FIRST GUIDELINES FOR THE CULTURE OF *CLARIAS LAZERA* IN CENTRAL AFRICA

P. DE KIMPE* and J.-C. MICHA**

UNDP/FAO Regional Fish Culture Training and Research Project, Bangui (Central African Republic)

*Present address: C.T.F.T., Avenue de la Belle-Gabrielle 45 bis, Nogent-sur-Marne (France)
**Present address: Laboratoire de l'Aquarium Institut de Zoologie, Quai Van Beneden, 22 Liège (Belgique)

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ABSTRACT


The first rearing experiments showed that *Clarias lazera* enjoys a remarkable growth rate and outstanding production qualities.

Breeding occurs in pond by external or internal stimulation throughout the year. This is most important for fish culture in Africa. But results are still irregular and problems of survival of larvae not yet completely solved. High mortality occurs between the 4th and the 20th day. This seems related to feeding problems.

Nevertheless, the high production obtained with this species suggest possibilities for utilization in intensive or rural fish culture if adequate and suitable food or fertilization is available.

*Clarias* culture should, in many regions, give an economical production from small units the yields of which until now have been insufficient.

INTRODUCTION

*Clarias lazera* Val. is a widely distributed catfish which is found from Syria to Upper Zaire.

It is reported in particular in the Nile, in lakes Victoria, Rudolf, Amin (Edward), Mobutu (Albert), Kivu, Chad, in the Niger basin. It is also to be found among the remaining fauna of Tibesti.

On the West Coast, it is reported by Daget (1959, 1968) in the Tawey at Richard Toll, by Irvine (1947) near Accra in Ghana, by Pellegrin (1923) in the Laguna of Porto Novo and by Boulenger (1912) in the Lower Zaire.

This wide distribution already shows the great adaptability of this species, which is remarkable because it is very easy to feed and it can withstand the most unfavourable environmental conditions. Sandon (1950) reports that in Sudan *Clarias* could survive for a relatively long period buried in the mud.

These fish move occasionally on the ground. In Nigeria J.B. Welman ob-
served about *Clarias lazera* covering a distance of about 180 m on the firm soil between a pool and a river bed in about 1 h.

In lake Chad, *Clarias lazera* comprises the bulk of the fish catch in the residual marshes, where sometimes dense overcrowding occurs.

Blache et al. (1964) mentions in his study of the fish of the Chad basin a crop of 8 tons of *Clarias* in 2 days in a pool of half an are.

The maximum individual weight observed in lake Chad is 6 800 kg for a fish of 88 cm. In lake Edward (Amin Poll (1950) reports the catch of *Clarias lazera* 1.31 m in length 12.8 kg in weight.

*Clarias*, are generally acknowledged as a migratory fish by different observers who established that they migrate upstream in rivers and brooks at the beginning of the first rains to spawn in marshes, where they lay their eggs on the grass or aquatic weeds. On lake Victoria, Greenwood (1955) has observed, for a related species *Clarias mossambicus*, that the migration is of short duration and that it happens suddenly. Although some studies were carried out on *Clarias lazera*, they were devoted mainly to anatomical characteristics, with a few biological data on individuals observed, mostly in their natural environment.

The study of the possibilities of introduction of this *Clarias* in fish culture required a complete programme of observations ranging from breeding habits to conditions for intensive rearing in ponds.

This programme was set up in Bangui in 1970, starting with a few specimens collected in the Ubangi river. It has been developed according to possibilities, in different aspects of breeding, reproduction, growth, density, feeding, and so on.

Taking into account the feasibility for fish culture in Central Africa that *Clarias lazera* appears to display, it seems useful to describe the present state of our knowledge of this fish and its possibilities for being cultivated in ponds in a first publication.

**DESCRIPTION OF THE GENUS AND SPECIES**

The *Clarias* are elongated cylindrical fishes, the flattened head has osseous pieces above and on the sides.

