BIOMETRICS AND FEED UTILISATION OF ARTIFICIALLY SPAWNED *Heterobranchus longifilis* VALENCIENNES, 1840

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ABSTRACT
The biometrics over a 22-week culture period of juvenile Heterobranchus longifilis was investigated with a view to determining levels of feed utilization within a commercial scale concrete pond cum water recirculation production system. The standard length, total length and weight of individual sampled fish were measured fortnightly with the aid of a measuring board for length determination and a digital Acculab 300-electronic balance for the latter, throughout the exercise. Negative allometry was observed with respect to the linear relationship between fish standard length and total length. While, that between fish weight and standard length showed a positive allometric growth pattern represented by weight (g) = -216.98 + 27.65x. Heterobranchus longifilis is an efficient utilizer of feed recording a live weight gain of 3.51g for every 1g of feed consumed. This is further evidenced by a growth utilization of feed value of 0.28 and mean condition factor of 1.7 obtained. Heterobranchus longifilis has significantly high survival and growth potentials. Growth rate though of genetic basis is influenced by feed accessibility and utilization.
Key words: Biometrics, Growth, *Heterobranchus longifilis,* Utilization

INTRODUCTION

The profitability of the aquaculture industry has become widely known (Huda *et al*., 2002). There is increased global attention on aquaculture because of the need to augment fish production from the wild. This is particularly noticeable in populous countries like Nigeria where there is high protein demand (Owodeinde *et al*., 2011). Aquaculture is acknowledged as the efficient means of providing food which is rich in protein, certain minerals, vitamins and valuable lipids. It is also a source of income and employment opportunities to the populace (Ojutiku, 2008).

One of the factors militating against fish seed production is meeting the dietary protein requirement. The optimum dietary protein requirement for the maximum growth and gonadal maturation of female *Heterobranchus longifilis* broodstock as determined by Madu *et al*. (2003) was 40% crude protein. Eyo (1996) stated that 42.2% dietary protein was required by fingerlings of *H. longifilis* and 40% crude protein was adequate for the female brooders.

Growth is an important component of biological production which directly affects the overall production. Negative changes in growth rates may result in poor individual health, reproductive failures and increased risk of predation and mortality (Wootton, 1990). Onimisi and Oniye (2010) reported that length-weight relationship of a fish is basically a measure of its growth pattern. *Clarias gariepinus* and *H. longifilis* are two commonly cultured clariid fishes that are very popular among fish farmers and consumers in Nigeria (Ojutiku, 2008). The rapid growth potential, amongst other qualities, of *H. longifilis* has stimulated multi-disciplinary research on this species on hybridization, growth and nutrition by Akinwade (2011), Onibaze (2000) and Eyo (2006), respectively. Despite this huge body of researches, virtually no documented information is available on the differential growth patterns of artificially induced *H. longifilis* in northern Nigeria. This research aimed at assessing the feed utilization and growth levels of artificially spawned *H. longifilis* within an intensive water recirculation system.

MATERIALS AND METHODS

Description of the Study Area

The culture exercise was carried out at Sama fish farm, Mando. Mando is situated in Igabi Local Government Area of Kaduna, Kaduna State, which falls on latitude 10º49′06″N and longitude 6 º42 ′00 ″

E. The annual rainfall in Kaduna varies from 0.0–825.0mm per month reaching its peak in August. Temperature during peaks of breeding season (June to September) ranges from 22-29 ºC and as low as 17 ºC in the dry season (Google Imagery, 2013).

The experimental system in Sama Fish Farm consists of sixteen 5m × 2.5m enclosed built up rectangular concrete grow out ponds with a water depth of 1m, and three 5m × 1.5m enclosed rectangular broodstock ponds with a water depth of 1m, a functional bore-hole, a 5m × 4m built-up concrete reservoir, the sedimentation, biofiltration and ultra violet treatment chambers, various aeration units. The different sections were systematically connected in a water recirculation management system.

Four thousand, eight hundred 8 week-old juveniles that had been hatched from triplicate crosses and raised on the farm were sorted, counted and transferred to six rectangular concrete grow-out ponds. The fish were nurtured on an artificial dry diet of 45% crude protein from Durante Superior Fish Concentrate catfish feed. Feed was administered twice daily at a rate of 5% of their biomass. The pellet size was adjusted to suit the diameter of the fish's buccal cavity from 2 mm diet pellet size as fish grew to 3, 4.5 and 6mm until they attained table-size.

