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On the origins of Madagascan and Seychellian eumastacids

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Abstract

Recent palaeo-oceanographic work (Ali & Huber 1910) shows that strong surface currents existed from the East Africa coast to Madagascar and beyond in the Palaeogene, making the rafting of masses of African vegetation possible during this period. Source Euschmidtinae are common on the East African coast. The only African relative of the Miraculinae is the chorotypid genus *Hemierianthus* of West and Central Africa. This leads to the hypothesis that the Miraculinae are closer to the Chorotypidae than to the Episactidae, as suggested by Descamps (1973), which is testable by molecular systematic methods.

Key words

Madagascar, Seychelles, fauna, tectonic movements, dispersal, grasshopper

The modern grasshopper fauna of Madagascar includes numerous representatives of two distantly related subfamilies of the Eumastacoidea *sensu* Descamps 1973, the Miraculinae and the Pseudoschmidtinae. Both groups are flightless. Descamps (1973), on the basis of their phallic structures, placed the former subfamily in the family Episactidae, and the latter in the family Euschmidtidae. The remaining episactids are mostly in the Caribbean and Central America, whereas the Euschmidtidae are widely distributed in tropical Africa, especially along the coast of E. Africa. The only eumastacid so far recorded from the Seychelles, *Euschmidtia cruciformis* (Bolívar, 1895), is also a member of the Euschmidtidae. Descamps (1973) further linked the Episactidae with the Chorotypidae, placing both in his division Cryptophalli; most chorotypids are found in S.E. Asia, but the genus *Hemierianthus* (Saussure 1903) is in the forests of West and Central Africa. Molecular systematic analyses (Matt *et al.* 2009) largely corroborate Descamps' arrangements, and also show that *E. cruciformis* is very closely related to modern E. African members of its genus.

This phylogeographic situation poses several questions. What was the source of the ancestors of present-day island forms, and how did they reach the islands?

The origin of the Madagascan (and to a lesser extent, the Seychellian) faunas is an old zoological problem, discussed especially with regard to the unique assemblage of terrestrial vertebrates found on these islands. Africa seems the most likely faunal source, both because of its relative proximity and its faunal resemblances. Simpson (1940) first proposed that rafting across the Mozambique Channel on large clumps of floating vegetation could provide the means. The major objection to this hypothesis is the fact that present day ocean currents and prevailing winds make such rafting impossible.

This problem has been recently re-examined by Ali and Huber (2010), who show that during the Palaeogene and through the

Oligocene, Madagascar lay south of the Equatorial Gyre and that strong surface currents then flowed from northeast Mozambique and Tanzania towards the north coast of Madagascar and on eastwards. This situation would favor rafting from Africa to the islands during this period.

An alternative hypothesis would be that the insular faunas are derived by vicariance from an original Gondwanaland fauna, following the separation of the Indian plate from Gondwana about 160 Mya and the subsequent separation of Madagascar, at about 90 Mya, from that plate. This seems, *e.g.*, to be the likely explanation for the presence of caecilians on the Seychelles (Hass *et al.* 1998). This hypothesis does not seem applicable to the grasshoppers, however, as the tectonic splits are older than the likely date of the evolution of the subfamilies in question, whereas the early tertiary ocean currents postulated by Ali and Huber (2010) would fit very well. Further, there are no closely related eumastacids in Southern India, as might be expected under this scenario.

Given that rafting in the Early Tertiary is a real possibility, the modern distribution of African Euschmidtidae on the East African coast provides a ready source for the ancestral insular forms of this family. But what about the Miraculinae? There are no candidate Episactid ancestors in Africa. However, the morphological arguments for placing the Miraculinae in the Episactidae could also be used to link them instead with the Chorotypidae and, as noted above, the latter are represented today in West and Central Africa. Given the dramatic variations in African climate known to have occurred over geological time, it is not extravagant to postulate that a wet-forest chorotypid occurred on the East African coast during the Eocene, and was rafted to Madagascar, where it gave rise to the Miraculinae.

This hypothesis implies that the Miraculinae should be more closely related to *Hemierianthus* and other chorotypids than to the Episactinae, despite their strong morphological resemblance to the latter group. This could be tested by molecular systematics; to date, no sequence data have been obtained from the Miraculinae and only very little from the Chorotypidae. Further work is required!

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