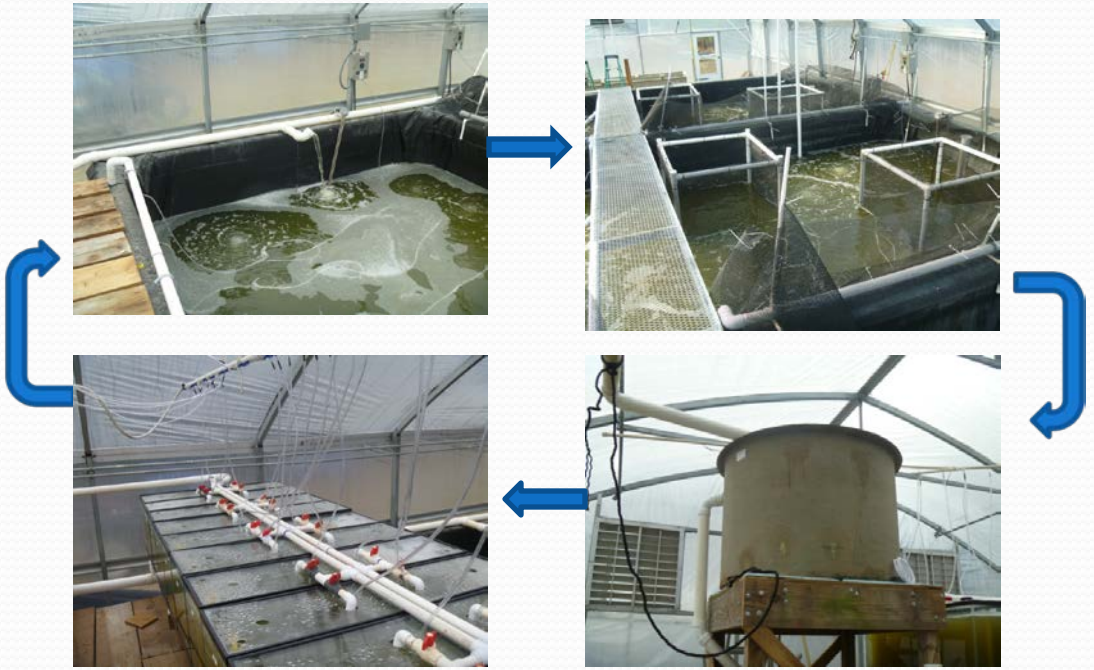
0.8 m², 1/8" sq mesh (3 mm) lift nets

1 m³, ¼" (6 mm) plastic mesh cages

Design



- 30.5 m^2 raceways (66 cm mean depth => 20 m^3 volume), linked.
- 122 cm mixing tank
- 48- 60L aquaria
- Common return line to raceways



Stocking

- Raceways- 150 shrimp/m^2
  - (250/m^3), by weight
- Cages 150/m^2, by weight
- 20 shrimp per aquarium, 333/m^3 (112/m^2), counted
- Size at stocking 2.31 ± 0.85 g

Management

- Shrimp fed Zeigler HyperIntensive 35, three times per day at the same rate
- Temperature, DO, pH and salinity checked twice daily
  - Each raceway, 6 aquaria (randomly selected daily)
- NH_3-N, NO_2-N, alkalinity, pH, turbidity, TSS, VSS, PO_4, total chlorophyll and chlorophyll a checked weekly.