They have four pairs of barbels, one nasal, one maxillary and two on the jaw; the mouth is broad, the teeths on the jaws are not well marked. The vomer bears villous or granular teeth.

The *Clarias* exists in all Africa, in the Near-East and in South-East Asia. There are 27 identified species.

The larger ones met in Africa are the following:

<table>
<thead>
<tr>
<th>Species</th>
<th>Max. length</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Clarias lazera</em></td>
<td>110 cm</td>
<td>Galilea—Nile—Chad—Zaire</td>
</tr>
<tr>
<td><em>Clarias anguillaris</em></td>
<td>90 cm</td>
<td>Nile—Victoria lake—Volta—Chad</td>
</tr>
<tr>
<td><em>Clarias senegalensis</em></td>
<td>85 cm</td>
<td>Senegal—Niger</td>
</tr>
<tr>
<td><em>Clarias mossambicus</em></td>
<td>65 cm</td>
<td>East Africa</td>
</tr>
<tr>
<td><em>Clarias gariepinus</em></td>
<td>62 cm</td>
<td>South Zaire—South Africa</td>
</tr>
</tbody>
</table>
The characteristics of *Clarias lazera* (Fig. 1) are the following: Depth of body 5–9 times in total, length of head 3–3 1/2 times. Head 1 1/2–1 2/3 times as long as broad, its upper surface coarsely granulate in the adult; occipital process angular or rounded, frontal fontanelle sole-shaped or knife-shaped, 2 1/2–4 times as long as broad; band of praemaxillary teeth 4–6 times as long as broad; vomerine teeth granular forming a crescentic band with or without a posterior median process, its greatest width, 1 1/2–2 1/2 times that of the praemaxillary band; nasal barbel 1/3–1/4 length of the head up to 4/5 in the very young; maxillary barbel usually a little shorter than head, sometimes a little longer in the very young, reaching extremity of pectoral spine outer mandibular barbel 1 1/2–1 2/3 times as long as inner. Gillrakers long and closely set 50–135 on anterior arch.

Dorsal fin 62–82 is separated 1/7–1/4 length of the head from occipital process. Anal 50–65, narrowly separated from caudal, this last has a length 1/2 of the head.

![Fig. 1. Clarias lazera.](image)

Ventrals equally distant from end of snout and of caudal. Pectoral fin with separated spines on the outer side is 2/5 to 1/2 the length of the head.

The color is uniform or marbled, greyish olive or blackish above, clear white beneath often with a clear vertical bar at the root of caudal.

The *Clarias* has an accessory breathing organ (Fig. 2) which looks roughly like a cauliflower located in two suprabranchial cavities. This arborescent organ, highly vascularised surround the epibranchial arteries of the second and the fourth branchial arch (Moussa, 1957).

At more or less regular periods, the *Clarias* comes to the surface to breathe air, which enters in contact with the accessory respiratory organ, where gaseous exchanges take place. The works of Abdel-Magid (1971) and Moussa (1957) showed that the access to the surface was a necessity for these fishes especially when the oxygen content of water was low. In a well oxygenated water, *Clarias* could survive without access to the surface, but the rhythm of branchial breath reaches then a level above normal conditions. The accessory respiratory organ allows *Clarias* to survive during many hours out of water or a few weeks in muddy marshes.
Fig. 2. Section of head showing suprabranchial accessory breathing organ.
On the internal anatomical point of view, *Clarias* shows also the particularity of having a lobe of the liver emigrated up to the skin under the pectoral fin, moreover a second gland stays behind the first. No excretive duct starts from this gland and no auxiliary duct could be seen at the corresponding surface of the skin. It does not seem as according to Frechkop (1954) that we are in the presence of a venomous organ as some authors have supposed.