Estimation of Growth Rate

The growth rate of 8 week-old juveniles of *H. longifilis* in concrete grow out ponds was monitored up to the attainment of table-size after 22 weeks. The standard length (cm), total length (cm) and weight (g) of individual sampled fish were measured fortnightly with the aid of a measuring board and a digital Acculab 300 electronic balance throughout the exercise. At the end of the experiment, the following variables were calculated as described by Madu *et al*. (2003):

i. Weight Gain (WG)

Weight Gain (g) = W_f - W_i

Where, W_f = Mean final body weight of fish

W_i = Mean initial body weight of fish

ii. Specific Growth Rate (SGR)

$$\text{Specific growth rate (\%)} = \frac{Log\ W_f - Log\ W_i}{t} \times 100$$

Where, t = Number of days of study

iii. Feed Efficiency Ratio (FER)

$$\text{Feed efficiency ratio} = \frac{\text{Wet weight gain of fish (g)}}{\text{Dry weight of total feed given (g)}}$$

iv. Feed Conversion Ratio (FCR)

$$\text{Feed conversion ratio} = \frac{\text{Total feed intake (g)}}{\text{Total wet weight gain of fish (g)}}$$

v. Protein Efficiency Ratio (PER)

$$\text{Protein efficiency ratio} = \frac{\text{Weight gain (g)}}{\text{Protein intake (g)}}$$

vi. Net Protein Utilization (NPU)

$$\text{Net protein utilization} = \frac{\text{Fish protein gained}}{\text{Protein consumed}} \times 100$$

vii. Nitrogen Metabolism (Nm)

The values of Nitrogen metabolism was calculated using the formula of Dabrowski (1977) as follows:

$$\text{Nm} = \frac{(0.54)(b-a)h}{2}$$

Where: a = initial weight of fish (g)
b = final weight of fish (g)
h = experimental period in days

Total length–Standard length Relationship of F1 generation

Linear regression analysis was used to compute the equation for the relationship between fish standard length and total length for the F1 generation. The linear relationship was represented by the equation:

Y=a+bx ………………… (Steel and Torrie, 1980)

Where,
Y = Fish standard length (cm)
× = Fish total length (cm)
a = Constant
b = Exponent

Length-weight Relationship

The relationship between length and weight relationships for the F1 generation of *H. longifilis* was calculated by a mathematical curvilinear relation as:

$W = aL^b$ …………………….. (Weatherly, 1972)

Where,

W = Weight of fish (g)

L = Length of fish (cm)

a = Constant

b = Exponent

Logarithmic transformation of the equation gave a linear relationship as:

$Log\ W = Log\ a + b\ Log\ L$ …………………………… (Bagenal and Tesch, 1978)

The values of a and b were then estimated through least square regression analysis.

Expressed logarithmically as:

$W = a + b\ Log\ L$………………… (Zar, 1984)

Where,

W = live weight in grams

L = total length in centimeters

Fulton's Condition Factor

Fulton's condition factor was calculated thus: $K = (\frac{W}{L^3}) \times 10^2$……………….. (Pauly, 1983)

Where;

W = weight in grams,

L = total length in centimeters

Estimation of Survival Rate

The survival rate of table-size fishes was determined by actual count method at the end of the study and calculated as:

Survival Rate (%) $= \frac{N_i - N_f}{N_i} \times 100$ …………………… (Fagbenro, 1996)

Where, N_f = final number of fish at the end of the study

N_i = initial number of fish at the beginning of the study

RESULTS

Growth Indices of *Heterobranchus longifilis*

Mean growth indices were recorded over the 22 week period of growth of juveniles to table-size. The linear relationship of the rate of growth with respect to standard length is represented by the equation: mean standard length (cm) = -4.49 + 2.07x. At the 22nd week standard length ranged from 34.6 to 42.7 cm ($\bar{x}$ = 38.6cm). The linear relationship of the rate of growth with respect to weight is represented by the equation; weight (g) = -332.85 + 56.60x. At the 22nd week, weight ranged from 601.5 to 1203.8 g ($\bar{x}$ = 1029.1 g).

The linear relationship between fish standard length and fish total length for the F1 generation is presented in Figure 1. This relationship is represented by the equation: mean standard length (cm) = -0.01 + 0.88x. The linear relationship between fish weight and standard length for *H. longifilis* F1 is presented in Figure 2. This relationship is represented by the equation: weight (g) = -216.98 + 27.65x.

