UN/ECE Working Group on Monitoring and Assessment

Monitoring of International Lakes

Background paper for the Guidelines on Monitoring and Assessment of Transboundary and International Lakes

UN/ECE Working Group on Monitoring and Assessment

under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992)

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Background paper for the Guidelines on Monitoring and Assessment of Transboundary and International Lakes

Olli-Pekka Pietiläinen and Pertti Heinonen (eds.)

Finnish Environment Institute • Helsinki 2002

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PREFACE

This document is a case study of the general properties and monitoring practices (sampling, analyses, data handling, reporting etc.) of selected transboundary/international lakes in the ECE region. The work was initiated and supervised by the Working Group on Monitoring and Assessment (WGMA) established under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes. The convention was drawn up under the auspices the Economic Commission for Europe and adopted at Helsinki on 17 March 1992. The Helsinki Convention sets, inter alia, the limits of emissions for hazardous substances and the general objectives of water quality. To achieve these targets, the Parties should use the best available technology and the best environmental practices when attenuating the harmful effects of point source and non-point source loading. The Convention also emphasises the role of joint or co-ordinated monitoring and assessment systems and joint or co-ordinated communication, warning and alarm systems in the field of protection and management of surface waters.

Information for this report has mainly been acquired through questionnaires sent to the designated experts in each country participating in the work of WGMA. The questionnaires were replied on a voluntary basis. This is the basic reason why this document does not cover all important transboundary/international lakes in the ECE region. The document “Transboundary Rivers and International Lakes”, a forerunner of the current document, was done by the UN/ECE Task Force on Monitoring and Assessment (the predecessor of the WGMA) and published in 1996. That document covered 14 international lakes in the ECE region. This very report covers 21 lakes, many of which are same as presented in the preceding document.

The main intention of this document is to provide representative and up-to-date information on monitoring and assessment practices covering a good variety of important transboundary/international lakes in the ECE countries. The monitoring and assessment practices seem to vary quite remarkably from lake to lake. In the future, international lakes should be monitored in a even more coherent and consistent way in order to provide reliable and comparable data for the management and conservation purposes of transboundary/international surface waters.

This document has close connections to two other WGMA documents which will be published soon: Monitoring and Assessment of Transboundary and International Lakes; part A: Strategy document, part B: Technical guidelines.

Should there arise any questions or suggestions concerning this document, please contact the authors. The lakes of this document are presented in an alphabetical order. The term "lake" also covers reservoirs (man-made lakes) in this context.

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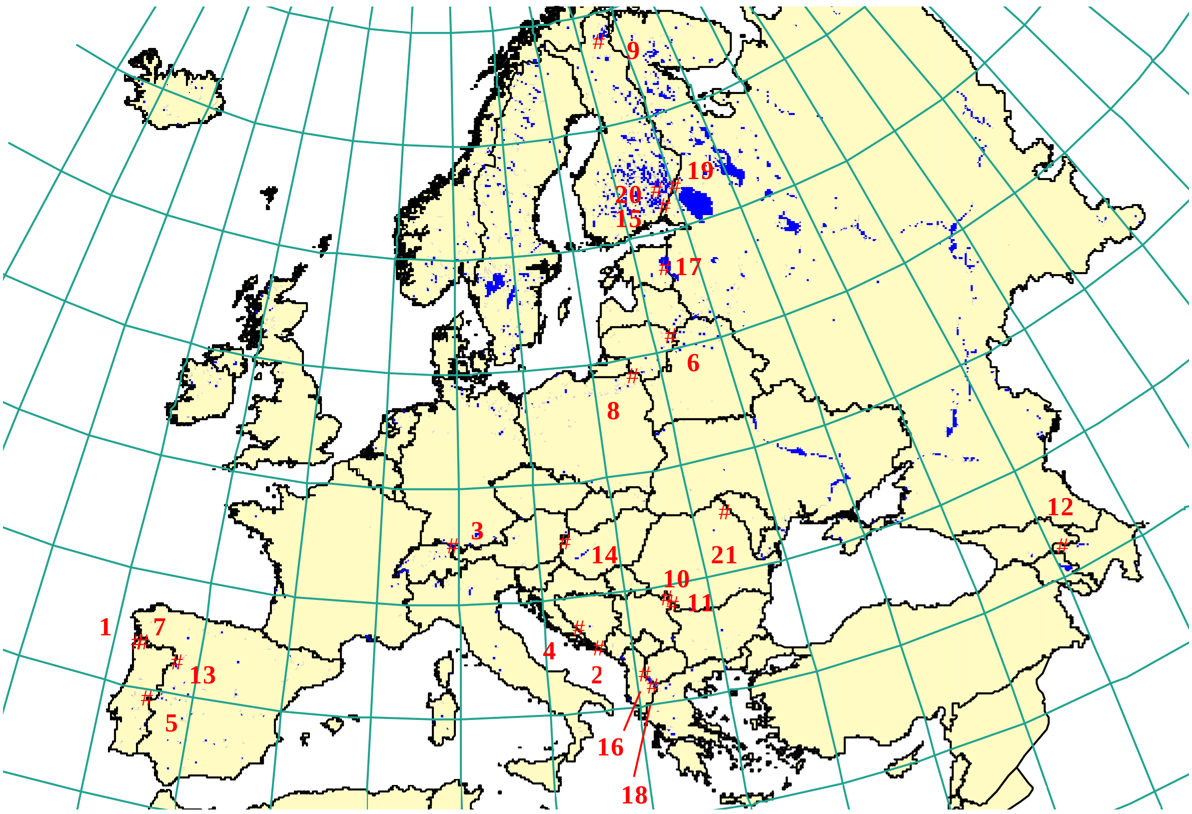


INFORMATION ON SELECTED TRANSBOUNDARY/INTERNATIONAL LAKES

ALTO LINDOSO RESERVOIR (Spain/Portugal)

Name of the lake:

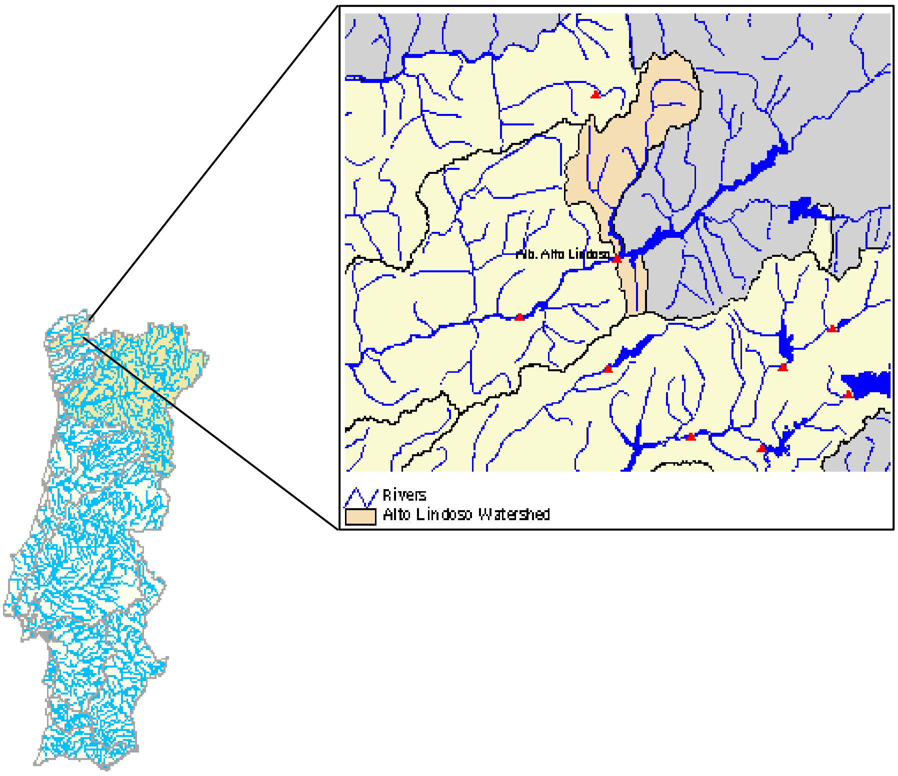
Alto Lindoso reservoir

Nature/history of the lake:

….

Location of the lake:

Countries:	Portugal/Spain	
Geographical region:	Province: Viana do Castelo	City: Ponte da Barca Parish: Lindoso
Coordinates:	Latitude: 41º52'15" (N)	Longitude: 8º12'16" (W)



Location and the Portuguese catchment area of the Alto Lindoso reservoir.

Physical dimensions:

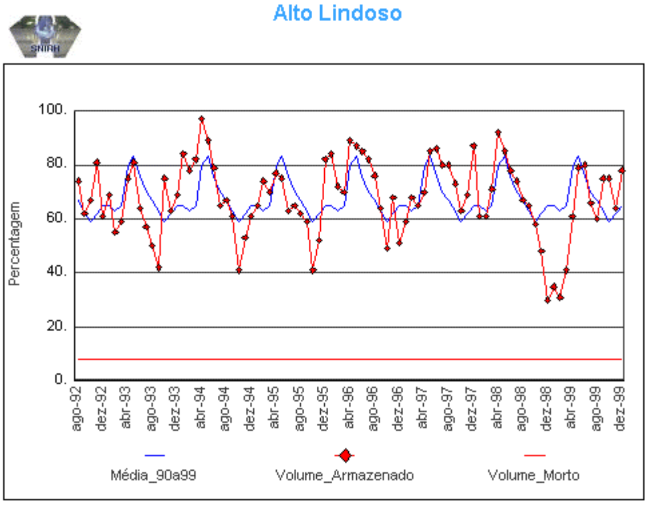
Area:	10.72 km^2
Volume:	390(10^6 m^3
Mean depth:	73 m
Max. depth:	109 m
Elevation:	722 m asl

Catchment area:

Total area:	1,525 km^2 (1,375 km^2 in Spain, 150 km^2 in Portugal)
Natural features:	Mountains basin within a natural park
Population density:	95 inhabitants/km^2
Important cities:	….
Agricultural area:	10 % of the catchment area
Industrial activities:	No industries in the Portuguese part, only a domestic septic tank (112 inhabitants)
Total loading:	Difficult to calculate, the load is mainly coming from Spain

Climatic and hydrological conditions:

Temperature:	Annual mean 11 ºC
Precipitation:	Annual mean 2200 mm
Inflow:	42 m^3/s
Outflow:	38.9 m^3/s
Residence time:	….

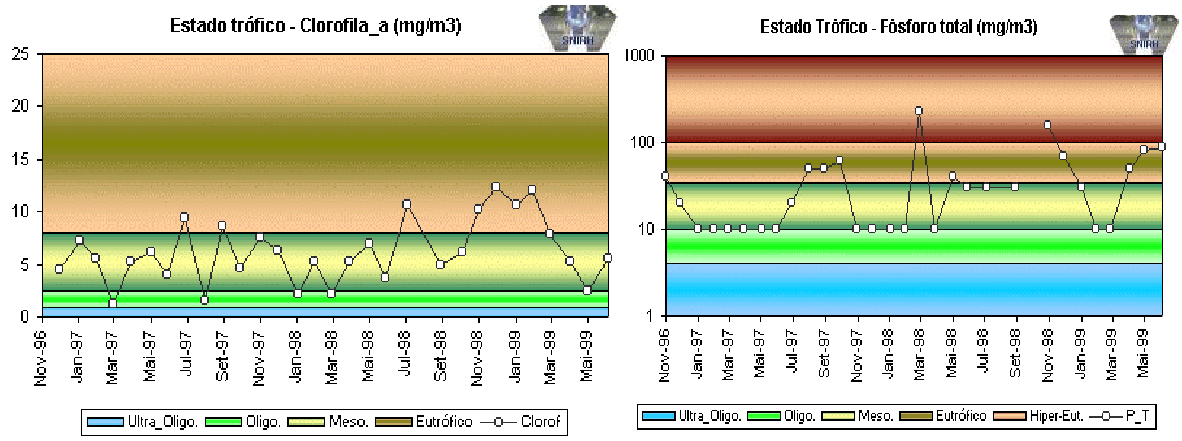


Evolution of the storage volume of the Alto Lindoso reservoir.

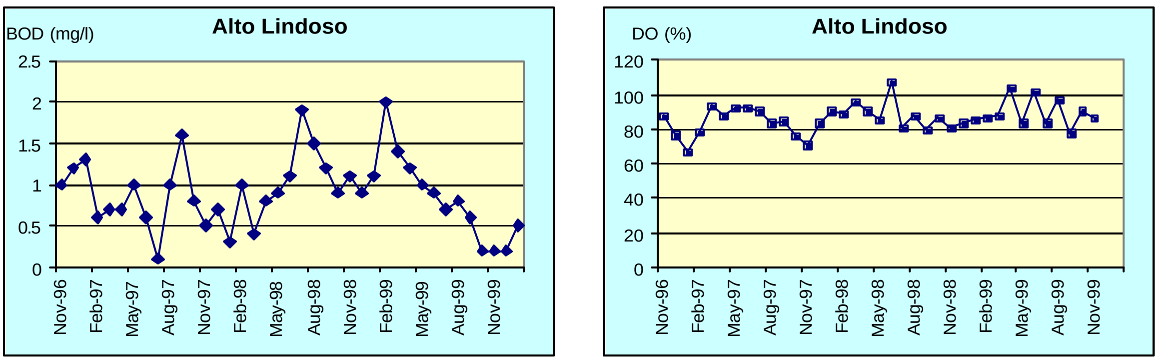
Major uses and functions of the lake:

Hydropower, explored by the National Power Company, is the major use and it has also recreational uses

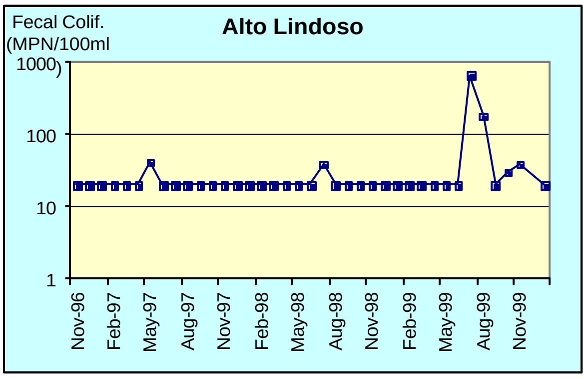
Long-term water quality changes / the present state of the lake:

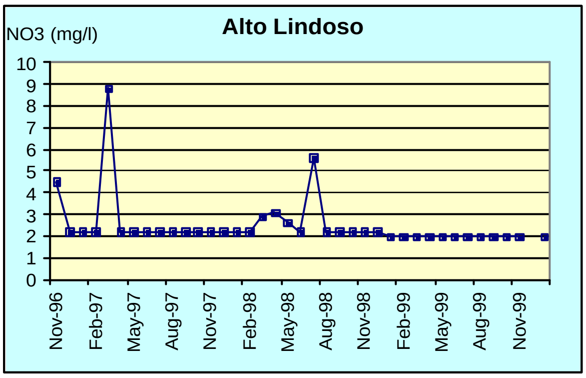


Long-term values of total phosphorus and chlorophyll *a* in the Alto Lindoso reservoir.



Long-term values of biochemical oxygen demand and dissolved oxygen in the Alto Lindoso reservoir.





Long-term values of fecal coliforms and nitrates in the Alto Lindoso reservoir.

Main problems/threats:

The eutrophication process is starting to be a problem in the lake. The trophic state of the reservoir is mesotrophic.

International agreements concerning water use and water protection:

….

Monitoring programmes:

The reason for monitoring is twofold: configuration of a large dam and its position as a boundary lake. In this lake the water quality has been monitored since November 1996 and the storage evolution since August 1992, with a monthly frequency. The attached graphics above show the evolution of the storage volumes and some water quality variables observed on this reservoir.

Reporting activity / exchange of information:

….

Data availability:

….

Use of reports for the management purposes:

….

Organisation(s) responsible for the monitoring programmes / contact person(s):

The Regional Water Authority for Northern Portugal is responsible for sampling and analysing the water quality data; the National Power Company monitors the storage volumes of the reservoir. The Institute for Water is responsible for the management of the all data and the storage of the information on the national database (SNIRH). The contact person at the Institute for Water is Engº Rui Rodrigues (e-mail: rrr@inag.pt, web: www.inag.pt/snirh).

Main publications/references:

….