**REPRODUCTION**

The identification of spawning places and determination of a possible breeding periodicity of *Clarias lazera* in the Ubangi river has met with great difficulties due to the importance of the river and to limited staff facilities. Obviously the local fishermen do not know anything about this breeding, as the larval stages of development easily escape observers. Moreover smaller species of *Clarias*, particularly *Clarias bythipogon* and *Clarias submarginatus*, are more frequently observed and possibly confused at juvenile stage with the former. This explains that breeding experiments were organised on an empirical basis, arranging for fishes the reconstitution of various habitats; stumps, grass, holes from pipes section or excavations in the dam. The choice of genitors is easy, on the morphological point of view, the male has a conical genital papilla and the female presents a longitudinal groove on the oviduct (Fig.3).

Moreover at full maturity the female abdomen is rounded. On the basis of works carried out in the Far East on *Clarias batrachus*, induced breeding experiments were attempted in September 1970, with injection of gonadotrophine chorionic (HCG) and of luteinic hormone (LH) without success (Micha, 1973) and we observed sometimes the death of genitors.

On the other hand a natural reproduction process in a pond of 4 ares where ten genitors were stocked was observed. On draining 400 fingerlings were counted. Two processes are therefore possible for breeding experiments, induced breeding and natural spawning in ponds.

The first did not succeed in 1970 and was resumed the next year by the use of synthetic corticosteroids and breeding occurred in the majority of the cases. The second was also tried with success, but in both processes the percentage of fingerlings cropped still remained low in comparison with the high number of eggs laid.

Recently, Van der Waal (1974) has stimulated *Clarias gariepinus* in aquaria by hormonal treatment and has described the breeding habits.

**Techniques of induced breeding in cages or tanks**

Spawning tanks or cages of small volume (1 m\(^3\) roughly) are stocked with a pair of fish. The choice of the couple still remains difficult as regards the male for its sexual maturity is not obvious. For the female the distended abdomen gives in some cases discharge of eggs on simple manual pressure. For males, attempts for milt discharge remained unsuccessful. Hence the choice had to be made on the basis of aggressiveness.
Fig. 3. *Clarias lazera*, male and female.
Fig. 4. Induced breeding, injection of hormona.
Two males are placed for observation in a large aquarium or a tank for 1 or 2 h. We select the most aggressive for mating. That is to say the one which is less injured. Nevertheless the choice remains limited and thus involves some failure in the breeding technique.

**Injection of hormona and preparation of genitors**

The injection has no effect on egg or milt maturity. The product acts as a stimulus for laying and hence, only the injection of the female is necessary. The hormona utilized is the Desoxycorticosterone acetate (DOCA) used at doses of 5 mg per 100 g of the weight of the female. This one receives the calculated dose of hormona in a single intraperitoneal injection (Fig.4).

The injected female and selected male are placed separately in buckets or tanks for 10 h. At noon the genitors are placed in a small breeding pond or in a wire netted tank. In both cases the bottom is fitted with clean gravel. The depth of water must be 30 cm and a light current is suitable. The tank or pond must be covered with a wire net strongly attached to prevent the genitor escaping.

**Spawning and first development of fingerlings**

Spawning occurs during the night that follows the stocking of genitors. These are removed in the following morning as there is no parental guard.

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Fig.5. *Clarias* larvae, 24 h after eclosion.
The eggs adhere to the gravel. They are transparent except the ones which were not fertilized. A renewal of water is necessary to avoid egg losses due to fungus development. Hatching takes place, in the conditions encountered in Bangui, 24 h after spawning; the larvae are very small and weight roughly 1 mg. It is possible to count some thousands after a successful laying with a maximum of 10 000–15 000. In fact the female has a greater number of ovules (about 60 000 for a genitor of 1 kg and 100 000 for genitors a little heavier) but a part only reaches sufficient maturity. Natural reproduction is likely achieved by successive spawnings.

After 72 h the larvae have resorbed their vitellin reserve and they begin to feed on living microorganisms (Fig. 5, 6 and 7).

This period of reproduction and raising shows no major difficulties. The possible accidents are due mostly to carelessness of workers in controlling water supply or in handling genitors.

Fig. 6. *Clarias*’ larvae; 3 days old.

