

# First attempts at artificial breeding and larval rearing of the butter catfish, *Eutropius depressirostris* (Schilbeidae: Pisces)

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## Abstract

The butter catfish, *Eutropius depressirostris* is endemic to Southern Africa. As a first attempt to domesticate this species, experiments on artificial propagation were undertaken. Successful stripping of eggs was achieved after a course of injections comprising of human chorionic gonadotropins (HCG) and homogenized pituitary glands of the sharptooth catfish, *Clarias gariepinus*. Male fish were also successfully induced to release motile sperm. Larval rearing did not meet with any real difficulties at stocking densities up to 10 fish per litre water. At this stocking rate a mean individual mass increase of 7 mg was achieved over the period ranging from day 12 to day 27 (15 days).

## Introduction

Aquaculture is coming of age worldwide but in South Africa it is still very much in the developmental phase. Research was initially focused on foreign species already in use in aquaculture. These include the common carp *Cyprinus carpio*, silver carp *Hypophthalmichthys molitrix*, grass carp *Ctenopharyngodon idella* and bighead carp *Aristichthys nobilis* (Kruger, 1978; Brandt and Schoonbee, 1980; Prinsloo and Schoonbee, 1984 a, b, c, d; Schoonbee *et al.* 1978, 1979; Schoonbee and Brandt, 1982; Schoonbee and Prinsloo, 1984).

Of the indigenous fish, the sharptooth catfish *Clarias gariepinus* shows much promise on the grounds of its wide distribution and hardiness towards environmental conditions (Van der Waal 1974 a, b; Schoonbee *et al.*, 1980; Hecht, 1981; Hecht, 1982; Polling *et al.*, 1984; Van der Waal, 1984). The blue tilapia *Oreochromis mossambicus* has only received little attention locally (Caulton, 1979; Gaigher *et al.*, 1982) although it is an important culture species in many other countries.

Fisheries development in the National States of Lebowa and Gazankulu depends heavily on extension work and research performed by staff of the University of the North. Large areas of both Lebowa and Gazankulu can be classified as Lowveld, with winter water temperatures rarely dropping below 10°C. Local fish species were considered for suitability in aquaculture and it was decided to select the butter catfish *Eutropius depressirostris* as a possible candidate on account of its palatability and the high nutritional value of schilbids in general (Otalunde, 1980).

Members of the Family Schilbeidae are widespread in Africa. The geographical distribution of the Schilbeidae in Southern Africa is fairly extensively documented by authors like Jubb (1967), Gaigher (1969), Pott (1969), Van der Waal (1976), Kleynhans (1980) and Hecht and Mashego (1981). Only two species occur in Southern Africa viz. *E. depressirostris* and the closely related *Schilbe mystus*. Due to limiting climatic conditions the butter catfish is not found further south than the 27° 30'

latitude. The biology of the Schilbeidae is relatively unknown but information on this is found in papers by Groenewald (1964), Otalunde (1978) and Hecht (1980).

Prerequisites for a successful aquaculture candidate are the ease in obtaining and raising fry or fingerlings, hardiness against disease and other environmental constraints, simple culture methods and acceptable marketing qualities. The aim of this study is to evaluate the butter catfish with regard to acquisition and incubation of eggs and raising of fry.

## Material and Methods

Broodfish were collected during December 1982 in the Nyl River impoundments north of the town of Potgietersrus. Gill nets of 70 and 90 mm stretch mesh were set out before sunset and then continually patrolled in the early night hours to remove all trapped fish as soon as possible. The same night the fish were transported to the University of the North in plastic containers of 100 l capacity fitted with oxygen diffusers. At the University all fish were transferred to a communal tank of 3 000 l capacity and left to recover for one week before experimenting commenced.

Butter catfish used in the experiments ranged in length from 250 to 300 mm (fork length) and mass from 240 to 370 g. Age of the fish was not determined but compared to results of Hecht (1980) should be from four to six years. In total 34 females and 15 males were subjected to artificial hormonal stimulation through intramuscular injections.

The induced spawning trials were performed by using chorionic gonadotropins (brand name CHORULON, Intervet International) and pituitary gland (PG) extracts of the sharptooth catfish *Clarias gariepinus*. Pituitary glands of the sharptooth catfish have been used with success in trials by Schoonbee *et al.*, (1980) and Polling *et al.*, (1984). Pituitary glands were stored in absolute alcohol. Prior to use they were dried on blotting paper for one minute and then homogenized in 0,9 % physiological saline solution (Schoonbee *et al.*, 1978). Dosage volumes of Chorulon and PG used in the trials never exceeded 0,25 ml per fish per injection (Tables 1 to 3). The injections were positioned at the base of the dorsal fin (Schoonbee *et al.*, 1978).

