Evolutionary Ecology: The Trinidadian Guppy

Anne. E. Magurran. Oxford University Press, 2005. 206 Pp.

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It is hard to imagine a species that has had a greater impact on the field of behavioral ecology than the Trinidadian guppy, *Poecilia reticulata*. This little livebearing fish has become an irresistible model system for evolutionary biologists thanks to a number of factors fortuitously converging in Trinidad to form what Caryl Haskins, a pioneering guppy ecologist, called a 'natural laboratory'. Foremost among these factors is that several rivers in different drainage basins in the island's Northern Ranges each have waterfalls along their course that form natural barriers. This simple feature has had a profound effect on the evolution of guppy life history and behavior for one simple reason (well, actually there are many reasons but these are minor compared with…): it causes the level of predation risk on guppies to vary within the same river. Typically, localities above waterfalls have reduced risk while those below have dramatically increased rates of predation-induced mortality. So, in effect, nature has provided biologists with an experimental treatment (predator present vs. absent) and a series of replicate populations with which to test a large body of evolutionary theory.

And test it we have. The guppy system has produced a voluminous literature in behavioral and evolutionary ecology. To take on the synthesis of this enormous body of work, I am sure we can all agree, is no light task. Anne Magurran does just this, and does it very well, in *Evolutionary Ecology: The Trinidadian Guppy*.

This engaging book is a concise discussion of the findings from decades of research on guppies. The monograph is abundantly illustrated with data-rich figures and opens with a very thorough introduction to guppy biology, segueing to the ecology of the guppy in Trinidad and progressing to the meat of the book – predator avoidance, reproduction, life-history patterns, and the evolution of reproductive isolation. These are areas in which Magurran is an active researcher and her personal experience gives an autobiographical feel to the volume.

All the chapters are packed with insight and detailed analysis and, as such, certainly deserve one's attention. However, the penultimate chapter is a *must-read* for guppy biologists as it deals with guppy conservation and the preservation of the 'natural laboratory'. As Magurran rightly argues, guppies are in no danger of becoming extinct – in addition to being found in most Trinidadian rivers and nearly every pet shop on the planet, they can also be found in such exotic locations as Malaysia, Australia, Hong Kong, Papua New Guinea, and the Philippines – however, they are increasingly facing many of the same conservation problems (e.g. pollution and competition from introduced exotic fishes) as other species around the world. I found the most startling revelation to be that scientists themselves could "unwittingly be compromising the rich variety of populations that attract guppy biologists to Trinidad in the first place" (pg. 141). The author points out that several decades of artificial introductions, transplants within and among populations and, to a lesser extent, over-harvesting may be taking their toll on the genetic and phenotypic mosaic currently found among guppy populations.

Since interest in studying guppies is unlikely to abate in the foreseeable future, the author solicits scientists to become "proactive in safeguarding the system that is so rewarding to study" (pg. 148). Magurran, a member of the Royal Society Working Party on Biodiversity Measurement, offers a landmark solution. She proposes that a centralized and uniform web-based recording repository be established in which data such as sample location, description of habitat, date, number, sex of individuals collected and so on be entered. In addition to assisting conservation efforts of the guppy in Trinidad, such a system would have the added advantage of serving as an exemplar for other intensively studied species.

Evolutionary Ecology: The Trinidadian Guppy compliments Houde's (1997) volume on sexual selection and mate choice in guppies. In fact, Magurran's book is a timely and welcome synthesis given the explosion of published research on guppies in the past dozen years – by Magurran's estimation 50% of all papers on guppies have been published since 1996. A terrific side-benefit of the author's scientometric analysis of guppy publications (spanning the years 1859, the first species description, to 2004) is the comprehensive bibliography – a handy resource, particularly for very early papers, for the novice researcher or even the experienced guppiologist.

Research on 'the millions fish', the colloquial name for guppies in Trinidad, has a long and remarkable history and this is something that Magurran acknowledges by weaving historical fact and anecdote throughout the text.

One historical tidbit of which I was unaware was that the first empirical work on sperm competition was conducted on guppies at the Carlsberg Laboratory in Copenhagen by Schmidt (1920) in 1917-1918. But I digress. My point is that given the long history of guppy research one would think that all there is to know about guppies must surely be known; particularly after a quick perusal of the hundreds of papers, books and book chapters on guppy evolution and ecology. This is one of the pleasant discoveries of *Evolutionary Ecology: The Trinidadian Guppy*: there are still gaps in the literature the size of an Alberta sunset. What's more, Magurran not only highlights these gaps throughout the book but she generously dedicates the final chapter to identifying important and profitable avenues of research. Consequently, one finishes the book with the thought that the most exciting and influential research on guppies is yet to come.

Of the myriad investigative possibilities highlighted by Magurran in the final chapter, unraveling the functional genomics of *Poecilia reticulata* will likely pack the biggest punch in terms of driving novel research and ultimately getting under evolution's hood to see how it all works. Fish provide some of the best model organisms in genomics research with the zebrafish (*Danio rerio*), medaka (*Oryzias latipes*) and pufferfish (*Fugu rubripes*) leading the way. However, unlike the guppy, we know very little about the natural history and behavioral ecology of the aforementioned species. By applying the candidate gene approach (Fitzpatrick et al. 2005), for example, behavioral ecologists will be able to acquire previously unimagined insight into the factors driving guppy behavioral and morphological adaptation. This line of investigation is not the stuff of fantasy, but is happening right now. For example, Hoffmann et al. (2007) are exploring the coevolution of visual perception and male ornamentation by identifying the genes influencing the expression of male color patterns and female perception of those patterns. This methodology will not only eventually lead to a better understanding of phenotypic differences among guppy populations but inevitably to our understanding differences among poeciliid species.

I have few serious criticisms of this book. There are some editorial errors in the text and index but these do not detract much from the overall presentation. My only real complaint is that some of the empirical research is not set in a hypothetico-deductive framework; I think readers would benefit from seeing how well the empirical research findings on guppies support theoretical predictions. However, these are minor quibbles, really, and I recommend this book certainly for those with interests in guppies but, even more generally, for anybody with an interest in fish behavioral ecology or in the evolutionary effects of predation risk on animal behavior and morphology.

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References

Fitzpatrick MJ, Ben-Shahar Y, Smid HM, Vet LEM, Robinson GE, Sokolowski MB, 2005. Candidate genes for behavioural ecology. Trends in Ecology and Evolution 20:96-104.

Hoffmann M, Tripathi N, Henz SR, Lindholm AK, Weigel D, Breden F, Dreyer C, 2007. Opsin gene duplication and diversification in the guppy, a model for sexual selection. Proceedings of the Royal Society B-Biological Sciences 274:33-42.

Houde AE, 1997. Sex, color, and mate choice in guppies. Princeton, N.J.: Princeton University Press.

Schmidt J, 1920. Racial investigations IV. The genetic behavior of a secondary sexual character. Comptes rendus des travaux du Laboratoire Carlsberg 14:227.