Spatial diversity of zooplankton in Gulf of Finland: how does distance between stations affect differences in community

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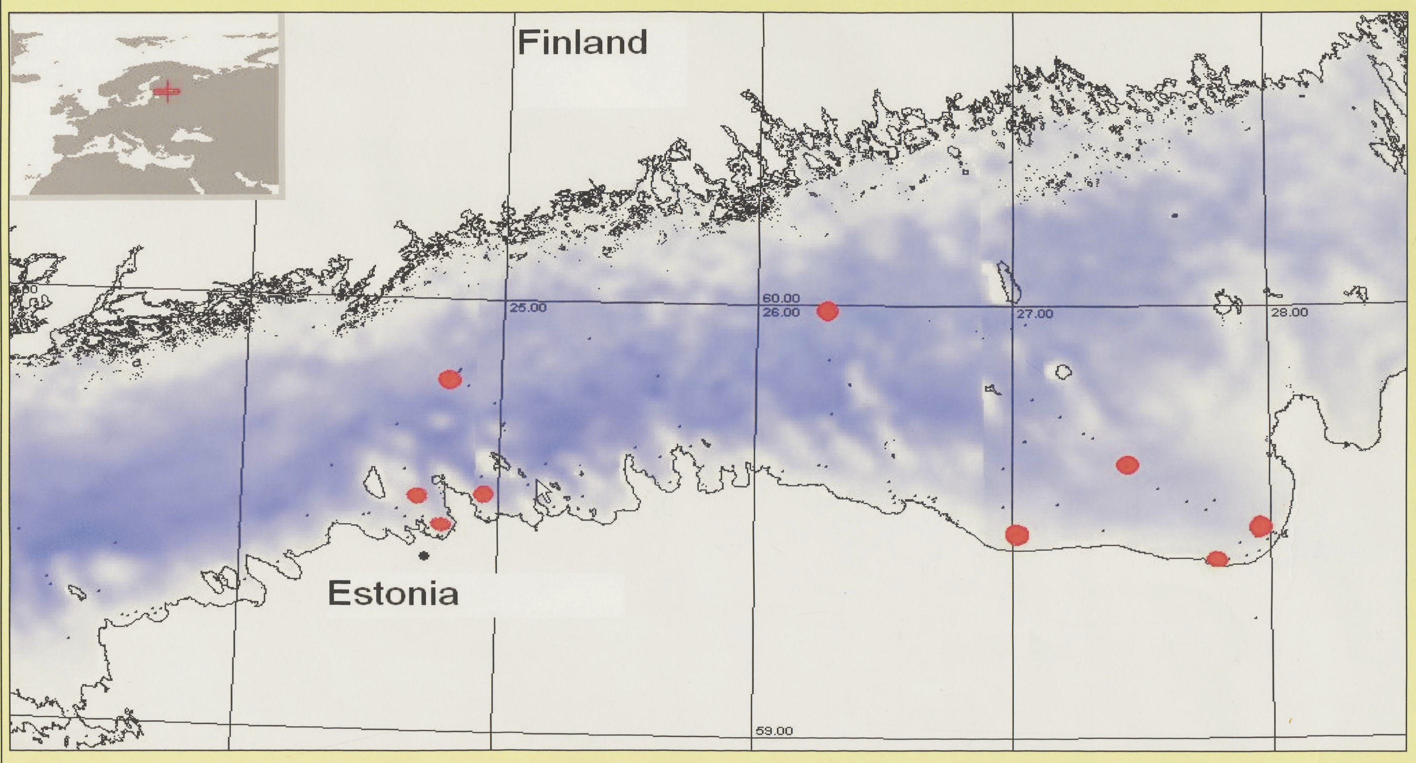
Estonian Marine Institute has collected zooplankton data from the Gulf of Finland since the 1960es. The diversity of mesozooplankton in the Gulf of Finland over the time and space is rather low. As the Gulf of Finland itself has elongated shape, having wide connection to the Baltic proper in the west and a big freshwater inflow - river Neva in east, there are several gradients of environmental factors along the axis of the gulf: salinity and winter temperature decreases, eutrophication and summer temperature increases toward the east. The current poster looks for spatial differences of zooplankton communities in the Gulf of Finland.

