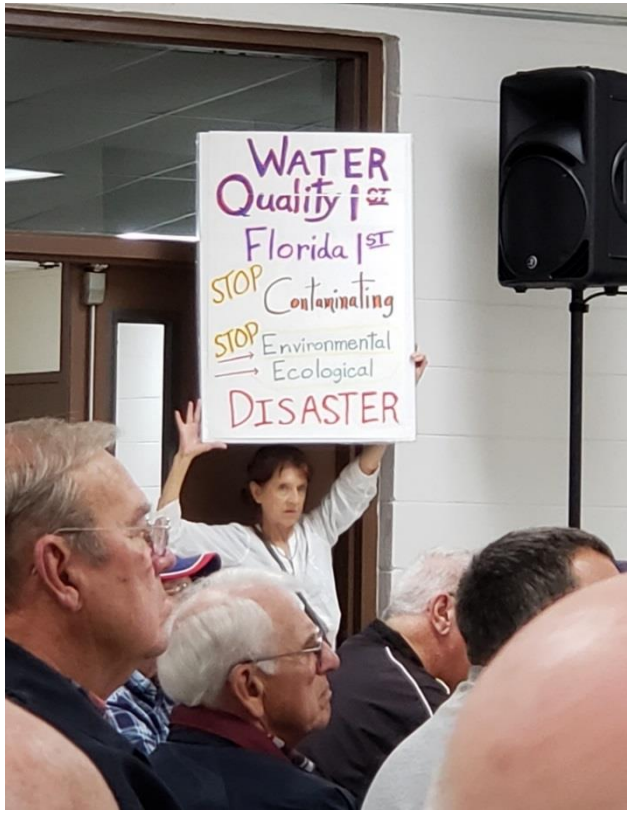
Utilizing Bacteria Augmentation to Reduce Organic Bottom Sediment and Nutrients.

Elroy Timmer: Principle Researcher
Trace Wolfe & Linda Defee: Associate Researchers

Purpose

- Provide Background information on Bacterial Augmentation
- Present Observations and Data from: Operational Analyses and Field Trials
- Spark Interest in Bacterial Augmentation as an Integrated Management Component



Bacteria

Bad Actors

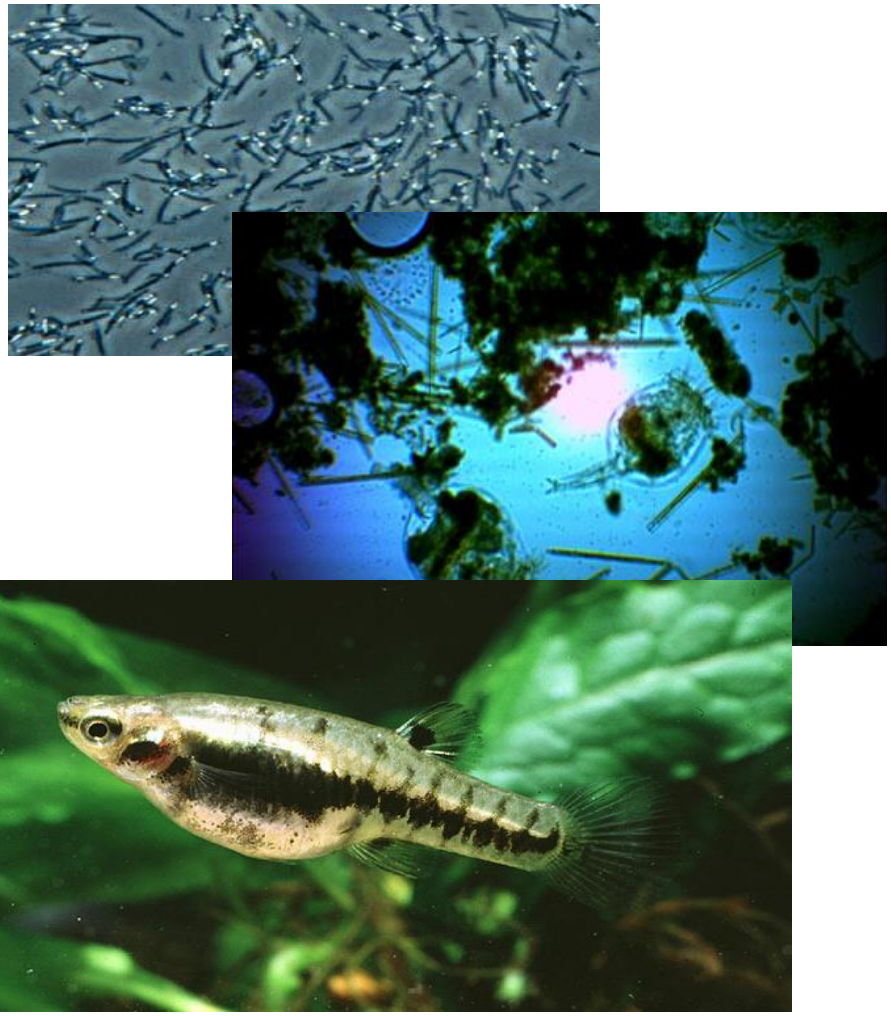
- Food Poisoning
- Infectious Diseases
- Forest/Ag Diseases

Beneficial Bacteria

- Health Benefits
- Food Production
- Oil Spill Cleanup
- Wastewater Treatment
- Nutrient Cycling
- Decomposition

Bacteria in the Aquatic Environment

- Bacteria is the major “base” of the food chain, from bacteria to protozoa to fish, etc.
- Bacteria conduct critical roles in nutrient utilization of nitrogen (N) and phosphorous (P).
- Bacteria reduce organic matter (sludge) by utilizing carbon compounds.
- Bacteria compete for nutrients.

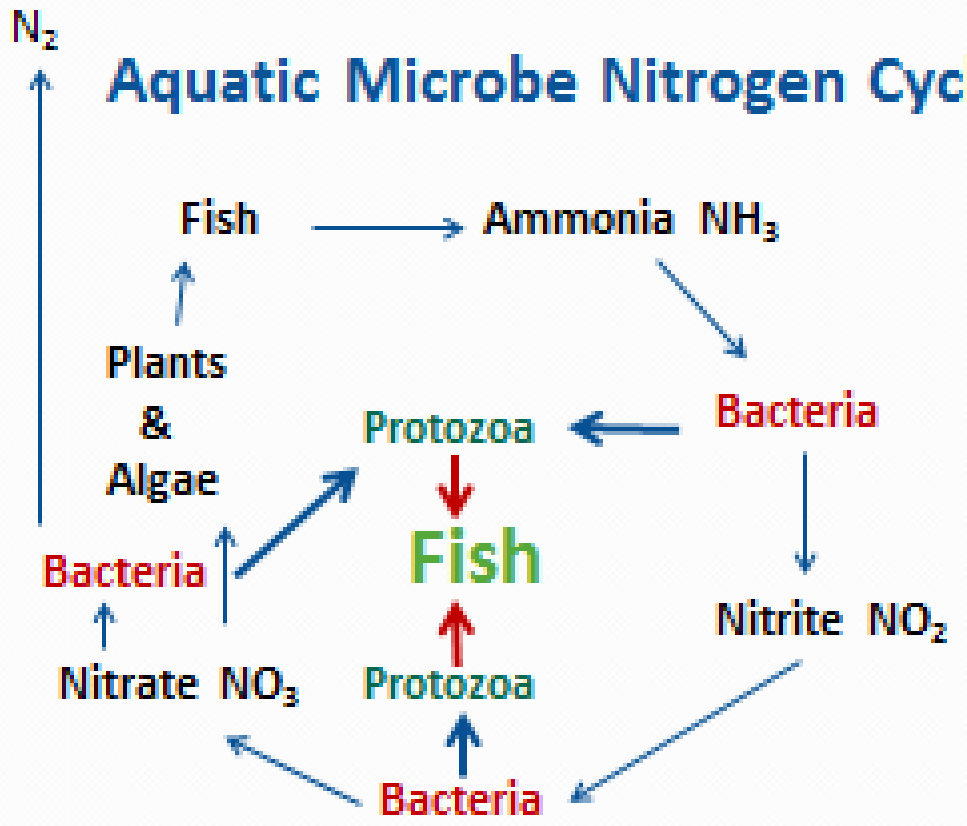


Product Background: Microbes and a Partial List of Roles.

- ***Nitrosomonas***
  - reduces NH_3 to NO_2
- ***Nitrobacter***
  - NO_2 to NO_3
  - both are soil bacteria; both are required for nitrification and both need aerobic conditions
- ***Aerobacter aerogenes***
  - aerobic
  - oxidizes carbohydrates C+(H_2O) (sugars, starches and cellulose) and short organic acid chains to CO_2 and H_2O
  - when O_2 is limited it ferments carbohydrates which become food for *Pseudomonas* sp.
- ***Bacillus subtilis***
  - degrade polymers such as protein, starch, and pectin, therefore, they are thought to be an important contributor to the carbon and nitroge cycles. Important in digestion in the gut of animals
- ***B. licheniformis***
  - produces a variety of extracellular enzymes that are associated with the cycling of nutrients in nature.
- ***B. amyloliquefaciens***.
  - oxidizes carbohydrates, organic acids, fats, oils, proteins and starches
  - active in the soil, its enzymes degrade organic material
  - denitrifying bacteria (NO_3 to NO_2 to N_2)
- ***Cellulomonas biazotea***
  - converts cellulose to soluble carbohydrates which serve for growth of *C. biazotea* and other bacteria
- ***Pseudomonas denitificans*** and ***P. stutzsri***
  - reduces level of nitrate nitrogen under anaerobic conditions
  - oxidizes and degrades organic compounds

Nitrogen Assimilation With Bio-Zyme Bacteria

- *Nitrosomonas* spp.
  - Ammonia (NH_3) to Nitrite (NO_2)
- *Nitrobacter* spp.
  - Nitrite (NO_2) to Nitrate (NO_3)
- *Pseudomonas* spp.
  - Nitrate (NO_3) to Nitrogen Gas (N_2)

