REARING CHANNEL CATFISH IN A BIOFLOC PRODUCTION SYSTEM

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Bart Green

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Stuttgart National Aquaculture Research Center

Stuttgart, AR

Mixed Suspended-Growth System

- **Phytoplankton, free & attached bacteria, aggregates of living and dead POM, and microbial grazers maintained in suspension**

Algal Biosynthesis (Photoautotrophic)

$$106\ CO_2 + 16\ NH_4^+ \ 52\ H_2O + PO^{-3} \rightarrow C_{106}H_{152}O_{53}N_{16}P + 106\ O_2 + 16\ H^+$$

Bacterial Biosynthesis (Heterotrophic)

$$BOD_5 + NH_4^+ \rightarrow C_5H_7NO_2$$

Nitrification (Chemautotrophic)

$$2\ NH_4^+ + 3\ O_2 \rightarrow 2\ NO_2^- + 4\ H^+ + 4\ H_2O$$
$$2\ NO_2^- + O_2 \rightarrow 2\ NO_3^-$$

Denitrification (Heterotrophic)

$$5\ C_6H_{12}O_6 + 24\ NO_3^- + 24\ H^+ \rightarrow 30\ CO_2 + 42\ H_2O + 12\ N_2$$

Objectives

- **Determine the effect of channel catfish stocking rate (Study 1) or initial biomass (Study 2) on production characteristics and water quality.**

Experimental Units

- 9 HDPE-lined (18.6 m^2, 15.5 m^3) tanks
- Continuous aeration
  - 1.865 kW regenerative blower per 3 tanks
- Evaporative losses replaced
- Maintained 100 mg/L Cl^-
- $NaHCO_3$ added as needed to control pH

Stocking

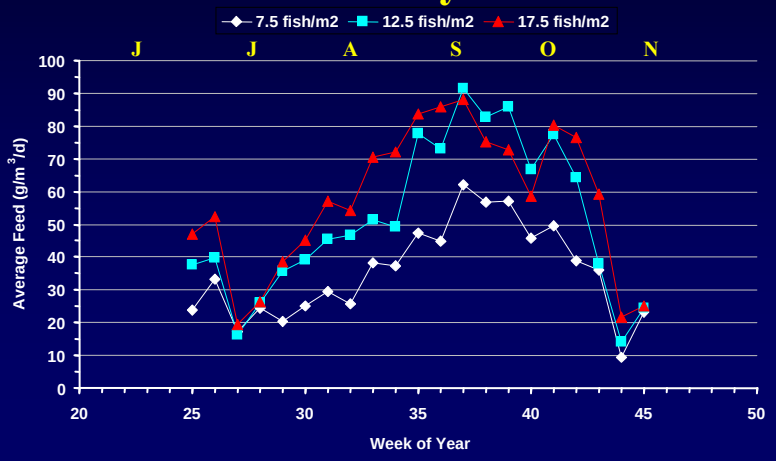
- Channel catfish
  - Study 1
    - NWAC 103 line, vaccinated against ESC
    - Stocked at 7.5, 12.5, 17.5 fish/m^2
    - Mean weight: 47 g/fingerling
    - 138-d duration
  - Study 2
    - Stocked 16, 21, or 26-cm fingerlings
    - Initial biomass 0.43, 0.97, 1.91 kg/m^3
    - 12.5 fish/m^2
    - 201-d duration
- 32% protein floating feed

