

# Constructed Wetlands in Pond Effluent Reduction



**Benedict C. Posadas**  
**Assistant Economics Extension/Research Professor**

# Participating Agencies

- **MSU-Coastal Research and Extension Center, Biloxi, MS**
  - Ben Posadas, Economist
  - Mark LaSalle, Estuarine Ecologist
  - David Veal, Head
- **MSU-Coastal Aquaculture Unit, Gulfport, MS**
- **Mississippi Power Company, Gulfport, MS**
- **Delta Pride Catfish, Inc., Indianola, MS**

## Funding Agencies

- **U.S. Department of Agriculture**
  - NRI -1992-94
  - NRI- 1995-98
- **U.S. Department of Commerce**
  - SK - 1995-98

## Objectives

- **evaluate effectiveness of constructed marsh systems toward improving water quality in aquaculture ponds**
- **determine optimal design and operating criteria for constructed wetlands**
- **determine the concomitant reductions in risk of crop loss, incidence of off-flavor, and release of nutrient-laden effluent into the environment**

## Objectives

- **determine the improvement in fish growth and feed conversion, and**
- **document the costs versus benefits of using this technology in pond culture**

## Methods

- **Pond Size:**
  - 1/4-acre ponds
  - 125 ft. long
  - 85 ft. wide
  - 4 ft. deep



## Fish Species

- **Channel catfish (*Ictalurus punctatus*)**
- **Phase II fingerlings (6-7 inch)**

## Wetland Plants

- **Duck Potato (*Sagittaria lancifolia*)**
- **planted at 1/2- ft. centers**



## Experimental Design

- **Control ponds (no marsh, simulated water flow)**
- **Treatment ponds (marshes of “standard” size and flow rate).**

## Wetland Size Variations

- **% of pond surface area**
  - **small, 15%**
  - **standard, 25%**
  - **large, 35%**

## Flow rate Variations

- **Slow**
  - 3.25gal/min
  - 3-day retention
- **Standard**
  - 6.5 gal/min
  - 2-day retention
- **Fast**
  - 13.0 gal/min
  - 1-day retention
- **Very fast**
  - 26.0 gal/min
  - 1/2-day retention

## Monitoring

- **Water Quality in Wetlands (inlet and outlet)**
  - **Weekly: salinity, pH, ammonia, nitrite, nitrate, total phosphorous, total suspended solids**

## Water Quality in Ponds

- **Daily (twice per day):**
  - dissolved oxygen
  - temperature
- **Weekly:**
  - same as for wetlands
  - chlorophyll a
  - phaeophytin

## Statistical Analysis

- **Analysis of Variance using General Linear Model (GLM)**
- **Means compared using SNK multiple range test**
- **All tests conducted at significance level of 0.05**