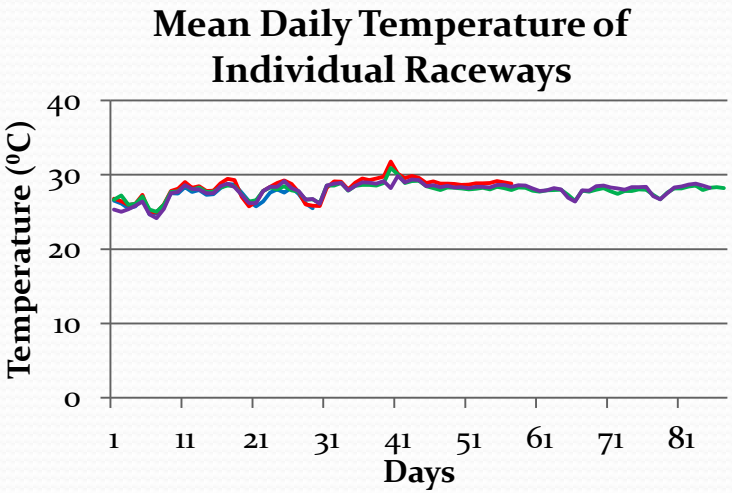
Harvest and Sampling

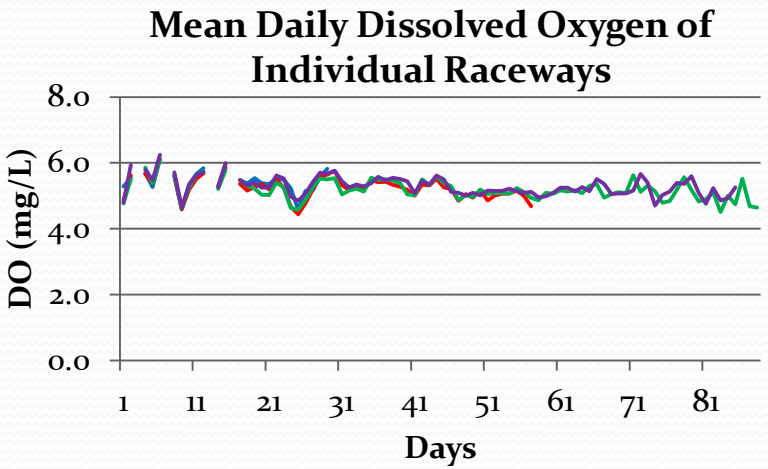
- One raceway harvested every 4 weeks.
- Cages harvested one day prior to raceway harvest.
- 4 lift nets deployed, shrimp acclimated, feed broadcast with seed spreader; after 10 minutes, raised nets, and shrimp counted and returned. Repeated twice for a total of 12 samples.

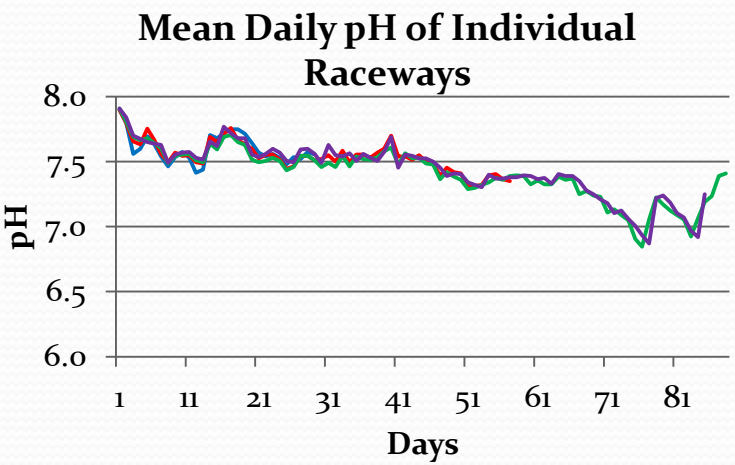
- On day of raceway harvest, 12 aquaria (randomly selected at beginning) also harvested.
- Survival and mean weight determined for raceways, cages and aquaria.

