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IDENTIFICATION OF SUBFOSSIL REMAINS OF CLADOCERANS *Latona setifera*, *Diaphanosoma brachyurum* AND *Holopedium gibberum*

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Abstract

The preservation of chitinous outer body parts of Cladocera is mostly selective, except in two families, the planktonic Bosminidae and the littoral Chydoridae. In addition, at least some body parts of several other genera and taxa preserve but many of them have not been widely identified. The aim of the article is to present photographs and line drawings of the postabdomen and the postabdominal claws of *Holopedium gibberum*, together with the postabdominal claws of *Latona setifera* and *Diaphanosoma brachyurum* for use of cladoceran analysts. In analysis of subfossil remains pictures and descriptions of separate body parts make the identification more reliable. It is hoped that with increasing knowledge about remains of as many taxa as possible, a more complete picture of the past cladoceran assemblages can be obtained, together with a more precise assessment of past ecological conditions, such as pH and trophic state.

Key words: Subfossil Cladocera, *Holopedium gibberum*, *Latona setifera*, *Diaphanosoma brachyurum*, identification.

INTRODUCTION

The analysis of subfossil cladoceran remains has been used in palaeolimnological studies since the 1950s (*e.g.* Frey 1986, Hann 1989, Korhola & Rautio 2001). Cladocera (water-fleas) are valuable bioindicators, since these microscopic animals leave abundant remains in the sediments of freshwater lakes. Unfortunately, the preservation of chitinous outer body parts of Cladocera is selective. In particular, the body parts of representatives of two families, the planktonic Bosminidae and the littoral Chydoridae preserve well in sediments. In addition to these families, at least some body parts of taxa of almost all families preserve but many of them have not been widely identified.

The identification of intact Cladocera differs from that of subfossil, detached body parts. When intact animals are identified, the entire animal, together with its specific features can be examined. In analysis of subfossil remains every body part must be identified separately. Therefore, the structures upon which the identification is based, often are not clearly visible in pictures of whole animals in keys. The availability of pictures and descriptions of separate body parts makes the identification of subfossil remains considerably more reliable.

Cladocerans of the families Sididae and Holopedidae (Korovchinsky 1992) are abundant in freshwater basins. *Sida crystallina* (O.F. Müller) has been widely identified by its claws, postabdomen and antennal segments (Frey 1960, 1962, 1964). Antennal segments of also *Diaphanosoma brachyurum* Liévin and *Latona setifera* O.F. Müller have been described (Frey 1960) but pictures of their postabdominal claws have not been available, except in Goulden (1964) where a picture of the postabdominal claw of *Latona setifera* was presented. Because identification of the claw on the basis of the drawing (Goulden 1964) is not easy, we decided to present photographs and line drawings of postabdominal claws of *Diaphanosoma brachyurum* and *Latona setifera* for the use of analysts of subfossil cladoceran remains.

Claws of these taxa were encountered during cladoceran analysis of sediments of Lake Arapisto, southern Finland (Nevalainen, Sarmaja-Korjonen, unpublished data). Also subfossil postabdomens and claws of *Holopedium gibberum* Zaddach were found and identified on the basis of specimens shown on microscope by S. Siitonen during the 5th Subfossil Calocera Workshop, Helsinki 2003, together with the aid of Flössner (1972) and Røen (1995). Frey (1964, 1967) stated that he had found postabdomens of *Holopedium gibberum* but as far as we know, no pictures of subfossil remains of it have been published. Therefore, also the postabdomen and postabdominal claws of *Holopedium gibberum* are presented here.

METHODS

Samples of 1 cm^3 from a sediment core of Lake Arapisto (60° 35´ N, 24° 05´E) were prepared by heating in 10% KOH (potassium hydroxide) for 20 minutes and sieving through a 44 µm mesh. The samples were mounted in glycerine jelly

Fig. 1. **A** – Subfossil remains of *Latona setifera* O.F. Müller from Lake Arapisto, southern Finland. Postabdominal claws (sample depth 175 cm). **B** – Postabdominal claw (sample depth 95 cm) showing also the marginal spinules, not clearly visible in A. Scale bar = 30 µm.

