

# Time series of plankton data from Lake Mjøsa, Norway

Jarl Eivind Løvik & S. Jannicke Moe 



Freshwater Metadata Journal  
DOI 10.15504/fmj.2016.18  
ISSN 2312-6604  
Published online: 2016-08-24



Published by University of Natural Resources and  
Life Sciences, Institute of Hydrobiology and  
Aquatic Ecosystem Management, BOKU - Vienna



# Time series of plankton data from Lake Mjøsa, Norway

Jarl Eivind Løvik<sup>1</sup> & S. Jannicke Moe<sup>1</sup> 

<sup>1</sup> Norwegian Institute for Water Research, Oslo, Norway; corresponding author: jmo@niva.no

Please cite this paper as follows: Løvik, J. E. & Moe, S. J., 2016. Time series of plankton data from Lake Mjøsa, Norway. *Freshwater Metadata Journal* 18: 1-9. <https://doi.org/10.15504/fmj.2016.18>

Received: 2016-08-04 / Published: 2016-08-24

## Keywords

lake, phytoplankton, zooplankton, time series, eutrophication, restoration, climate change

## Short description of the dataset/summary

This paper gives an overview of the >40 years long time series of zooplankton, phytoplankton and other environmental monitoring data from Lake Mjøsa in South-East Norway. The lake was impacted by eutrophication in the 70s-80s and has been successfully restored to good ecological status. The dataset currently comprises zooplankton and phytoplankton at species level from early 1970s to 2015, and water chemistry data from the same period.

The phytoplankton and water chemistry data are available online from NIVA's web portal AquaMonitor and will be updated regularly with new monitoring data. Zooplankton data are not yet publicly available, but publication through AquaMonitor is foreseen for future projects.

## General information

dataset entry ID:	FWM_9
<b>name of the dataset:</b>	
full name of the dataset:	Time series of plankton data from Lake Mjøsa, Norway
dataset short name:	Mjøsa plankton series
<b>type of dataset:</b>	species (taxonomic group) per site database including environmental information
data type:	point data/observation data
<b>science keywords according to <a href="#">GCMD</a>:</b>	
topic:	Agriculture, Biosphere, Biological Classification, Climate Indicators, Terrestrial Hydrosphere
<b>ISO topic category according to <a href="#">ISO 19115</a>:</b>	Farming, Biota, Environment, Inland Waters
own science keywords:	lake, phytoplankton, zooplankton, time series, eutrophication, restoration, climate change, monitoring

## Technical and administrative specifications

<b>data format:</b>	Oracle
others/details:	Data are stored in Oracle, can be downloaded to Access and Excel via web interface (in Norwegian).
<b>operating system:</b>	all Windows systems
<b>data language:</b>	Norwegian
<b>current access level:</b>	web (public)
web address:	<a href="http://www.aquamonitor.no/mjosovervak/">http://www.aquamonitor.no/mjosovervak/</a>
others/details:	Zooplankton data are not yet publicly available, but can be obtained upon request.
currently available through <a href="#">GBIF</a> :	no
exchange planned:	no
data in data repository:	no

### Do you plan to publish the data on the Freshwater Biodiversity Data Portal:

no

<b>update level:</b>	update planned
others/details:	The dataset is updated yearly
<b>documentation:</b>	
type:	internal description
others/details:	A data report is published yearly by NIVA (in Norwegian with English summary).
language:	others/specify
specify:	Norwegian

### contact details:

#### metadata contact person:

first, last name:	Jannicke Moe
phone:	+47 90898108
email:	jmo@niva.no
institution:	NIVA
address:	Gaustadalléen 21
postal code, city:	0349 Oslo
country:	Norway
web address:	www.niva.no

#### technical contact person:

first, last name:	Birger Skjelbred
email:	bis@niva.no

#### scientific contact person:

first, last name:	Jarl Eivind Løvik
email:	jel@niva.no

## Intellectual property rights and citation

<b>dataset publisher:</b>	NIVA
<b>dataset creator (data compiler):</b>	
contact name:	Jannicke Moe
contact email:	jmo@niva.no
contact institution:	NIVA
<b>data contributors to/owners of this dataset:</b>	

criteria for using this dataset: single  
The dataset is publicly available (data portal, data archive) and can be used without restrictions, but dataset creator/data contributors must be informed prior to publication. Data must be acknowledged and cited correctly.

other/additional criteria: The data can be downloaded and used, but we recommend that the contact persons are contacted for collaboration on use of the data.

