LIITE 1

RAKKOLEVÄN LEVINNEISYYSMUUTOKSET

POSTERI

Vahteri, P., Kohonen, T. & Vuorinen, I. 2003. Distributional changes in the occurrence of bladderwrack, *Fucus vesiculosus* (L.) within the last decade in the Archipelago Sea, S-W Finland. *In*: Bäck, S., Harjunkoski, R., Koivu, J., Toivanen, R. & Viitasalo, I. (Eds.). Abstract Publication. Baltic Sea Science Congress 2003 Helsinki, Finland, August 24-28, 2003, 262-263.

Distributional changes in the occurrence of bladderwrack, *Fucus vesiculosus* (L.) within the last decade in the Archipelago Sea, S-W FINLAND.

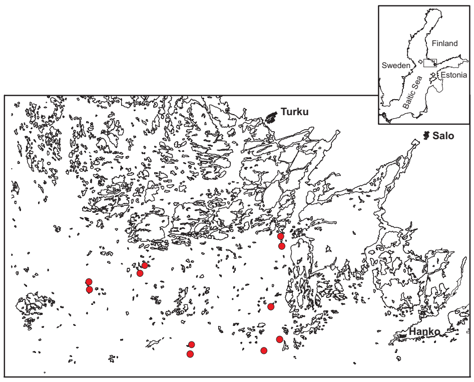
Vahteri Petri, Kohonen Tuula & Vuorinen Ilppo
Archipelago Research Institute, University of Turku, FIN-20014

During 1993 and 1994, the Archipelago Research Institute was involved in mapping the Archipelago Sea, during which, twelve underwater vegetation lines were created in the outer parts of the Archipelago Sea for long-term surveillance. Eleven of these long-term transects were reinvestigated in 2001, as part of an environmental assessment in the Fish Reproduction Areas of the Archipelago Sea study by Varsinais-Suomi TE-Centre.

The distribution data on eleven of these vegetation lines was used to study population dynamics of bladderwrack (*Fucus vesiculosus*). Between the period 1993-2001, bladderwrack zones had decreased in width on seven transects, remained unchanged on one and increased on three study lines. Cumulatively, between 1993 and 2001, bladderwrack zones had decreased from 123 to 73 metres, by forty percent. In four study areas the bladderwrack zones had vanished completely. In six out of seven cases, bladderwrack zones started further out from the shoreline in 2003 than previously recorded, while in five cases, the maximum depth of the zones had increased.

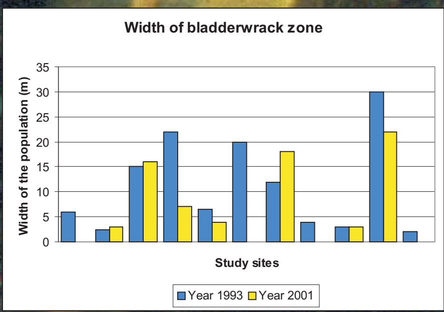
Bladderwrack has decreased in coverage at all surveillance sites. The total coverage of all studied bladderwrack populations at the time of transect foundation was 52,61 m^2, while in 2001 the total area had diminished to 15,42 m^2. This translates to over 70 percent loss in coverage by bladderwrack populations.

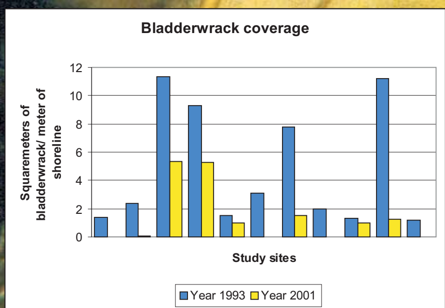
It is evident that bladderwrack cover has markedly decreased within the past decade in the outer areas of the Archipelago Sea. It seems easier to observe the changes through coverage measurements than by only observing the changes in littoral zonation. It is hypothesised that the factors affecting the observed decline include; increased filamentous algae production, eutrophication, and increased occurrence of drifting filamentous algal mats.



Location of study sites. The data from these stations gathered in 1993, 1994 and 2001 was used for this presentation.

Literature:
Vahteri Petri , Anita Mäkinen, Sonja Salovius and Ilppo Vuorinen. 2000. Are Drifting Algal Mats Conquering the Bottom of the Archipelago Sea, SW Finland? Ambio Vol. 29. No. 6.
Rönnberg, O., Lehto, J. & Haahtela I. 1985: Recent changes in the occurrence of Fucus vesiculosus in the Archipelago Sea, SW Finnland. Ann. Bot. Fennici





LIITE 2

GEOLOGISET JA HYDROFRAFISET TUTKIMUSMENETELMÄT

POSTERI

Kohonen, T., Helminen, U., Vahteri, P., Virtasalo, J. & Vuorinen, I. 2003. Methods for assessing the state of fish reproduction areas in the Archipelago Sea, SW Finland. *In*: 2003 ICES ASC Handbook. Contributions. Agendas and Orders of the Day. Abstracts. 2003 Annual Science Conference, 24-27 September 2003. Tallinn, Estonia, 144.

CM 2003/P38

Archipelago Research Institute

METHODS FOR ASSESSING THE STATE OF FISH REPRODUCTION AREAS IN THE ARCHIPELAGO SEA, SW FINLAND

University of Turku

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Background

A good state of fish reproduction areas is necessary to ensure fishery productivity. Fish species use reproduction areas for spawning, breeding, feeding, growth, and shelter. These functions are often endangered in coastal areas, where human impact causes deterioration of fish habitats.

Close to harbours and navigation routes aquatic habitats are adversely affected by various human activities e.g. ship traffic, and dredging and dumping of sea floor sediments.

Excess nutrient load from municipal sewage plants, agriculture, and fish farming enhance eutrophication of coastal waters, which will result in enhanced algal blooms and oxygen depletion in bottom sediments and near-bottom waters.

Reliable methods are needed to assess the state of fish reproduction areas and the human impact on fish habitat function. We are studying the state of fish reproduction areas in the Archipelago Sea, SW Finland in a project funded by Varsinais-Suomi TE-Centre.

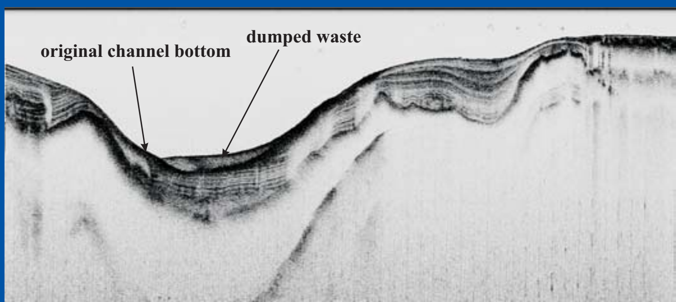
A proud parent (Bull-Rout, *Myoxocephalus scorpius*) watching over the development of the next generation.

Methods

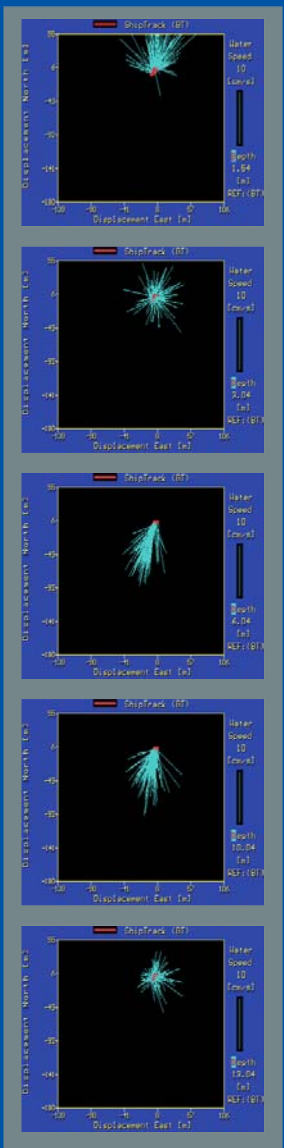
Characteristics of water column, sea floor deposits, sedimentary dynamics and submerged vegetation are mapped e.g. by CTD-sond equipped by turbidity and oxygen sensors, acoustic doppler current profiler (ADCP), acoustic sub-bottom profiler, sediment samples, underwater camera, aerial photographs, and by scuba diving.

Grain size distribution, contents of organic matter, and phosphorus fractions are analysed from sediments to determine the typical bottom characteristics for different fish reproduction grounds.

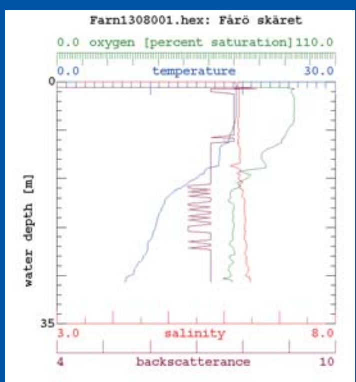
Collected data are used to characterise the present state of the identified fish reproduction areas and to predict their future development..



An acoustic profile across a main shipping route adjacent to a dumping area. The dredged waste has slided into the channel and is moved by near-bottom water currents towards the herring spawning areas in the northern Archipelago Sea.

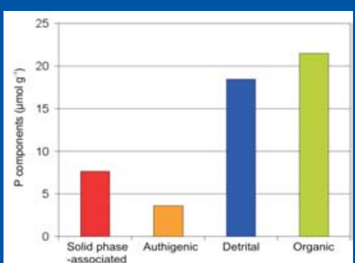


ADCP-data from Fårö skäret in the southern Archipelago Sea. Velocities and directions of water currents at different water depths: 1.5, 3, 6, 10, and 13 meters (southerly wind 4-6 m/s).



CTD-data from Fårö skäret in the southern Archipelago Sea. Temperature, oxygen saturation, salinity, and turbidity (back-scatterance) in the water column.

An aerial photograph of the eastern corner of the Tallören island near Sandön. (Photograph: M. Lappalainen 2001)



Phosphorus components in anoxic surficial sediments. Concentrations of solid phase-associated and authigenic P forms are low and levels of refractory organic P high. Enriched detrital P component reflects the input washed away from adjacent shores.

Acknowledgements:

The study "Fish reproduction areas in the Archipelago Sea" is funded by Varsinais-Suomi TE-centre.
We thank the Finnish Coast Guard for the assistance with helicopter fligths and the crew of r/v Aurelia for their help during cruises.

LIITE 3

LAIVALIIKENTEEN AIHEUTTAMA RANTAEROOSIO

POSTERI

Helminen, U. & Kohonen, T. 2003. Ship-induced erosion on the shores close to a main navigation route in the Archipelago Sea, SW Finland – A case study. *In*: Bäck, S., Harjunkoski, R., Koivu, J., Toivanen, R. & Viitasalo, I. (Eds.). Abstract Publication. Baltic Sea Science Congress 2003 Helsinki, Finland, August 24-28, 2003, 134.

Ship-induced erosion on the shores close to a main navigation route in the Archipelago Sea, SW Finland - a case study

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Archipelago Research Institute

Figure 1. The location of the study area

A

B

C

D

E

F

Figure 6. Changes in the shoreline of the Kolkka island (1). The lines digitized on rectified aerial photographs show shore displacement of over 15 meters in the northeastern corner of the island between the years 1962 and 2001 **(A)**. The Kolkka island in 1962 **(B)**, in 1977 **(C)**, in 1989 **(D)**, in 1995 **(E)**, and in 2001 **(F)**. Copyright of the aerial photographs by National Land Survey of Finland.

Background and methods

The most extensive archipelago area in Finland, the Archipelago Sea, comprises over 22 000 islands and possesses more than 14 000 km of shoreline (Ref. 1). It is an area of land uplift, where crustal rebound (today 4-5 mm/year) has been gradually increasing the land area since the Weichselian glaciation. Still, there are places where the land area is decreasing due to erosion, when the erosive forces (storm- and ship-induced waves and currents) are stronger than the erosion resistance of the beach sediment.

We studied shoreline erosion in the Innamo area (Fig. 1 & Fig. 2) close to the main navigation route leading to Turku and Naantali. Shoreline changes were studied in the islands sited 0.25 -2 km from the route by using overlapping aerial photographs from the years 1962, 1977, 1989, 1995, and 2001 (Fig. 6).

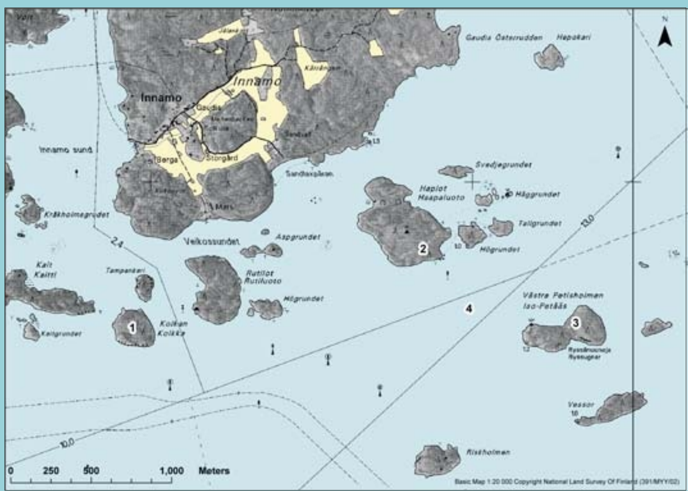


Figure 2. A map of the study area. The numbers refer to the areas presented in this poster.

Results

Interpretation of the rectified aerial photographs showed that large-scale erosion had taken place in the study area between the 1980's and the middle of the 1990's. The most severe erosion could be observed in the shores locating at a distance of 500 m from the main fairway (Fig. 3 & Fig. 5). The shore displacement and erosion process is still continuing in the area (see Fig. 6 & Fig. 7).