LAKE BILECKO (Bosnia and Herzegovina/Montenegro, Yugoslavia)

Name of the lake:

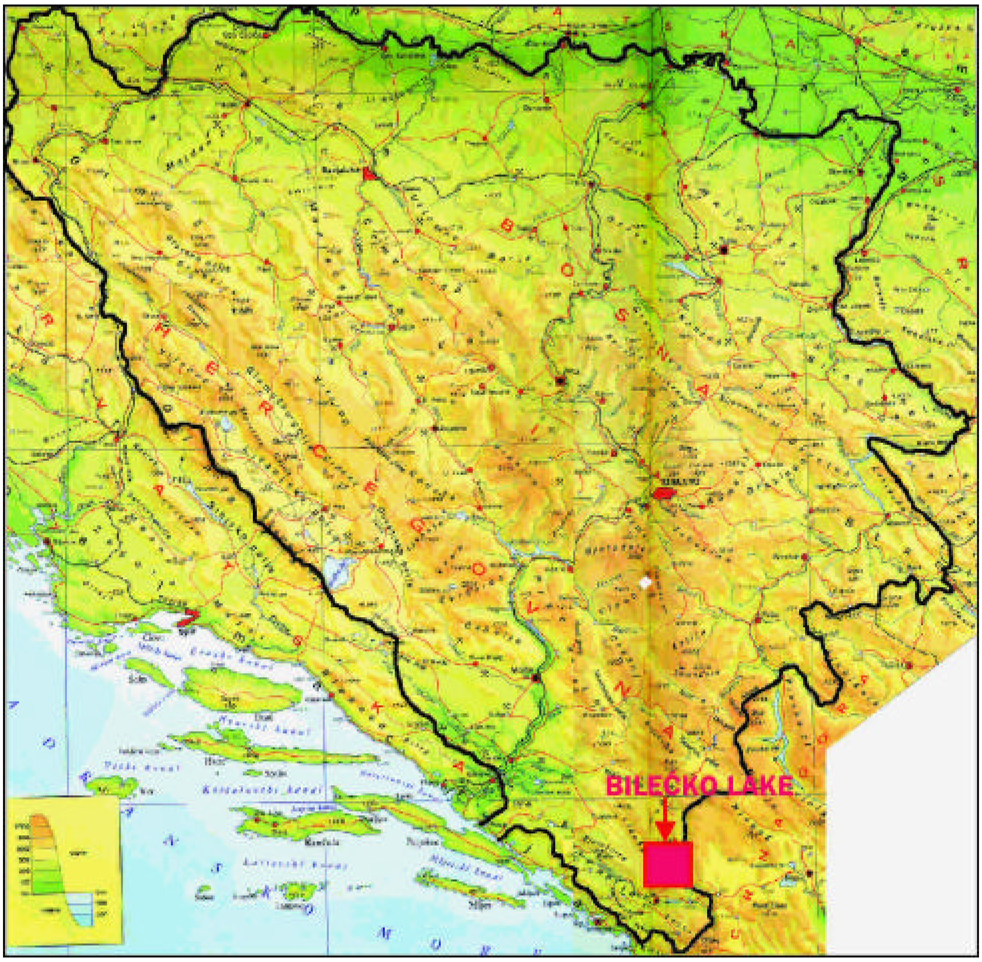
Bilecko jezero (Bilecko Lake)

Nature/history of the lake:

Artificial lake - reservoir formed in 1967

Location of the lake:

Countries:	Bosnia and Herzegovina / Yugoslavia
Geographical region:	Republic of Srpska, Bosnia & Herzegovina / Montenegro,Yugoslavia
Coordinates:	Latitude: 42º46' (N) Longitude: 18º27' (E)



Location of Lake Bilecko, a transboundary reservoir shared by Bosnia and Herzegovina and Montenegro, Yugoslavia.

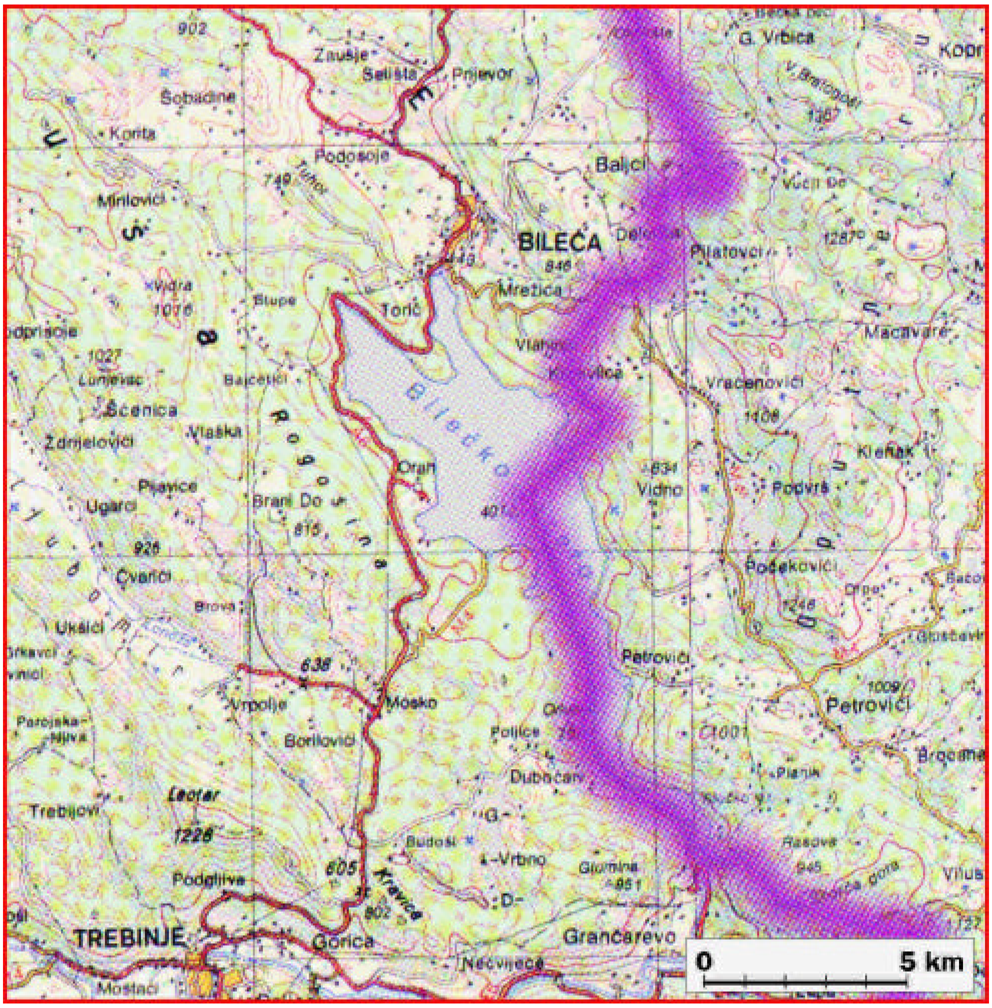
Physical dimensions:

Area:	27.64 km^2
Volume:	$1{,}280 \times 10^6$ m^3
Mean depth:	46.3 m
Max. depth:	104 m
Elevation:	401 m asl

Catchment area:

Total area:	Approximately 10,100 km^2 (Neretva River and Trebisnjica River), however, due to the complexity of karstic terrain the area varies.
Natural features:	Situated in very complex karstic area of the Adriatic sea basin. The whole area consists of limestone and dolomites from the Mesozoic age.

Population density:	18 inhabitants/km^2 (1991)
Important cities:	Bileca
Agricultural area:	390 km^2, approximately 3-4% of the catchment area
Industrial activities:	Textile and carpet industry "Bilecanka"
Total loading:	Population Equivalent = 22,225 (1991)



Map over the Lake Bilecko region.

Climatic and hydrological conditions:

Temperature:	Annual mean 12.1 ºC
Precipitation:	Annual mean 1,633 mm
Inflow:	85.6 m^3/s
Outflow:	Artificial water management regime
Residence time:	200 days (conditional time of water exchange)

Major uses and functions of the lake:

Hydropower production, control of floods, irrigation, increase of water quantity

Long-term water quality changes / the present state of the lake:

Due to the very big surface area and long retention time of the reservoir, water is exchanging very slowly creating a suitable environment for the development of eutrophication. Wastewaters from the textile industrial plant "Bilecanka", located in the city of Bileca near the lake, are discharged directly into the lake. In the past, there were certain problems related to the presence of *Escherichia coli* in the water, as well as the presence of parasite *Ligula intestinalis* in the intestinal tract of fish.

Main problems/threats:

Eutrophication

International agreements concerning water use and water protection:

Bosnia and Herzegovina still has not ratified the Helsinki and Danube Conventions. As a legal successor of the Socialistic Republic of Bosnia and Herzegovina, Bosnia and Herzegovina (at that time the Republic of Bosnia and Herzegovina) became a member of the international multilateral agreements on environment and waters, as well as those related to the environment. One of these agreements is the Convention on the Protection of Mediterranean Sea against Pollution known as the Barcelona Convention (1976) and its 4 Protocols from the period 1976-1982.

The governments of B&H and Croatia have signed the Agreement on regulation of interrelations in the field of water management (Dubrovnik, 1996). In general, the Agreement represents the verification of agreement signed between Socialistic Republic of Bosnia and Herzegovina and Croatia in the period from 1978-82. Main subjects treated in this Agreement are related to water usage, without the usage of modern water management principles. The protection of transboundary water was also poorly treated in the Agreement. However, at present, the validity of the Agreement is questionable since the representatives from the Republic of Srpska were not present at the signing ceremony.

In 1984, the Socialistic Republic of Bosnia and Herzegovina and the Socialistic Republic of Serbia signed the Agreement related to the Drina River.

Monitoring programs:

Unfortunately, after the war (1992-1995) monitoring programs at the whole territory of Bosnia and Herzegovina have been brought to the minimum. No regular monitoring programs exist neither for this lake nor for the majority of rivers and other lakes in the area. The reservoirs are not equipped with adequate equipment or instruments for water quality monitoring, and no care is taken concerning the development of water quality. For more details on monitoring of rivers and lakes in Bosnia and Herzegovina, please consult reference 6.

Reporting activity / exchange of information:

….

Data availability:

….

Use of reports for the management purposes:

….

Organisation(s) responsible for the monitoring programmes / contact person(s):

….

Main publications/references:

Bjelica, S. Review of Water Quality Analysis and Pollution Degree of Reservoirs on Hydropower Plants System Trebisnjica, Proceedings from Symposium on Artificial Lakes' Influence on Living Environment, Trebinje, B&H, 15-18 March, 1978.

Kupusovic, T., Nuhic, D. Water Reservoirs in Bosnia and Herzegovina: pro et contra, Proceedings from Symposium on Soil and Water Use Relating to Sustainable Development and Environmental Protection, Sarajevo, B&H, 17-19 July, 1998.

Framework Basis for Water Management in Bosnia and Herzegovina, Water Management Institute, Sarajevo, B&H, 1994.

Statistical Annuals of Federal Meteorological Institute, Sarajevo.

Documentation of Hydro-Engineering Institute, Sarajevo.

Kupusovic, T., Radulovic G., Kupusovic, E., San, I. and Jusic, S. New Approaches to Water Monitoring And Assessment in Bosnia & Herzegovina, Proceedings from International Workshop on Information for Sustainable Water management MTMIII, 25-28 September, 2000, Nunspeet, The Netherlands.

LAKE BODENSEE/CONSTANCE (Austria/Germany/Switzerland)

Name of the lake:

Lake Bodensee/Lake Constance

Nature/history of the lake:

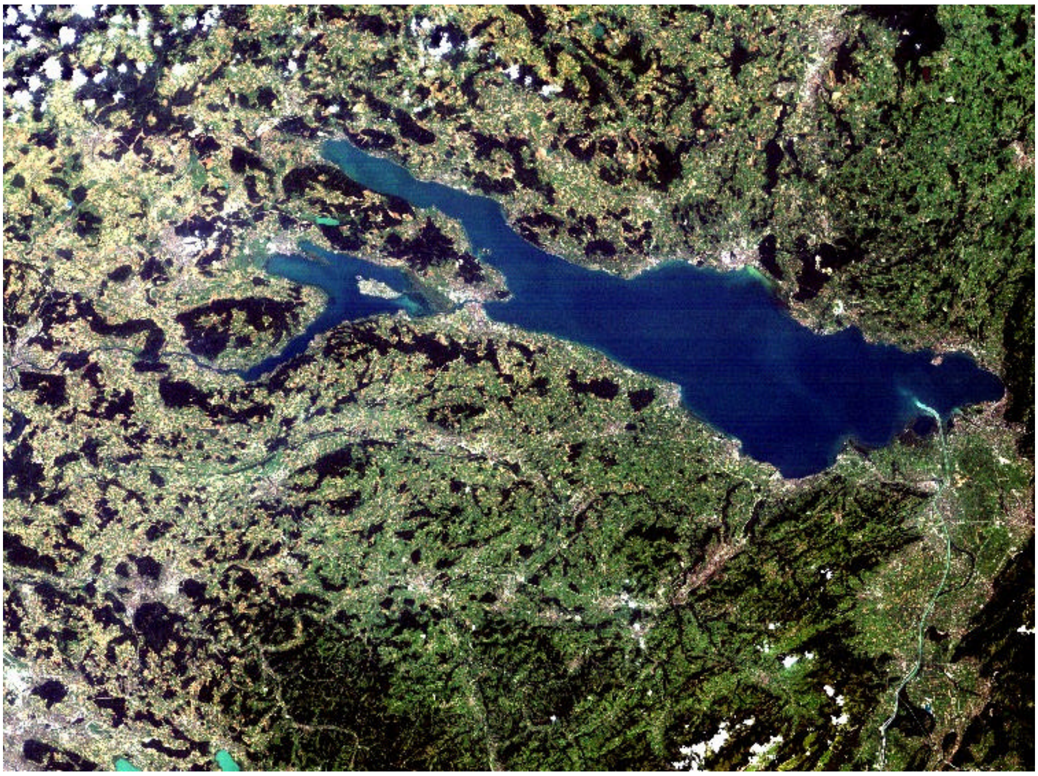
Natural lake formed/reshaped by the last Ice Age about 15,000 years ago

Location of the lake:

Countries:	Austria/Germany/Switzerland	
Geographical region:	Pre-alps	
Coordinates:	Latitude: 5276250	Longitude: 3528300

Physical dimensions:

Area:	572 km^2
Volume:	48,522*10^6 m^3
Mean depth:	85 m
Max. depth:	254 m
Altitude:	395.45 m



Data: German Aerospace Centre (DLR Oberpfaffenhofen), Dr. Thomas Heege, DLR Oberpfaffenhofen.

Catchment area:

Total area:	11,488 km^2
Natural features:	Catchment area alpine + pre-alpine
Population density:	Approx. 122 inhabitants/km^2 (2001)
Important cities:	Konstanz, Friedrichshafen, Lindau, Bregenz
Agricultural area:	5,147 km^2 (2001)
Forest area:	3,107 km^2 (2001)
Urban area:	653 km^2 (2001)
Industrial activities:	High Tech, IT, Automotive supply
Total loading to the lake:	1,495 t/a P (Obersee, 1997)
	15,934 t/a N (Obersee 1997)
	59,395 t/a Corg (Obersee 1997)

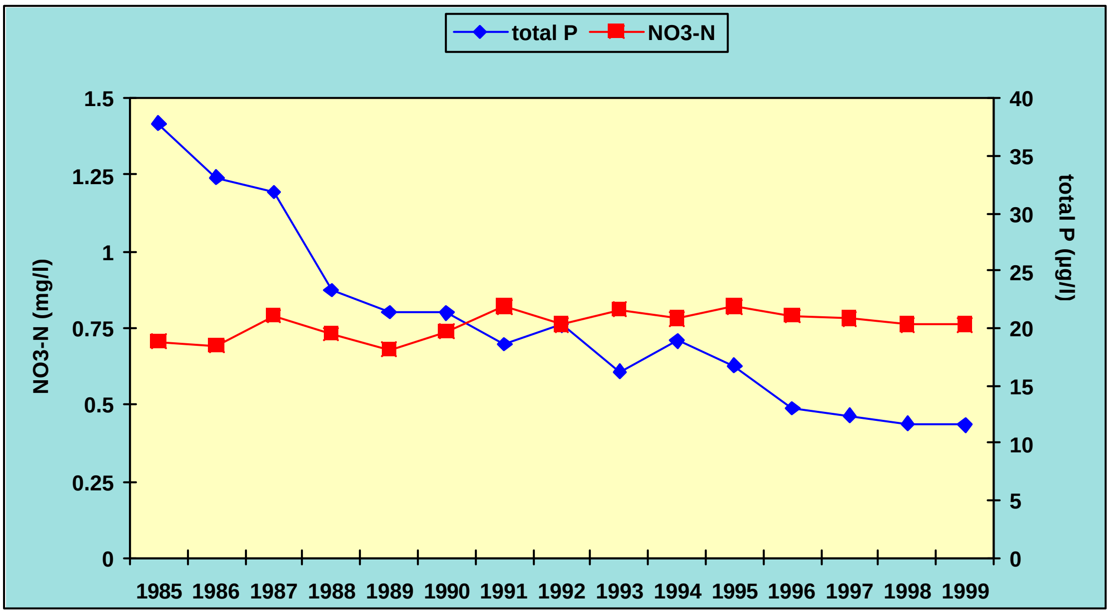
Climatic and hydrological conditions:

Temperature:	Annual mean 8.6 °C
Precipitation:	Annual mean 950 mm
Inflow:	370 m^3/s
Outflow:	370 m^3/s
Residence time:	4.2 years

Major uses and functions of the lake:

Drinking water supply, fishery, recreation, scientific studies

Long-term water quality changes / the present state of the lake:



Total phosphorus concentrations increased from the early 1950s until to the beginning of 1980s. Since then phosphorus concentrations have shown a decrease. The improvement is mainly due to the diminished loading of phosphorus caused by point sources. The concentrations of total nitrogen (input mainly from agriculture) has remain unchanged.

