Freshwater ostracods from ice-wedge polygon ponds in Adventdalen, Svalbard

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Ice-wedge polygon ponds in Adventdalen, Svalbard, differ in hydrochemical parameters according to pond type. We report the first finding of the freshwater ostracod species *Tonnacypris glacialis* from Adventdalen.

Fig. 1

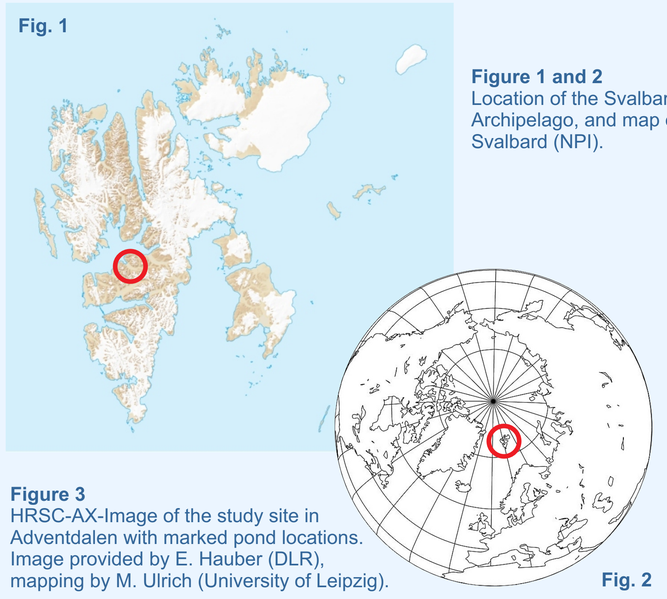

Figure 1 and 2
Location of the Svalbard Archipelago, and map of Svalbard (NPI).

Figure 3
HRSC-AX-Image of the study site in Adventdalen with marked pond locations. Image provided by E. Hauber (DLR), mapping by M. Ulrich (University of Leipzig).

Fig. 2

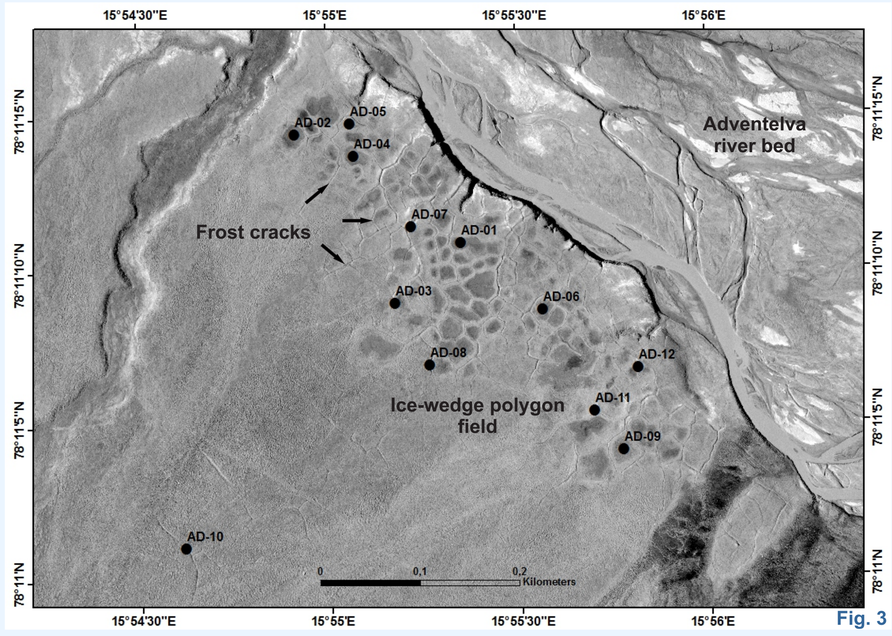

Fig. 3

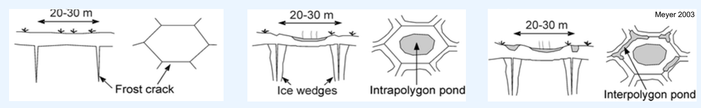

Fig. 4

Background and method

Polygon ponds and freshwater ostracods

Ice-wedge polygons form due to thermal contraction cracking in the ground. On the ground surface, depressions or trenches appear. If water-filled, those ponds are the most abundant aquatic ecosystem type in the Arctic.
Ostracods are 1-2 mm long crustaceans. They often inhabit polygon ponds and serve as proxies in paleo-environmental studies. However, environmental conditions in periglacial waters are rarely studied.