Second growth of fingerlings

At this stage the young *Clarias* are placed in ponds of 1 to 4 ares, where they need an abundant natural food until they reach 9–10 g. This occurs approximately 1.5–2 months after hatching or sometimes less depending on the quantity and quality of the available natural food (Fig. 8). At this stage it is possible to feed them artificially.
Fig. 7. *Clarias* larvae, 5 days old.

Fig. 8. *Clarias* fingerlings, 45 days old.
**Induced reproduction in ponds**

For this method several couples are needed. It could be practiced in more or less large ponds. The best results were obtained with four to six females and four males placed in a 4 ares pond.

The preparation of the females is the same as that for the reproduction in tanks. It is also necessary to prepare the pond the bottom of which should be clean, grassy or pebbly and somewhat hard. The pond is partly filled with water (a few inches) just before stocking the genitors, then filled to a height of about 0.50 m.

Breeding occurs normally during the night. The crop of fingerlings is obtained by emptying the pond 1.5–2 months after stocking.

This method is suitable or obtaining a few thousands fingerlings. In fact the survival percentage is still low as the crop does not surpass one to two fingerlings per m$^2$. The best result obtained is ten fingerlings per m$^2$.

The short cycle of cropping allows a limited diffusion of this species in extension work. This is an encouraging result for the short experimentation period.

**Natural reproduction in ponds**

The period of natural reproduction of *Clarias* coincides generally with the wet season, but catfish with more or less developed gonads are found all the year through. When we dispose of a batch of mature fishes, we could simulate in ponds the natural conditions of water level raising during the rainy season. This is enough in most of the cases to release spawning.

The density of genitors is the same as indicated above as well as the preparation of the bottom of the pond.

A few days after draining, the pond is partly filled with a small quantity of water. The genitors are then stocked and after a few hours, the level is raised up to 30 or 40 cm. Spawning occurs generally rapidly, but is not always easy to control. In all experiments carried out in ponds with many couples, the genitors and fingerlings were not separated before 6–8 weeks. The results are favorable for the percentage of successful spawning but the number of fingerlings obtained on cropping hardly exceeded one or two fishes per m$^2$ as with the former method.

**PRODUCTION METHODS IN PONDS**

Using the first batches of fingerlings produced in the station, different tests were carried out to determine the main characteristics of growth and yield of *Clarias lazera* which rapidly showed the exceptional value of the species.
Growth

In low density and with artificial feeding, Clarias lazera reaches in pond a weight of 10 g about 2 months after hatching, but exceptionally fishes of more than 90 g have been obtained during the first stage of development. This exceptional growth is probably the result of some cannibalism, sometimes observed when rearing fishes in tanks.

Above 10 g the fingerlings could be artificially fed with dry food rich in animal or vegetable protein.

The growth curve hereafter was established for a population of 1 400 Clarias stocked in two ponds of 4 ares (Fig. 9 and 10).

According to this growth curve in ponds, it appears that the individual increase of weight for a population of Clarias is the following:

- Fishes from 10 to 40 g: 1.5 g/day
- 40 to 110 g: 1.75 g/day
- 110 to 450 g: 4.50 g/day

![Weight Growth Curve for Clarias lazera](Fig.9. Mean growth of a population of Clarias lazera (feeding: 30% vegetal protein)).

![Weight Growth Curve for Clarias lazera](Fig.10. Mean growth of a population of Clarias lazera (feeding: 30% animal protein)).
The increase is normally reduced after, but isolated individual, fed with a rich food may increase more than 10 g/day in weight as observed for a *Clarias* stocked alone in a *Tilapia* pond and which increased from 300 to 900 g within 2 months. Fish of more than 1 kg rapidly double their weight when they are small in number and fed with a rich food.

The following table concerning a small batch of *Clarias* of the same origin fed with blood from a slaughter-house and wheat bran, gives some maximum and minimum individual growth.

