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EVOLUTION OF VIVIPARITY IN REPTILES: INTRODUCTION TO THE SYMPOSIUM

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The Fifth World Congress of Herpetology, held in 2005 at the University of Stellenbosch (Republic of South Africa), provided an excellent opportunity to host a symposium on the evolution of viviparity in reptiles. Several symposia on viviparity have been held during the past 15 years, and these have yielded comprehensive reviews of squamates (e.g., Blackburn, 1993, 1998, 2000; Stewart, 1993; Stewart and Thompson, 2000, 2003; Thompson et al., 2000, 2004) and many other papers. However, most of these symposia were limited in scope to particular features (placental membranes, the oviduct) or aspects (morphology, physiology). The World Congress venue represented the first broad-based symposium to focus on viviparity in squamates, a taxon of special importance to biologists interested in viviparity. This symposium was multi-disciplinary, and integrated morphology, physiology, biochemistry, molecular biology, and evolutionary theory.

The evolution of viviparity holds intrinsic interest for a number of reasons. First, humans are viviparous and have natural curiosity about their own reproduction. Second, mode of reproduction relates closely to a species' ecology, physiology, and behavior, and is central to its life history strategy. Third, viviparity is a central, recurring theme in vertebrate history, and its existence raises fascinating functional and evolutionary questions.

Squamate reptiles provide an excellent model system for studies on the evolution of viviparity because live-bearing reproduction has evolved in the Squamata at least 100 times (Blackburn, 1999), and complex placentae have evolved four or five times (Thompson and Speake, 2006). Many of the reptilian origins of viviparity have occurred at low taxonomic levels and in geologically recent times, potentially allowing a reconstruction of the transition to viviparity. Additionally, reptiles are amniotes, and their fetal membranes are homologous to those that contribute to mammalian placentae. Consequently, squamate reptiles arguably are the best available model for attempts to understand the evolution of mammalian reproduction. Nevertheless, squamates have a reptilian physiology as well as unique features (such as a yolk cleft and an isolated yolk mass), and the sequence by which viviparity and placentation evolved differs in squamates and mammals (Blackburn, 2006). Therefore, caution is required in applying conclusions from reptilian studies to mammalian systems. One mark of the growing maturity of the field is that studies on squamate viviparity are justified in their own right, aside from whatever insight they may give into mammals.

This symposium addressed two related questions: how viviparity has evolved from oviparity, and how complex placentae have evolved from simple placentae. The symposium consisted of fifteen invited presentations, beginning with a review of the utility of reptiles to a more general model of the evolution of viviparity, followed by three papers on morphological details of extra-embryonic and placental development and structure. Four papers described aspects of the physiology of maternal-embryonic interactions, including the occurrence of HoxA10 genes. The afternoon session began with a focus on eggs and oviparous species and the factors that may have led to or limited the evolution of viviparity, and concluded with a series of papers that covered diverse topics in ecology, morphology, and physiology.

The symposium highlighted the rapid progress that has been made in understanding

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the evolution of viviparity, mostly in lizards (with some information on snakes). The world-wide nature of current research is evident from the fact that contributors came from nine different countries on five continents. One major benefit of the symposium was in clarifying future directions and establishing potential future collaborations. Two types of investigations that are particularly needed are functional studies of the interactions between mothers and embryos and molecular studies of placental development. Other areas in need of research include immunological studies and respiratory physiology of the placenta.

The following nine papers stem directly from the symposium, and provide an excellent coverage of its scope and content. Some other presentations have been published elsewhere (Atkins et al., 2007; Parker and Andrews, 2006). The papers have been arranged to begin with the general model system, followed by papers that deal with eggs and egg retention, morphological changes to the viviparous uterus, functional aspects of placental nutrient exchange, and finally, a molecular perspective on viviparity.

Literature Cited

Atkins, N., R. Swain, E. Wapstra, and S. M. Jones. 2007. Late stage deferral of parturition in the viviparous lizard *Niveoscincus ocellatus* (Gray 1845): implications for offspring quality and survival. Biological Journal of the Linnean Society (in press).

Blackburn, D. G. 1993. Chorioallantoic placentation in squamate reptiles: structure, function, development, and evolution. Journal of Experimental Zoology 266:414–430.

———. 1998. Structure, function, and evolution of the oviducts of squamate reptiles, with special reference to viviparity and placentation. Journal of Experimental Zoology 282:560–617.

———. 1999. Are viviparity and egg-guarding evolutionarily labile in squamates? Herpetologica 55:556–573.

———. 2000. Reptilian viviparity: past research, future directions, and appropriate models. Comparative Biochemistry and Physiology — Part A: Molecular and Integrative Physiology 127:391–409.

———. 2006. Squamate reptiles as model organisms for the evolution of viviparity. Herpetological Monographs 20:131–146 (this volume).

Parker, S. L., and R. M. Andrews. 2006. Evolution of viviparity in Sceloporine lizards: in utero PO2 as a developmental constraint during egg retention. Physiological and Biochemical Zoology 79:581–592.

Stewart, J. R. 1993. Yolk sac placentation in reptiles: structural innovation in a fundamental vertebrate fetal nutritional system. Journal of Experimental Zoology 266:414–449.

Stewart, J. R., and M. B. Thompson. 2000. Evolution of placentation among squamate reptiles: recent research and future directions. Comparative Biochemistry and Physiology — Part A: Molecular and Integrative Physiology 127:411–431.

———. 2003. Evolutionary transformations of the fetal membranes of viviparous reptiles: a case study in two lineages. Journal of Experimental Zoology 299A:13–32.

Thompson, M. B., and B. K. Speake. 2006. A review of the evolution of viviparity in lizards: Structure, function and physiology of the placenta. Journal of Comparative Physiology 176:170–189.

Thompson, M. B., J. R. Stewart, and B. K. Speake. 2000. Comparison of nutrient transport across the placenta of lizards differing in placental complexity. Comparative Biochemistry and Physiology — Part A: Molecular and Integrative Physiology 127:469–479.

Thompson, M. B., S. M. Adams, J. F. Herbert, J. M. Biazik, and C. R. Murphy. 2004. Placental function in lizards. International Congress Series 1275:218–225.