

CHANNEL CATFISH PRODUCTION IN THE PARTITIONED AQUACULTURE SYSTEM



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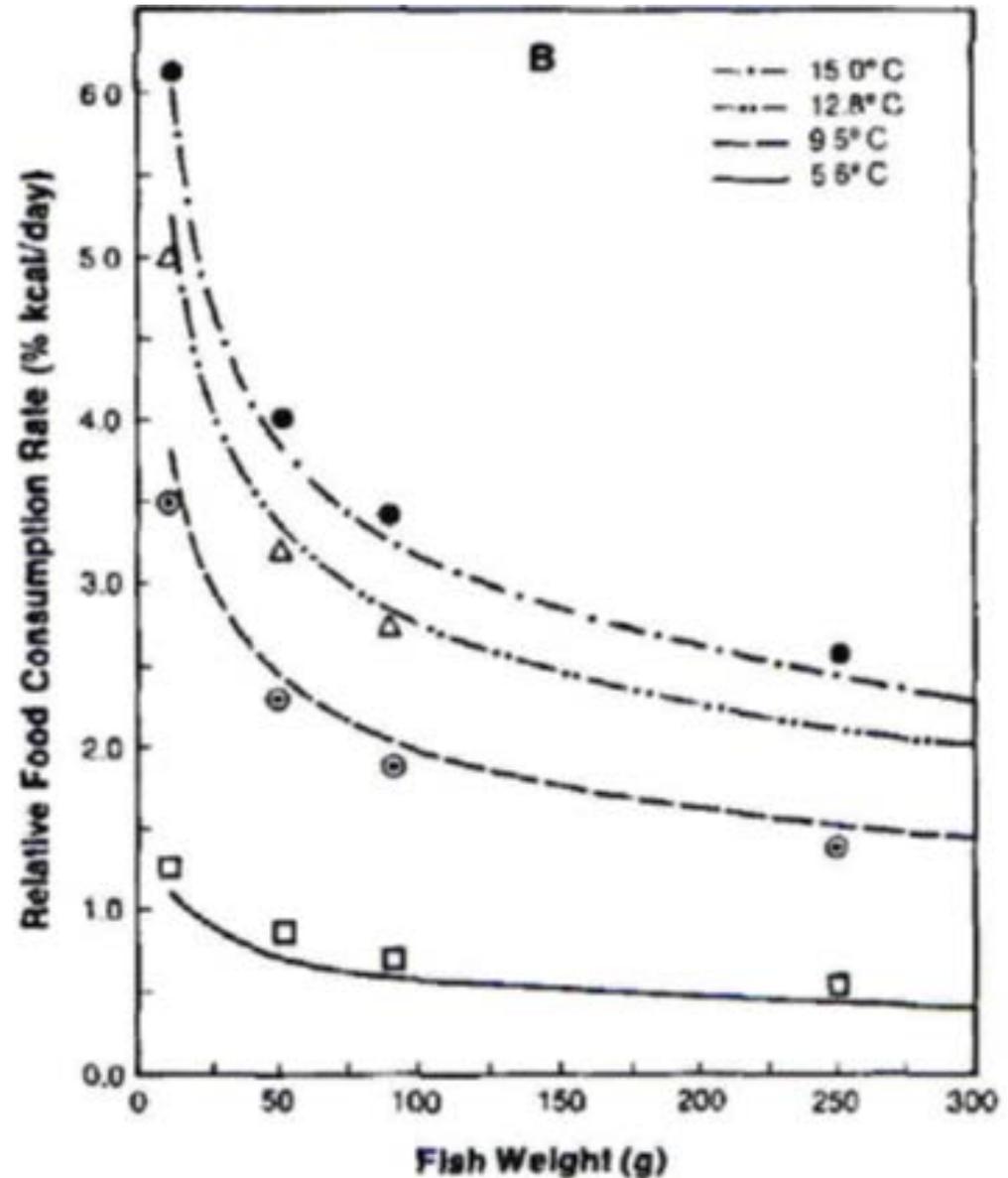
Theoretical Model of Fish Growth and Food Consumption

Long history of attempts to develop models of fish growth and feed uptake;