<table>
<thead>
<tr>
<th>Stocking</th>
<th>1st month</th>
<th>2nd month</th>
<th>3rd month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. weight</td>
<td>60 g</td>
<td>220 g</td>
<td>410 g</td>
</tr>
<tr>
<td>Min. weight</td>
<td>10 g</td>
<td>70 g</td>
<td>130 g</td>
</tr>
</tbody>
</table>

The daily rates of growth (in grams) are the following:

<table>
<thead>
<tr>
<th>Period, growth</th>
<th>Maximum</th>
<th>Mean</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st month</td>
<td>5.6</td>
<td>2.8</td>
<td>1.6</td>
</tr>
<tr>
<td>2nd month</td>
<td>8.4</td>
<td>5.8</td>
<td>3.3</td>
</tr>
<tr>
<td>3rd month</td>
<td>1.7</td>
<td>2.4</td>
<td>0.6</td>
</tr>
</tbody>
</table>

The individual margins may be partially explained by lower gain in weight for the females. This difference was already observed by the analysis of the growth curve of a population where for a mean weight of 376 g the mean for the *Clarias lazera* males was 427 g and for the females 292 g showing thus a margin of 135 g corresponding to 33% of the males weight (Fig.11).

The growth of a few batches of fingerlings of the same origin and age but

![Fig.11. Individual growth of Clarias lazera.](image-url)
of different weight on stocking was also observed. Placed in the same conditions, the smaller fishes quickly recover the initial difference of weight. This does not exclude that improving mean growth could be obtained through genitor selection. This aspect of the production should be specially studied after perfecting the reproduction method in which genitors of large size are already used.

The individual growth is equally a function of the rate of stocking. Observations made in tanks for a period of 7 months for three batches of the same origin, give the following results:

<table>
<thead>
<tr>
<th>Rate of stocking</th>
<th>Mean weight after 7 months</th>
<th>Production kg/m²/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/m²</td>
<td>176 g</td>
<td>2.587</td>
</tr>
<tr>
<td>20/m²</td>
<td>102 g</td>
<td>2.429</td>
</tr>
<tr>
<td>50/m²</td>
<td>54 g</td>
<td>2.297</td>
</tr>
</tbody>
</table>

Although losses were observed in the higher rate, during the growth, it is remarkable to observe that the total production remains more or less identical in the three cases. There is no apparent need to surpass 10 fishes/m² for intensive production in tanks of 0.75 m in depth.

The rough production is very remarkable as it agrees with 250 kg of fishes per are per year.

The production observed in ponds of 4 ares for a smaller density of two fishes per m² was a little less as it corresponds to 120 and 180 kg/are/year.

The ideal density for ponds of mean depth seems to be between two and ten fishes per m². Future experiments should allow us to determine more exactly the rates to be recommended. This might be influenced by the depth of the ponds.

The analysis of the growth curve shows also that for fishes of 50 g and more, the daily rate of increase in weight is equal or superior to 10 g/m²/day or 100 kg/ha/day. From this, in intensive production, it seems advisable to foresee two stages in fish-farming. The first should start with fingerlings of a few grams to obtain fishes of 50–100 g at a high rate of ten fishes per m² as a minimum stocking.

The second stage leading to marketing could use larger ponds of 50–100 acres and utilize fishes raised in first development ponds. For this stage of growing we could foresee in the future separating the fishes and using only males.

With an adequate food, the growing stage should not exceed 3–4 months, and this could allow a minimum of 3 crops per year with a total production equal or superior to 20 tons/ha/year.

*Feeding of *Clarias

*Clarias lazera* is an omnivorous fish. Gosse (1963) in his study on the ecology of fishes in the Yangambi region (Zaire) suggest that it is a bottom omnivorous fish. Following Welman, the *Clarias* feed on fishes, frogs, molluscs,
insects and grass. Worthington and Ricardo (1936) consider it rather as a predator feeding on *Tilapia, Haplochromis*, but able to filter little zoo-organism and algae with their branchiospines. On lake Rudolph many small crustacea, *Diaptomus*, and *Cyclops* as well as remains of insects and chironomids larvae were recorded in their stomach contents.