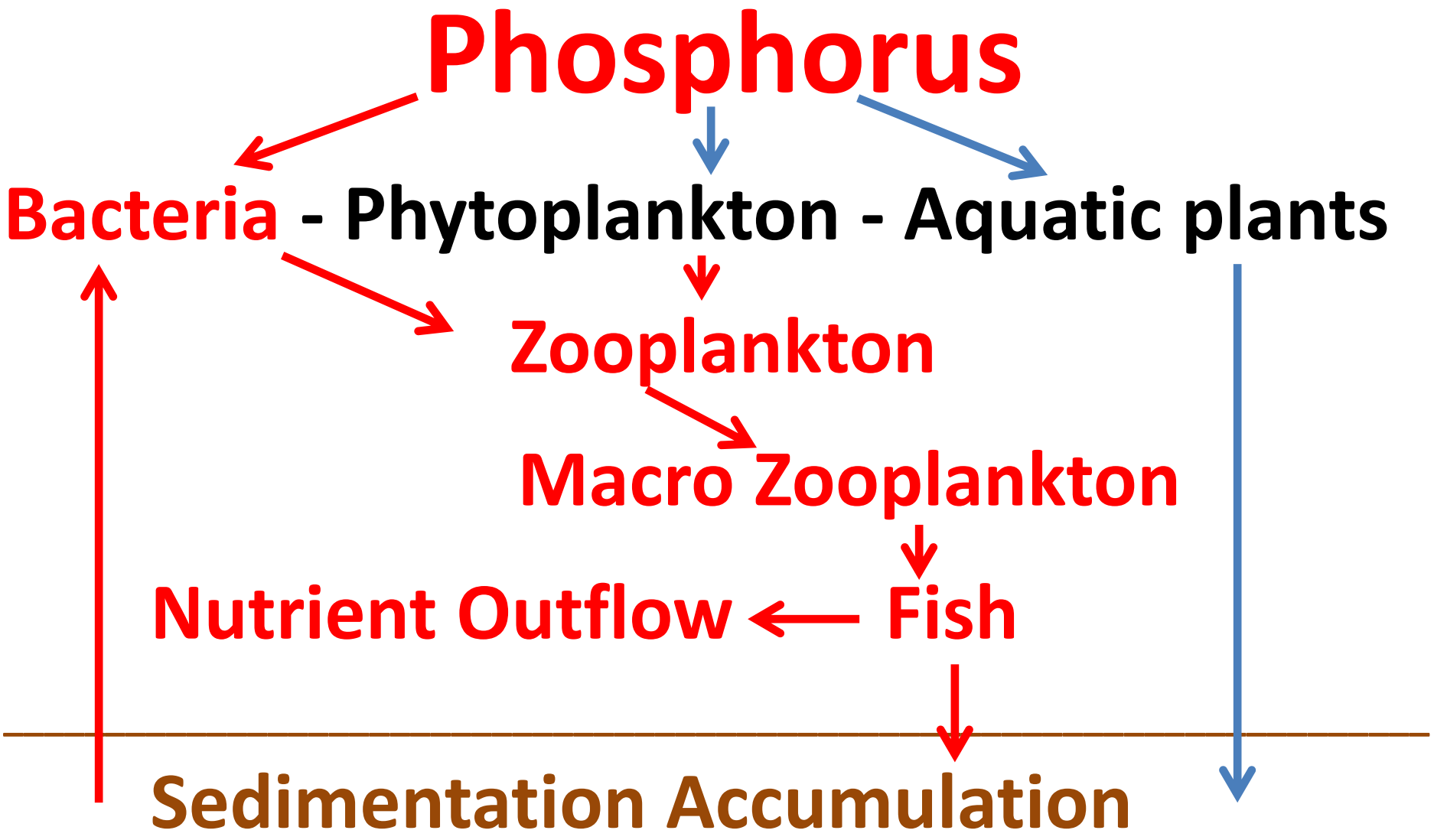


Bacteria assimilates N in its various forms converting it to fish through protozoa

Carbon utilization - Known Players

- ***Aerobacter aerogens - B. amyloliquefaciens***
  - **oxidizes carbohydrates**
- ***Bacillus subtilis***
  - **degrades polymers such as protein, pectin and starch. It is also a contributor to the carbon and nitrogen cycles.**
- ***Cellulomonas biazotea***
  - **converts cellulose to soluble carbohydrates**
- ***Pseudomonas denitificans* and *P. stutzsri***
  - **oxidizes and degrades organic compounds**

All bacteria use P in cell development and DNA



Nitrogen, Phosphorous and Carbon Utilization

- **Bio-Zyme primarily reduces sediment (organic matter) (C) and utilizes C in its metabolism and cell structure.**
- **This is critical because as Bio-Zyme uses C it must also use N and P. Most living creatures are comprised of approximately 50% C, 14% N and 3% P. These elements are used in cell walls, amino acids, enzymes, energy and essential body components.**
- **Bio-Zyme carbon utilization therefore provides the "base" of the food chain.**
- **These bacteria multiply using N, P and C which are transferred from bacteria to protozoa to fish, etc.**
- **Bio-Zyme only needs to remove about 2 oz. of P from water (0.05 mg/l to 0.005 mg/l per acre foot) for the trophic state index (TSI) of water to be changed from eutrophic to oligotrophic.**

Naturally Occurring Bacteria

- Beneficial bacteria populations have naturally maintained aquatic balances, but now are overwhelmed given:
  - exponential nutrient inputs,
  - habitat disruption,
  - oxygen depletion.
- Muck contains phosphorus, nitrogen, carbon and other components
- Bacteria naturally can utilize muck as it occurs in many lakes without excessive nutrients.

Bacteria Aquatic Management Systems

- Science has Identified key microorganisms.
- R&D has resulted in bacteria production methods and delivery systems.
- These are needed due to increased pressures on waterbodies.

- **Benefits:**
  - Increased clarity
  - Reduced odor
  - P and N reduction
  - Potential herbicide reduction because of lower P and N
  - Sediment reduction
  - Increased O_2 from decrease in organic material in water

Bacteria Product Use

- Currently operational for 15 aquatic management companies in FL and the US. This represents 20,000 managed waterbodies totaling in excess of 60,000 surface acres.
- Primary use has been golf course waterways, private lakes and municipal drainage networks in Florida.
- Results are reduced nutrients, shifts in sediments from muck to sand, decreased sprinkler clogging, and aesthetic benefits. All have been observed and documented.

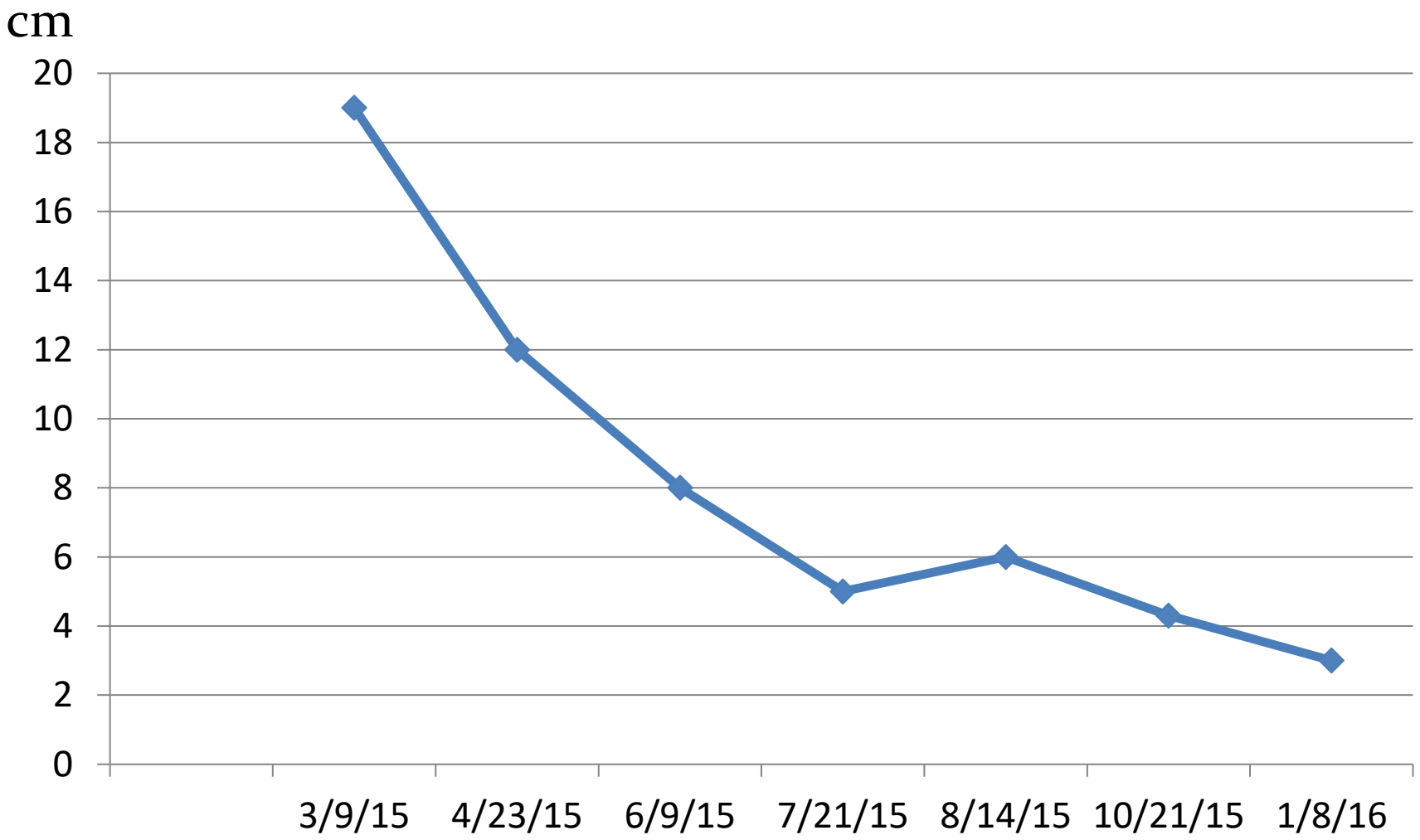
Bio-Incubator - Field Evaluation Methods

- **Inoculation Methods**
- **Bacteria can be incubated in a bio-incubator and distributed directly as living organisms with active enzymes.**
  - Temperature can be controlled.
  - Product can be bacteria, food, spores in socks.
  - 4.5 lb. socks are exchanged monthly.

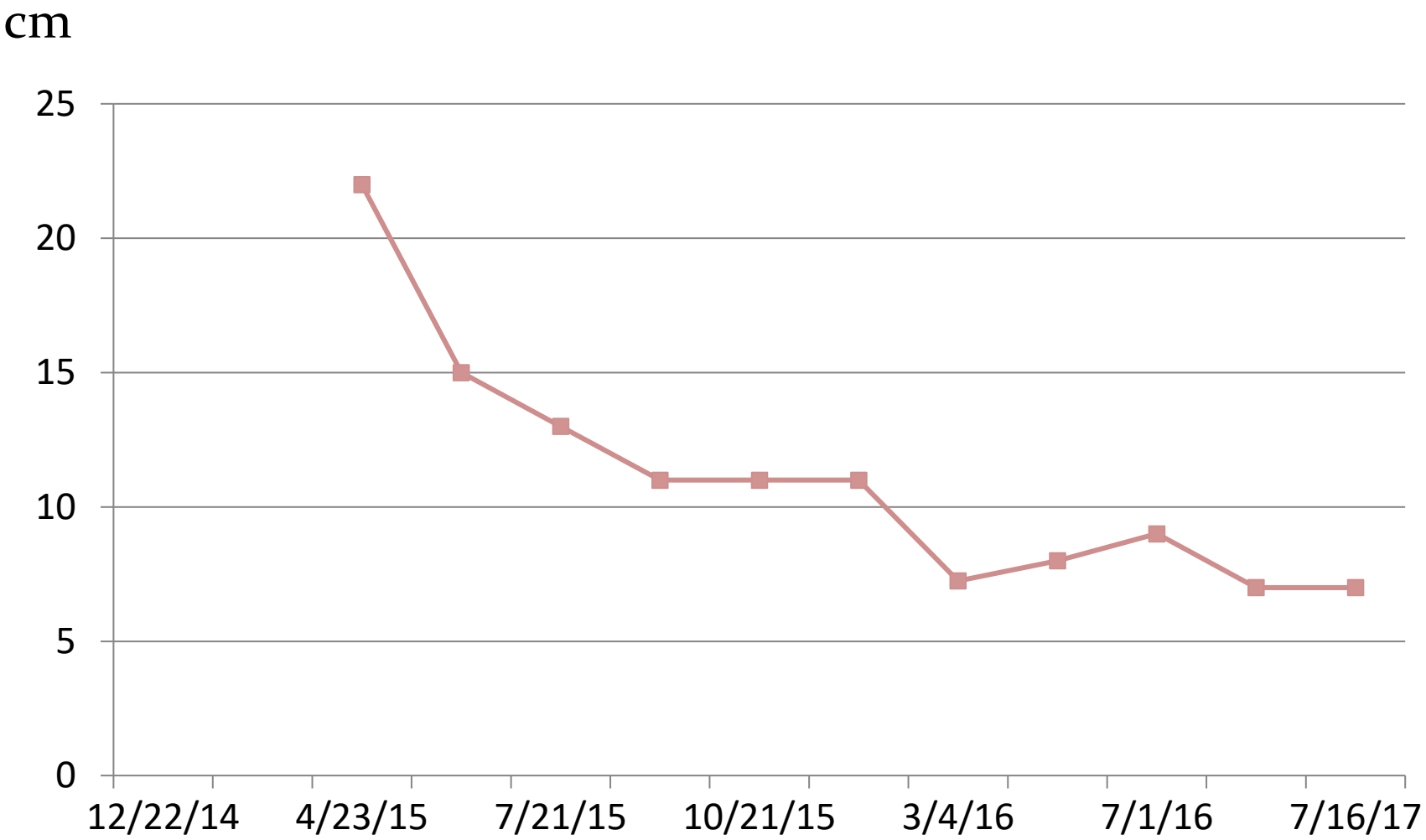
- **Monitoring Methods**
  - Permanent stations designated.
  - Quarterly sediment depth measurement taken with meter stick/Tube.
  - Depth measured to nearest cm.
  - Muck and Water Sample Analyses.