In all instances where a course of injections was used the Chorulon dosage preceded the PG dosages. Chorulon was administered as a starter or "booster" to aid in maturation of the follicles.

Antalfi and Tölg (1971) found that belly girth measurements were valid indicators of the extent of hydration of ova in female Chinese carps, and hence the effectiveness of the artificial hormonal stimulation. In order to evaluate this phenomenon in the case of the butter catfish, body girth measurements were taken of female fish of the first and second trials (Table 5). Circumference measurements were made with a

flexible tape just anterior to the dorsal fin. Initially this measurement was obliquely positioned to reach over the genital opening but was altered later to be at right angles to the long axis of the body.

Eggs were hand stripped from ripe-running female fish into dry plastic bowls. During the first three trials the authors were unable to strip sperm from the males, consequently they had to be sacrificed in order to remove the lobular testes. After an improved dosage programme, stripping of males was achieved by exerting pressure on the ventral abdomen and directing the resulting fluid from the genital papilla onto a plastic cake mixing spoon and then onto the eggs. Fertilization was accomplished after addition of enough 0,9 % physiological saline to cover the eggs. After one minute the eggs were transferred to an incubator.

A variety of incubating aids was initially employed including perspex funnels, sheets of glass and stacked trays, but from the third trial onwards only stacked trays were used. These trays, (Heath Tecna incubators) are commonly used in salmonid culture. As the mesh of the built-in screens was too large for the butter catfish eggs, loose cloth bottoms were installed. To combat fungal growth on dead eggs during incubation, 1 % acriflavin solution was added at a concentration of 1 ml per 100 l of water.

After hatching, the fry were transferred to rectangular PVC containers with dimensions 1400 mm x 1000 mm x 600 mm. Artificial aeration of the water was only done in a few containers. Fry were fed on *Artemia* naupliae as well as zooplankton which was collected on a daily basis. As a bactericide, a tetracycline (Terramycin) was occasionally added to the water at a concentration of 5 mg/l.

In one instance immediately after stripping, certain empirical measurements were taken of a sample from one batch of eggs (Table 6). Similarly, the measurements were repeated on another sample of the same batch after the eggs had been in contact with water for half an hour. These data were analysed statistically.

## Results

### First and second trials

The first two trials on 7 December, 1982 and 3 January, 1983 were spent in trying to establish some form of a workable recipe. In the process twenty-one females were injected of which 12 received one or two starter dosages ranging from 50 to 200 IU Chorulon over a period of 24 h. These fish then received two dosages of PG, the first, a ¼ gland and the second, ½ gland per fish. The remaining 9 females were only injected with pituitary gland extracts ranging from ¼ to ½ gland per fish. The time lapse after the Chorulon dosage (if applicable) was 24 h with 6 h between consecutive PG dosages. Stripping of the females was attempted 15 to 22 h after the last injection.

Of the 21 females, 18 were completely stripped of eggs. Fertilized eggs were initially transferred to breeding funnels but it soon became evident that the eggs turned sticky after coming into contact with water. The time lapse for the development of the stickiness was 6 min. In an attempt to remove the stickiness one batch of eggs was washed with full cream milk for 45 min (Schoonbee *et al.*, 1980) and then incubated in a funnel. The remainder of the eggs was then incubated on trays. The eggs initially had a translucent yellow colour which soon turned to an opaque light yellow.

All the eggs failed to hatch except for four larvae found in one of the funnels. The larvae are extremely difficult to detect by the eye as they are totally transparent.

### Third trial

The third trial was carried out on 9 January 1983 (Table 1).

The period between the last injection and stripping can be critical (Eding *et al.*, 1982). In order to investigate the possibility that stripping was delayed too long with consequent overripening of the eggs, a third trial was devised. Four females were treated according to the dosage programme in Table 1. Trial stripping commenced 10 h after the PG injection and the first positive results were obtained 13 h after hormonal stimulation. One and two hours later eggs were again obtained. Only the females injected with 0,5 PG produced viable eggs.

Hatching occurred after an incubation period of approximately 40 h on stacked trays at a water temperature of 22°C. An estimated 800 larvae hatched, signifying the first moderate success. Of special interest is female 1 (Table 1) which was stripped three times at hourly intervals. For some unknown reason the second batch produced no larvae while the other two batches had similar hatching percentages (26 %).