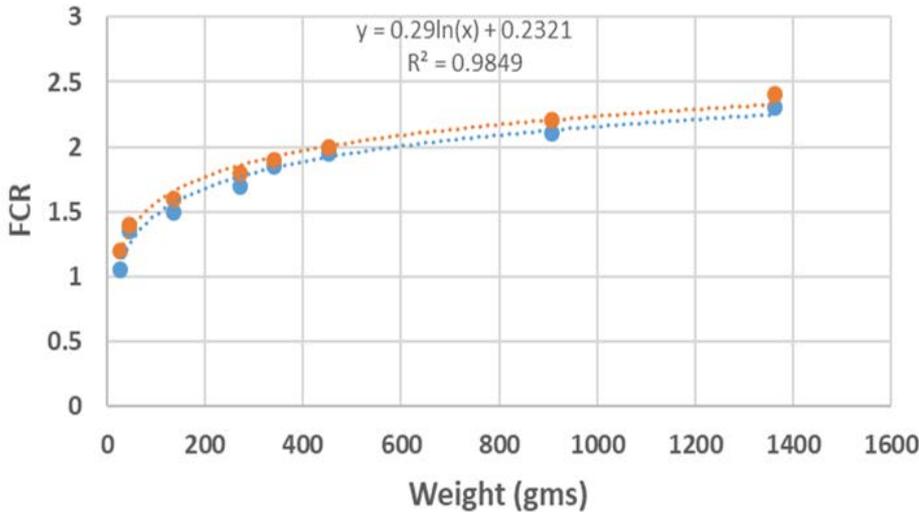
$$*\text{Feed/Weight} = A + B (\ln W)$$

where; **A, B = constants, W = Weight**

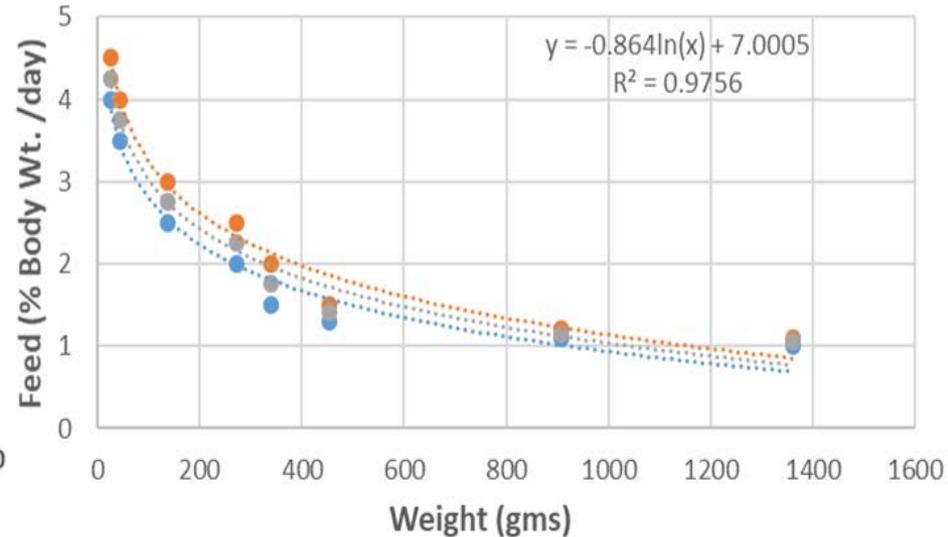
*Cuenco, M.L., R. R. Stickney and W. Grant,
Fish Bioenergetics and Growth in Aquaculture
Ponds, Ecological Modeling, 27, 1985 169-190



Lovell FCR vs wt (gms)



Lovell Catfish Feed Uptake



Robinson ⁽¹⁾ and Lovell ⁽²⁾ suggested (without data presented) catfish feed uptake and food conversion ratio (FCR) can be predicted as log expressions:

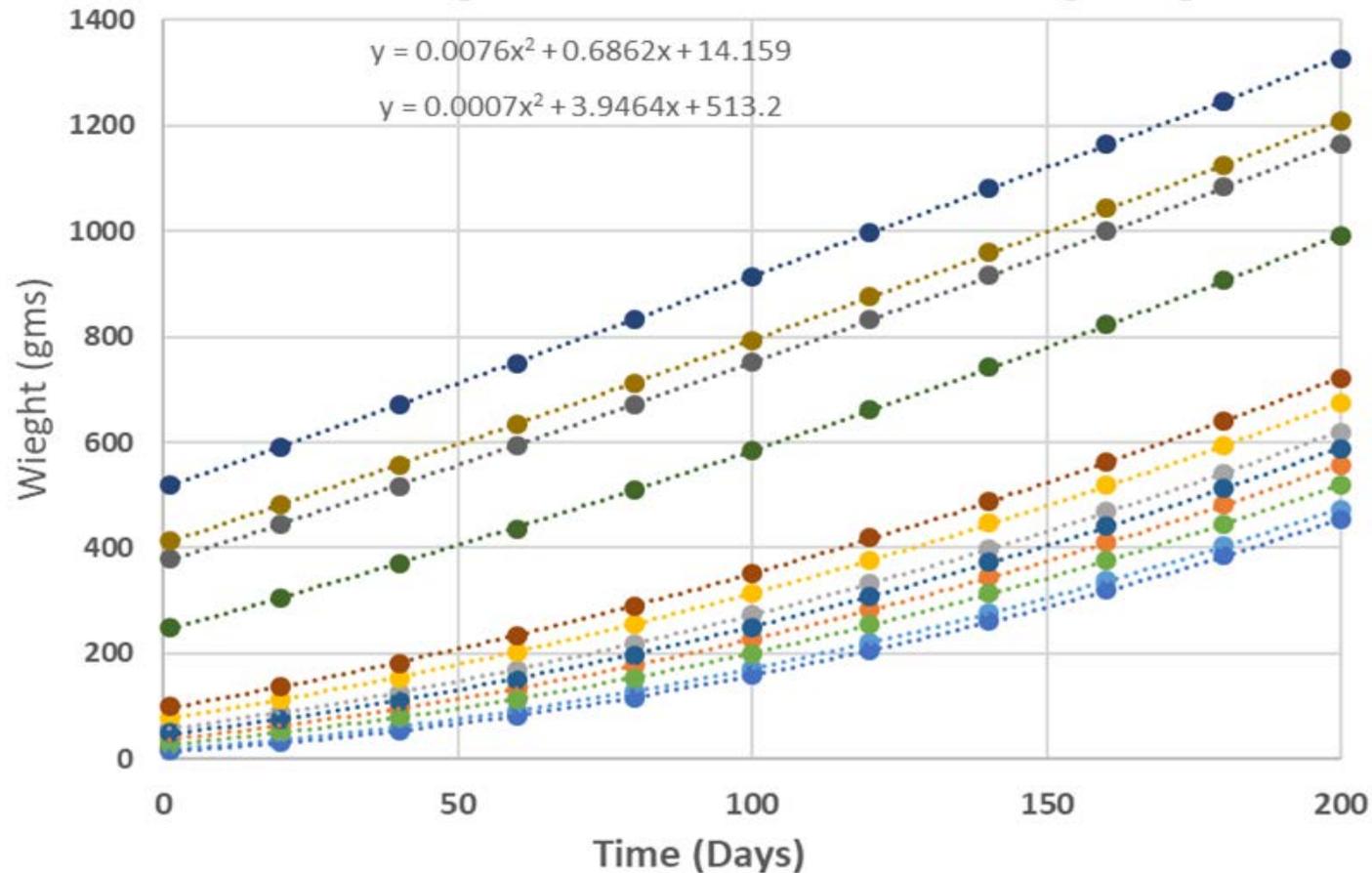
$$\% \text{Feed per day/body weight} = 7.0005 - 0.864 \ln (\text{Weight gm})$$