Port Saint Lucie E8 Basin
Organic Sediment Removal

(Each point is an average of 3 plots with 4 measurements per plot)



Evaluation-PGA Pond
Organic Sediment Removal
(Each point is an average of 3 plots with 4 measurements per plot)



Institute of Food and Agricultural Sciences
Analytical Services Laborat
UNIVERSITY OF FLORIDA
ories
Livestock Waste Testing Laboratory, Gainesville, FL

Livestock Waste Testing Lab
631 Wallace Building
Gainesville, FL 32622
(352) 392-1950
FAX (352) 392-1960

Typical Muck Analysis

Livestock Waste Analysis Grower Report

Clarence Elroy Timmer
482 SW Deer Run
Port St Lucie, FL 34953

PHONE: 561-249-4628

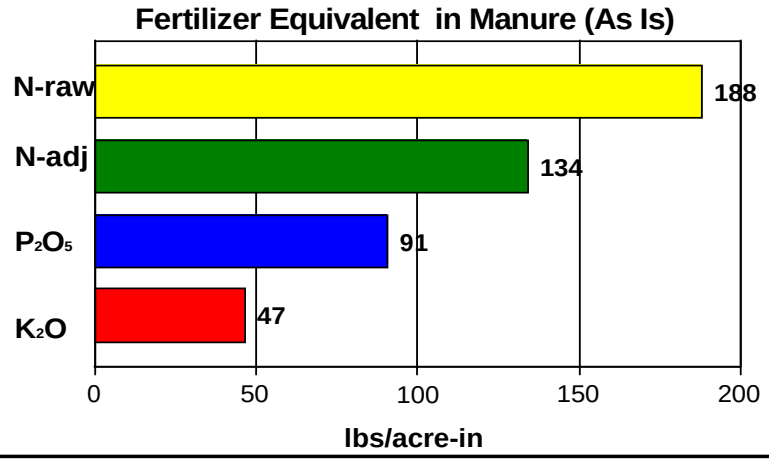
Lab #	**9007**
Sample Label	**IS #1**
Date Collected	**April 29, 2016**
Date Delivered	**May 4, 2016**
Date of Report	**May 16, 2016**
County of Sampl	**Palm Beach**
Collected By	**0**

Sample Type: Dairy waste collected from lagoon.
Crop or Use: #N/A
Application Equipment:Applied through center pivot
Incorporation #N/A
Previous Applications #N/A

*****Nutrient Content in Manure as Delivered to Laboratory**

Nutrient Constituent	Raw Sample	Adjusted For Application Losses of N	Units
Nitrogen (N):	188	134	lbs/acre-in
Phosphorus (P2O5)	91	91	lbs/acre-in
Potassium (K2O):	47	47	lbs/acre-in

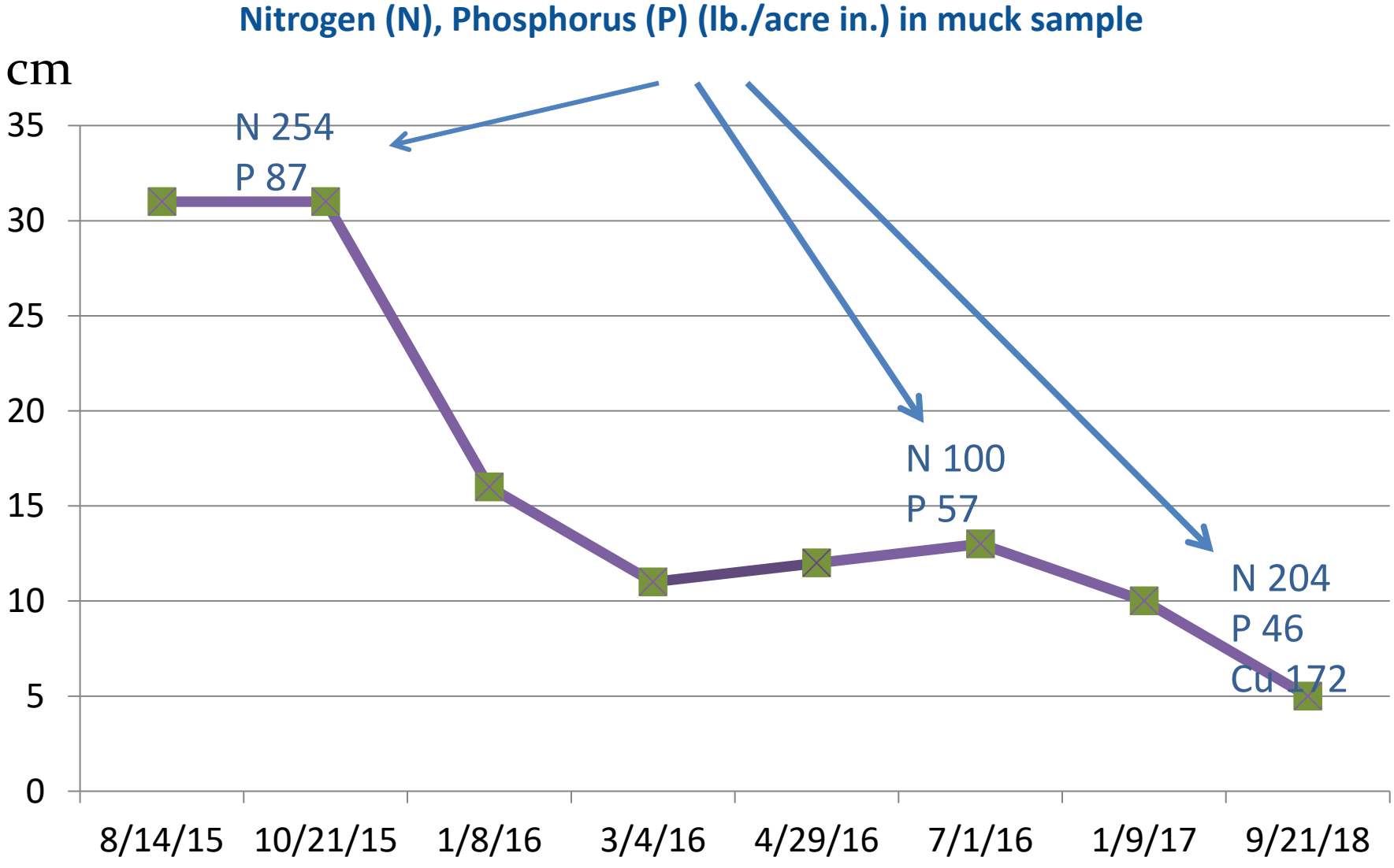
pH as Sampled	6.9
Moisture Content:	78.3%
Total Solids:	21.7%
Total Ash	18.8%



Lab Number	Sample Id	Cu mg/kg	Mn mg/kg	Zn mg/kg
L9813	I 5-1	40.20	10.23	9.5

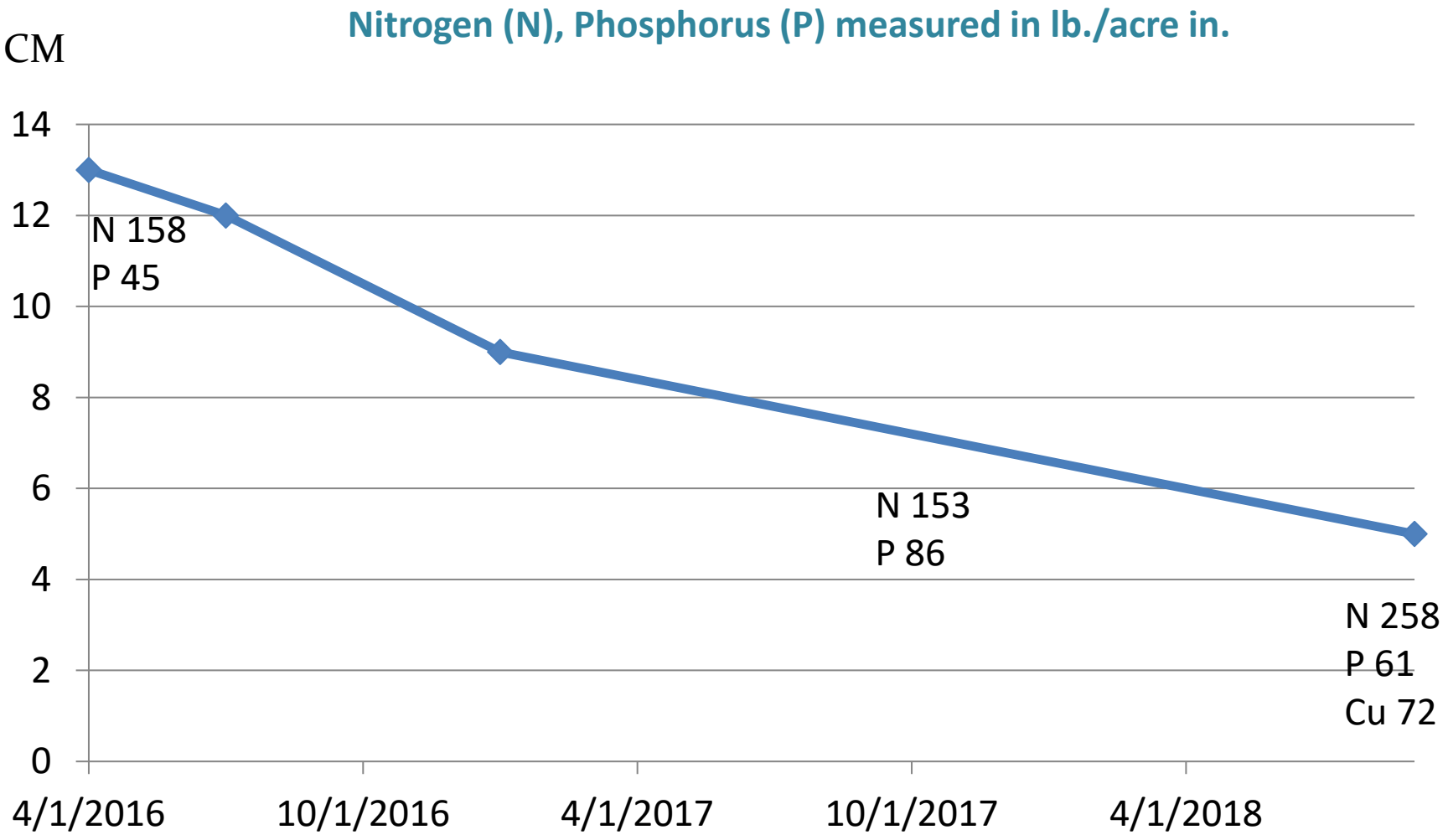
Ibis Country Club Lake 10 - Organic Sediment Removal

(Each point is an average of 3 plots, 4 measurements per plot)



Ibis Country Club Lake 5 – Organic Sediment Removal

(Each point is an average of 3 plots, 4 measurements per plot)