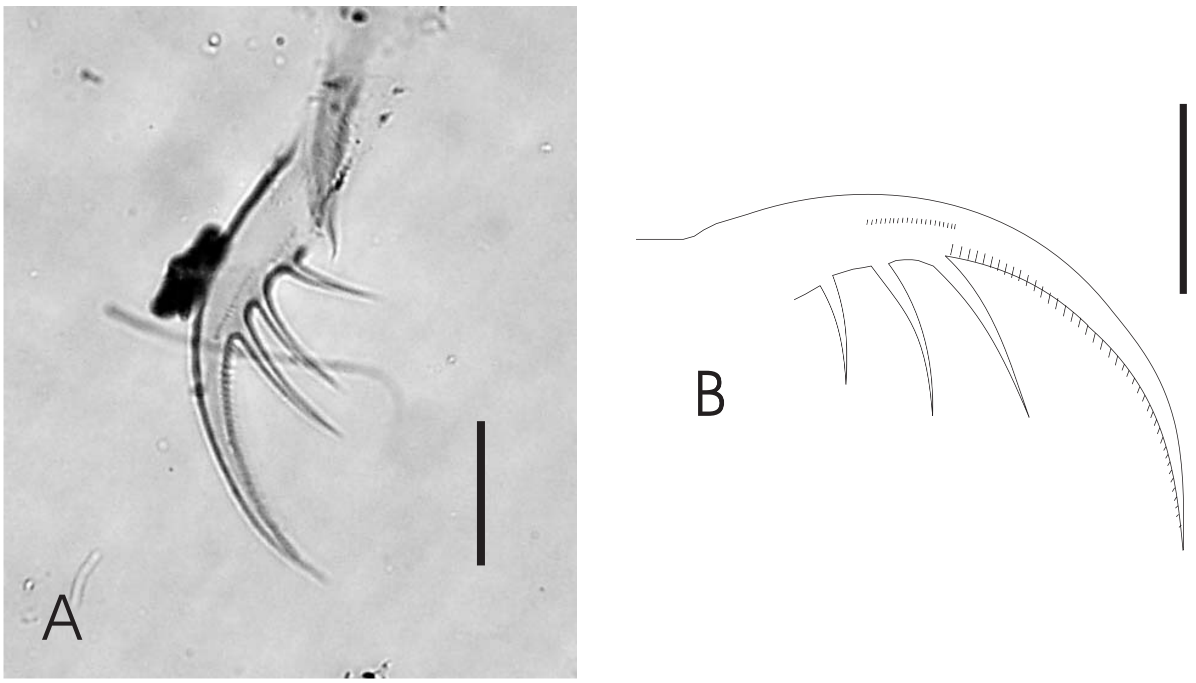

Fig. 2. **A**, **B** – Subfossil postabdominal claws of *Diaphanosoma brachyurum* Liévin from Lake Arapisto, southern Finland (sample depth 25 cm). Scale bar = 40 µm.

stained with safranine. The remains were photographed from the slides with an Olympus DP10 camera attached to an Olympus BX40 microscope.

REMAINS

Latona setifera (Sididae)

The postabdominal claws (Fig. 1) are characterized by two long spines. There are fine spinules (Fig. 1B) on the margin, starting from behind the second spine.

Diaphanosoma brachyurum (Sididae)

The postabdominal claw has three relatively curved long spines (Fig. 2A, B) which become larger towards the tip. The margin between the spines and the tip is characterized by small spinules. There is also a short row of spinules on the lateral side of the claw (Fig. 2B).

Holopedium gibberum (Holopedidae)