$$\text{FCR} = 0.2321 + 0.29 \ln (\text{Weight gm})$$

¹ Robinson, E. H., Li, M.H., and M. W Brunson, Feeding Catfish in Commercial Ponds, SRAC Publication, No. 161, 1998.

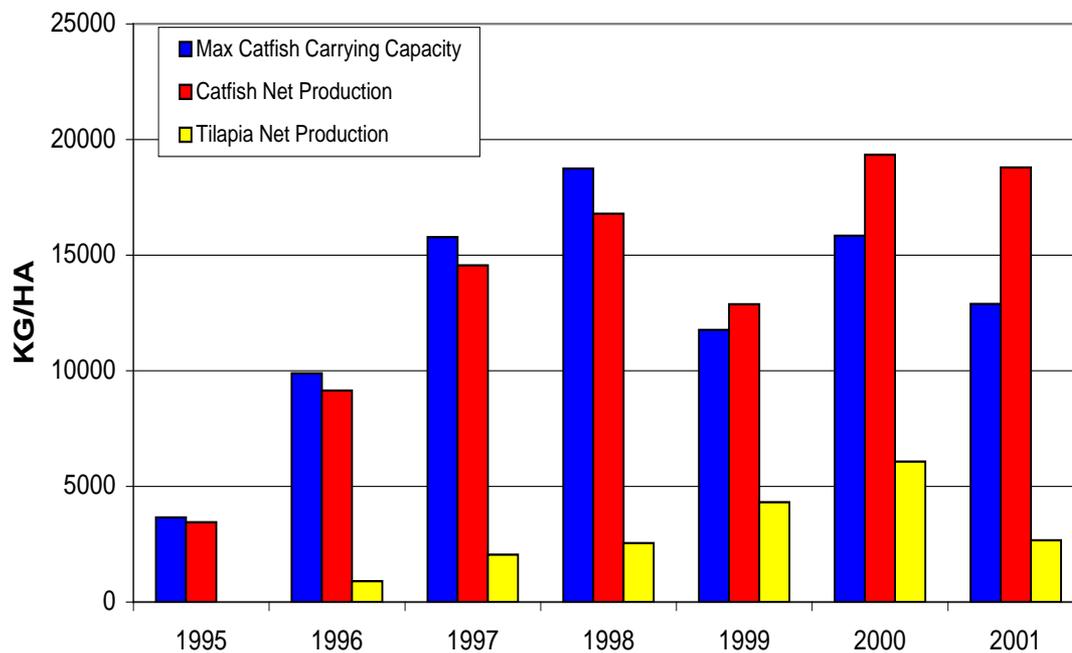
² Lovell, T.,(ed), Nutrition and Feeding of Fish, Kluwer Academic Publishers 2nd edition, 1998.

