Fecundity and egg sizes of pelagic fishes, *Stolothrissa tanganicae* and *Limnothrissa miodon* in relation to size of the fish.

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Introduction

Lake Tanganyika stretches in a north-south orientation between the steep eastern and western escarpments of the Western Rift Valley, from 03°20'S to 08°48'S latitude. It is a major aquatic resource on both a local and global scale, containing 18% of the world's surface freshwater, and the second largest volume of anoxic water after the Black Sea (Coulter, 1991).

Lake Tanganyika has a very rich pelagic fishery, which consists mainly of endemic clupeid species (*Stolothrissa tanganicae* and *Limnothrissa miodon*) and their predators, endemic centropomids (*Lates* spp.). *Stolothrissa tanganicae* is the most important species in the fishery. Coenen (1995) estimated a total overall fish catch for Lake Tanganyika from 1992 to be 167,000 metric tones, of which 80,000 tonnes were contributed by Tanzania. Annual harvest levels have been estimated to vary in the range of 165,000-200,000 tonnes with Tanzania landing about 31% of the total catch (Mölsä et al., 1999).

The health of the pelagic fishery depends on the fecundity and mortality rate of the pelagic fishes. Therefore it is important to study the reproductive capacity of these species. My project examines the effect of body size on the number and size of eggs produced by sardines (*Stolothrissa tanganicae* and L*imnothrissa miodon*).

Research problem

The lake has historically supported a remarkably productive pelagic fishery that currently provides 25%-40% of the animal protein supply for the population of the surrounding countries (Coulter, 1991). *Stolothrissa tanganicae* is most important species in this fishery, but recent data show their catch decreasing each year. Biological information is necessary for management of these species (Mölsä et al., 1999). For example, data on the fecundity and egg size of the Tanganyikan sardines is critical for understanding their population dynamics and harvest potential.

Objectives

- To investigate the effect of body size on the number of eggs produced by these fishes.
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Hypotheses

- The body size of the fish is directly proportional to number of eggs.
- The body size of the fish is directly proportional to the size of eggs.
- The size and number of eggs are inversely proportional.

Material and methods

Study area

All samples were collected from the fishermen landing at Katonga during late July and early August 2004. Because of the unpredictable fishing grounds used by the fishermen, the exact location where fish were collected could not be identified.

Methodology

Fresh fishes were bought from the fishermen and kept on ice during transport to the laboratory. Each fish was measured (mm SL) and weighed (to nearest 0.01g using a digital balance), then dissected to determine sex and maturity stage. Gonads from mature females of stage IV were removed and weighed. A single gonad was cut open to release the eggs into a petri dish for enumeration.

Eggs were counted using a dissecting scope. They were spread uniformly in a petri dish (10 cm diameter) that was divided into sixteen equal-sized wedges. Eggs within three wedges were counted and multiplied by 16/3 to estimate the total number of eggs. The same eggs were categorized according to size using an ocular micrometer. To compare egg sizes in relation to body size of fish, fish were divided into five size classes (very-small, small, medium, large, and extra-large) with equal numbers of individuals. The frequency distribution of egg sizes in each fish size class was calculated.

Results

I found 27 mature, stage IV female *Stolothrissa tanganicae*. Each female contained between 7104-37323 eggs. There was a positive relationship between wet mass (g) of the *Stolothrissa* and the number of eggs (Fig. 1). A similar relationship applied to fish length, which ranged from 7.3-10.3 cm (Fig. 2). There were far fewer large eggs (> 600 µm) in any fish size class compared to small (< 300µm) and medium (300-599µm) eggs, and fewer medium than small eggs (Fig. 3).

Only six stage IV *Limnothrissa miodon* females were available, and the relationship between the fish length and number of eggs was weak (Fig. 4). The fish ranged from 11.3-13.5 cm SL, and contained between 16235 and 51403 eggs. There was no variation in egg size within *Limnothrissa*; they were all approximately 400µm in diameter. Comparing the two sardine species suggests that the number of eggs may increase more quickly with mass in *Limnothrissa* than *Stolothrissa* (Fig. 5).