Bio-Incubator Installation at City of Port St. Lucie
Peacock Lake

PEACOCK LAKE

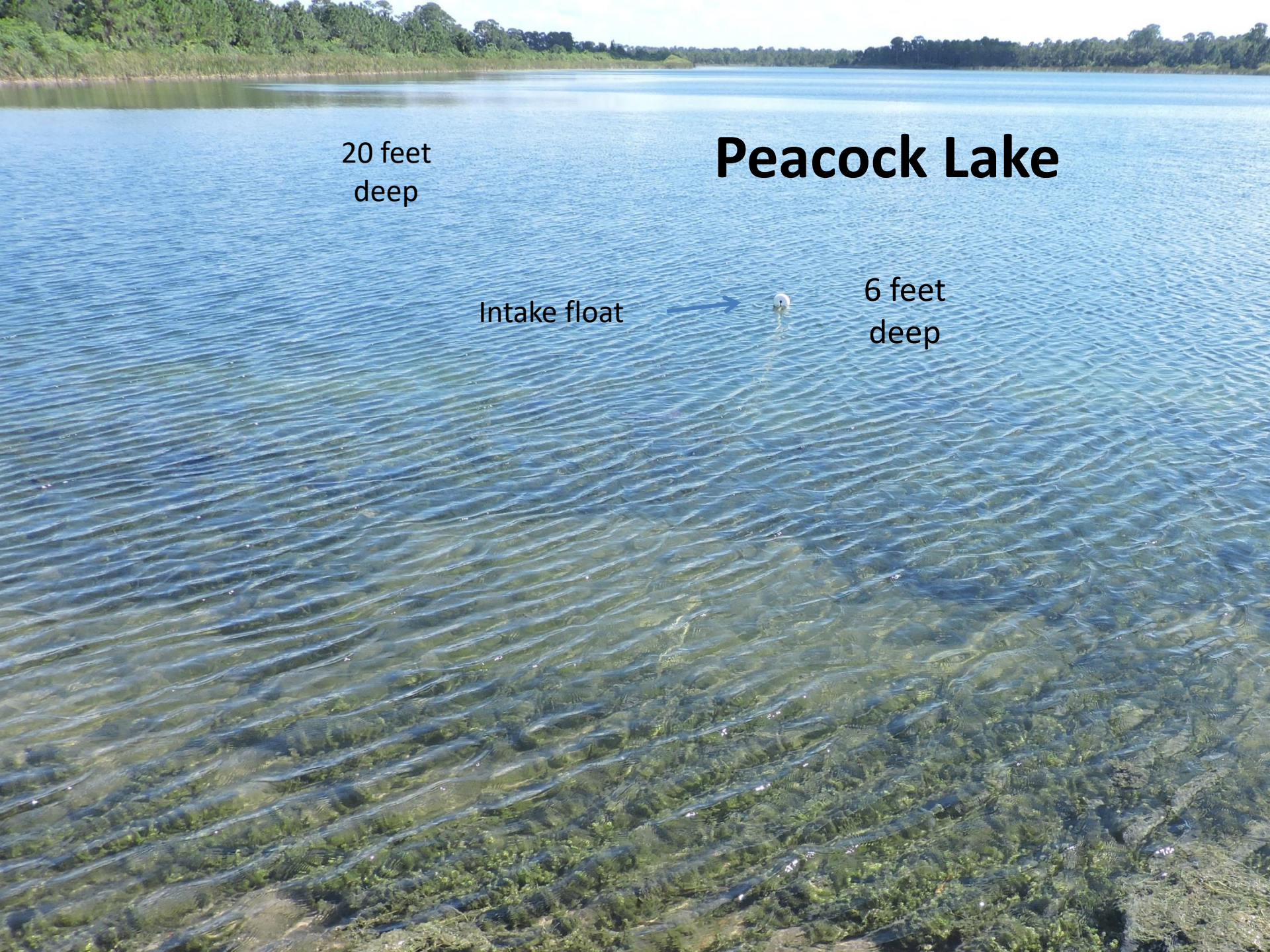
- Lake (100 acres) 18 foot depth.
- Lake is an enclosed system with no Stormwater Inputs.
- *Microcystis* bloom in December 2016.
- Objective: reduce total phosphorus.
- Weekly treatments of Bio-Zyme using bulk powder solids spread by airboat.
- Currently treated by a 200 gallon bio-incubator releasing every 72 hours as needed.

Peacock Lake 100 acres-

Total Phosphorus reduced from:

0.05 mg/l - 0 mat
0.015 mg/l - 6 mat
<0.005 mg/l - 18 mat

Date	Bio-Zyme Bulk	Laboratory	Total Phosphorous rate mg/l
1/9/17			
1/16/17	5 lbs.		
1/18/17		Pace	0.05
1/23/17	5 lbs.		
1/30/17	5 lbs.		
2/6/17	50 lbs.		
2/21/17		Flowers	0.04U
3/27/17	50 lbs.		
3/30/17		Jupiter Env.	0.024
4/9/17		Jupiter Env.	0.021
5/23/17	10 lbs.		
5/31/17	10 lbs.		
6/8/13	10 lbs.		
6/13/17	10 lbs.		
6/20/17	10 lbs.		
6/27/17	10 lbs.		
7/3/17	10 lbs.		
7/3/17		Jupiter Env.	0.015
7/11/18	300 lbs.	Jupiter Env.	<0.005


20 feet
deep
Peacock Lake
Intake float
6 feet
deep

Clear Waters, Inc.

Goal to Improve Water Quality and Reduce the Use of Copper

Clear Waters, Inc.

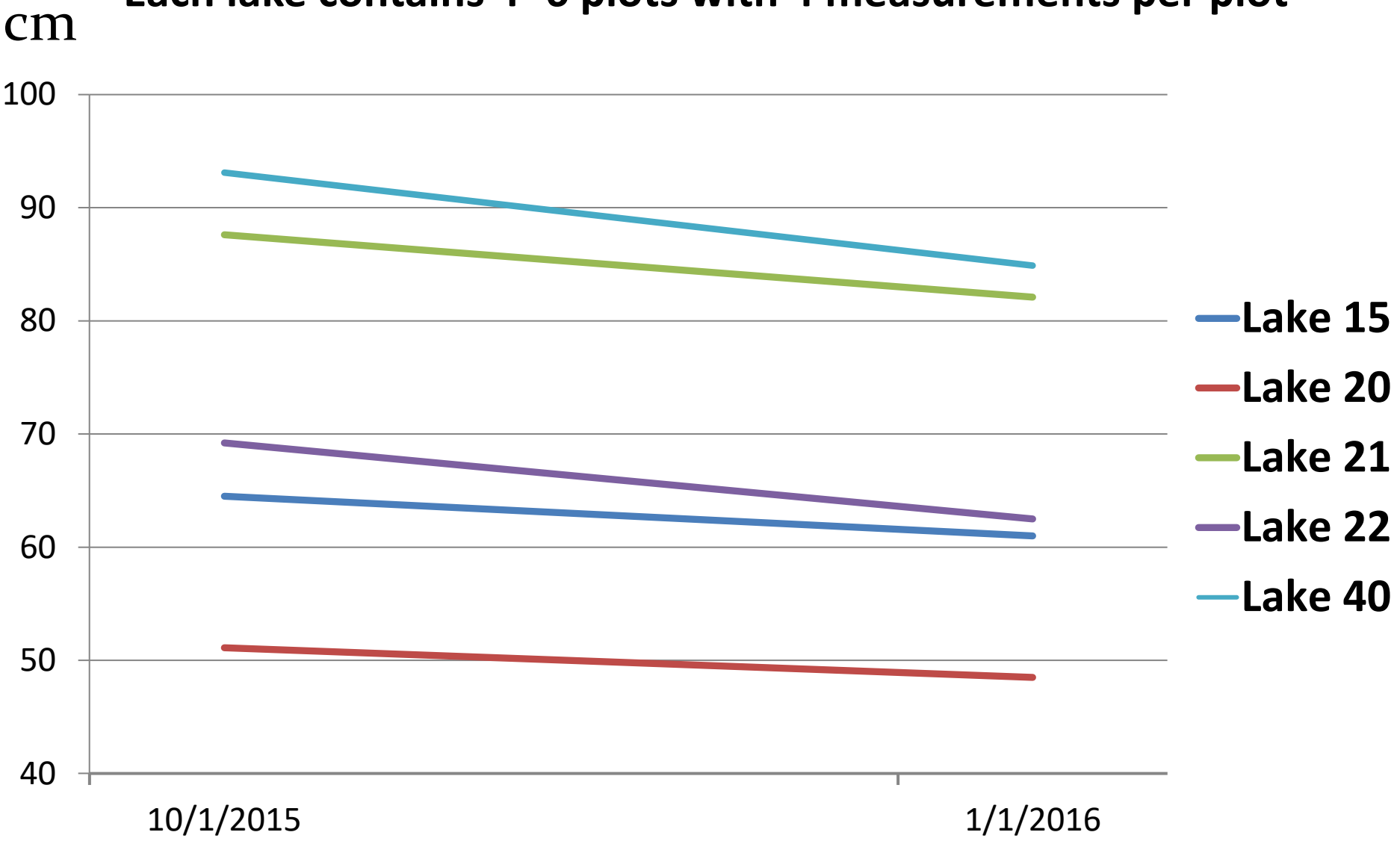
After 6 Months with Bio-Incubator

Players Club POA

Clear Waters, Inc.

Organic Sediment Removal **1.8 cm Per Month**

Each lake contains 4- 6 plots with 4 measurements per plot



STAs or Constructed Wetlands Have Been Used for Years as Key Components of Restoration.

Benefits

- Nutrient Removal
- Water Storage
- Wildlife Habitat
- Research Opportunity
- Recreation Opportunity
- Public Education (PR)
- Urban Greenspace
- Downstream Restoration

Concerns

- Large Land Tracts
- Require Large Capital Investment
- Maintenance Expense
- Accumulate “muck”
- Accumulate Nutrients
- Require periodic drawdowns
- May require periodic mechanical removal of “muck”

South Florida Water Management District Muck Reduction Trial

- AVC performed a muck reduction Field Trial in STA 1 West in 2016-17.
- The STA contained large areas of floating tussocks and waist deep muck.
- Some tussocks were vegetated but most bare mud above the waterline with sparse vegetation.
- The visible water was 1-3 inches deep above the muck.

STA Field Trial and Results

- Treatment prescription was 500 gallons of incubated Bio-Zyme (12.5 lbs. + 2.5 gal, Nitrifier) per week via airboat.
- Each week a 25 acre plot within the 50 acre trial area was treated.
- Duration was 9 months July to March of 2017.
- The initial area impacted by the trial appears to encompass over 350 acres. Later the result spread to about 800 acres.
- Most of the area still remains tussock free with reduced muck 3 years after treatment


Floating Tussocks Before Treatment

Prior to initial application
Mud to the surface

March 2017 – After Treatment


March 2017
(After Treatment)

Summary;
Supported Observations

- Decreased depth of organic sediment layer.
- Increased water clarity and light penetration.
- Elimination of floating tussocks
- The bottom sediments became consolidated and firm compared to mush and soup.
- More fish were observed

In Closing: The Potential is Exciting!
Innovation - Repurposing Known Technology

- **Lake Okeechobee**
  - Flocculent Management.
  - Organic Sediment and Nutrient especially P. Reduction.
  - Fish Spawning Area Restoration.
  - Increase Light Penetration to Promote SUV Growth.
  - Aquatic Plant Management – Reduction of decaying plant material from treatment.

In Closing: The Potential is Exciting!
Innovation - Repurposing Known Technology

- **STAs**
  - Organic Sediment Reduction/Consolidation.
  - Extend Cell Life Span and Reduce Management Costs.
  - Nutrient reduction
- **Private Land Discharges**
  - Pretreatment Option.
- **Lagoons – City Water - Lakes**
  - Reduce Lake Discharge Nutrients that Feed Toxic Algae.

Acknowledgements

- **Aquatic Vegetation Control. Inc.**
  - Elroy Timmer, Senior Scientist — 60 yrs. — 561-248-4628
  - Linda DeFee — 10 yrs. — 561-845-5525
  - ***www.avcaquatic.com***
- **Aquatic Balance**
  - Rick Anderson, President — 40 yrs. — 772-360-8115
  - ***www.aquaticbalance.net***
- **Clear Waters Inc.**
  - Trace Wolfe, President — 45 yrs. — 386-767-4928
  - ***www.clearwaterslakemgmt.com***

Large data set and 1000's of sites are available for inspection

Thank You.