Catfish Weight vs Time at Various Stocking Weights



These equations can be used to predict catfish weight gain vs time at optimum temperature and water quality as:

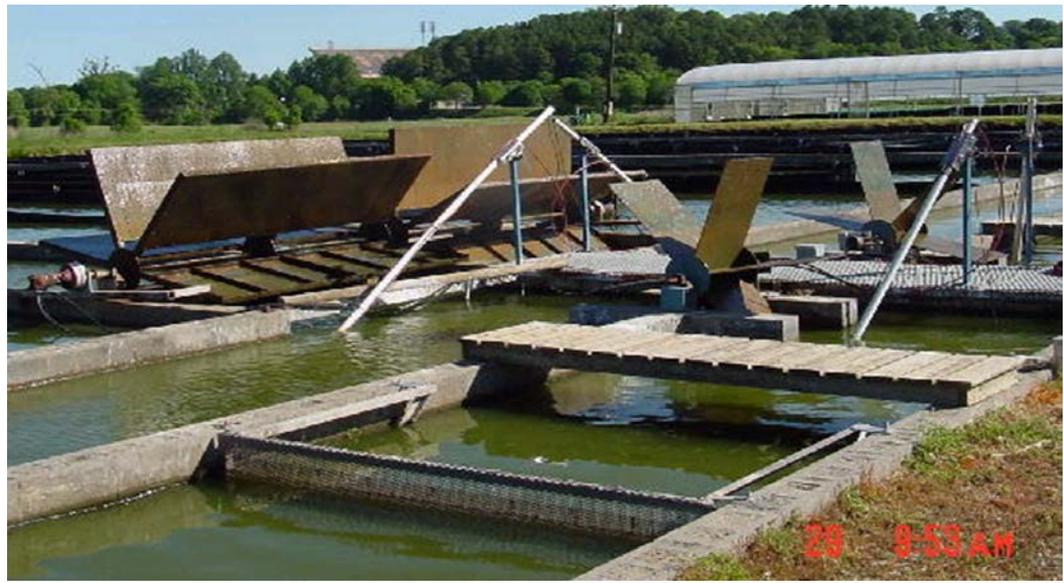
$$\text{Weight}_{(t)} = A (\text{days})^2 + B (\text{days}) + C (\text{stocking weight, gm})$$



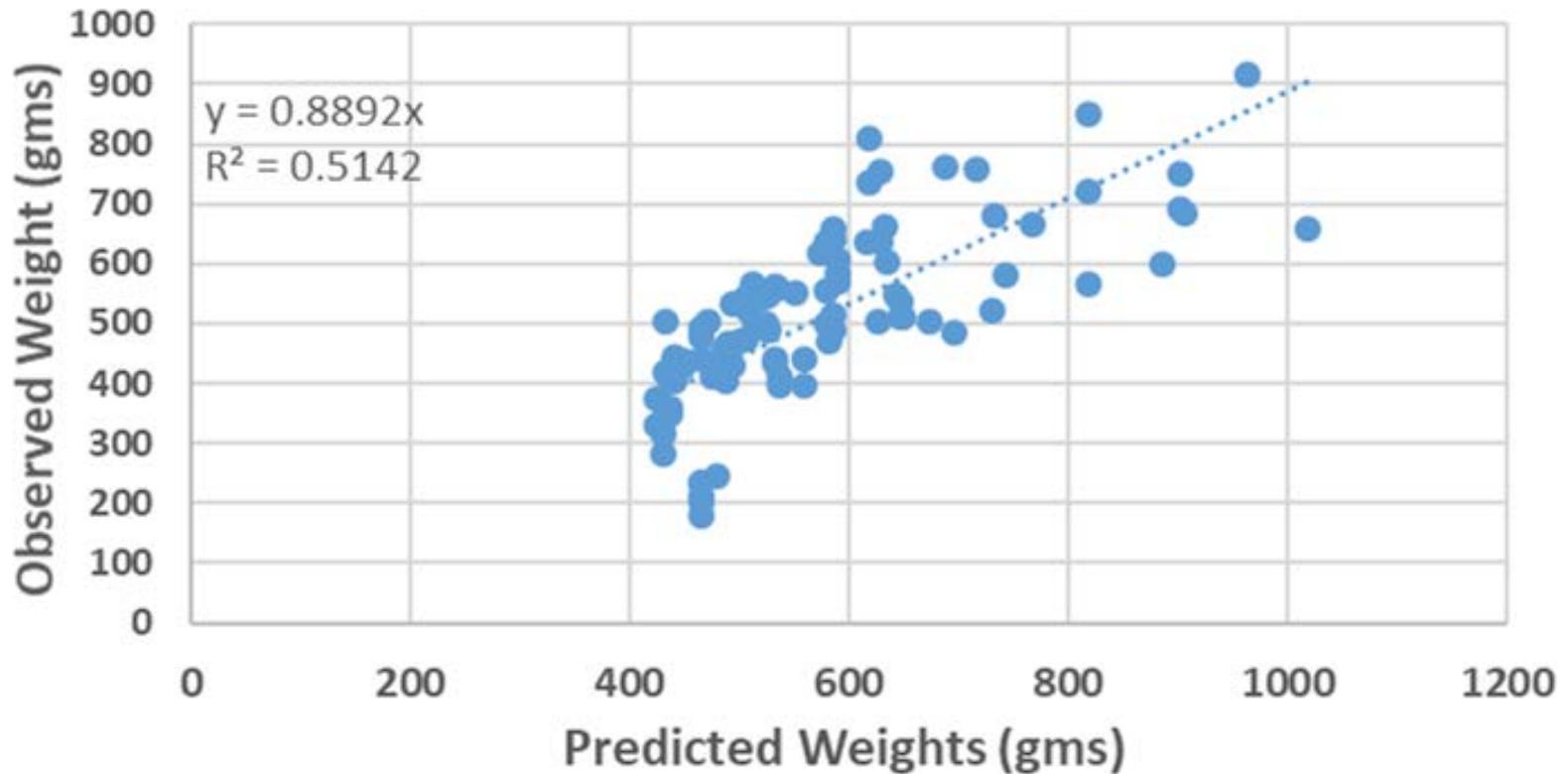
In an attempt to validate Lovell's feed uptake and growth predictions, data from six years of catfish growth trials in Clemson's Partitioned Aquaculture System was compared to fish growth predictions generated from Lovell's relationships;