The observed erosion phenomenon has at least two possible explanations. Navigation traffic has been continuously increasing since the 1960's. Today more than 10 000 yearly passings of commercial vessels (Fig. 4) take place in studied area (Ref. 2). At the same time-scale a significant increase in vessel sizes has taken place. For example the passenger ferries travelling between Turku in Finland and Stockholm in Sweden are ten times bigger today than in the early 1970's.

It seems clear that the erosion phenomenon on the studied shores is caused by ship-generated waves and currents. Still, more research is needed from the areas further away the shipping routes for comparison. It is also important to study the amount of underwater erosion both near the navigation routes and in the pristine areas. These erosion studies are necessary in order to find ways to prevent biodiversity loss and deterioration of underwater habitats in the areas subject to erosive forces.

Figure 3. The southern shore of the Haapaluoto island (2) photographed from the sea in the summer 2001. (Photograph by T. Kohonen).

Figure 4. A ferry passing (4) the study area on its way to Stockholm. (Photograph by M. Lappalainen 2001).

Figure 5. The northern shore of the the Iso-Petääs island (3) photographed from the sea. (Photograph by T. Kohonen 2003).

Figure 7. A closeup of the northeastern part of the Kolkka island (1) in the summer 2001. (Photograph by M. Lappalainen).

References

(Ref.1): Granö O., Roto M. & Laurila, L. 1999: Environment and land use in the shore zone of the coast of Finland. - Turun yliopiston maantieteen laitoksen julkaisuja -Publicationes Instituti Geographici Universitatis Turkuensis 160, 76 p.

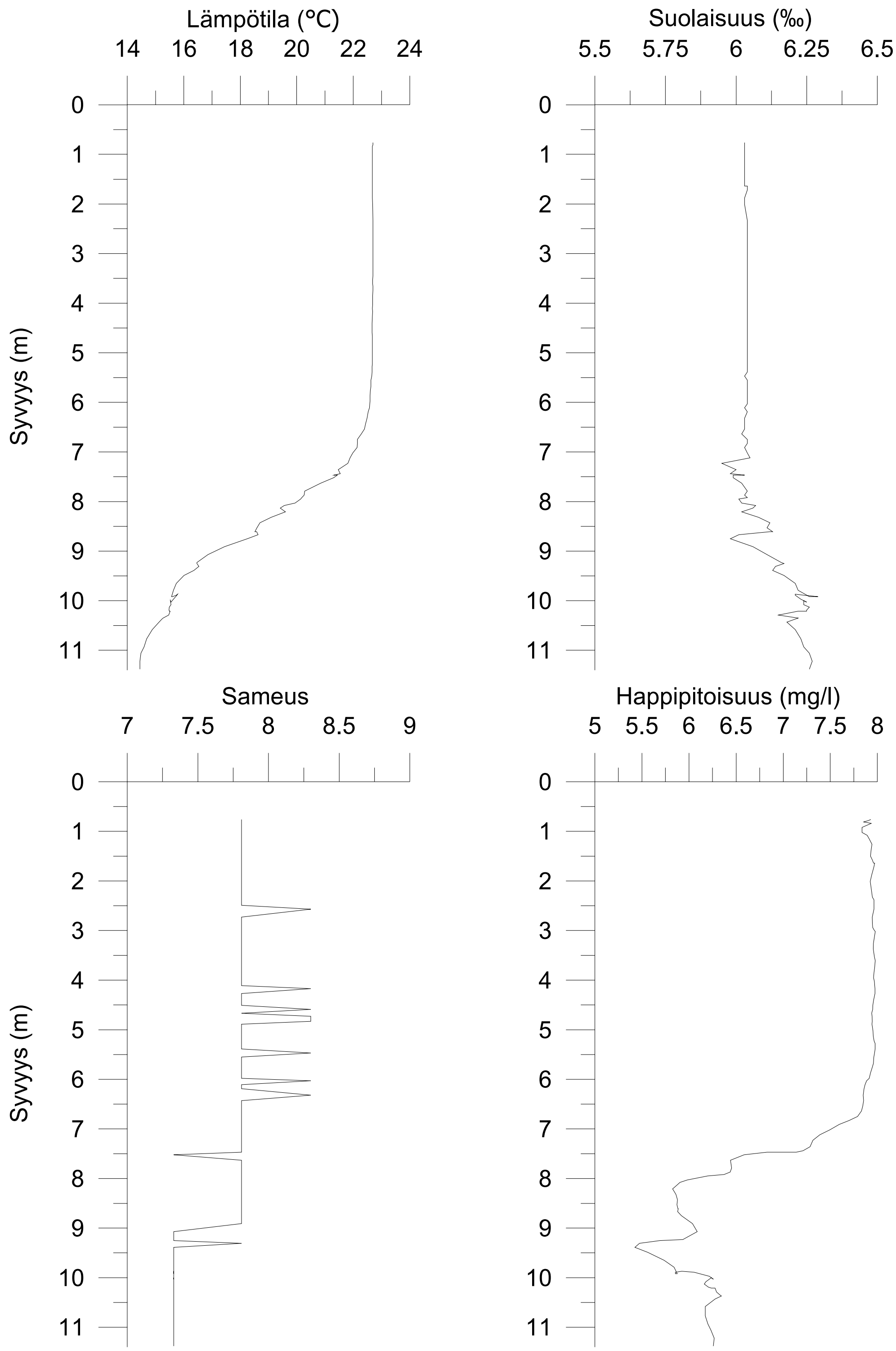
(Ref.2): Rintala, V-M. 2001: Kauppamerenkulku Saaristomerellä: määrä ja alueellinen jakautuminen. Pro Gradu, Turun yliopisto, Maantieteenlaitos. 79 p. (In Finnish).

Acknowledgements

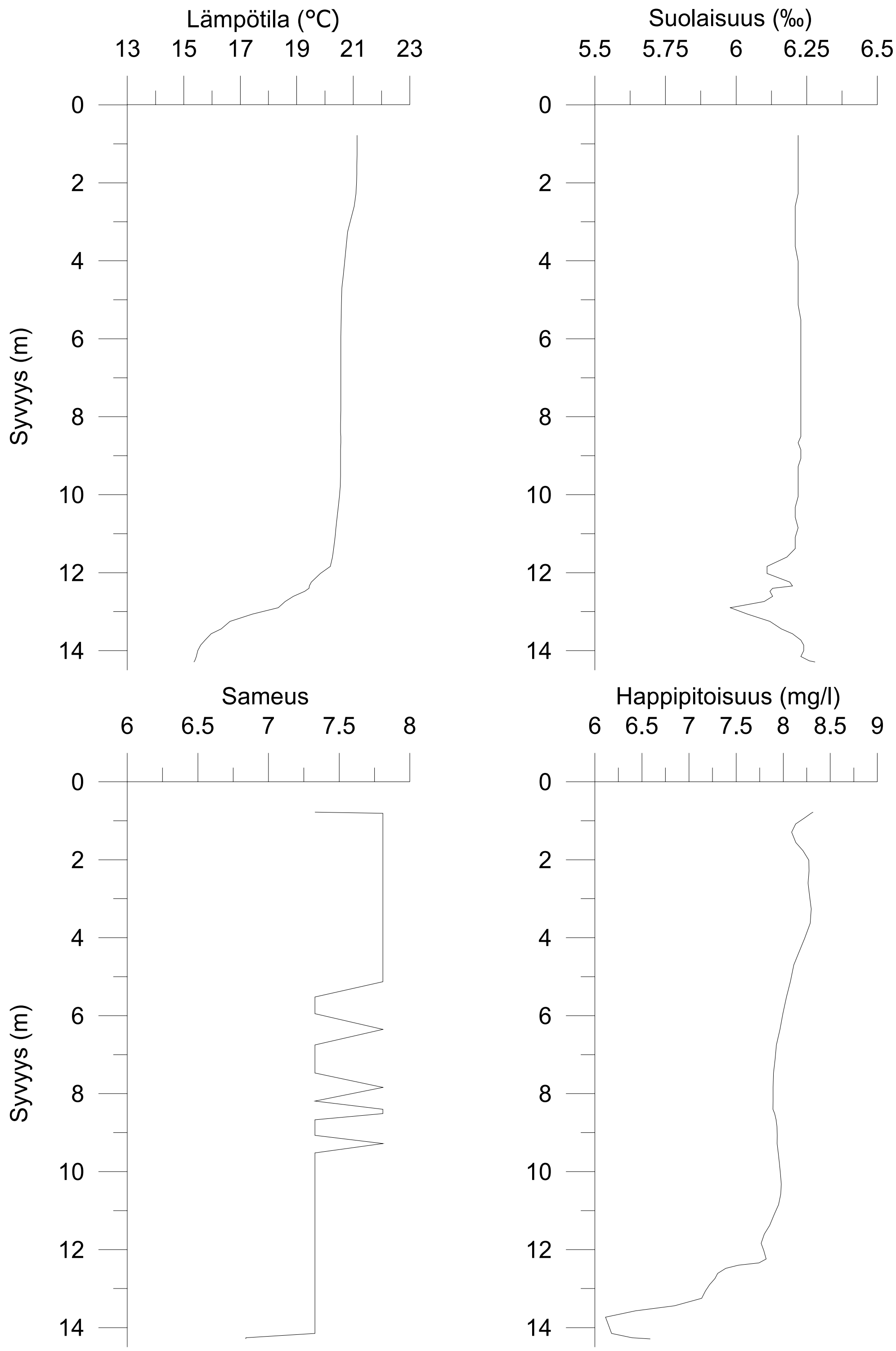
The study is a part of the research project "Fish reproduction areas in the Archipelago Sea" funded by Varsinais-Suomi TE-Centre.

