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# FINDINGS OF *Alona protzi* HARTWIG 1900 (BRANCHIOPODA: ANOMOPODA, CHYDORIDAE) IN FINLAND

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**Abstract**
*Alona protzi* is a rare species of Cladocera, occurring in lake littoral throughout Europe. However, little is known about this animal, and so far it has not been included in provisional lists of species found in Finland. In this short report we present our findings of *Alona protzi*, both recent and subfossil material, as well as one previous, unpublished finding site of the species in Finland. We found three subfossil shells of this species in the bottom sediments of two lakes. In a third lake we found intact animals, an ephippial female and a male, while sampling stony bottom of lake littoral.

**Key words:** Cladocera, *Alona protzi*, biogeography, ecology, Finland

## INTRODUCTION

*Alona protzi* Hartwig 1900 is a small cladoceran (water flee) (Branchiopoda: Anomopoda), which belongs to the family Chydoridae (chydorids). Flössner (1972) defines its distribution as palaearctic, Dumont & Negrea (1996) as west palaearctic. Although the species occurs throughout Europe, it is very rare, and little is known about its ecology. According to Flössner (1972) most findings had been made in lake littoral, both in mud substratum and on algae growing on stones. Also Brancelj & Sket (1990) reported the latter habitat for *A. protzi* in the Ohrid Lake, Macedonia. According to Røen (1995) the species lives among algae in small, clear-water lakes. However, according to Van Damme (pers. comm.) *A. protzi* occurs in lake littoral always in vicinity of springs.

Dumont (1983) pointed out the findings of this species in underground habitats or habitats immediately connected to the groundwater system, such as an underground water pipe in England (as pers. comm. from Frey) or stonewall with deep, wide cracks along a canal in Turkey. Interesting are also the findings among *Cordylophora,* a colony-forming hydroid. Gurney (1921; cited in Flössner 1972 and in Dumont, Negrea 1996) had found the species in England in fast-running water among *Cordylophora*, which grew on a wooden bridge beam. Also the stone block lining in the canal in Turkey with several *A. protzi* females, was partly covered by *Cordylophora* (Dumont, Negrea 1996).

In their conspectus of the Cladocera of the subterranean waters Dumont & Negrea (1996) defined *A. protzi* as pelophilic and phytophilic, inhabiting stagnant and slow-flowing waters on silt or algal substratum. They also listed the known findings of the species in interstitial waters of rivers and lakes, water-piping systems and other underground waters. Like Dumont (1987, 1995), they define the species as stygophile, which means a transitory way of life between surface-water forms and true groundwater forms.

The provisional list of Finnish crustacea (Silfverberg 1999) does not include *A. protzi*. The species has been found in Latvia (Flössner 1972) but Mäemets (1961) who studied living Cladocera from over 500 water bodies (including springs) in Estonia did not find this species. It has also been found in Denmark (Whiteside 1970, Røen 1995). Since the species has been found in countries near Fennoscandia it is possible that its distribution is wider in northern Europe, but it has remained undiscovered (or even been misidentified) because of its rarity. In this short report we present our findings of *A. protzi*, in both recent and subfossil material. We also describe one previous, but unpublished finding site of the species in Finland.

## FINDINGS OF *Alona protzi* IN FINLAND

Generally, cladoceran species can be studied with two different methods. Firstly, living specimens are collected with nets from different habitats in water bodies. They are identified as intact animals and identification is based on *e.g.* general shape, postabdomen and parts that do not preserve (antennas, labrum) in sediments. Secondly, subfossil chitinous body parts of dead and moulting animals are identified from lake sediments. These body parts have been detached and must be identified separately; identification is based on *e.g.* shape, surface sculpture, head pores and denticles.

