



COMMUNICATING SCIENCE SERIES

THE SECRET WORLD OF 'NAKED SNAKES'

Monday, 7 December 2009

The Meeting Rooms, The Zoological Society of London, Regent's Park, London NW1 4RY

Chair: Ken Livingstone

An introduction to the world of naked snakes

Mark Wilkinson, The Natural History Museum, London

I will give a brief introduction to the biology of naked snakes, what they are, where they live, what they are related to and how they differ from other living amphibians. Caecilians are widely considered to be the least well-studied major tetrapod group and to be particularly difficult from a taxonomic perspective. I will provide some historical background on the slow growth of knowledge of caecilian diversity and the particular obstacles that have stood in the way of more rapid progress. My aim is to set the scene for subsequent speakers to address more recent and exciting developments.

Recent discoveries – a golden age for caecilian biology?

David Gower, The Natural History Museum, London

Caecilian amphibians have been considered the most poorly studied and least well-understood major group of vertebrates. This has been strongly reflected in recent conservation assessments, with approximately two thirds of caecilian species categorized as "Data Deficient". Despite this, we have recently witnessed what appear to be major breakthroughs in our knowledge of caecilian biology, with stand-out discoveries including lunglessness, reproductive mode diversity, evolutionary relationships based on DNA sequences, putative fossil relatives with limbs, and quantitative insights into ecology. Are these discoveries evidence of a golden age in caecilian biological research? There is no evidence from gross numbers of publications per year that the last 10, 20 or even 30 year periods are exceptional in terms of caecilian research output. However, I will argue that the nature and breadth of some of the recent progress, the way in which this has been achieved, and the number and diversity of researchers involved does demonstrate particularly exciting times for studies of caecilian biology. This talk will highlight some major recent discoveries, positive aspects of recent and ongoing research, and where future effort might most usefully be directed.

Yummy mummy: skin feeding and caecilian reproductive biology

Alexander Kupfer, Institut für Spezielle Zoologie und Evolutionsbiologie mit Phyletischem Museum, Friedrich-Schiller-Universität Jena, Erbertstrasse 1, 07743 Jena, Germany

Caecilians display a high diversity of reproductive modes. In contrast to most amphibians they mostly favour terrestrial reproduction, which includes oviparity (egg-laying) with either indirect developing aquatic larvae or direct development circumventing the aquatic larval stage, and viviparity (live-bearing). In addition, caecilians have internal fertilization and the male phallodeum operates as an intromittent organ during copulation. Among amphibians, caecilians show an exceptionally high level of parental care and investment ranging from egg guarding to intra-oviductal feeding.

A new mode of parental investment, maternal dermatophagy (aka skin feeding), was recently discovered in an oviparous African caecilian amphibian. This unusual form of parental investment, involving co-evolved specialisations of both maternal skin and offspring dentition, has been found in a second, distantly related Neotropical species. The multiple presence of skin feeding in various caecilian species provides evidence of homology and has consequences for understanding the evolution of viviparity in amphibians. Maternal dermatophagy is likely widespread among oviparous direct developing caecilians. Viviparous caecilians, which feed on the hypertrophied maternal oviduct, might have evolved from skin-feeding ancestors. The diversity of parental care strategies makes the limbless tropical caecilian amphibians an excellent model group to study life-history evolution.

Further reading

Wilkinson, M., Kupfer, A., Marques-Porto, R., Jeffkins, H., Antoniazzi, M. M. & Jared, C. (2008): One hundred million years of skin feeding? extended parental care in a Neotropical caecilian (Amphibia: Gymnophiona). *Biology Letters*. **4**: 358–361. <http://dx.doi.org/10.1098/rsbl.2008.0217>

Kupfer, A., Müller, H., Antoniazzi, M. M., Jared, C., Greven, H., Nussbaum, R. A. & Wilkinson, M. (2006): Parental investment by skin feeding in a caecilian amphibian. *Nature* **440**: 926–929. <http://dx.doi.org/10.1038/nature04403>