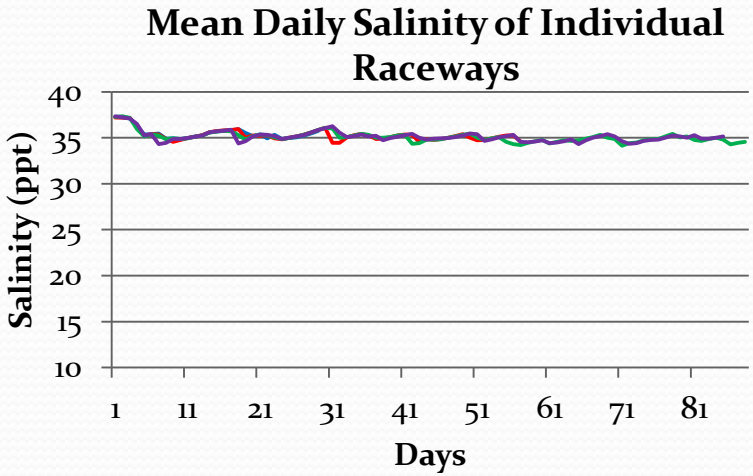
Daily Water Quality of Raceways

RRW2 RRW3 RRW4 RRW5

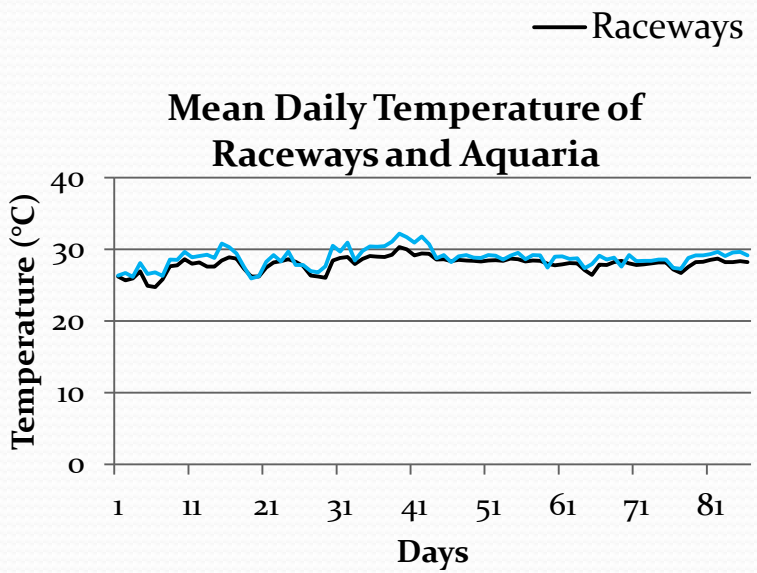


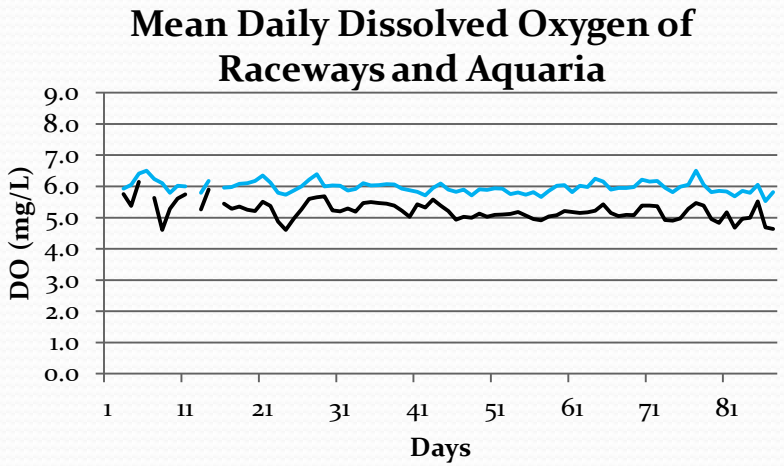


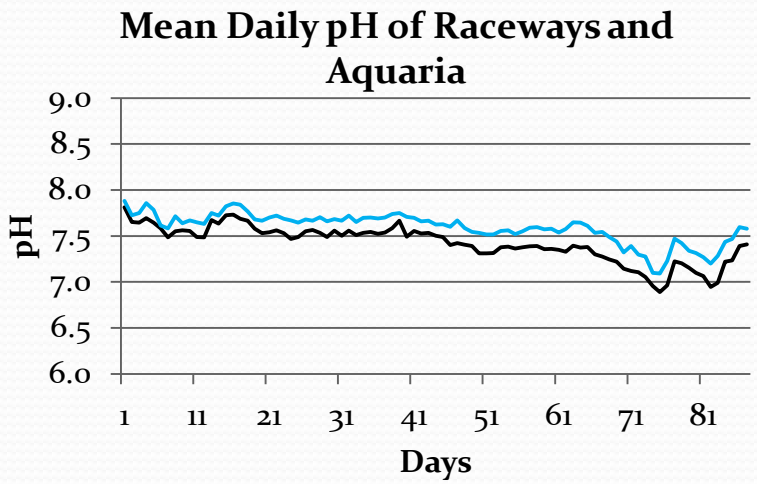


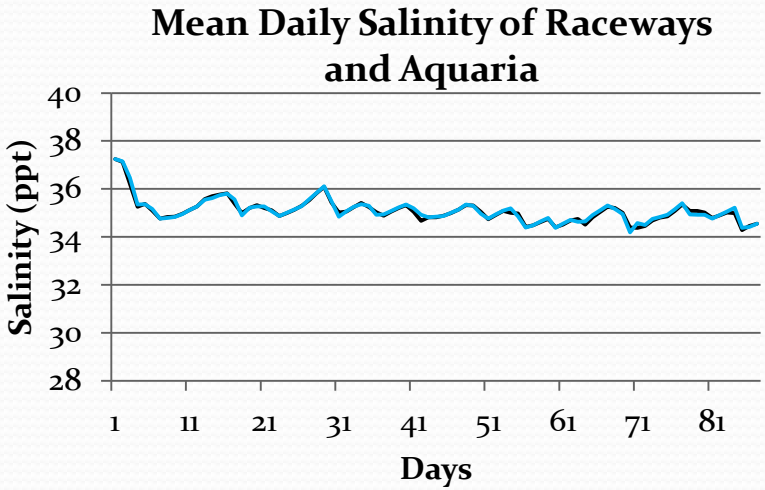


Daily Water Quality of Raceways and Aquaria

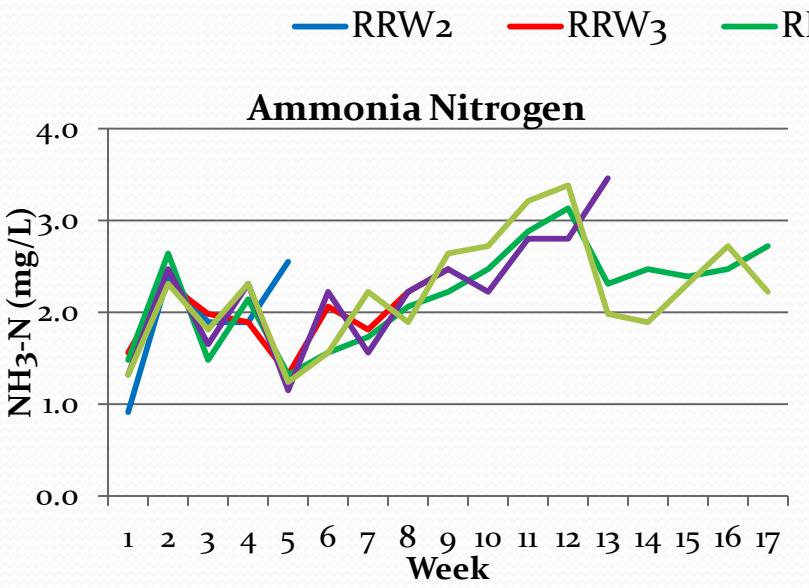


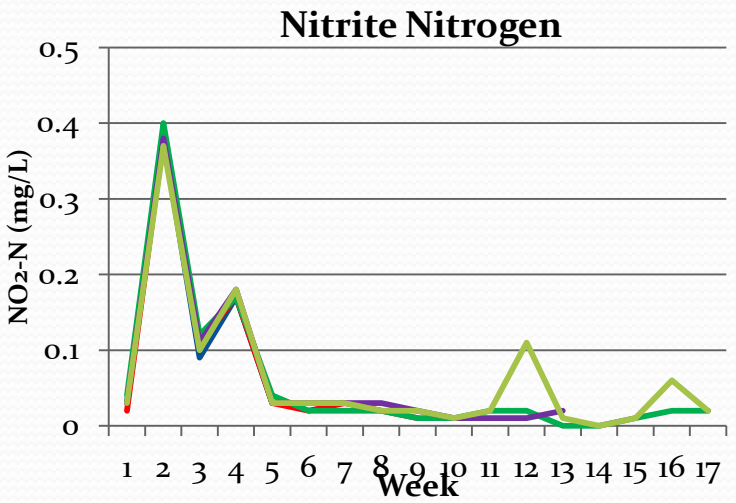


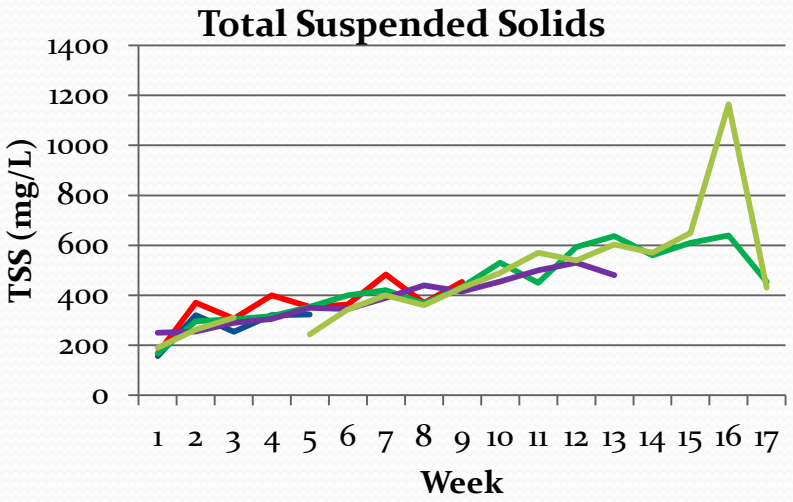


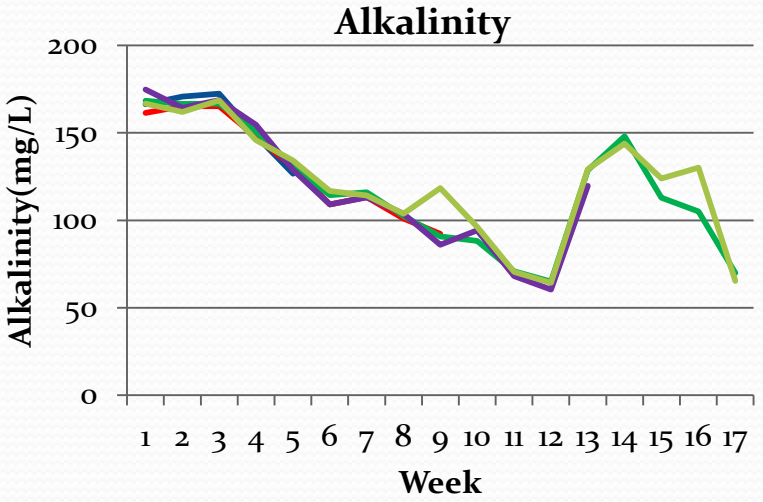


Weekly Water Quality









Shrimp Survival by Sampling Method 0-28 days

Days	Raceways	Cages (mean ± sd)	Aquaria (mean ± sd)	Lift Nets (mean ± sd)
28	97.2	93.0 ±1.4 n=2	88.3 ± 7.5* n=12, P=0.002**	55.4 ± 13.5* n= 11, P<0.001