The detached body parts from different habitats are usually distributed relatively uniformly across the lake bottom

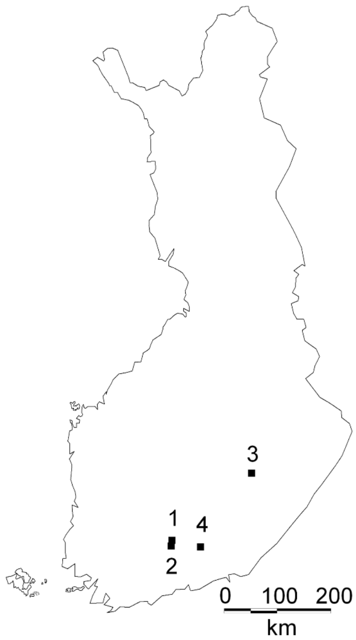


**Fig. 1.** Location of the lakes discussed in the text. 1 – Lovonjärvi, 2 – Riikoisten Valkjärvi, 3 – Valvatus, 4 – Sylvöjärvi.

before the final deposition. Therefore, the entire spectrum of chydorid fauna, which inhabit a lake in different habitats and at different times, is reflected in one bottom sediment sample with a minimum of time and effort (Frey 1960). Due to that even new species have been discovered this way (Sarmaja-Korjonen *et al.* 2000) and in fact, *A. protzi* was found at the first time in Denmark in sediment analysis (Whiteside 1970).

## Findings of intact animals of *Alona protzi*

In Finland the species of *Alona protzi* has been found both as intact animals and as subfossil remains. Intact animals were found in a study of littoral chydorid species, which was a part of a EU-funded project ECOFRAME (Moss *et al.* 2003), and evaluated their use in lake ecological quality classification. Sampling was conducted with hand nets (mesh size 100 µm), swept over the lakebed at a site where the water depth was *ca*. 0.5 m. A total of 66 shallow lakes across Europe were sampled this way from stony substratum and plant bed separately (de Eyto *et al.* 2003). *A. protzi* was found in three lakes, two of which were located in Sweden, and one, Lake Sylvöjärvi, in southern Finland (Fig. 1).

Two *A. protzi* individuals were found in Lake Sylvöjärvi, an ephippial female and a male (Fig. 2). The total length of the ephippial female (Fig. 2A) was 383 µm and that of the male (Fig. 2C) – 289 µm. The carapace surface sculpture of intact animals was more detailed than in subfossil shells. Besides blurry lines, fine punctuation was visible. The ephippial female had three denticles on one valve and only two on the other (Fig. 2A, B). The male had three and four denticles, respectively (Fig. 2C, D). The ephippium had a slightly thicker dorsal line, but no strong pigmentation (Flössner 1972).

According to Flössner (1972) the dorsal margin of the female postabdomen has 8–13 small denticles, with 6–10 small bundles of setae on the lateral sides of the postabdomen. The male postabdomen has bundles of setae only, but no denticles. The basal tooth of the postabdomen is half as long as the claw.

Identification of intact animals can be based also on body parts, which do not preserve in sediments (cf. Flössner 1972, Smirnov 1974, Røen 1995). The ocellus of *A. protzi* is smaller than the eye, and is situated slightly closer to the eye than to the rostral apex. The antennules are twice as long as their basal width and they end at a distance of about the width of the eye before the apex of the rostrum. The plate of labrum is triangular with pointed apex, well visible in Fig. 2.

Lake Sylvöjärvi is a eutrophic, shallow lake (Table 1), the catchment of which is a mixture of deposits, mainly till and clay, but also outcrops of bedrock and fine sands, as well as gravel and sand in eskers. There are also paludified areas at the both ends of the lake. Clay soils are almost totally in agricultural use. Dense emergent vegetation, *Phragmites australis* and *Scoenoplectrus lacustis*, fringe the lake, behind which there is a zone of floating-leaved plants. The lake bot-