- TRM, Inc.
- trmbiozyme.com
- Martin County
- NPBCID
- Port St. Lucie
- SFWMD

Presentation 2

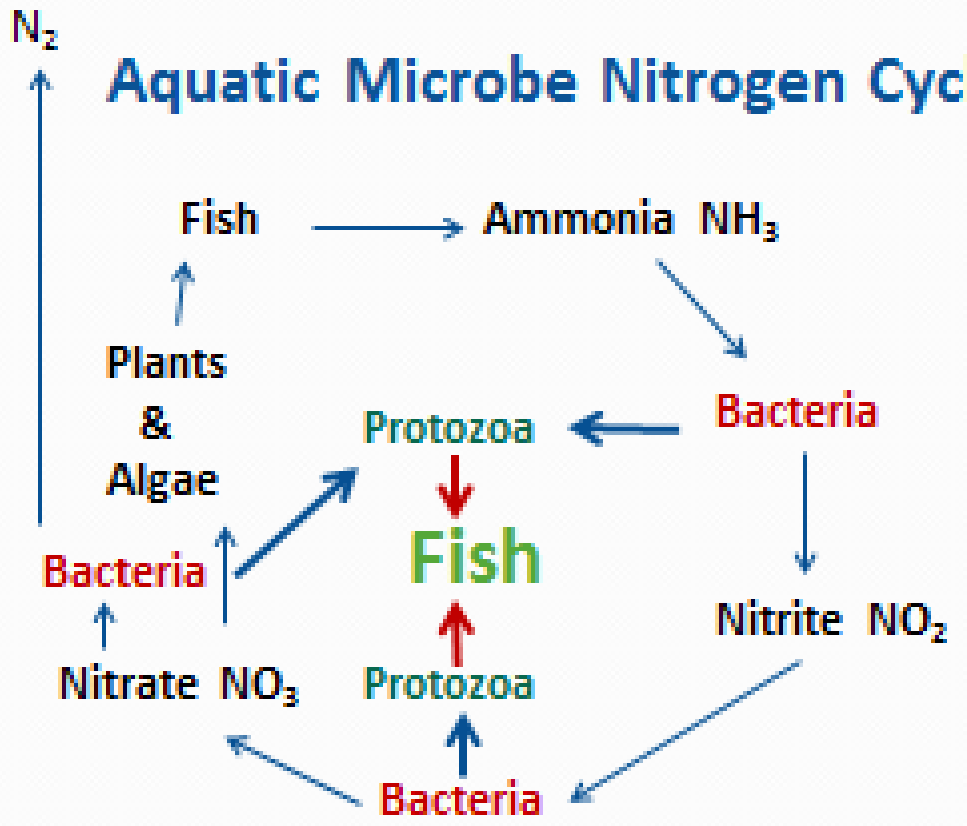
- Bacteria Synopsis of how Bio-Zyme works

Bacteria Product Use

- Currently operational for 15 aquatic management companies in FL and the US. This represents 20,000 managed waterbodies totaling in excess of 60,000 surface acres.
- Primary use has been golf course waterways, private lakes and municipal drainage networks in Florida.
- Results are reduced nutrients, shifts in sediments from muck to sand, decreased sprinkler clogging, and aesthetic benefits. All have been observed and documented.

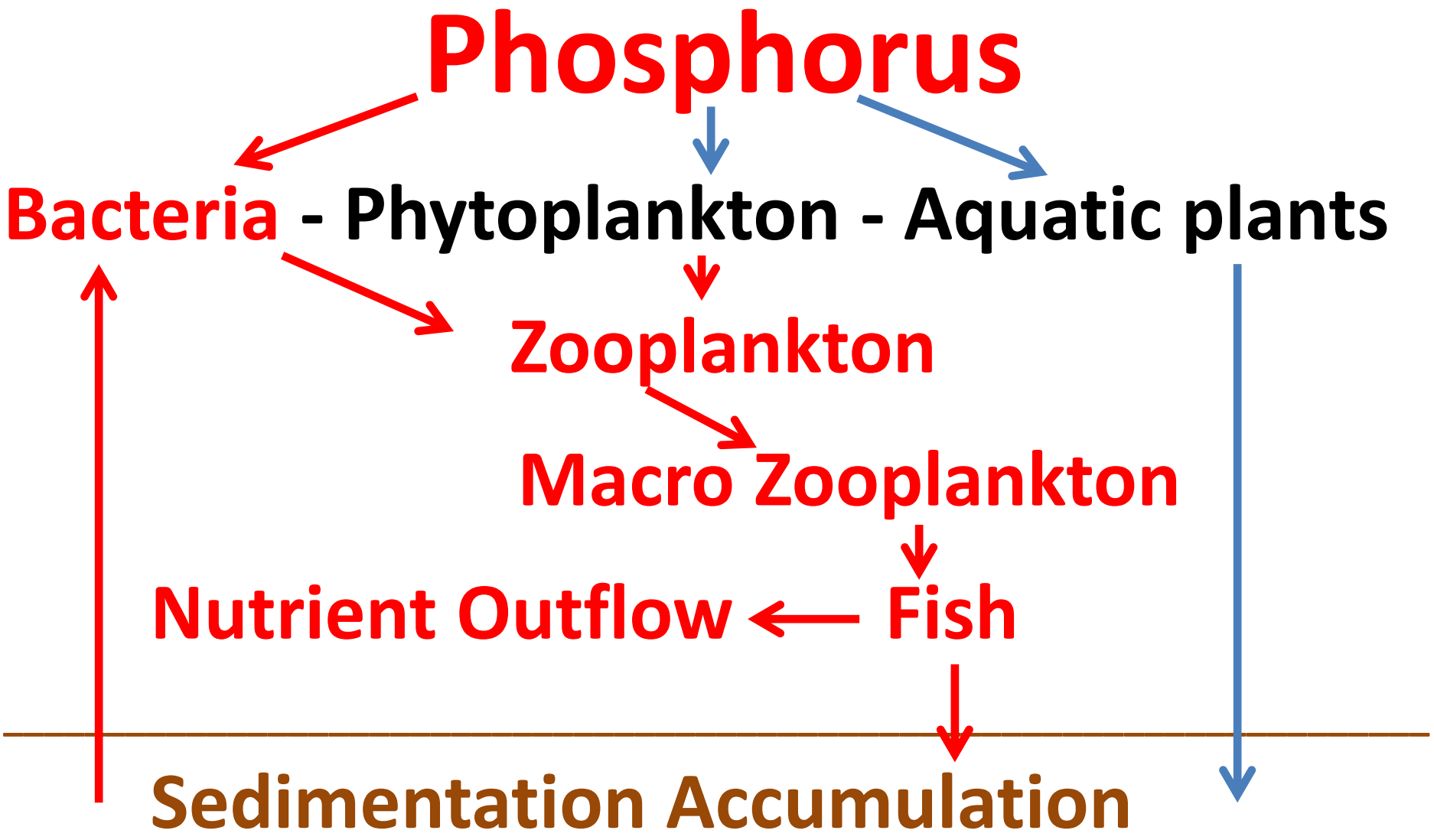
Nitrogen Assimilation With Bio-Zyme Bacteria

- *Nitrosomonas* spp.
  - Ammonia (NH_3) to Nitrite (NO_2)
- *Nitrobacter* spp.
  - Nitrite (NO_2) to Nitrate (NO_3)
- *Pseudomonas* spp.
  - Nitrate (NO_3) to Nitrogen Gas (N_2)



Bacteria assimilates N in its various forms converting it to fish through protozoa

All bacteria use P in cell development and DNA



Nitrogen, Phosphorous and Carbon Utilization

- **Bio-Zyme produces enzymes that reduces sediment (organic matter) (C) and utilizes C in its various forms in its metabolism and cell structure.**
- **This is critical because as Bio-Zyme uses C it must also use N and P. Most living creatures are comprised of approximately 50% C, 14% N and 3% P. These elements are used in cell walls, amino acids, enzymes, energy and essential body components.**
- **Bio-Zyme carbon utilization through enzymes therefore provides the "base" of the food chain.**
- **Bio-Zyme bacteria and naturally occurring bacteria multiply using N, P and C which are transferred from bacteria to protozoa to fish, etc.**
- **Only 2 oz. of P from water (0.05 mg/l to 0.005 mg/l per acre foot) needs to removed for the trophic state index (TSI) of water to be changed from eutrophic to oligotrophic.**

Carbon utilization - Known Players

- ***Aerobacter aerogens - B. amyloliquefaciens***
  - **oxidizes carbohydrates**
- ***Bacillus subtilis***
  - **degrades polymers such as protein, pectin and starch. It is also a contributor to the carbon and nitrogen cycles.**
- ***Cellulomonas biazotea***
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  - **oxidizes and degrades organic compounds**

Presentation 3

- Phosphorus and Muck Reduction

Phosphorus and Muck Reduction
The dynamic duo for water management

Aquatic Vegetation Control, Inc.

Environmental Management

Riviera Beach, FL
Port Saint Lucie, FL
Pembroke Pines, FL
Florida City, FL
Charleston, SC
Jesup, GA
Gainesville, GA

www.avcaquatic.com

Elroy Timmer
Senior Scientist

Reducing Phosphorus and Muck With Bio-Zyme Bio-Incubators

The Supporting Data for Bio-Zyme usage in Water:

- Reduces nitrogen.
- Reduces nitrogen in muck.
- Reduces phosphorus.
- Reduces phosphorus in the muck.
- Reduces the amount of muck.
- Reduces the need of copper in lake management.

The Suggested Benefits for Bio-Zyme:

- **Will reduce the amount of harmful bacteria by outcompeting them for nutrients.**
- **Will reduce the amount of nutrients from septic systems and human activity entering the estuaries.**
- **Likely to impede the development of the Red Tide which feeds on nutrients.**
- **Improve fish production because nutrients are funneled into the food chain. Bacteria are eaten by protozoa and protozoa are eaten by fish.**

STA (Storm Treatment Area) Review

Constructed Wetland to Reduce Phosphorous

- **STA's and wetlands have been used to reduce nutrients for years.**
- **STA's produce excellent habitat for wildlife.**
- **STA's can produce additional water storage.**
- **STA's utilize plants to remove the phosphorous from water.**
- **STA's provide valuable recreational areas.**

STA's Negative Values

- **STA's need large additional tracts of land.**
- **STA's are very expensive to buy, build and maintain.**
- **STA's take years before they are ready for use.**
- **STA's accumulate phosphorus in muck.**
- **STA's accumulate muck from plant deposition.**

Natural Bacteria

- **How do STA's compare with the new method using incubated bacteria for nutrient reduction?**
- **Bacteria have maintained lakes since the beginning of time but have not been able to keep up with high nutrient demands.**
- **Most bacteria products work but incubated Bio-Zyme bacteria works much better and is way less expensive than any I have tried over the last 40 + years.**

Incubated Bio-Zyme

- **Bio-Zyme does not need additional land.**
- **Bio-Zyme is less expensive than STA's.**
- **Bio-Zyme works faster than STA's.**
- **Bio-Zyme reduces nitrogen.**
- **Bio-Zyme augments the effectiveness and longevity of STA's.**
- **Bio-Zyme may help control the red tide by reducing nutrients in city waterways.**
- **Bio-Zyme reduces coliform bacteria by out-competing it for nutrients.**

Names of Some of the Bacteria and a Partial List of the Tasks They Perform

- *Nitrosomonas*
  - reduces NH_3 to NO_2
- *Nitrobacter*
  - NO_2 to NO_3
  - both are soil bacteria; both are required for nitrification and both need aerobic conditions
- *Aerobacter aerogens*
  - aerobic
  - oxidizes carbohydrates C+(H_2O) (sugars, starches and cellulose) and short organic acid chains to CO_2 and H_2O
  - when O_2 is limited it ferments carbohydrates which become food for *Pseudomonas* sp.
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  - degrade polymers such as protein, starch, and pectin, therefore, they are thought to be an important contributor to the carbon and nitrogen cycles. Important in digestion in the gut of animals
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- *Pseudomonas denitificans* and *P. stutzsri*
  - reduces level of nitrate nitrogen under anaerobic conditions
  - oxidizes and degrades organic compounds

Muck Reduction

- **As the bacteria digest the muck, the bacteria are consumed by microscopic animals like protozoa.**
- **Protozoa are consumed by small fish.**
- **Small fish are consumed by large fish, birds etc.**
- **The muck therefore, ends up in the food chain.**

Muck and Phosphorus Reduction

- **Muck contains phosphorus, nitrogen, carbon and other undesirable components.**
- **Muck reduction therefore, is a good measurement of the effectiveness of the beneficial Bio-Zyme bacteria.**
- **As the phosphorus is digested, the lakes are clearer, and produce a hard bottom suitable for clams, snails and fish reproduction.**
- **The apparent increase in clams may also help manage water quality.**

South Florida Water Management District Muck Reduction Trial

AVC performed a muck reduction trial in a Stormwater Treatment Area in 2016.