Discussion

Stolothrissa tanganicae has a short life span (~1 year) and may spawn several times after reaching maturity (Ellis, 1971). This study shows that the species produces primarily small (<300µm) and medium eggs (300-599µm), though it also makes a few large ones (> 600µm). Safari's (1998) study of the sinking rate of *Stolothrissa tanganicae* eggs found that larger eggs (300-500µm) sink more quickly than small ones (150-300µm). The eggs of this species increase in size two-fold

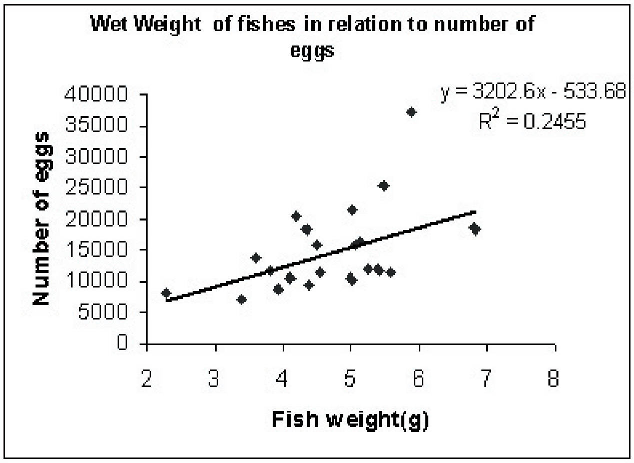

Figure 1: Effect of *Stolothrissa* mass on number of eggs

after fertilization and sink slowly (4-5cm/minute), hatching 24-36 hours later (Mattes, 1967a). Having large eggs (> 600µm) may be maladaptive for this species because large eggs tend to sink at high speed, thereby reaching the anoxic waters before hatching. However, the advantages of provisioning young with more resources may select for investment in a few large eggs along with mostly small ones.

It was hard to find mature *Limnothrissa miodon* during the study period. Out of 123 individuals dissected, only 6 were mature females. This may reflect their spawning pattern, which reaches a peak during the rainy season between November and May (Coulter, 1991). The preferences of the fishermen may also have contributed, as they prefer fishing for *Stolothrissa tanganicae* and *Lates stappersi* that live further offshore than *Limnothrissa miodon* (Leevéque, 1997).

It was interesting to note the lack of size variation among eggs of *Limnothrissa miodon*, all of which were approximately 400µm in diameter. Their uniform small size may contribute to the fact that the number of eggs in *Limnothrissa miodon* appears to rise more quickly with female size than in *Stolothrissa tanganicae*.

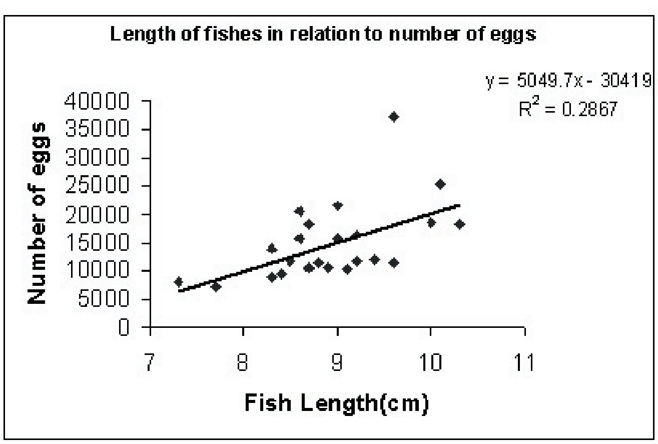

Figure 2: Effect of *Stolothrissa* length on number of eggs

Conclusion and recommendations

Fisheries statistics show that the catch of the fish in Lake Tanganyika is decreasing each year, and biological information is needed to improve fishery management (Mölsä *et al*., 1999). This study suggests that the endemic sardines produce enough eggs replace themselves under normal mortality rates. However, the use of fishing nets with small mesh allows harvest of even juveniles that have not had an opportunity to reproduce. Thus, management of the sardine fishery may require stricter regulations on the mesh size of nets to avoid catching juveniles (i.e. 8mm mesh size).

