Cladoceran assemblages of surface sediments and contemporary samples – are they similar?

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Introduction

In the development of training sets in paleolimnology one often uses the composition of the flora and fauna of the surface sediments of the lake profundal zone. The underlying assumption of this approach is that the surface sediments integrate the flora and fauna over space and time. This is not necessarily true. For cladocerans, especially in larger lakes, true planktonic species are often overrepresented in the sediment assemblages, whereas littoral species can be underrepresented. Such discrepancies could have consequences when employing trainings sets in the paleolimnological reconstruction of the past environment. For example, increased nutrient loading or significant changes of water levels can affect the ratio of planktonic to littoral cladocerans. Hence, the species assemblages of the surface sediments should be compared with species assemblages based on other sampling methods, but this is rarely done (Davidson et al. 2007).
Here we compare the cladoceran assemblages of the surface sediments with the contemporary assemblage based on planktonic and littoral zooplankton nethauls of ten lakes scattered over the southern part of Norway.

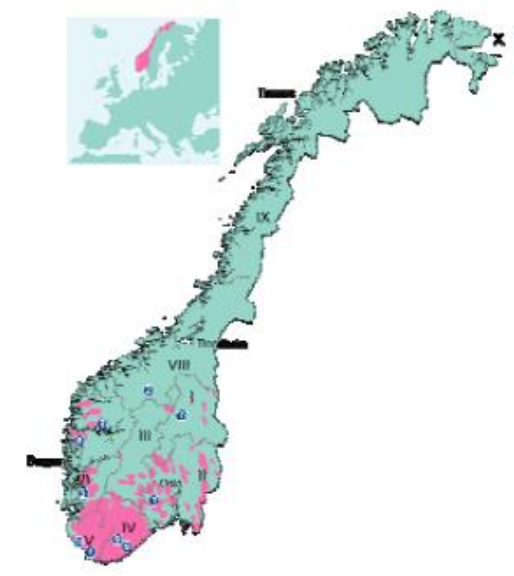

Fig. 1. Distribution of investigated lakes (blue dots) in Southern Norway.

Table 1. Major characteristics for the 10 lakes.

	Altitude (m)	Area (km2)	Sediment	Nethauls
Ljosvatn	150	0,29	2001	1998-2000
Saudlandsvatn	106	0,16	2001	1998-2000
Markusdalsvatn	96	0,27	2001	1998-2000
Nystølsvatn	730	1,27	2001	1998-2000
Svartdalsvatn	1018	0,60	2001	1998-2000
Røyravatn	230	0,43	2001	1998-2000
Bjorvatn	226	0,38	2000	1997-1999
Ø. Jerpetjern	455	0,11	2000	1997-1999
L. Hovvatn	503	0,19	2000	1997-1999
Atnsjøen	700	5,01	2000	1997-1999

Methods

One sediment core was taken in each lake in 2000 or 2001 from the deepest part of the lakes. The lakes are oligotrophic lakes with low sedimentation rates. The surface sediments represent the upper 1-2 cm (0,5-1,0 cm in Atnsjøen). Sediment samples were treated and analyzed by standard procedures (Frey 1986, Lotter et al. 1997, Korhola and Rautio, 2001). The contemporary caldoceran assemplages are based on zooplankton nethauls (both littoral and pelagic). Data for each lake are from the three years preceeding the sampling of the sediment. Each year, sampling was done twice (June/July and August/September). The cladoceran community were analyzed using Principal Component Analysis (PCA). CANOCO 4.5 (ter Braak 1998) was used for the analysis with presence/abscense as input data.

