SYMPOSIUM

“Mangrove ‘Killifish’: An Exemplar of Integrative Biology”: Introduction to the Symposium

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From the symposium “Mangrove ‘Killifish’: An Exemplar of Integrative Biology” presented at the annual meeting of the Society for Integrative and Comparative Biology, January 3–7, 2012 at Charleston, South Carolina.

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Synopsis The mangrove rivulus, Kryptolebias marmoratus, (hereafter, rivulus) is one of the only two vertebrates known to self-fertilize, with the other being a recently named close relative, Kryptolebias hermaphroditus (Tatarenkov et al. 2012). Rivulus is also the first fish species found to have environmental sex determination, whereby lower temperatures inhibit ovarian development, thus providing one potential route that avoids inbreeding depression (Harrington 1967; Conover 2004). Wild rivulus exist as androdioecious populations in which both hermaphrodites and, although relatively rare, males are found (Taylor 2000). In the laboratory, individual adult rivulus can produce isogenic embryos. Under as yet unknown environmental conditions, males develop and outcrossing between the hermaphrodites and males occurs (Taylor 2000; Mackiewicz et al. 2006a, 2006b). It is intriguing to consider the behavioral, neurological, and endocrinological control necessary to accommodate this reproductive strategy (Sakakura et al. 2006; Orlando et al. 2006; Earley et al. 2008). In addition to environmental sex determination and androdioecious reproduction, rivulus is also known to emerge from its aquatic surroundings and assume a transitory, terrestrial existence (Ong et al. 2007; Taylor et al. 2008; Cooper et al. 2012). Rivulus is an emerging and potentially powerful model for integrative and comparative biological research and, in part, this emergence has been catalyzed by this first symposium on its biology. The well-attended symposium comprised 11 speakers, which included four women and seven men, with academic ranks ranging from postdoctoral fellow to full professor, who came from four countries. This symposium will help drive future research within this taxon and will facilitate collaborations among researchers. It has already facilitated networking between heads of laboratories and current and potential future postdoctoral fellows and students. The organizing committee looks forward to the next rivulus symposium with great anticipation.

Overview of the symposium

This symposium focused on the latest research on the mangrove rivulus, Kryptolebias marmoratus, encompassing topics ranging from genomics to behavior. As the first symposium speaker, Scott Taylor gave an informative overview of the almost quarter century of research that he and others have conducted and which has laid the groundwork for our understanding of the natural history and ecology of this species (Taylor 2012). One of the fascinating life history strategies of rivulus is its ability to move between aquatic and terrestrial habitats. This strategy requires a number of adaptations in the skin that enable gaseous exchange, regulation of ions, and elimination of nitrogenous wastes; these topics were explored in detail and presented by Wright (2012). Rivulus has been used as a model for environmental toxicology for a number of years, and in this symposium, the effects of salinity on sequestration and elimination of zinc were examined by Bielmyer et al. (2012). To understand the genetic basis for these and other adaptations, Kelley et al. (2012), who is working on the sequencing and bioinformatics of the mangrove rivulus genome, discussed the attributes of rivulus as a model for understanding the genomics of adaptation.

Fascinated by its reproductive mode, Tatarenkov et al. (2012) explained their research on how androdioecy affects population genetics. They presented
research that documents extensive spatial genotypic diversity in local rivulus populations on the Florida Keys, implying severe constraints on effective gene flow (Tatarenkov et al. 2012). A set of papers presented by Brian Ring, Tetsuhiro Kudoh, and Edward Orlando highlight a mutual interest in rivulus embryonic development. Ring and colleagues are using a classic mutagenesis screen to discover genes that regulate gonadal development and other developmental endpoints (Moore et al. 2012). Kudoh presented techniques for rivulus embryo manipulation and imaging, with a research interest in maternal contribution of RNA versus gene expression by the embryo. In an unsuccessful attempt to create functional female rivulus, Orlando and colleagues demonstrated that exogenous treatment with high concentrations of 17α-ethinylestradiol depresses relevant gene expression, decreases fertility, increases sterility, and delays age of reproductive maturity (Farmer and Orlando 2012). Results of this and other studies from this laboratory suggest that the development and maintenance of a simultaneous ovotestis may be particularly sensitive to its hormonal milieu.

The afternoon session of the symposium was comprised of three speakers, two whose research focus exploits rivulus strain isogenicity and high interstrain variability to understand behavior. Yuying Hsu presented the results of her lab’s research on the correlation of cortisol and testosterone titer to the “behavioral syndrome,” i.e. the consistency in aggressiveness, boldness, and exploratory tendency in an individual rivulus (Chang et al. 2012). Earley and colleagues investigate phenotypic plasticity of behavior, morphology, and hormonal correlates in the context of the genetics of wild rivulus collected along an ecocline (Earley et al. 2012).

David Bechler wrapped up the symposium with a paper, which reflected on the genomic, genetic, life history, ecological, physiological, developmental, and behavioral research in rivulus. Finally, he discussed the virtues and challenges of using rivulus, compared with other model fish species (D. Bechler, unpublished data).

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