Required reading for (ecological) battles

The Triumph of Evolution…and the Failure of Creationism
by Niles Eldredge. WH Freeman and Company, New York, 2000. $24.95 (223 pages) ISBN 0 7167 3638 1

This is the latest volume in Eldredge's struggle with creation 'scientists' and is largely motivated by teaching creationism in US public schools as a form of science. However, a better title for the book would have been '*Why Hasn't Evolution Triumphed Over Creationism*' (answer below). The volume is slim and readable (although at times the writing becomes a bit intemperate) and can be divided into three main parts. The first two chapters set the stage for the battle, which is not with creationism *per se*, a personally held belief, but with 'creation science', which is a poorly disguised attempt to put political and religious beliefs into the scientific curriculum, using evolutionary theory as a tool. In the process of setting the stage, Eldredge provides an explanation of science as a way of knowing that is a gem.

A two-chapter discussion of the fossil record and of what drives evolution follows. Eldredge emphasizes that although scientists might disagree about the details of micro- and macroevolution (e.g. how punctuated it is), there is little dispute about the fundamental ideas. As a good detective should, he carefully leads the reader to strong qualitative predictions (e.g. 'that a hierarchical nesting of all living forms must necessarily be the result if evolution – descent with modification – is correct') that emerge from evolutionary theory regardless of the details in dispute. He notes that the disputes will be resolved by 'good, honest work, empirical at its base'.

The next two chapters deal with various attacks by creationists and his rebuttal of them. Part of the trouble with 'scientific creationism' is that it is a moving target, with no true base of its own, but mainly a goal of discrediting evolutionary theory from Darwin through to today. For example, 'modern' creationists accept small-scale evolutionary change and the origin of new species from old, but still reject the common ancestry of humans and other primates. In this context, it is interesting to note that the Papal response to the overwhelming evidential support for evolution by natural selection and common ancestry is the assumption of an 'ontological discontinuity' and injection of a soul in the human lineage at the time of divergence from the other primates[1]. These two chapters conclude that scientific creationism poses no testable hypotheses and makes no predictions. So, why is it still here?

The final chapter deals with the culture war that creationists see between the atheistic force of science and the clear (to them) theistic force of a creator. To the creationists Eldredge writes about, all of the ills of society, including selfishness and its implications, can be attributed to the acceptance of evolution by natural selection. Eldredge argues that there is no necessary set of ethical implications from evolutionary theory. However, he makes no mention of evolutionarily stable strategies and the evolution of cooperation as an achievement of modern evolutionary theory. This chapter ends with a discussion of the biodiversity crisis. Like White[2], Eldredge tries to pin the biodiversity crisis on 'the Judaeo–Christian tradition' (as if there is just one such tradition; presumably, he has in mind the 19th century European Protestant interpretation of the Bible[3]). For example, he asserts that 'There is no doubt in my mind that the Israelites (and presumably their agriculturally based neighbors) saw themselves as living outside – or above – the natural world surrounding them'. However, written evidence in the Jewish tradition suggests otherwise[4]. I suspect that Eldredge has spent too much time with urban intellectuals[5]. There is no doubt in my mind that it was the separation of people from nature during major urbanizations that led to people seeing themselves above and outside nature. Perhaps the best example is given by Cronon[6], who shows that, as the Chicago (IL) metropolitan area expanded, and people became further and further removed from nature, they simultaneously became more likely to see themselves above nature.

In an upbeat note, Eldredge concludes that we will make progress by looking for resonance rather than dissonance between religion and science – 'for a common understanding of the grave threats faced by the world's ecosystems and species'. I heartily concur[7], as do some religious scholars[8]. Indeed, true creationists rather than political ones should be the strongest supporters of biodiversity conservation, because humans have no right to destroy what a creator began.

Why has evolution not triumphed over creationism? Although he alludes to it, Eldredge does not give the answer explicitly, so here it is: 'Creation scientists' know the answer to their question (what are the origins of humans?) before they begin a study of the question and the purpose of their science is to support the answer, not answer the question. This observation is extremely important for any ecologist interested in doing applied work (and this is what makes the book required reading). Many ecologists have a passion for the environment and would consider themselves environmentalists. However, passion for the environment is most effective when it is firmly grounded in scientific work and environmentalism is not a scientific discipline; it is a political philosophy[9]. As ecologists work on applied problems, they will encounter environmentalists who know the answer to the question in advance and for whom the purpose of science is to support that answer. Some examples that I have encountered include: marine reserves will increase the catch of fish outside the reserve; biodiversity improves the stability and performance of an ecosystem[10]; and all genetically modified food is bad. Although we hesitate to lump environmentalists and creationists together, the problem can often be the same and Eldredge's book is a good training manual for how to deal with assertion pretending to be science.