## Constructed Wetlands MSU-CAU, 1997

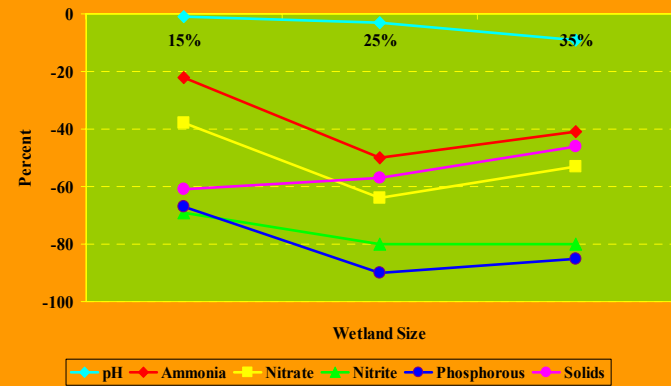


May 16-17, 2002

SERA-IEG 30

15

## Percent changes of inlet to outlet values of weekly water quality variables in wetlands of variable sizes, 1997



May 16-17, 2002

SERA-IEG 30

16

## Pond Aeration MSU-CAU, 1997

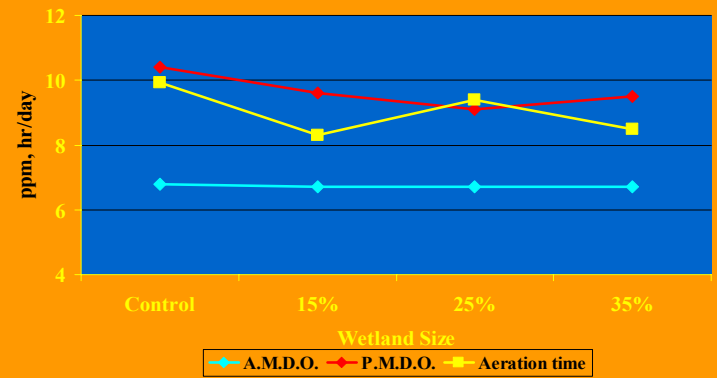


May 16-17, 2002

SERA-IEG 30

17

## Mean values of daily pond water quality variables in ponds with wetlands of variable sizes, 1997

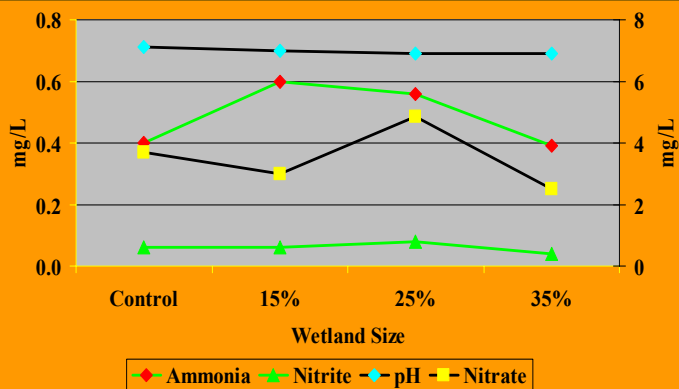


May 16-17, 2002

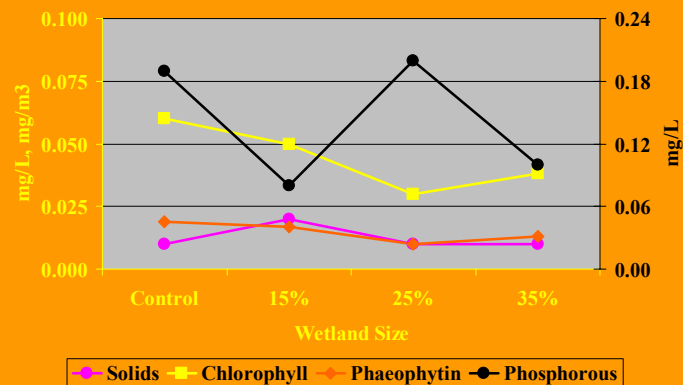
SERA-IEG 30

18

Mean values of weekly water quality variables in ponds with wetlands of variable sizes, 1997

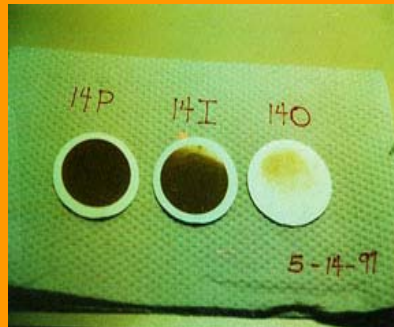


Mean values of weekly water quality variables in ponds with wetlands of variable sizes, 1997



## Dried Matter from Water Samples MSU-CAU, 1997

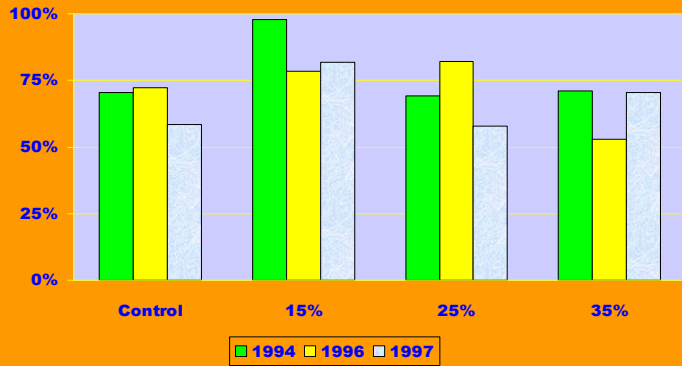
- **14P - Sample from Pond 14**
- **14I - Sample from Inlet**
- **14O - Sample from Outlet**



## Catfish Stocking Densities Per Production Acre

- **5,000 3-4 inch in 1994**
- **6,000 7-8 inch in 1996**
- **8,000 7-8 inch in 1997**