All data were extracted from the Estonian national marine monitoring database. Zooplankton samples were collected with Juday plankton net (mesh size 90 µm). Samples were preserved with 4% formaline and analysed according HELCOM suggestions (HELCOM COMBINE manual). Zooplankton biomass data was used for analyses. The abundance for whole water column was calculated, when zooplankton samples were collected separately from different layers.

All environmental factors were measured in same time and location as zooplankton samples. Following environmental factors were included: Temperature and salinity at depth 5 m, standard deviation of whole temperature and salinity profile, DIN and DIP at depth 5 m, water transparency (Secchi depth), chlorophyll *a* (integrated sample 0-10m) and biomass of some phytoplankton groups (Cryptophycea, Diatomophycea, Dinophycea, Cyanophycea).

A total 381 sampling occasions were found in database, without missing data in any of listed factors. Samples were collected during March to November of 1993-2006, the most representative months were May and August. Samples were collected from 9 stations (Figure 1), 4 stations were shallow – 8-12 m, the rest were 30 – 80 m.



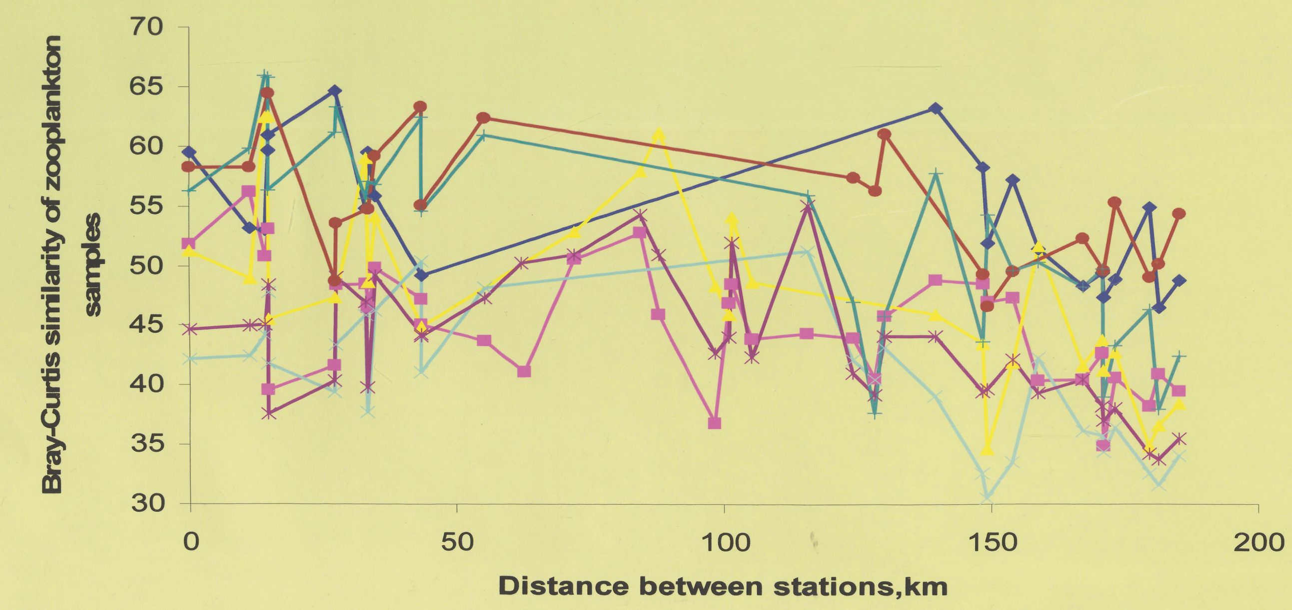
The PRIMER software was used to calculate the similarity matrices for zooplankton, phytoplankton and other environmental factors, the distances in kilometres were also calculated between each sample pairs. The similarities between the same station pairs were averaged to create the similarity-distance plots.