Main problems/threats:

Eutrophication, toxic substances, deterioration of banks

International agreements concerning water use and water protection:

International Commission for the protection of Lake Constance (IGKB) 1959

Monitoring programmes:

The lake is monitored by the IGKB regularly. The lake is also monitored for scientific purposes.

Duration of monitoring: Since 1961

Sampling activity: At least monthly

Physical and chemical analyses: Temperature, oxygen, total phosphorus (P), PO_4-P, part. P, NO_3-N, NO_2-N, NH_4-N, part. N, Kjeldahl-N, SiO_2, inorg. C, Fe, Mn, pH, alkalinity, conductivity, Fe, Mn, Na, K, Ca, Mg, Cl, SO_4

Biological analyses: Chlorophyll *a*, chlorophyll *a+b*, phaeophytin, phytoplankton biomass, zooplankton biomass (benthic animals and fish population are irregularly studied)

Microbiological analyses: Bacterioplankton

Radiological analyses: Yearly by LfU (State Institute for Environmental Protection Baden-Württemberg - Landesanstalt für Umweltschutz Baden-Württemberg)

Reporting activity / exchange of information:

Monitoring results reported yearly by IGKB

Data availability:

Water quantity and quality data is stored in the Data System of IGKB (ORACLE Data Base).
Selected data are available at the Water Quality Data System QUADAWA at the German Federal Environmental Agency (Umweltbundesamt).

Use of reports for the management purposes:

Local, regional and national environmental authorities for inspection, supervision and enforcement of water management related issues mainly use these reports

Organisation(s) responsible for the monitoring programmes / contact person(s):

Responsible organisation:
International Commission for the protection of Lake Constance / Internationale Gewässerschutzkommission für den Bodensee
c/o Landesanstalt für Umweltschutz Baden-Württemberg
Institut für Seenforschung
P.O. Box 42 53
D-88081 Langenargen
Germany

Main publications/references:

BÄUERLE E., O. OLLINGER AND J. ILMBERGER (1998) Some meteorological, hydrological, and hydrodynamical aspects of Upper Lake Constance. *Arch. Hydrobiol. Spec. Issues Advanc. Limnol., 53, 31-83*.

BODENSEE-STIFTUNG (The Lake Constance Foundation)
http://www.bodensee-stiftung.org/

BWV (Bodensee-Wasserversorgung); The Lake Constance Water Supply Board
http://www.zvbwv.de/

DGJ (1996): Deutsches Gewässerkundliches Jahrbuch. Rheingebiet, Teil I. Landesanstalt für Umweltschutz Baden-Württemberg (eds.), *162*, Karlsruhe.

GELLER W. AND H. GÜDE. (1989) Lake Constance – the largest German lake. *W. Lampert and K.-O. Rothaupt (eds.), Limnology in the Federal Republic of Germany. Int. Ass. Theor. Appl. Limnol. 13-19 Aug 1989, Munchen, 9-17*.

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IGKB: Yearly Monitoring Reports (*Jber. Int. Gewässerschutzkommision Bodensee:* Limnol. Zust. Bodensee – ISSN 1011-1271)

IGKB (1998): Die submersen Makrophyten des Bodensees - 1993 im Vergleich mit 1978 und 1967. Report Nr. 46.

IGKB (1998): Zustand des Seebodens 1992-1994 - Sedimentsinventare - Phosphor – Oligochaeten. Report Nr. 47.

IGKB (1998): Langjährige Entwicklung chemischer Parameter im Bodensee-Obersee. Report Nr. 48.

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IGKB (2000): Transport wassergefährdender Stoffe im Ufer- und Zuflußbereich des Bodensees. Report Nr. 52.

IGKB - Internationale Gewässerschutzkommission für den Bodensee. http://www.seespiegel.de/

INTERNATIONAL LAKES ENVIRONMENT COMMITTEE (ILEC) FOUNDATION. World Lakes Database – Bodensee (Lake Constance). http://www.ilec.or.jp/database/eur/eur-33.html

KÜMMERLIN R.E. (1998) Taxonomical response of the phytoplankton community of Upper Lake Constance (Bodensee-Obersee) to eutrophication and re-oligotrophication. *Arch. Hydrobiol. Spec. Issues Advanc. Limnol., 53, 109-117.*

Länderarbeitsgemeinschaft Wasser (LAWA): Seen in der Bundesrepublik Deutschland. München 1985.

LUFT G. (1993): Langfristige Veränderung der Bodensee-Wasserstände und mögliche Auswirkungen auf Erosion und Ufervegetation. In: W. Ostendorp and P. Krumscheid-Plankert (edts): Seeuferzerstörung und Seeuferrenaturierung in Mitteleuropa, *61-75*, Gustav Fischer (publ.), Stuttgart.

PRASUHN V. (1999) Phosphor und Stickstoff aus diffusen Quellen im Einzugsgebiet des Bodensees 1996/97. *Internationale Gewässerschutzkomission für den Bodensee, Blaue Bericht Nr. 51.*

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SCHRÖDER H.G., M. WESSELS AND F. NIESSEN (1998): Acoustic facies and depositional structures of Lake Constance. *Arch. Hydrobiol. Spec. Issues Advanc. Limnol., 53, 351-368.*

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WESSELS M. (1998): Geological history of the Lake Constance area. *Arch. Hydrobiol. Spec. Issues Advanc. Limnol., 53, 1-12.*

LAKE BUSKO (Bosnia and Herzegovina/Croatia)

Name of the lake:

Busko jezero (Lake Busko)

Nature/history of the lake:

Artificial lake - reservoir formed in 1973

Location of the lake:

Countries:	Bosnia and Herzegovina
Geographical region:	Livanjsko Field, Federation of Bosnia & Herzegovina, Bosnia and Herzegovina. The lake is completely located at the territory of Bosnia and Herzegovina but the use of its water is on the territory of Croatia.
Coordinates:	Latitude: 43°40' (N) Longitude: 17° 05' (E)

Map over the Lake Busko region.

Physical dimensions:

Area:	55.8 km^2
Volume:	$800*10^6$ m^3
Mean depth:	….
Max. depth:	17.3 m
Elevation:	716.5 m asl

Catchment area:

Total area:	Approximately 2,310 km^2 (Cetina River catchment area).
Natural features:	The area of Lake Busko belongs to the complex or geosynclinal kart with thick linked carbonate layers. Narrower area basically consists of cretaceous carbonate layers. Its brim consists of the same layers. On smaller area only, tertiary sediment was deposited on the cretaceous layers.
Population density:	26 inhabitants/km^2 (1998)
Important cities:	Tomislavgrad, Livno
Agricultural area:	188,578 ha (pasture: 117,855 ha; arable land: 70,723 ha)
Industrial activities:	Wood processing in Livno and Tomislavgrad, textile industry and industry of aluminium-steel wires in Livno, Thermo Power Plant in Livno, coal mine Tusnica near Livno.
Total loading:	Population Equivalent = 22,057 (1991)

Climatic and hydrological conditions:

Temperature:	Annual mean temperature 8.9 ºC
Precipitation:	Annual mean precipitation 1470 mm
Inflow:	31.9 m^3/s
Outflow:	Artificial water management regime
Residence time:	Days

Major uses and functions of the lake:

Hydropower production, control of floods, irrigation

Long-term water quality changes / the present state of the lake:

Based on the water quality analyses done in the period 1996-1998, it can be said that the state of the lake is satisfactory. The concentration of particular indicators exceeded the permissible values: phenol values were increased by 8.3% and heavy metal chromium by 16.7%. The other measured parameters are the following:

Data on the water quality in the storage reservoir Lake Busko (mean values for 1996-1998):

Temperature (°C)	PH	Oxyg. (mg/l)	% satur.	BOD_5 (mg/l)	$KMnO_4$ (mg/l)	Total N (mg/l)	total chollyformi/ 100 ml
11.4	20	8.5-13.3	67-118	1.9-3.4	7.2-10	0.233	0-1,300

Main problems/threats:

Phenols and chromium

International agreements concerning water use and water protection:

Bosnia and Herzegovina has still not ratified the Helsinki and Danube Conventions. As a legal successor of the Socialistic Republic of Bosnia and Herzegovina, Bosnia and Herzegovina (at that time the Republic of Bosnia and Herzegovina) became a member of the international multilateral agreements on environment and waters, as well as those related to the environment. One of these agreements is the Convention on the Protection of Mediterranean Sea against Pollution known as the Barcelona Convention (1976) and its 4 Protocols from the period 1976-1982.

The governments of B&H and Croatia have signed the Agreement on regulation of interrelations in the filed of water management (Dubrovnik, 1996). In general, the Agreement represents the verification of agreement signed between the Socialistic Republic of Bosnia and Herzegovina and Croatia in period between 1978-82. Main subjects treated in this Agreement are related to water usage, without usage of modern water management principles. The protection of transboundary water was also poorly treated in the Agreement. However, at present, the validity of the Agreement is questionable since the representatives from the Republic of Srpska were not present at the signing ceremony.

In 1984, the Socialistic Republic of Bosnia and Herzegovina and the Socialistic Republic of Serbia signed the Agreement related to Drina River.

Monitoring programs:

Unfortunately, after the war (1992-1995) monitoring programs at the whole territory of Bosnia and Herzegovina have been brought to the minimum. No regular monitoring programs exist neither for this lake nor for the majority of rivers and other lakes in the area. The reservoirs are not equipped with adequate equipment and instruments for water quality monitoring, and no care is taken about the water quality development. For more details on monitoring of rivers and lakes in Bosnia and Herzegovina, please consult reference 5. The Cetina River catchment area has been monitored for quality parameters for some time. Lake Busko belongs to the Cetina River catchment area, where the quality analyses were performed monthly in period between 1996-1998. However, this is not part of regular monitoring activity.

Reporting activity / exchange of information:

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Data availability:

….

Use of reports for the management purposes:

….

Organisation(s) responsible for the monitoring programmes / contact person(s):

….

Main publications/references:

Nikolic, R. Water Balance of the Busko Jezero Reservoir, Bulletin of Speleological Society "Nas Krs/Our Karst", Volume VI, no 10-11, 1981, p. 165.

River Cetina Watershed and the Adjacent Coastal Area, *Environmental and Socio-economic Profile*, UNEP/MAP/ Priority Actions Program, 2000.

Kupusovic, T., Nuhic, D. Water Reservoirs in Bosnia and Herzegovina: pro et contra, Proceedings from Symposium on Soil and Water Use Relating to Sustainable Development and Environmental Protection, Sarajevo, B&H, 17-19 July, 1998.

Framework Basis for Water Management in Bosnia and Herzegovina, Water Management Institute, Sarajevo, B&H, 1994.

Statistical Annuals of Federal Meteorological Institute, Sarajevo.

Documentation of Hydro-Engineering Institute, Sarajevo.

Kupusovic, T., Radulovic G., Kupusovic, E., San, I. and Jusic, S. New Approaches to Water Monitoring And Assessment in Bosnia & Herzegovina, Proceedeings from International Workshop on Information for Sustainable Water management MTMIII, 25-28 September, 2000, Nunspeet, The Netherlands.

CEDILLO/CEDILHO RESERVOIR (Spain/Portugal)

Name of the lake:

Cedillo reservoir

Nature of the lake:

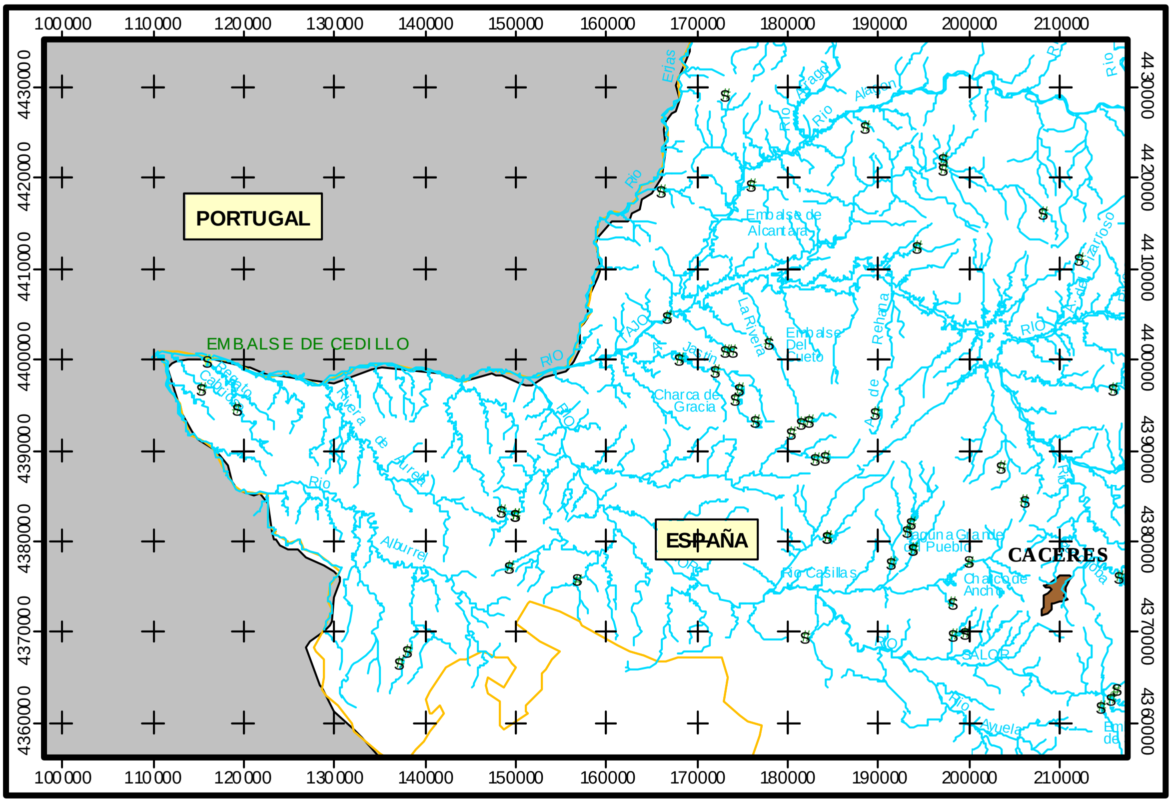
Man-made reservoir

Location of the lake:

Countries:	Spain/Portugal
Geographical region:	Extremadura, Cáceres province, Tajo/Tejo river basin
Coordinates:	Latitude: 4391667 (YUTM)
	Longitude: 625097 (XUTM) (referred to zone 29)
	Also: 39º39’54” (N) 7º32’30” (W)

Physical dimensions:

Area:	14 km^2
Volume:	260*10^6 m^3
Mean depth:	….
Max. depth:	117 m
Elevation:	120 m asl



Location of Cedillo reservoir (referred to zone 30).

Catchment area:

Total area:	59,000 km^2
Natural features:	Granites of Paleozoic age
Population density:	30 inhabitants/km^2
Most important town:	Cedillo (Cáceres)
Agricultural area:	Predominant

Climatic and hydrological conditions:

Temperature:	Annual mean 10 ºC
Precipitation:	Annual mean 584 mm
Inflow:	325 m^3/s
Outflow:	325 m^3/s
Residence time:	….

Major uses and functions of the lake:

Hydroelectric power production 440,000 Kw.
Belongs to IBERDROLA hydropower Co.

