Research Note

Crustacean species new to Spitsbergen with notes on the polymorphism and the subfossil preservation of *Cytherissa lacustris* (G. O. Sars)

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The copepods *Limnocalanus macrurus* G. O. Sars and *Eucyclops serrulatus* (Fisch.) and the ostracode *Cytherissa lacustris* (G. O. Sars), hitherto unknown on Spitsbergen, were found in Lake Revvatnet, the last species also in Lake Svartvatnet. Samples from parthenogenetic populations of *C. lacustris* showed a complete lack of electrophoretically detectable variability at four enzyme-encoding loci, two of which are highly variable in mainland populations. However, morphological variation in the carapace length and nodation was no less than in the mainland populations. The carapace valves of *C. lacustris* do not preserve well in the sediments of Revvatnet.

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An interesting crustacean community was found in samples taken with a dredge on 31 August 1990 from Lake Revvatnet in Spitsbergen (Wedel Jarlsberg Land, 77°02'N, 15°23'E). This lake is approximately 0.9 km^2 in area, with a maximum depth of 27 m, and does not freeze to the bottom. The profundal zone is extensive, its area being ca. 64% of the lake's surface area; its upper border coincides more or less with the 7 m isobath (Kuziemski 1959). The bottom sediment is an organogenic silty mud containing ca. 5.03% organic matter, 0.32% calcium, 3.6% magnesium and 6.0% iron d. w.; 86.6% of particles are of $\phi < 0.063$ mm.

As many as 7 species of Crustacea were found: a cladoceran *Macrothrix hirsuticornis* Norm. et Br. (not very abundant); copepods, *Limnocalanus macrurus* G. O. Sars (very abundant), *Eucyclops serrulatus* (Fisch.) f. *typica* (not very abundant), *Diacyclops crassicaudis* (G. O. Sars) (not very abundant), *Harpacticus uniremis* Kröyer (single specimens); and ostracodes *Candona rectangulata* Alm (abundant) and *Cytherissa lacustris* (G. O. Sars) (abundant). Of these species, *E. serrulatus* and *C. lacustris* are new to Spitsbergen. *L. macrurus* was previously collected on Spitsbergen in 1977 by I. Jørgensen and J. A. Eie (Jørgensen & Eie 1993).

The occurrence of *L. macrurus* and *E. serrulatus* on Spitsbergen is not unexpected. Both species are widely distributed in the Arctic. On the other hand, the presence of *C. lacustris* was a great surprise.

C. lacustris, which has come to be known metaphorically as "The *Drosophila* of paleolimnology" (Danielopol et al. 1990), is a strictly specialised lacustrine species with a Holarctic distribution which prefers the muddy bottom of a profundal habitat. Neither adults nor any larval stages are capable of swimming, nor do they penetrate the littoral zone. The dispersal of *C. lacustris* between lakes is presumably effected in two stages: a specimen is first swallowed by a fish or macrobenthic invertebrate which itself then becomes the prey of

a water bird (Sywula 1990). However, considering the rapid passage of food through a bird's digestive tract, such long-distance transport over the Barents Sea hardly seems possible. Hence the statement that the occurrence of *C. lacustris* on Spitsbergen was absolutely unexpected.

The relatively thick and strongly calcified valves of *C. lacustris* are usually well preserved in the sediments of mainland lakes: *C. lacustris* is thus considered a very significant species in paleolimnology. It is noteworthy, however, that in the sediment of Revvatnet the valves of this species do not preserve well. This is due to the dissolution of the calcite crystals in the valve's external wall immediately after the animal's death. This decalcification is difficult to explain. Although one measurement indicated the water to be slightly acidic (pH 6.8), the composition of the diatom assemblage inhabiting this lake indicates that the water is neutral or slightly alkaline: among the 68 taxa found in samples by one of us (A. W.), 34 were alkaliphilous, one was even alkalibiontic (*Denticula tenuis* Kütz.), but only 3 were acidophilous.