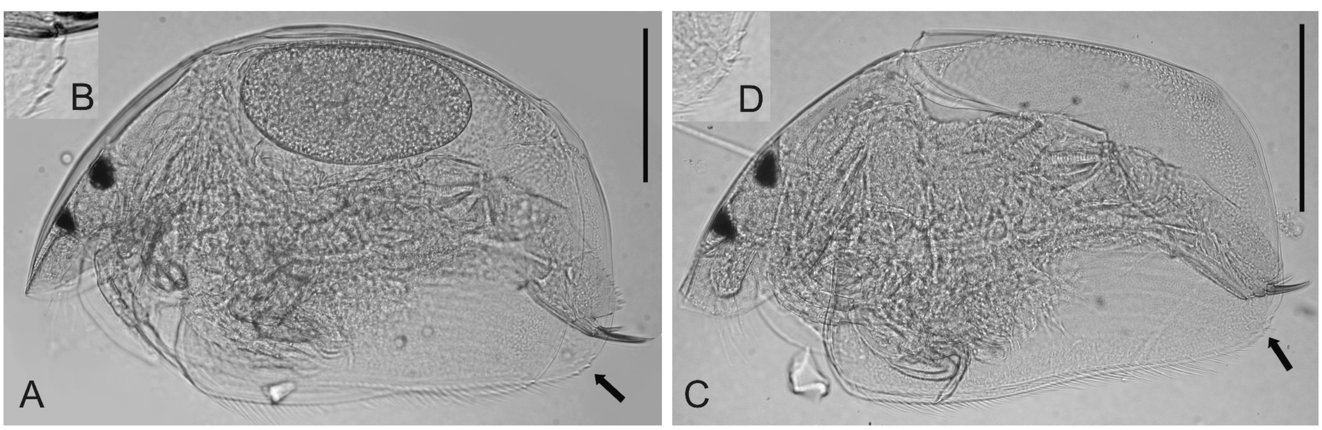


**Fig. 2.** *Alona protzi* Hartwig individuals found in Lake Sylvöjärvi, southern Finland. **A** – ephippial female. The arrow points to the location of the denticles (enlargement in **B**) at the posterior-ventral corner of the shell (carapace). **C** – male. The arrow points to the location of the denticles at the posterior-ventral corner (enlargement in **D**). The number of denticles can vary between the valves of the same individual. There are 3 denticles on the lower valve of the female and 2 on the upper valve. The upper valve of the male has 3 and the lower one 4 denticles. Scale bar = 100 µm.

Table 1

General characteristics of the lakes with *A. protzi* in Finland. Values are summertime means of surface water samples

| | Sylvöjärvi | Lovonjärvi | R. Valkjärvi | Valvatus |
|---|---|---|---|---|
| Surface area, ha | 235 | 5 | 8 | 303 |
| Maximum depth, m | 5.5 | 17.5 | 9.0 | 7.5 |
| Conductivity, mS $m^{-1}$ | 9.3 | 12.9 | 2.5 | 15.0 |
| Alkalinity, mmol l-1 | 0.446 | 0.514 | 0.045 | 0.655 |
| pH | 7.0 | 7.2 | 6.2 | 7.4 |
| Water colour, mg Pt $l^{-1}$ | 40 | 160 | 73 | 100 |
| Total P, µg $l^{-1}$ | 38 | 49 | 15 | 42 |
| Total N, µg $l^{-1}$ | 700 | 872 | 340 | 830 |
| Chlorophyll-*a*, µg $l^{-1}$ | 7 | 28 | 6 | 31 |
| Secchi depth, m | 1.1 | 1.0 | 2.3 | 1.1 |

tom is soft and submerged vegetation poorly developed due to the relatively high turbidity of the lake.

The species was found on a sampling site with rocky bottom and only sparse vegetation, which is quite exceptional site for this lake. Besides small epilithic algae, only some isolated stems of *Isoetes* sp., *Potamogeton perfoliatus* and *Elodea canadensis* were observed. The rocks at the sampling site were quite uniform in size, mostly small cobbles (64–128 mm), and to a lesser extent large pebbles (32–64 mm). Two *A. protzi* individuals were found among a total of 455 chydorid individuals identified from this rocky site. Total of 605 chydorids were identified from two submerged plant beds of Lake Sylvöjärvi, but no *A. protzi* individuals were recorded there. Sampling date was early autumn, 7th of September.

Interestingly, the species has already been found in Finland in 1980's, but has remained unpublished. Uimonen (1985) report in her Master's thesis (in Finnish) that the species had inhabited (among many others) an artificial substratum, a plastic net sponge, which she used to collect animals among submerged littoral vegetation in Lake Lovonjärvi, southern Finland (Fig. 1). Incubation period was several weeks in July and August.

