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ABSTRACTS

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Biogeographic origins and assembly of the viviparous sea snake fauna (Elapidae) of the Indian Ocean

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Abstract

Introduction & Aim: One of the major goals in biogeography is to understand how biotas have been assembled in different regions of the world. The origins of the viviparous sea snakes in the Indian Ocean pose a unique question in this regard. Viviparous sea snakes evolved from the viviparous terrestrial elapids in the Australasian region approximately eight mya (million years ago). It is believed that the ancestors of present day viviparous sea snakes initially colonized the seas adjacent to the northern Australian and Southeast Asian regions and then dispersed to the Indian and Pacific Oceans. In this study, we aimed to evaluate the origins, patterns of colonization and the assembly of the Indian Ocean sea snake fauna to test this hypothesis.

Location: Indian Ocean, Southeast Asia, West Pacific.

Methods: To examine the origins, patterns of colonization and the assembly of the Indian Ocean sea snake fauna, a multi-locus time-calibrated phylogeny for *c.* 70% of viviparous sea snake species were reconstructed using likelihood and Bayesian methods and their ancestral areas were estimated. Further, to evaluate how past and present barriers to gene flow have affected the species and genetic diversity of Indian Ocean sea snakes, we examined the population genetic structure of the widespread sea snake, *Hydrophis curtus* using mitochondrial, nuclear and microsatellite markers.

Results: Our phylogenetic analyses and ancestral area reconstructions strongly indicate that the majority of the Indian Ocean sea snakes were derived from the Southeast Asian sea snake fauna through dispersal and colonization. However, evidence for *in-situ* radiations and vicariant speciation in the Indian Ocean sea snakes are also present. In several species, our results revealed deep genetic divergence between the populations in the Indian Ocean and Southeast Asia that is largely congruent with patterns reported for marine fishes and invertebrates. Divergence dating suggested that most Indian Ocean species diverged from their Southeast Asian populations approximately 3.0-2.0 mya in the late Pliocene or early Pleistocene. Population genetic analysis of *H. curtus* revealed strong concordant geographic structure with a prominent genetic break between populations broadly distributed in the Indian Ocean and Southeast Asia. Microsatellite admixture analyses suggested limited recent gene flow between these populations despite the current lack of barriers to dispersal, indicating possible cryptic species.

Discussion: These results indicate that viviparous sea snakes have a relatively long and complex evolutionary history in the Indian Ocean region and have a unique conservation value. Our results are consistent with the view that climatic fluctuations during the Plio-Pleistocene generated high levels of cryptic genetic diversity in *H. curtus*, and add to similar findings for diverse other marine groups in the region.

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