* Denotes a statistically significant difference from raceway survival using one-sample t-test (α=0.05).

**Failed Shapiro-Wilk Normality Test

Aquaria underestimate population by 9.2%

Lift nets underestimate population by 43%

Cages underestimate population by 4.3%

Shrimp Survival by Sampling Method 0-56 days

Days	Raceways	Cages (mean ± sd)	Aquaria (mean ± sd)	Lift Nets (mean ± sd)
29	97.2	93.0 ±1.4 n=2	88.3 ± 7.5* n=12	55.4 ± 13.5* n= 11
56	**97.3**	**94.4 ± 2.2** **n=3**	**74.2 ± 13.6*** **n=12, P<0.001**	**53.1 ± 4.4*** **n=10, P<0.001**

* Denotes a statistically significant difference from raceway survival using one-sample t-test (α=0.05).

Aquaria underestimate population by 23.7%
Lift nets underestimate population by 45.4%
Cages underestimate population by 3.0%.

Shrimp Survival by Sampling Method 0-83 days

Days	Raceways	Cages (mean ± sd)	Aquaria (mean ± sd)	Lift Nets (mean ± sd)
28	97.2	93.0 ±1.4 n=2	88.3 ± 7.5* n=12	55.4 ± 13.5* n= 11
56	97.3	94.4 ± 2.2 n=3	74.2 ± 13.6* n=12	53.1 ± 4.4* n=10
83	**91.5**	**92.7 ± 6.1 n=2**	**61.2 ± 11.5* n=12, P<0.001**	**57.8 ± 3.9* n=12, P<0.001**

* Denotes a statistically significant difference from raceway survival using one-sample t-test (α=0.05).

Aquaria underestimate population by 33.1%
Lift nets underestimate population by 36.8%
Cages **overestimate** population by 1.3%.

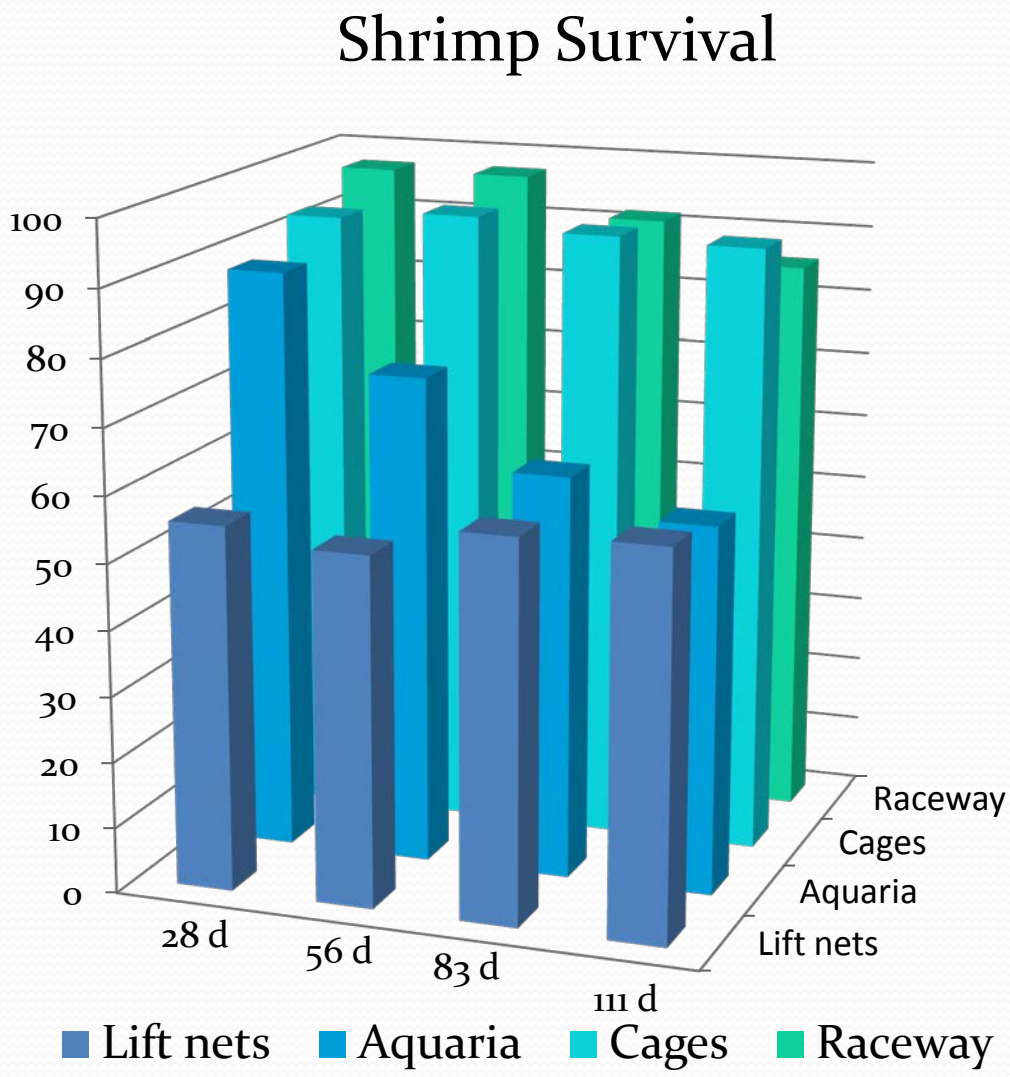
Shrimp Survival by Sampling Method 0-111