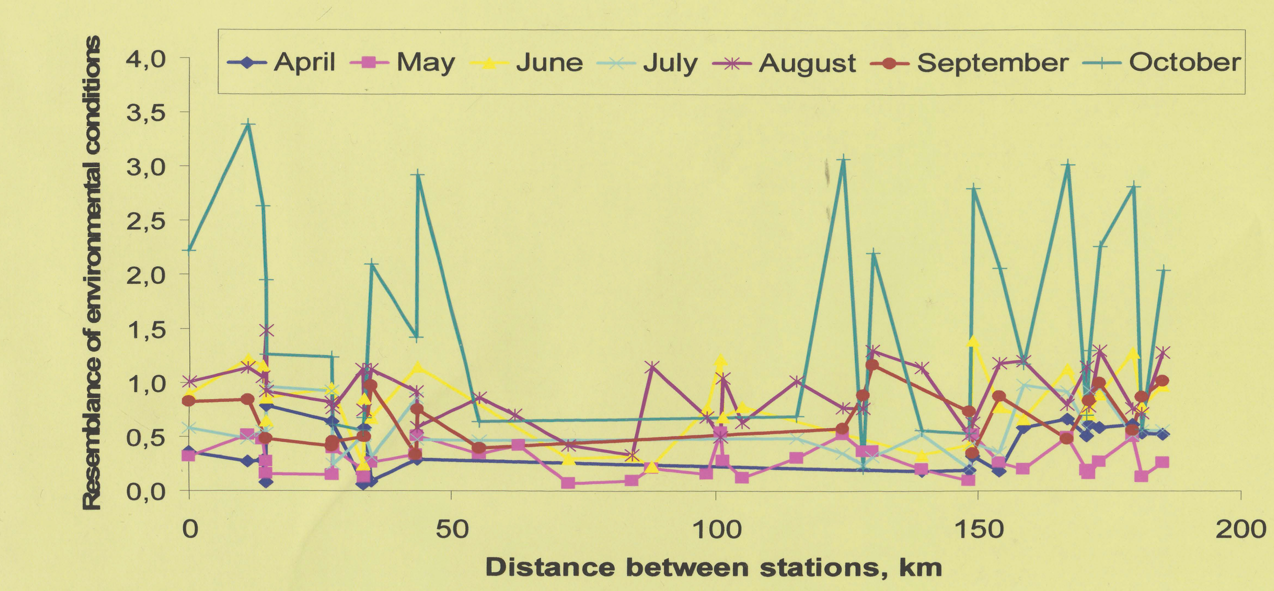
The BVSTEP procedure was used to find out the zooplankton taxons, which are most correlated with distance between stations and 2STAGE procedure was used to compare the matrices of all factors.

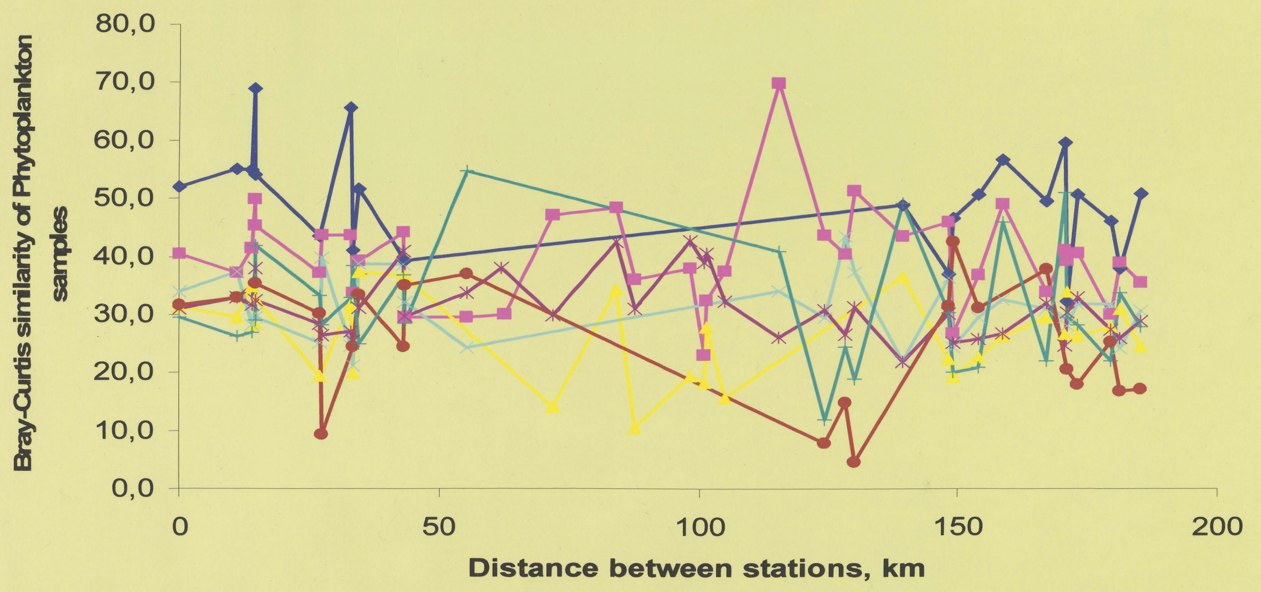
Table shows significant Spearman rank correlations of all zooplankton groups and other factors against Longitude. Although most factors had significant longitudinal correlation, the relationship is usually weak. The salinity is showing the strongest gradient, water transparency is clearly dropping eastwards. Among the zooplankton species *Temora longicornis* and *Frittillaria borealis* are clearly more abundant in west, while cyclopoid copepods have higher biomass in the east.

