



## Molecular phylogeny and divergence time estimates of Penaeid Shrimp Lineages (Decapoda: Penaeidae)

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### Abstract

Fossil record of penaeids indicates that the family exists since the Triassic period, but extant genera appeared only recently in Tertiary strata. Molecular based divergence time estimates on the matter of penaeid radiation were never properly addressed, due to shortcomings of the global molecular clock assumptions. Here, we studied the diversification patterns of the family, uncovering, more specifically, a correlation between fossil and extant Penaeid fauna. For this, we have used a Bayesian framework that does not assume a global clock. Our results suggest that Penaeid genera originated between 20 million years ago and 43 million years ago, much earlier than expected by previous molecular studies. Altogether, these results promptly discard late Tertiary or even Quaternary hypotheses that presumed a major glaciations influence on the diversification patterns of the family.

**Key words:** Mitochondrial genes, maximum likelihood, MCMC, molecular clock, multidistribute, Phylogeny, Shrimps, Tethys Sea, Vicariance

### Introduction

Penaeidae is a diverse and worldwide-distributed family of shrimps, particularly in the Indo-West Pacific region. Their intimate association with fine dishes on our table secures their economically status, representing half of crustacean fisheries in the world (FAO 2008), and possibly the most important family within commercial crustaceans.

Regardless of their economic relevance, however, only a few papers concerning evolutionary relationships between major penaeid lineages have been published (e.g. Burkenroad 1983; Dall *et al.* 1990; Kubo 1949; Lavery *et al.* 2004; Pérez-Farfante & Kensley, 1997). Penaeidae family is thought to be ancient, and one of the most primitive groups of decapod crustaceans with records that date back to the Triassic Period. Representatives of the family appear in Mesozoic geological records (Dall 1991), but evidence for the origin of most extant genera is yet to be encountered (Pérez-Farfante & Kensley 1997; Beschin & Garassino 1999). Fossil data indicates a sharp increase in diversity in the Cretaceous (Glaessner 1969; Garassino 1994), but there is no evidence whether any of these old lineages survived the K-T extinction (Dall *et al.* 1990).

Assuming a global molecular clock, studies have estimated a very recent origin and have proposed late Tertiary, or even Quaternary, diversification hypotheses for penaeids (Dall 1991; Tong *et al.* 2000; Maggioni *et al.* 2001; Quan *et al.* 2004). It is possible, however, that a clock-like assumption does not hold for those lineages, causing serious bias in those estimates (Rambaut & Broham, 1998). A Bayesian approach has recently become available, in which clock-like assumptions are not required (Thorne & Kishino, 2002). This may be the missing tool to shed some light in the evolutionary history of this economic important family.