Sex Dev 2010;4:5–6
DOI: 10.1159/000289512
Published online: March 16, 2010

Preface

Reptiles are a fascinating group when reflecting on sexual development. Their sex determination mechanisms span a continuous spectrum from strict genetic determination (SGD) with or without differentiated sex chromosomes to strict thermal determination (STD), which are all within a range of intermediate SGD systems that are variably overridden by environmental effects.

Observing a single sex determination system in some groups, like crocodiles (STD) and snakes (SGD), other groups, like lizards, show that 2 systems can co-exist even in the same family. Variegated situations are also found within groups that are characterized by a single sex determination mechanism. Some SGD species lack differentiated sex chromosomes, whereas others have them with male or female heterogamety. Three different patterns have been described in STD species: MF, where lower incubation temperatures are masculinizing and higher ones are feminizing; FM, where the opposite is true; and finally a FMF pattern, where both extreme temperatures are feminizing, whereas intermediate degrees are masculinizing.

Reptiles are therefore a more appropriate model than other vertebrates to study important aspects such as (1) the evolutionary transition between different modes of sex determination, (2) the influence of environmental factors on sex determination, (3) the complex interactions between these factors and intrinsic genetic, physiological, and molecular mechanisms, and (4) the role of sex determination in evolutionary processes.

This themed issue collects the latest data on the different aspects of sex determination in reptiles. With regard to the evolutionary viewpoint, the first contribution highlights that reptiles are more challenged than other vertebrates by the thermal environment in which their embryos develop and suggests that reptiles might be predisposed to evolving thermal sex determination from genotypic sex determination by virtue of the highly variable thermal environment experienced by their embryos during the period in which sex is determined.

A further extensively explored aspect is the genetic and molecular mechanism of sex determination. The molecular bases of sex determination and differentiation in reptiles have not been completely revealed. Several studies have described some expression patterns of orthologs of mammalian sex determining genes, many of which are evolutionarily conserved. However, new experimental approaches, like unbiased screening of the transcriptome and proteome and multivariate analysis of the gene network underlying sex development, have provided interesting information, such as (1) the existence of new genes that are expressed differentially at male and female sex determination temperatures, (2) a new model of the role of aromatase and the genes that would regulate its transcription, and (3) the contribution of heat-shock proteins to STD in the American alligator.

Sex allocation, an important phenomenon in reptiles, may have played a role in the transition between the different modes of sex determination. The sex in the offspring, especially in STD species, depends on the combination of direct environmental effects (i.e., nest temperature) and intrinsic maternal factors, such as sex steroid deposition in the yolk. The hypothesis has been advanced

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1661–5425/10/0042–0005$26.00/0

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that in oviparous species, the mothers might adjust the sex ratio of their progeny through nest-site selection, even though their ability to predict the thermal conditions of the nest during the critical sex-determining period is difficult to explain.

Viviparous STD species are a particularly promising model to understand sex determination in reptiles. It has been documented that in such species mothers influence the sex of their offspring by controlling their own body temperature during pregnancy via the length of basking periods or other physiological mechanisms. The main advantage of viviparity in reptiles would thus be the mother's ability to manipulate developmental temperatures to enhance the fitness and survival of their progeny in unpredictable or unsuitable environments for embryo development.

The last mentioned data raise additional concern to the effects of anthropogenic climate change on biodiversity. Drastic temperature alterations could have dramatic consequences on species' survival by changing the sex ratios in STD reptile populations. It is therefore essential to monitor climate change and its potential effects on natural sex determination in reptiles.

I would like to take the opportunity to express my gratitude to all the authors involved in this themed issue. Alone their extreme efforts in finding time to cope with these extra burdens show us the wonderful, high level results of dedicated scientific work – and we all do know how precious time can be! My thanks also go to the reviewers for their time and expertise, as well as to the Chief Editors of *Sexual Development* for giving me the possibility to edit this themed issue.

Ettore Olmo, August 2009