- **Six 1/3-acre units with 3 raceway pens** per unit yielding 10K-19K kg/ha (9K-17K lb/acre)
- Paddlewheels providing 0.3-0.5 fps algal raceways, and 0.08-0.35 fps fish raceways
- Stocked with channel catfish at **16 to 500 gm/each, with 1,000-3,000 fish/pen**
- Growing season of 45-191 days, **averaging 152 days**, fish survival 38-100%.
- **82,000 measurements** of feed consumption, DO, ammonia, temperature, pH and nitrite

**Clemson PAS with
Paddlewheels
Moving Water in
Algal Culture Basin
and Fish Raceways**



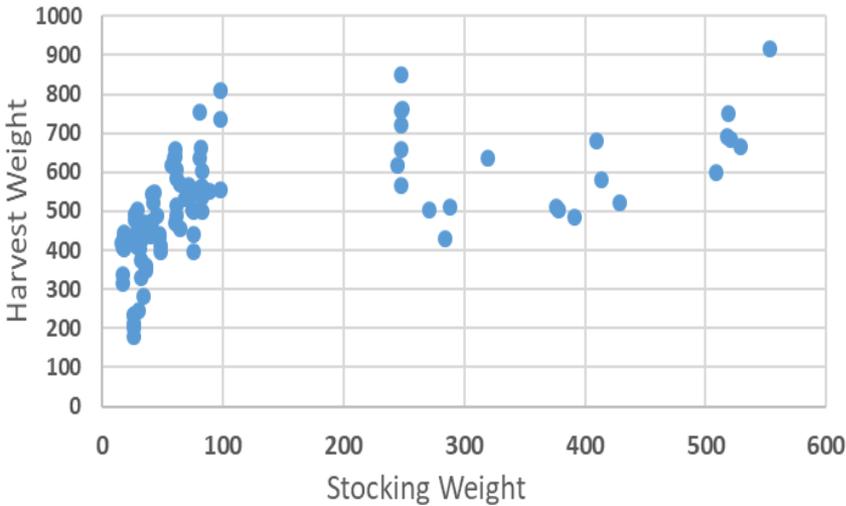
PAS Catfish Harvest Weights vs Predicted



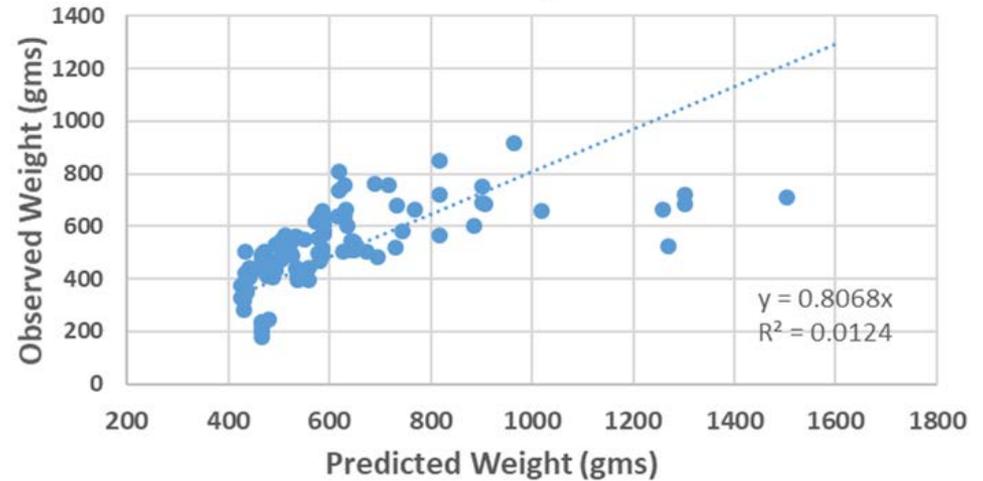
Final Predicted Catfish Harvest Weight (from Lovell equation) vs Observed Weight from PAS Growth Trials with Catfish Stocking Weight Less than 100 gm (88 culture trails)