LIITE 4

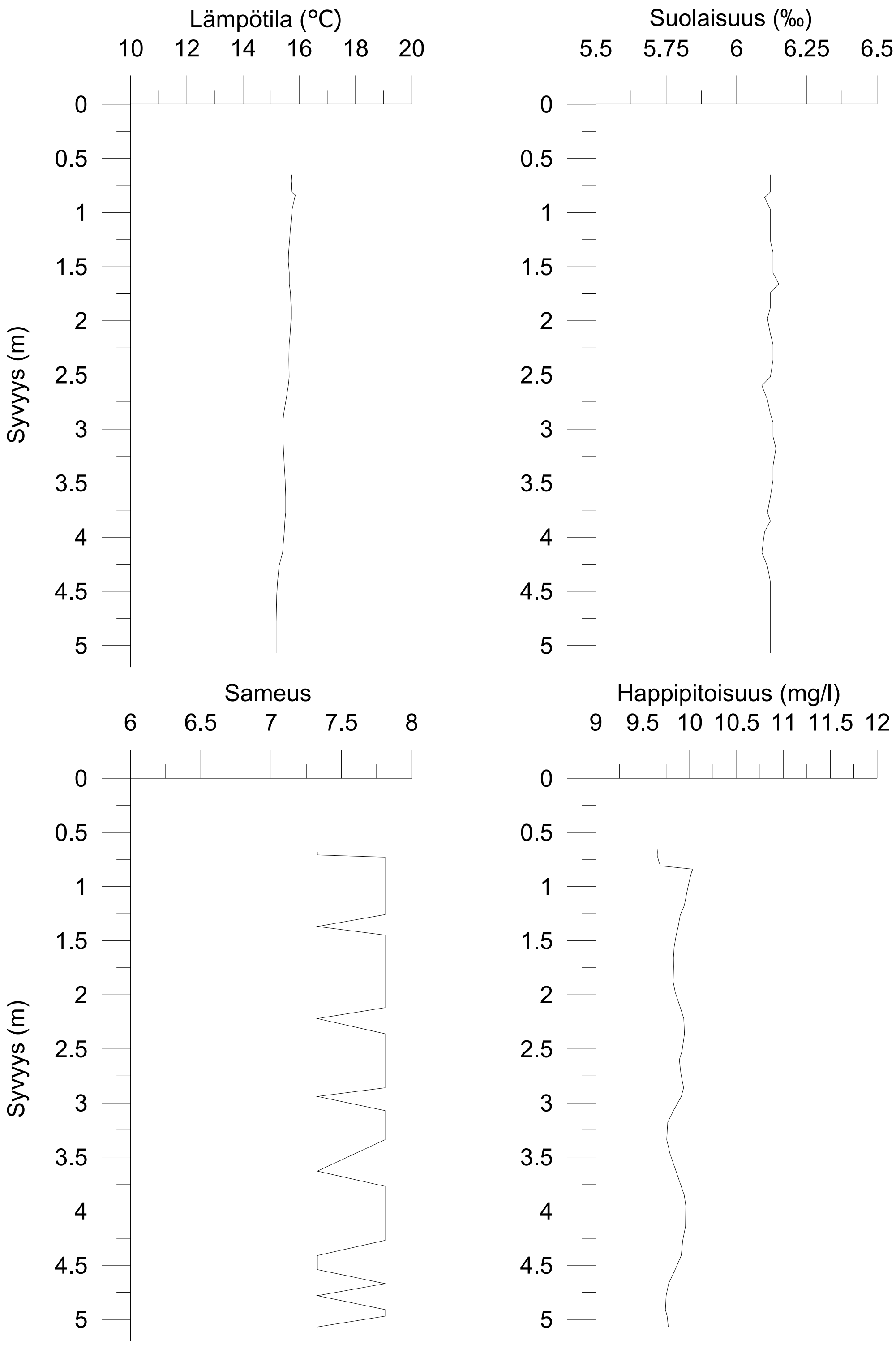
CTD-MITTAUSTEN TULOKSET



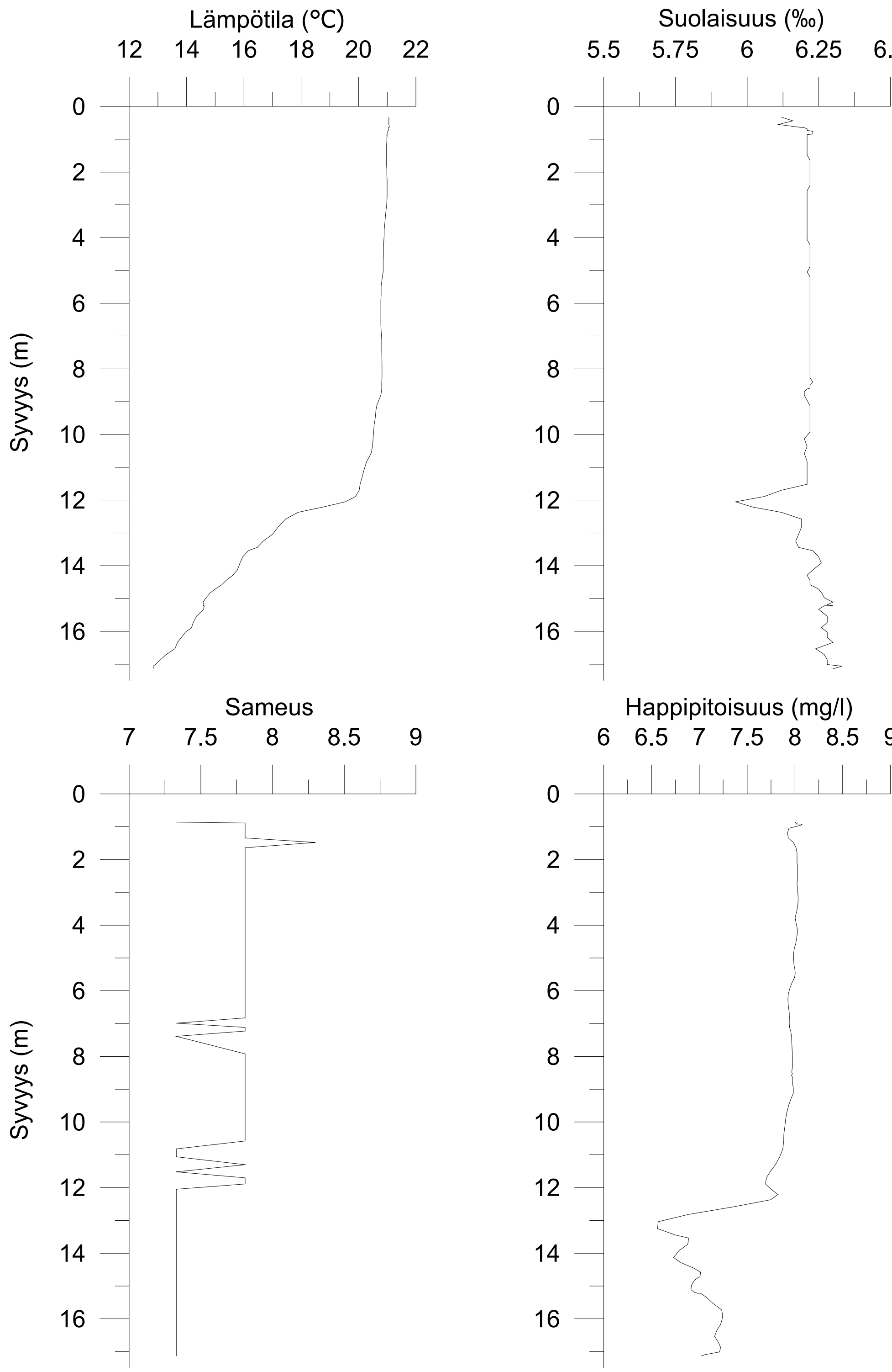
Kuva 1. Apulskär CTD- mittaus 5.8.2003.



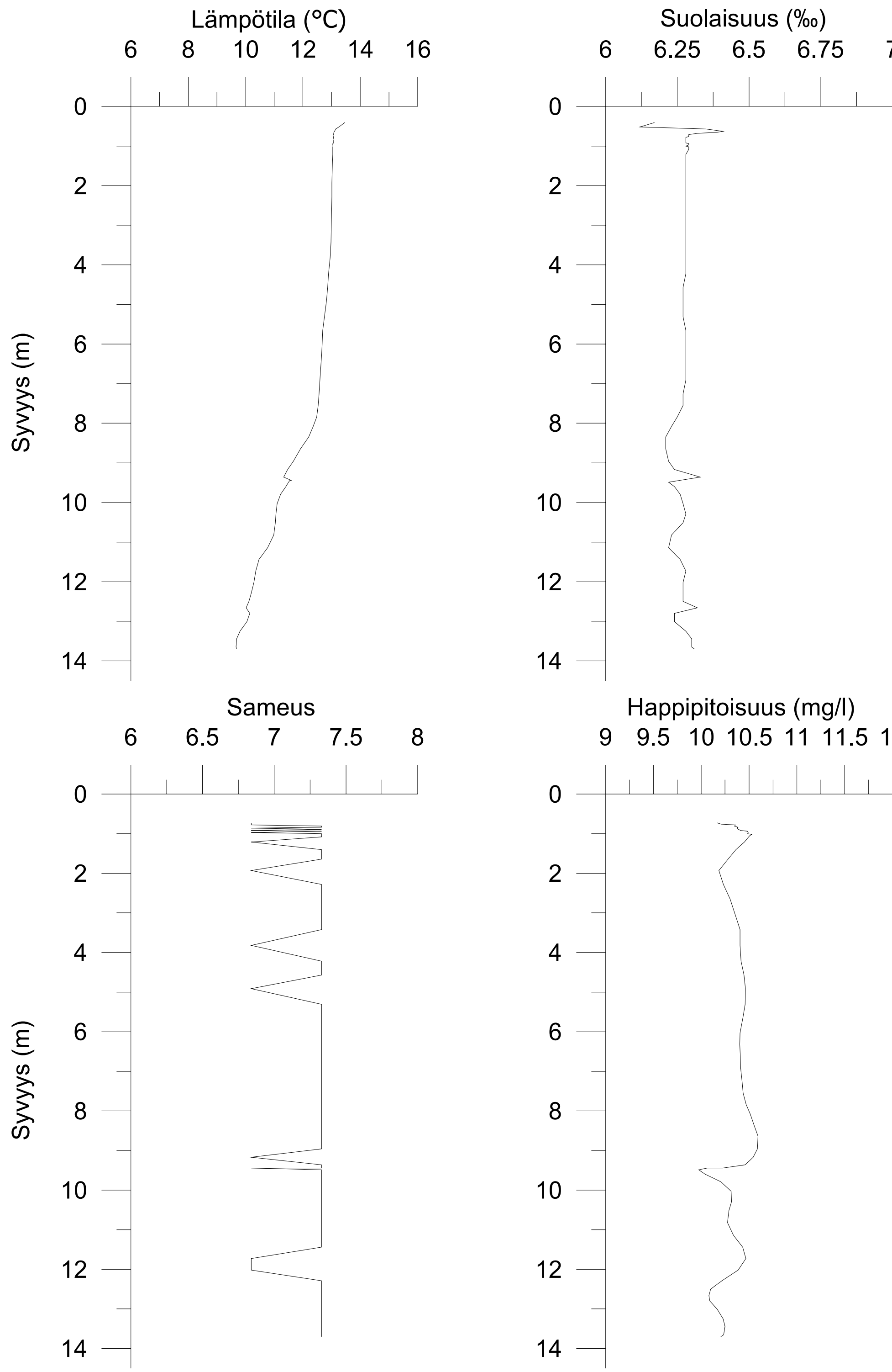
Kuva 2. Bodö CTD- mittaus 7.8.2003.



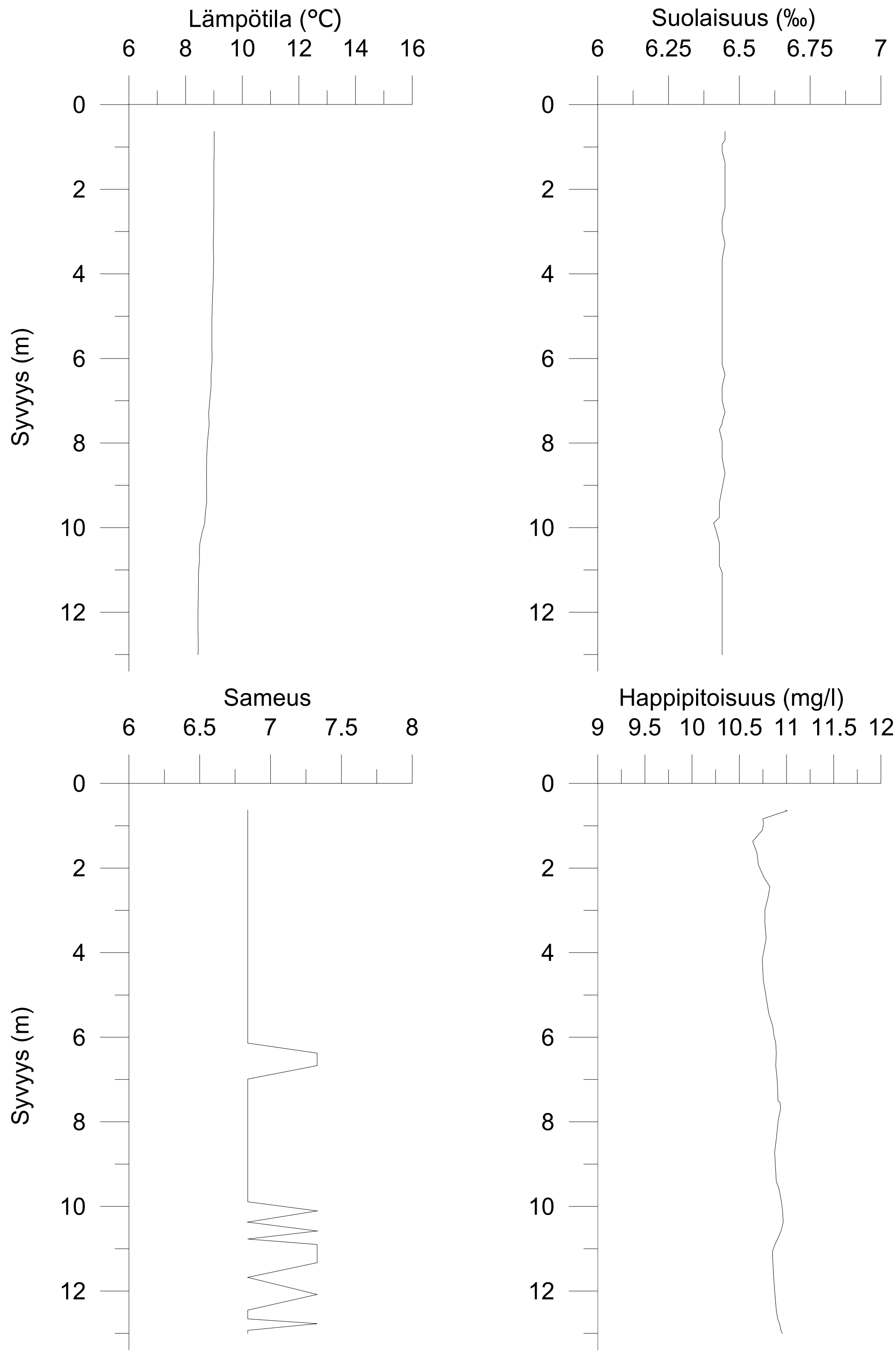
Kuva 3. Fårö CTD- mittaus 25.6.2002.