### Fourth trial

This fourth trial took place on 19 January 1983 (Table 2).

Guided by the previous success, a breeding programme was devised consisting of two injections (starter of Chorulon followed by PG) combined with an advanced stripping attempt (Table 2). A control female was injected only once with 1½ PG coinciding with the second injection of the other females. Fishes 1 to 3 were totally stripped of eggs 11 h after the second dosage (Table 2). The sticky layer surrounding the eggs was particularly well developed compared to previous instances. Egg colour was a bright translucent yellow. The control female could only be partially stripped. Very little pressure was exerted on the abdomen of the fish to release the eggs, consequently all females survived the handling stress.

Two male fish were subjected to the same injection programme as the females (Table 2), resulting in the first success. A fluid clear to light milky in colour could be stripped when exerting pressure on the ventral abdomen. Hatching percentages as determined by subsampling some 12 h before the anticipated time of hatching ranged from 5 to 90 % (Table 2).

### Fifth trial

This trial was carried out on 21 February, 1983 (Table 3).

It was essentially a repetition of the fourth trial but only a month later. Table 3 reveals that all female fish were totally stripped, but the quantity of eggs recovered was small. This was due to the poor condition of the brood fish after 2½ months in captivity during which period they fed only reluctantly on chopped fish.

One male which was hormonally treated was stripped over egg batches 1 and 2 after which the testes were removed to provide sperm for egg batches 3 and 4. Both methods gave positive results. At a prevailing water temperature of 24°C incubation was completed within 52 h. Hatching success ranged from 0 to 75 %. Once again all female fish survived the injection and stripping procedures.

The contribution of gonad mass to the total unit mass of female butter catfish was determined (Table 4, n=16). The average value was 10,9 % with a range from 7,2 to 15,6 %. Egg counts on representative samples of three females averaged 2 100 eggs per gram gonad mass. Using this figure, the fecundity of

**TABLE 1**  
**DETERMINING THE TIME LAPSE BETWEEN A PG-INJECTION AND THE STRIPPING OF FREE RUNNING EGGS FROM *E. DEPRESSIROSTRIS*, (THIRD TRIAL, 3 JANUARY, 1983). WATER TEMPERATURE 22°C**

DATE	09.1.83	10.1.83					
TIME	22h30	08h30	09h30	10h30	11h30	12h30	14h00
TIME AFTER DOSAGE (h)	-	10	11	12	13	14	15,5
FEMALE NO.	DOSAGE	TRIAL STRIPPING					
1	0,5PG	Negative	Negative	Negative	Small quantity eggs obtained. Jamlike consistency. Sticky layer well developed	Same as previous	Same as previous fresh blood mixed with eggs
					26,6 % hatch	0 % hatch	26,8 % hatch
2	0,5PG	Negative	Negative	Few eggs 50 % dull coloured Discarded	Still difficult to extract eggs. Discarded	Complete spawn-few dead eggs	-
						5,4 % hatch	
3	0,25PG	Negative	Negative	Negative	Negative	Incomplete spawn-eggs discarded	Negative
4	0,25PG	Negative	Negative	Negative	Negative	small quantity obtained - added to fish 2	Complete spawn All eggs dead. Discarded
2 males	0,25PG	Sperms could not be stripped - fish sacrificed					

**TABLE 2**  
**STRIPPING AND HATCHING RESULTS OF 4 FEMALE AND 2 MALE *E. DEPRESSIROSTRIS* AFTER ADMINISTERING A COURSE OF HORMONAL INJECTIONS. (FOURTH-TRIAL 19 JANUARY, 1983). WATER TEMPERATURE 23°C.**

DATE	19.1.83	20.1.83	21.1.83	22.1.83
TIME	11h30	21h30	08h45-09h20	~ 23h00
TIME AFTER FIRST DOSAGE (h)	-	34	~ 45	
FEMALE NO.	1	DOSAGE 2	STRIPPING	HATCHING PERCENTAGE
1	200 IU Chorulon	0,5 PG	Total spawn. Sticky layer well developed. 20 g eggs, 2 males stripped over eggs	90
2	200 IU Chorulon	0,5 PG	Total spawn. Ovaria have only small quantity of eggs. Male sacrificed.	5
3	200 IU Chorulon	0,5 PG	Total spawn. Sticky layer well developed. 26,5 g eggs. Male sacrificed	60
4	-	1,5 PG	Only 1/3 of eggs could be stripped. Dead eggs already visible. Male sacrificed. Eggs clump together.	10
2 males	200 IU Chorulon	0,5 PG	Could be stripped to some extent. Fluid clear to light milky. First success in this respect.	

females ranged from approximately 45 000 to just short of 100 000.