Days	Raceway	Cages (mean ± sd)	Aquaria (mean ± sd)	Lift Nets (mean ± sd)
28	97.2	93.0 ±1.4 n=2	88.3 ± 7.5* n=12	55.4 ± 13.5* n= 11
56	97.3	94.4 ± 2.2 n=3	74.2 ± 13.6* n=12	53.1 ± 4.4* n=10
83	91.5	92.7 ± 6.1 n=2	61.2 ± 11.5* n=12	57.8 ± 3.9* n=12
111	**85.6**	**92.2 ± 5.4 n=3**	**55.8 ± 13.3* n=12,P<0.001**	**58.4 ± 3.3* n=12,P<0.001**

* Denotes a statistically significant difference from raceway survival using one-sample t-test (α=0.05).

Aquaria underestimate population by 34.8%
Lift nets underestimate population by 31.8%
Cages **overestimate** population by 7.7%.

Summary



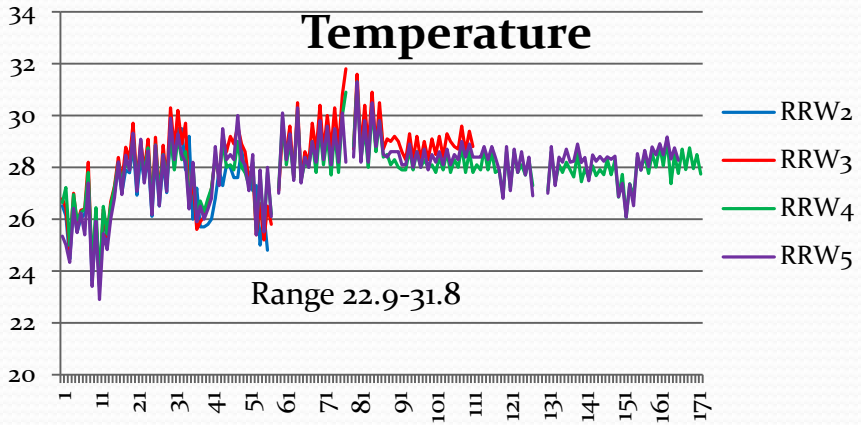
- Cages are most reliable method.
- Survival in cages remains high and stable.
- Survival in aquaria decreases over time and is highly variable.
- 60 L aquaria cannot support 20 shrimp; 10 may be better.
- Lift nets consistently estimate survival at 53-58% throughout the growout cycle.

