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INFLUENCE OF BODY WEIGHT/AGE ON THE FOOD INTAKE, GROWTH AND CONVERSION EFFICIENCY OF GAMBUSIA AFFINIS

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Abstract

On a restricted food supply of *Tubifex tubifex* (2 h/day) the fish consumed only 69.5 mg dry food/g live fish/day and grew only to 25.6 mg live body weight by the 30th day of it's age, while those fed *ad libitum* consumed 94.7 mg/g/day and attained a body weight of 125.9 mg live weight by the 30th day. Conversion efficiency (K_1) averaged to 8.3% in the former and 14.1% in the latter series, throughout the 30 day experimental period.

Feeding rate of the test series fed individually and at *ad libitum*, decreased from 780 mg dry food/g dry fish/day for a fish weighing 4 mg dry weight to 180 mg/g/day for one weighing 41 mg, exhibiting a log-log relationship to the body weight ($Y = 2.2014 - 0.5639\ X$). Growth rate also decreased as a log-log function with increasing body weight ($Y = 1.2309 - 0.4384\ X$).

Introduction

Experimental determinations of food intake, growth and conversion efficiency are known to offer important clues with regard to the ecological success of any organism (Kinne, 1971). These sequential parameters may be affected by environmental and/or endogenous factors (Pandian, 1975) and the endogenous factors like body weight/age are known to modify the conversion efficiency of fish (Gerking, 1952, 1971; Staples & Nomura, 1976; Gerald, 1976). As a successful biological agent of mosquito control, the larvivorous fish *Gambusia affinis* has been repeatedly introduced in various types of freshwater habitats (Gerberich & Liard, 1966), where the fish has survived well even under adverse environmental conditions (Goodyear *et al.*, 1972; Maglio & Rosen, 1969). The present paper describes the influence of body weight/age on the food intake, growth and conversion efficiency of *G. affinis*.

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Material and methods

Gestating females of *Gambusia affinis* were collected from a local fish farm and reared individually in battery jars containing aerated freshwater. To minimise the genetic variation, the 60 to 180 young ones born of a single gestating female were used for each experimental series.

Test individuals of *G. affinis* were fed on restricted (2 h/day) or unrestricted *(ad libitum)* diet of the oligocheate worms *Tubifex tubifex* from the first day of their birth. Sex differentiation in *G. affinis* occurs by 30 days of age and involves disparity in the food intake and growth between the sexes (see Love, 1970; Katre, 1976). Hence, feeding experiments were discontinued after 30 days. During the thirty days experiment, at selected intervals, the levels of the following parameters were estimated:

Food intake was determined by subtracting the dry weight of uneaten food from the dry weight of daily food provided and expressed as mg dry food eaten/fish/day; feeding rate was calculated as mg dry food consumed/g live fish/day; growth as the gain in mg dry weight/fish/day and conversion efficiency (K_1) as a percentage of food consumed.

Results

On a restricted diet (2 h/day) food intake increased from 0.9 mg/day for an individual weighing 11.0 mg on the 9th day of it's age to 1.8 mg/day for a fish weighing 26.0 mg

Table 1. *Gambusia affinis*: Effects of body weight and age on food intake, growth and conversion efficiency. Each value represents the average performance of 10 individuals reared on a restricted supply (2 h/day) of *Tubifex tubifex*.

Age of fish (day)	Live body weight of fish (mg)	Food intake (mg dry food/ fish/day)	Feeding rate (mg dry food/g live fish/day)	Growth (gain in mg dry weight/fish/day)	Conversion efficiency (K_1) (%)
9	11.3 ± 3.25	0.87 ± 0.08	79.5 ± 4.32	0.08 ± 0.007	8.69 ± 0.46
15	17.3 ± 0.87	1.12 ± 0.15	64.7 ± 2.82	0.09 ± 0.003	8.30 ± 0.59
22	18.8 ± 0.82	1.06 ± 0.05	68.4 ± 2.44	0.09 ± 0.003	8.77 ± 0.81
30	25.6 ± 5.25	1.78 ± 0.32	69.5 ± 3.42	0.13 ± 0.050	7.24 ± 0.50

on the 30th day (Table 1). The corresponding values for growth were 0.08 and 0.13 mg/day. On the other hand conversion efficiency remained more or less constant at about 8.3% throughout the 30 day experiment. This conversion efficiency showed a slight decrease to 7.2% on the 30th day and might have decreased further beyond this age/body weight (Raghuraman, 1972).

Food intake is known to be dependent on the mode of presentation of food and ideally the fish should be provided with unlimited opportunity to feed (Brett, 1971). When the food supply of *Gambusia affinis* was thus unrestricted *(ad libitum),* the daily food intake showed an increase from 3.3 mg on the 9th day (20.1 mg body weight) to 7.1 mg on the 30th day (125.9 mg body weight; Table 2); daily growth increased from 0.48 to 0.95 mg in the corresponding period. Conversion efficiency however was apparently constant (14.1%) but was markedly higher than when the food was restricted (Table 1). It is evident from Tables 1 and 2 that at any interval of age of *G. affinis,* growth depends on the level of food intake, and higher conversion efficiency is exhibited by the fish when the food supply is unlimited. Average feeding rate was also higher when there was unlimited food supply (94.7 mg/g fish/day) than when it was limited to 2 h/day)70.5 mg/g fish/day). This indicates that growth and conversion efficiency are dependent on food intake.

