Optimal Harvest Time for *S. rivoliana* with Soy Mariculture Diet

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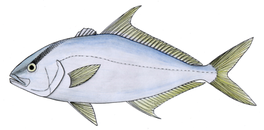
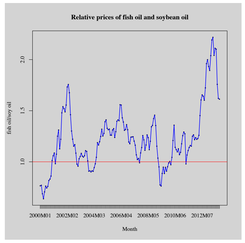


Introduction

- In 2011, global aquaculture production of food fish was 62.7 mmt, almost double compared to 2001 (FAO, 2013).
- Production of global aquafeed was about 34 mmt in 2012 (Alltech, 2013), while in 2000 it was only 4.5-4.6 mmt (Tacon, 1997).
- Fishmeal and fishoil have been primary components in aquafeed, but the rapid growth of aquaculture is putting pressure on fisheries that provide these components, and increasing fish oil prices relative to soy oil prices.
- Experiments have shown soy protein concentrate (SPC), can successfully replace fishmeal in these diets, while genetically engineered soybean oil rich in omega-3 fatty acid can successfully substitute for fishoil (Clemente, 2013).



Objectives

The overall objective of this research is to investigate the economic feasibility and potential impact of high omega-3 soybean oil for deep-water aquiculture. Here we report differences in growth curves, optimal harvest age, and production costs when the *S. rivoliana* species are fed the soy-based ration instead of the traditional fish-based ration.

Methods

1. Fish growth under the two diets is estimated as logistic functions, feed consumption as power functions.
2. Asset replacement principles derived by Perrin (1972) are used to identify the marginal condition for optimal harvest age:

$$R(s) + M^{'}(s) = \rho M(s) \qquad (1)$$

Where, R(s)= flow of costs at age s, $M^{'}(s)$=change in sale value of the asset at age s, and ρ =continuous-time interest rate.

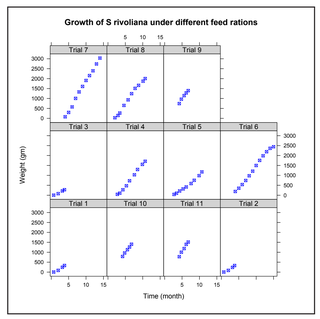
Replacing M(s) and R(s) with the estimated functions:

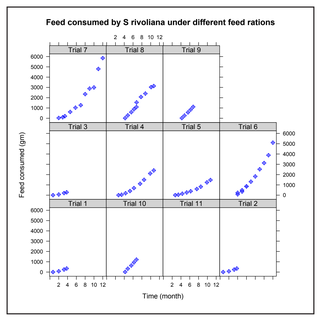
$$-\gamma_1\gamma_2 S^{(\gamma_2-1)} + \frac{p\beta_1\beta_2 exp^{(\beta_2-\beta_3 S)}}{(1+exp^{(\beta_2-\beta_3 S)})^2} = \frac{\rho p\beta_1}{1+exp^{(\beta_2-\beta_3 S)}} \qquad (2)$$

Data

Data from eleven experimental trials are pooled for estimation of the functions, categorized into two groups:

- Soy-based rations (STA, SOY, and Kuehnle): Trials 1,2,4,9,10.
- Traditional rations (Skretting and EWOS): Trials 3, 5-8, 11.

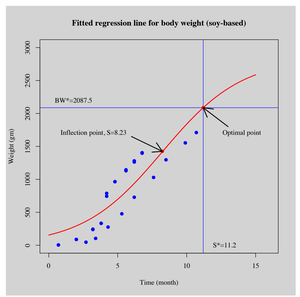


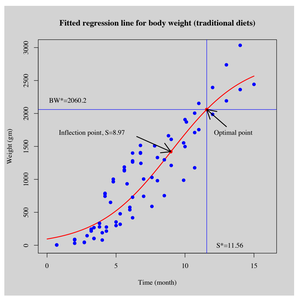


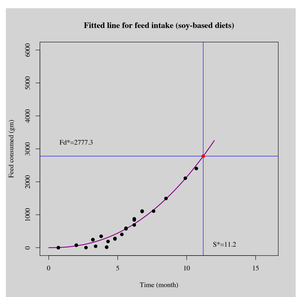
Source: UNL-Kampachi experiments, 2010-2013.

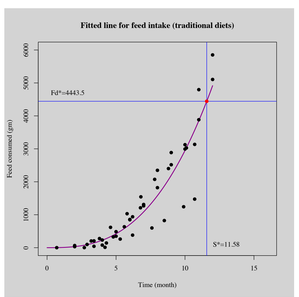
Results

- Estimated optimal harvest age is 11.20 months with soy ration and 11.56 months with traditional ration (about 10 days difference)
- Optimal body weights are about 2.08 kg and 2.06 kg per fish, respectively (about 27 gm difference).









Results

Table 1: Variables and parameters estimates at the optimal level

	Soy-based	Traditional
Price of fish ($/Kg)	12.5	12.5
Price of feed ($/Kg)	2.5	1.8
S* (age, months)	11.20	11.58
BW* (wt per fish, gm)	2087.5	2060.2
Fd* (feed consumption, gm)	2777.3	4443.5
FCR (feed to gain ratio)	1.33	2.15
Cost ($/fish)	6.94	7.99
Cost ($/Kg of fish)	3.32	3.88
Revenue ($/fish)	26.09	25.75
Revenue ($/Kg of fish)	12.5	12.5
Revenue - feed cost ($/fish)	19.15	17.75
Revenue - feed cost ($/Kg of fish)	9.17	8.61

Conclusion

- The optimal time to harvest fish, and body weight at optimal ages are almost the same under both feed rations.
- The amount of feed per kg of fish is lower for the soy ration.
- The inclusion of high omega-3 soy oil along with SPC in diets for *S. riviolana* results in lower feed cost per kg of fish than traditional diets, under estimated prices.

References

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