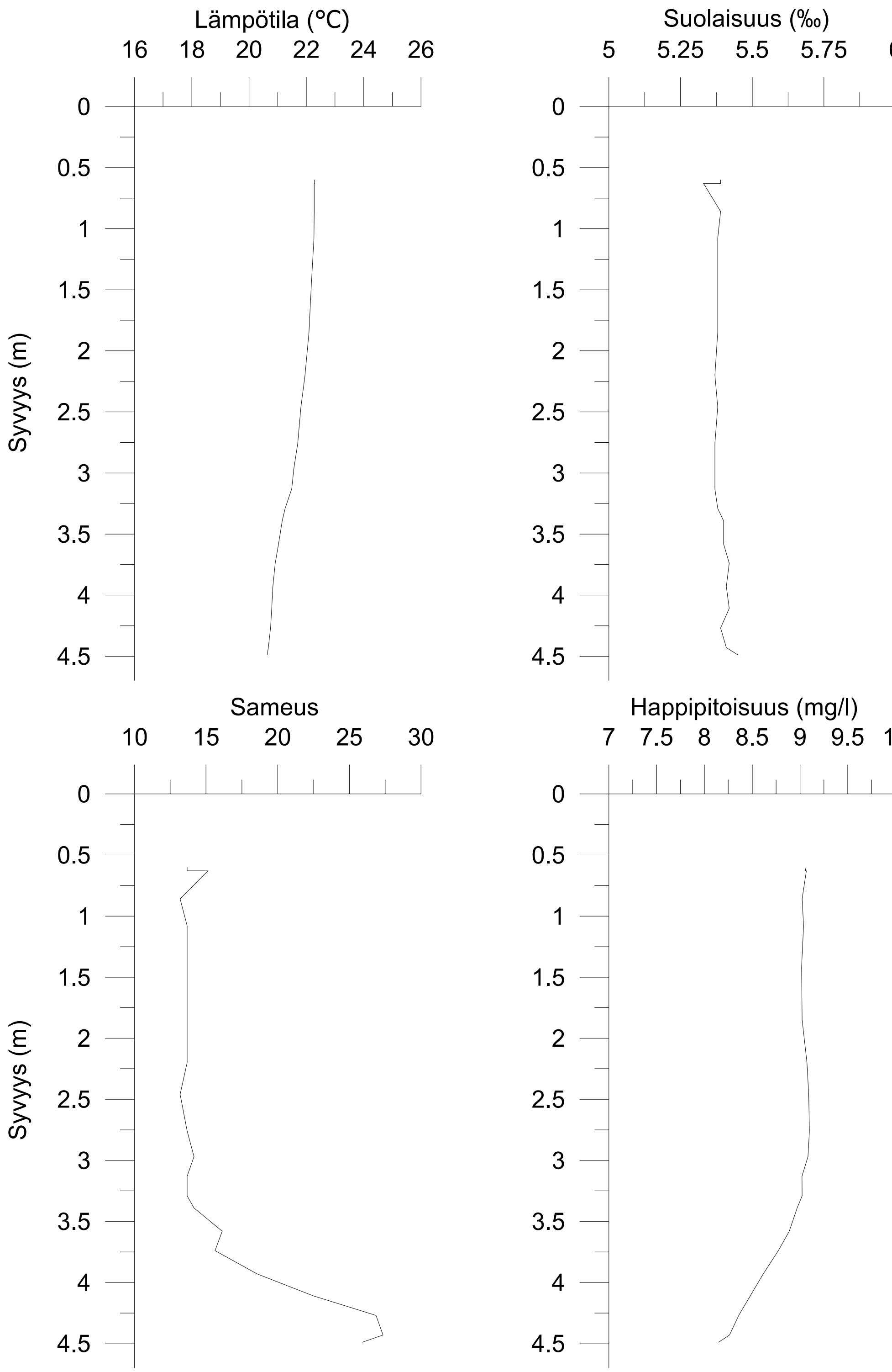
Kuva 4. Fåröskäret CTD- mittaus 7.8.2003.



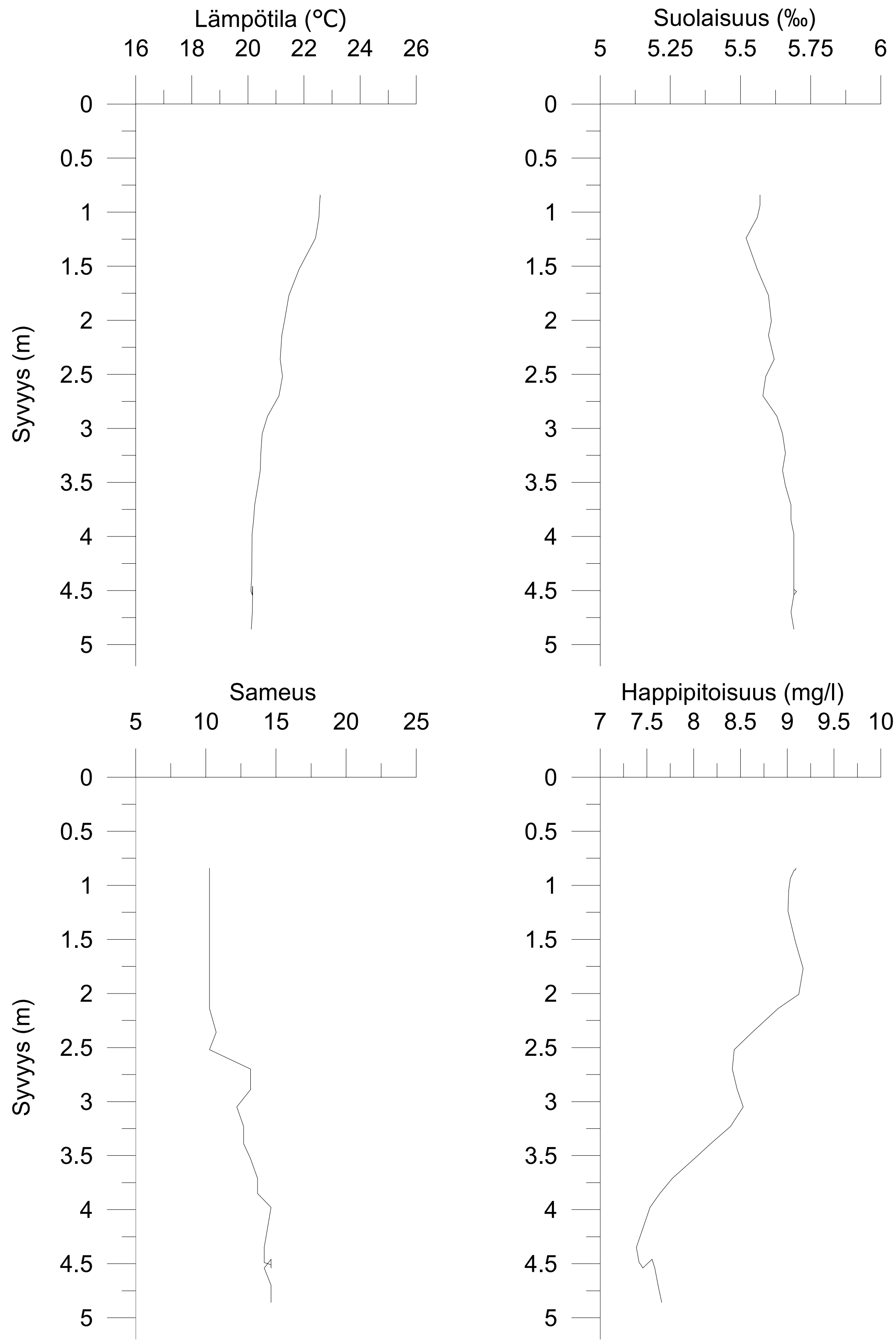
Kuva 5. Granholm CTD- mittaus 7.8.2003.



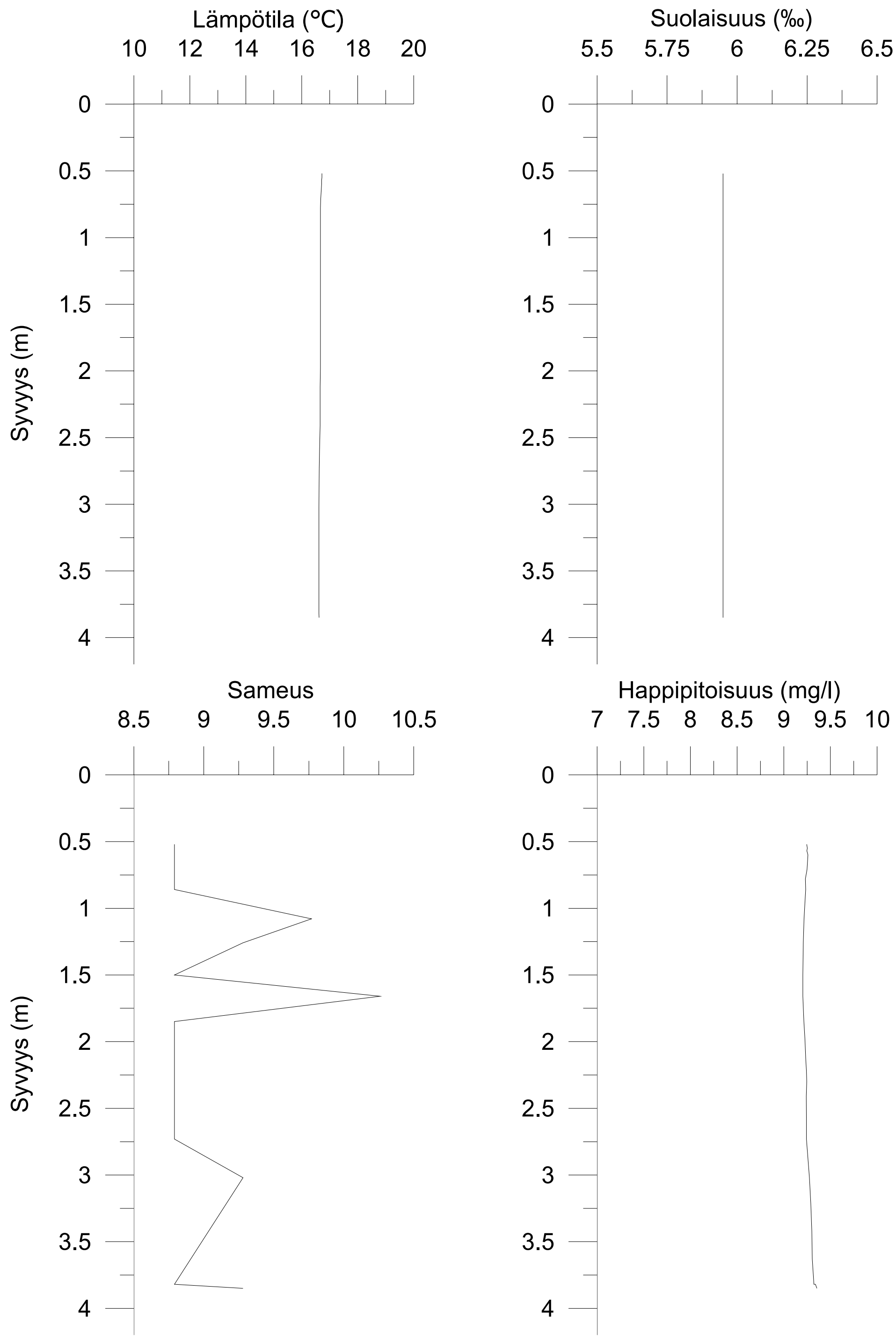
Kuva 6. Gåsholm CTD- mittaus 24.6.2002.



Kuva 7. Haarla CTD- mittaus 15.7.2002.



Kuva 8. Harvaluoto CTD- mittaus 17.7.2002.