Study site

In summer 2013, we performed field studies of polygon ponds in Adventdalen (centered 78°120´N, 16°200´E; Figs. 1-3).
The mean annual air temperature is -6°C, and with an average annual precipitation of 190mm, the region is one of the driest on Svalbard.
Ice-wedge polygons occur on the lowermost river terasse in fluvial sediments.

Sampling strategy

From in total 13 ponds (8 intrapolygon, 5 interpolygon ponds) a data-set was collected comprising:

- general characteristics (coordinates, water and thaw depth),
- air and water temperature,
- water sampling (standard parameters, ion composition),
- freshwater ostracods.

Precipitation and river water was also sampled.

Pond characteristics

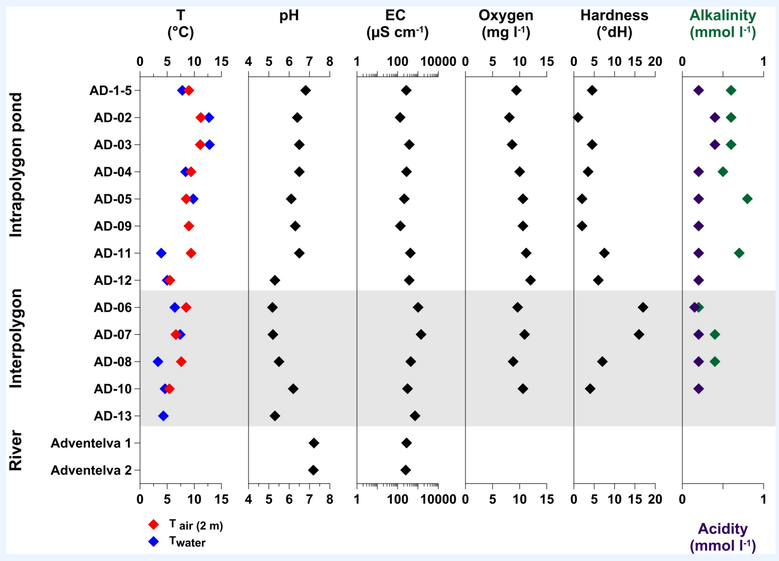

Fig. 5 Hydrochemical cgaracteristics of the sampled ponds.

Dimensions

Circular intrapolygon ponds (diameter 10-15m) and Y-shaped interpolygon ponds (20-30m long, up to 1m wide) were 9-30cm deep.

Hydrochemistry

Hydrochemical characteristics reveal differences between interpolygon and intrapolygon ponds (Figs. 5, 6).
Overall electrical conductivity (EC), water hardness and alkalinity are elevated in interpolygon ponds, while temperature and pH are decreased. In contrast, we found higher relative abundances of HCO_3, Na and K in intrapolygon ponds.

Interpolygon ponds are likely to be in contact with minerogenic sediment due to their origin as water-filled frost cracks, while evaporation on the larger surface of intrapolygon ponds may impact their major ion composition.

Freshwater ostracods

Exclusively pond AD-01 was inhabited by freshwater ostracods.

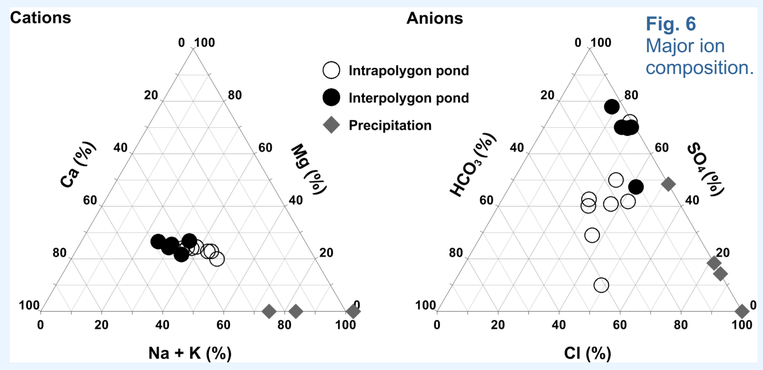

Fig. 6
Major ion composition.

Fig. 7
Alive *Tonnacypris glacialis* (Sars, 1890).

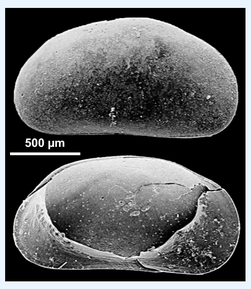

Fig. 8
SEM micrographs of valves of *T. glacialis*. From Griffith et al., 1998.