Substantial variation within predicted weights, general agreement with predicted log growth

Catfish Stocking vs Harvest Weight

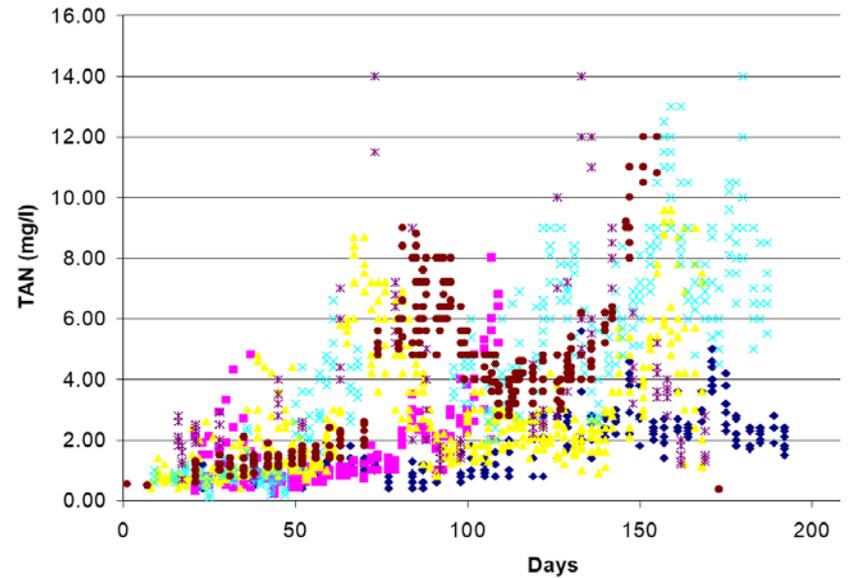
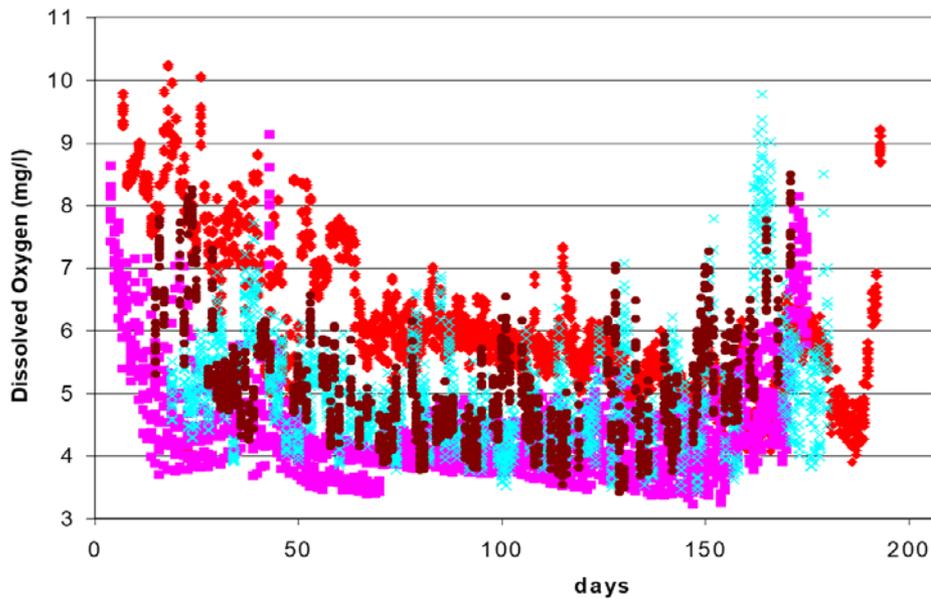


PAS Catfish Harvest Weight vs Predicted



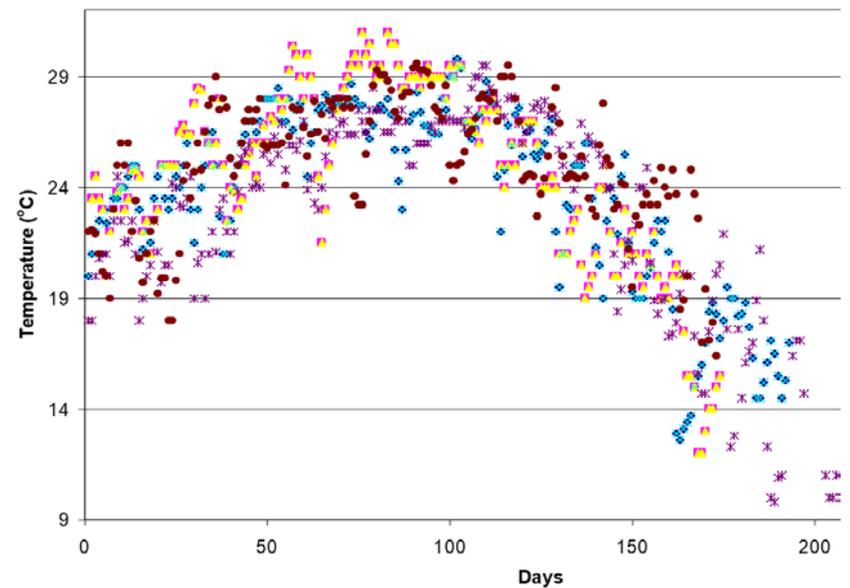
Final Predicted Catfish Harvest Weight (from Lovell equations) vs Observed Weight from PAS Growth Trials Including Catfish Stocking Weight of 240-550 gms (20 culture trials)