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Speciation in the world's greatest forest

Mammals of the Rio Juruá and the Evolutionary and Ecological Diversification of Amazonia

by J.L. Patton, M.N.F. Da Silva and J.R. Malcolm. American Museum of Natural History, 2000. $30.00 pbk (306 pages)
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During his extensive fieldwork throughout Amazonia, A.R. Wallace observed that '…the Amazon, the Rio Negro, and the Madiera formed the limits beyond which certain species never passed'. He noted in the same paper that 'In these observations I have only referred to the monkeys, but the same phaenomena occur both with birds and insects, as I have observed in many instances'[1].

These observations represent the earliest hypothesis of a biogeographical mechanism for species diversification in Amazonia, the 'Riverine Barrier Hypothesis' (RBH). The main premise of the RBH is that major rivers divide Amazonia into large blocks, and delimit discrete geographical areas within which, there is a similar community of species but, between which, species compositions are different. The RBH implies that evolution has proceeded along independent trajectories in these different blocks and that rivers have served as causal mechanisms for this divergence[2]. A corollary of the RBH is that the strength of any river barrier should be a function of its width and flow; so that isolation should be greatest at the river mouth and should decrease towards the headwaters, where species might cross the relatively narrow channel[2]. This was supported by a recent study of Amazonian primate community composition[3], which showed that species similarity on opposite sides of rivers decreased as an increasing function of river size[3].

The Patton *et al.* monograph stands out not only because the work was carried out along a river bisecting the heart of the largest and most sparsely populated of the world's three major tropical wilderness areas (the others being the Congo River Basin and the islands of New Guinea and Melanesia)[4], but also because every aspect of the monograph exemplifies the 'real work of systematics'[5]. The work is based on an inventory of small mammals (predominantly marsupials, and echimyid and murid rodents), collected during a year-long survey of the 1000 km-long Rio Juruá in western Brazil, and the objectives were twofold. First, the authors summarize patterns of ecological and geographical distribution, genetic differentiation and phylogeography of multiple co-distributed species of terrestrial mammals in this basin. Second, they integrate patterns of distribution and differentiation of these species into the broader region of Amazonia.

The sampling design was based on 16 trapping stations distributed along the river, with sampling of both river banks carried out so as to survey canopy and terrestrial faunas, in both seasonally flooded *várzea* and unflooded upland *terra firme* forests. These forest types are expected to respond very differently to seasonal flooding and long-term meandering of Amazonian rivers. Low vagility species confined to *terra firme* forests are expected to show differentiation, as specified by the RBH because they are isolated by the river and its wider flood plain, whereas those confined to the *várzea* forests are expected to experience passive gene flow via occasional lateral channel shifts along these rivers[6]. The design provided a critical test of the RBH as a primary cause of speciation in these taxa. Both the number of species tested and the phylogeographical analyses employed meant that the authors successfully moved such studies far beyond previous work, which was hampered by either inadequate sampling and/or collection of allele-frequency data in such a way that precluded the separation of historical versus ongoing demographic influences.

To place the phylogeographical studies into a taxonomic context, the authors thoroughly review all the species covered, including revisions and descriptions of new species. For many species, accounts include not only the expected distribution maps and summary tables of the voucher specimens examined, but also photographs of karyotypes, skulls and dental patterns, haplotype cladograms, summaries of external and cranial measurements, bivariate plots of discriminant function analyses, bivariate plots of genetic or morphological divergence and geographical distance, descriptions of habitat preferences, reproductive cycles and fecundity and estimated growth rates. General patterns of community structure show that the number of species at any given pair of cross-river sites is approximately equal along the total length of the river, but that there is turnover in species composition among sites, a shift more pronounced in the *terra firme* than in the *várzea* forests. On the scale of greater Amazonia, patterns of species diversity in these three groups show strong geographical structure, with community similarities clearly divisible into eastern and western groups, along an approximate N–S axis formed by the Rio Madiera and Rio Negro.

The authors summarize patterns of genetic differentiation (in mtDNA cytochrome-*b* sequences) for 41 species of mammals, most of which falsify RHB expectations, but phylogeographical patterns for many species show up- and downriver groups of reciprocally monophyletic mtDNA clades. Levels of divergence suggest pre-Pleistocene separation events for most clades, and concordance in the geographical placement of clade boundaries across multiple taxa and, in association with an underlying geological feature (the Iquitos Arch), imply a shared history strongly structured by previously underappreciated tectonic events. The authors emphasize the difficulty of identifying speciation mechanisms in such an environment because many of the previously proposed multiple models[7] were not testable unambiguously . These limitations compound logistical problems, and the inadequacy of available specimens for even

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