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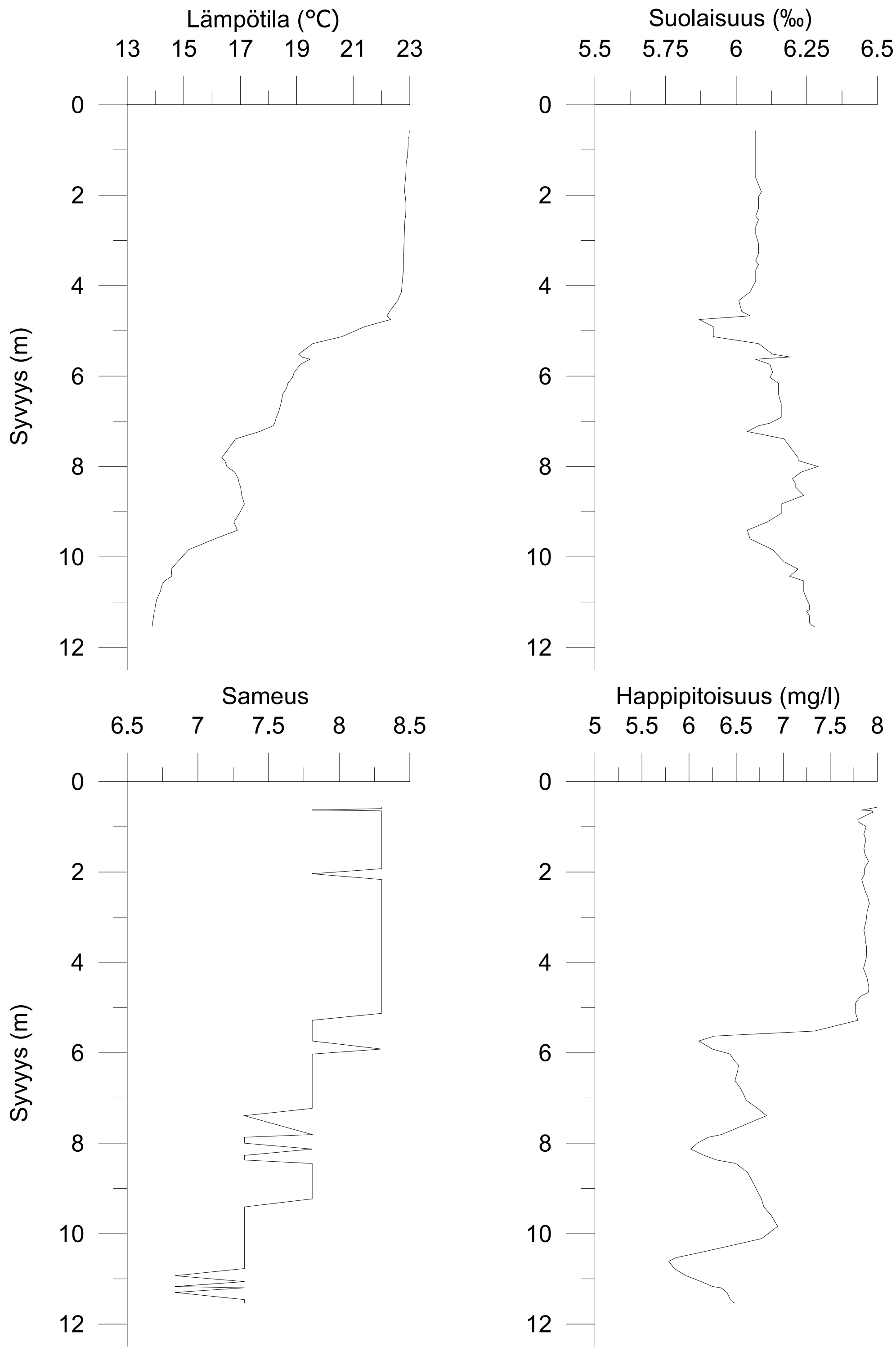
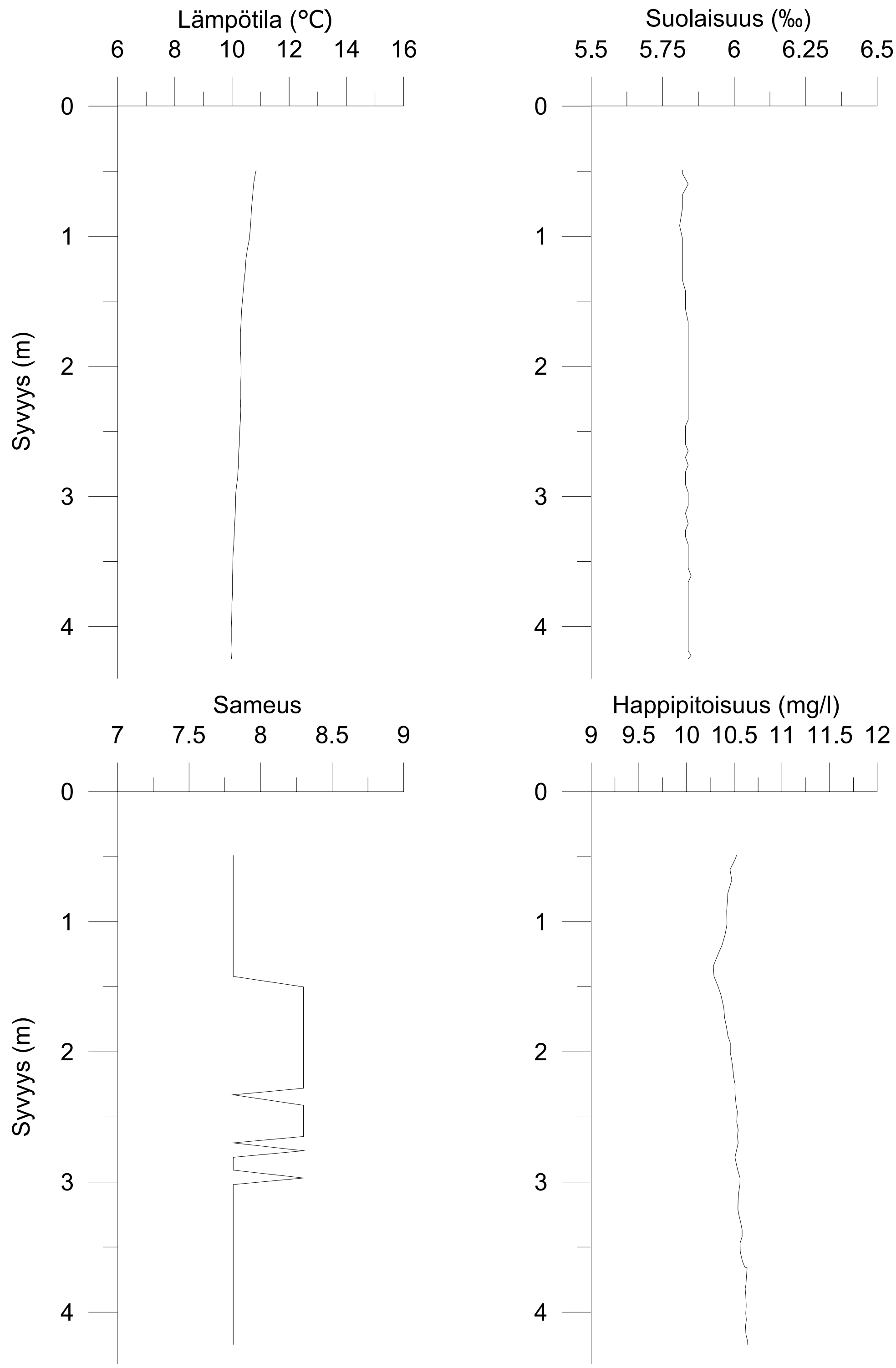
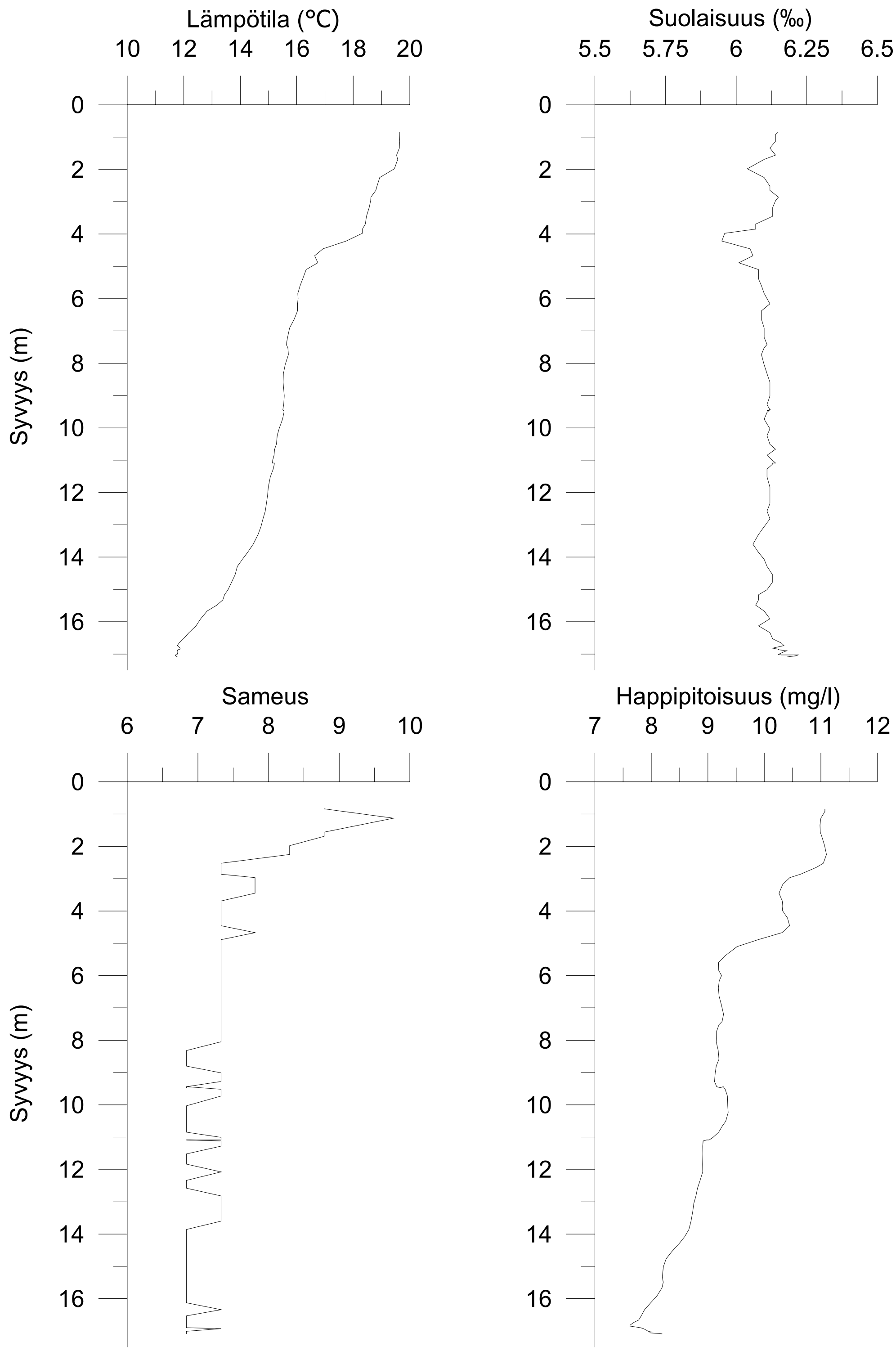


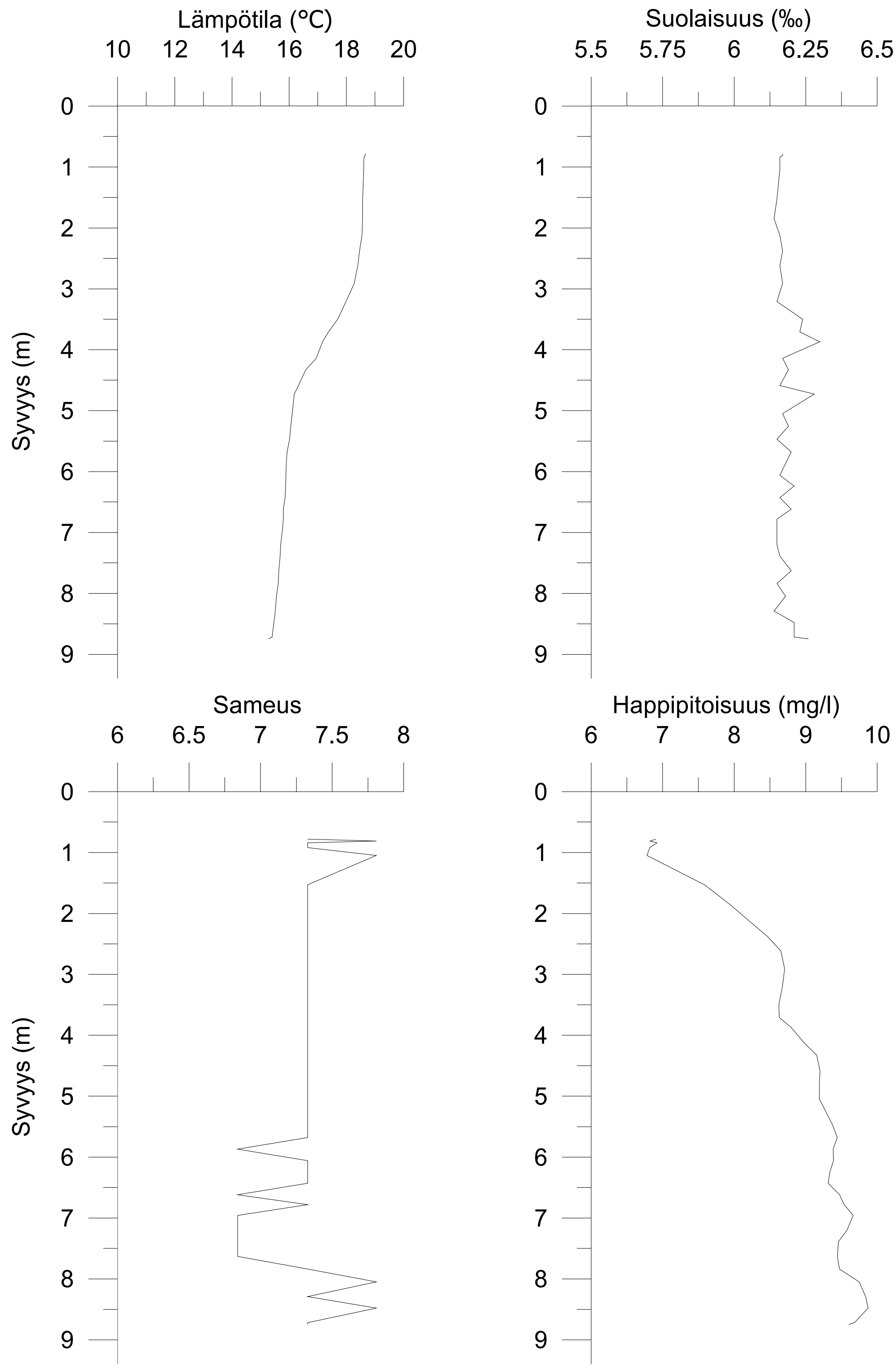
Kuva 10. Högsåra CTD- mittaus 5.8.2003.



Kuva 11. Innamo CTD- mittaus 27.6.2003.



Kuva 12. Jurmo1. CTD- mittaus 16.7.2002.



