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Just Ask a Scientist!

WITH DR. MICHI TOBLER, ALA

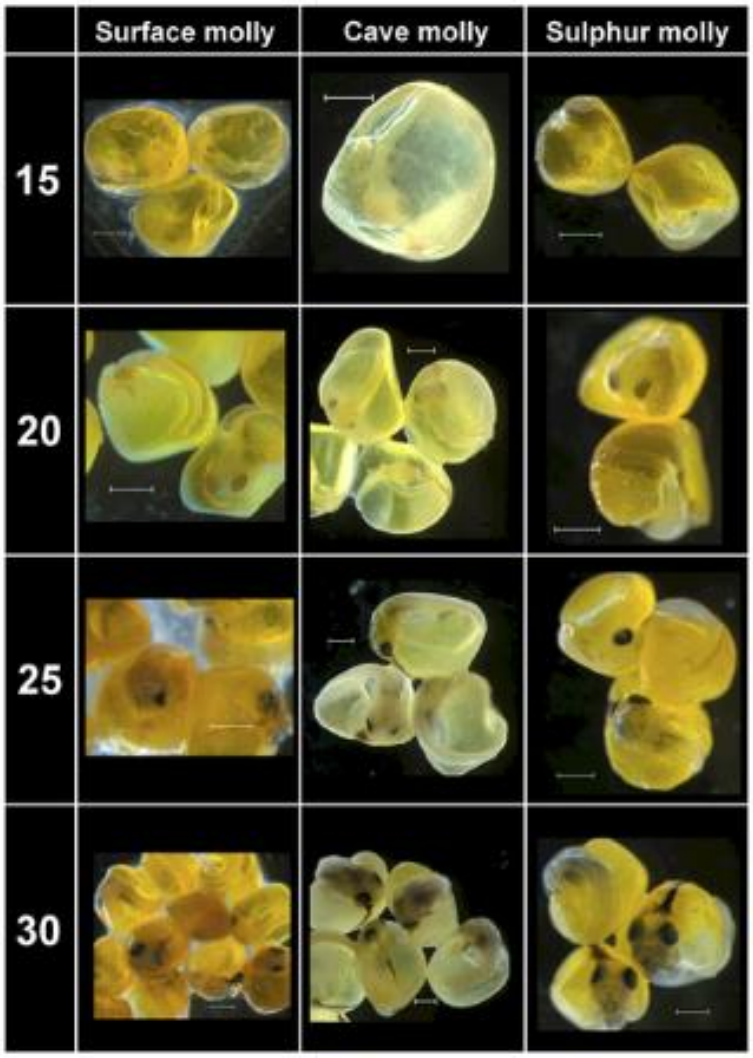
Kansas State University Division of Biology

Question: Do Poeciliid livebearers receive any nourishment from their mother (like goodeids) or are they truly just eggs laid inside the parent?

Livebearers in the family Goodeidae are indeed well known for nutrient transfer from the mother to her offspring. Nutrient transfer occurs through specialized, placenta-like structures called trophotaeniae. These ribbon-shaped, often branched structures extend from the hindgut of the developing embryo and essentially absorb nutrients provided by the mother to support the embryo's growth and development. Keepers of goodeids may be familiar with this phenomenon, because newly born fry typically still have remnant trophotaeniae until they disappear within a few days.

In contrast, the fry of livebearing poeciliids are never born with comparable structures. In most poeciliid species (like the swordtails, platyfish, and mollies popular in the hobby), embryos actually receive no nutrition from the mother other than the yolk originally contained within the egg prior to fertilization. This mode of development is called lecithotrophy. In lecithotrophic species, embryos lose weight during development, such that new born fry weigh less than the egg that was initially produced by the mother. This weight loss can be considerable (between 25-55% of the initial egg weight) and is caused by the energy loss during development.

That said, research by David Reznick from the University of California Riverside has shown that multiple species within the Poeciliidae have actually evolved the ability to provide nutrients from the mother to the embryo after



fertilization. This mode of development is called matrotrophy and has evolved independently in Heterandria formosa, Phalloceros caudimaculatus, Micropoecilia branneri, multiple species of the genus Poeciliopsis, and some other species that are relatively unknown in the hobby. In contrast to lecithotrophic species, the embryos of matrotrophic species gain weight during development, such that the weight of new born fry is larger than the egg originally produced by the mother. In some species with matrotrophy, nutrients provided by the mother are simply enough to offset the energetic cost of development (new born fry are just slightly bigger than the original egg), while others transfer considerable amounts of nutrients after the fertilization of the egg. For example, new born fry of Micropoecilia branneri and Poeciliopsis retrospinna can be up to 100 times heavier than the original egg. How exactly nutrients are transferred from the mother to the embryo remains poorly studied, but matrotrophic species in the Poeciliidae – like goodeids – also appear to have placenta-like structures.

It is important to note that livebearing species within the family Poeciliidae don't clearly fall into either the lecithotrophic or matrotrophic mode of development (that distinction is purely made based on whether embryos lose or gain weight during development), but different species rather fall along a continuous gradient spanning from little to no nutrient transfer after fertilization to a lot of nutrient transfer after fertilization. For example, research by Edie Marsh-Matthews from the University of Oklahoma has shown that even species that are clearly considered lecithotrophic based on embryo weight loss (e.g., species of the genus Gambusia) still transfer measurable quantities of nutrients

from the mother to the offspring. She has documented this by injecting pregnant females with amino acids (the building blocks of proteins) that contained radioactive atoms. Some of the radioactivity was ultimately detected in the offspring, suggesting that mothers provided some of the injected amino acids to the embryos after fertilization.

Interestingly, the evolution of matrotrophy has been linked to several other aspects of poeciliid biology. For example, matrotrophic – but not typically lecithotrophic – species also exhibit superfetation. During superfetation, females carry offspring at different developmental stages. So rather than fertilizing a batch of eggs, carrying them to term, and giving birth to many offspring at once, species with superfetation produce smaller broods at shorter intervals. Lecithotrophic and matrotrophic species also appear to differ in their reproductive behavior. Males of lecithotrophic species are often ornamented (think of the intense colors and swords in species of the genus Xiphophorus) and engage in courtship displays to entice females during mating. In contrast, males of matrotrophic species are typically duller, do not court, and instead rely of forced copulations to assure their reproductive success. Why exactly that is might be the topic of another "Just Ask a Scientist!" column.

"Just Ask a Scientist!" *will hopefully be a regular component of Livebearers Journal. However, this requires your input. Have you ever wondered about the meaning of observations you made in your fish tank? Do you have questions about the behavior, reproduction, ecology, or evolution of livebearers? Submit your questions directly to Michi (tobler@ksu.edu). He will do his best to answer your question or find somebody that can.*