**citation of this dataset:**

author(s): NIVA  
title and journal (name, number, pages):  
Data from Lake Mjøsa. Accessed at [www.aquamonitor.no/mjosovervak](http://www.aquamonitor.no/mjosovervak)  
year: 2016

**citation of the metadata:**

author(s): Løvik J. E. & Moe S. J.  
title and journal (name, number, pages):  
Time series of plankton data from Lake Mjøsa, Norway. Freshwater Metadata Journal 18: 1-9  
year: 2016  
doi: <https://doi.org/10.15504/fmj.2016.18>

**General data specifications****regional coverage of the dataset:**

spatial extent of the dataset: catchment  
continents: Europe

**spatial extent (bounding coordinates):**

southernmost latitude [°]: 60.400  
northernmost latitude [°]: 61.134  
westernmost longitude [°]: 10.433  
easternmost longitude [°]: 11.294  
minimum altitude: 123 metres  
maximum altitude: 123 metres  
countries: Europe: Norway

**world climatic regions according to Köppen:**

Group C: temperate/mesothermal climates

freshwater ecoregions of the world (FEOW) according to [WWF](#):

Europe: Northern Baltic Drainages

**European ecoregions according to Illies (WFD):**

Fenno-Scandian Shield (ER22)

**ecosystem type:**

lakes/ponds

**covered timeframe:**

1974 - 2015

**comments:**

From 1980s until present, there are data from 10-12 samples every year. Data from the 1970s are less regular than the later data.

**Site specifications****coordinate system/grid data:**

latitude/longitude, format: DMS  
datum (e.g. WGS84): WGS84  
grid data available: no

**ecosystem type classification:**

lakes (classification mainly according to WFD):

altitude typology

lowland: < 200 m

exact altitudinal data available

depth typology based on mean depth

> 15 m

exact depth data available

size typology based on surface area

0.5 to 1 km<sup>2</sup>, 1 to 10 km<sup>2</sup>, 10 to 100 km<sup>2</sup>, > 100 km<sup>2</sup>

exact surface area data available

geology

siliceous

exact geological data available

trophic state

stratification

site coding available:

yes, alphanumerical

example:

M074

**number of sites:**

<100

exact number of sites:

5

**comments:**

Species-level phytoplankton data are currently available from one station only.

Phytoplankton data from more stations may be available in the future.

Zooplankton samples have been taken from one station only.

Water chemistry and other environmental data are also available from 6 tributary rivers.

More site information (geology, stratification etc.) is available from Holtan (1979) and Boehrer et al. (2013).

## Climate and environmental data

**climate related data:**

spatial resolution of the data (if not catchment/site related):

others/specify

others:

see comments

available parameters per site:

mean annual temperature January, July

data source: [www.met.no](http://www.met.no)

mean annual temperature for each month

data source: [www.met.no](http://www.met.no)

minimal, maximal and mean winter and summer temperatures

data source: [www.met.no](http://www.met.no)

daily air temperatures

data source: [www.met.no](http://www.met.no)

mean annual precipitation

data source: [www.met.no](http://www.met.no)

winter and summer precipitation

data source: [www.met.no](http://www.met.no)

mean discharge

data source: [www.nve.no](http://www.nve.no)

wind

data source: [www.met.no](http://www.met.no)

comments: Daily meteorological data can be downloaded from [eklima.met.no](http://eklima.met.no), stations Kise (12550) and Toten (11500).

**environmental data:**

available parameters per catchment:

catchment size  
 data source: <http://vann-nett.no>  
 catchment geology  
 data source: [www.ngu.no](http://www.ngu.no)  
 catchment land cover/land use  
 data source: Løvik et al. 2016  
 population density  
 data source: Hobæk et al. 2012  
 presence of barriers/dams/reservoirs (fragmentation)  
 hydrological regime/flow regime  
 data source: [www.nve.no](http://www.nve.no)

available parameters per site:

catchment land use upstream of sampling site  
 data source: Løvik et al. 2016  
 information on water uses (e.g., irrigation, fish ponds)  
 data source: Løvik et al. 2016  
 distance to next migration barrier upstream  
 distance to next migration barrier downstream  
 distance to the next lake upstream  
 distance to the next main village/town upstream  
 altitude  
 data source: [www.nve.no](http://www.nve.no)  
 hydrological regime/flow regime  
 data source: [www.nve.no](http://www.nve.no)  
 discharge  
 data source: [www.nve.no](http://www.nve.no)  
 maximum depth  
 data source: [www.vann-nett.no](http://www.vann-nett.no)  
 mean depth  
 data source: [www.vann-nett.no](http://www.vann-nett.no)

**physico-chemical data:**

total P, nitrate, total N, hardness, alkalinity, TOC (total organic carbon), water temperature, pH, conductivity, chlorophyll, colour, Secci disc depth, thermocline depth

other physico-chemical parameters:

Other parameters: E. coli (2009-2011), ice cover (1949-2009), primary production, SiO<sub>2</sub>, turbidity (2007-2012)

availability of physico-chemical data, if there is more than one sample per site:

per sample

**stressors influencing the sites:**

reference sites available: no

stressor	restored sites available	data before/after restoration available	stressor gradient available	comments
eutrophication	yes	yes	yes	The lake was eutrophied until 1990s.
organic pollution	no	no	no	
toxic stress	no	no	no	
hydrologic stress (e.g. impoundment, flow velocity reduction, hydropeaking, water abstraction, flow velocity increase, etc.)	no	no	no	
thermal stress	no	no	no	Lake temperature has increased during the monitoring period.

## Biological data

### biological data origin:

from sampling,

Monitoring of Lake Mjøsa by NIVA from 1972 until present.

organism group addressed:

zooplankton, phytoplankton

comments:

Zooplankton samples include *Mysis relicta*.

More information on zooplankton data can be found in Rognerud & Kjellberg 1990, Kjellberg et al. 1991 and Løvik & Kjellberg 2003.

More information on phytoplankton data (including palaeolimnological data) can be found in Hobæk et al. 2012.

## Sample specifications/sample resolution

### zooplankton:

#### sample information:

covered timeframe: 1972 - 2015

historical data: yes

palaeo data: no

season: spring, summer, autumn

temporal resolution/frequency of sampling:

biweekly samples, 10-12 per year during May-October

time series data: yes

#### taxonomic resolution:

level: species

percentage of species level data: 100

#### taxonomic coding:

taxalist according to: Artsdatabanken (Norwegian Biodiversity Information Centre)

reference(s): Artsdatabanken (2015). Artsnavnebasen. Norsk taksonomisk database.

<http://www.artsportalen.artsdatabanken.no/>.

Artsdatabanken follows the International Code of Zoological Nomenclature (<http://www.iczn.org/>).

coding system: full species name



example: *Bosmina longispina*

**sample specifications:**

type: quantitative (abundance data)  
 replicate samples: no  
 number of samples: 408  
 specification of method(s) used for sampling and sorting:  
 25-L Schindler trap, counting of individuals in whole samples or a representative part of samples by means of binocular microscope.  
 reference(s): Bottrell et al. (1976), Hessen et al. (1995), Schindler (1969).  
 sample type (e.g. habitat specific samples, composite samples etc.):  
 9 separate samples from the 0-50 m depth interval each sampling date, counting data integrated for the whole interval.  
 specific sample location (e.g. littoral, profundal, transect, shoreline, hyporheic zone, etc.):  
 Pelagial zone, sampling location at the deepest part of the lake  
 comments: Sampling, identification and counting of zooplankton have been performed mainly by Gösta Kjellberg, Gerd Justås and Jarl Eivind Løvik.

**phytoplankton:**

**sample information:**

covered timeframe: 1972 - 2015  
 historical data: yes  
 season: spring, summer, autumn  
 temporal resolution/frequency of sampling:  
 biweekly samples, 10-12 per year during May-October  
 time series data: yes

**taxonomic resolution:**

level: species  
 percentage of species level data: 100  
 comments: Phytoplankton data grouped by class are available online on [www.aquamonitor.no/mjosovervak](http://www.aquamonitor.no/mjosovervak). Original data on species level can be obtained upon request.

**taxonomic coding:**

reference(s): The database uses the taxonomic code RUBIN, which is not international. All taxonomic information can be obtained upon request.  
 coding system: RUBIN code  
 example: APHA FLO

**sample specifications:**

type: quantitative (abundance data)  
 number of samples: 476  
 specification of method(s) used for sampling and sorting:  
 Sampling: Norwegian Standard (NS 9459:2004)  
 Analysis: Norwegian Standard (NS-EN 15204:2006)  
 reference(s): NS 9459:2004: Water quality - Guidance on sampling of phytoplankton from lakes and reservoirs  
 NS-EN 15204:2006: Water quality - Guidance standard on the enumeration of phytoplankton using inverted microscopy (Utermöhl technique)  
 sample type (e.g. habitat specific samples, composite samples etc.):  
 Integrated sample from the pelagic, representing the euphotic zone of the lake.  
 specific sample location (e.g. littoral, profundal, transect, shoreline, hyporheic zone, etc.):  
 Pelagic, integrated sample from 0-10 meters.

comments: Identification and counting of phytoplankton have been performed mainly by Pål Brettum and Birger Skjelbred.