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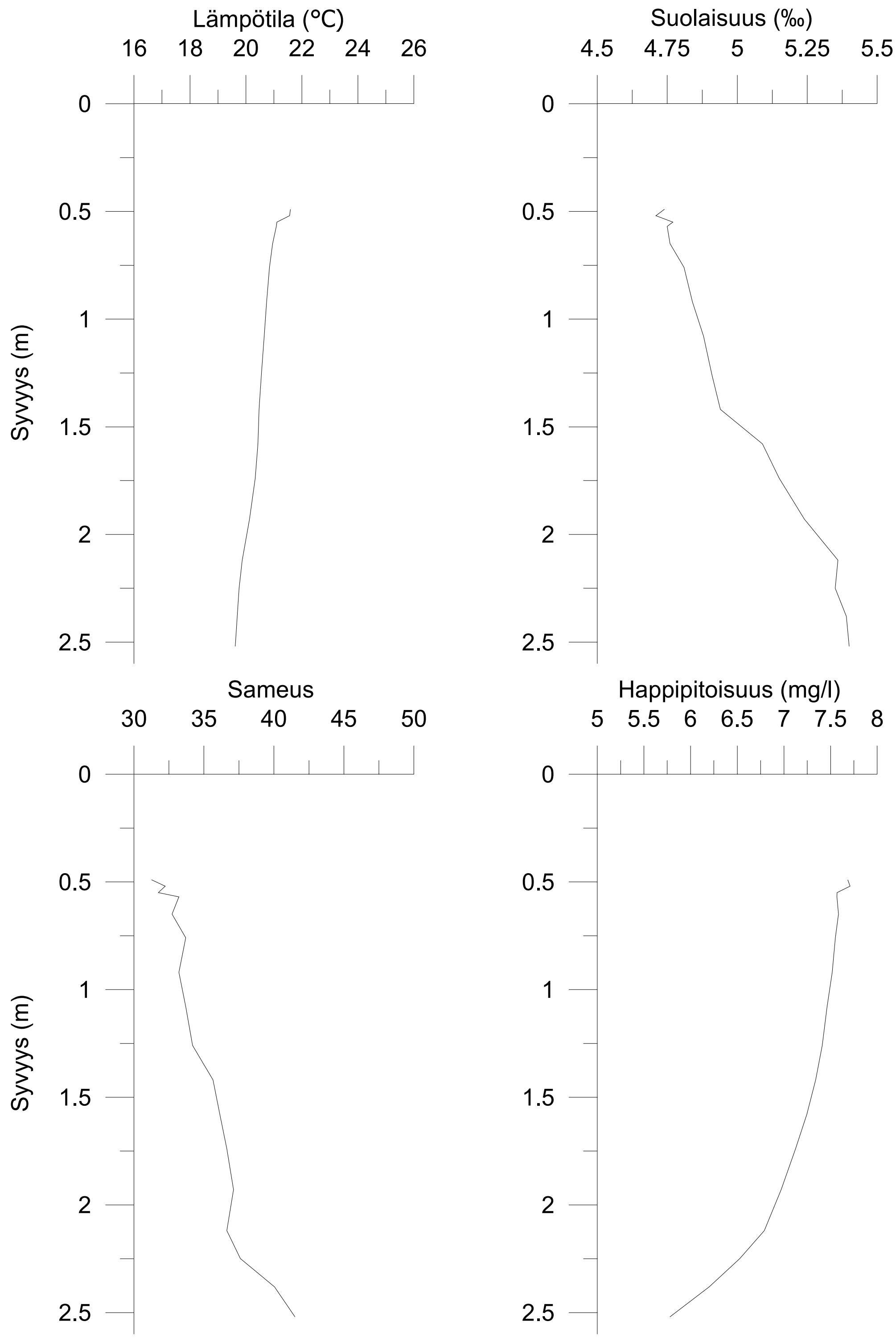

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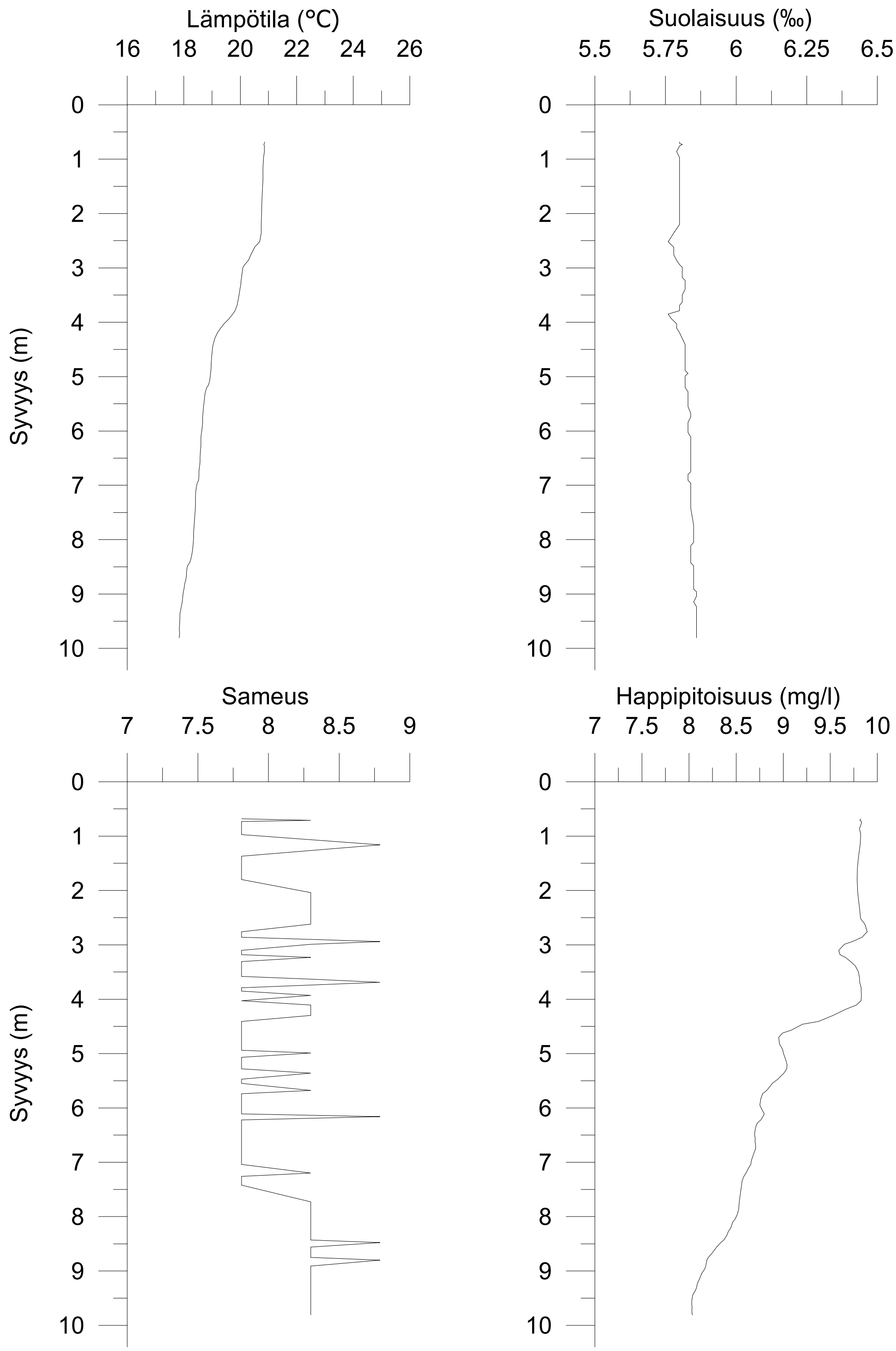

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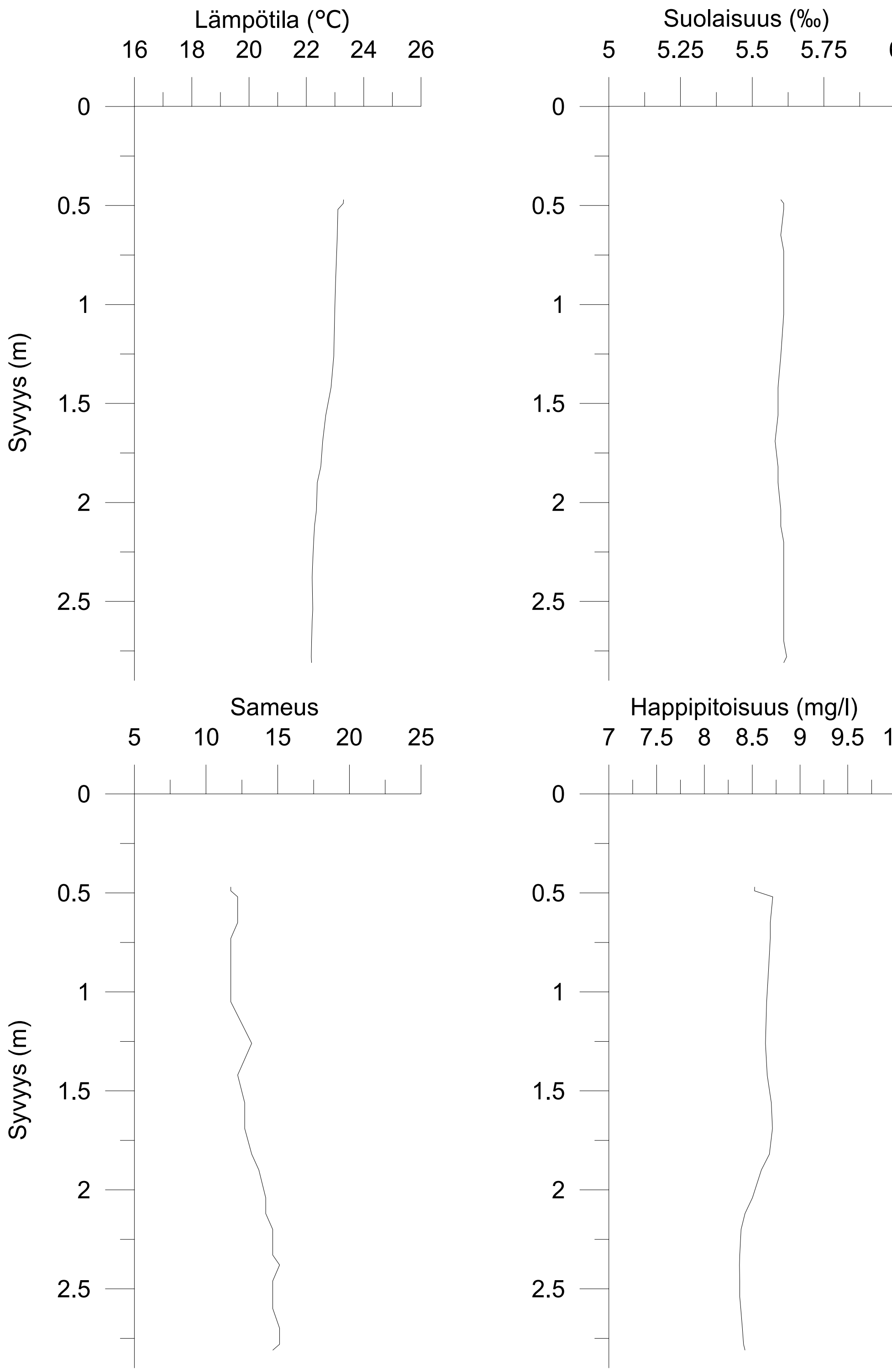

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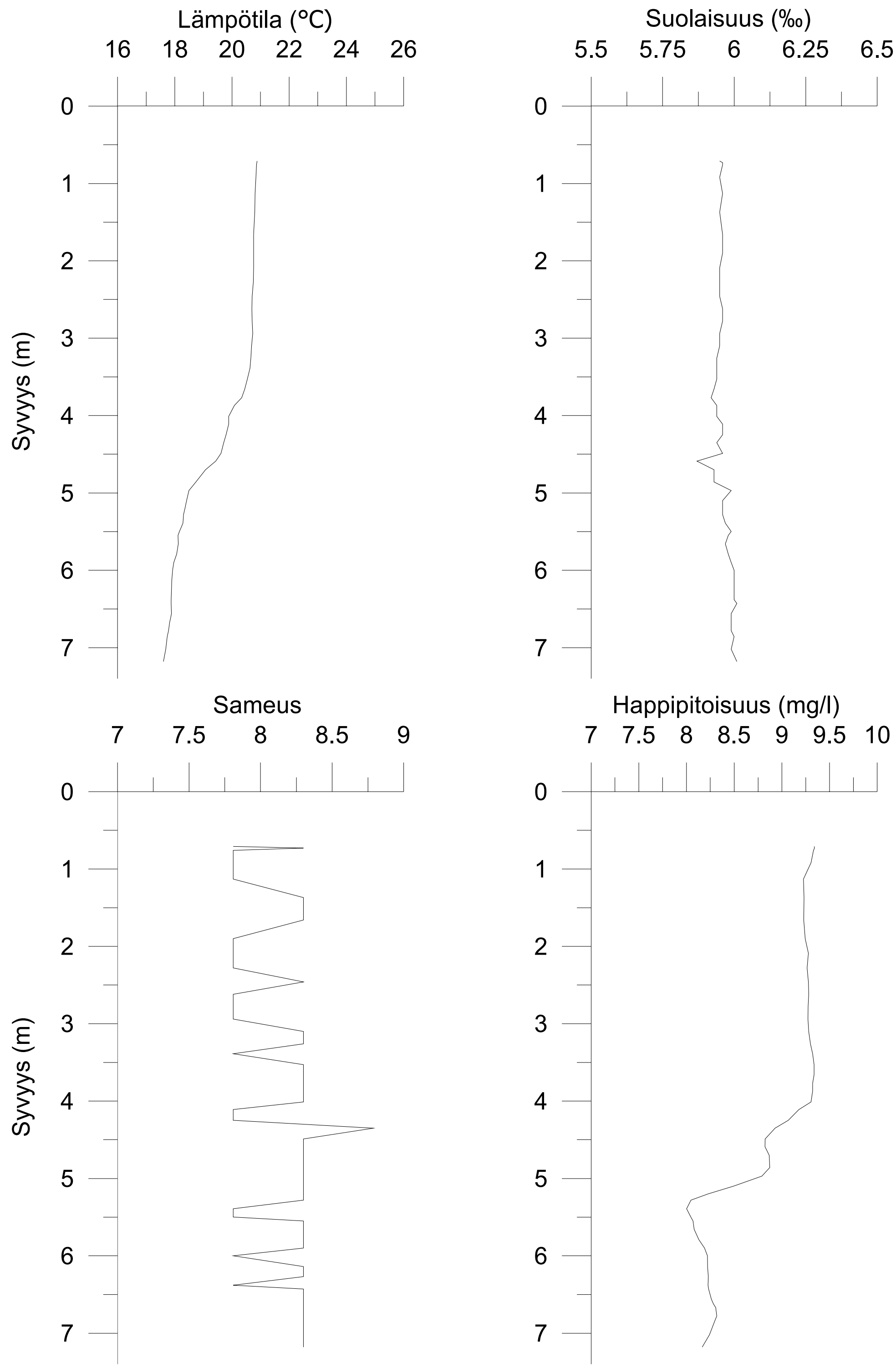

