



Classification of *Crangonyx islandicus* (Amphipoda, Crangonyctidae) based on morphological characters and comparison with molecular phylogenies

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Abstract

Crangonyx islandicus is a groundwater amphipod species endemic to Iceland and a member of the family Crangonyctidae which is widespread throughout the Holarctic region. A previous study based on variation in nuclear genes showed that *C. islandicus* closest relatives are *Crangonyx* species from North America, where most of the species diversity of the genus occurs. In this study, we aim at describing the morphological affinities of *C. islandicus* with North American *Crangonyx* species and two Eurasian species, *C. chlebnikovi* and *C. subterraneus*. We used the morphological characters defined by Zhang & Holsinger (2003) and scored them for different populations of *C. islandicus* as well as for *C. chlebnikovi* and *C. subterraneus*. The molecular phylogeny of the Crangonyctidae family and the morphological character states are compared in order to detect potential convergence in the morphological traits, common in subterranean species. *C. islandicus* appears to be close morphologically to *C. subterraneus* from Europe and *C. longicarpus* from North America. The morphological proximity of *C. islandicus* and *C. subterraneus* is incongruent with the pattern observed from molecular data.

Key words: Crustacea, groundwater, morphology, RNA, convergence, biogeography, colonization, Iceland

Introduction

Crangonyx islandicus Svavarsson & Kristjánsson, 2006 is a subterranean groundwater amphipod endemic to Iceland (Svavarsson & Kristjánsson 2006). This species belongs to the freshwater family Crangonyctidae, currently widespread in the previously unglaciated Holarctic regions. The occurrence of *C. islandicus* in an island in the midst of the Atlantic Ocean which has repeatedly been covered by glaciers during the Ice Age has raised questions about its origin and colonization of Iceland. The genus *Crangonyx* contains 47 species, 42 of which occur in North America (Zhang & Holsinger 2003, Messouli 2006, Svavarsson & Kristjánsson 2006, Sidorov & Holsinger 2007). Based on 18S and 28S nuclear RNA genes, Kornobis *et al.* (2011) showed that *C. islandicus* closest relatives are *Crangonyx* species from North America and concluded that it had probably colonized Iceland via an ancient land bridge between Greenland and Iceland.

Analyses of mtDNA of *C. islandicus* have revealed geographic patterns of variation in Iceland (Kornobis *et al.* 2010). Populations along the volcanic region in Iceland are characterized by different monophyletic clades of the mtDNA genealogy, which have been diverging for 250 thousand years up to 5 Million years. The oldest branching includes the divergence of a single population in northeastern Iceland from the other populations. As populations from adjacent regions are generally more related than populations sampled at larger distances, Kornobis *et al.* (2010) concluded that the differentiation among the populations must have occurred within Iceland and thus that the species had survived repeated glaciation periods underneath glaciers.

The family Crangonyctidae, encompassing the genus *Crangonyx*, is an exclusively freshwater crustacean family and 80% of the species are hypogean (Väinölä *et al.* 2008). Morphological characters affected by convergence or parallelism, e.g. reduced eyes and loss of pigmentation, have been commonly observed among subterranean species and were originally termed as “troglomorphic” by Christiansen (see Jones *et al.* 1992). These common features could obscure the phylogenetic relationships based on morphological data, particularly among the *Crangonyx* species. The phylogenies based on 18S and 28S revealed that *Crangonyx* is clearly polyphyletic (Kornobis *et al.*