Results and discussion

- The lakes span a gradient in altitude and size (Table 1). A majority of the lakes are/have been affected by acidification.
- **41 cladoceran species/taxa were identified from the lakes, 37 and 34 in the surface sediments and zooplankton nethauls respectively.** In five lakes species richness was highest in the zooplankton nethauls, in four lakes species richness was highest in the surface sediments and in one lake species richness was equal (Fig. 2). However, on **average species richness was slightly higher in the zooplankton nethauls** (average ± SD: 16,1 ± 3,63 and 18,2 ±5,61 in sediments and nethauls respectively).
- **The PCA indicate that the cladoceran assemblages of the surface sediments in each lake differ from that of the zooplankton nethauls in the same lakes both using the full number of species recorded in sediments and nethauls in the ordination (Fig. 3), but also on after removing the species not recorded in the surface sediments from the analysis (data not shown)**.
  - The first two axes in the PCA explained 23,0 % and 13,9 % respectively of the variance in the cladoceran-material (Table 2, Fig. 3).
  - In accordance with the literature several species found in zooplankton net hauls were lacking from the surface sediments (*Ceriodaphnia quadrangular, Simocephalus vetula, Alonella exigua, Pseudochydorus globosus and Polyphemus pediculus*, Fig. 4). On contrary there were also species occurring in the surface sediments absent from the zooplankton nethauls (*Drepanothrix dentate, Macrothrix laticornis, Alona costata. A. quadrangularis, A. rectangular, Pleuroxus uncinatus and P. aduncus*, Fig. 4).
- **Taphonomic processes, and a general lower taxonomic resolution of paleo-samples as compared to contemporary samples probably explains some of the differences between the cladoceran assemblages of surface sediment and contemporary samples.** The surface sediment probably span a longer time period than the three years of the nethauls (1997-1999 or 1998-2000). Assuming a sedimentation rate 2 mm per year the surface sediments range back to 1990/1991. Environmental changes during this period affecting the cladoceran communities could probably also explain some of the difference between the cladoceran assemblages of surface sediment and contemporary samples. Many of the lakes are recovering from acidification. However, pH does not seem to be an important parameter in determining differences between assemblages from surface sediments or contemporary samples (Fig. 3)

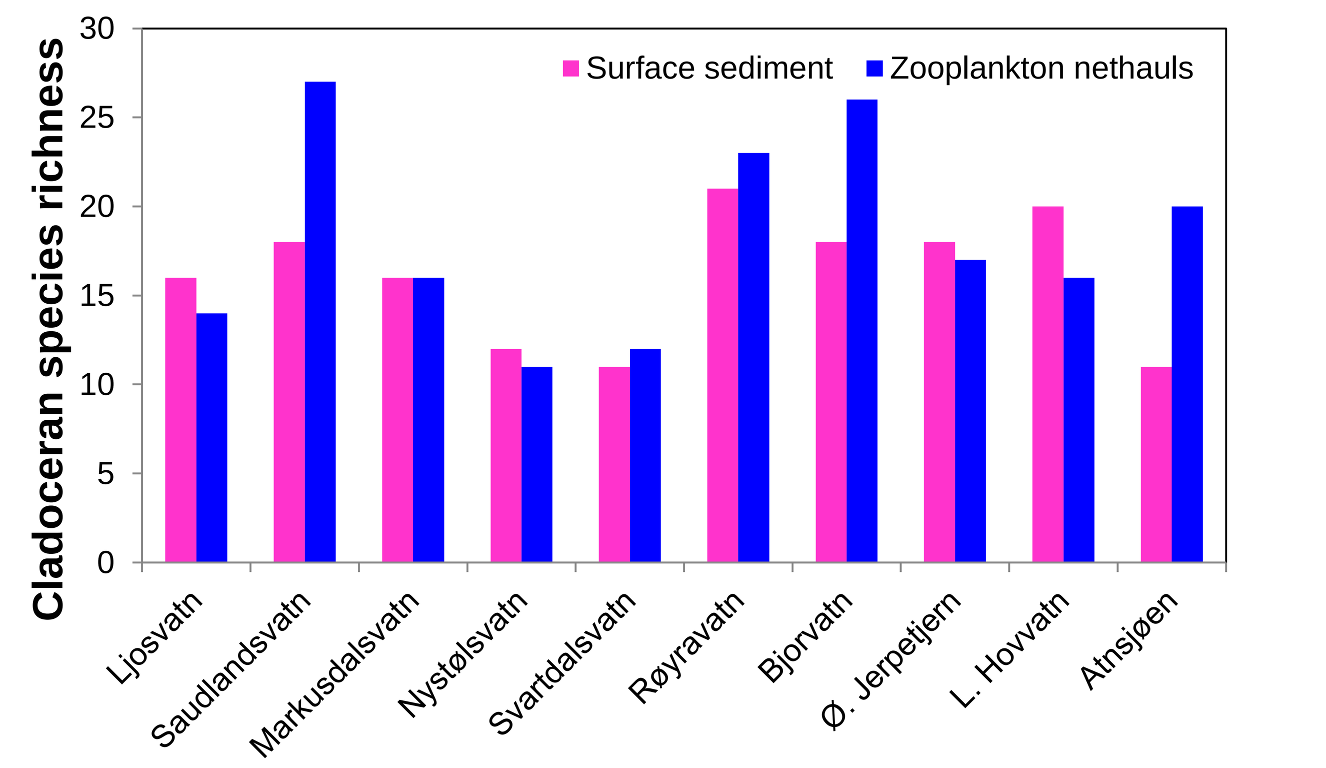

Fig. 2 Cladoceran species richness in the ten investigated lakes in surface sediments and zooplankton nethauls respectively.