Future studies should investigate the production of fry in addition to eggs. The fitness consequences of investing in many small eggs (*Limnothrissa miodon*) versus fewer larger eggs (*Stolothrissa tanganicae*) should also be investigated. This may reflect a trade-off between fecundity and juvenile survival (Stearns, 1994).

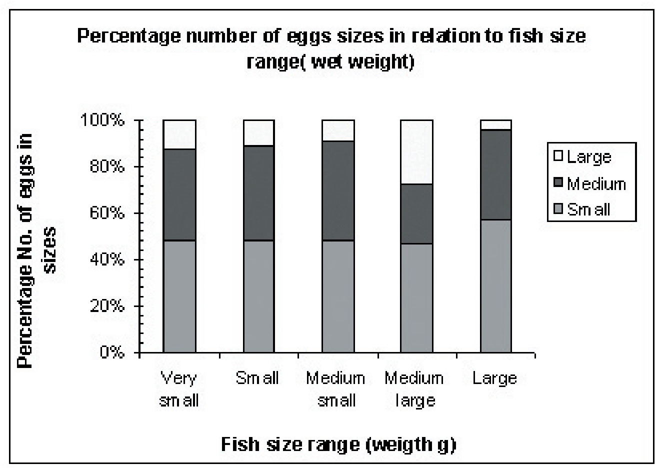

Figure 3: Size distribution of *Stolothrissa* eggs compared to female mass

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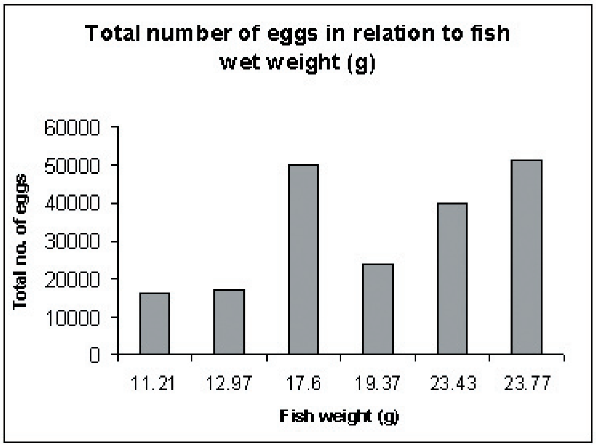

Figure 4: Effect of Limnothrissa length on number of eggs

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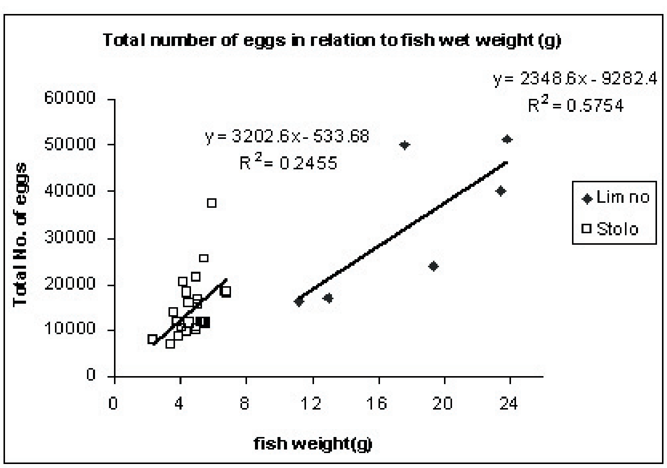

Figure 5: Effect of female mass on number of eggs in *Limnothrissa* (Limno) and *Stolothrissa* (Stolo)