Lake Lovonjärvi (Table 1) is also a eutrophic and relatively turbid lake, but smaller and deeper than Lake Sylvöjärvi. Populated areas, as well as agriculture on fine sands characterize the catchment area. The lake is situated beside eskers, and probably receives groundwater through them. It is relatively deep and meromictic (Huitu, Mäkelä 1998).

## Findings of *Alona protzi* in sediments

Besides intact animals, Uimonen (1985) had found also several *A. protzi* shells in the annually laminated sediment of Lake Lovonjärvi, representing the years 1959–1981. Recently, we found subfossil shells of *A. protzi* in the surface sediments of two other lakes. Two shells were found from the sample taken from the deepest point of Lake Riikoisten Valkjärvi, southern Finland (Fig. 1) (Nykänen, unpubl). Another subfossil shell of *A. protzi* was found in the surface sediments of Lake Valvatus, eastern central Finland (Fig. 1) (Sarmaja-Korjonen, unpubl.).

The subfossil shell of *A. protzi* (Fig. 3) is a relatively small *Alona*-type shell, with a rounded posterior-dorsal margin. The ventral margin is almost straight or slightly concave with setation still visible, if the shell is well preserved. The anterior margin has a slight thickening of the shell wall. The surface sculpture includes blurred parallel lines, slightly curving down towards the posterior-ventral corner. In our samples the lines were not visible in the anterior part of the shells. The shell can be identified by the denticles at the posterior-ventral corner, which are separate *i.e.* there is some free valve margin between them. The base of the denticles is rather wide when compared to those of other *Alona* spp., *e.g. Alona affinis dentata* (Røen 1968). The number of denticles varies from 2 to 4, and an unequal number of denticles on valves of one individual is common (Flössner 1972). In the subfossil shells we found, the two from Lake Riikoisten Valkjärvi had three denticles on both valves (Fig. 3A, B) and the third, from Lake Valvatus, had two and three, respectively (Fig. 3C, D). According to Flössner (1972) there are 5–7 tiny bristles between the denticles, which were weakly visible in the shells from Lake Riikoisten Valkjärvi. Such group of bristles was visible above the dorsalmost denticle in the Lake Valvatus shell (Fig. 3D). A line of short bristles runs along the posterior-dorsal part, close to the shell margin.

In theory, also headshields and postabdomens can be recovered from sediments. *A. protzi*-headshield has 3 headpores, well described in Røen (1995) and a short, truncated rostrum (Flössner 1972, Røen 1995). Identification of such headshields in sediment may be difficult, however, because of their similarity to other *Alona*-type headshields. Although Uimonen (1985) found several shells in the Lake Lovonjärvi sediments, she was not able to identify the headshield or the postabdomen. In subfossil remains the postabdominal claw is often detached from the postabdomen.