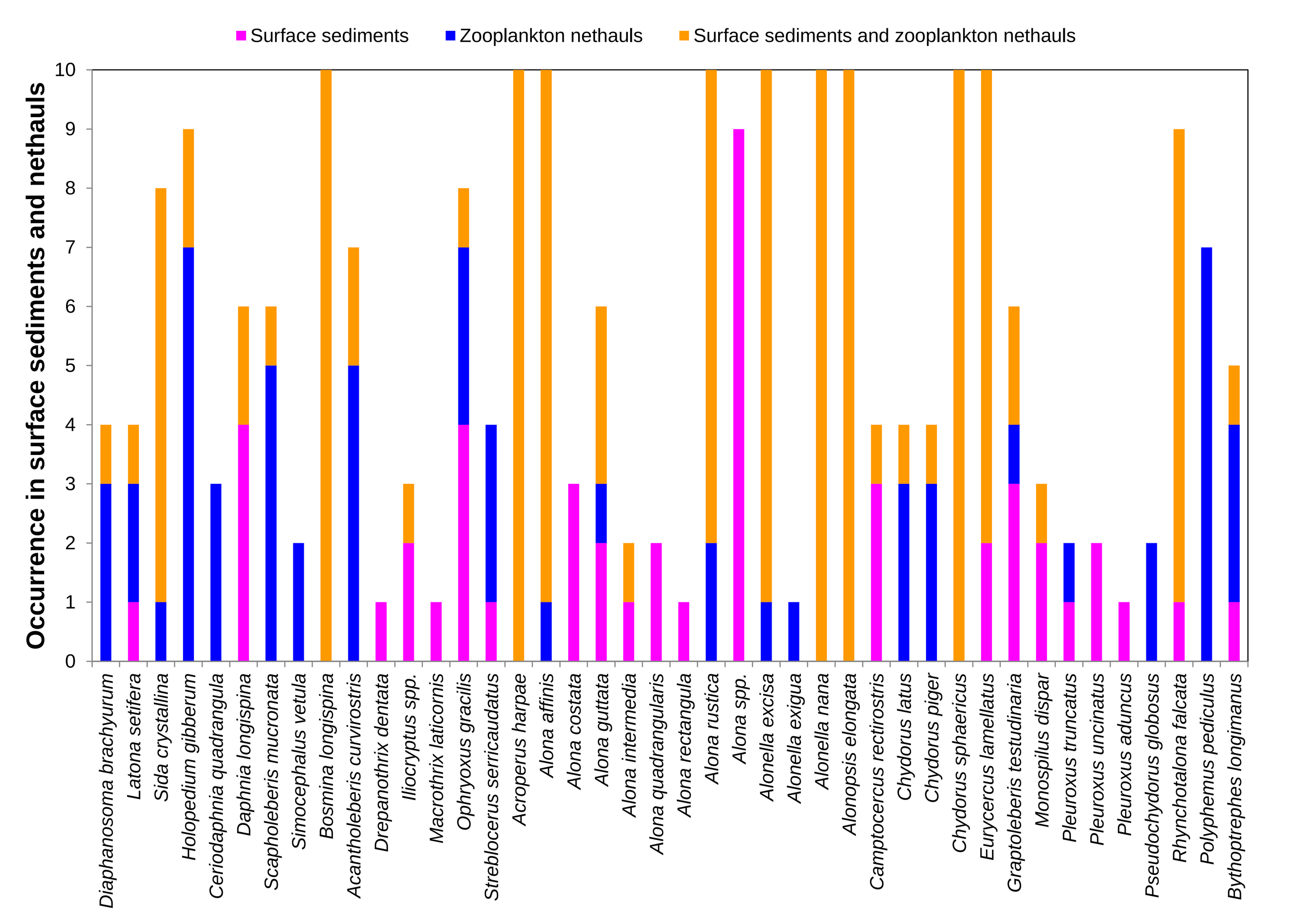

Fig. 4 Occurrence of cladocerans in the ten lakes in surface sediments, zooplankton nethauls or both.

Table 2 Results of the PCA, axis summary statistics.