Belly girth measurements of female *E depressirostris* at various stages of the spawning stimulation process are given in Table 5. Where more than one injection was administered to a fish, an interesting phenomenon was experienced *viz.* that there was an initial decrease in body girth in more than half of the fish. This is clearly shown in Table 5 by the GI mostly having negative

values. The reason for this is not clear. After the last injection though, which invariably comprised of PG, the GI<sub>2</sub> values show a sudden increase even up to 11,8 % of the initial girth. Hydration of the eggs in the ovaria must obviously have taken place during the latter phases of egg maturation. It is evident that the PG dosages were responsible for this hydration. Body mass increase could also have been taken as a criterion for egg maturation and hydration but would have necessitated very careful monitoring.

TABLE 3  
STRIPPING AND HATCHING RESULTS OF 5 FEMALE AND 1 MALE *E. DEPRESSIROSTRIS* AFTER ADMINISTERING A COURSE OF HORMONAL INJECTIONS. (FIFTH TRIAL 21 FEBRUARY, 1983) WATER TEMPERATURE 24°C.

DATE	21.2.83	22.2.83	23.2.83	24.2.83
TIME	12h30	22h30	09h00-09h30	17h00
TIME AFTER FIRST DOSAGE (h)	-	34	44,5	(32 h after stripping)
FEMALE NO.	DOSAGE		STRIPPING	HATCHING PERCENTAGE
	1	2		
1	200 IU CHORULON	0,5 PG	Total spawn. Eggs very dry. Male stripped.	All eggs died within 3 hours
2	do	do	Total spawn. Eggs syrupy consistency. Male stripped (same as previous).	75
3	do	do	Total spawn. Eggs dry. Male sacrificed. Few eggs.	66
4	do	do	Total spawn. Eggs syrupy. Male sacrificed. Few eggs.	21
5	do	do	Total spawn. Eggs syrupy. Male sacrificed. Few eggs.	20
1 Male	do	do	Stripped over egg batches 1 and 2, then sacrificed for batches 3 and 4.	

TABLE 4  
RELATIONSHIP OF OVARY MASS TO FISH MASS, AND THE FECUNDITY FIGURES FOR *E. DEPRESSIROSTRIS* BROODFISH USED DURING THE ARTIFICIAL PROPAGATION TRIALS (n = 16).

Fish mass (g)	Ovary mass (g)	Ovary as % body mass	Egg no/g	Fecundity	
				Calculated	Estimated.
322,3	30,0	9,3	2 100	63 000	
194,5	39,5	13,4	1 673	66 083	
281,8	20,4	7,2	2 777	56 650	
248	23	9,2			50 209
221	21	9,5			45 843
237	37	15,6			80 771
331	45	13,5			98 235
328	28	8,5			61 124
328	43	13,1			93 869
304	32	10,5			69 856
258	26	10,0			56 758
262	25	9,5			54 575
282	32	11,3			69 856
247	23	9,3			50 209
283	42	14,8			91 686
284	28	9,8			61 124

Various parameters of measurements on butter catfish eggs are shown in Table 6. From this table it is evident that no correlation exists between the diameter of dry and wet eggs; the diameter of dry eggs and the thickness of its surrounding layer; the diameter of wet eggs and the thickness of its surrounding layer; as well as the total diameter of dry eggs (including the surrounding layer) and the total wet egg diameter (including the surrounding layer). This implies that no measurable swelling of

the eggs takes place during and shortly after fertilization. Bearing in mind that the eggs are flattened dorso-ventrally it might be that an increase in diameter is manifested on this plane.

The average diameters of the dry eggs of two batches of eggs were 1,22 and 1,23 mm respectively, with a range of 1,02 to 1,42 mm (Table 6). In comparison, a close relative *Schilbe mystus* in the Kafue River has eggs with an average diameter of 0,83 mm and a range of 0,71 to 1,01 mm (Carey and Bell-Cross, 1967).

TABLE 5  
BELLY GIRTH MEASUREMENTS OF FEMALE *E. DEPRESSIROSTRIS* COINCIDING WITH INJECTION AND STRIPPING TIMES.

