Egg Size Determines Fry Size in Cichlid Fishes

California State University, Sacramento, Department of Biological Sciences

SACRAMENTO STATE

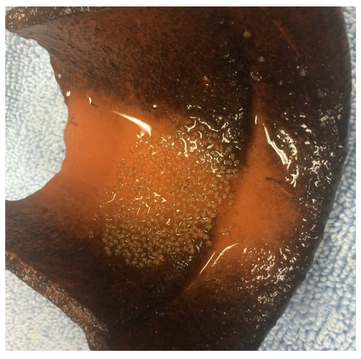
Evolutionary Ecology of Fishes Laboratory

California State University, Sacramento

Abstract

Cichlids are freshwater fish belonging to the family Cichlidae. Globally, people use cichlids as farm, game, and hobby fish. Among cichlid species, a huge range of egg size variation exists. Species trade off egg size and egg number. For instance, a species laying large eggs will usually spawn fewer eggs. Why does this variation exist, and what advantage does forming a larger or smaller egg have?

In this study, researchers paired fish for captive breeding. Samples of eggs, hatchlings, and fry were then collected and preserved. So far, researchers have collected and examined eggs from 47 unique species. The data demonstrates a strong positive relationship between fry length and egg diameter. This study indicates that egg size plays a crucial role in the future size of the fry.



Introduction

Egg size varies between the 2000 species in the fish family Cichlidae (Coleman and Galvani 1998). Understanding why this variation exists, i.e. the costs and benefits of egg size, is the goal of this research.

There is a tradeoff between egg size and egg number. A female laying large eggs can lay only a few eggs at a time. A female laying smaller eggs gains a clear benefit by laying many more eggs. This raises the question: what is the benefit of laying a larger egg?

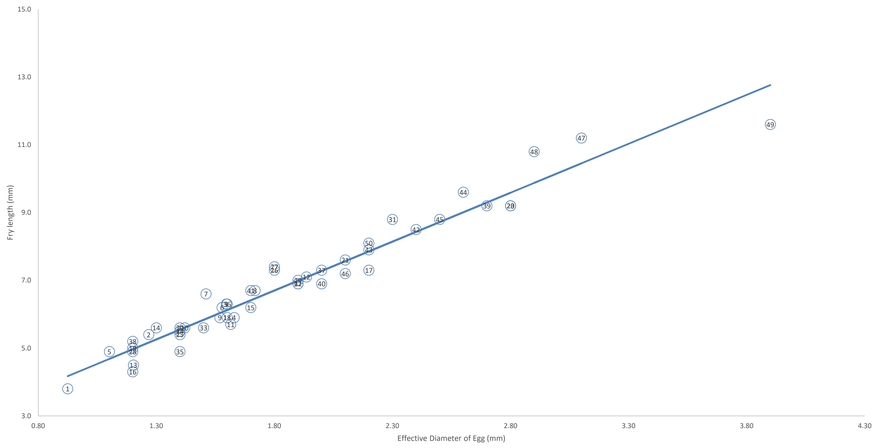


Figure 1: Mean fry Total Length (TL) as a function of mean effective diameter for 47 species of cichlid. Each number represents one species as follows: *1=Mikrogeophagus ramirezi*; *2=Herotilapia multispinosa*; *3=Amatitlania nigrofasciatus "Red Point"*; *4=Amatitlania nigrofasciatus*; *5=Anomalochromis thomasi*; *6=Amatitlania myrnae*; *7=Geophagus brasiliensis; 8=Cryptoheros chetmulensis*; *9=Amatitlania septemfasciatus; 10=Cleithracara maroni; 11=Cryptoheros cutteri; 12=Hypsophrys nicaraguense; 13=Apistogramma panduro; 14=Pterophyllum scalare; 15=Nanochromis parilus; 16=Laetacara curviceps; 17=Pelvicachromis sacramontis; 18=Rocio octofasciata; 19=Hemichromis lifalili; 20=Steatocranus casuarius; 21=Mesoheros atromaculatus; 22=Criboheros alfari; 23=Steatocranus tinanti; 24=Adinocara pulcher; 25=Guianacara dacrya; 26=Talamancaheros sieboldii; 27=Wallaceochromis signatus; 28=Hemichromis stellifer Nioke 29=Parachromis montaguense; 30=Cichlasoma araguaiense; 31=Parachromis dovii; 32=Petenia splendida; 33=Thorichthyes maculipinnis; 34=Adinocara latifrons; 35=Laetacara thayeri; 36=Pelvicachromis pulcher; 37=Wallaceochromis rubrolabiatus; 38=Hemichromis sp. Moanda; 39=Tahuantinsuyoa macantzatza; 40=Oreichromis mossambicus; 41=Pseudocrenilabrus multicolor Victoriae; 42=Astatotilapia calliptera; 43=Pundamilla nyererei; 44=Geophagus steindachneri; 45=Iodotropheus sprengeri; 46=Orthochromis stormsi; 47=Labeotropheus fulleborni orange blotch.*

Materials and Methods

This study involves many students. Each student breeds their own species of cichlid, some of which rarely spawn in captivity.

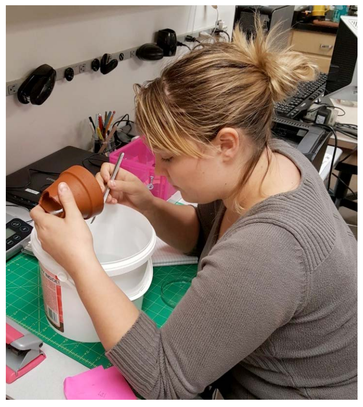
Researchers maintained pairs of cichlid fishes in freshwater aquaria. Tanks consisted of gravel, artificial plants, air filters, and heaters. Either broken flowerpots or pieces of slate acted as spawning substrates. Researchers observed tanks daily for the presence of eggs, hatchlings, and fry. Researchers collected and preserved samples of eggs, hatchlings, or fry within 24 hours. Eggs were preserved in 70% isopropyl alcohol, while hatchlings and fry were preserved in 5% formalin. A dissecting scope fitted with an ocular micrometer was used to measure the eggs. Eggs were measured along the major and minor axes, and these were used to calculate an effective egg diameter (Coleman 1991). Effective diameter is equal to the cube root of the major axis times the minor axis squared (d = 1/3[a*2b]). Fry were measured for total length.

Results

Regression analysis reported a strong positive relationship between mean fry size and effective egg diameter (Regression, R2= 0.95, df= 46, P< 0.001), meaning that small eggs become small fry and large eggs become large fry.

Discussion

The next steps are to examine the consequences of larger fry. We suspect that larger fry can swim better and are less susceptible to predation than smaller fry. Additionally, larger fry can consume a broader range of food than smaller fry. But a female laying small eggs generally produces more offspring than one laying large eggs. The key question becomes how many more offspring does a female receive by laying smaller eggs to counterbalance the fact that the fry are smaller? Stay tuned.



Acknowledgments

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