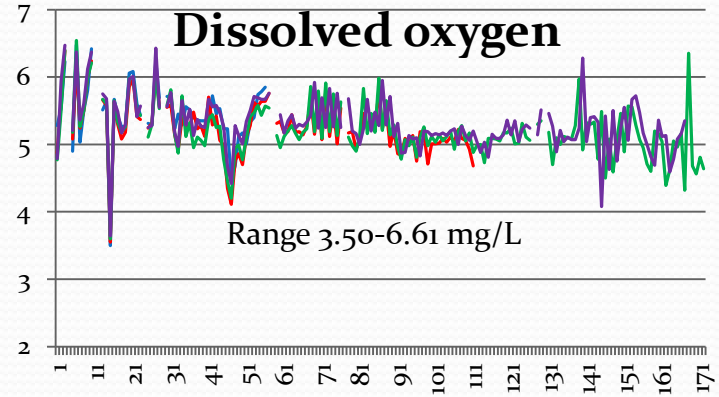
Improving Cage Sampling Methods

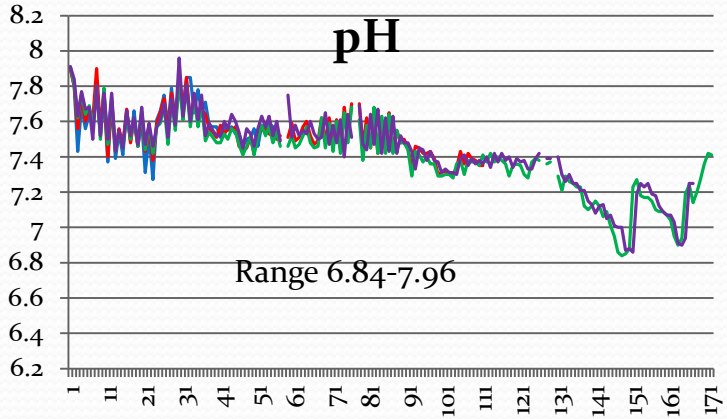
- Further investigate cage size
  - Minimize obstructions to water flow
- Increase number of cages to improve power
- Refine sampling protocol

