Effects of Different Fish Feed Percentages on Growth Rates of Cobia, *Rachycentron canadum*.

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Introduction

Aquaculture is the farming of fish and other aquatic animals and plants. The decline in global fish stocks has led to an increase in aquaculture in recent decades making it a major source of food worldwide (Naylor *et al.* 2000). Aquaculture provides an important source of protein for humans and has the potential, if practiced sustainably, to alleviate the current stress on wild fish stocks as an alternative source of fish (Naylor *et al.* 2000). However, large amounts of wild forage fish from low trophic levels are used in fishmeal fed to carnivorous farmed fish (Naylor *et al.* 2000). This only increases the stress on global fish populations. If the aquaculture industry is to fulfill its potential as an alternative source of fish for human consumers and relieve the stress on wild fish stocks, it must be practiced in a much more sustainable and efficient way than it is now (Naylor *et al.* 2000).

Cobia, *Rachycentron canadum,* is considered a good species for aquaculture. It is one of the most efficient fish grown in commercial aquaculture because of its high growth rate and low food conversion ratio, which is the ratio of food consumed by the fish to the amount the fish grows. (Benetti *et al.* 2010). Furthermore, cobia's high quality flesh makes it an excellent table fish (Kaiser and Holt, 2005). The substitution of up to 75% of fishmeal protein in the diets of juvenile cobia with plant based protein has been shown to produce a statistically equal performance rate to juvenile cobia fed aqua feeds containing 100% protein from fishmeal (Salze *et al.* 2010). There remains a need for further information in the effectiveness of substituting specific percentages of fishmeal in the diets of cobia.

The purpose of this study was to compare the growth rates of cobia fed different percentages of fishmeal. It was hypothesized that the fish fed the higher percentages of fishmeal would have the fastest growth rate.

Figure 1: Cobia in the holding tank during biometrics

Figure 2: Elizabeth and Izza weighing a cobia during biometrics

Figure 3: Marco catching fish for biometrics

Figure 4: Elizabeth feeding the cobia in one of the tanks

Methods

The study took place in Cape Eleuthera, Bahamas at the Cape Eleuthera Institute (CEI) in the spring of 2011. The lab was divided into two sides (figure 1): East side and West side. All tanks were connected to a central raceway, held 13,000 liters and were 3.64 meters in diameter. East side tanks that had bagfilters over the in-flow that filtered to 200 microns. West side tanks had Triton fiberglass sand filters. Each tank had 2 airstones for aeration. Flow rates were measured twice a week in each tank and ranged from 300% to 700% turnover per day. Dissolved oxygen and temperature were monitored daily in all tanks.

The study began with 720 cobia fish that were equally divided into four tanks contained 180 fish. The study started when the cobia were 172 days post hatch and continued for 2 months.

Tanks West 1 and East 1 were fed fish feed containing 80% fishmeal. Tanks West 2 and East 2 were fed fish feed containing 40% fishmeal (Figure 1). The fish were hand fed twice a day, once in the morning and once in the afternoon, until satiation.

Biometrics were performed once a week to measure the growth of the fish. 15 fish were randomly selected from each tank, placed in a holding tank, and then measured individually. The fishes' weight, standard length, and total length were measured. Weight was measured in grams. Standard length is the measurement of the length from the front of the head to the caudal peduncle (mm). Total length is the measurement of the length from the front of the head to the end of the tail (mm).

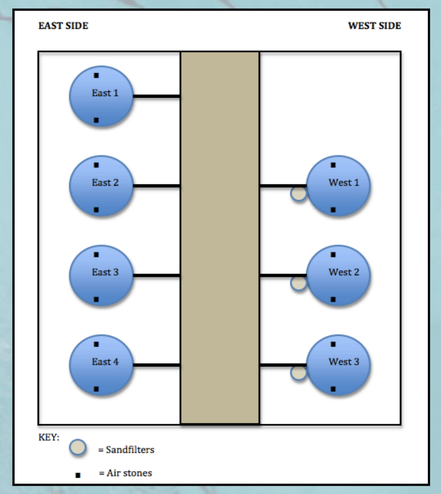

Figure 5: The lab divided into East side and West side. All the tanks are connected to the central raceway and have air stones. West side has sandfilters and the east side has bag filters. East 3 & 4, and West 3 are not a part of the study.