Water Quality Analyses

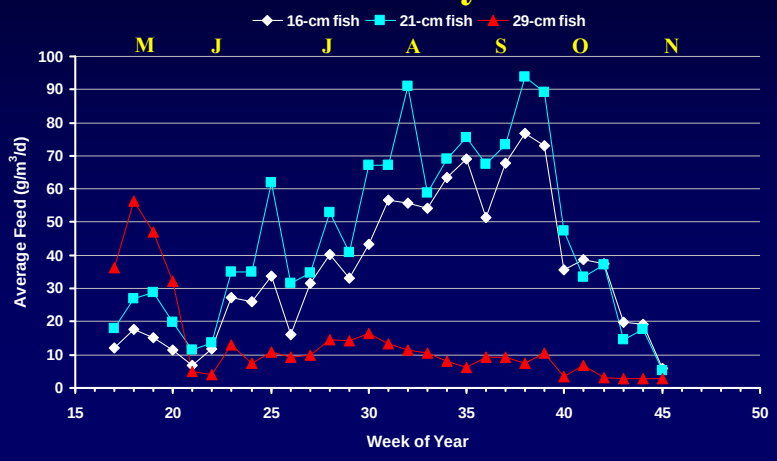
- TAN, NO_2-N, NO_3-N, SRP
  - Flow injection analysis
- Chlorophyll *a*
  - Chloroform-methanol extraction
- TSS, Settleable Solids
  - Standard methods
- DO, T, pH
  - Meters

Daily Feed Loading

Study 1



Study 2



Treatment	Mean Daily Feed ($g/m^3/d$) High Period (weeks)	Mean Daily Feed ($g/m^3/d$) Entire Experiment	Cumulative Feed Burden (mg/L)
7.5 fish/m^2	46.9 (33-43)	37.2 b	4,874 b
12.5 fish/m^2	69.4 (33-43)	54.4 ab	7,131 ab
17.5 fish/m^2	74.9 (33-43)	60.3 a	7,902 a
16-cm fish	53.7 (27-40)	38.3 a	7,192 a
21-cm fish	66.3 (27-40)	47.8 a	8,996 a
29-cm fish	10.3 (27-40)	12.9 b	2,404 b

ab: means within column within study followed by same letter do not differ significantly, $P > 0.05$.

Mean Nitrogen Concentrations

LS Means ± SE

Treatment	NH_4-N	NO_2-N	NO_3-N
	(mg/L)		
7.5 fish/m^2	0.31 ± 0.12 a	2.28 ± 0.45 a	40.84 ± 5.08 a
12.5 fish/m^2	0.36 ± 0.12 a	1.56 ± 0.45 a	61.61 ± 5.08 a
17.5 fish/m^2	0.45 ± 0.12 a	1.17 ± 0.45 a	62.03 ± 5.08 a
16-cm fish	1.37 ± 0.12 a	2.14 ± 0.60 a	58.28 ± 12.64 a
21-cm fish	1.78 ± 0.12 a	2.10 ± 0.60 a	89.04 ± 12.64 a