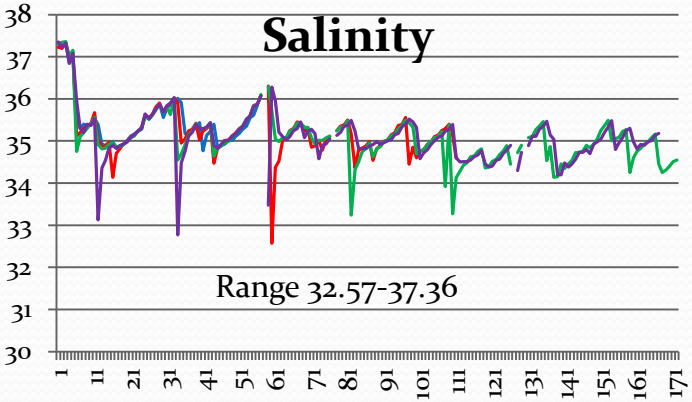
Thank you

Daily Water Quality

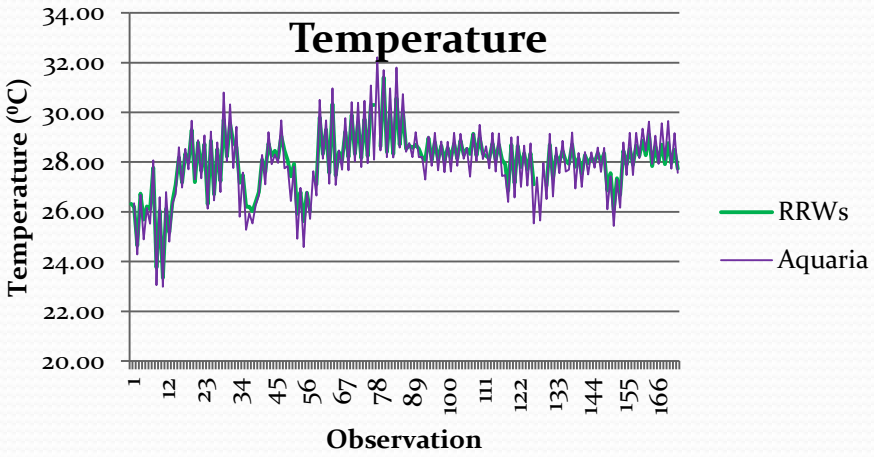


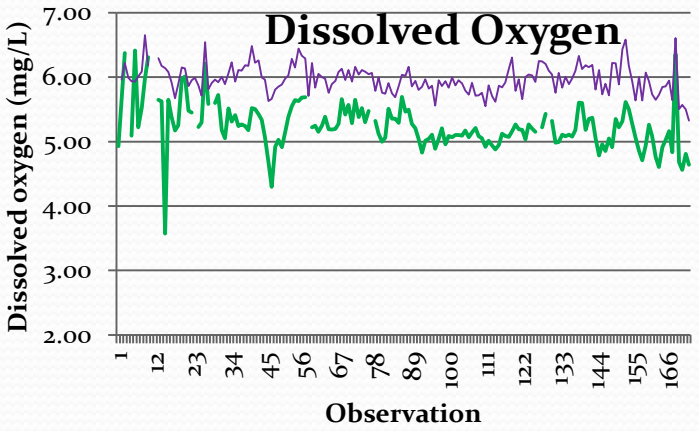


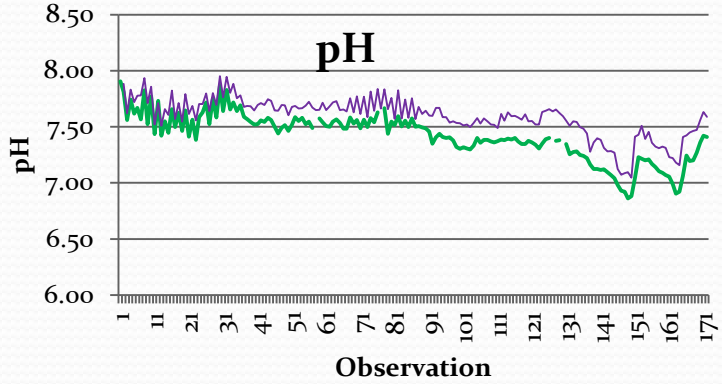


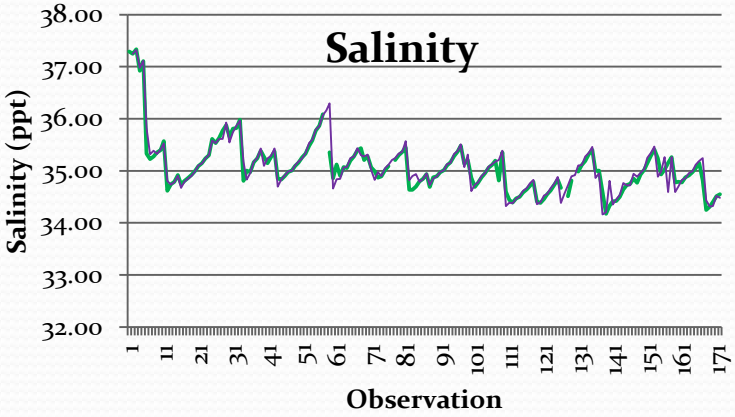


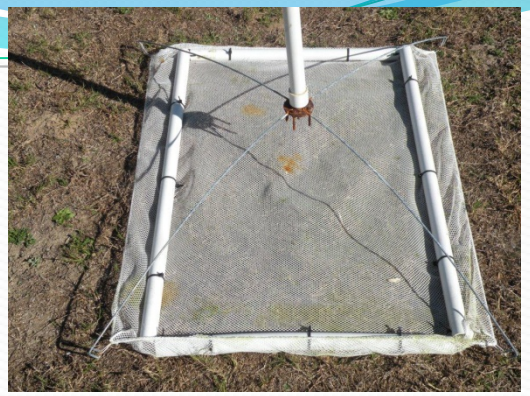
Daily Water Quality



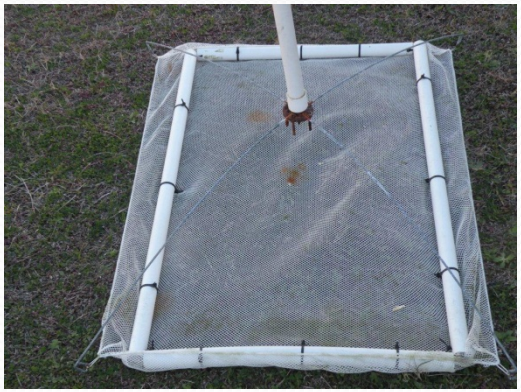


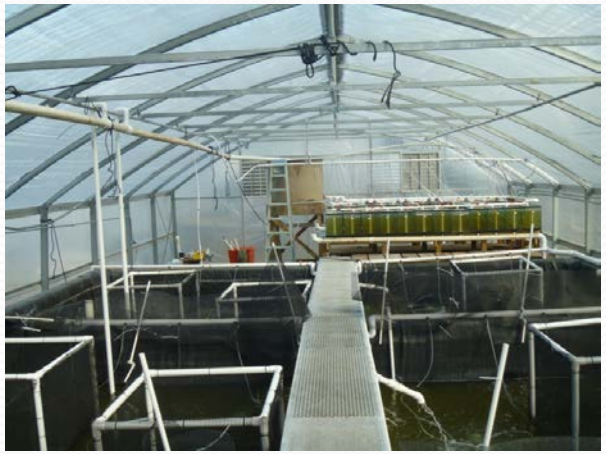







Turf Builder






Turf Builder
Scotts
Handy Green II