Axes	1	2	3	4
Eigenvalues	0,23	0,14	0,10	0,09
Species-environment correlations	0,98	0,84	0,93	0,66
Cumulative percentage variance of species data	23,0	36,9	47,1	56,3
Cumulative percentage variance of species-environment relationdata	35,3	51,3	65,4	71,9

Literature

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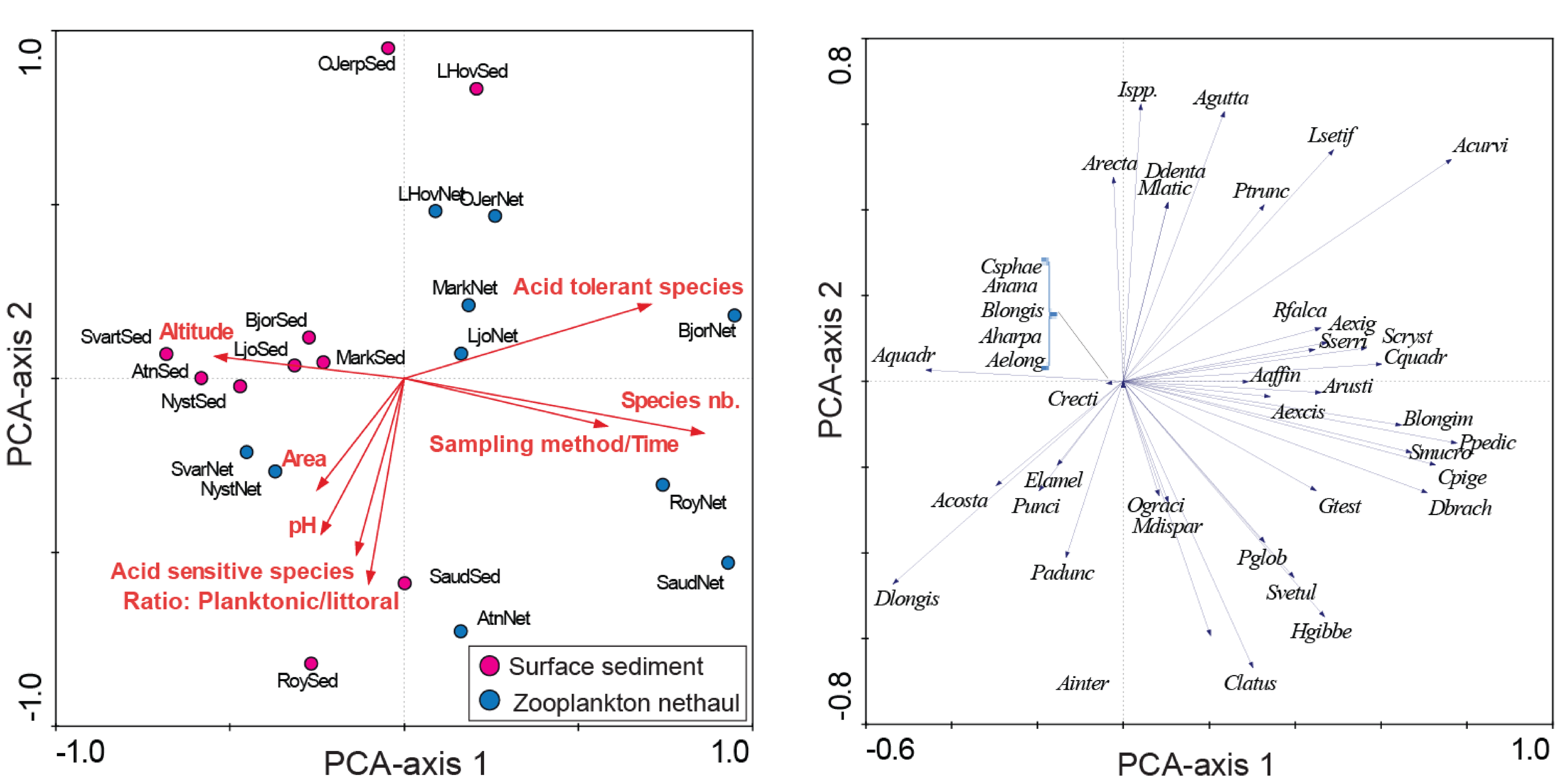

Fig. 3 Left panel: PCA site plot for the ten lakes based on cladoceran fauna (withh presence/abscense as input data.). Relation of the ordination with sampling method (surface sediment or nethaul), altitude,and area of the lakes, fraction of acid-sensitive and –tolerant species, species number and ratio of planktonic to littoral species also indicated. Right panel: PCA species plot for the ten lakes.

Lake Atnsjøen (summer and winter), one of the investigated lakes, with the mountain range Rondane in the background.

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