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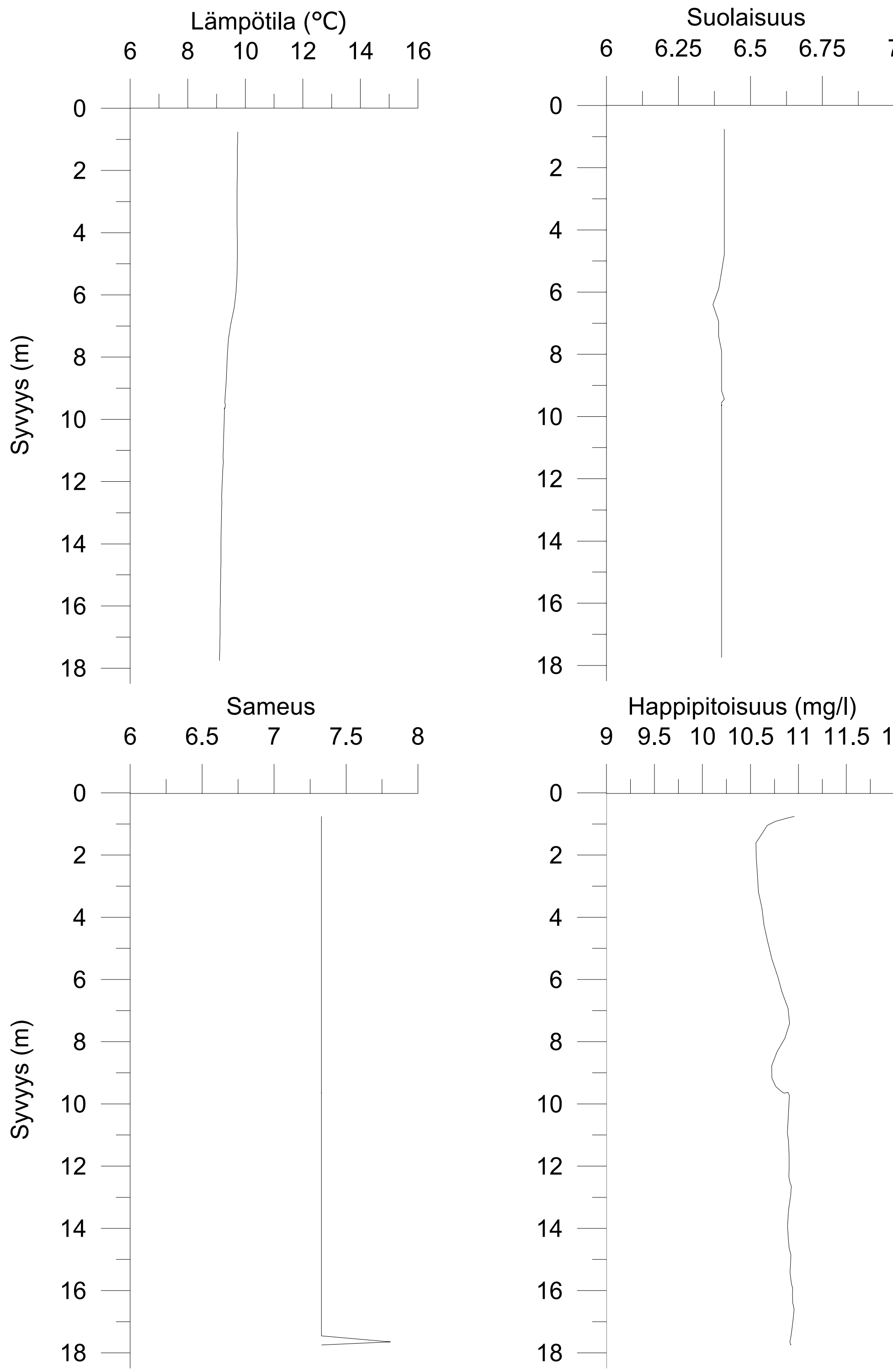

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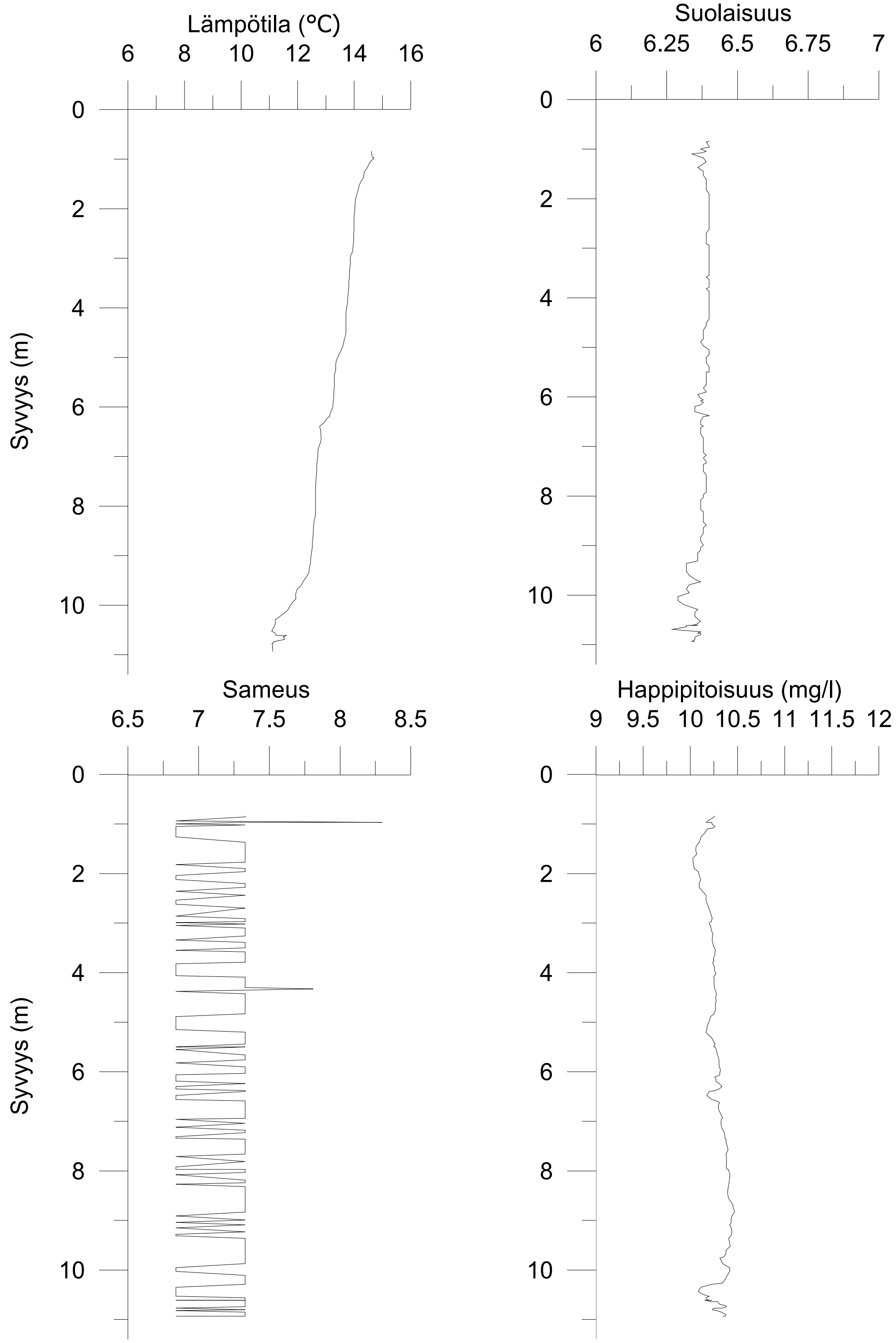

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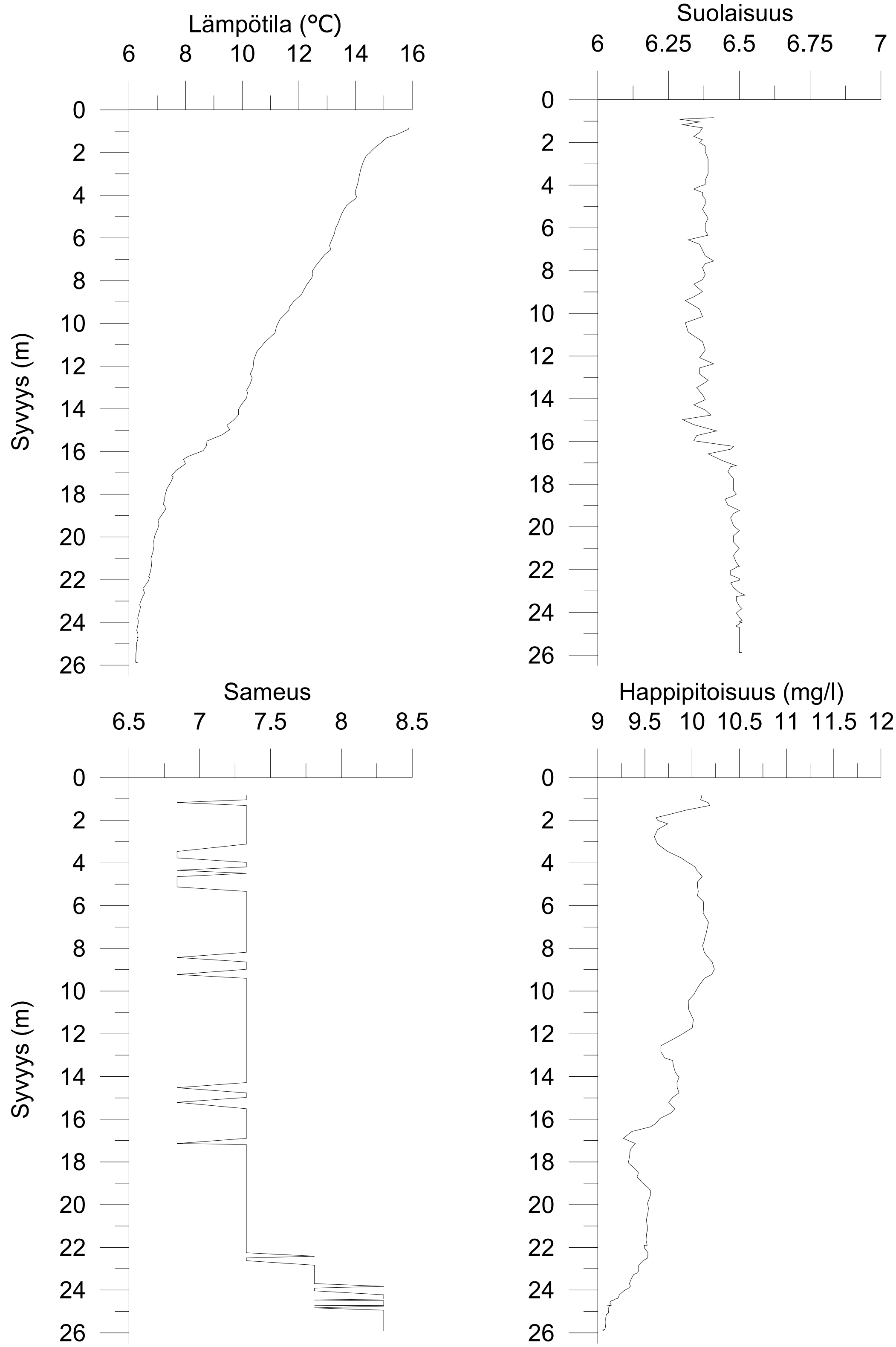

