"Point of No Return" for starved larvae of the redbreasted tilapia, *Tilapia rendalli* (Boulenger, 1915)

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Abstract
The effect of different timing of feed supply to newly hatched larvae of *Tilapia rendalli* for first exogenous feeding was investigated at Bunda College fish farm, Lilongwe, Malawi, using 1300 larvae from a single batch of eggs that hatched on 6th February 2003. In each of the two experiments, 650 larvae were separately stocked in groups of 50 in 13 beakers and provided with food starting at different times: 5, 6, 7, ... 4, 15, and 16 days after hatching (DAH). In two beakers, fingerlings were never fed until they all starved to death by day 17 after hatching. Mortalities in all beakers were recorded daily up to day 20 after hatching when the experiment was terminated. Results show that timing of first feed supply has an effect on the survival of *T. rendalli* larvae. Survival was more than 50% in larvae that were first fed by 7th day after hatching, below 30% in those that were first fed 10 days after hatching, and below 25% in larvae fed 12 days after hatching. All larvae not fed within the first 13 days after hatching died by day 17after hatching. The point of no return was 13 DAH. Results suggest that in subsequent propagation of this species, total fry mortality will likely occur if larvae are not supplied with appropriate feed by day 13 after hatching. Results also showed that for higher survival and healthier fingerlings feed should be supplied by as early as 8 days after hatching.

Key words: *Tilapia rendalli*, larvae, hatching, endogenous, exogenous, first feeding, point of no return

Introduction

Tilapia rendalli (Boulenger, 1915), the red-breasted tilapia also known as the Congo tilapia (Teichert-coddington *et al.*, 1997) and locally known as: "Chilunguni" and "Nyungwesali" in Malawi, is one of the four most widely cultured species in sub-Saharan Africa (Penman and McAndrew 2000). In Malawi, *Tilapia rendalli* comes next in importance to *Oreochromis shiranus* with which it is often stocked in polyculture in ponds. Both species are highly valued as a food source (Msiska, 1988, Mandeng 1988-cited by Kaunda 1996; Ambali, 1998, Coward and Bromage, 2000) but *T. rendalli* has a reportedly superior flavour. In addition, *T. rendalli* performs better at higher (and cooler) altitudes (around 1,000 m; 22 ^{0} C) than any *Oreochromis* species available in Malawi and may therefore be suitable for aquaculture in the high-altitude areas where fish supply is limited (Msiska, 1988). However, inadequate supply of fingerlings is one of the constraints to fish farming in high altitude areas as *T. rendalli* breeds only when temperatures exceed 27 °C (Ohashi *et al.*, 2001), and the asynchronous nature of tilapia species makes it difficult for large numbers of uniform-size fry to be obtained naturally (Tave, 1993).

Seed production for tilapia by synchronized massive spawning in concrete tanks and hapa hatchery systems appears to be more efficient than production in ponds (Guerrero and Villanueva 1978 cited by Antonio *et al.*, 1988) due to elimination of predators, improved harvest efficiency and better water quality.

However, in order to further develop massive seed production and nursing techniques in aquaculture, the understanding of biological aspects such as effects of environmental variables on reproductive processes and morphological development vis-à-vis feeding performance in larval and juvenile stages, is indispensable. A typical teleost embryo feeds endogenously on yolk reserves, but sometime after hatching the larva takes exogenous food usually in form of microscopic plankton. Endogenous feeding ceases as the yolk gets completely resorbed, making exogenous feeding a compulsory means to survival.

The time when fish larvae switch from endogenous feeding to exogenous feeding is a vulnerable period in the life cycle of fish and is of important significance in the captive spawning of fish. A common constraint to captive spawning is the lack of food, which often occurs at around this time. It is indeed believed that lack of suitable food is the main cause of fry mortality (Woynarovich and Horváth, 1980).