Kupfer, A., Nabithabatha, J. & Himstedt, W. (2004): Reproductive ecology of female caecilian amphibians (genus *Ichthyophis*): a baseline study. *Biological Journal of the Linnean Society* **83**: 207–217. <http://dx.doi.org/10.1111/j.1095-8312.2004.00382.x>

Caecilians on the EDGE

Helen Meredith, Conservation Programmes Department, Zoological Society of London

A lack of knowledge and study of caecilians has resulted in an astonishing two-thirds being Data Deficient on the IUCN Red List of Threatened Species, meaning that too little is known to assign a threat category to them or even make appropriate conservation recommendations. This problem is compounded by the fact that most people have never even heard of caecilians and, when presented with one, few would think it was even an amphibian since caecilians more closely resemble worms or snakes. They comprise one of the three orders (or main groups) of the Amphibians (the other two being the Caudata or “the newts and salamanders” and the Anura or “the frogs and toads”). There are currently 174 recognised species of caecilian – at just under 3% of the total amphibians in terms of species number, they represent a tiny yet fascinating and ecologically important fraction of amphibian life on earth.

The Zoological Society of London's EDGE of Existence Programme (www.edgeofexistence.org) seeks to conserve Evolutionarily Distinct and Globally Endangered (EDGE) species from across the tree of life. EDGE species face extinction and represent a disproportionately high amount of evolutionary history, making them some of the world's most unusual, threatened and neglected species. Caecilians occupy a crucial part of the EDGE Amphibians project, which was launched in January 2008. Caecilians constitute all 10 of the top 10 "Potential EDGE Amphibians" (species that are highly evolutionarily distinct, but too little is known about them to understand their threat status), and all of these caecilians are currently receiving absolutely no conservation attention. Furthermore, according to the top 100 EDGE Amphibians list, a Critically Endangered caecilian from Kenya – the Sagalla caecilian (*Boulengerula neideni*) – is the third highest priority EDGE amphibian species (www.edgeofexistence.org/amphibians/top_100.php). The Sagalla caecilian was discovered as a new species to science in 2005 and was collected from Sagalla Hill, an isolated mountain block of the Taita Hills complex in the Eastern Arc Mountains of Kenya.

The ZSL EDGE Programme is working in partnership with the Taita Taveta Wildlife Forum (TTWF) and the South African National Biodiversity Institute (SANBI), with funding from Conservation International and the Critical Ecosystems Partnership Fund (CEPF), on a project entitled: "Restoration of Sagalla Hill with a view to creating a sustainable future for the Critically Endangered caecilian *Boulengerula niedeni*", which is the first conservation project to focus on the protection of a caecilian species. The Sagalla caecilian thrives in moist, black, fertile soil in forests and small agricultural holdings, but on Sagalla these habitats are dwindling due to a combination of increasing human population, soil erosion through unsustainable agricultural practices, and the spread of invasive *Eucalyptus* and pine trees. The future of this species rests on the reduction of soil erosion, and replacement of introduced *Eucalyptus* and pine trees with indigenous plant species, providing a reserve for the species. At the same time, removal of *Eucalyptus* will provide more water for inhabitants of Sagalla, reduce soil erosion and increase awareness of responsible farming activities. In essence, what is good for the caecilian is good for the sustainable future of farmers in Sagalla. Caecilians may therefore prove to be great flagship conservation species for the sustainable management of land and water where they occur.

Given the extremely low level of public general knowledge of the caecilians, increasing appreciation of the phylogeny, biology and ecological importance of caecilians is an essential first step in their conservation as a group. The Secret World of 'Naked Snakes' event will address this urgent need and seeks to stimulate conservation and awareness-raising efforts for caecilians in the future.

Further reading

Please see www.edgeofexistence.org for more information about the Zoological Society of London's EDGE of Existence Programme.