Fish stocked at large size (>240 gms) significantly under-performed relative to predicted growth



Aranguren⁽¹⁾ presented a model to modify/adjust observed feed uptake as a function of raceway temperature (10-32°C), dissolved oxygen (3-10 mg/l), and free ammonia (0-3 mg/l).

(1) Aranguren, A., A Model of Channel Catfish Growth in the Partitioned Aquaculture System, PhD Dissertation, Clemson University, 2004



Pooled Observations of Catfish Feeding Rate vs Modified Predicted Feeding Rate

Lovell equation

$$\text{Feed} = 7.005 - 0.864 (\ln \text{ gm})$$

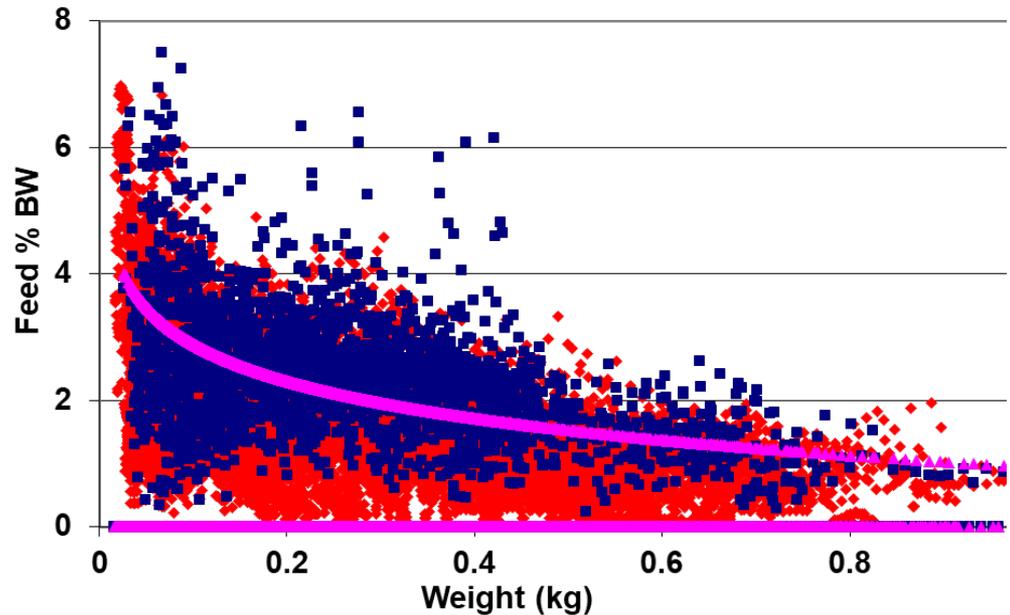
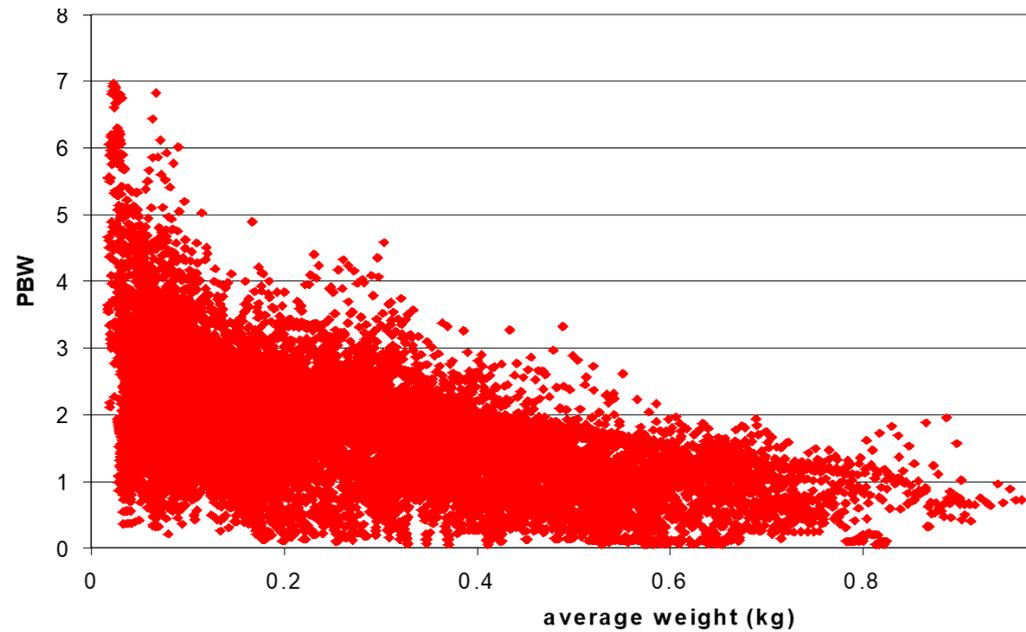
VS