Long-term water quality changes / the present state of the lake:

….

Main problems/threats:

….

International agreements concerning water use and water protection:

Convention on the Protection and use of Transboundary Watercourses and International Lakes, 1992.

Convention on Cooperation for the protection and sustainable use of the waters of the Spanish-Portuguese catchment areas. The agreement between Spain and Portugal was signed in 1998 and entered into force in 1999.

Monitoring programmes:

To be determined by the bilateral Commission of the Convention

Reporting activity / exchange of information:

Both Parties to the Convention will exchange available information, on a regular and systematic basis, on matters covered by the Convention and on data and records regarding these matters. These data and records are referred to in an Annex to the Convention.

Data availability:

Information on matters covered by the Convention shall be made available to whoever makes a reasonable request

Organisation(s) responsible for the monitoring programmes / contact person(s):

Ministerio de Medio Ambiente. Mr. Angel Cajigas

Main publications/references:

Ministerio de Medio Ambiente. Inventario de presas españolas. 2000.

LAKE DRISVYATY/DRUKSHIAI (Belarus/Lithuania)

Name of the lake:

Lake Drisvyaty

Nature/history of the lake:

Lake Drisvyaty is of glacial origin and was formed during the Baltic stage of the Neman complex

Location of the lake:

Countries:	Belarus/Lithuania
Geographical region:	Drisvyata river basin in the Braslav region of the Vitebsk Province
Coordinates:	Latitude: 55°38' (N) Longitude: 26°36' (E)

Physical dimensions:

Area:	49 km^2 (6.7 km^2 in Belarus, 42.3 km^2 in Lithuania)
Volume:	369(10^6 m^3
Mean depth:	7.6 m (high water)
Max. Depth:	33.6 m (high water)
Elevation:	141.2 – 151.4 m asl (varies according to the regulation)

Catchment area:

Total area:	613 km^2
Natural features:	….
Population density:	….
Important cities:	….
Agricultural area:	….
Industrial activities:	….
Total loading:	….

Climatic and hydrological conditions:

Temperature:	Annual mean 5.4 °C (January –6.6 °C, July +17.4 °C)
Precipitation:	Annual mean 615-640 mm
Inflow:	….
Outflow:	….
Residence time:	….

Basic characteristics of the lake and its drainage basin:

Lake Drisvyaty is a trans-border wetland, shared by Belarus and Lithuania and is attributed to the Braslav lake group. The lake is situated in the basin of the Prorva river, the left tributary of the Drisvyaty river draining to the Disna river. L. Drisvyaty is one of the largest lakes in Belarus and Lithuania. The lake has a form of an arc stretched from west to south. There are 7 islands comprising a total area of about 36 ha. The biggest island, Zamkovy, is about 26 ha in area. The hollow of the lake has a laciniate form with indented coastline and numerous boulders especially in the southern part. The bottom is sandy and sandy-pebbly up to the depth of 5 meters, while silts are deposited deeper. The shores are mainly slow and swampy, and there are some hills and ridges along slopes of the lake basin, up to 15 m in height, covered by forests. Lesser massifs of raised and transitional bogs adjoin the lake; there are sites of flooded meadows and lowland bogs. The lake is an important area for waterfowl to breed, stage and moult. Some of the bird species are rare and protected. In 1953 a water power station was constructed at the Prorva river draining from the lake and in 1984 the Ignalina Nuclear Power Station was built at the western bank of the lake (Lithuania). The lake is used as a cooler of this station. The drainage basin of L. Drisvyaty includes 113 other lakes, the biggest of them are Richi (1293 ha), Alvardai (584 ha), Prutas (452 ha) and Smalvas (336 ha).

The groundwater regimen is primarily affected by infiltration of atmospheric precipitation. Seasonal amplitude of water level fluctuations on the lake is about 100 cm, the average daily fluctuation amplitude - 2.3 cm, the maximum - 5 cm, and the minimum 0.5 cm. The average length of a spring flood is 82 days. A major part of the lake is ice-covered in winter, but the site adjoining the Ignalina Nuclear Power Station is always ice-free.

L. Drisvyaty belongs to the following Ramsar wetland types: Inner wetlands, permanent freshwater lake (O), permanent streams (N), permanent freshwater marshes (Tr), seasonal (temporal) freshwater marshes including flooded meadows and sedge marshes, freshwater tree-dominated wetland (Xf), tree-dominated peatbogs (Xp).

Ecological features

In the ecological complex of the Drisvyaty wetland the following ecotypes are distinguished: the water area, the coastal line, islands, floodplain forests and marshes.

The water area of Lake Drisvyaty:

The lake is deep and characterised by a large surface area and thermal stratification of water masses, oxygen-saturated bottom layers of water, low concentration of phosphorus compounds, low eutrophication and the presence of a complex of glacial relict species. pH of the lake water is 7.32 – 8.49, the CO_2 concentration does not exceed 15.5 mg/l.

95 species of aquatic and semi-aquatic plants are found in the lake helogigrophils and the algae is dominated by the genus *Chara*. The number and biomass of phytoplankton has varied between 1235 and 15 440 000 cells per litre. Blue-green algae dominate the phytoplankton community.

The wetland provide a refuge for numerous flocks of waterfowl.

Coastline:

There are three main peninsulas and two major bays on the lake. The banks of the lake are preferentially low and overgrown with alder and other small-leaved trees. About 5% of the highest steep banks (up to 8-10m) are covered by pinewood. In the southern part of the lake the coastal slopes are partly cultivated and ploughed.

The structure of the soil is heterogeneous. About 43 % of the coastline is loamy, 36 % sandy, and 21 % peaty. The width of the coastal vegetation ranges from 30 to 200 m. The plant associations and communities of this zone are dominated by *Phragmitetum australis* and *Scirpetum lacustris*.

The coastal reed zone is populated by the colonies of the Great Crested Grebe. Several gull species and a variety of wildfowl is also found in this region.

Islands:

The islands of the lake consist mainly of sandy and sandy-gravel soil and are open and overgrown with gygro-mesophilic vegetation. The islands are practically not exposed to any substantial anthropogenic pressure. They provide a refuge for a number of waterfowl species including some rare and protected ones.

Floodplain forests:

Large forest areas are mainly situated on the north-western and south-western coasts of the lake and consist mainly of spruce and birch. The highest parts of the relief are mainly vegetated by coniferous trees (about 80%).

Coastal forests:

The coastal forests are of great importance for water protection. This zone is characterized by the colonies of the Grey Heron (*Ardea cinerea*) and the Cormorant (*Phalacrocorax carbo*). Several species of birds of prey and some waterfowl are also breeding in this zone.

Floodplain marshes:

They are quite small in area and stretched along the floodplains of Drisvyata, Opyvardka, Smalva and Rychanka. They are also found in the hollows of lesser-discharged lakes. They are presented by sedge associations with some sites of reed along the riverbeds and willow brakes on the borders of floodplain terraces.

Floodplain marshes are important from the point of view of wildfowl protection. Many species of stints and ducks are breeding here. A number of species having significant regional or international protection status are reported here as well.

Major uses and functions of the lake:

From the Lithuanian side the lake is used as a water-cooling reservoir for the Ignalina Nuclear Power Station. From the Belorussian side the lake is used for commercial and free-time fisheries.

Adjacent forests are exploited by the Braslav state timber industry enterprise. The lake is surrounded by approximately 1 km wide forest belt, which is important from the point of view of water protection. These forests are cut down seldom and very selectively.

The meadows are used by the local people for haymaking and cattle grazing. In the south and southeast the ploughed lands adjoin the coast of the lake to some extend.

The coastal zone is used for recreational purposes as well but due to the trans-border location of the lake the pressures onto natural communities are not essential.

Long-term water quality changes / the present state of the lake:

….

Main problems/threats:

The following factors influence negatively on natural communities:

Immediately on the lake:

The discharge of industrial thermal waters from the Ignalina Nuclear Power Plant and non-purified sewage from the Lithuanian town Sneckus are a problem. An accumulation of polluted sediments was registered in deeper parts of the lake (up to 1.4 kg/m^2). 3.9 % of the bottom is polluted with oil products. 27.5 % of the lake bottom sediments are moderately or heavily polluted with heavy metals (Pb, Cd, Cr, Zn, Cu) and petroleum hydrocarbons. As a result the lake is transforming into a moderately polluted watercourse.

Thermal pollution influences extremely negatively on the lake resulting in eutrophication and, subsequently, degradation of the most valuable relict component of a zoo- and phytocenosis complex.

The changes of hydrological regimen of the wetland are a problem. After the construction of a hydroelectric power station at the Prorva river the water level of the lake rose up to 1m. This has resulted in the submerging of the lowered floodplain part of the wetland. The annual fluctuation of the lake water level, depending on the changes of filling, is up to 0.9m, what may cause flooding of bird nests during the breeding period. The Ignalina NPS is connected to the lake by two channels. The amount of water discharged from the station is 9 times the volume of the lake and 27 times the natural annual influx of water to the lake.

The lake is affected by commercial fishery, which may result in over fishing since the catches are not co-ordinated between Lithuania and Belorussia.

The drainage of adjacent over-moistened lands on both the countries results in the lowering of groundwater level and changes in the flow pattern of the rivers draining the lake.

Fertilisers, herbicides, insecticides and a soil from the adjacent agricultural lands are washed into the lake.

On the ecotypes adjacent the wetland:

The drainage of nearest hyper-moistened territories.

The forest felling including the selective one in most valuable key biotopes important for a conservation of a species diversity of zoo- and phytocenoses.

The use of the floodplain lands in agricultural purposes including ploughing, early haymaking, intensive cattle grazing.

The disorderly recreational activities resulting in fires, contamination with a garbage of most valuable aesthetic elements of the landscape, thinning out of coastal forests, destroying of the undergrowth and soil layer.

International agreements concerning water use and water protection:

Current protection:

Protective activities are performed in accordance with the legislation in the field of use of natural resources and protection of natural environment of Belarus and Lithuania. Special measures of protection are not provided from both sides.

Proposed measures of protection:

In order to secure the protection of Lake Drisvyaty and its natural communities it is necessary to establish an appropriate trans-border nature protection institute and develop a co-ordinated Belarussian-Lithuanian plan on the regulation of economic activities and protective measures.

Social and cultural significance of the wetland:

Lake Drisvyaty is one of the largest lakes in Belarus and the largest in Lithuania. Water resources of the lake are of great social value. The lake provides the functioning of the Ignalina Nuclear Power Station and Drisvyata hydroelectric station.

The shores of the lake are populated since the immemorial time. A castle was built on the Zamkovy island in the XI century. It was destroyed during the Swedish wars in the XVII century. The expedition of the Institute of History of NAS of Belarus revealed and excavated ancient Belarussian burials of a high historical significance. The lake is used for fishing by the local people. The coastal zone is used for agriculture and the surrounding forests provide mushrooms and berries.

Noteworthy fauna:

Micro- and macrozooplankton is composed of 250 taxons including 47 species of Cladocera, 25 species of Copepoda, and 60 species of Rotifera. The communities of macrozoobenthos number 143 species, among them Spongia-1, Coelenterata-3, Turbellaria-2, Nematomorpha-1, Oligochaeta-37, Hirudinea-7, Mollusca-39, Crustacea-10, Insecta-43. The most noteworthy is a complex of relict species of the quaternary period, among *them Limnocalanus macrurus, Mysis relicta, Pallasea quadrispinosa and Pontoporea affinis* (all entered the Red Data Book of Belarus).

The ichtyofauna of the lake is rich and diverse. 26 species of fish are found, among them some especially valuable glacial relicts such as *Coregonus albula* typica, white fish *Coregonus lavaretus maraenoides*, and lake smelt *Osmerus eperlanus relicta*.

The raccoon dog, American mink, beaver, weasel, ermine and polecat are common in the surroundings of the lake. The otter is rare around the lake. Almost all economically valuable (hunting) mammals are found in the adjacent forests.

14 species of the gerpeto-batrachofauna is included in the Red Data Book of Belarus – for example the natterjack (*Bufo calamita*).

Birds:

The wetland is an especially valuable area for breeding, moulting and staging of birds.

A mixed colony of Cormorants (*Phalacrocorax carbo*) and Grey Herons (*Ardea cinirea*) numbers about 600 nests. The lake is a major breeding centre for the Great Crested Grebe (*Podiceps cristatus*) the colonies of which include hundreds of nests, mainly in the Belarussian side. The breeding density of the Coot (*Fulica atra*) is also high on both sides of the wetland.

Large staging flocks of migratory waterfowl concentrate on the wetland both in spring and autumn, with up to 700 Mallards (*Anas platyrhynchos*), 500 Goldeneyes (*Bucephala clangula*), and 120 Mute Swans (*Cygnus olor*). The islands and wet banks are important breeding and stop-over sites for numerous stint and gull species.

The western part of the lake and, particularly, the site with regular influx of warm water provides a refuge for various species of waterfowl during the winter period. This area regularly supports wintering Mergansers, Mute Swans, Mallards, Goldeneyes and Coots. 16 species of birds inhabiting the wetland are included into the Red Data Book of Belarus: the Black-throated Diver (*Gavia arctica*), Bittern (*Botaurus stellaris*), Goldeneye (*Bucephala clangula*), Mute Swan (*Cygnus olor*), Red-necked Grebe (*Podiceps grisegena*), Dunlin (*Calidris* *alpina*), Red-breasted Merganser (*Mergus serrator*), Goosander (*Mergus merganser*), Little Crake (*Porzana parva*), Oystercatcher (*Haemotopus ostralegus*), Short-toed Eagle (*Circaetus gallicus*), White-tailed Eagle (*Haliaeetus albicilla*), Crane (*Grus grus*), Curlew (*Numenius arquata*), Kingfisher (*Alcedo atthis*), Bluethroat (*Luscinia svecica*).

Noteworthy flora:

A special research on the wetland flora and related natural communities was not conducted.

Scientific research:

Scientific investigations of Lake Drisvyaty and wetlands were started in the beginning of the 20^{th} century. However, regular monitoring of the wetland was initiated before the construction of the Nuclear Plant (1980). Mainly the hydrochemistry and hydrobiology of the water-body were studied. The results were published in numerous scientific papers. The ornithofauna of the wetland was examined mostly by Lithuanian specialists.

Recreation and Tourism:

The lake and its surroundings are of a high aesthetic and recreational value and are practically not used due to the Belarus-Lithuania border zone restrictions. At the present time the main forms of recreational pressures are tourism, fishing, hunting, and picking of berries and mushrooms.

Criterions of Lake Drisvyaty to be entered into the List of Ramsar Wetlands:

Criterion 1. It is a representative example of natural or near-natural wetland type, characteristic of northern Belarus. The lake is an example of a wetland of a great hydrological, biological and ecological importance in the trans-border Belorussian-Lithuanian region.

Criterion 2. It supports a significant number of rare, vulnerable or threatened species of birds, mammals, fishes and crustaceans.

Management authorities:

The Braslav Region Executive Committee
The Braslav State Timber Industry Enterprise

Jurisdiction:

The Braslav Region Executive Committee
The Ministry of Natural Resources and Nature Protection of Belarus
The Braslav Regional Inspection of the Ministry of Natural Resources and Nature Protection

Monitoring programmes:

….

Reporting activity / exchange of information:

….

Data availability:

….

Use of reports for the management purposes:

….

Organisation(s) responsible for the monitoring programmes / contact person(s) :

….

Main publications/references:

….

