

The Evolution of Mouthbrooding: Are mouthbrooder eggs different?

California State University, Sacramento, Department of Biological Sciences

By: Breann Benitez

Abstract

The Cichlid Fry Project investigates the relationship between egg size and fry size among various species of cichlids and demonstrated a relationship between egg size and fry size. However the project hasn't incorporate mouthbrooder cichlids because mouthbrooders exhibit a different breeding system and typically lay few but large eggs. It is unknown if mouthbrooder egg size and fry size follow the same positive relationship as substrate-spawning cichlids. Analysis of the mouthbrooder egg size and fry size shows the same positive relationship between mean fry size and effective egg diameter as substrate-spawning cichlids.

Introduction

Cichlids are a large family of fishes and considering the amount of diversity within the species, egg size varies tremendously among species. Some lay many small eggs and some lay few but large eggs.

Considering the size and diversity, cichlids exhibit two different breeding systems: substrate-spawning and mouthbrooding. Mouthbrooder refers to the female cichlid incubating and tumbling eggs in her mouth and she will keep them in her mouth until they are fry. Typically, mouthbrooder cichlids lay few but large eggs.

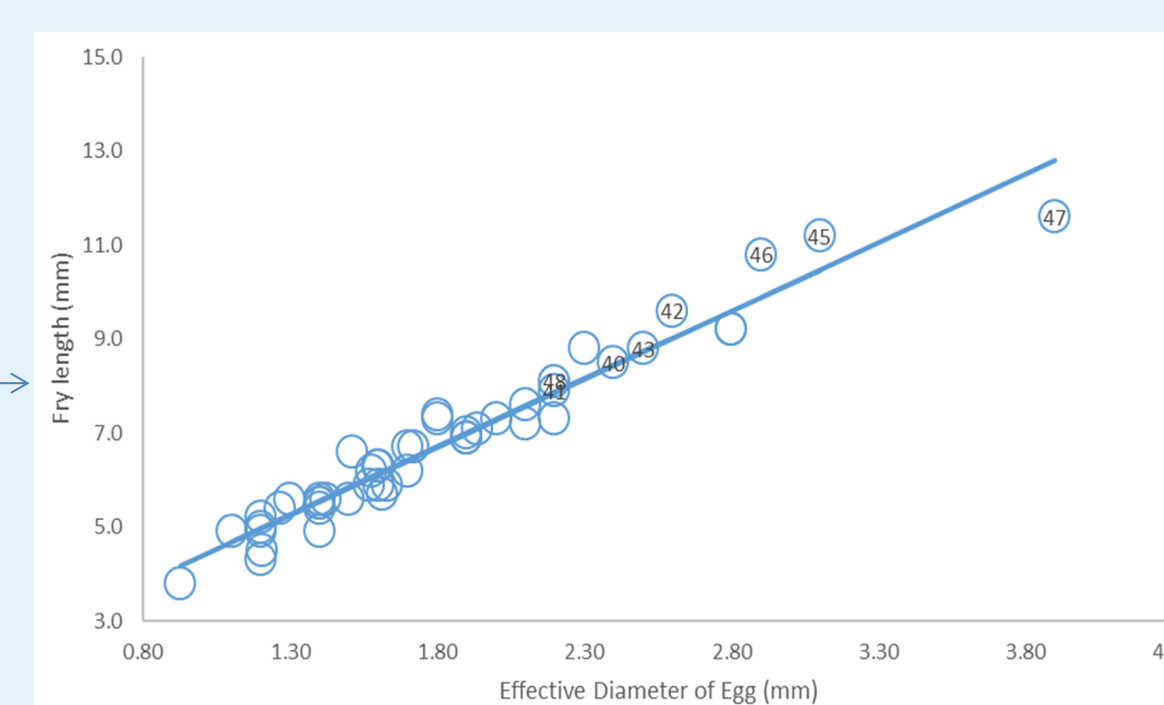
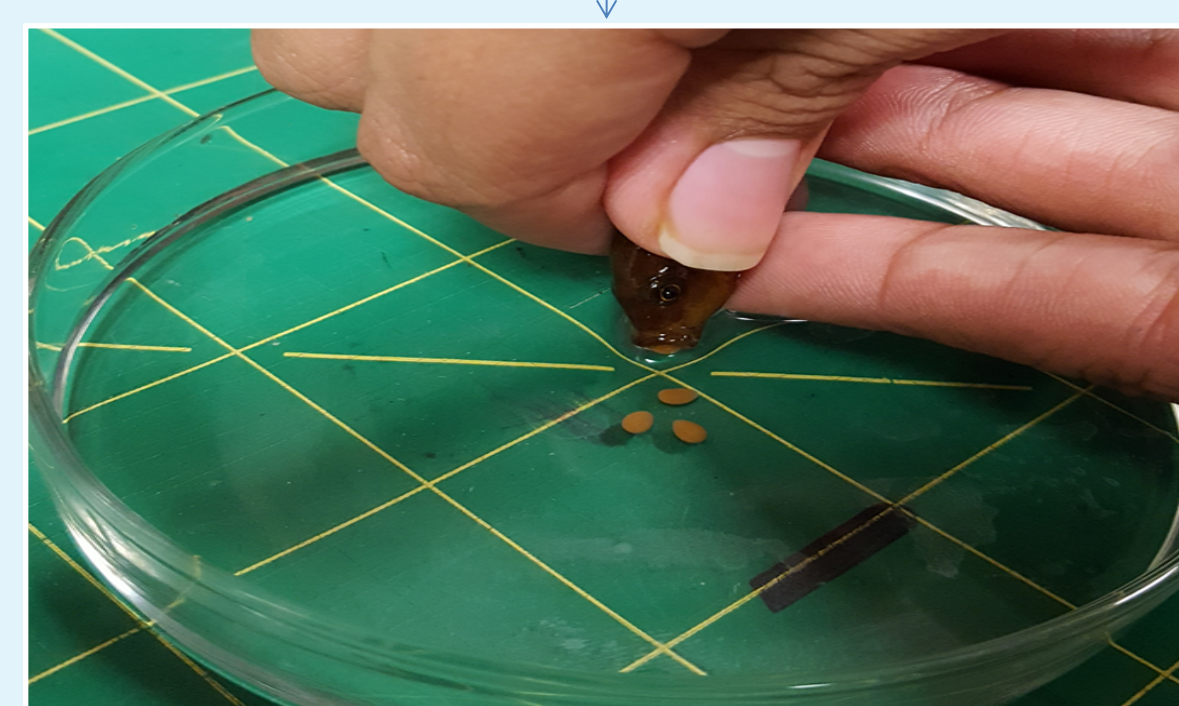
We hypothesize that larger eggs produce larger fry which benefit the fry by making them able to swim faster, avoid predators, and have more dietary options. Smaller eggs result in a larger number of eggs, and subsequent fry.