Description of the STA

- The STA contained large areas of floating tussocks and waist deep mud.
- Some of the tussocks had a lot of vegetation but many of the tussocks were little more than a few inches of mud above the water with sparse vegetation.
- The visible water was about 1 inch deep above the muck.


Floating Tussocks
++Floating Tussocks Before Treatment

Prior to initial application
Mud to the surface

The Bio-Zyme Program

The treatment prescription was to apply 500 gallons of incubated Bio-Zyme (12.5 lbs. + 2.5 gal, Nitrifier) per week.

A 25 acre plot within the 50 acre trial area was treated. This continued 9 months through March of 2017.

The total area impacted by the trial appears to encompass over 350 acres.

March 2017 – After Treatment


March 2017
After Treatment

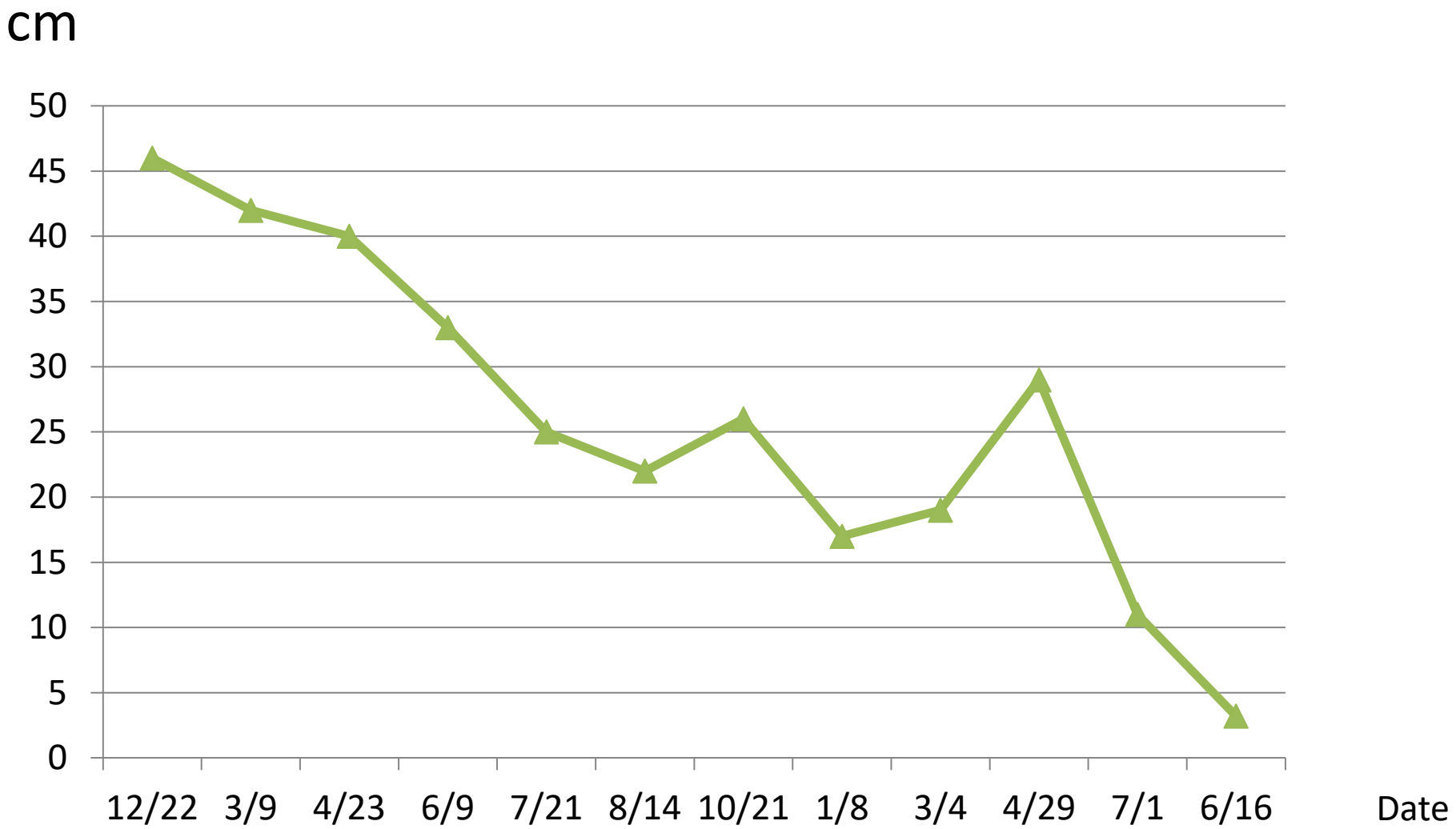
Conclusion

- **The impacts of the Bio-Zyme Program moved with the flow of the water to the south covering over 8 times the acreage treated.**
- **The bottom sediments became consolidated and firm compared to mush and soup.**
- **The water clarity was greatly improved.**
- **There was no improvement up current from the treatment area**

PGA Country Club Marsh

Organic Sediment Removal

Each point is an average of 3 plots, 4 measurements per plot



PGA Country Club Pond

Organic Sediment Removal

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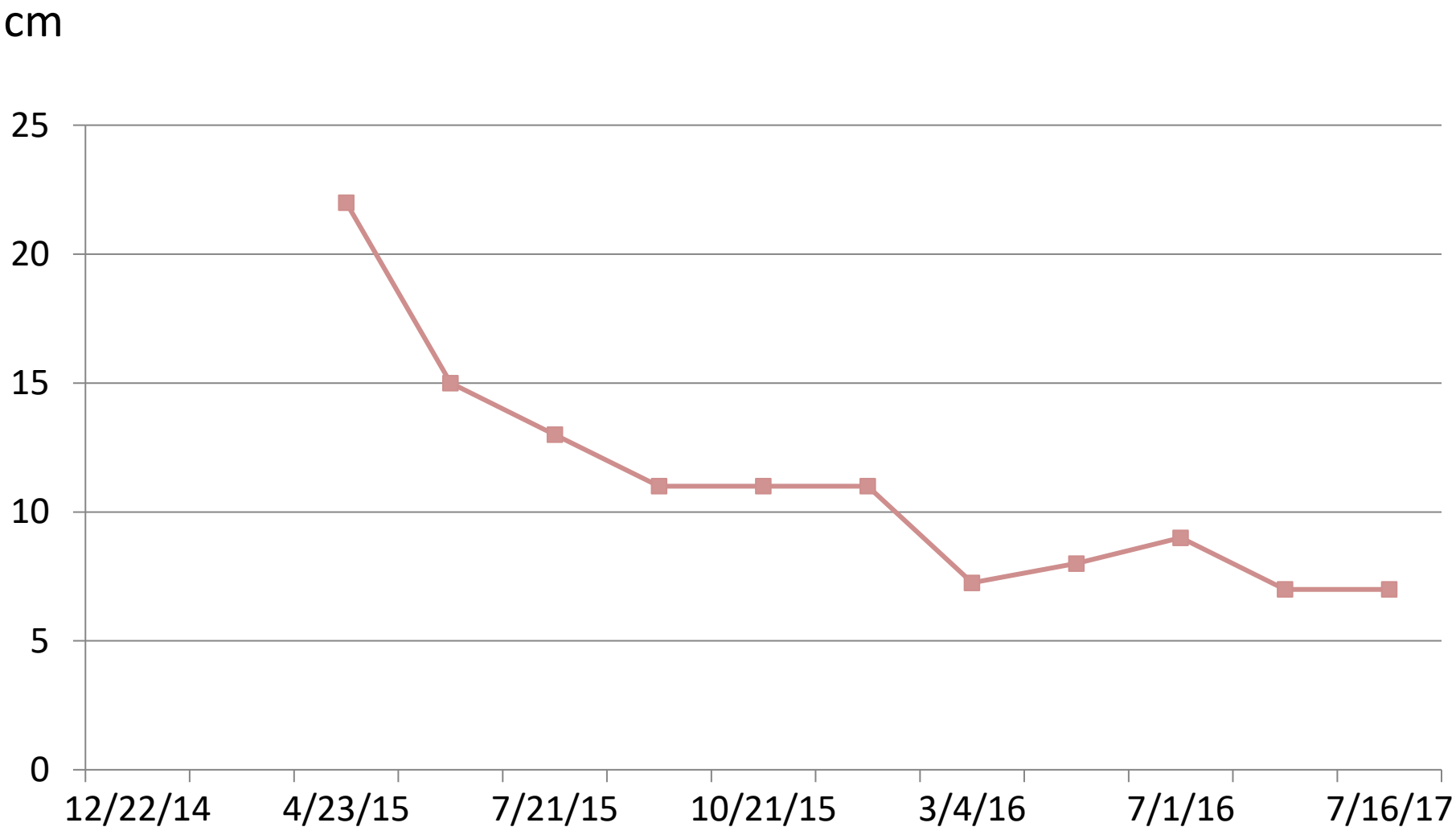
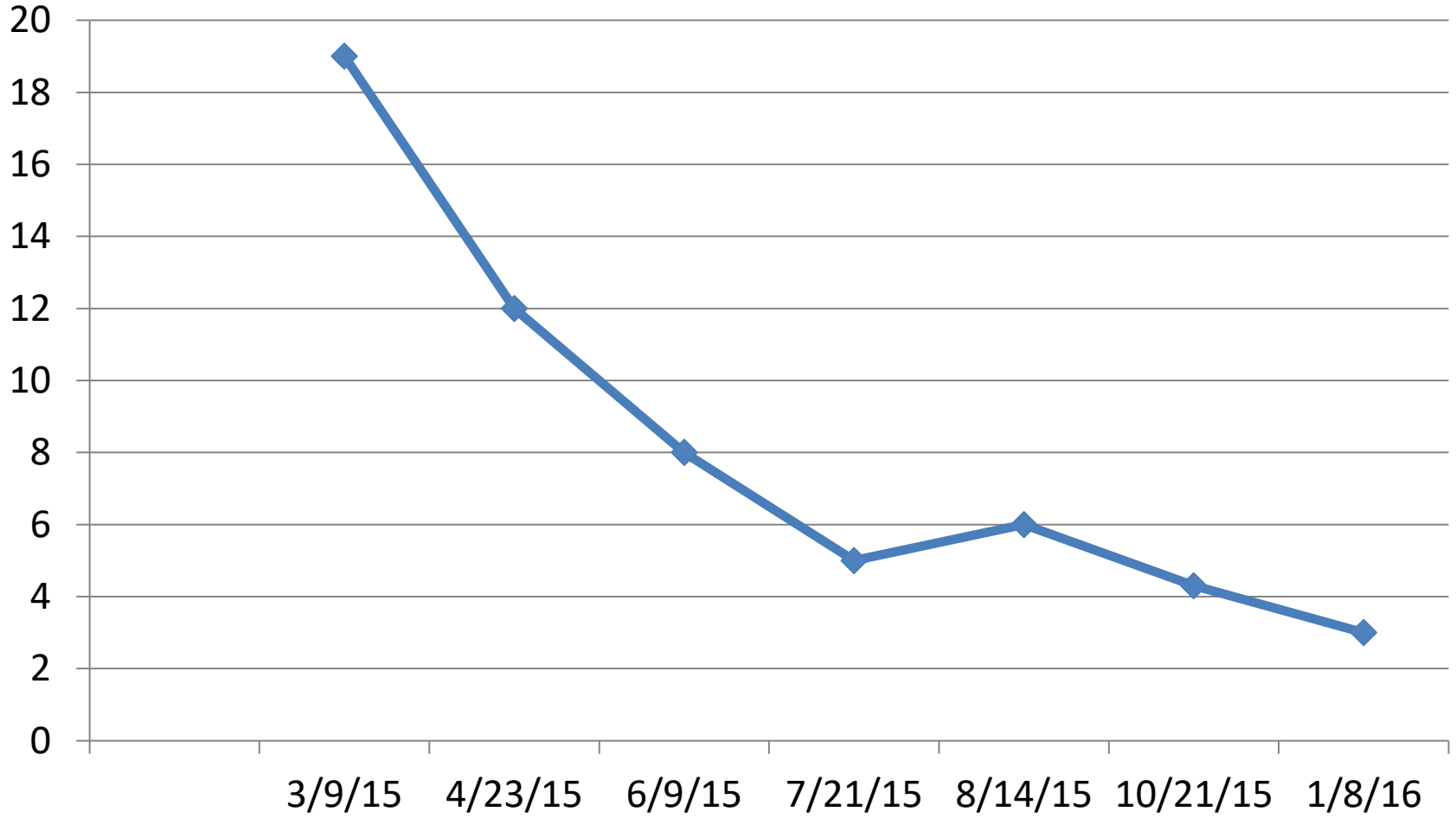