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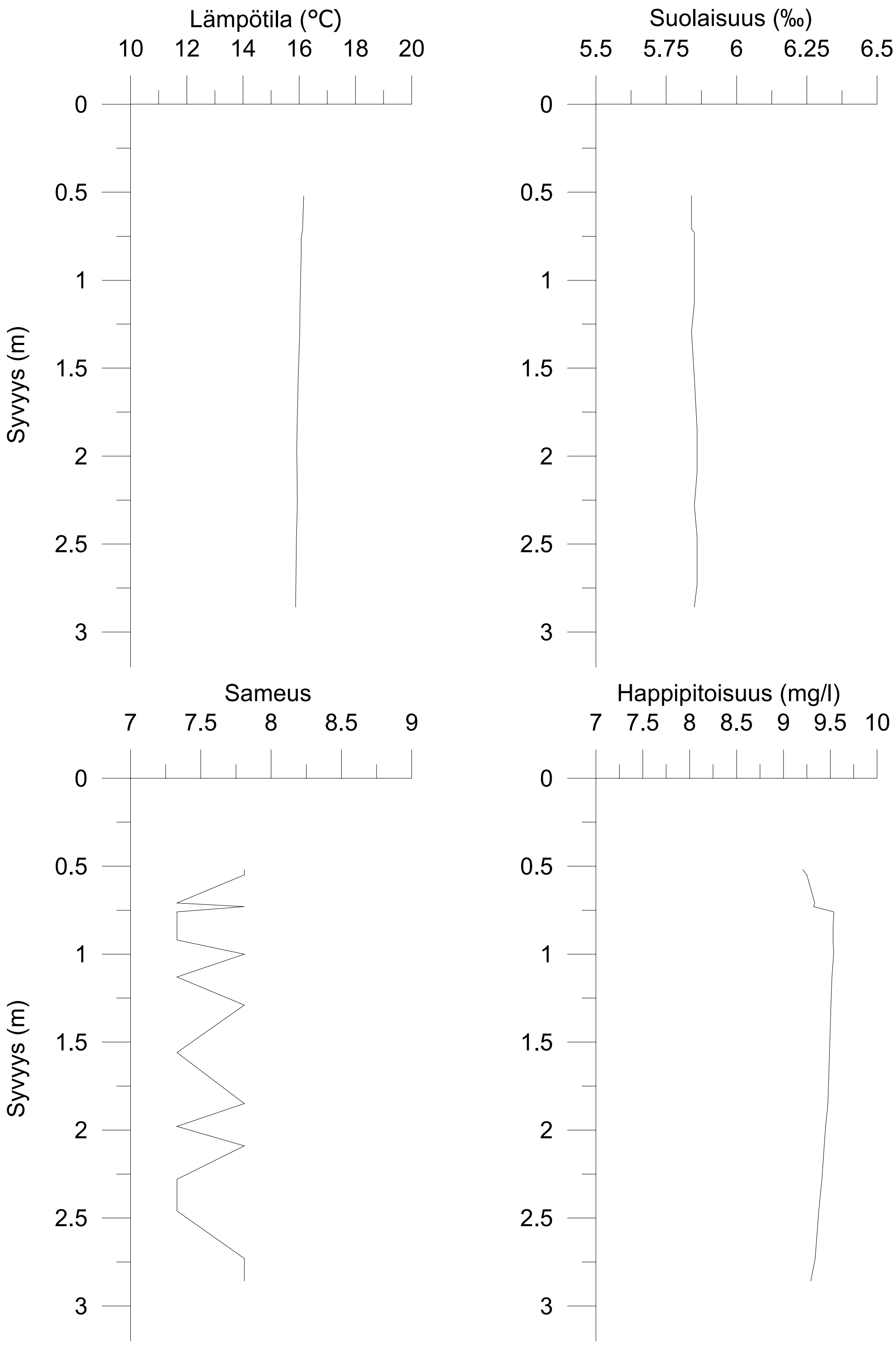
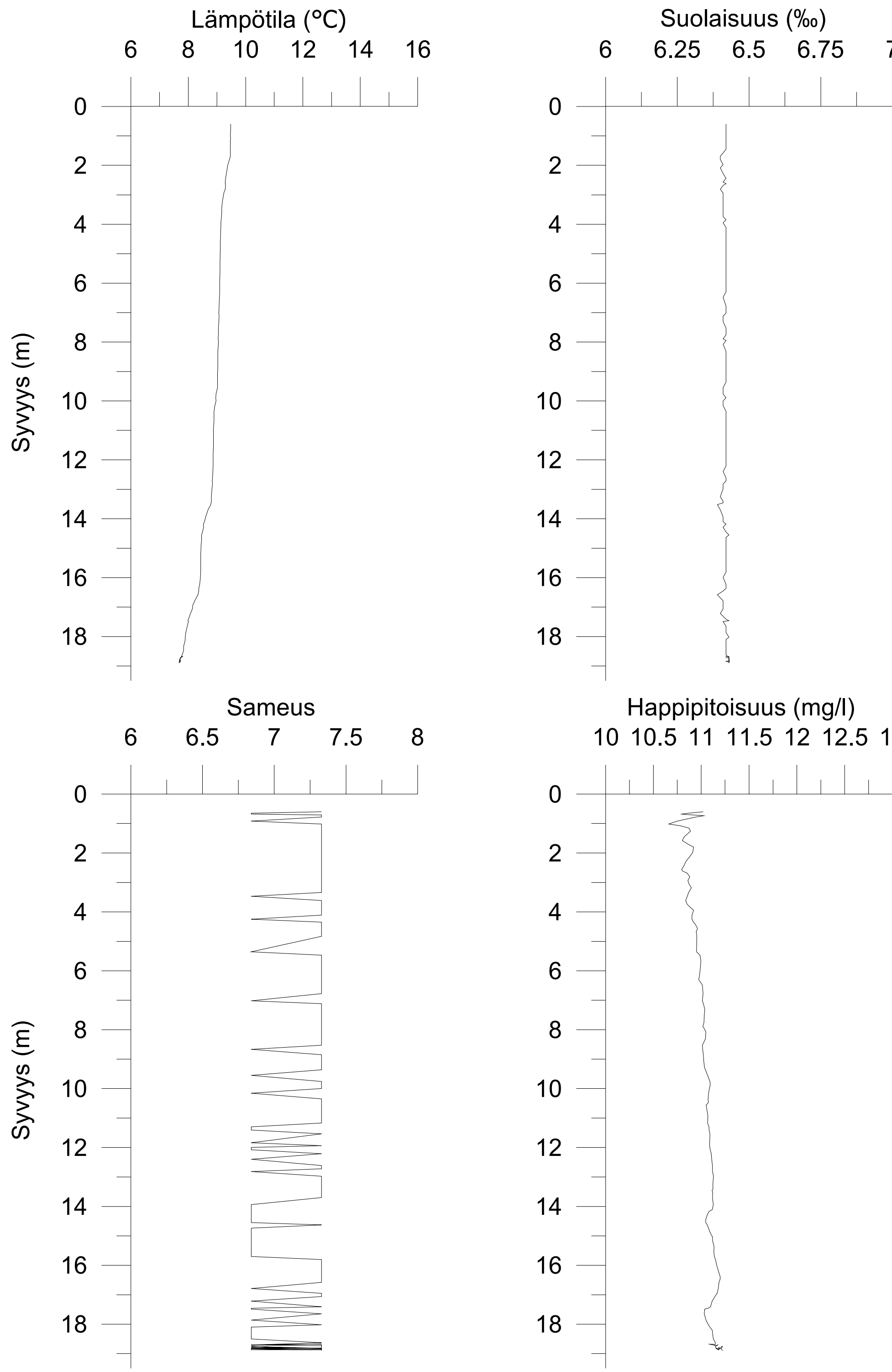


Kuva 21. Sandön1. CTD- mittaus 24.6.2002.



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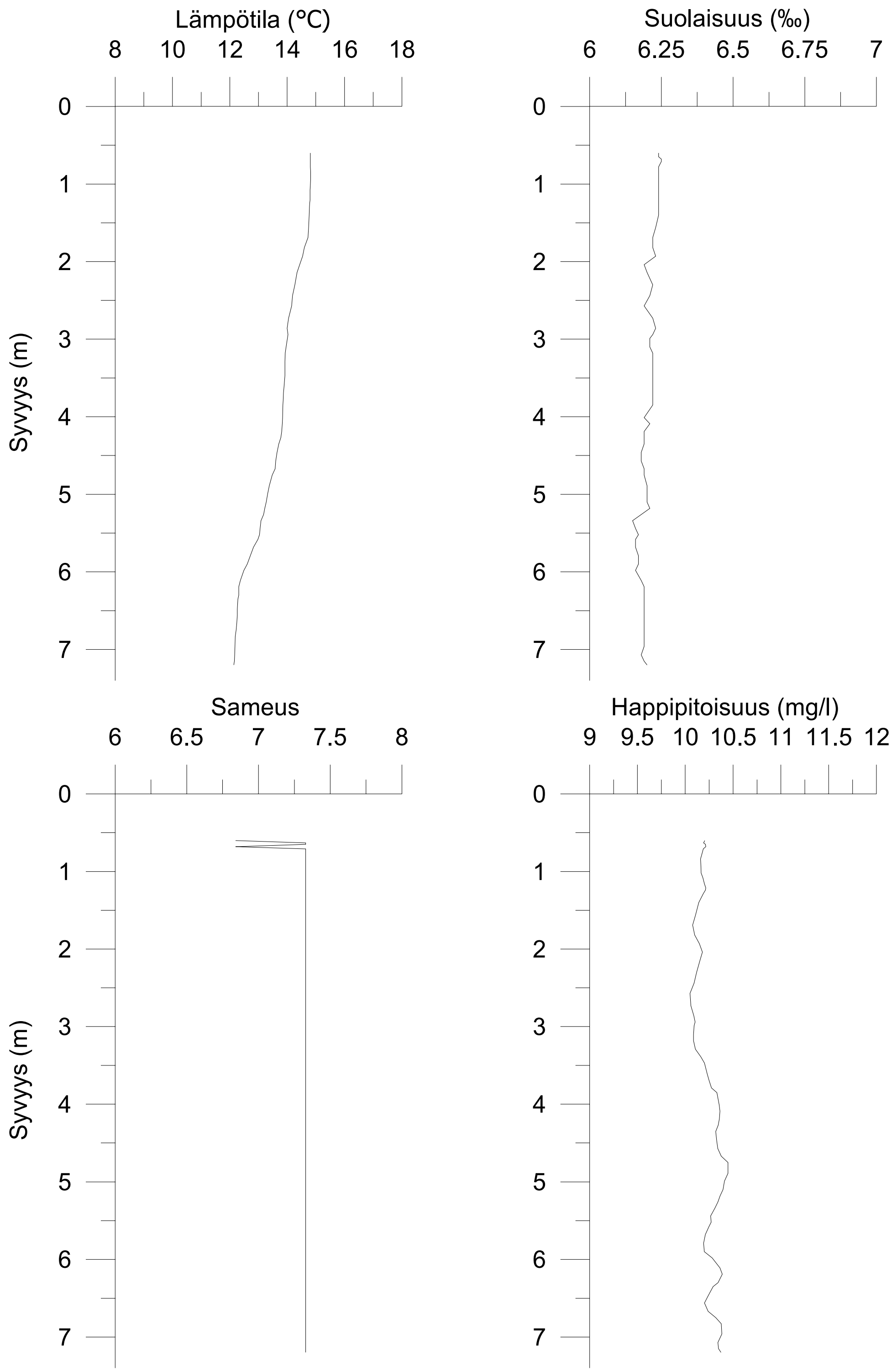

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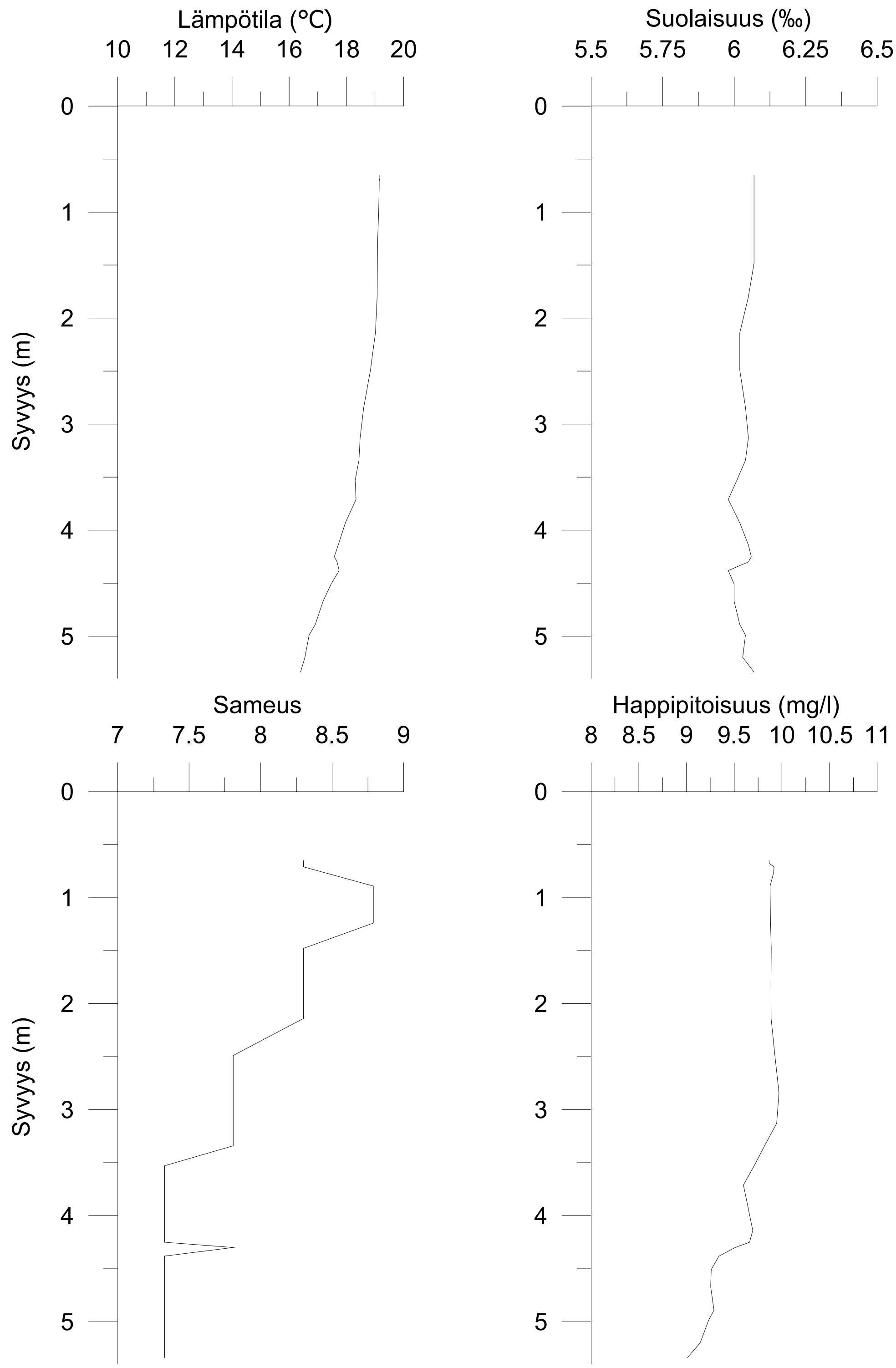

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