ID: W2037241649

TITLE: Multilocus phylogeny and recent rapid radiation of the viviparous sea snakes (Elapidae: Hydrophiinae)

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ABSTRACT:

The viviparous sea snakes (Hydrophiinae: Hydrophiini) comprise a young but morphologically and ecologically diverse clade distributed throughout the Indo-Pacific. Despite presenting a very promising model for marine diversification studies, many relationships among the 62 species and 16 genera in Hydrophiini remain unresolved. Here, we extend previous taxonomic and genomic sampling for Hydrophiini using three mitochondrial fragments and five nuclear loci for multiple individuals of 39 species in 15 genera. Our results highlight many of the impediments to inferring phylogenies in recent rapid radiations, including low variation at all five nuclear markers, and conflicting relationships supported by mitochondrial and nuclear trees. However, concatenated Bayesian and likelihood analyses, and a multilocus coalescent tree, recovered concordant support for primary clades and several previously unresolved inter-specific groupings. The Aipysurus group is monophyletic, with egg-eating specialists forming separate, early-diverging lineages. All three monotypic semi-aquatic genera (Ephalophis, Parahydrophis and Hydrelaps) are robustly placed as early diverging lineages along the branch leading to the Hydrophis group, with Ephalophis recovered as sister to Parahydrophis. The molecular phylogeny implies extensive evolutionary convergence in feeding adaptations within the Hydrophis group, especially the repeated evolution of small-headed (microcephalic) forms. Microcephalophis (Hydrophis) gracilis is robustly recovered as a relatively distant sister lineage to all other sampled Hydrophis group species, here termed the 'core Hydrophis group'. Within the 'core Hydrophis group', Hydrophis is recovered as broadly paraphyletic, with several other genera nested within it (Pelamis, Enhydrina, Astrotia, Thalassophina, Acalyptophis, Kerilia, Lapemis, Disteira). Instead of erecting multiple new genera, we recommend dismantling the latter (mostly monotypic) genera and recognising a single genus, Hydrophis Latreille 1802, for the core Hydrophis group. Estimated divergence times suggest that all Hydrophiini last shared a common ancestor ?6million years ago, but that the majority of extant lineages diversified over the last ?3.5million years. The core Hydrophis group is a young and rapidly speciating clade, with 26 sampled species and 9 genera and dated at only ?1.5-3million years old.

SOURCE: Molecular phylogenetics and evolution

PDF URL: None

CITED BY COUNT: 104

PUBLICATION YEAR: 2013

TYPE: article

CONCEPTS: ['Biology', 'Paraphyly', 'Monophyly', 'Clade', 'Zoology', 'Lineage (genetic)', 'Phylogenetics', 'Evolutionary biology', 'Genetics', 'Gene']