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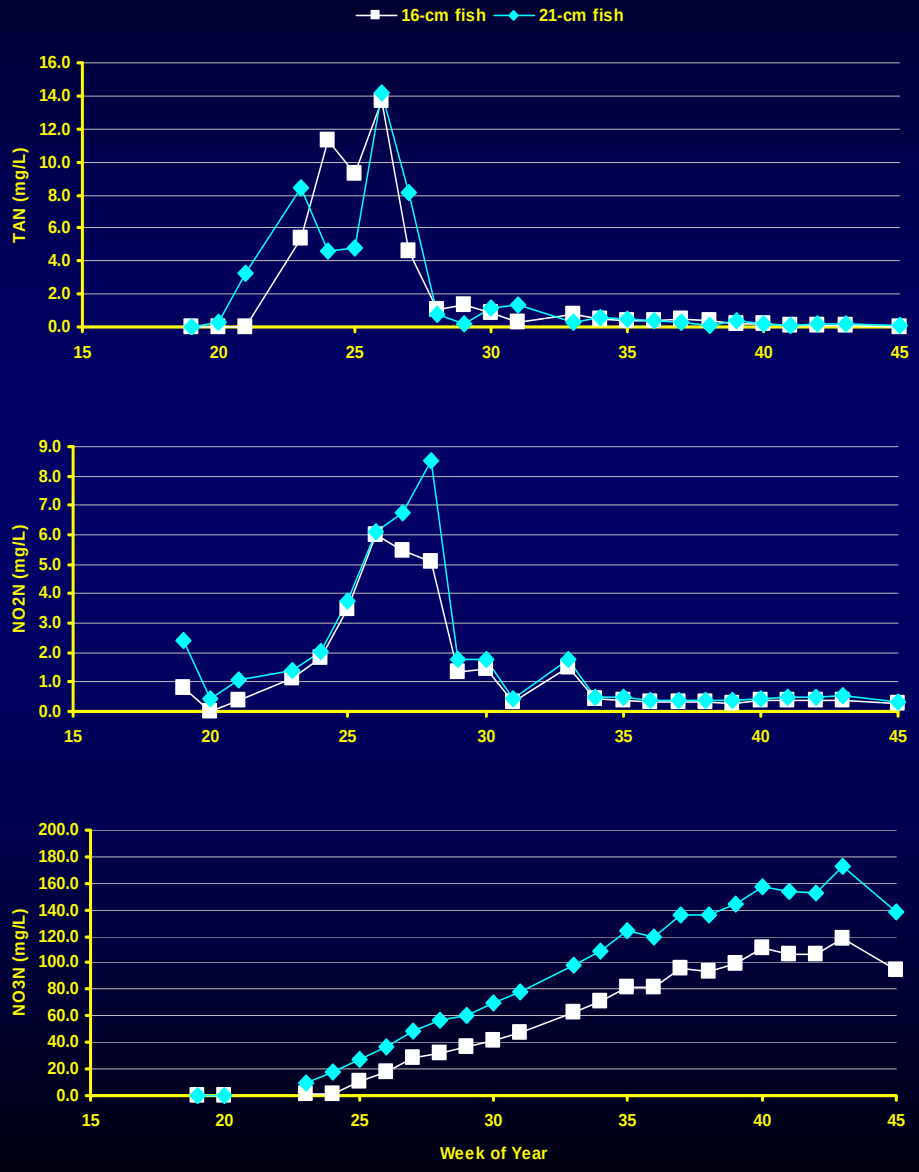
Weekly Nitrogen Concentrations



Water Quality

LS Means ± SE

Treatment	PO_4-P (mg/L)	Chlorophyll *a* (mg/m^3)	Settleable Sol (mL/L)	TSS (mg/L)
7.5 fish/m^2	12.2 ± 1.5 a	1,021.7 ± 99.8 a	34.1 ± 3.6 a	401.2 ± 26.9 a
12.5 fish/m^2	16.9 ± 1.5 ab	851.9 ± 99.8 a	43.0 ± 3.6 a	439.4 ± 26.9 a
17.5 fish/m^2	19.2 ± 1.5 b	738.0 ± 99.8 a	36.6 ± 3.6 a	443.3 ± 26.9 a
16-cm fish	15.3 ± 2.4 a	1,139.9 ± 123.3 a	35.1 ± 5.7 a	364.2 ± 22.1 a
21-cm fish	19.7 ± 2.4 a	1,194.5 ± 123.3 a	38.3 ± 5.7 a	411.9 ± 22.1 a

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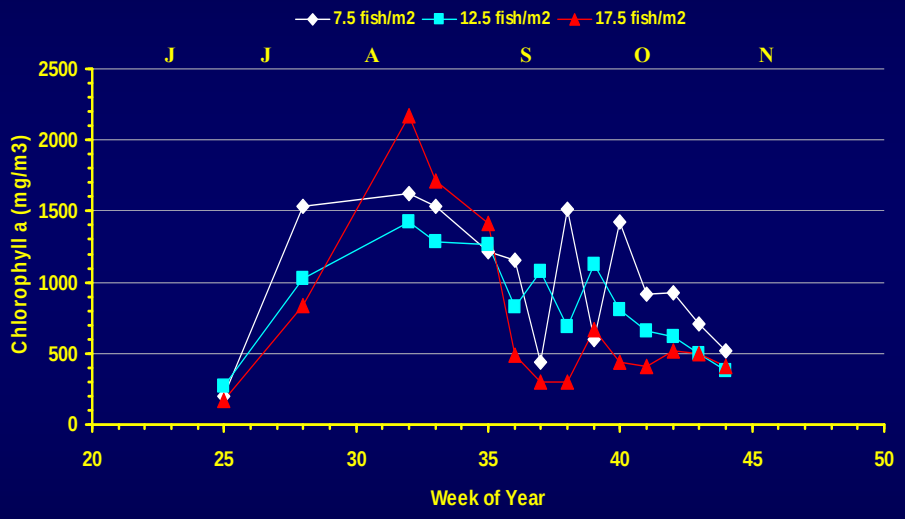
Water Quality Relationships

