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## Ghost shrimp *Calliax* de Saint Laurent, 1973 (Decapoda: Axiidea: Callianassidae) in the fossil record: systematics, palaeoecology and palaeobiogeography

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### Abstract

Ghost shrimps of the family Callianassidae are very common in the fossil record, but mostly as isolated cheliped elements only. The assignment to biologically defined genera, diagnosed on the basis of soft part morphology, is thus rather difficult. In this respect, proxy characters present on chelipeds that are the most durable ghost shrimp remains are needed to ascribe fossil material to extant genera. The genus *Calliax* de Saint Laurent, 1973 has been particularly obscure in this respect. Thorough comparison of extant members of the genus resulted in evaluation of characters present on chelipeds being taxonomically important on the genus level, specifically: 1) rectangular major P1 propodus with two ridges on the base of the fixed finger extending onto manus; 2) major P1 fingers relatively short; and 3) minor P1 chela with dactylus longer than fixed finger and possessing a wide gap between fingers. On this basis, *Callianassa michelottii* A. Milne Edwards, 1860, from the Oligocene and Miocene of Europe is herein reassigned to *Calliax*. Further re-examination of the ghost shrimp fossil record revealed that *C. szobensis* Müller, 1984, from the Middle Miocene of Hungary represents the same animal as *C. michelottii* and they are synonymised herein. The known geographic distribution of *C. michelottii* is expanded by the first confirmed occurrence of the species in Slovakia. All occurrences of *C. michelottii* known to date are reviewed and documented. The presence of *Calliax michelottii* comb. nov. may be considered an indicator of deeper marine settings. Based on the scarce fossil record known to date, *Calliax* has a Tethyan origin; it supposedly migrated westward to establish present day communities in the Caribbean sometime before the Middle Miocene.

**Key words:** Ghost shrimp, *Calliax michelottii* comb. nov., Oligo-Miocene, systematics, palaeoecology, palaeobiogeography

### Introduction

Ghost shrimps (Decapoda: Axiidea: Callianassidae) are elongate, soft-bodied, fossorial shrimps with an abdomen distinctly longer than the carapace. They inhabit predominantly shallow intertidal and subtidal marine habitats (or habitats under seawater influence) mainly in the tropics and subtropics (Dworschak 2000, 2005; Dworschak *et al.* 2012). They are known for their sophisticated behaviour, which involves digging complex burrow systems (Griffis & Suchanek 1991; Felder 2001; Dworschak *et al.* 2012), and they can influence the geochemistry of the substrate (Ziebis *et al.* 1996a, b; Felder 2001).

The fossil record of ghost shrimps is very robust and they are present in most associations of Cenozoic decapod crustaceans described so far (Glaessner 1969; Bishop & Williams 2005); however, the generic assignment of their remains is rather difficult because their preservation is often incomplete. In general, there are several different views on the evaluation of taxonomically important characters as exemplified by works of Biffar (1971), Manning & Felder (1991), Ngoc-Ho (2003), Poore (1994, 2008) and Sakai (1999, 2005, 2011). Palaeontological literature usually emphasizes the contribution of Manning & Felder (1991), which treated some characters present on chelipeds as taxonomically important on the genus level.

Neontological and palaeontological practice commonly handles ghost shrimps differently: whereas zoologists

## Conclusions

1. Based on thorough comparison between extant and fossil ghost shrimps, a set of characters present on P1 are considered of taxonomic importance at the genus level. The combination of rectangular major P1 propodus with short fixed finger exhibiting two more-or-less parallel ridges extending onto the manus and a minor P1 with the fixed finger distinctly shorter than the dactylus and with a wide gap between the fingers is unique among ghost shrimps and characterizes *Calliax*. Even the morphology of the major P1 propodus alone is distinct enough to be safely assigned to *Calliax*, yet the fossil specimens have been rarely interpreted as members of this genus.

2. *Callianassa michelottii* originally described from the Miocene of NW Italy (A. Milne Edwards 1860) and later widely reported from the Oligocene and Miocene of Europe (Fig. 1, Table 2) is re-assigned to *Calliax*. *Callianassa szobensis* from the Middle Miocene of Hungary (Müller 1984) is considered a junior subjective synonym of *C. michelottii*. New occurrences of the species are reported from the Neogene basins of the former Central Paratethys Sea, specifically from the North Alpine Foreland Basin and the Vienna Basin.

3. The presence of *Calliax michelotti* comb. nov. may be considered an indicator of deeper marine settings. This hypothesis, however, must be further tested.

4. The fossil record of *Calliax* is revised and the presence of the genus in the Miocene strata of South America is documented. Compared to today's occurrences, the geographic distribution of *Calliax* was wider in the geologic past. Based on the fossil record known so far, a Tethyan origin for the genus is postulated.

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