FRIEIRA RESERVOIR (Spain/Portugal)

Name of the lake:
Frieira reservoir

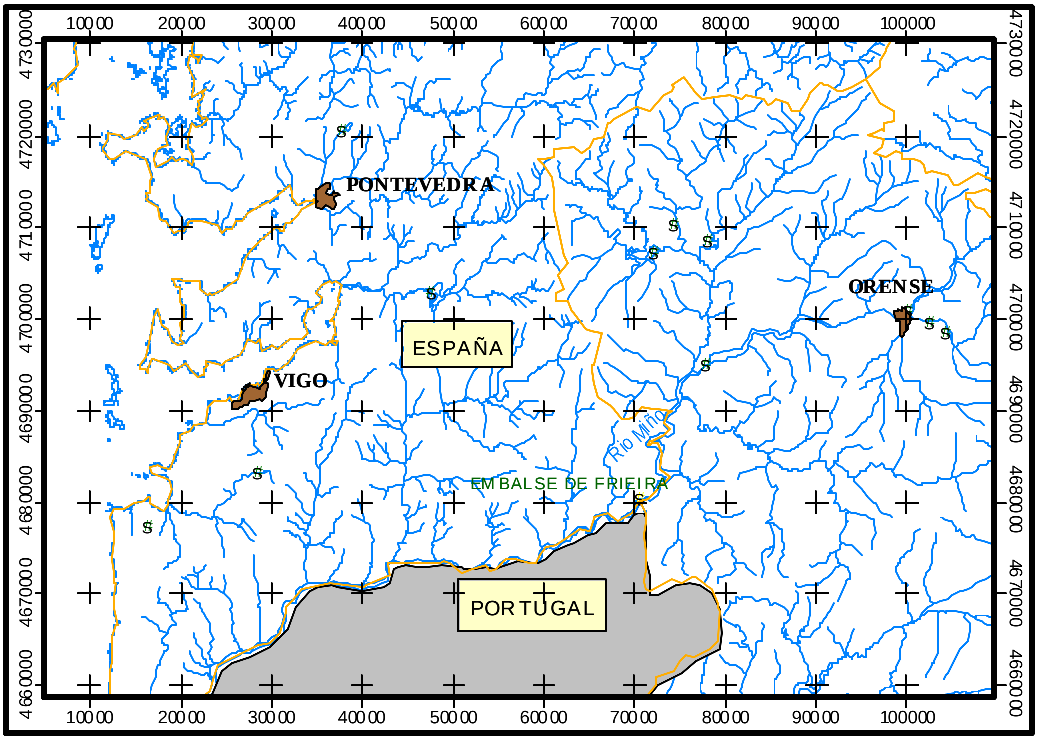
Nature/history of the lake:
Man-made reservoir

Location of the lake:

Countries:	Spain/Portugal
Geographical region:	Galicia (Northwestern Spain), Pontevedra province, the Miño/Minho river basin
Coordinates:	Latitude: 4667600 (YUTM)
	Longitude: 566780 (XUTM) (referred to zone 29)
	Also: 42º09'25" (N) 8º11'30" (W)

Physical dimensions:

Area:	4.86 km^2
Volume:	$44.4*10^6$ m^3
Mean depth:	20 m
Max. depth:	27 m
Elevation:	69 m asl



Location of Frieira reservoir (referred to zone 30), jointly managed by Spain and Portugal.

Catchment area:

Total area:	14,950 km^2
Natural features:	Geology: marls and sandstones of Paleozoic age
Population density:	40 inhabitants/km^2
Most important town:	La Cañiza (Pontevedra)
Agricultural area:	Approximately 95 % of the catchment area

Climatic and hydrological conditions:

Temperature:	Annual mean temperature: 14 ºC

Precipitation:	Annual mean precipitation: 1,456 mm
Inflow:	302 m^3/s
Outflow:	302 m^3/s
Residence time:	….

Major uses and functions of the lake:

Hydroelectric power production. 130,000 Kw. Belongs to UNION FENOSA hydropower Co.

Long-term water quality changes / the present state of the lake:

Mesotrophic in 1988. Data for that year: conductivity: 79 $\mu S\ cm^{-1}$; total P: 29 $\mu g\ L^{-1}$; mean chlorophyll *a* in euphotic zone: 2.6.

Main problems/threats:

….

International agreements concerning water use and water protection:

Convention on the Protection and use of Transboundary Watercourses and International Lakes, 1992.

Convention on Cooperation for the protection and sustainable use of the waters of the Spanish-Portuguese catchment areas. The agreement between Spain and Portugal was signed in 1998 and entered into force in 1999.

Monitoring programmes:

To be determined by the bilateral Commission of the Convention.

Reporting activity / exchange of information:

Both Parties to the Convention will exchange available information, on a regular and systematic basis, on matters covered by the Convention and on data and records regarding these matters. These data and records are referred to in an Annex to the Convention.

Data availability:

Information on matters covered by the Convention shall be made available to whoever makes a reasonable request.

Use of reports for the management purposes:

….

Organisation(s) responsible for the monitoring programmes / contact person(s):

Ministerio de Medio Ambiente. Mr. Angel Cajigas.

Main publications/references:

Ministerio de Medio Ambiente. Inventario de presas españolas. 2000.

Ministerio de Medio Ambiente-CEDEX. Catálogos limnológicos de embalses de las cuencas del Duero y del Norte de España. 1988.

LAKE GALADUS (Poland/Lithuania)

Name of the lake:

Lake Galadus (Lithuanian: Galadusys)

Nature/history of the lake:

Natural lake of postglacial origin

Location of the lake:

Countries:	Poland/Lithuania
Geographical region:	Podlasie region in northeastern Poland, the western part of the Lithuanian Lake District. Through the lake runs the border between the Polish Republic and the Republic of Lithuania. Geographically, the lake belongs to the western part of the Lithuanian Lake District
Coordinates:	Latitude: 54°10’9’’ (N) Longitude: 23°24’6’’ (E)

Physical dimensions:

Area:	7.367 km^2 (5.6 km^2 in Poland, 1.7 km^2 in Lithuania)
Volume:	92.5(10^6 m^3
Mean depth:	12.7 m
Max. depth:	54.8 m
Elevation:	135 m asl

Location and the catchment area of Lake Galadus.

Catchment area:

Total area:	85.5 km^2 (53.5 km^2 in Poland, 32.0 km^2 in Lithuania)
Natural features:	Rich variety of the topography of the earth, undulating hillside shaped by the Baltic glaciation. Its northern border runs along the ridge of high moraine wall reaching 200 m (700 feet) above sea level. Quaternary forms are made of post-glacial clays. The lake fills the northern part of a narrow glacial gully stretching much further to the south. The lake has steep banks, only rarely interspersed with gentle slopes. The catchment encloses mostly agricultural lands with scarce woodland. There are mostly brown and pseudo-podsol soils produced from the glacial till, loams and ashes of various origins.
Population density:	About 1,800 people live in over a dozen villages in the area (about 20 inhabitants/km^2)
Important cities:	….
Agricultural area:	60 % of the catchment area
Industrial activities:	At the moment there is no industry in the area. Until 1980s there were some stock-raising farms.
Total loading:	Phosphorus: 4.8 t/a, nitrogen: 80 - 87 t/a

Climatic and hydrological conditions:

Temperature:	Annual mean 6.1 °C
Precipitation:	Annual mean 584 mm
Inflow:	….
Outflow:	0.5 m^3/s
Residence time:	5.7 years

Major uses and functions of the lake:

Recreation: the lake is used for recreation type of fishing (angling); there are also recreation residential plots around the lake.

Long-term water quality changes / the present state of the lake:

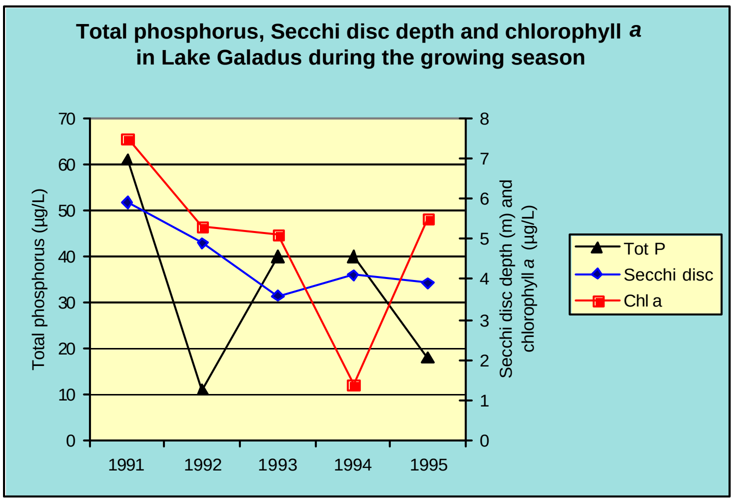
The lake can be included into a mesotrophic group. It is characterized by the well oxygen-saturated bottom layer of water and low productivity level. According to the Polish classification it belongs to II class.

Main problems/threats:

Eutrophication connected with agricultural activities

International agreements concerning water use and water protection:

There is an agreement signed between the Ministry of Environmental Protection, Natural Resources and Forestry of the Polish Republic and the Department of Environment Protection of the Republic of Lithuania regulating the bilateral co-operation in the protection of environment (1992).



Long-term changes of some water quality variables in Lake Galadus.

Monitoring programmes:

Reason for monitoring: The main objectives were to research the purity of water and create a link and co-operation between the Polish and Lithuanian environment protection services.

Duration of monitoring: It was carried out throughout 1991-1995. The research is to be repeated continually after a couple of years.

Sampling activity: Samples were collected at three locations on the lake and three other locations on the tributaries (+1 tributary in 1994). Originally the samples were collected four times a year, but finally, according to the Polish methodology, the samples were collected twice a year (spring circulation and summer stagnation).

Physical and chemical analyses: Temperature, pH, conductivity, transparency (Secchi depth), colour, alkalinity, oxygen, P-tot, P-PO_4, N-tot, N-NO_3, N-NH_4, COD, BOD_5, Ca, Mg, Na, K, Cl, SO_4, Pb, Cd, Cu, Cr, Ni, Zn, Al, Fe, Mn

Biological analyses: Chlorophyll *a*, macrozoobenthos and phytoplankton

Microbiological analyses: Coliform count

Radiological analyses: The marking of general ß radioactivity was done in the years 1992-1993

Reporting activity / exchange of information:

Issued irregularly: The first report was prepared in 1994, and the next one in 1996. A report as a book was printed in 1996 in "Biblioteka Monitoringu Stodowiska" series.

Data availability:

Water quality data are stored in a Polish Lakes Water Quality Data Base. They are not available via Internet.

Use of reports for the management purposes:

By regional and state environmental authorities

Organisation(s) responsible for the monitoring programmes / contact person(s):

Organisation:
Wojewódzki Inspektorat Ochrony Srodowiska w Bialymstoku
Delegatura w Suwalkach
ul. Piaskowa 5
16-400 Suwalki
Contact persons:
Mr Alfred Dorochowicz
e-mail: suwalki@btok.bialystok.pios.gov.pl; suwalki@pios.gov.pl.
Ms Hanna Soszka
e-mail: hasoszka@ios.edu.pl

Main publications/references:

Stan czystosci jeziora Galadus w latach 1991-1995. 1996. Panstwowa Inspekcja Ochrony Srodowiska, Warszawa, 90 p. (Quality state of Lake Galadus waters in the years 1991-1995).

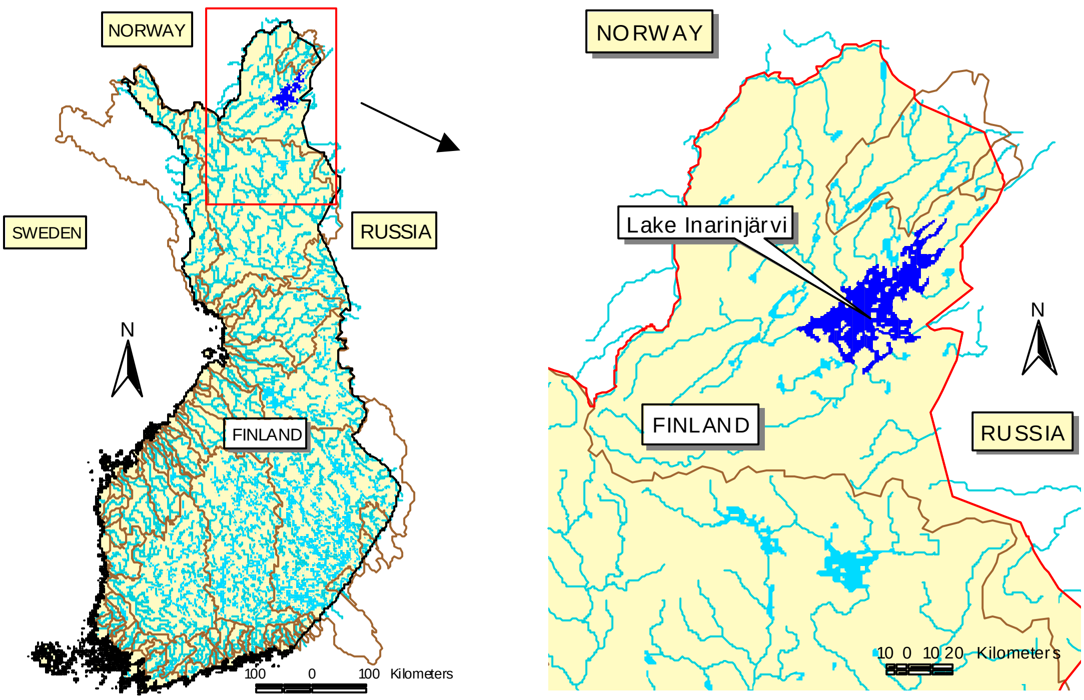
LAKE INARIJÄRVI (Finland/Russia)

Name of the lake:
Lake Inari

Nature/history of the lake:
Natural lake formed/reshaped by the last Ice Age ca 9,000 years ago

Location of the lake:

Countries:	Finland
Geographical region:	Finnish Lapland, the Paatsjoki river basin
Coordinates:	Latitude: $68^0 45'$- $69^0 22'$ (N) Longitude: 27^0 - $28^0 30'$ (E)



Location of Lake Inarinjärvi, an international lake in northern Finland.

Physical dimensions:

Area:	1,043 km^2 (the whole lake in Finland, discharges to Russia)
Volume:	15,920(10^6 m^3
Mean depth:	14.3 m
Max. depth:	95 m
Elevation:	119 m asl

Catchment area:

Total area:	14,512 km^2 (almost totally in Finland, small parts in Russia)
Natural features:	Bedrock mainly granulites, granites or granite-gneiss, soil consists mainly of moraine; northern boreal zone; Forest Lapland vegetation zone; about 13 % of the catchment area consists of water areas, 17 % of mires, 37 % of forests and 32 % of low-productive land. Low-productive land consists mainly of low-productive timberline forests and treeless tundra. About 63 % of the catchment area is part of either the statutory protection area or some kind of national protection programs.
Population density:	There are about 7,100 inhabitants in the catchment area, the population density being about 0.5 inhabitants/km^2; there are no cities, the biggest population centre is Ivalo, where live approximately 4100 inhabitants.

Important cities:	Ivalo
Agricultural area:	< 0.01 % of the catchment area
Industrial activities:	There is no industrial activity. Point source loading is coming from three municipal sewage treatment plants and two fish farms.
Total loading:	Total loading from human activities is 3 t/a phosphorus and 41 t/a nitrogen

Climatic and hydrological conditions:

Temperature:	Annual mean 0.5 – -1 ºC (thermal growing season 120–125 days)
Precipitation:	Annual mean 530 mm (45–50 % of the precipitation as snow)
Inflow:	57 m^3/s (River Juutua), 39 m^3/s (River Ivalo)
Outflow:	153 m^3/s (River Paatsjoki)
Residence time:	3.3 years

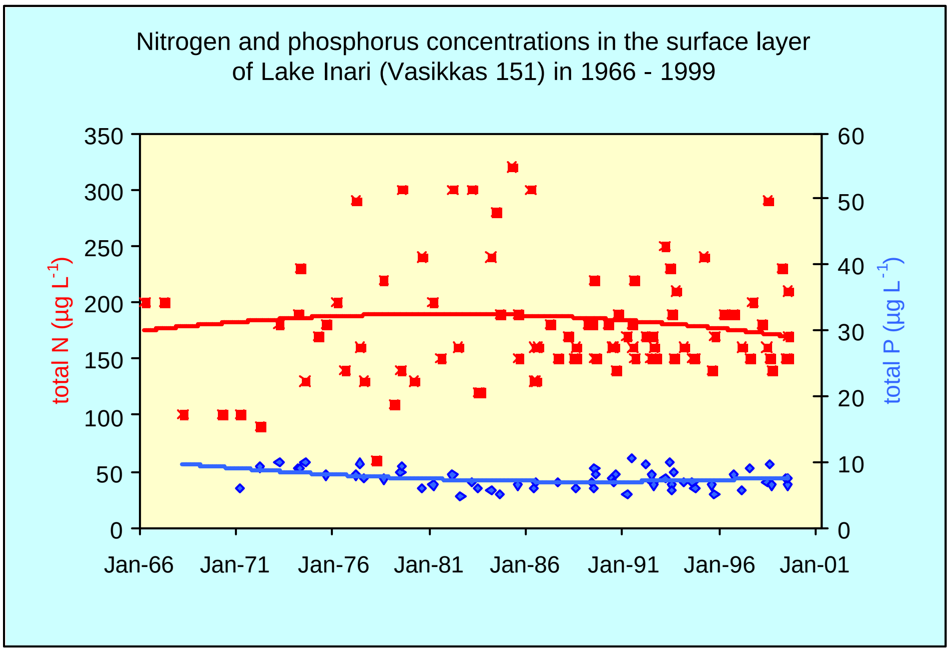
Major uses and functions of the lake:

Lake Inari has been regulated since 1942. Finland, Russia and Norway made an agreement to regulate the water level in the lake by the Kaitakoski dam in Paatsjoki in Russia in 1959. According to the regulation permit the minimum limit for water level regulation is 117.14 m and maximum 119.50 m. The range of water level regulation has been less, in average about 1.45 m, and the mean water level has increased by 0.5 meter.