Blache (1964) on lake Chad observed that young *Clarias lazera* feed on insects, seeds, and vegetal scraps where as adults eat small fishes and mollusces. For Hulot (1950) following the study of Industrial Fisheries on lakes Kivu, Edward, and Albert, *Clarias lazera* existing in each, must be considered as a microphageous, malacophageous occasionally entomophageous and equally voraceous fish.

In Ubangui, Micha (1973) showed that *Clarias lazera* is omnivorous and can eat vegetal detritus, larvae and adult of insects, plancton, other fishes, and so on.

Following the observations of these different authors it appears that the scope of the natural food of *Clarias lazera* is very wide as it could vary from a microphageous food promoted by their numerous branchiospines to a carnivorous feeding habit.

A few observations have been made about the most appropriate diet.

Iman et al. (1970) in a study on feeding of *Clarias lazera* in U.A.R. emphasized that animal protein ensures a better growth and stability, then a progression in protein content of flesh, but a vegetal protein food based on fresh plants allows too a rapid and significant increase of protein in the muscular flesh of the *Clarias* which is only surpassed the 3rd month when using animal protein food.

Exclusive rice bran feeding gave a result plainly inferior to the one obtained with protein diet. The works of these authors showed also a variation of the fat and mineral content of the flesh according to the types of food used.

Although these experiments bring indications about the influence of the type of diet, we must emphasize that the growth of controlled fishes mentioned by the former authors is far below the growth observed in C.A.R. and in Gabon, in theory for the same species. A study of the value for food products of fishes from natural surroundings, made by INSEE in Senegal shows equally seasonal variations, sometimes important, in the composition of the flesh of fishes:

For 1,000 g of filleted catfish: Protids ranges from 199.72 to 228.55 g; Lipids ranges from 33.30 to 63.30 g; Phosphorus ranges from 0.17 to 0.26 g; Calcium ranges from 0.03 to 0.23 g. The calorie content ranges from 1,243.00 to 1,472.72.

For comparison with some other species, the annual mean values for 1,000 g of filleted fish captured in the Senegal Valley are the following:

<table>
<thead>
<tr>
<th>Genus</th>
<th>Calories</th>
<th>Protids</th>
<th>Lipids</th>
<th>Phosphorus</th>
<th>Calcium</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Hydrocynus</em></td>
<td>1,822.59</td>
<td>243.27</td>
<td>86.90</td>
<td>0.39</td>
<td>0.28</td>
</tr>
<tr>
<td><em>Citharinus</em></td>
<td>1,414.69</td>
<td>244.68</td>
<td>41.01</td>
<td>0.39</td>
<td>0.37</td>
</tr>
<tr>
<td><em>Lates</em></td>
<td>1,386.76</td>
<td>251.87</td>
<td>34.51</td>
<td>0.39</td>
<td>0.41</td>
</tr>
<tr>
<td><em>Tilapia</em></td>
<td>1,273.77</td>
<td>269.41</td>
<td>13.68</td>
<td>0.60</td>
<td>0.87</td>
</tr>
<tr>
<td><em>Clarias</em></td>
<td>1,361.32</td>
<td>213.00</td>
<td>50.09</td>
<td>0.21</td>
<td>0.10</td>
</tr>
</tbody>
</table>
The experiments on *Clarias* feeding accomplished in Bangui were not always carried out on an identical pattern owing to variations in fingerlings production and to the individual characteristics of ponds.