	All data	May	June	July	August
Acartia spp	-0,23	-0,43	n.s.	-0,35	-0,38
Balanus improvisus nauplii	-0,14	n.s.	n.s.	-0,25	n.s.
Bivalvia larvae	-0,15	n.s.	0,47	n.s.	-0,50
Bosmina coregoni	0,27	0,35	0,35	0,30	n.s.
Centropages hamatus	-0,27	-0,39	n.s.	n.s.	n.s.
Cercopagis pengoi	0,20	n.s.	n.s.	0,36	n.s.
Cyclopidae	0,58	0,61	0,62	0,64	0,65
Daphnia sp	0,37	n.s.	n.s.	0,60	0,45
Eurytemora affinis	n.s.	n.s.	0,34	n.s.	n.s.
Evadne nordmanni	-0,17	n.s.	n.s.	-0,42	-0,33
Frittillaria borealis	-0,45	-0,50	-0,52	-0,53	-0,33
Gastropoda larvae	-0,31	n.s.	-0,31	-0,50	-0,50
Harpacticoida	0,27	0,46	0,37	n.s.	n.s.
Keratella cochlearis	0,23	0,38	0,44	0,47	n.s.
Keratella cruciformis	-0,17	n.s.	0,00	-0,29	-0,41
Keratella quadrata	0,14	0,28	0,59	n.s.	-0,33
Limnocalanus macrurus	0,13	0,37	n.s.	n.s.	n.s.
Copepod nauplii	n.s.	n.s.	n.s.	n.s.	n.s.
Podonidae	-0,16	n.s.	n.s.	-0,32	-0,27
Polychaeta larvae	n.s.	n.s.	n.s.	n.s.	n.s.
Pseudocalanus elongatus	-0,31	n.s.	-0,31	-0,55	-0,32
Synchaeta total	-0,28	-0,27	n.s.	-0,45	-0,40
Temora longicornis	-0,53	n.s.	-0,63	-0,52	-0,58
chla _mg/m3_	0,29	0,46	0,46	0,33	n.s.
Cryptophyceae	n.s.	n.s.	n.s.	n.s.	n.s.
Diatomophyceae	0,22	0,35	0,44	0,32	0,36
Dinophyceae	-0,22	n.s.	-0,33	-0,41	-0,36
Cyanophyceae	0,13	n.s.	n.s.	n.s.	n.s.
Secchi (m)	-0,58	-0,71	-0,62	-0,59	-0,50
DIN	0,30	n.s.	0,30	0,45	0,33
DIP	0,11	n.s.	n.s.	n.s.	n.s.
Salinity	-0,75	-0,74	-0,82	-0,75	-0,67
Temperature	n.s.	n.s.	n.s.	n.s.	n.s.
stdev.Salinity	0,21	0,33	0,30	n.s.	0,23
stdev.Temperature	n.s.	n.s.	n.s.	n.s.	n.s.