Monitoring a low-center polygon pond

Pond AD-01

Low-center polygon pond AD-01 (Figs. 9, 10) was visited 8 times between July 20 and September 25, 2013. The pond dimensions are 5x8 m, it is enclosed by a moss-sedge zone and polygon rims with frost cracks. We collected a data-set as from the other ponds.

Field observations

During August, the water level in all ponds rose and formerly dry intrapolygon depressions turned into ponds. The newly formed neighbouring pond merged with AD-01, roughly doubling its size. At the last sampling day, September 25, 2013, the pond was covered with clear 2 cm thick ice with bubbels, while the ostracods were alive.

Ostracod assemblage

We found exclusively female *Tonnacypris glacialis* (Figs. 7, 8) with dark olive-green valves in pond AD-01. The species commonly occurs north of latitude 65°N, reproducing parthenogenetically with overwintering eggs (Griffith et al. 1998; Wojtasik 2008). In our record, stepwise increase in abundance may represent variations in timing of hatching, or a succession of different developmental stages.

Fig. 9

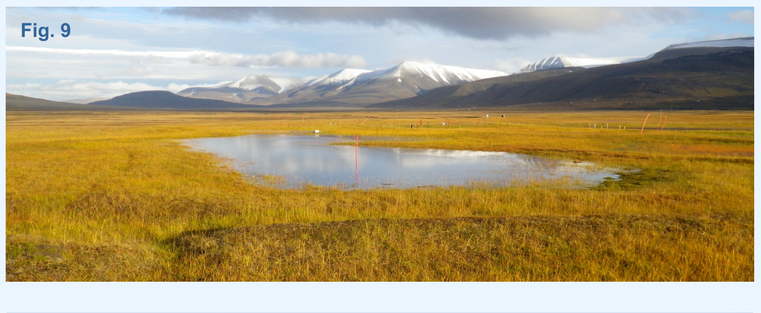

Fig. 10

Fig. 9
Pond AD-01 in September 2013.

Fig. 10
Pond AD-01 in October 2013. Polygon rims are snow free, snow accumulates in surface depressions.

Fig. 10 A

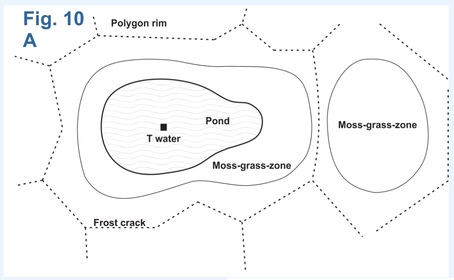

Fig. 10 B

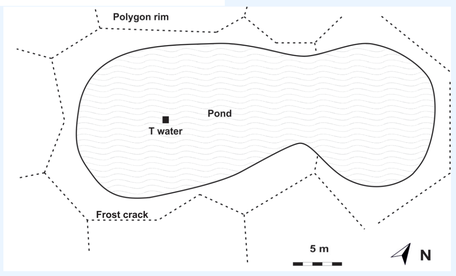

Fig. 10
Sketch of pond AD-01 before (A) and after (B) expanding and merging with the flooded neighbouring polygon depression.

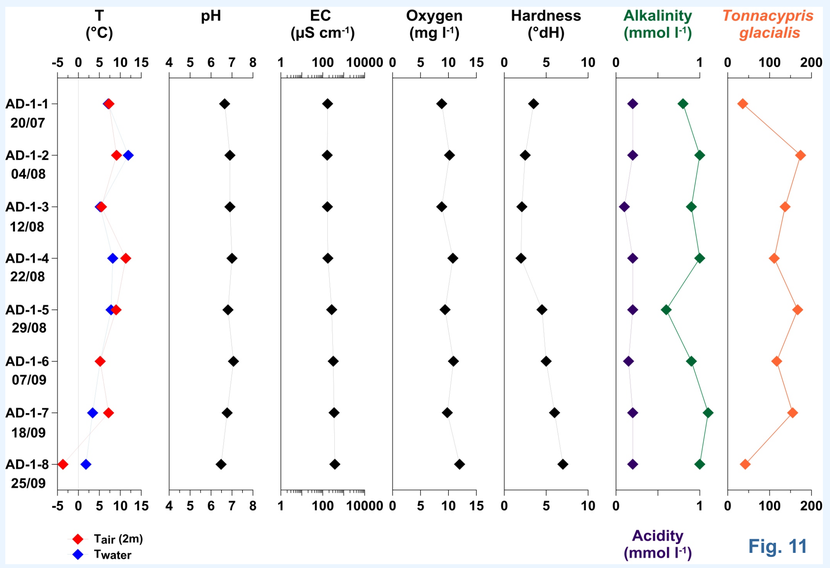

Fig. 11

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