Fish no.	Injections				Stripping	GI <sub>1</sub>	GI <sub>2</sub>
	1	2	3	4			
1	170 mm	157	182	178	190	4,7	11,8
2	190	184	184	179	202	-5,8	6,3
3	179	171	170	174	177	-0,1	-1,1
4	227	221	212	213	-	-	-
5	208	207	200	191	-	-	-
6	176	197	195	187	182	6,3	3,4
7*	241	240	240	-	245	-0,4	1,2
8	225	221	214	-	228	-4,8	1,3
9	207	210	201	201	213	-2,9	2,9
10	186	184	-	-	204	-1,1	9,6
11	213	212	-	-	221	-0,5	3,3
12	197	212	-	-	215	2,5	9,1
13	184	180	184	-	194	0	5,4
14	183	186	192	-	188	4,9	2,7
15	193	193	201	-	195	4,1	1,0
16	165	-	-	-	184	-	11,5
17	188	-	-	-	188	-	0
18	216	-	-	-	232	-	7,4
19	189	-	-	-	202	-	6,9
20	190	-	-	-	200	-	5,3
21	190	-	-	-	191	-	0,5

\*Change in position of measurement from this fish onwards.

GI<sub>1</sub> = girth increase (or decrease) at last injection as percentage of initial girth.

GI<sub>2</sub> = girth increase (or decrease) at stripping as percentage of initial girth.

TABLE 6  
PARAMETERS OF SOME MEASUREMENTS ON THE EGGS OF THE BUTTER CATFISH *E. DEPRESSIROSTRIS* AS WELL AS CORRELATION COEFFICIENTS

	n	$\bar{x}$	max	range	min.	r <sup>2</sup>
Diameter dry egg (mm)	22	1,23	1,42	0,40	1,02	0,38
	16	1,22	1,42		1,02	
Diameter wet egg (mm)	16	1,34	1,46	0,40	1,20	0,12
	14	1,36	1,46		1,20	
Thickness wet surrounding layer (mm)	14	0,09	0,30	0,26	0,04	-0,13
Thickness dry surrounding layer (mm)	24	0,10	0,18		0,03	
Diam. dry egg + surrounding layer (mm)	14	1,47	1,60	0,13	1,32	-0,01
Diam. wet egg + surrounding layer (mm)	14	1,55	2,07		1,32	

### Larval rearing

Newly hatched larvae were transferred from the trays to rearing containers at densities of 2 to 10 fish per litre of water. Food reserves in the yolk sac were resorbed within 3 days. The fry were initially strongly negative phototrophic and tended to aggregate in the darkest corners. At least over the first 10 days larvae were rarely found on the bottom; they rather clung to the sides of the container near the water surface and changed position from time to time. The fry have no special adhesive organs or structures but the abdominal region probably secretes a substance which is adhesive.

On day 4 the fry started moving about more activity and this may be taken as an indication to commence with the feeding. As starter food, newly hatched brine shrimp naupliae (*Artemia sp.*) were used. It was observed that up to 70 % of the fry had taken one or more naupliae within one hour after food was introduced. Brine shrimps are positively phototrophic and therefore pose somewhat of a problem in keeping food and fry in close proximity. Mild agitation of the water by an aerator proved successful in achieving this. Fry were sometimes observed swimming upside down skimming the surface water layer for floating food particles.

Stocking density of fry has a marked influence on their growth rates. This is a normal phenomenon experienced in fish rearing. At the higher densities of approximately 10 fry per litre,

growth was slow, the fry attaining a unit mass of 8,7 mg after 26 days (Fig. 1). In contrast fry at densities of ca. 2 per litre already attained a mass of 30 mg on day 26. Water temperatures over the rearing period were  $23 \pm 1^\circ\text{C}$ .

### Discussion

Hecht (1980) found the butter catfish to have an extended breeding season in the Luphephe-Nwanedi Dam, Republic of Venda, lasting from January to March. The closely related *Schilbe mystus* has a breeding season in the Kafue River stretching from December to April (Carey and Bell-Cross, 1967). Similarly Van der Waal (1976) found the breeding season for *S. mystus* in Lake Liambezi (Eastern Caprivi) extending from November through to April with a peak in January. Since the present artificial spawning trials all fall within these limits it seems justifiable that the improved results achieved in January and February compared to earlier results, may be attributed to an improved breeding programme and not to the natural development of the gonadal condition during that time of the year.