Lake Inari is an important fishing area for both local and tourist fishermen. The total catch in years 1992 - 1999 has ranged between 150 - 200 t and the most important catch species are the whitefish, brown trout, land locked salmon, arctic char, lake trout, vendace, pike, grayling, burbot and perch. There has been done quite large restockings of fish in order to compensate the harmful effects of regulation.

Long-term water quality changes / the present state of the lake:

No major changes have occurred during the last 35 years of physico-chemical monitoring



The low basic levels of total nitrogen and total phosphorus concentrations show that Inarinjärvi has long been and still is an oligotrophic lake.

Main problems/threats:

The main problems in Lake Inari have been connected to the regulation and management of the fish stocks and fisheries. However, there has been development work going on to reduce these problems. The regulation practise has been improved since 1999 and fish restockings have been reduced.

International agreements concerning water use and water protection:

The agreement between Finland, Russia and Norway on the regulation of the water level of the lake by the Kaitakoski dam in Paatsjoki in Russia, 1959. Lake Inari belongs to the Global Environment Monitoring System (GEMS).

Monitoring programmes:

Reason for monitoring: Regional and national monitoring programmes to monitor long-time changes in surface water quality, since 2000 also part of the Eurowaternet (3 stations in lake, 1 in outlet); also statutory monitoring in the loaded areas. There is also a statutory monitoring program for fisheries (Game and Fisheries Research Institute is responsible for that monitoring).

Duration of monitoring: Water quality monitoring from the early 1960s

Sampling activity: At least three times a year: once in late March (winter stagnation), once in late August (summer stagnation) and once in October (autumn circulation).

Physical and chemical analyses: Temperature, transparency (Secchi depth), oxygen, turbidity, conductivity, alkalinity, pH, colour, COD_{Mn}, total P, PO_4-P, total N, NO_{23}-N, NH_4-N,Cl, SO_4, Fe, Mn, Na, K, Ca, Mg, Al, Se and chlorophyll *a* in summer.

Biological analyses: At one station phyto- and zooplankton sampling five times per summer and bottom animal sampling once in October.

Microbiological analyses: Analysed only in the loaded areas (near fish farm and municipal wastewater outputs)

Radiological analyses: None

Reporting activity / exchange of information:

Statutory monitoring yearly; regional and national programmes less frequently (approx. 4-5 years intervals).

Data availability:

The data is stored in the Environment Data System of Finland (EDS) that is the basic tool for environmental control, monitoring and assessment. It is used by environmental authorities at all levels of organisation through the Finnish Environment Network. EDS is also open to other users outside the environmental government.

Use of reports for the management purposes:

The monitoring data and reports have been used to reduce harmful effects of regulation, to develop fish stock and fisheries management and to develop monitoring of water quality.

Organisation(s) responsible for the monitoring programmes / contact person(s) :

Water quality monitoring: Lapland Environment Centre / Pekka Räinä, Annukka Puro-Tahvanainen and Eira Luokkanen (statutory monitoring).

Fisheries monitoring: Game and Fisheries Research Institute in Inari / Erno Salonen

Main publications/references:

….

LAKE IRON GATES I (Romania/Yugoslavia)

Name of the lake:

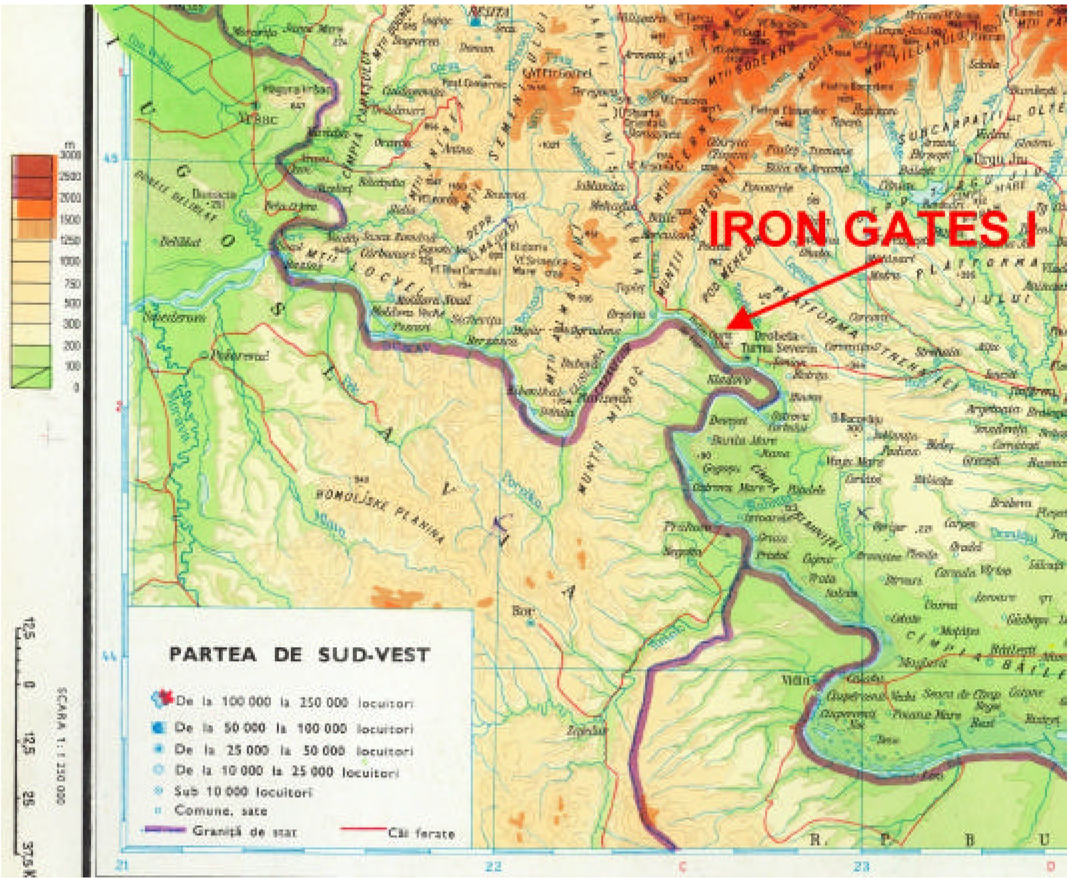
Lake Iron Gates I – upstream Turnu Severin

Nature/history of the lake:

This reservoir, on the Danube River, is a part of the Hydro-technical knot and for Navigation System; Romania and Yugoslavia built it between 1970 and 1972.

Location of the lake :

Countries:	Romania/Yugoslavia
Geographical region:	South-West of Romania, between Gura Vaii-Sip (km 940) and Pancevo (km 1,149); the Danube river traverses the Meridional Carpathian Mountains and forms, along 100 km, the Iron Gates narrow path (1,040km – 940 km).
Coordinates:	Latitude 44°40' (N) Longitude: 22°32'50'' (E)



Location of the Iron Gates I and II region.

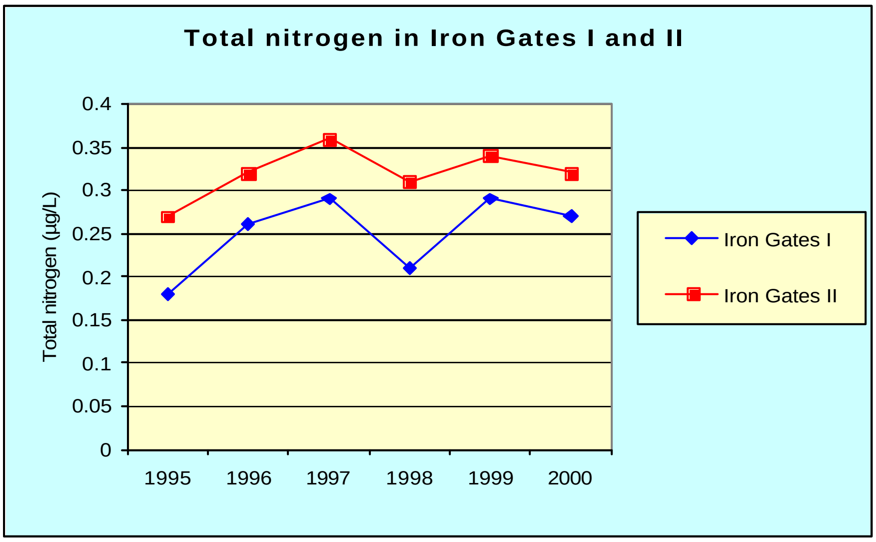
Physical dimensions:

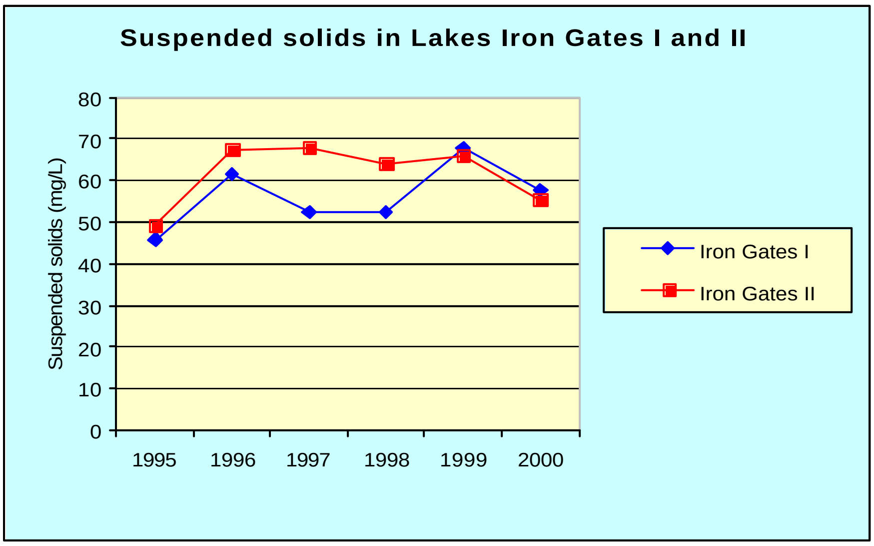
Area:	260 km^2
Volume:	2,400(10^6 m^3
Mean depth:	25 m
Max. depth:	40 m
Elevation:	60 m

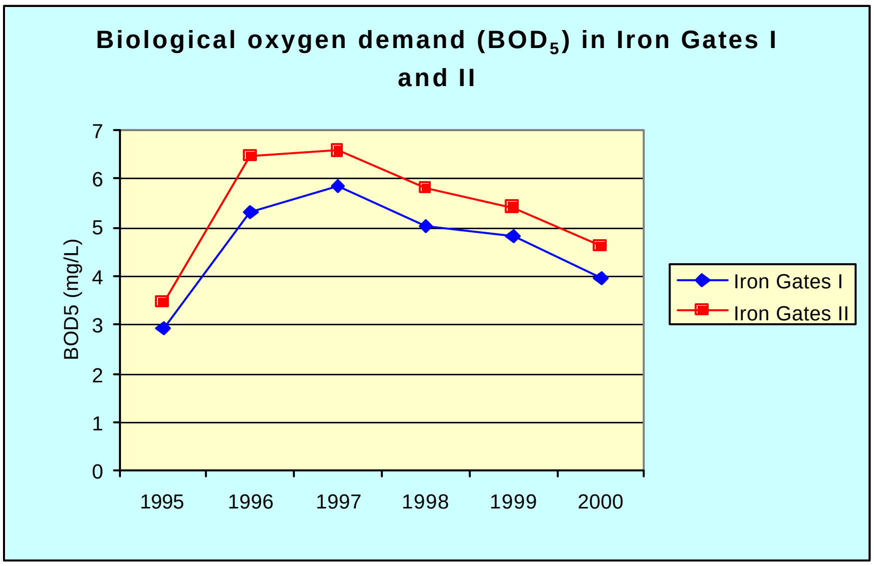
Catchment area:

Total area:	1,607 km^2 in the Romanian part
Natural features:	Situated between the Mehedinti Mountains and the Eastern Mountains of Serbia
Population density:	Approximately 31 inhabitants/km^2 (in Romania)

Important cities:	Turnu Severin, Orsova, Moldova Noua (in the Romanian part)
Agricultural area:	1,048 km^2
Industrial activities:	Mining industry, naval engineering
Total loading::	….







Observed water quality trends in Lakes Iron Gates I and II.

Climatic and hydrological conditions:

Temperature:	Annual mean 15.1°C in 2000
Precipitation:	Annual mean 285.6 mm in 2000
Max. inflow:	16,000 m^3/s
Mean outflow:	5,400 m^3/s
Residence time:	….

Major uses and functions of the lake:

Transportation, hydroelectric power production, scientific studies and protection against floods

Long-term water quality changes / the present state of the lake:

The overall water quality of the lake is classified as to the 1st category, taking into consideration the Romanian STAS 4706/88, for the majority of indicators. The variation of the concentrations of suspended matters, total phosphorous, organic substances (BOD_5) and total nitrogen are presented in the figures below.

Main problems/threats:

There are no main problems

International agreements concerning water use and water protection:

Bilateral Convention (Romania/Yugoslavia)
Convention on the Protection and use of Transboundary Watercourses and International Lakes, 1992
Danube Convention

Monitoring programs:

Reason for monitoring: Lake Iron Gates belongs to national and Danube monitoring program networks

Duration of monitoring: Since 1971 in National and Danube programs

Sampling activity:

Sampling sites: Svinita, Dubova, Orsova and upstream barrage

Physical and chemical analyses: temperature, pH, conductivity, dissolved oxygen, BOD_5, COD-Mn, COD-Cr, Cl, SO_4, Ca, Ma, ammonium, nitrates, nitrites, total nitrogen, total Fe, PO_4-P, total P, Mn, suspended matters, turbidity, CO_3.

Biological analyses: Phytoplankton, zooplankton

Microbiological analyses: Not performed

Radiological analyses: Not performed.

Sampling frequency: Seasonally (4 times/year)

Reporting activity / exchange of information:

Statutory monitoring results reported 4 times per year to the Jiu Water Directorate, and once per year to the National Company "Apele Romane"

Data availability:

Water quantity and quality data is stored in the national water data system (WDS) of Romania and are used as a basic tool for water management (control, monitoring and assessment, etc), studies, Synthesis and reports, bilateral conventions. WDS is used by water authorities at all organizational levels and is also open to users outside the water administration.

Organisation(s) responsible for the monitoring programmes / contact person(s):

Responsible organization: National Company "Apele Romane", Edgar Quinet, nr.6, sector 1, Bucharest, Romania
Contact person: eng. Rodica-Carmen OGNEAN, National Company "Apele Romane", Edgar Quinet, nr.6, sector 1, Bucharest, Romania, tel 40-1-3155535; fax 40-1-3122174, mobile 095-052575, E-mail carmen@ape.rowater.ro

Main publication/references:

The Danube Cadastrage Synthesis and The Danube Water Quality Synthesis .