Feed Utilization and Survival Rates of *Heterobranchus longifilis*

Thirty week-old *H. longifilis* had a mean increase in standard length of 21cm, mean weight gain of 1,010.8g and mean condition factor of 1.79, while a daily specific growth rate of 2.08% was recorded. Feed efficiency and gross utilization values of 3.51 and 0.28, respectively were recorded. With a protein efficiency ratio of 7.81, net protein utilized was 7.05%. Mean feed utilization of table-size *H. longifilis* F1 is presented in Figure 3. The value for nitrogen metabolism was 23,307.03. Survival rate increased as the fish grew (Figure 4), and a mean survival rate of 81.75% was obtained.

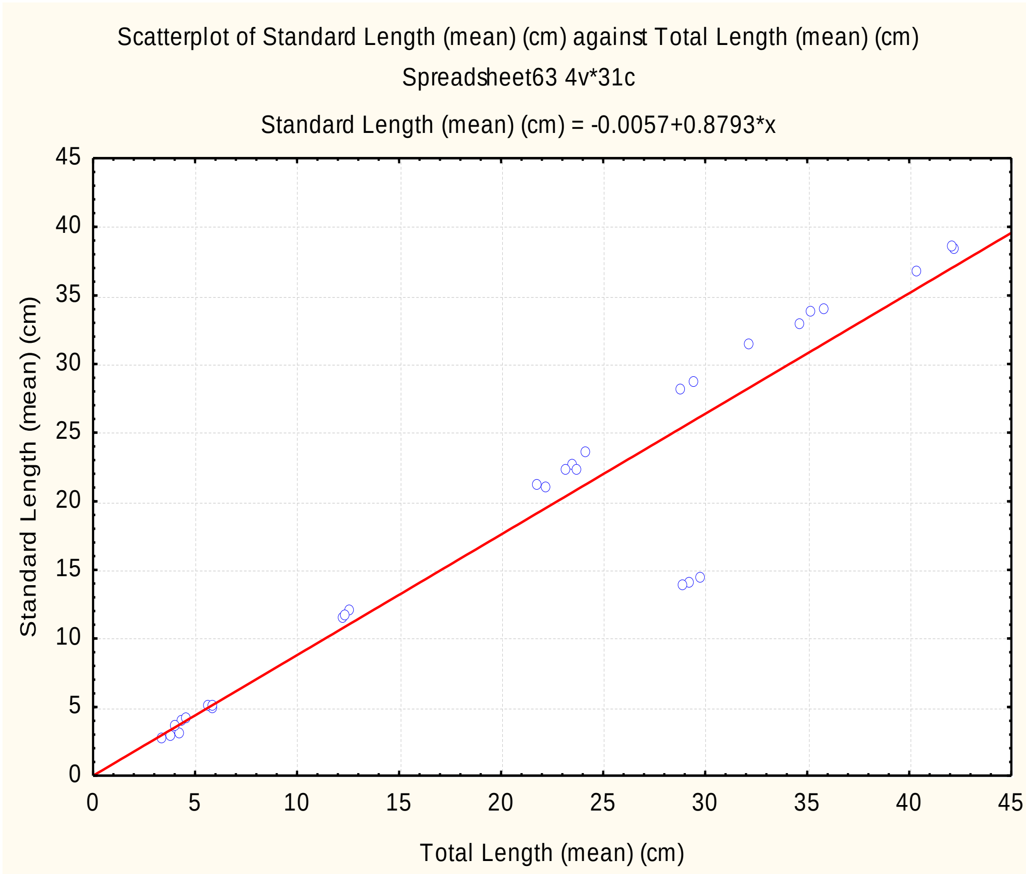

Fig. 1: Standard length-Total length Relationship of *Heterobranchus longifilis* F1