Currently the Cichlid Fry Project has only examined a few mouthbrooder cichlids because it is unknown why mouthbrooders show such a unique breeding system and there are limited resources about mouthbrooder cichlids eggs and fry sizes so it is unknown if mouthbrooders follow the same positive relationship as substrate-spawning cichlids.

The project's research objectives is to answer the a few questions; are mouthbrooder eggs different than substrate-spawning eggs and does the relationship between mouthbrooder cichlid egg size and fry size follow the same pattern as substrate-spawning cichlids.

Materials and Methods

Aquaria consisted of gravel, artificial plants, air filter, heater, and either broken flowerpots or pieces of slate. Mouthbrooders were observed daily for parental behavior and presence of holding eggs or hatchings. When mouthbrooders spawn, catch the female holding the eggs then remove the eggs in her mouth and preserve a sample of eggs in 70% isopropyl alcohol. At this point two options occur: you can let the female tumble her eggs in her mouth until they hatch (wrigglers) or place eggs in an egg tumbler and allow eggs to hatch. Once the eggs reached to the wriggler stage then isolate wrigglers in a small tank with an air filter and observe the tank daily for the presence of swimming (fry) and preserved fry in 5% formalin. A dissecting scope fitted with an ocular micrometer was used to measure the eggs and fry. Analyze egg size and fry size and produce a graph.



Results

Regression analysis indicated a positive relationship between mean mouthbrooder fry size and effective egg diameter.