In 1991, an abundant population of *C. lacustris* was found in another deep Spitsbergen lake – Svartvatnet (Sørkapp Land, 76°53'N, 15°40'E); this lake, like Revvatnet, does not freeze to the bottom either.

Except in Lake Baykal (Bronshtein 1947), *C. lacustris* reproduces parthenogenetically. This is also true of both Spitsbergen populations (the presence of males would be conspicuous owing to the pronounced sexual dimorphism in the carapace structure – a characteristic of the family Cytherideidae in general).

We considered it interesting to compare the degree of morphological polymorphism in the two Spitsbergen populations of *C. lacustris* with that of the Central European populations and to assess the genetic relationship between both Spitsbergen populations. To do so, we examined patterns of morphological polymorphism in carapace size and nodation as well as genetic variation at enzyme-encoding loci.

Samples were taken on 24 July 1991 (Revvatnet) and 27 July 1991 (Svartvatnet). The carapaces were measured and their nodation was assessed as described by Sywula & Geiger (1990). Homogenates from single living individuals were prepared 1–2 days after sampling and subjected to electrophoresis on cellulose acetate gels in accordance with the methods of Hebert & Beaton (1989). 120 adult specimens from each lake were examined. The following enzyme systems were studied from each specimen: glucose-phosphate isomerase (GPI), leucine aminopeptidase (LAP) and esterases (EST). Both GPI and LAP in *C. lacustris* are coded for by a single locus. However, the genetic background of esterases is more complex; the zymograms from *C. lacustris* are similar to those from representatives of the genus *Cyprinotus*, for which the esterases are coded for by two loci (Sywula et al. 1991; Sywula 1992).

Table 1. Carapace length and nodation of adult *Cytherissa lacustris* from two Spitsbergen and two Austrian lakes (data concerning Austrian populations, existing as continuous ones since the Atlanticum, from Sywula & Geiger 1990).

	Number of specimens	Mean length (μm)	Coefficient of variation (%)	Specimens with smooth carapace (%)
Revvatnet	76	875	5.2	59
Svartvatnet	59	835	2.4	29
Mondsee	47	885	3.2	24
Attersee	42	915	3.9	41

All sampled specimens from both populations proved to be genotypically identical and homozygous at all four loci. By contrast, the morphological characters were variable (Table 1).

At least two of the examined loci – Gpi and Est-1 – are highly variable in Central European populations (Sywula 1990; Sywula & Geiger 1990). Studies of other species of parthenogenetic ostracodes also show that genetic variation is common (Havel & Hebert 1989; Sywula 1992) except in very young populations. These data suggest that even though they consist of several thousand specimens, both Spitsbergen populations are still in their initial phase from the population-genetic point of view. They also suggest that the group of successful founders (i.e. those whose genotypes persist in the populations) might be very small and might well be representatives of only one clone. These suggestions seem probable, despite the fact that the present evidence is based on very few loci.

Populations are enriched with new clones from two sources – mutation and migration. The possibility of successful migration of *C. lacustris* from the mainland to Spitsbergen may be limited in two ways. Firstly, the ecological conditions in the

young Spitsbergen lakes differ considerably from those in the continental lakes inhabited by *C. lacustris*; thus, strong selection of immigrants might be expected. Secondly, potential immigrants to the existing abundant populations may have, due to some unknown reasons, restricted access to these populations – an effect suggested for another parthenogenetic ostracode *Cyprinotus incongruens* (Ramd.) (Sywula 1992). Thus, it is possible that genetic differentiation in the Spitsbergen populations of *C. lacustris* may be attained mainly by mutation. In the future, there will be a special opportunity for testing the above assumptions while studying temporal changes and the mode of increase in genetic variation within and between these large natural populations of this parthenogen.

The morphological characters of carapace length and nodation are no less variable in Spitsbergen populations of *C. lacustris* than in the old Central European ones (Table 1; Sywula & Geiger 1990). In view of the fact that the genetic background in the two Spitsbergen populations seems to be at the most only slightly differentiated, it could be inferred that the morphological differences between them are largely the result of environmental modification of the phenotype.

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