	TSS		CFB	
	Study 1	Study 2	Study 1	Study 2
TAN	+	++	+	++
NO_2N		+	-	+
NO_3N	++	++	++	++
Chlorophyll *a*	-		--	
pH	--	--	--	--
Settleable solids	+	++	+	++
PO_4P	++	++	++	++
CFB	++	++		

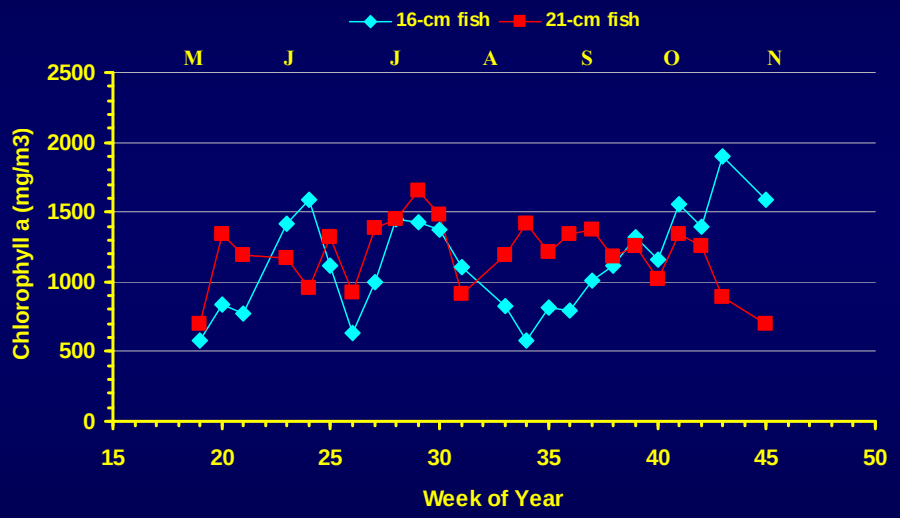
-, +: $R^2 \leq 0.33$
--, ++: $R^2 > 0.33$

Chlorophyll *a*

Study 1



Study 2



Production Data

Treatment	Yield			Average Weight	Survival	
	Gross	Net	Net Daily			
	(kg/m^3)		($g/m^3/d$)	(kg/fish)	(%)	FCR
7.5 fish/m^2	3.5 b	3.1 b	22.2 b	0.40 a	96.4 a	1.58 a
12.5 fish/m^2	5.2 a	4.4 ab	32.2 ab	0.36 a	96.3 a	1.57 a
17.5 fish/m^2	5.8 a	4.8 a	35.0 a	0.31 a	88.9 b	1.63 a
16-cm fish	5.2 a	4.7 a	23.6 a	0.39 a	89.1 a	1.52 a
21-cm fish	6.8 a	5.8 a	29.0 a	0.52 a	84.0 a	1.58 a

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Summary

- **Combined photoautotrophic -chemoautotrophic system**
- **Sustained high feed rates**
  - **CFB → 10,000 mg/L, TSS < 700 mg/L**
- **High channel catfish productivity & survival**
  - **Net yield increased linearly as stocking rate increased from 7.5 – 17.5 fish/m^2**
  - **No effect of initial biomass at rates tested**
  - **FCR not affected by stocking rate or initial biomass**

Acknowledgement

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