In 8 m concrete tanks fingerlings of 5 days stocked at a density of 10/m² were fed in equal part with brewery waste and peanut cake; the growth was the following:

<table>
<thead>
<tr>
<th>Age</th>
<th>Density</th>
<th>Mean weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 days</td>
<td>10/m²</td>
<td>0.015</td>
</tr>
<tr>
<td>1 month</td>
<td>8/m²</td>
<td>14.00</td>
</tr>
<tr>
<td>2 months</td>
<td>7/m²</td>
<td>31.50</td>
</tr>
<tr>
<td>3 months</td>
<td>7/m²</td>
<td>46.00</td>
</tr>
<tr>
<td>4 months</td>
<td>7/m²</td>
<td>61.00</td>
</tr>
<tr>
<td>10 months</td>
<td>7/m²</td>
<td>130.00</td>
</tr>
</tbody>
</table>

The loss of fingerlings was 20% the first month, then 10% the second, it remained zero after. The production was equivalent to 920 g/m²/year.

With a pelleted food (30% vegetale protein) the production in concrete tanks with a similar density of 3 g fingerlings was 2 500 g/m²/year.

In ponds, when feeding with pellets, the yields were a little less, 1 200 and 1 830 g/m²/year but for a fish density four times less (two fishes per m²). Obviously better yields should be obtained in small ponds than in concrete tanks.

Combined with pigs, in a well fertilized pond, catfish of 95 g mean weight, at a stocking rate of 1/m² reach 381 g in 4½ month, giving a production equivalent to 7 tons/ha/year. This relatively mean yield for catfish has been obtained with a small density of fish and already it surpasses plainly the production obtained in the same pond with *Tilapia nilotica* at a rate of two fishes per m².

Observations on digestion were made for a diet composed of brewery draft and peanut cake.

The results based on the index of food content in the stomach after overfeeding are the following:

<table>
<thead>
<tr>
<th>Type of food</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 h</td>
</tr>
<tr>
<td>Brewery draft</td>
<td>247</td>
</tr>
<tr>
<td>Peanut cake</td>
<td>69</td>
</tr>
</tbody>
</table>

The brewery draft is well absorbed by the *Clarias* which digests it rapidly in less than 6 h, where it is digested only in 12 h by *Tilapia nilotica*, but in the intestine, rough particles remain showing an incomplete use of food. The peanut cake which has been absorbed in smaller quantity is rapidly digested.
The fast digestion indicates that this species should be normally fed several times per day to insure a good growth.

However it is necessary to complete the actual data with other experiments to improve the conversion rate obtained and to study the growth with other types of food and waste mixing.

**Polyculture**

Only one experiment of joint production of *Clarias lazera* has been realized in Bangui in the following proportions:

- *Tilapia nilotica* (97.3%); *Heterotis niloticus* (1.2%); and *Clarias lazera* (1.5%)

On cropping the following percentages has been obtained:

- *Tilapia nilotica* (92.4%); *Heterotis niloticus* (4%); and *Clarias lazera* (3.6%)

This result was obtained after a 6-month production period for the first two species and a 5-month period for the *Clarias* fed with a brewery waste.

When the pond was drained, the crop of *Tilapia* fingerlings was sufficient to supply restocking.

**Fishculture in cages**

Only one test was carried out in Landjia fishculture station in C.A.R. with a small batch of *Clarias* placed in a wire cage in the water supply canal of the station. The yield obtained was more or less equal to that observed in ponds. Apparently *Clarias lazera* is not a fish of running water. As it can tolerate a low oxygen content in water, this limits the interest of the culture in running water but it could be interesting for cage culture in lakes.

**Fishculture in brackish water**

Following Nair (1969), in Nigeria, *Clarias lazera* could acclimatized very well to low salinity water.

With quick salinity increase, the species could tolerate 10% salt and with progressive increases according to laboratory experiments it could bear up to 29%.

**PATHOLOGY**

Following Reed et al. (1967), the catfish observed in Nigeria could be occasionally infected by nematods occurring mainly in internal organs but also in the flesh. Infected fishes must be carefully cleaned before cooking.

Another case of parasitism has been mentioned by B. Roman for *Clarias anguillaris* in Upper Volta. This fish acts sometimes as intermediate host to *Botriocephalus* larvae. This larva dies in a few minutes when the fish is well cooked. Other Cestodes were noted in the intestine of small fingerlings of *Clarias lazera* in Bangui (Micha, 1972). The species provisionally identified as
*Lytocestus* sp. does not affect the vitality of the young fishes. Phenothiazine mixed with the food (1–5%) gave good results against this infection. One or two repetitions secure a complete elimination of the parasite.