Figure 6: A cobia in a weighing bucket during biometrics

Results

The parameter and biometric data was analyzed using T-tests. Temperature, and dissolved oxygen had a uniform affect across all the tanks and impacted the cobia's growth rates equally. Flow rates varied significantly across the tanks, but there was no statistical difference in the data.

The statistical analysis on the biometric data produced probability values (p-values), which when below 0.05 meant the data compared was statistically different, but when greater than 0.05 there was no statistical difference. These tests were run using average mass of the fish fed 80% fishmeal, compared to the fish fed 40%, with a resulting p-value of 1.000 (table 1), therefore there is no statistical difference in the growth rates of the fish fed 80% and 40% fish meal (figure 7). Next, the percent growth per day of the fish fed 80% was compared against the fish fed 40%, resulting in a p-value of 0.729 (table 1). Finally the food conversion ratio of the fish fed 80% was tested against the fish fed 40%, the p-value was 0.367 (table 1). From these tests it was noted that there was no statistically significant difference in the data.

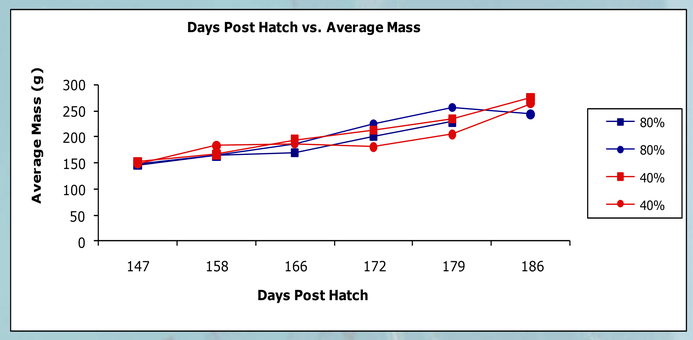

Figure 7: The growth rate of the cobia over the course of the study

Figure 8: Emma taking parameters in one of the tanks

Feeds (80% vs. 40%)	Average Mass	P =1.000
	% Growth/Day	P =0.729
	Food Conversion Ratio	P =0.367

Table 1: The P -values of the average mass, percent growth per day and food conversion ratio for the cobia fed feed containing 80% fishmeal.

Discussion

Figure 7 demonstrates that there was no significant difference between the growth rates of the fish fed the feed containing 80% fishmeal and the fish fed the feed containing 40% fishmeal. The hypothesis that the fish being fed 80% fishmeal would have the fastest growth rates can be rejected, and it can therefore be concluded that fishmeal percentages in cobia feeds can be reduced to 40% without decreasing the cobia's growth rates. Because of this, it would be beneficial if further research could be done in this study to identify if there was a lower content of fishmeal feed to use for the fish. Using 40% fishmeal to feed the cobia would make aquaculture more sustainable but it is still requiring forage fish to make the feed. Research could compare the growth rates of cobia fed 40% fishmeal and cobia fed feed containing less than 40% fishmeal. In the study by Salze et al. (2010), they were able to successfully eliminate 100% fishmeal using a marine worm and 94% fishmeal using soy ingredients. However, findings are different from that of Chou et al. (2004) who found a reduction in the growth rates of cobia fed less than 50% fishmeal. The difference between these studies may have been due to the use of different ingredients used to replace the fishmeal. It would therefore also be beneficial to conduct research on alternative feed ingredients. Zhou et al. (2004) tested defatted soybean meal, peanut meal, yeast powder, wheat flour, poultry meal, as well as other soy meal ingredients to supplement fishmeal with amino acids, but corn gluten, fishmeal and poultry meal produced the best results. Other alternatives include amino acids and terrestrial plant ingredients. Being able to reduce the amount of fishmeal in cobia diets will help reduce the aquaculture industry's dependence on wild forage fish for feed, and help increase its sustainability.

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