LAKE IRON GATES II (Romania/Yugoslavia)

Name of the lake:

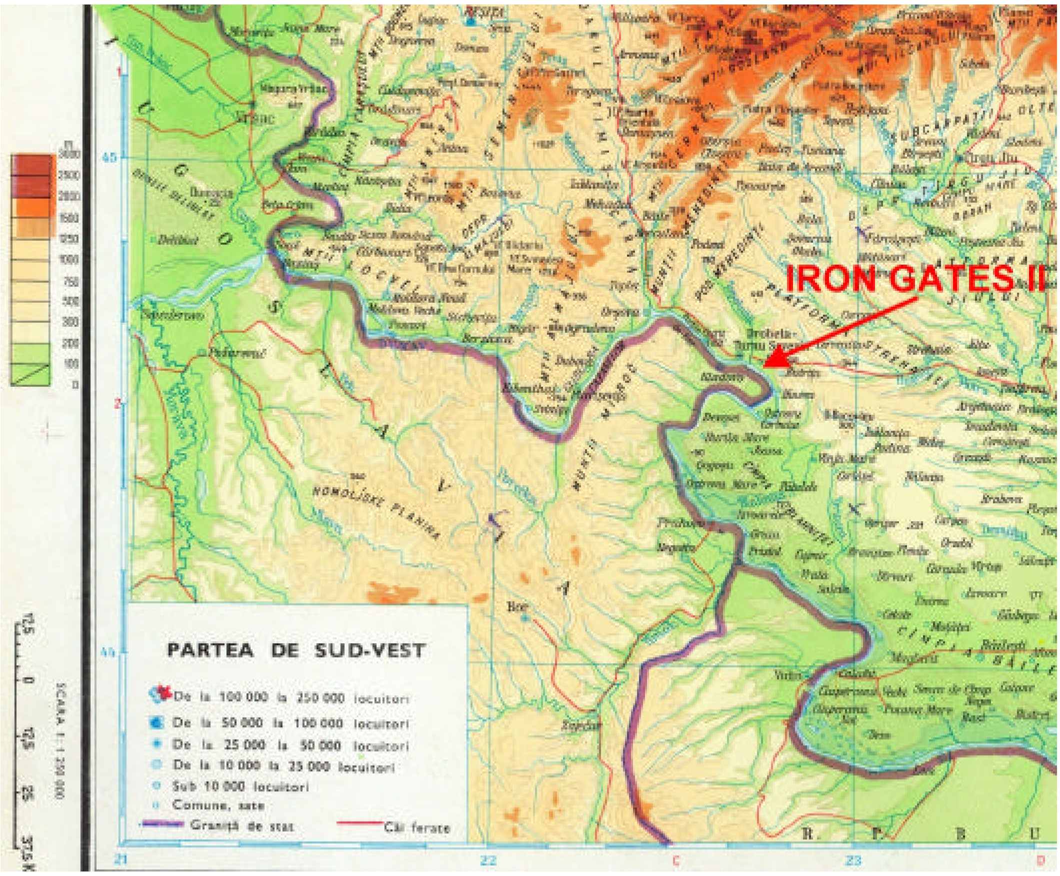
Lake Iron Gates II – downstream Turnu Severin

Nature/history of the lake:

This reservoir, on the Danube River, is a part of the Hydro-technical knot and for Navigation System; Romania and Yugoslavia built it between 1977 and 2000

Location of the lake:

Countries:	Romania/Yugoslavia	
Geographical region:	South-West of Romania, at the contact of Oltenia plain and Mehedinti tableland	
Coordinates:	Latitude: 44°19'4" (N)	Longitude: 22°34'50'' (E)



Location of the Iron Gates I and II region.

Physical dimensions:

Area:	7,800 ha
Volume:	$800(10^6$ m^3
Mean depth:	10 m
Max. depth:	25 m
Elevation:	34 m

Catchment area:

Total area:	2,312 km^2 in the Romanian part
Natural features:	Situated between Oltenia plain and Krajina tableland
Population density:	Approximately 63 inhabitants/km^2 (in Romania)
Important cities:	Turnu Severin (in Romanian part)
Agricultural area:	1,250 km^2

Industrial activities: Mining industry, naval engineering
Total loading: ….

Climatic and hydrological conditions:
Temperature: Annual mean 15.1°C in 2000
Precipitation: Annual mean 285.6 mm in 2000
Max. inflow: 16,000 m^3/s
Mean outflow: 5,400 m^3/s
Residence time: ….

Major uses and functions of the lake:
Transportation, hydroelectric power production, scientific studies and protection against floods

Long-term water quality changes / the present state of the lake:
The overall water quality of the lake is classified as to the 1st category, taking into consideration the Romanian STAS 4706/88, for the majority of indicators. The variation of the concentrations of suspended matters, total phosphorous, organic substances (BOD_5) and total nitrogen, see figures presented with Lake Iron Gates I.

Main problems/threats:
There are no main problems

International agreements concerning water use and water protection:
Bilateral Convention (Romania/Yugoslavia)
Convention on the Protection and use of Transboundary Watercourses and International Lakes, 1992
Danube Convention

Monitoring programs:
Reason for monitoring: Lake Iron Gates belongs to national and Danube monitoring program networks

Duration of monitoring : Since 1986 in National programs

Sampling activity:

Sampling sites: Upstream Turnu Severin, downstream Turnu Severin, and Tiganasi

Physical and chemical analyses: Temperature, pH, conductivity, dissolved oxygen, BOD_5, COD-Mn, COD-Cr, Cl, SO_4, Ca, Ma, ammonium, nitrates, nitrites, total nitrogen, total Fe, PO_4-P, total P, Mn, suspended matters, turbidity, CO_3

Biological analyses: Phytoplankton, zooplankton

Microbiological analyses: Not performed

Radiological analyses: Not performed

Sampling frequency: Seasonally (4 times/year)

Reporting activity / exchange of information:
Statutory monitoring results reported 4 times per year to the Jiu Water Directorate, and once per year to the National Company "Apele Romane"

Data availability:
Water quantity and quality data is stored in the national water data system (WDS) of Romania and are used as basic tools for water management (control, monitoring and assessment, etc), studies, Synthesis and reports, bilateral conventions. WDS is used by water authorities at all organizational levels and is also open to users outside the water administration.

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Contact person: eng. Rodica-Carmen OGNEAN, National Company “Apele Romane”, Edgar Quinet, nr.6, sector 1, Bucharest, Romania, tel 40-1-3155535; fax 40-1-3122174, mobil 095-052575, E-mail carmen@ape.rowater.ro

Main publication/references:

The Danube Cadastrage Synthesis and The Danube Water Quality Synthesis.

LAKE JANDARI (Georgia/Azerbaijan)

Name of the lake:

Lake Jandari

Nature/history of the lake:

The lake was formed artificially in the XIX century

Location of the lake:

Countries:	Georgia/Azerbaijan
Geographical region:	The Kura/Mtkvari river basin in the Gardabani Region of Georgia and the Kazakh Region of Azerbaijan
Coordinates:	Latitude: $41^0 26'$ (N) Longitude: $45^0 13'$ (E)

Physical dimensions:

Area:	12.5 km^2 (6 km^2 in Georgia, 6,5 km^2 in Azerbaijan)
Volume:	52(10^6 m^3 (high water), 23(10^6 m^3 (low water)
Mean depth:	4.8 m
Max. depth:	7 m
Elevation:	291.5 m asl

The length of the lake is 6.6 km, the maximum width 2.8 km, and the average width 2.3 km. The length of the shoreline is 17 km. The relief of the lake basin varies in different parts. The northeastern area is covered with 400 - 660 m hills. In the eastern and southeastern area there are some low ranges divided hillsides. In the west and northwest there is a sloping plain. The banks are mostly sloping and low, only the southeastern bank is precipitous. The wetlands are located in the northwestern and western banks, where the rush and reed communities are abundant. The bottom of the lake is flat and covered with wash load.

Catchment area:

Total area:	330 km^2 (is not defined separately in Georgia and Azerbaijan)
Natural features:	The Gardabani Channel (territory of Georgia) flows into the lake and the Jandargel Channel (territory of Azerbaijan) flows out of it. The lake is fed mainly by the water of the Kura/Mtkvari river (via the Gardabani Channel).
Population density:	65 inhabitants/km^2 in Georgia
Important cities:	No cities
Agricultural area:	Most of the catchment area is agricultural land
Industrial activities:	No industry
Total loading:	No information

Climatic and hydrological conditions:

Temperature:	Annual mean 12.9 ºC
Precipitation:	Annual mean 422 mm

Parameter	Annual (total)	Winter (XII-II)	Spring (III-V)	Summer (VI-VIII)	autumn (IX-XI)
Precipitation, mm	422	56	145	118	103
% of total	100	13	34	28	25

Inflow and outflow:

Inflow, 10^6 m^3/year			Outflow, 10^6 m^3/year		
Inflow from the Gardabani Channel	Precipitation	Total	Evaporation	Use for irrigation	Total
835	38	873	160	670	830

Residence time: 1 year

The climate of the Lake Jandari region can be determined as typical for deserts and arid steppes, with hot summer and warm winter. The annual average temperature is about 12,9 ^oC, the average temperature of the coldest month 0.3 ^oC, and the average temperature of the warmest month 25 ^oC. The absolute maximum recorded is 41 ^oC and the lowest recorded minimum -25 ^0C. The first autumn frosts begin in November and the late frosts last until the end of March. Snow cover lasts approximately only for 10 days. The depth of snow is about 1-3 cm, but in some years 10-15 cm has been recorded. The mean annual evaporation from the lake area is 1000-1100 mm.

Major uses and functions of the lake:

The water from Lake Jandari is used for irrigation. The lake is also an important area for commercial fisheries. There are a lot of fish species in the lake, the main of them being the Carp and the Sheat-fish.

The surroundings of the lake are covered by agriculture. The lake is only of a limited recreational value.

The water of the lake is not used for industrial purposes, and there are not industrial enterprises in the surroundings.

Long-term water quality changes / the present state of the lake:

Recorded concentrations of different contaminants in the water are as follows:

Determinant	Concentration, mg/l	
	Average	Maximum
Suspended solids	57	288
Dissolved oxygen	9.16	5.5
COD	12.3	20.6
BOD	5.56	9.91
Phenols	0.013	0.037
Hydrocarbons	0.02	0.08
Detergents	0.02	0.05
Ammonia (N_{NH4})	1.26	1.4
Nitrites (N_{NO2})	0.023	0.036
Nitrates (N_{NO3})	1.37	4.87
Phosphates	0.016	0.046
DDT	0.092	0.191
Hexachlorecyclohexane	0.007	0.013

Main problems/threats:

Various agricultural activities including the use of fertilisers as well as commercial fisheries are the main sources of water pollution. Influx of nutrients and other pollutants into the lake accelerates eutrophication of the lake.

The lake is seriously affected by several agricultural practices. However, no exact data are available on the loads originating from agriculture. Irrigation of fields, which is not supplied with drainage-collector circuits in Georgia, and the use of artificial fertilisers are the most deteriorating effects of agriculture. The lake is also polluted by pesticide residues.

International agreements concerning water use and water protection:

After the break-up of the Soviet Union all official contacts between Georgia and Azerbaijan water authorities were practically interrupted. As a result, the investigations of water quality were carried out separately by each country and the evaluation of the information based on local measurements was not compared with official information from the neighbouring countries. At the same time serious problems, such as uneven distribution of water resources of the Kura/Mtkvari river and the Lake Jandari over the territories of Azerbaijan and Georgia as well as the continuous transboundary contamination of the water, showed the necessity of significant changes in co-operation.

As a result in February 1997 the Governments of Georgia and Azerbaijan signed the Agreement on Collaboration in Environmental Protection.

The Article 6 of the Agreement says that the Parties of the Agreement shall consolidate their efforts and take all appropriate measures to ensure that the Kura/Mtkvari river and the Lake Jandari waters are used with the aim of ecologically sound and rational water management, conservation of water resources and environmental protection.

Monitoring programmes:

The State Hydrometeorological Service Department is responsible for the surface water monitoring system used in Georgia. Before 1990, the monitoring networks of Georgia and Azerbaijan were parts of the former Soviet Union monitoring network. The monitoring station on the Lake Jandari was located at the Georgian part of the lake (one site) and standardised analyses were introduced in 1976. Monitoring consist of 12 sampling events per year. The objective of the monitoring effort is to give a general view of the pollution situation in the surface water. Biological, microbiological and radiological analyses have not been carried out on the lake.

At present, the monitoring system is (almost) non-operational due to the lack of operational equipment for both sampling and analyses, frequent interruptions of power supply, funds to collect and transport samples etc.

Reporting activity / exchange of information:

In accordance with the Law of the Environmental Protection, adopted by the Parliament of Georgia on 10 Dec 1996, the Ministry of Environment of Georgia presents a National Environmental Report to the President of Georgia every year. The report includes a description of the state of the country's environment (surface and ground waters, the Black Sea, soil, air), analyses of the main problems and priorities in this field. The reports are meant for the general public as well.

The monitoring reports done by the State Hydrometeorological Service Department are also presented on an annual basis to the Ministry of Environment.

Data availability:

Water quantity data is stored in the Ministry of Agriculture of Georgia, Department of Irrigation. Water quality data is stored in the State Hydrometeorological Service Department of Georgia. Data is used by the Ministry of Environment of Georgia and local (regional) authorities for environmental control, monitoring and assessment.

Use of reports for the management purposes:

The reports are used for elaboration of the strategy of environmental policy, regulation, licensing, supervision, and control in this field.

Organisation(s) responsible for the monitoring programmes / contact person(s):

Water Resources Protection Department,
Ministry of Environment of Georgia
68a Kostava St., Tbilisi, Georgia
Contact person: Ms. Mariam Makarova, Deputy Head of the Water resources Protection Department, tel. +995 (32) 33 25 99, fax + 995 (32) 33 39 52,
E-mail: airdept@caucasus.net

Main publications/references:

Rules for operation of the Jandari Lake, Baku, 1987.

Natural Resources of Georgia and Main Problems of their use, Tbilisi, 1991.

Annual Reports on Surface Water Quality, State Hydrometeorological Service Department (1988-1992).

Documentation of Department of Irrigation, Ministry of Agriculture of Georgia.

MIRANDA RESERVOIR (Spain/Portugal)

Name of the lake:

Miranda reservoir

Nature/history of the lake:

….

Location of the lake:

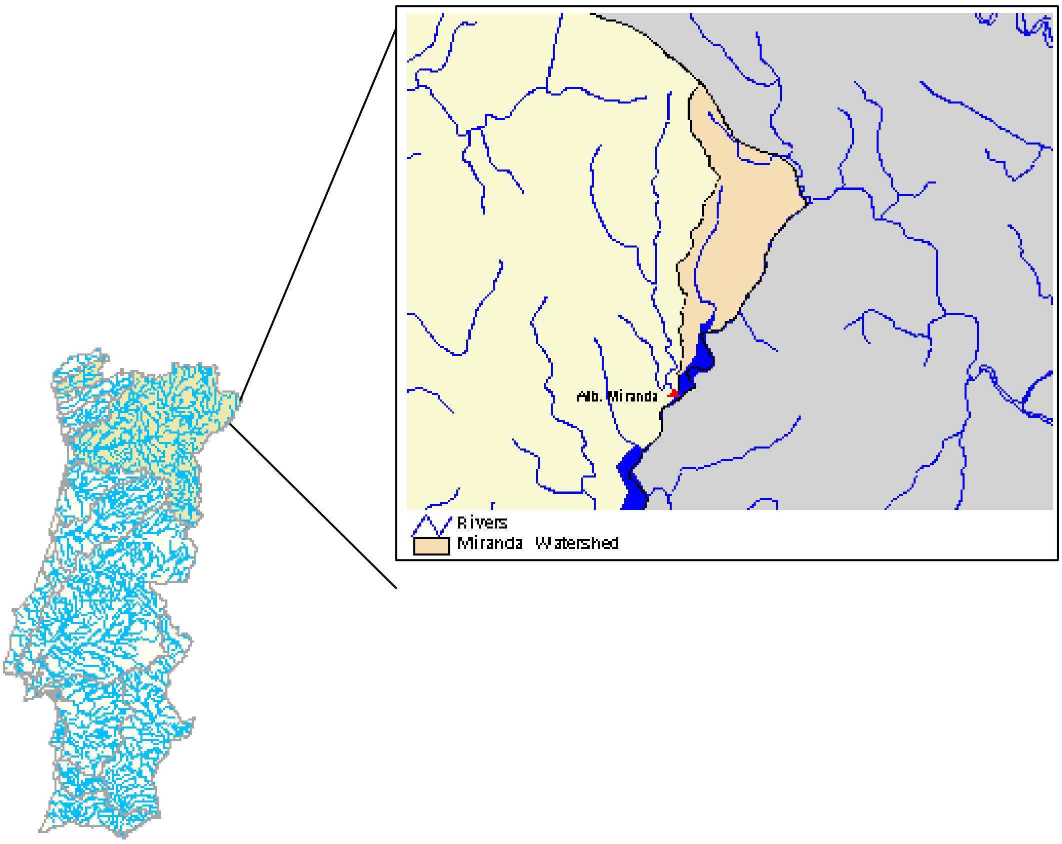
Countries:	Spain/Portugal
Geographical region:	Province: Bragança City: Miranda do Douro Parish: Miranda do Douro
Coordinates:	Latitude: 41º29'02" (N) Longitude: 6º16'49" (W)

Physical dimensions:

Area:	1.22 km^2
Volume:	28.1(10^6 m^3
Mean depth:	45 m
Max. depth:	68 m
Elevation:	….

