

## **Relationships of fecundity and body size of *Lates stappersii* in central Lake Tanganyika, East Africa.**

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### **Introduction**

Although *Lates stappersii* is critically important fisheries biology in Lake Tanganyika, and is a major predator of the pelagic zone, its biology is still poorly understood. In this work I address a cornerstone in understanding the life history of this important fish with data on the relationship between female body size and fecundity. This relationship will be useful both for understanding pelagic ecosystem dynamics and in management of this species.

*Lates stappersii* one of the four endemic *Lates* species found in Lake Tanganyika. Unlike the other three *Lates* (*L. mariae*, *L. angustifrons*, *L. microlepis*, generally referred to as large *Lates*), *L. stappersii* is a pelagic water fish through out its life. Though it is found in different lake habitats, it generally occurs in deep and steep basins (Mannini 1998). It seems to aggregate more strongly than other *Lates* species especially during main spawning seasons. It is concentrated at night by fishing lights and caught mainly by using lift nets and purse seines. *L. stappersii*, together with clupeids, form the major commercial species and contribute greatly to the people in the region at least at two levels. Economically they are a source of income to stakeholders (fishermen and fish traders) and nutritionally, they provide relatively the best (and perhaps cheapest) animal protein to the local people.

Fecundity is the number of ripening eggs found in the female prior to the spawning act (Bagenal

1978). This contrasts with fertility, which is the number of eggs shed. Fecundity varies greatly in individuals of one species of the same weight, length and age, but in many species it increases in proportion to the size of fish (Lowe-McConnell 1975). Except for the preliminary Pearce (1985) study on the reproductive potential of *L. Strappersii*, no detailed investigation has ever been done to determine fecundity of *Lates* spp. No work information existed previously on how fecundity is related to maternal body size.

### **Research Objectives**

- Define the relationship between fecundity and body size.
- Test how strongly seasonal reproduction is in *L. stappersii*.
- Determine whether sex ratios are even or biased.

### **Methods**

#### **A. Maturity Stages**

I bought fish samples of *Lates stappersii* (n=407), the largest available daily from different fish markets around the Kigoma area. I weighed, sexed, measured total length, for each fish. Then I identified the different stages of maturity based on macroscopic observation of the gonads (i.e. color, shape, transparency, and vascularisation of ovaries). I supplemented this with microscopic observation of egg size distribution at different stages of maturity. Before opening the fish I also pressed lightly on the belly of the fish to check if white milt (for males) and eggs (for females) were running (stage IV).

#### **B. Fecundity**

I counted ripe (big size) eggs from ovaries of female fish at stage IV only using volumetric sub-sampling technique. I weighed both ovaries and emptied one of them into the beaker of water and the volume of the mixture

recorded (sample). Generally I used 100ml of the sample. Then I swirled the contents of the beaker to ensure uniform mixing of eggs. Quickly I pipetted 1.0ml sub-sample from the beaker using a 1.0ml plastic dropper and counted the number of eggs in the sub-sample under the microscope (30X). I repeated this process ten times and fecundity was taken as a mean of counts in sub-samples. Fecundity formula:

$$F = n * (A/a) * (G/g)$$

n = mean number of eggs in sub-sample

A = volume of eggs and water (100ml)

a = volume of sub-sample (1ml)

G = total weight of both ovaries (g)

g = weight of ovary used in the sample

## Results

Preliminary maturity stage observations in *L. stappersii*

Stage I (immature). Gonads not developed. Sex of fish is difficult to differentiate. Stage II. (Maturing). In females, small slender ovaries, reddish in color due to increased number of blood vessels. Gonads are small, flat, and appear translucent in males.

Stage III (mature). Ovaries appear reddish-yellow (not completely ripe). White milt comes out when gonad is cut and pressed in males.

Stage IV (ripe-running). Ovaries are big (finger-size) and ripe, yellow in color. A slight press on belly of fish results in some eggs being released, so are sperm for males at this stage.

Stage V (spent). Eggs already shed. Ovaries appear like Stage 2 but longer.

## Egg size distribution

I observed about three to four size groups of eggs in mature ovaries. Each egg is contained in an oil droplet. The diameter of big eggs measured about 0.5mm, medium (0.3mm), small

(<0.2mm) and very small eggs (<0.1mm).

## Sex Ratio

I found the sex ration between females and males to be 1:2 respectively, n=407. Females at stage IV to mature males; the sex ratio was 1:7. The percentage of females at stage IV was 9%, n=407.

## Fecundity

I found fecundity for *L. stappersii* varying from 60,000 to 800,000 per fish (average 256,000). These refer to one big size group of eggs at stage IV. The relationships between total length of *Lates stappersii* with gonad weight, with fecundity, and between gonad weight and fecundity are shown in Figure 1.

## Interpretation of Results

Fecundity for *Lates stappersii* is expected to be high because of small eggs. There is probably no parental care, predation and mortality of eggs and juveniles must be high. Pearce (1985) estimated the eggs to range between 7,600 and 287,000 per fish (average 107,000) and estimated the total number of eggs spawned by a female each year to probably range between 100,000 to 1,000,000 (sample size n=14). I found fecundity to be higher ranging between 60,000 and 800,000 per fish (average 256,000) as shown in Table 1. Since I saw three to four size groups of eggs in mature ovaries, probably spawning may occur several times within a protracted spawning season. Fecundity may thus range between 180,000 and 2.4 million eggs per fish per year (sample size, n=37).

According to Aro and Mannini (1995), the spawning season for *Lates stappersii* in Zambia and Rukwa (Tanzania) is from November to April with peak in March when there are more mature females. In August there are more pro-

ducing males. My study shows that fecundity is still high in the summer dry season (July and August). Sex ratios are highly biased in this study with most fish being male (1:2 females:males). Bias becomes more extreme at large sizes 1:7. This supports earlier observations (Aro and Mannini(1995), Chitamweba, pers.comm.) and suggests that large mature males remain at this stage for a relatively longer period of time.

Fecundity and body size have an approximately a linear relationship in current data sets. ( $r^2=0.4472$ ), similarly for gonad weight and body size ( $r^2=0.5095$ ). There is a stronger correlation between fecundity and gonad weight ( $r^2=0.8603$ ). The relationship between fecundity and body size may be increasing and non-linear at large sizes, however this is a suggestion based only on a single data point (fig.1). Further tests must be based on samples with more large fish.

### Future Work

- Detailed sampling year round it compare in-season and off-season differences in fecundity.
- Increased sampling of the largest females to determine linearity of body size and fecundity relationships.
- More data on differences in sex ratios.
- This project is the cornerstone of my M .Sc. thesis.

### References

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Table 1.

TOTAL SAMPLE SIZE	FEMALE IN STAGE IV	FECUNDITY RANGE	AVERAGE FECUNDITY	ANNUAL FECUNDITY ESTIMATE	SOURCE
407	37	60,000 - 800,000	256,000	180,000 - 2.4 million	Musonda 1999 (this study)
?	14	7,600 - 287,000	107,000	100,000 - 1 million	Pearce 1985