Speciation and Ecology

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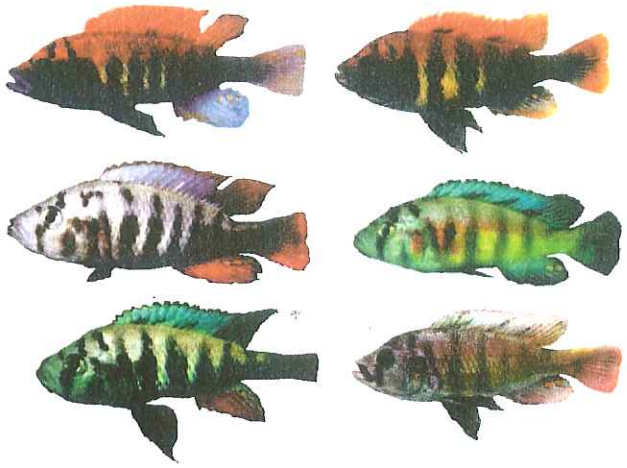

The Evolutionary Play in an Ecological Theatre

Why do people go to conferences? A few hypotheses come to mind: (i) people like to be away from home, (ii) they like to meet and talk with their colleagues from elsewhere, (iii) they have been invited to give a talk on their research, (iv) they like to hear what others are doing. The list could be extended, and multiple reasons may provide the real explanation. This may also be the case with the paramount evolutionary question: "How many species are there?" (the ecological equivalent being: "Why there are so many species?"). The question surfaced repeatedly during the two days of the BES 2007 Annual Symposium: 'Speciation and Ecology' held at The University of Sheffield.

Anyone seriously concerned with speciation inevitably sees that the play has to meet the theatre. The organizers of the symposium, Roger Butlin, Jon Bridle and Dolph Schluter, put together an attractive programme, with various aspects of ecology as the interface when addressing speciation. One cannot talk of species without touching on the issue "what is a species?" The biological species concept seems most intuitive. We were cautioned that care has to be taken that the other ways referring to species (classical and molecular taxonomy that can not follow up mating behaviour and life cycle) serve the purpose they are called for and are not raised up as artefacts of the methodology.

The concept of a "species" may also lose its operative precision when looking at bacteria and their kind, as "there is lots of space down there". This the 160 registered delegates learned in a nice talk by Graham Bell, using museum-preserved presentation technology, suggesting that a pinch of forest floor soil contains more bacterial species than there are stars in the sky. One became convinced that microbial ecology might serve as an excellent platform for evolutionary research. With bacteria and protozoa, experiments can be replicated in a small amount of laboratory space, and in a short time they have gone through hundreds if not thousands of generations. Petri dish, pipette and computers are the tools of modern-day evolutionary ecologists, replacing the rubber-boots, insect net and binoculars of the old-timers.

The theory of speciation is much where it was left in the wake of the "Modern Synthesis" and quotes from Ernst Mayr and Theodosius Dobzhansky surfaced now and then in the talks. But we also learned that contemporary research on ecological speciation makes good use of deriving system-specific hypotheses (far more specific than in the first paragraph of this text) that, subject to experimentation in the field and lab, can be used to rule out alternative explanations from the pattern observed. Also, increasing the dimensionality of the system in focus better identifies local adaptations and population responses to challenges set by the environment.

When reading on speciation and evolution of adaptive radiation one cannot avoid the species richness of the tropics that keeps challenging theoreticians. Following Douglas Schemske's presentation there are now 100 and one hypotheses explaining why tropics harbour much richer fauna and flora than temperate areas. Heliconid butterflies with their mimicry-patterns changing over space in Brazilian forests are another classic example. Here hybridization begets speciation as does increasing diversity, a self-reinforcing system, indeed. From the classics we were displayed obligatory pictures of the geospizine finches of the Galapagos Islands, but no Hawaiian Drosophila were mentioned. Instead Ole Seehausen updated us on speciation in African cichlid fish. In waters with good visibility blue (surface-water dwellers) and red morphs (deeper down in water column) are a distinct class in ecological and behavioural terms. Whilst in turbid waters the picture is less clear.

Speciation is an ongoing process that also can reverse its gears, as the unique data on merging of benthic and pelagic stickleback morphs shows in a lake within a few years after an introduction of freshwater grayfish (research done by Dolph Schluter).

Good taxonomy and modern molecular techniques provide us with phylogenetic trees, where closely-related species make the neighbouring branches and as the evolutionary distance increases so does the distance between branches in the tree crown. The crown is composed of sets of branches where relatedness is highest within a branch and less so between branches. These trees provide material for various aspects of the branching process, like rate of branching against time. A tree is a hypothesis of speciation history of a given group, but they are also taken as objects of research. Much of the making of a tree remains hidden. The tree crown is a constructed story of those that made it. Those that did not survive, but may have been of importance in determining the branching structure, are left out from the history. I was left pondering to what degree the tree story calls for those who did not make it up to the end. This is just an example of the work for the brain that the symposium presentations raised.

Paleontology, one of the tree-providers, is a branch of science often considered as an equivalent of historical speciation. John Alroy made all of us join him in wondering if the "five historical extinction waves" identified from Sepkoski's charts on historical speciation rate, were perhaps artefacts based on the way the original material is treated. An interesting corollary of the new way of treating the paleontological data is that if Earth's history has not witnessed any mass extinctions, as suggested by Sepkoski, the current human-caused extinction-threat in the tropics and elsewhere would be a unique case!

The two spring days gave us 18 presentations with lively discussion both in the lecture theatre and after the sessions. The atmosphere of the conference was dynamic, and delegates clearly enjoyed the talks. Were any major recent advances in ecological speciation left out? Sexual selection was mentioned in a few cases, but largely left for Sergey Gavrilets' computer program (and the African cichlids) to do. The unified neutral theory of biodiversity was mentioned (and criticised in passing by Robert Ricklefs). But where were presentations of the Adaptive Dynamics School?

As Dobzhansky has already concluded, "Nothing in biology makes sense except it the light of evolution!"

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There will be a volume based on the talks presented at the meeting published in the Ecological Reviews series, published by the BES in association with Cambridge University Press. Esa Ranta is Professor of Ecology and Evolutionary Biology at the University of Helsinki and a former member of BES Council. For further information on Esa's work see **http://www.cambridge.org/uk/catalogue/catalogue.asp?isbn=0521854350**

Photographs of *Pundamilia* courtesy of Ole Seehausen