

A review of the Ephemeroptera of Finnmark – DNA barcodes identify Holarctic relations

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The knowledge of the diversity and distribution of mayflies in Finnmark county, the northernmost part of mainland Norway, is reviewed. Eighty five DNA barcodes representing 23 species in the region are released and used in association of life stages as well as evaluation of morphological characters commonly used in identification of Scandinavian Ephemeroptera. Comparisons of DNA barcodes from North American species indicate close relations between Norwegian and North American populations of *Acentrella lapponica* Bengtsson, 1912, *Heptagenia dalecarlica* Bengtsson, 1912, *Metretopus borealis* (Bengtsson, 1909), *Ephemerella aurvillii* (Bengtsson, 1908) and *Parameletus chelifer* Bengtsson, 1908. The DNA barcode from *Siphonurus alternatus* (Say, 1824) cluster closely with specimens of the same species from Finland, but are more than 7.8% different from North American populations, indicating that the Fennoscandian specimens might constitute a separate species. Two species new to Finnmark and ten new province records are reported.

Key words: Ephemeroptera, DNA-barcoding, Finnmark, Norway, North America.

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Introduction

The use of the short, standardized gene sequences in the identification and delimitation of species (so-called DNA-barcoding) has ever since Hebert *et al.* (2003) been increasingly popular in most organism groups. Although exceptions exist (e.g. Whitworth *et al.* 2007), most studies confirm the effectiveness of partial cytochrome c oxidase subunit I (COI) sequences in the identification of insect species (e.g. Zhou *et al.* 2009, Ekrem *et al.* 2010). DNA-barcoding has also been shown to be a valuable and effective tool in identification and association of life stages also in mayflies (Ball *et al.* 2005, Zhou *et al.* 2009, Webb *et al.* 2012). A comprehensive barcode library of mayflies and

other freshwater invertebrates will enable future use of environmental barcoding in monitoring of freshwaters (Hajibabaei *et al.* 2011) and facilitate a common understanding of the taxonomy of this interesting group of insects.

The distribution of the Ephemeroptera in Finnmark was relatively poorly known until Reidar Brekke published a list of Norwegian mayflies, which included 18 species from Finnmark (Brekke 1938). Later the works of Huru (1981a,b,c, 1982) and Eie *et al.* (1982), which cover several watercourses in Finnmark, made important contributions. The most intensively investigated river concerning freshwater invertebrates in Finnmark, undoubtedly, is the River Alta. In connection with a major river regulation in the