## Other specifications

### GIS layers, shape files related to the dataset:

catchments, river-sub-basins  
 others/details: More GIS layers are probably available, but not included in this dataset.  
 availability of photos: yes  
 availability of maps: yes  
 quality control procedures:  
 Were any quality control procedures applied to your dataset?  
 yes  
 quality control protocols and comments:  
 Sampling and biological and chemical analyses followed standard procedures and Norwegian Standards.  
 reference(s): Direktoratgruppen (2013). Klassifisering av miljøtilstand i vann. Økologisk og kjemisk klassifiseringssystem for kystvann, grunnvann, innsjøer og elver. Veileder 02: 2013. Utgitt av Direktoratgruppen for gjennomføring av Vanndirektivet. 263 pp. (In Norwegian)

## Acknowledgements

This work was supported by MARS (Managing Aquatic ecosystems and water resources under multiple stress), funded by the European Union under the 7th Framework Programme contract no. 603378 and by SUSTAIN (Sustainable management of renewable resources in a changing environment: an integrated approach across ecosystems), funded by the Research Council of Norway contract no. 244647.

## References

- Artsdatabanken, 2015. Artsnavnebasen. Norsk taksonomisk database. <http://www.artsportalen.artsdatabanken.no/>.
- Boehrer, B., Golmen, L., Løvik, J.E., Rahn, K. & Klaveness, D., 2013. Thermobaric stratification in very deep Norwegian freshwater lakes. *Journal of Great Lakes Research* 39 (4): 690-695. <https://doi.org/10.1016/j.jglr.2013.08.003>
- Bottrell, H.H., Duncan, A., Gliwicz, Z.M., Grygierek, E., Herzig, A., Hillbricht-Ilkowska, A., Kurasawa, H., Larsson, P. & Weglenska, T., 1976. A review of some problems in zooplankton production studies. *Norwegian Journal of Zoology* 24: 419-456.
- Direktoratsgruppen, 2013. Klassifisering av miljøtilstand i vann. Økologisk og kjemisk klassifiseringssystem for kystvann, grunnvann, innsjøer og elver. Veileder 02: 2013. Published by Direktoratgruppen for gjennomføring av Vanndirektivet. 263 pp. (In Norwegian)
- Hessen, D.O., Faafeng, B.A. & Andersen, T., 1995. Replacement of herbivore zooplankton species along gradients of ecosystem productivity and fish predation pressure. *Canadian Journal of Fisheries and Aquatic Sciences* 52: 733-742.
- Hobæk, A., Løvik, J.E., Rohrlack, T., Moe, S.J., Grung, M., Bennion, H., Clarke, G. & Piliposyan, G.T., 2012. Eutrophication, recovery and temperature in Lake Mjøsa: detecting trends with monitoring data and sediment records. *Freshwater Biology* 57: 1998-2014. <https://doi.org/10.1111/j.1365-2427.2012.02832.x>
- Holtan, H., 1979. The Lake Mjøsa story. *Archiv für Hydrobiologie, Beiheft* 13: 242-258.

- Kjellberg, G., Hessen, D.O. & Nilssen, J.P., 1991. Life history, growth and production of *Mysis relicta* in the large, fjord-type Lake Mjøsa, Norway. *Freshwater Biology* 26: 165-173. <https://doi.org/10.1111/j.1365-2427.1991.tb01726.x>
- Løvik, J. E., Skjelbred, B., Eriksen, T. E., & Kile, M. R., 2016. Tiltaksorientert overvåking i vannområde Mjøsa. Årsrapport for 2015. (Monitoring of Lake Mjøsa, S Norway. Annual report for 2015. In Norwegian with English summary). Report no. 7028-2016. 105 pp.
- Løvik, J.E & Kjellberg, G., 2003. Long-term changes of the crustacean zooplankton community in Lake Mjøsa, the largest lake in Norway. *Journal of Limnology* volume 62 (2): 143-150. <https://doi.org/10.4081/jlimnol.2003.143>
- Norwegian Standard, 2004. NS 9459:2004. Water quality - Guidance on sampling of phytoplankton from lakes and reservoirs.
- Norwegian Standard, 2006. NS-EN 15204:2006. Water quality - Guidance standard on the enumeration of phytoplankton using inverted microscopy (Utermöhl technique).
- Rognerud, S. & Kjellberg, G., 1990. Long-term dynamics of the zooplankton community in Lake Mjøsa, the largest lake in Norway. *Verhandlungen des Internationalen Verein Limnologie* 24: 580-585. <https://doi.org/10.4081/jlimnol.2003.143>
- Schindler, D.W., 1969. Two useful devices for vertical plankton and water sampling. *Journal of the Fisheries Research Board of Canada* 26: 1948-1955.