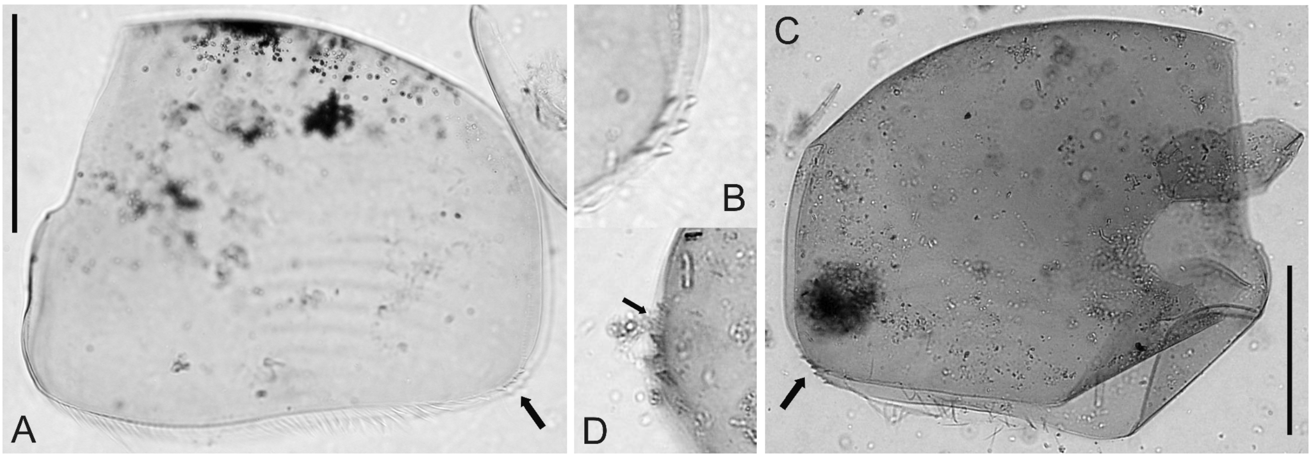


**Fig. 3.** Subfossil shells (carapaces) of *Alona protzi* Hartwig from Finland. **A** – shell in a surface sediment sample from Lake Riikoisten Valkjärvi. The arrow points to the location of the denticles at the posterior-ventral corner (enlargement in **B**). **C** – shell in a surface sediment sample from Lake Valvatus. The arrow points to the location of the denticles at the posterior-ventral corner (enlargement in **D**). **D** also shows a group of bristles above the dorsalmost denticle (arrow). The number of denticles can vary between the valves of the same individual. The shell in **A** has three denticles on both valves whereas the shell in **C** has 2 denticles on the upper valve and 3 on the lower valve. Scale bar = 100 µm.

In contrast to Lake Sylvöjärvi and Lovonjärvi, Lake Riikoisten Valkjärvi is oligotrophic. This small lake has a small catchment area, which is characterized by granite bedrock, till soils and nearly undisturbed coniferous forest. The sediment in the littoral zone is highly minerogenic, with rocks and sparse vegetation, although there is a wide area of *Potamogeton natans* on the other side of the lake. The lake has no clear in- or outlets, suggesting long retention time (Huitu, Mäkelä 1998). Lake Valvatus, instead, is a brownwater lake rich in nutrients that suffers from non-point pollution and occasionally from turbidity. Agriculture is practiced on the catchment area, and there are many fields in the close vicinity of the lake.

## DISCUSSION

The findings we present here confirm the occurrence of *Alona protzi* in Finland. The low number of findings further confirms its status as a rare species, although Uimonen (1985) found it in relatively high numbers in Lake Lovonjärvi. Cotten (1985) studied thoroughly surface sediments of 46 lakes in eastern Finland, but did not find any *A. protzi* remains. The authors have studied bottom sediments of numerous lakes in southern Finland, but so far, have found subfossil remains of *A. protzi* from two lakes only, and living specimens from only one lake.

The value of this species in paleolimnological reconstructions is low because of its rare occurrence. Also, the very limited data of this species confounds the ecological inferences. The reported occurrences of this species show diverse habitats (Dumont, Negrea 1996), but more observations are needed to specify its ecological requirements. Three of the lakes we present here are quite eutrophic and turbid lakes, and only one is a clear-water oligotrophic forest lake. Springs were not obvious in our sampling sites, but underwater springs are quite common in Finnish lakes. Therefore we cannot exclude the possibility of springs and drift of animals or their remains from groundwater habitats to our sampling sites.

The findings of fresh animals gave additional pieces of information. The timing of the appearance of males and sexual females in Lake Sylvöjärvi was early autumn (7th of September), but little is known about the lifecycle of this species. Assuming the animals were not drifted from underground habitats, they lived in eutrophic Lake Sylvöjärvi among small epilithic algae and sparse macrophyte vegetation on rocky lake littoral, in agreement with the information in Flössner (1972) and Brancelj & Sket (1990). On the other hand, Uimonen (1985) found the animal from artificial substratum among submerged vegetation. Regardless the obviously flexible choice of habitats, this pelo-, phyto- and stygophilic species is rare. Has this flexibility diminished its ability to compete with the other, more specialized species? Or is the life in lake littoral just a second choice after accidental drifting from the actual, preferred underground habitat, which is evidently less well studied? More studies, especially in underground habitats, are needed to answer these questions.

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