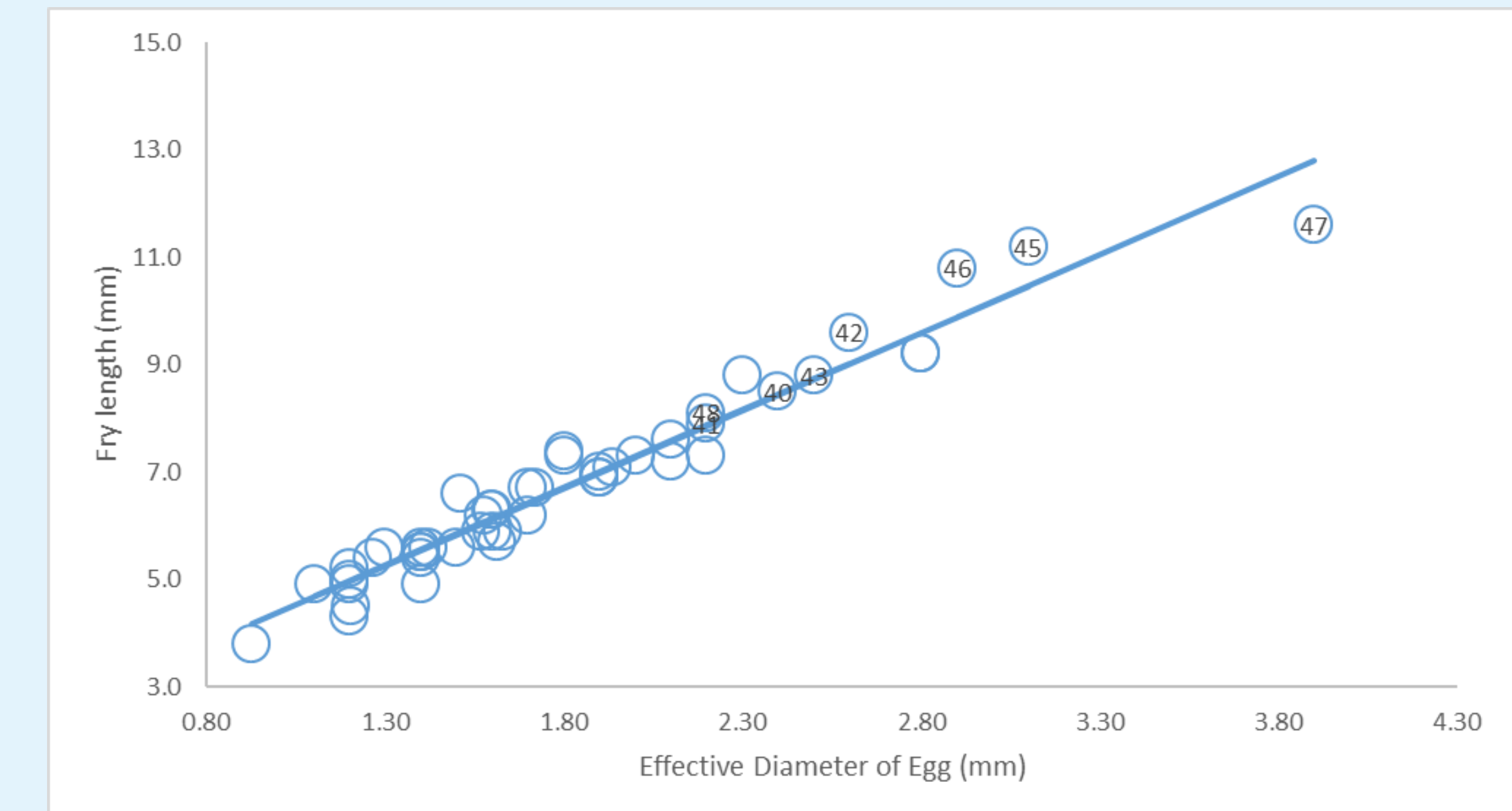


Figure 1: Mean fry Total Length (TL) as a function of mean effective diameter for species of substrate-spawning and mouthbrooder cichlids. Each number represents one mouthbrooder species: 40: *Oreochromis mossambicus* Salton Sea 41: *Pseudocrenilabrus multicolor* Victoriae 42: *Astatotilapia calliptera* 43: *Pundamilia nyererei* 44: *Geophagus steindachneri* 45: *Iodotropheus sprengeri* 46: *Orthochromis stormsi* (wild) 46: *Labeotropheus füllebourni* orange blotch 47: *Labeotropheus füllebourni* orange blotch 48: *Chromidotilapia guntheri* Loennbergii

Discussion

Even though mouthbrooder cichlids exhibit a different breeding system and lay fewer and larger eggs than substrate-spawning cichlids they still follow the same positive relationship between mean fry size and effective egg diameter as substrate-spawning cichlids. Female cichlids face a trade-off of her egg size choice. Smaller eggs results with more eggs and smaller fry which are more susceptible to predation and have limited diet. Larger eggs result with less eggs but larger fry which result with less predation, stronger swimmers, and have more dietary options.

Acknowledgments

We gratefully thank all the hard work of all students in the Cichlid Fry Project. This research was funded through the Sacramento State Instructionally Related Activities (IRA) and Science Educational Equity (SEE).

References:

Coleman, R.M. (1991) Measuring parental investment in nonspherical eggs. *Copeia* 4: 1092-1098.
Coleman, R.M. and A.P. Galvani. (1998) Egg Size Determines Offspring Size in Neotropical Cichlid Fishes (Teleostei: Cichlidae). *Copeia* 1: 209-213.



Breann Benitez Dr. Ron Coleman

Email: breannbenitez@csus.edu