Discussion

The IBP scheme of energy balance (Petrusewicz & Macfadyen, 1970) for a fish may be represented by the following equation:

$$C = P + R + F + U$$

Table 2. *Gambusia affinis*: Effects of body weight and age on food intake, growth and conversion efficiency. Each value represents the average performance of 10 individuals reared on an *ad libitum* diet of *Tubifex tubifex*.

Age of fish (day)	Live body weight of fish (mg)	Food intake (mg dry food/ fish/day)	Feeding rate (mg dry food/g live fish/day)	Growth (gain in mg dry weight/fish/day)	Conversion efficiency (K_1) (%)
9	20.1 ± 4.35	3.28 ± 0.05	163.2 ± 12.48	0.48 ± 0.056	14.4 ± 0.85
15	37.7 ± 5.60	4.50 ± 0.07	106.1 ± 11.57	0.64 ± 0.090	14.2 ± 0.76
22	98.9 ± 8.20	5.25 ± 0.22	53.1 ± 3.98	0.76 ± 0.080	14.3 ± 0.94
30	125.9 ± 11.36	7.10 ± 0.45	56.3 4.32	0.95 ± 0.098	13.3 ± 0.50

where C is the enrgy (food) consumed, P is the growth, R the energy loss as heat due to metabolism (estimated from oxygen uptake), F the faeces and U the urine excreted by the fish. Large number of earlier publications have established the fact that in fishes, absorption efficiency, which has a bearing on the F, does not significantly vary as a function of body weight (Gerking, 1952; Pandian, 1967a), quantity of food (Gerking, 1955; Davies, 1963; Pandian, 1967c), quality of food (Pandian, 1967b) and temperature (Menzel, 1960; Hari Sethi, 1970). Therefore any factor that alters either the C, the P and/or the R, will necessarily influence the one which is not modified.