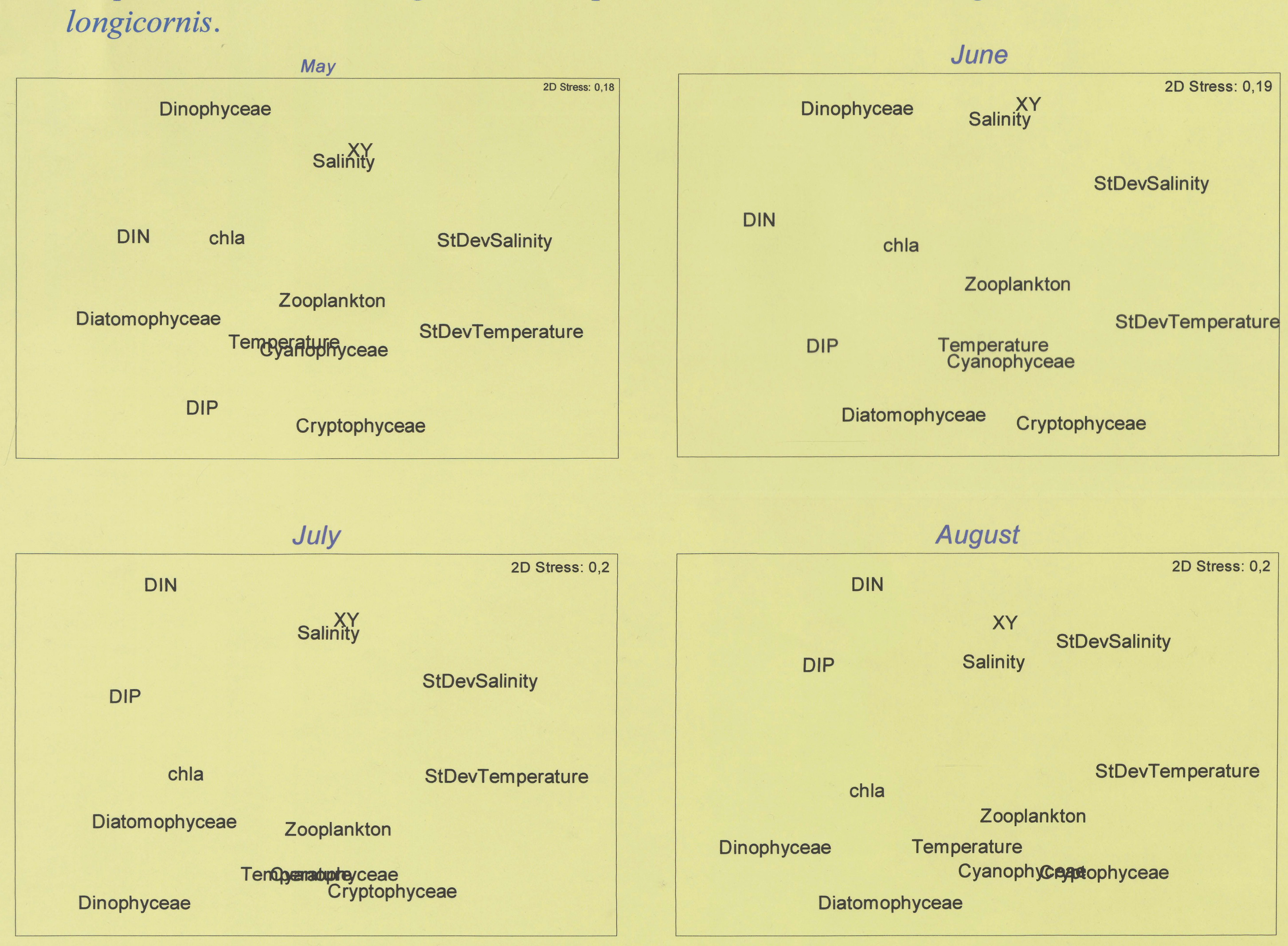
On figure 2 the real distances between samples are plotted against the average resemblance of zooplankton samples of the same station pairs. In the figure of zooplankton very light decrease of resemblance over the distance can be seen. However the average similarity of stations more than 100 km apart can be about the same as similarity of the same samples from the same stations (distance 0). Figure also shows that zooplankton community is more diverse during May –August than it is in April, September and October. In the case of phytoplankton groups and the rest of environmental factors no trend of similarity change over the distance can be seen.







2STAGE results for 4 months are presented in Figure 3. The distance matrix is named on figures as "XY". All 4 plots are relatively alike, meaning that the similarities of matrices do not change much over the season. Salinity and distance between stations are stuck together, confirming the salinity gradient in the Gulf. Zooplankton community as a whole is mostly related to temperature, same applies for blue-green algae. The BVSTEP analyses for same months revealed that the most distance dependent species of zooplankton is *Temora longicornis.* Sample statistic Rho= 0.475 in august for *T. longicornis*.



Conclusions

There are several zooplankton species with decreasing or increasing biomass along the salinity gradient or longitudinal axis of the Gulf of Finland, but those species are not dominating in zooplankton community.

Zooplankton community does not change considerably in the scale of several hundred kilometres, however the changes are more evident than in case of phytoplankton or oceanographic conditions.