Modified equation

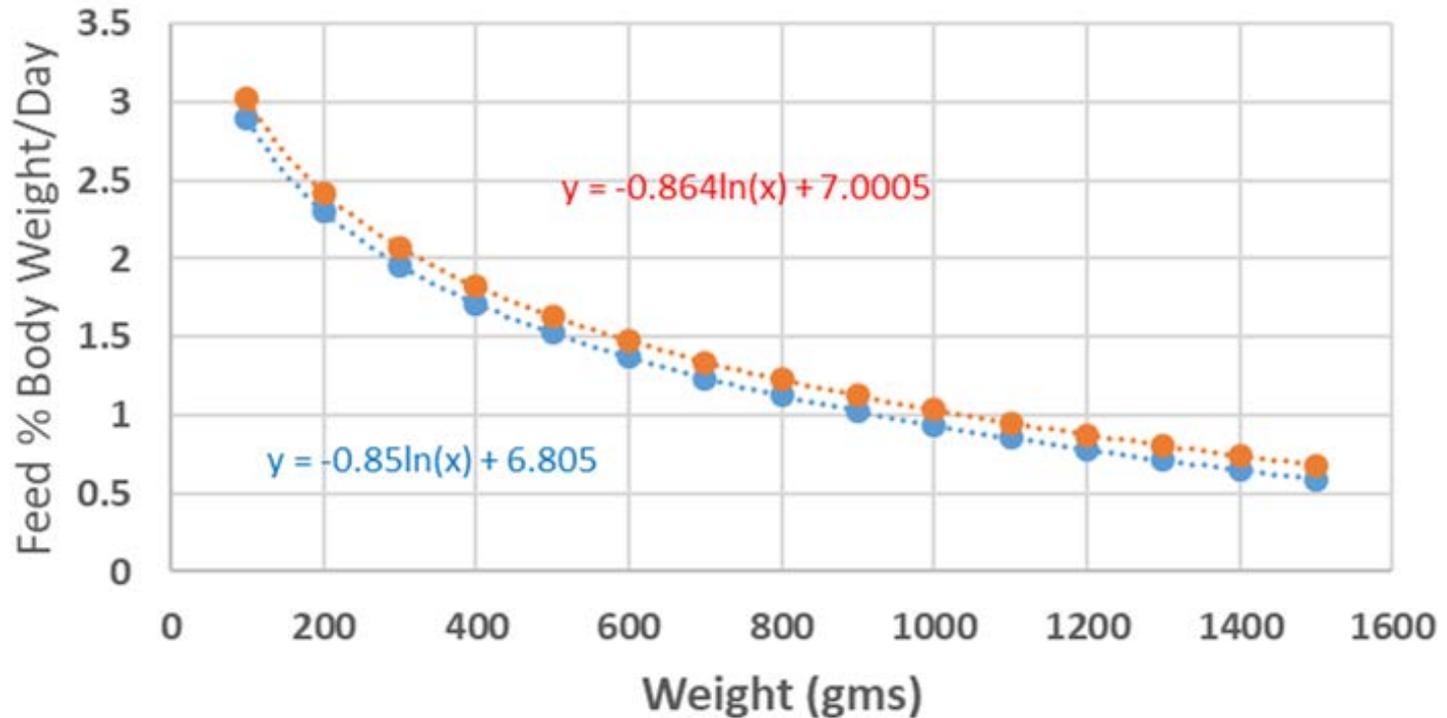
$$\text{Feed} = 6.805 - 0.85 (\ln \text{ gm})$$

$$\times F_{\text{O}_2} \times F_{\text{NH}_3} \times F_{\text{temp}}$$

50% Reduction in (sum of errors)²



Lovell vs Modified Feed Uptake Prediction



Lovell vs Modified Feed Uptake Equation

Relative to Lovell, modified equation under-predicts feeding (4.5% at 100 gms, and 15.8% at 1,500 gms).

Summary

Equations predicting catfish weight vs time, at optimum culture conditions was prepared from feeding rate and FCR relationships suggested by Lovell/Robinson.

A comparison of observed weights of catfish from 88 PAS growth trials over six years suggests general agreement with Lovell log feed uptake/FCR prediction for fish stocked at weights < 100 gms.

Observed weights of catfish from 20 PAS growth trial over six years suggest 40-50% under-performance for fish stocked at weights > 240 gms.

A log feed uptake equation modified by temperature, oxygen, and ammonia correction factors improves fit to observed feed uptake data by 50%.

The modified equation under-predicts channel catfish feeding by 4.5% (100 gms) to 15 % (1,500 gm) relative to Lovell equation.

Question or Comments?

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See you in San Diego 2022