The point of no return (PNR) a concept first put forward by Blaxter and Hempel in 1963 (cited by Ew... 1992) is the point in time, after final yolk resorption, when starved larvae lose their feeding ability, approach neutral buoyancy and become so inactive that supply of food afterwards neither arrests mortality nor restores normal growth and development since the larvae would already be too weak to eat. PNR for a species may therefore be defined as the duration in days, of delayed first feeding, which causes irreversible effect that larvae cannot recover from. The PNR for *T. rendalli* has not been determined and this study was conducted to establish the PNR in larvae of *T. rendalli.*

Methodology

From a single batch of eggs that hatched on 6th February 2003 at 08:00 hours, two sets of experiments each having 650 larvae were carried out. In each experiment larvae were stocked in groups of 50 in 13 beakers. Treatments were in form of 12 different timings of first diet supply that is, feeding delayed for up to 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16 days after hatching. The group of 50 larvae reared in the 13th beaker were not fed. Due to shortage of uniform-size beakers, one experiment was done using 3-litre beakers and the other one in 2-litre beakers. Feed consisted of *Artemia* nauplii except occasionary, when due to shortage of *Artemia,* larvae were fed zooplankton (mainly rotifers) harvested from outdoor concrete tanks. Fish were fed 5 *Artemia* /zooplankton per ml of water three times a day. To prevent deterioration of water quality, uneaten feed from the previous day's meals was regularly removed by siphoning, before adding feed for each new morning. Mortalities were recorded twice everyday until 3 days after all larvae in the "unfed" groups were starved to death. This was on day 20 after hatching.

Results and Discussion

By the end of 20 days, survival was more than 50% and 30% in beakers where larvae were fed at 7 DAH (7 days after hatching) and 10 DAH, respectively. For larvae that were first fed 11-12 days after hatching, survival was below 30% in the larger beakers and below 20% in the smaller beakers. Survival for larvae first fed 13 days after hatching was over 5% in the large beaker and 0% in the small beaker.

The effect of delayed feeding was greater at 13 DAH (300 HAH) between larvae fed at 8 DAH and those not fed by then (Figure 1). The point of no return was around 13 DAH and 14 DAH (for the small beakers and larger beakers respectively) (Figures 1 a and b). Mortality due to starvation was generally higher in smaller beakers than in the larger beakers although the difference was not significant.

The PNR of *T. rendalli* obtained in this study makes sense as it is lower than the one reported for *O. mossambicus.* In general, eggs of *Tilapia* are smaller than those of *Oreochromis* species. Balarin and Hatton (1979) and Rana (1985) established that DAH is higher in larvae obtained from larger than small eggs. PNR for *O. mossambicus* were 15-16 DAH and 21 DAH in larvae from small to medium and large eggs, respectively (Rana 1985).

In conclusion, this study established that the point of no return for unfed *T. rendalli* larvae is 13–14 DAH and that delayed feeding beyond 8 DAH has a negative impact on their survival.

