

How the salamander got his spots: the genetics of colour, shape, and local adaptation in European salamanders

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Adaptive, non-adaptive, and stochastic forces are all at play in the evolution of the great diversity of size, shape and colour phenotypes we see in nature. While it has long been difficult to distinguish the relative roles of these different forces in evolution, recent advances in biology, such as next-generation sequencing, now make it possible to test evolutionary hypotheses in an environmental context. For this reason, research on the genomics of adaptation is an 'area to watch' and driving important breakthroughs on understanding biodiversity.

Colouration and patterning are phenotypes that, across many vertebrates, are strongly under selection in local environments and are easy to quantify and manipulate. Colour patterns thus provide a tractable model for investigating whether neutral genetic variation or, alternatively, selection for adaptation, explain differences observed in natural populations. In this project the student will use European salamanders as a model to investigate the selective forces acting on colour variation. Although amphibians often have relatively little colour pattern variation on their bodies, some lineages are famously quite colourful. In the case of fire salamanders, some subspecies differ quite dramatically in colouration, including some populations having lost the characteristic colours and patterns. Particular colourations are also associated with different morphologies, suggesting that there has been convergent phenotypic evolution, which creates natural replication of the phenotype in different localities. Through an integrative analysis of phenotype (colouration, morphology) and genetics in an evolutionary and environmental context, this studentship will contribute an important advance to understanding the role of adaptation in the evolution of colouration.

To test the hypothesis that there may be an adaptive component to convergent colour and shape variation across lineages of European salamanders, the following questions will be addressed:

- 1) Does the loss of colour patterning and changes in body shape vary across lineages of salamanders in association with local environmental factors?
- 2) Which genetic loci are involved in colour patterning, are they the same across populations, and do those genomic regions show signals of response to selection?

The successful student will join an active and dynamic research group in Molecular Ecology and Evolutionary Analysis, where we are applying cutting edge genomic techniques and modern phenotyping methods to study biodiversity in nature. The project will involve field-work to collect new samples, body shape analyses of museum collections, and genome-wide analyses with next-generation sequencing.

Further details of the research interests of the University supervisors can be found at:

<http://www.gla.ac.uk/researchinstitutes/bahcm/staff/>

For further details on the project or general inquiries, please contact Kathryn Elmer (Kathryn.Elmer@glasgow.ac.uk).

Relevant publications by supervisory team

Kautt A, Elmer KR, Meyer A (2012) Genomic signatures of divergent selection and speciation patterns in a “natural experiment”, the young parallel radiations of Nicaraguan crater lake cichlid fishes. *Molecular Ecology*, **21**, 4770–4786.

Elmer, K. R. & Meyer, A. (2011) Adaptation in the age of ecological genomics: insights from parallelism and convergence. *Trends in Ecology and Evolution* **26**, 298-306.

Elmer KR, Dávila JA, Loughheed SC (2007) Applying new inter-individual approaches to assess fine-scale population genetic diversity in a neotropical frog, *Eleutherodactylus ockendeni*. *Heredity*, **99**, 506–515.

Hume, JB, Bean C, Mable BK, Adams CE (In Press) Post-zygotic hybrid viability in sympatric species pairs – a case study from European lampreys. *Evolutionary Ecology*

Marsden, CD, Woodroffe R, Mills MGL, McNutt JW, Creel S, Groom R, Emmanuel M, Cleaveland S, Kat P, Rasmussen GSA, Ginsberg J, Lines R, André J-M, Begg C, Wayne RK, Mable BK (2012) Spatial and temporal patterns of neutral and adaptive genetic variation in the endangered African wild dog (*Lycaon pictus*). *Molecular Ecology*, **21**(6), 1379-1393.