The postabdomen resembles that of *Sida crystallina* but

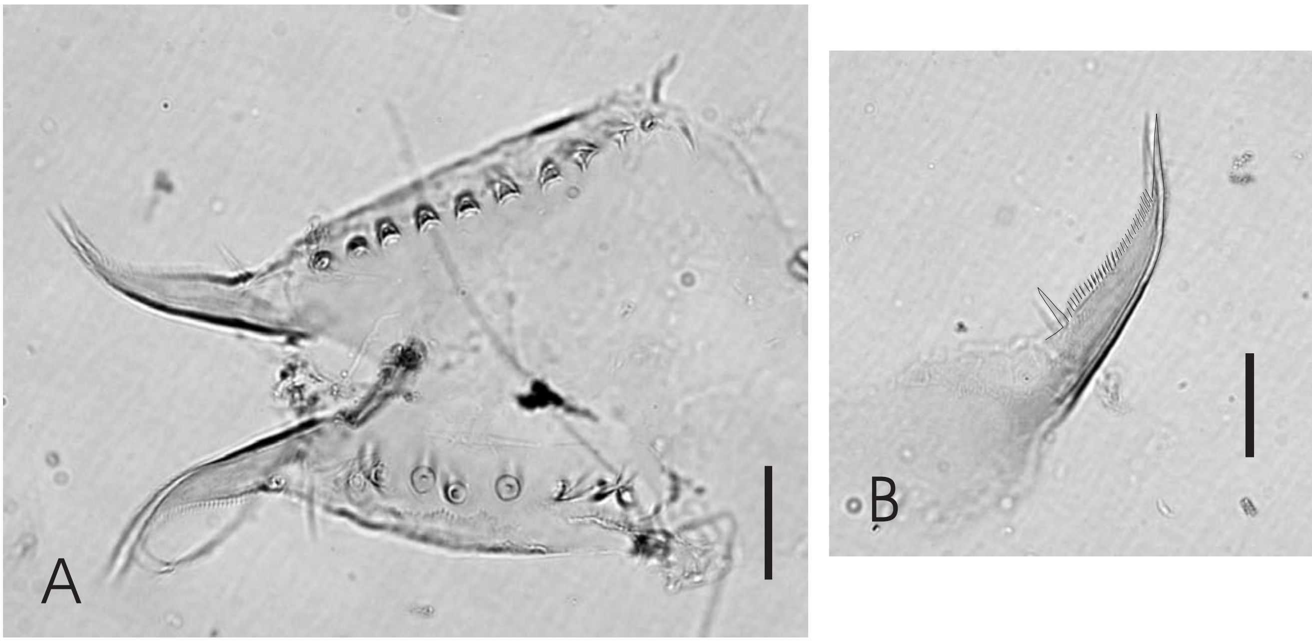

Fig. 3. **A** – Subfossil remains of *Holopedium gibberum* Zaddach from Lake Arapisto, southern Finland. Postabdomen and postabdominal claws (sample depth 25 cm). **B** – Postabdominal claw (sample depth 100 cm). The remain is so delicate that the margins and spinules were highlighted with black (with Corel Draw program). The lower tip of the claw and the lower basal spine are most probably optical illusions. Scale bar = 30 μm.

is more delicate (Fig. 3A). Many subfossil postabdomens from Lake Arapisto had 10–11 teeth preserved on the dorso-lateral margins, but sometimes the postabdomen was so well preserved that up to 20 teeth were visible. The postabdominal claw (Fig. 3B) is short and robust and has small spinules on the dorsal margins. According to Flössner (1972) and Røen (1995) there is a basal spine on the claw. However, the claws in Fig. 1 have two tips visible as if two claws were on top of each other and in the same way, two delicate basal spines are visible in Fig. 3B. Most probably these are optical illusions at the magnification x 400 as the double tips and spines are not visible at the magnification x 1000.

DISCUSSION

Several authors report findings of these three taxa from lake sediments (*e.g.* Goulden 1964, Korhola 1990, 1992, Jones & Tsukada 1981, Matveev 1986, Sandøy & Nilssen 1986) but few mention which body parts had been identified.

Latona setifera prefers oligotrophic-weakly eutrophic waters and has been found in British tarns with pH lower than 5.0 (Fryer 1980). It is a benthic form (sublittoral; Flössner 1972) and feeds on particles lying on lake bottom.

Diaphanosoma brachyurum is a planktonic form found both in littoral and pelagial zones. It has a wide tolerance on pH (Mäemets 1961) but according to Sandøy and Nilssen (1986) it is most common in acidic lakes and relatively rare in lakes with pH above 6 in Norway and has been found in pH below 5.0 in British tarns (Fryer 1980). Aparently, it is a warm water species; it was not found in mountain areas in Norway (Sandøy & Nilssen 1986) and it was very rare in northwestern Finnish Lapland (Korhola 1999).

Holopedium gibberum is a planktonic form which prefers waters with low trophic state and pH (Mäemets 1961, Flössner 1972, Røen 1995). However, Nilssen and Sandøy (1990) found in Norway that it was not common in lakes with pH below 5 and in Lake Gulspettvann it decreased during recent acidification. It was relatively rare in northern Finnish Lapland where Korhola (1999) studied surface sediments from 53 lakes and was associated with deep and cold lakes.

The presence of these taxa in the same lake suggests that Lake Arapisto was an oligotrophic, acidic lake which is in agreement with other data (Nevalainen, Sarmaja-Korjonen, unpublished data). Since relatively few remains of planktonic Cladocera, except *Bosmina* spp., are preserved, identification of remains of *Holopedium gibberum* and *Diaphanosoma brachyurum* increase the knowledge about plankton species composition and assemblages, important in reconstruction of the past food web, together with a more precise assessment of past ecological conditions, such as pH and trophic state.

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