## Catfish Survival Rate

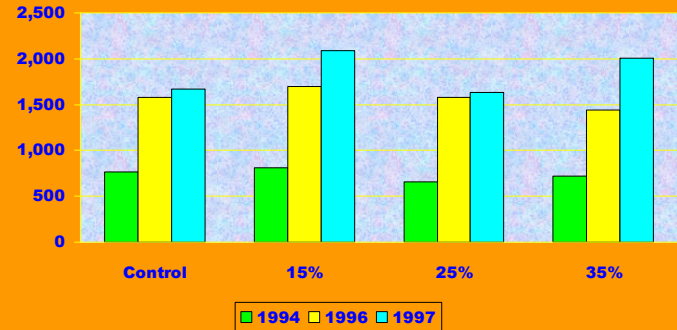


May 16-17, 2002

SERA-IEG 30

23

## Catfish Yield Pounds Per Qtr Acre

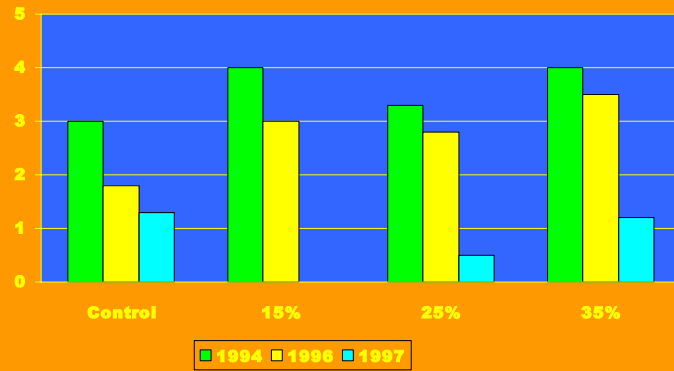


May 16-17, 2002

SERA-IEG 30

24

## Catfish Off-flavor Scale

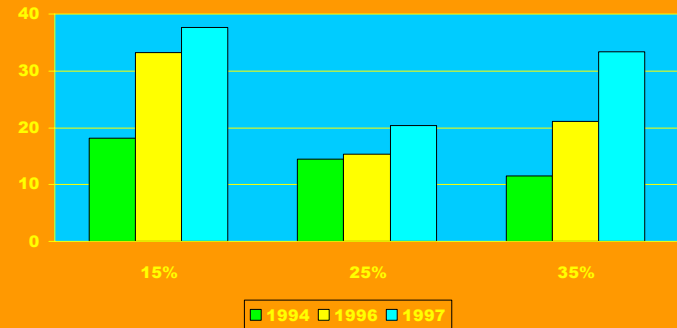


May 16-17, 2002

SERA-IEG 30

25

## Wetland Electricity Use KWH Per Week

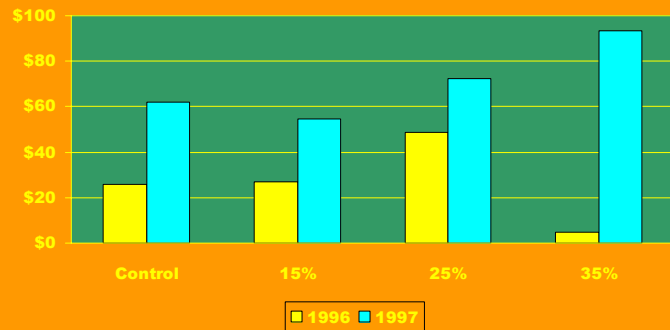


May 16-17, 2002

SERA-IEG 30

26

## Chemical Costs \$ Per Qtr Acre

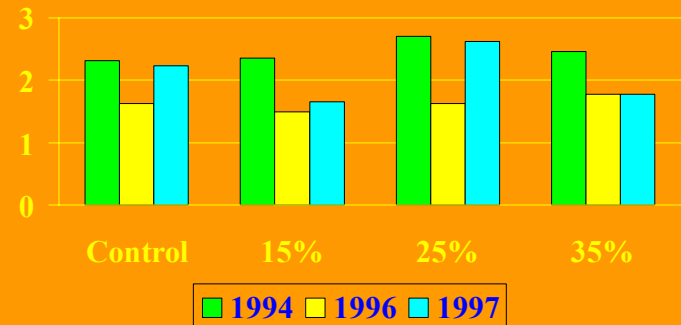


May 16-17, 2002

SERA-IEG 30

27

## Net Feed Conversion lbs of feed per lb of fish gained

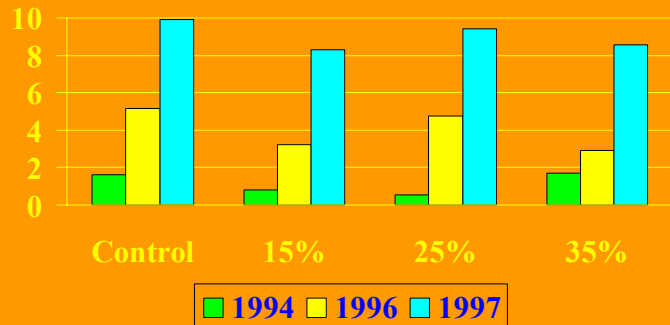


May 16-17, 2002

SERA-IEG 30

28

## Daily Aeration Hours



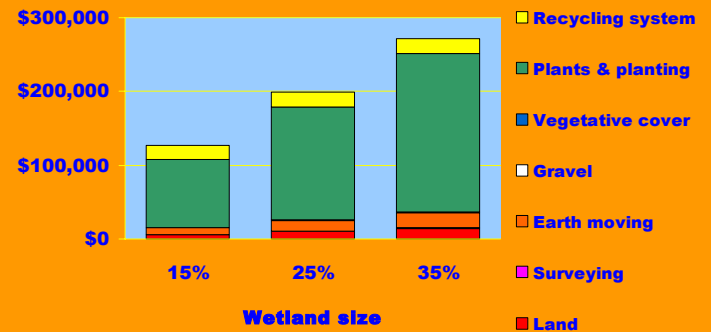
## Catfish Pond-Wetland Systems

- **Six 8-water-acre catfish ponds (CCF)**
- **Six constructed wetlands built adjacent to catfish ponds:**
  - 15% of pond size or 1.2 acres each
  - 25% of pond size or 2.0 acres each
  - 35% of pond size or 2.8 acres each

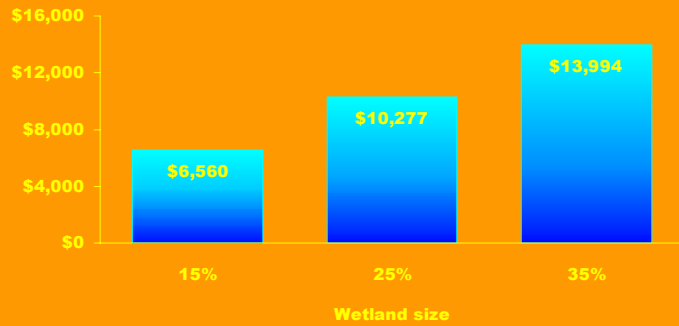
## Catfish Stocking and Production, 1997

- **Stocking rate: 8,000 fingerlings per acre**
- **Stocking size: 7-8 inch CCF fingerlings**
- **Culture period: 8 months**
- **Survival rate: 57 percent**
- **Catfish yield: 6,744 pounds per acre**
- **Net feed conversion ratio: 1.0:2.4**