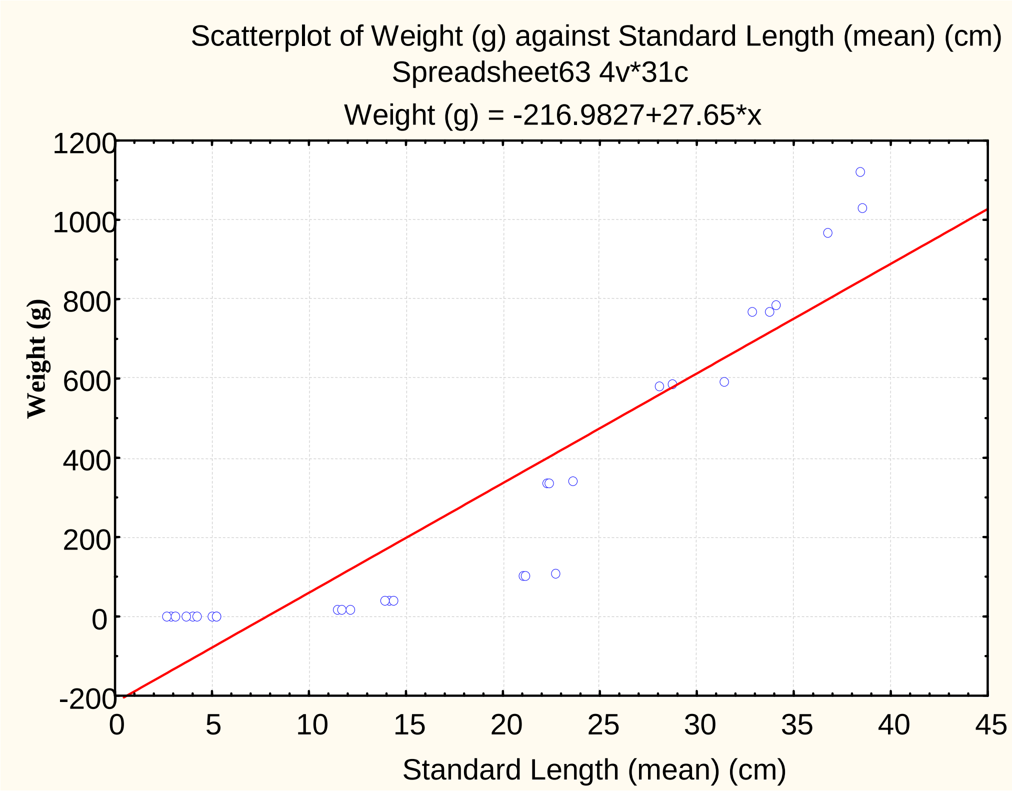

Fig. 2: Length-Weight Relationship of *Heterobranchus longifilis* F1

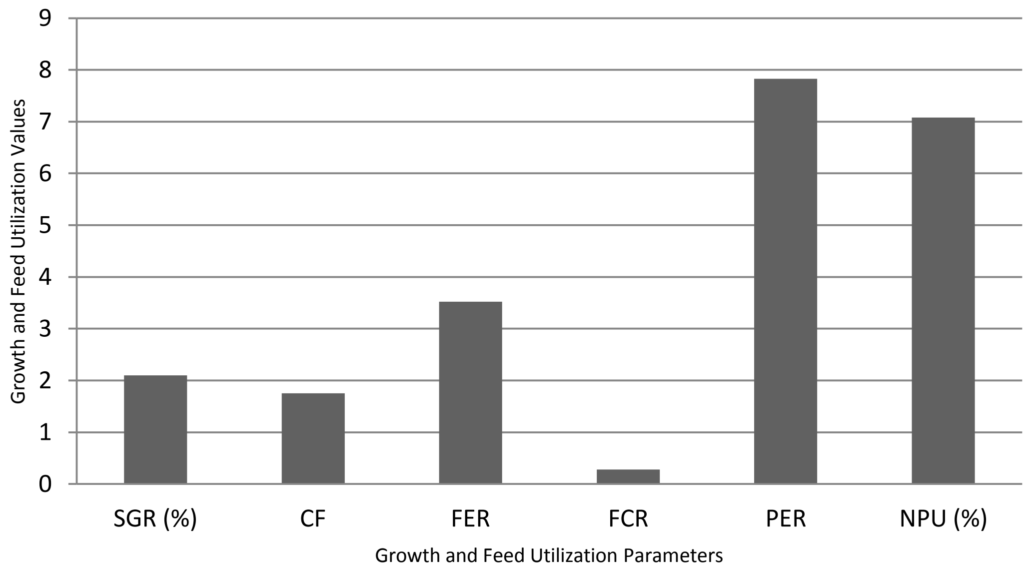

Fig. 3: Growth and Feed Utilisation Indices of *Heterobranchus longifilis* F1

Legend: SGR – Specific Growth Rate CF – Condition Factor

FER – Feed Efficiency Ratio
PER – Protein Efficiency Ratio
FCR – Feed Conversion Ratio
NPU – Net Protein Utilization