Khalil (1972) reports in tract of *Clarias lazera* a new *Digeneous Allocreadidae*: *Afromacroderoides lazerae*.

**MARKETING**

In the area where it is common smoked *Clarias lazera* is widely distributed. Following Nair (1969) in Nigeria, there is a big demand for *Clarias lazera* specially in the south, where its price is double that of the price paid for other fish.

In Cameroon and Gabon, the consumers prefer *Clarias* to *Tilapia*. In Central African Republic opinions are divided concerning fresh products, it seems however, that the price of fresh *Clarias* would at the minimum be equal to that of *Tilapia*.

According to Irvine (1947), it is not eaten by Fetish priests in Ghana, and in Ivory coast *Tilapia* is preferred.

In South-East Asia, catfish are always appreciated and reach higher prices than other fish. In these countries, catfishes are sold alive. This practice exists in Zaire and could be spread in Africa as far as an intensive production of *Clarias* is obtained near large towns (Fig.12). Until now the *Clarias* fishing

![Smoked Clarias lazera. Market of Maroua, Cameroon.](image)
grounds are rather distant from consumers centers, and fishermen have no other resources than smoking or drying their fishes before marketing.

The *Clarias* could be easily preserved alive for 1 or 2 days or even more with some care using elementary equipment such as basins and metal drums.

CONCLUSIONS AND PROPOSAL FOR A STUDY PROGRAM

The first rearing experiments showed that *Clarias lazera* enjoys a remarkable growth rate and outstanding production qualities.

Fingerlings rearing still display some difficulties, which could be solved at least in reproduction stations. This is not in principle a major obstacle for distribution in extension work taking in account that many species of fish raised in ponds such as trout, eel, mullet breed elsewhere.

Further, very small *Clarias* fingerlings can tolerate handling and transportation. High productions obtained with this species give equal possibilities of utilization in intensive or rural fishculture on condition that adequate and suitable food or fertilization is available.

*Clarias* culture should allow an economical production by small units the
yields of which have until now been insufficient. The stages to be covered to realize a mass extension work of *Clarias* culture could be summarised as follows.

(i) *Survival of fingerlings*

It is necessary to raise a minimum of 60,000 fingerlings in order to get three crops per ha per year in intensive production. Such a significant number should be obtained with about 10 couples of genitors, at the rate of 40% hatched eggs survival. Until now such high percentages were reached in low densities, which mobilize larger ponds surfaces with a relatively short cycle.

Larvae survival seems to be connected mainly with a feeding problem immediately after the yolk sac is resorbed.

In ponds on the organic matter rich bottom survival is higher than in tanks, but predation is more intensive. This predation especially by frogs is somewhat reduced in the presence of genitors. It seems that a protective device as complete as possible of a natural breeding pond should significantly increase the yield of fingerlings. We may also suggest the reproduction in Dubish type ponds, where genitors could be cropped after 1 or 2 weeks.

If we use several couples in reproduction ponds we must crop and raise separately fingerlings of different breed and size because a certain cannibalism between the young fishes does exist.

(ii) *Determination of conditions for maximum production*

This stage could be conducted in parallel with the first one. The optimal density of stocking in relation with different steps of growing should be determined. The types and nature of the more economical food for high yields, the advisable association with farm-yard animals and the ideal proportions in multiple species production should also be specified. It is also advisable to know the best conditions of crops cycles for the different stages of growth.

The possibilities of rearing *Clarias lazera* in brackish water should be also studied in this part of the programme.

(iii) *Selection*

A third stage which could also be started with the other two should give a better knowledge of possibilities of improving yields through selection of genitors. A study of this type needs several ponds and could only be considered in a well equipped station.

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REFERENCES