Egg numbers per gram gonad weight of *Eutropius depressirostris* compare well with the 2 200 recorded for *E. niloticus* in Lake Kainji, Nigeria (Otalunde, 1978) and 2 700 eggs per gram for *Schilbe mystus* in the Kafue River (Carey and Bell-Cross, 1967). In comparison another silurid, *Clarias gariepinus*,

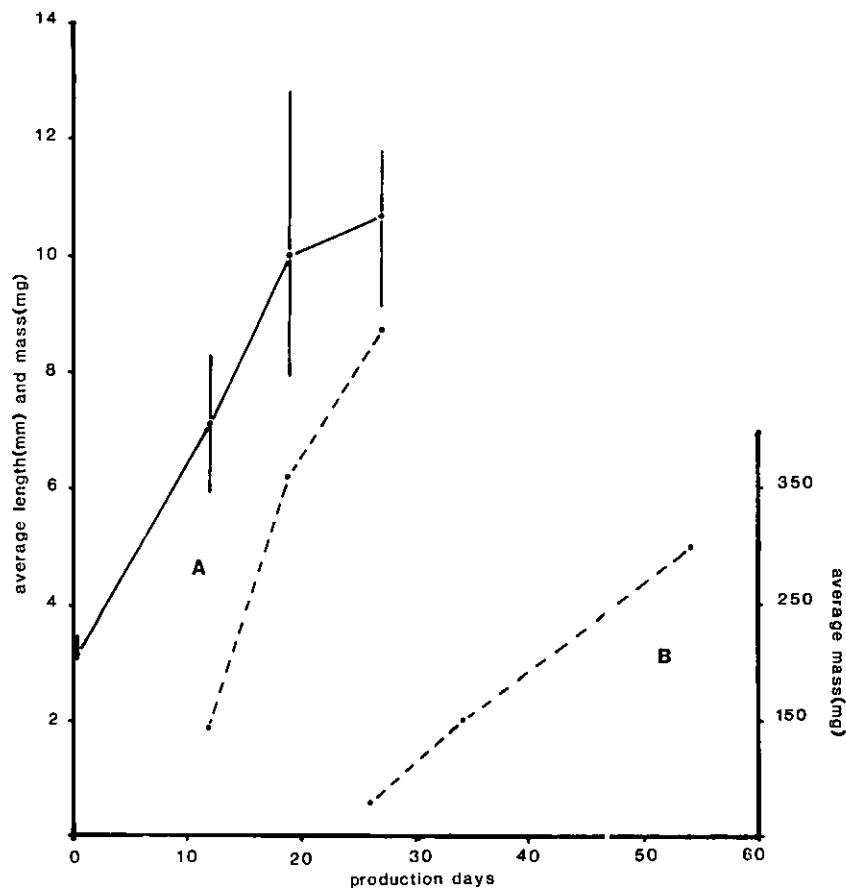


Figure 1  
Relation of length (—) and mass (---) increases to the production days, in containers with different stocking rates of *E. depressirostris* fry - A =  $\pm 10/l$ ; B =  $\pm 2/l$ .

which is also a strong aquaculture candidate, yields 750 eggs per gram gonad weight in Zambian lakes (Clay, 1979) consequently the eggs are much larger in size (Van der Waal 1974 a, b).

The first attempts at larval rearing did not meet any real problems. The butter catfish fry are tolerant to chemicals such as malachite green, acriflavine and tetracyclines generally applied in aquaculture. Unfortunately this is not the case with fry of the sharptooth catfish (L. Polling, 1983).

A growth rate in mass of 6,5 mg for butter catfish fry over a 15 day period from the age of 12 days (Fig. 1) may be regarded as modest. Length increase over the same period is 3,6 mm. Under similar feeding and environmental conditions over the same experimental period, Van der Waal (1984) found sharptooth catfish fry to increase in mass by 13,6 mg and in length by 3,6 mm.

The butter catfish has no auxiliary respiratory mechanism like the sharptooth catfish and is therefore totally dependent on gill respiration. In some fry rearing containers in which no supplementary aeration was applied, oxygen levels as low as 2,5 mg/l at 24°C were recorded. These coincide with the lower threshold values quoted for a hardy culture fish like the common carp (*Cyprinus carpio*) (Schaeperclaus, 1961). At these low levels the fry were still actively swimming about and feeding. Nothing is known of the water temperature tolerance levels of the butter catfish and these will have to be established in order to determine the potential annual culture period under natural conditions.

Considering the progress made during the first season of experimenting, the butter catfish warrants further investigation as an exciting new possible contribution to the range of aquaculture species.

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