Port Saint Lucie E8

Organic Sediment Removal

1.5 cm Per Month

Each point is an average of 3 plots with 4 measurements per plot

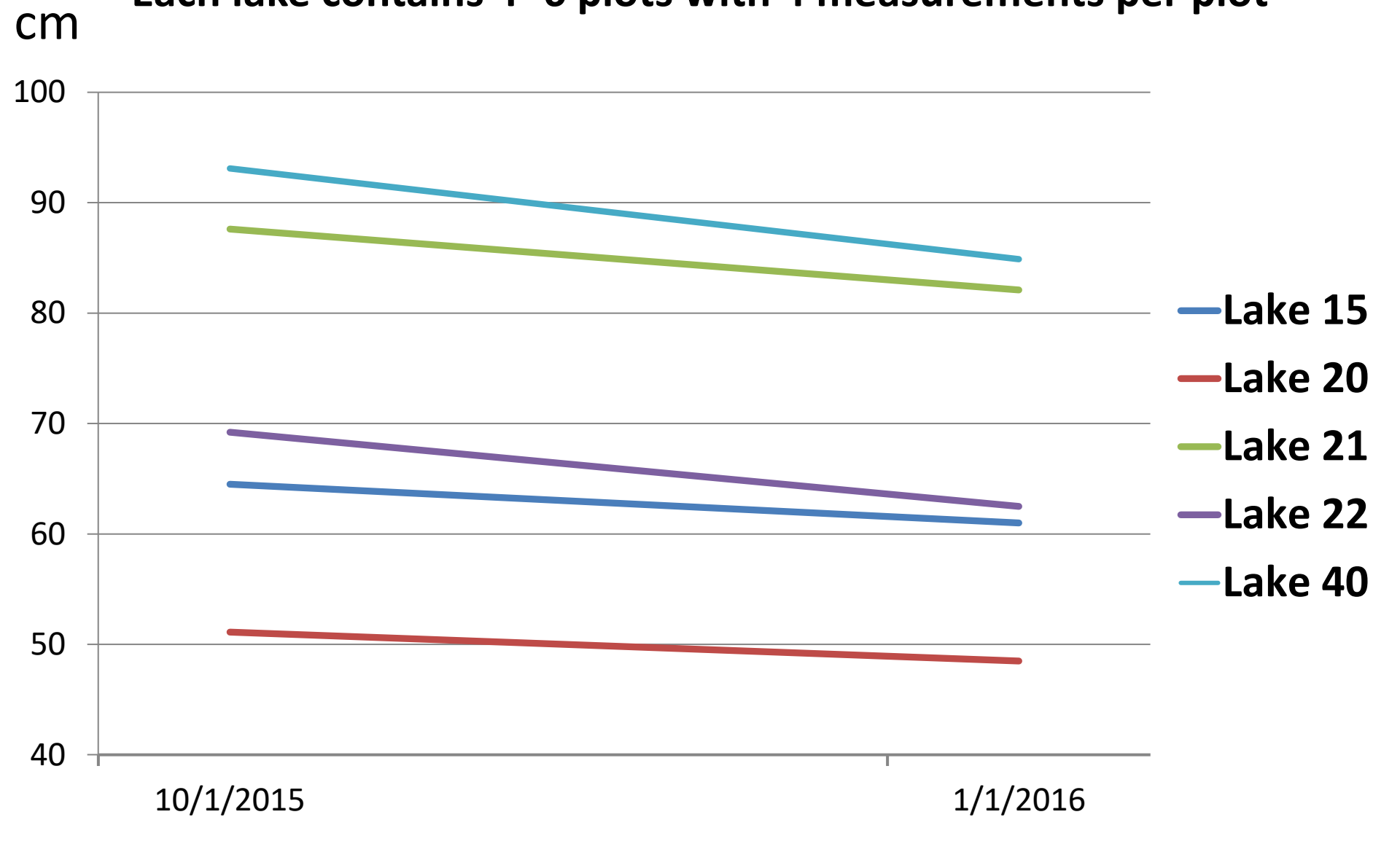


Players Club POA

Clear Waters, Inc.

Organic Sediment Removal **1.8 cm Per Month**

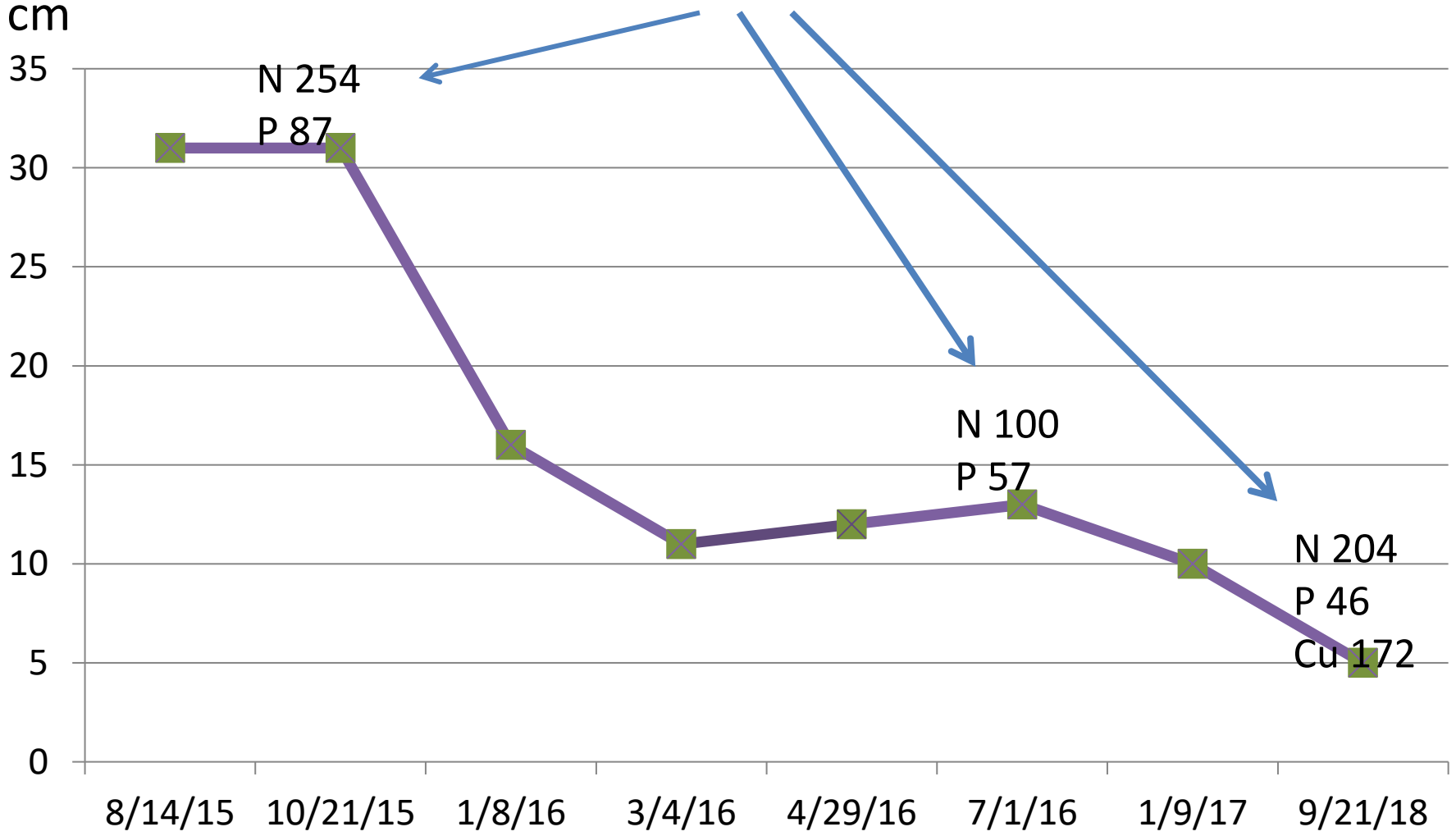
Each lake contains 4- 6 plots with 4 measurements per plot



Ibis Country Club Lake 10 - Organic Sediment Removal

≈ 3000 lb. of N and 900 lb. P per acre removed in the muck in 3 years

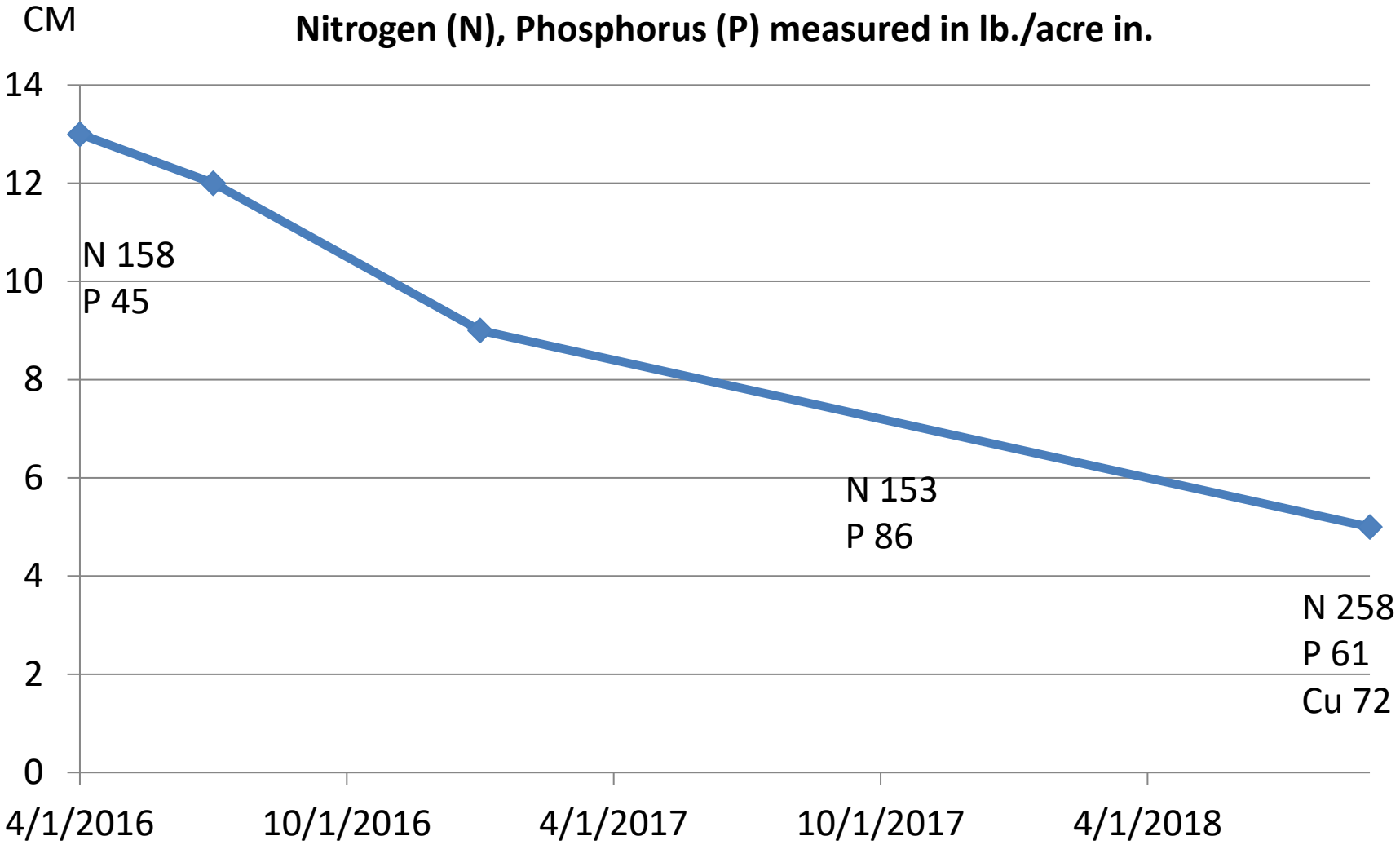
Each point is an average of 3 plots, 4 measurements per plot