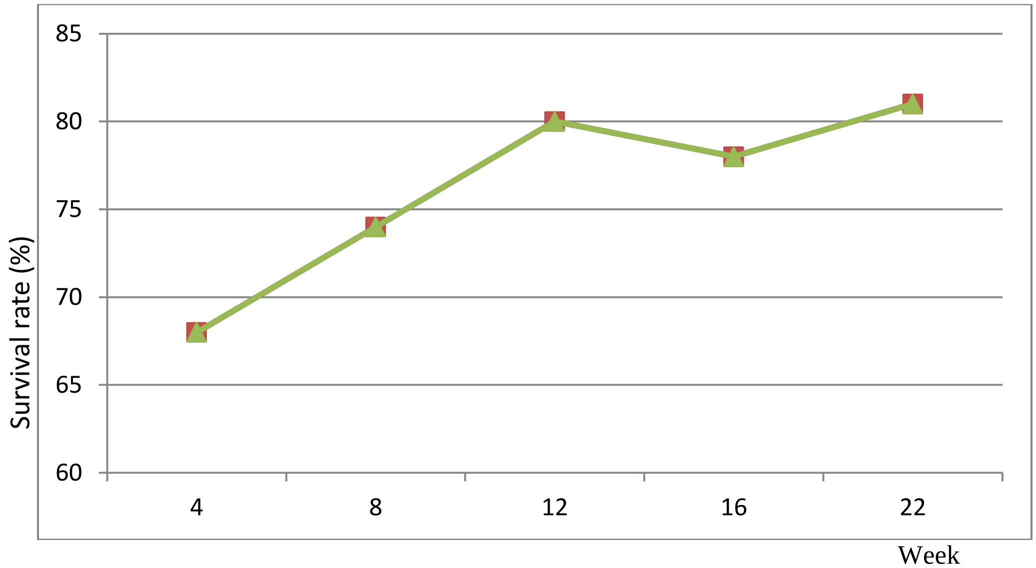

Fig. 4: Survival Rate of *Heterbranchus longifilis*

DISCUSSION

With respect to total length-standard length relationship, the coefficient of regression between the standard length and total length of *H. longifilis* is close to unity with a b-value of 0.88 indicating negative allometry. Negative allometry suggests that the overall increase in total length was slightly faster than increase in standard length. Results obtained is similar to the standard length (mean) (cm) = -0.18 + 0.81x reported by Shinkafi and Ipinjolu (2010) in *Auchenoglanis occidentalis* from River Rima in Sokoto State.

The length-weight relationship of *H. longifilis* shows a positive allometric growth pattern. Positive allometry is associated with a slightly faster overall increase in weight compared to increase in standard length (Khaironizam and Norma-Rashid, 2002). This is divergent to the negative allometric growth reported by Anibaze (2000) for the same species from Idodo River, Nigeria. The difference may be associated with the closed intensive system in this study. Positive allometric growth was reported by Oniye *et al*. (2006) for *Protopterus annectens* in Jachi dam, Katsina State.

Changes in growth pattern from juvenile to adulthood is subject to availability of food, temperature, season of the year, dissolved oxygen, ammonia, crowding and competition, and diseases amongst other factors which accompany growth as fish species pass through different stanzas. The condition of 1.79 in this study was higher than 1.53 reported by Owodeinde and Ndimele (2011) for *H. bidorsalis*.

Heterobranchus longifilis has been reported to have high feed efficiency and utilization (Adebayo and Olanrewaju, 2000). Survival rate was observed to be positively correlated to growth in this study. The relative higher mean weight gain, specific growth rate and survival rate recorded in this study compared to the findings of Akinwade (2011) for hapa-earthen pond raised *H. longifilis*, could be attributed to the disparity in culture systems because enhanced productivity in water-recirculation and built-up concrete pond systems has been reported by Adekoya *et al*. (2006).

The protein efficiency ratio of 7.81 in this study, estimates the relationship between the increment in weight and the protein consumed by the fish. The live weight gain of 7.81g was recorded per gram of protein fed as suggested by Falayi (2009). The apparent net protein utilization of 7.05% obtained here corroborates the results of the protein efficiency ratio. In this study, the gross utilization of feed for growth by *H. longifilis* F1 was 0.28; this is based on the assumption that the weight gain was due to an increase in body weight. This low value implies that feed was efficiently utilized by the fish. The feed efficiency ratio of 3.51 obtained here indicates that for every 1g of feed consumed a proportionate weight gain of 3.5 times was achieved by the fishes. This is important in estimating the total weight of feed required in raising juvenile *H. longifilis* to table-size when planning the economic implication of an aquaculture enterprise.

CONCLUSION

Heterobranchus longifilis has significantly high survival and growth potentials. Differential growth rate though of genetic basis is influenced by feed accessibility and utilization. Further studies should be carried out in relation to the association between growth factors and metabolic enzymes.

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