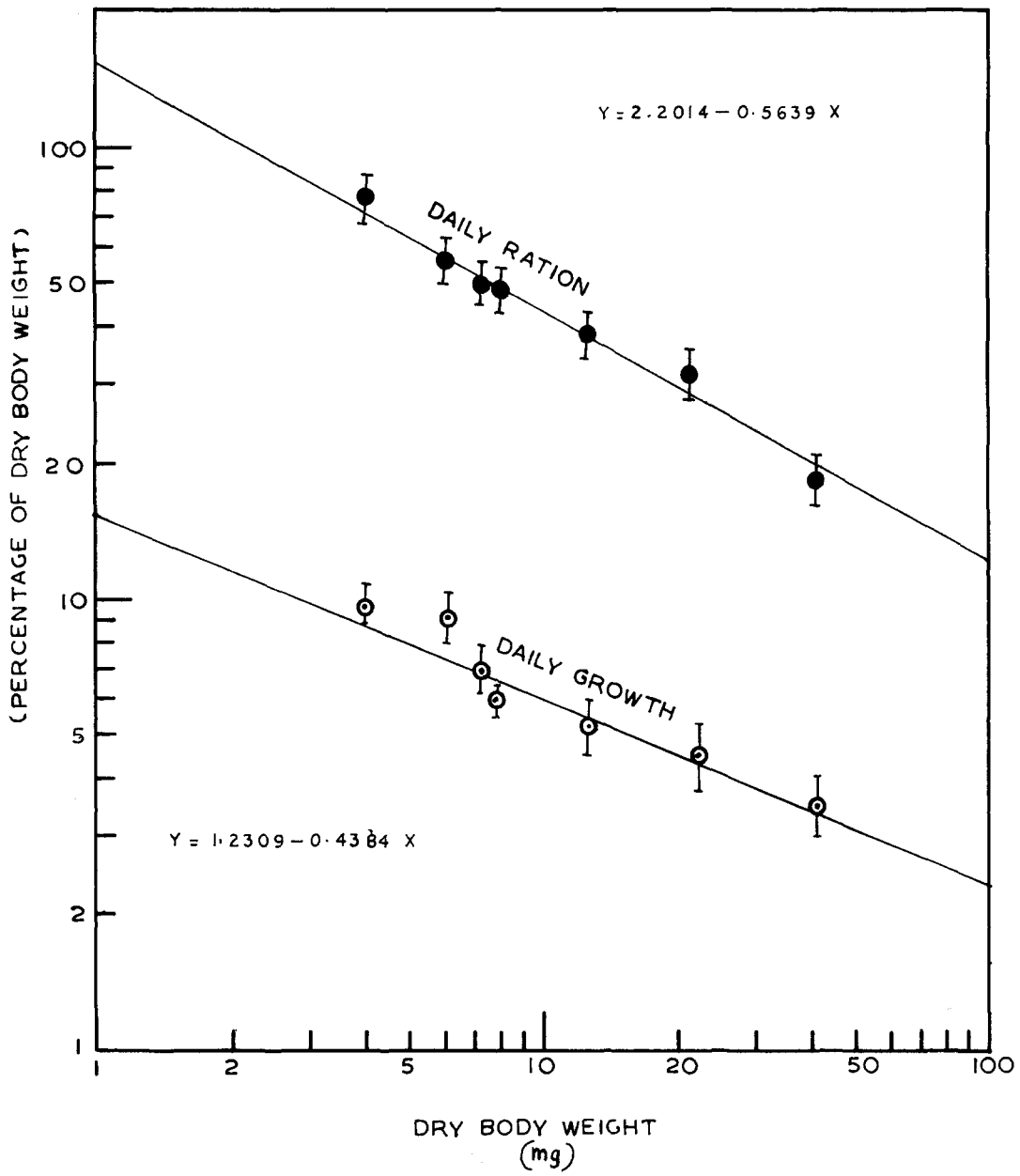

Fig. 1. *Gambusia affinis:* Daily ration and growth (expressed as percentages of dry body weights) as functions of body weight of fish fed on *Tubifex tubifex,* under optimum laboratory conditions (fish reared individually in freshwater at 25 ± 1°C and fed *ad libitum*).

The C of *Gambusia affinis* of different body weights fed at optimum laboratory conditions (individual values obtained from the mean values given in Table 2), decreased as a log-log function of the dry body weight from 78% body weight for the 4 mg *G. affinis* to 18% body weight for a 41 mg fish (Fig. 1). A similar log-log relationship has also been reported for *Onchorhynchus nerka* (Brett, 1971), in which the decrease is from 17% body weight for a 4 g fish to 4.3% body weight for a 216 g fish. The values obtained in the present study cannot be compared with those of Brett (1971) for *O. nerka* or Davis and Warren (1968) for *O. tshawytscha* due to the large differences in the body weights of the test individuals used in the experiments. However, the value of the C obtained for a 16 mg live *G. affinis* (78% body weight) is comparable to that obtained by Krivobok (1953) for the young wild carps *(Cyprinus carpio)* of 15 mg live weight (54% body weight). On the whole, the C values obtained for *G. affinis* in the present study are rather high when compared to those obtained by Karzinkin (1952) for either the young inconnu (*Stendus* sp.) or the young sturgeon *(Acipenser guildenstädti)* of the comparable body weights (see Winberg, 1960). Winberg (1960) computed that for a fish weighing 100 mg live weight, the C would be 18 or 35% body weight, for fish with a P (K_1) efficiency of 16 or 48 respectively. A corresponding sized *G. affinis* where the K_1 during the present experiment never exceeded 14.4% (Table, 2), yielded the C value of 31.40% body weight per day (note: The water content of *Tubifex* worms used during the present experiment averaged to 83.6% of the live weight of the worms). Based on the oxygen consumption values, Winberg (1960; 1961) reported that in viviparous Cyprinodont fishes which are small in size, the R is low and decreases more than usual with increase in weight of the body. The high values obtained for the C in the cyprinodont fish *G. affinis* of body weights ranging from 4 to 8 mg dry weights suggest that the R may still be high. The C however, decreases with increasing body weights at the rate of 1.8% body weight for every 10 mg increase in the dry body weight of the fish; although, the P value decreases as a log-log function *per se* (Fig. 1) the proportionate decrease in the R is not as high as in C, so that after a particular body weight (maximum final weight of the species) is reached, growth of fish ceases (see Parker & Larkin, 1959; Brett, 1970).

Pandian (1967a) has considered that body weight of the fish approximately represents the age of the fish. The results obtained for *Gambusia affinis* lead us to conclude that these two parameters need not always be representing each other. For instance, an individual of 20 mg body weight, on a restricted food supply exhibited a feeding rate of only 68 mg/g fish/day at the age of 22 days, but a fish of the same body weight on unrestricted food supply exhibited a higher feeding rate of 163 mg/g fish/day by the age of 9 days. Similarly, a 15 day old *G. affinis* on a restricted food supply and a lower feeding rate of 65 mg/g/day weighed only 17 mg while a fish of the same age, on an unrestricted food supply, by virtue of its high feeding rate (106 mg/g/day), weighed 38 mg (Tables 1 & 2). However, when the fish was exposed to the same set of environmental conditions, especially the availability of food, there was some correlation between the body weight and the age as indicated by the minor deviations from the mean values given in the tables. It may therefore be suggested that, while conducting laboratory experiments on fish, especially during its growth phase, both body weight as well as age of the individuals must be considered rather than any one of these parameters only or else the individuals must be collected from a single population, living in the same set of environmental conditions.

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