Ibis Country Club Lake 5 – Organic Sediment Removal

Each point is an average of 3 plots, 4 measurements per plot

≈ 800 lb. of N and 300 lb. P removed in 2 years



Institute of Food and Agricultural Sciences
Analytical Services Laborat
UNIVERSITY OF FLORIDA
ories
Livestock Waste Testing Laboratory, Gainesville, FL

Livestock Waste Testing Lab
631 Wallace Building
Gainesville, FL 32622
(352) 392-1950
FAX (352) 392-1960

Livestock Waste Analysis Grower Report

Clarence Elroy Timmer
482 SW Deer Run
Port St Lucie, FL 34953

PHONE: 561-249-4628

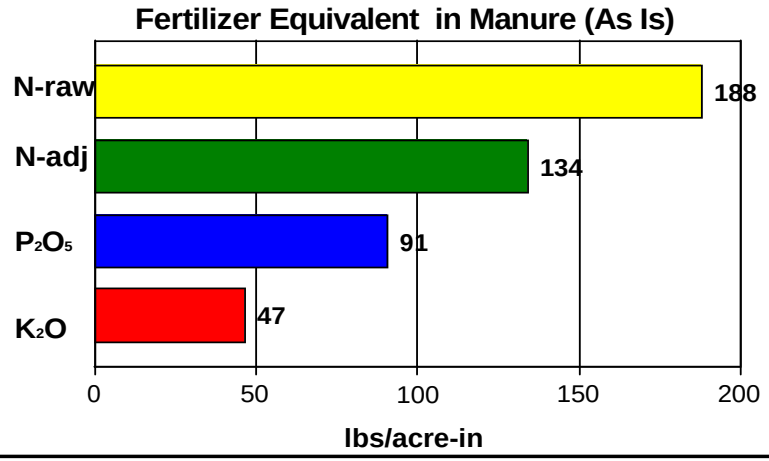
Lab #	**9007**
Sample Label	**IS #1**
Date Collected	**April 29, 2016**
Date Delivered	**May 4, 2016**
Date of Report	**May 16, 2016**
County of Sampl	**Palm Beach**
Collected By	**0**

Sample Type: Dairy waste collected from lagoon.
Crop or Use: #N/A
Application Equipment:Applied through center pivot
Incorporation #N/A
Previous Applications #N/A

*****Nutrient Content in Manure as Delivered to Laboratory**

Nutrient Constituent	Raw Sample	Adjusted For Application Losses of N	Units
Nitrogen (N):	188	134	lbs/acre-in
Phosphorus (P2O5)	91	91	lbs/acre-in
Potassium (K2O):	47	47	lbs/acre-in

pH as Sampled	6.9
Moisture Content:	78.3%
Total Solids:	21.7%
Total Ash	18.8%



Lab Number	Sample Id	Cu mg/kg	Mn mg/kg	Zn mg/kg
L9813	I 5-1	40.20	10.23	9.5

Case Study of Lake Pine Shadow *Clear Waters, Inc.*

Outfalls discharging runoff into the Turnbull Basin then Spruce Creek, a Florida Outstanding Waterway.

Goal to Improve Water Quality and Reduce the Use of Copper

Lake Pine Shadow

Clear Waters, Inc.

After 6 Months with Bio-Zyme

Copper and Bio-Zyme Cost Before and After the Bio-Zyme Bio-incubator in 2014

	Copper	Bio-Zyme
June - Sept 2011	$ 287.55	$ 180.30
June - Sept 2012	$ 365.01	$ 78.00
June - Sept 2013	$ 0.00	$ 383.50
June - Sept 2014	$ 7.74	$ 162.74
June - Sept 2015	$ 0.00	$ 170.13
June - Sept 2016	$ 0.00	$ 29.79

PEACOCK LAKE

- Lake (100 acres) about 18 foot average depth
- Microcystis bloom in December 2016
- Objective: reduce total phosphorus
- Weekly treatments of Bio-Zyme

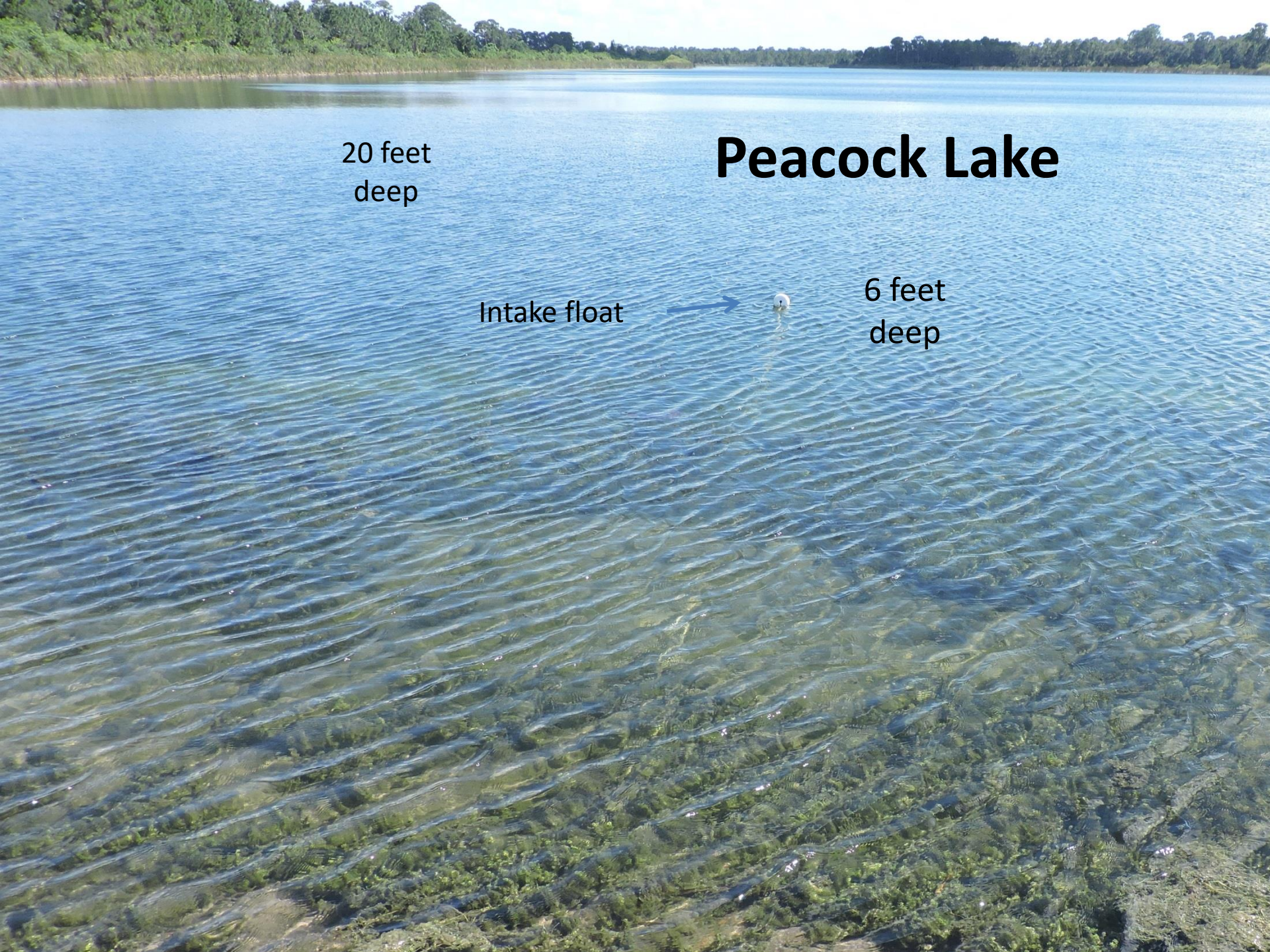
Peacock Lake 100 acres
No watershed

Total Phosphorus reduced from
0.05 mg/l - 0 mat
0.015 mg/l - 6 mat
<0.005 mg/l - 18 mat

Date	Bio-Zyme Bulk	Laboratory	Total Phosphorous rate mg/l
1/9/17			
1/16/17	5 lbs.		
1/18/17		Pace	0.05
1/23/17	5 lbs.		
1/30/17	5 lbs.		
2/6/17	50 lbs.		
2/21/17		Flowers	0.04U
3/27/17	50 lbs.		
3/30/17		Jupiter Env.	0.024
4/9/17		Jupiter Env.	0.021
5/23/17	10 lbs.		
5/31/17	10 lbs.		
6/8/13	10 lbs.		
6/13/17	10 lbs.		
6/20/17	10 lbs.		
6/27/17	10 lbs.		
7/3/17	10 lbs.		
7/3/17		Jupiter Env.	0.015
7/11/18	300 lbs.	Jupiter Env.	<0.005

Peacock Lake Bio-Incubator

The key to successful treatment is in
bacteria, increasing it billions of tir
incorporating it into the la


20 feet
deep
Peacock Lake
Intake float
6 feet
deep

Lake Okeechobee

- **Lake Okeechobee and lakes north would benefit from Bio-Zyme to reduce excessive phosphorus.**
- **The reduction of phosphorus in Lake Okeechobee would cost about 30-45 million per year and require about 12, 20,000 gal. bio-incubators. Perhaps it could be started in an area which has the most phosphorus.**
- **Phosphorus reduction in Lake Okeechobee, will solve many of the problems in the Caloosahatchee and Indian River Lagoon as well as save Lake Okeechobee.**
- **Microcystis algae seems to be the main concern on both coasts but the real fuel is phosphorus upstream.**

Bio-Zyme

- **Bio-Zyme is not a chemical.**
- **Bio-Zyme is not toxic or harmful to algae, plants, fish or animals.**
- **Bio-Zyme products are formulated with natural, native, probiotic bacteria that reduce nitrogen and phosphorus.**
- **Bio-Zyme also contains sludge-digesting bacteria.**
- **Bio-Zyme on large lakes needs to be directed by a TRM Biologist Certified Facilitator.**

Bio-Zyme

- **Is used by 15 large aquatic management companies in Florida and the US.**
- **Is used in approximately 20,000 lakes and in about 60,000 acres of water**
- **Is used in the major golf courses in Florida where it reduces nutrients to produce better water quality, changes bottom from muck to sand, decreases sprinkler clogging and much more**
- **Has so much data and experience behind it that it cannot be said It may not work. It works and is cost effective!**

Contacts

Instrumental in the Development of Bio-Zyme

Improving Our Lakes Every Day

- **Aquatic Vegetation Control. Inc.**

	Years in Aquatics	
• Elroy Timmer, Senior Scientist	59 yrs.	561-248-4628
• Sharon Gillenwalters, President	25 yrs.	561-845-5525
• *www.avcaquatic.com*		

- **Aquatic Balance**
  - Rick Anderson, President 40 yrs. 772-360-8115
  - *www.aquaticbalance.net*
- **Clear Waters Inc.**
  - Trace Wolfe, President 40 yrs. 386-767-4928
  - *www.clearwaterslakemgmt.com*

A volume of data and 1000's of sites are available for inspection

Aquatic Vegetation Control owns no stock or interest in Bio-Zyme