- **Catfish off-flavor scale: greater than zero**

## Total Investment Requirements



## Average Investment Requirements Per Production Hectare

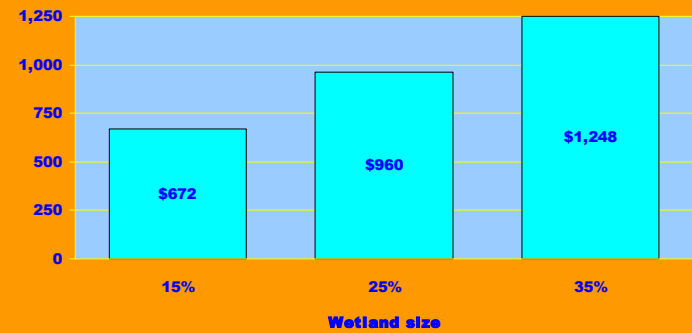


May 16-17, 2002

SERA-IEG 30

33

## Added costs of constructed wetlands in recirculating catfish pond production \$ per production hectare



May 16-17, 2002

SERA-IEG 30

34

### Added costs of constructed wetlands in recirculating catfish pond production \$ per kilogram of catfish yield



### Conclusions

- Wetlands do appear to significantly reduce the levels of nutrients from catfish pond effluents
- Wetlands that are sized to about 25% of pond area with a 2-day retention time appear to provide optimal treatment of effluents
- No significant differences in the yield of marketable catfish.
- Higher investment requirements and operating costs.

## Recommendations

- **Testing in commercial farms.**
- **Use of other economically important culture species.**
- **Testing other plant species and methods of creating vegetation.**



## Constructed Wetlands Website

- **<http://www.msstate.edu/dept/crec/cwres.html>**
- **<http://www.msstate.edu/dept/crec/crec.html>**
  - **Go to Natural Resource Economics**
- **msucares.com**
  - **Go to Centers and Institutes**
  - **Go to Coastal Research and Extension Center**
  - **Go to Natural Resource Economics**