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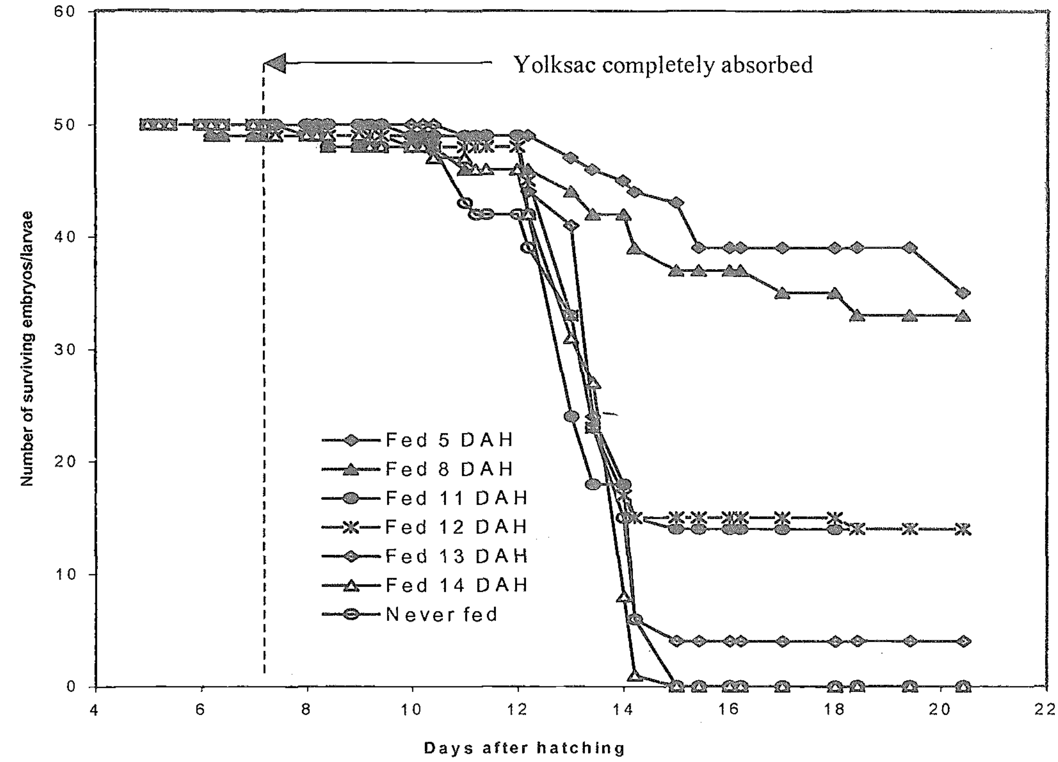
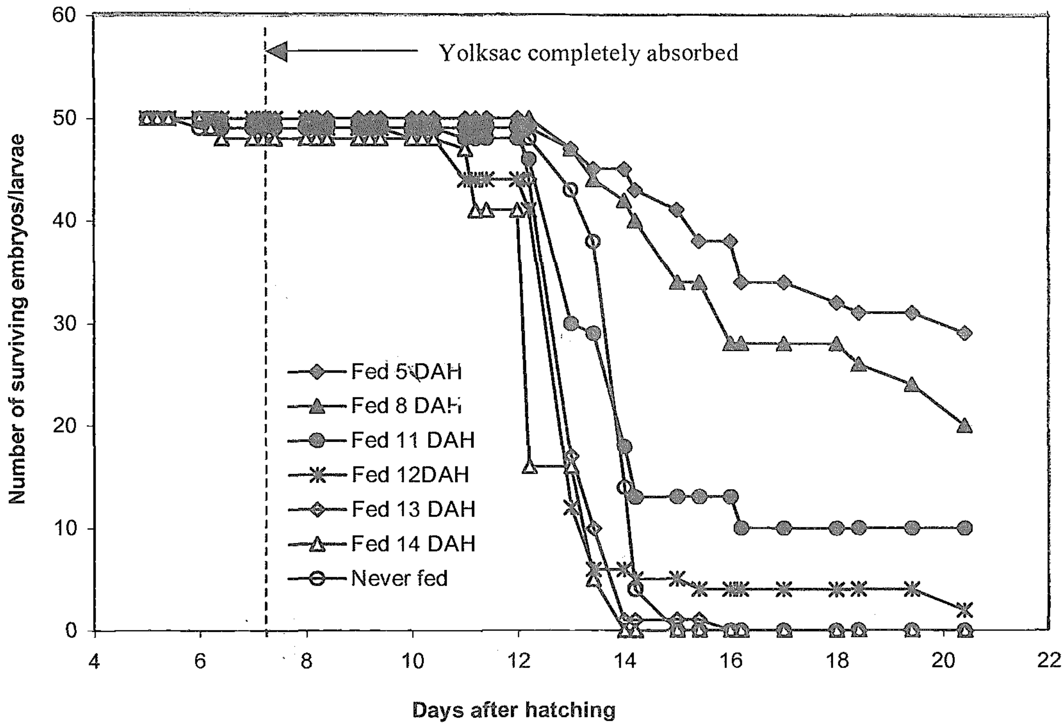


a)



b)

Figure1. Number of surviving embryos/larvae at different days after hatching (DAH) of *T. rendalli* : a) larger beakers; below, b) smaller beakers, (only selected treatments are shown)

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