Catchment area:

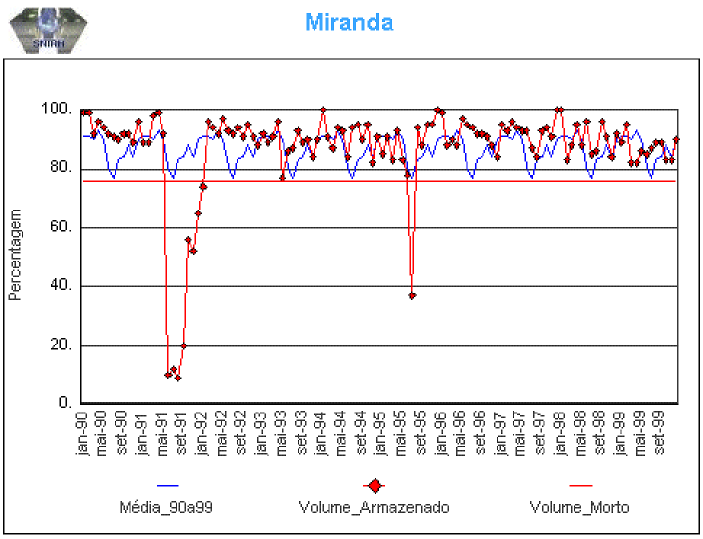
Total area:	63,500 km^2 (63,450 km^2 in Spain, 47.5 km^2 in Portugal)
Natural features:	….
Population density:	17 inhabitants/km^2
Important cities:	….
Agricultural area:	80 % of the catchment area
Industrial activities:	A nuclear power plant in Spain. No industries in the Portuguese part, only a domestic direct discharge from 185 habitants.
Total loading:	Difficult to calculate because the load is mainly coming from Spain



Location and the Portuguese catchment area of the Miranda Reservoir.

Climatic and hydrological conditions:

Temperature:	Annual mean 13 ºC
Precipitation:	Annual mean 577 mm
Inflow:	284.65 m^3/s
Outflow:	284.65 m^3/s
Residence time:	….

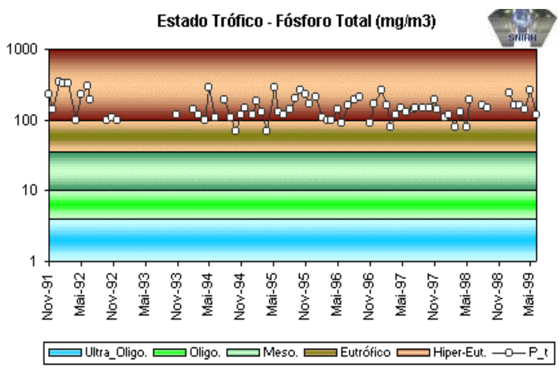


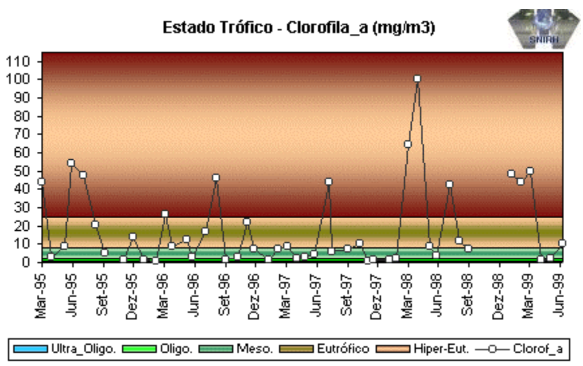
Evolution of the storage volume of the Miranda reservoir.

Major uses and functions of the lake:

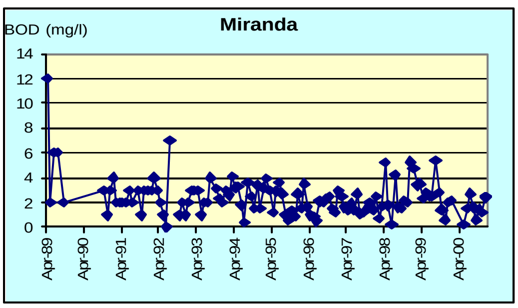
Hydropower (waterline), explored by the National Power Company, is the major use and, it is also a source for water supply and a bathing zone.

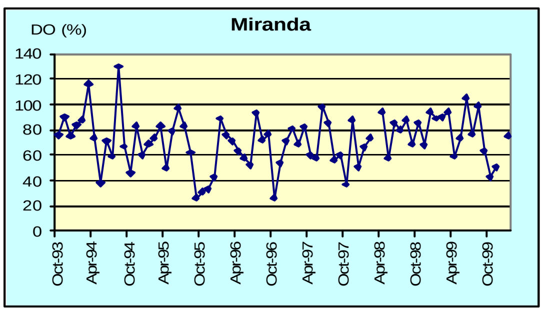
Long-term water quality changes / the present state of the lake:



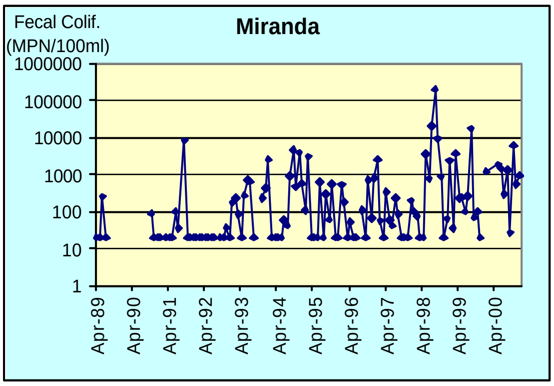


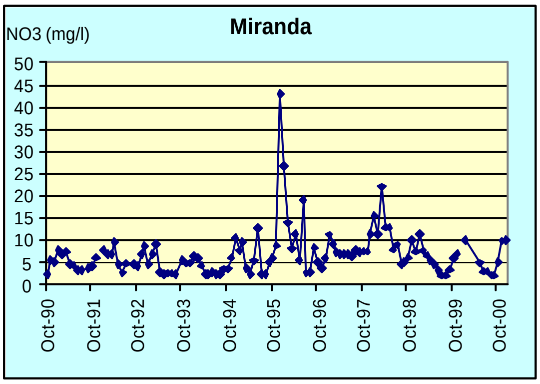
Long-term values of total phosphorus and chlorphyll *a* in the Miranda reservoir.





Long-term values of biochemical oxygen demand and dissolved oxygen in the Miranda reservoir.





Long-term values of faecal coliforms and nitrates in the Miranda reservoir.

Main problems/threats:

The eutrophication process is being a problem in this reservoir. The trophic state is hypertrophic.

International agreements concerning water use and water protection:

The lake belongs to the Council Decision 77/795/EEC Information exchange on surface water quality.

Monitoring programmes:

The reason for monitoring is threefold: it is a water supply source, a bathing zone, and a boundary lake. In this lake the water quality has been monitored since April 1989 and the storage evolution since January 1990, with a monthly frequency. The graphics above show the evolution of the storage volumes and some water quality variables observed on this reservoir.

Reporting activity / exchange of information:

….

Data availability:

….

Use of reports for the management purposes:

….

Organisation(s) responsible for the monitoring programmes / contact person(s) :

The Regional Water Authority for Northern Portugal is responsible for sampling and analysing the water quality data; the National Power Company monitors the storage volumes of the reservoir. The Institute for Water is responsible for the management of the data and the storage of the information on the national database (SNIRH). The contact person at the Institute for Water is Engº Rui Rodrigues.

Main publications/references:

….

LAKE NEUSIEDLER SEE/FERTO TÓ (Austria/Hungary)

Name of the lake:

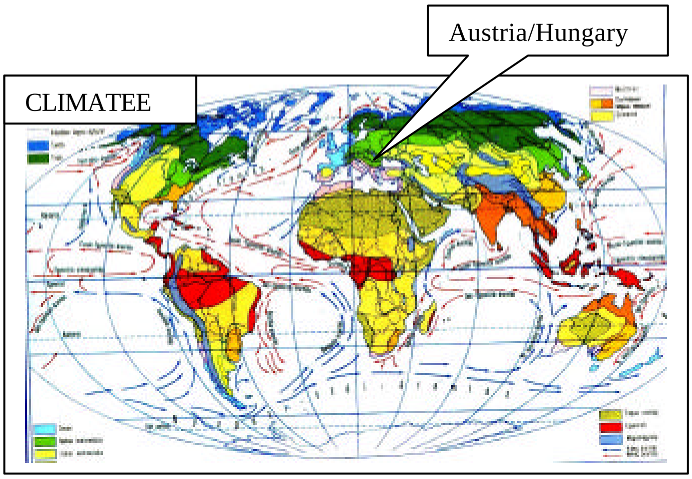
Neusiedler See/Ferto tó

Nature/history of the lake:

Natural lake of tectonic origin, formed about 10,000–15,000 years ago

Location of the lake:

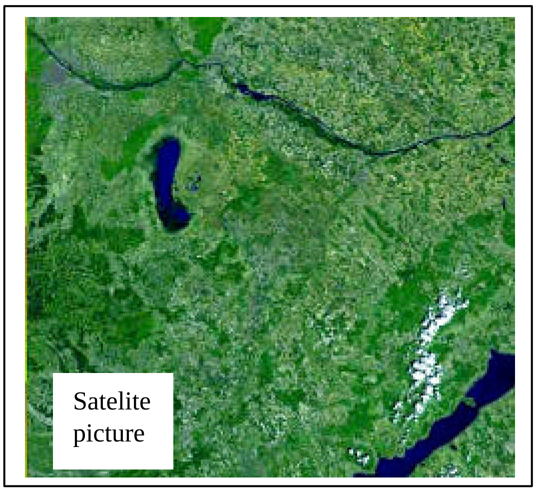
Countries:	Austria/Hungary
Provinces:	Burgenland/Austria – Gyor-Moson-Sopron/Hungary
Coordinates:	Latitude: 47º38' – 47º57'(N) Longitude: 16º 41' - 16º52'(E)

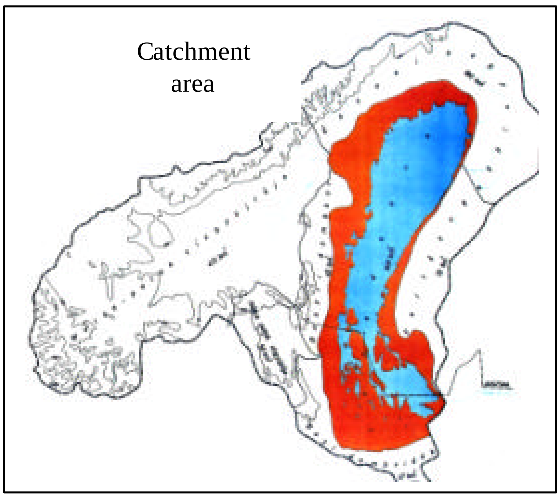


Location of Neusiedler See/Ferto tó, a transboundary lake shared by Austria and Hungary.

Physical dimensions:

Area:	315 km^2 (240 km^2 in Austria, 75 km^2 in Hungary)
Volume:	$2{,}500 * 10^6\ m^3$
Mean depth:	1.17 m
Max. depth:	2.00 m
Elevation:	115.45 m asl





Catchment area:

Total area:	1,120 km^2 (955 km^2 in Austria, 165 km^2 in Hungary)
Natural features:	This kidney-shaped lake is overgrown with reed – Phragmites – that covers over half

	of its surface area. The lake is highly labile with a fluctuating water level. In the past the area of the lake exceeded 500 km^2, but during the last two centuries the lake dried partly or completely out on several occasions. According to the Hungarian-Austrian Water Commission's instructions, the water level is stabilised at the outlet of the lake by a sluice. The lake is one of the most turbid, opaque inland waters in Europe, with a low degree of transmission. Mud and organic/inorganic substances are easily removed from the bottom of the lake and mixed to water even by a light breeze. The lake is the last and most western example of so-called steppe-like lakes in Europe.
Population density:	Approximately 110 inhabitants/km^2
Most important cities:	Eisenstadt (A), Rust (A), Neusiedl am See (A), Podersdorf (A), Balf (H), Fertorákos (H)
Agricultural area:	Approximately 75 % of the catchment area (50% arable land, 25% vineyard)
Industrial activities:	No major industry, only two local conserve factories

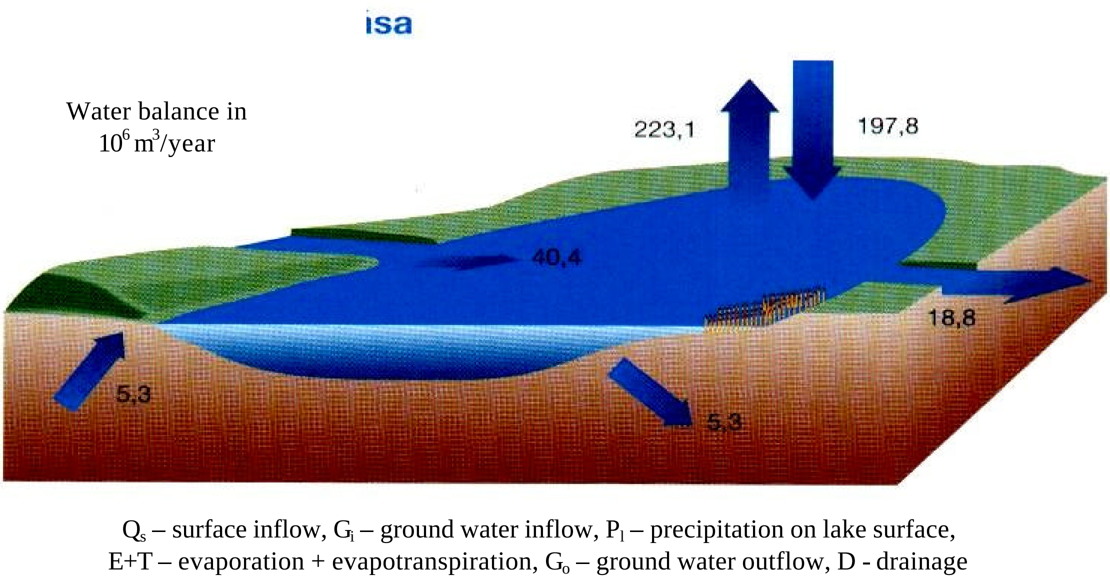
Climatic and hydrological conditions:

Temperature:	Annual mean 9.9 °C (1960–1999)
Precipitation:	Annual mean 639 mm (1960–1999)
Inflow of major watercourses:	
	Wulka: 1.250 m^3/s
	Rákos patak: 0.070 m^3/s
Outflow	Regulated due to the water level. Max. sluice capacity: 15 m^3/s
Residence time:	Approximately 1.5 - 2.0 years
NOTE 1.	The water level was stabilised in 1965 and rose up about 25 cm in 1996
NOTE 2.	Major events of water level changes:
	1638–1640 the lake completely dried out
	1740–1741 water level rose up rapidly, the dam was built around the lake
	1836–1838 rapid water losses
	1865–1868 the lake completely dried out, buildings were constructed on the former bottom of the lake
	1881–1882 high water level
	1905–1907 considerable losses of water
	1995–1996 high water level

Water balance:

The water balance equation for Lake Neusiedl See/Ferto tó in 10^6 m^3/year (Plattner):

$$\mathbf{Q_s+G_i+P_l-(E+T)-G_o-D = 0 \quad 40.4+5.3+197.8-223.1-1.6-18.8 = 0}$$



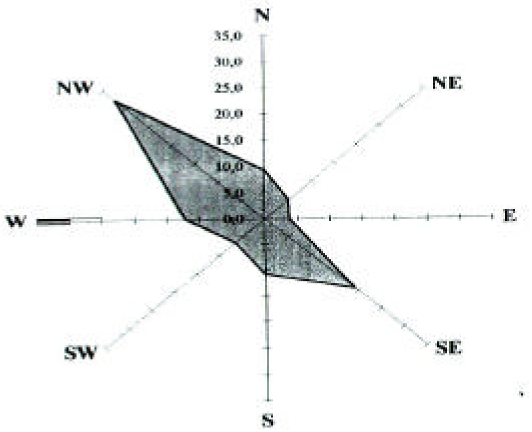
Q_s – surface inflow, G_i – ground water inflow, P_l – precipitation on lake surface,
E+T – evaporation + evapotranspiration, G_o – ground water outflow, D - drainage

Water level (above the Adriatic see) regulation:

Winter period 115.60 m asl
Summer period 115.70 m asl
Transition period 115.65 m asl (March and September).

Winds:

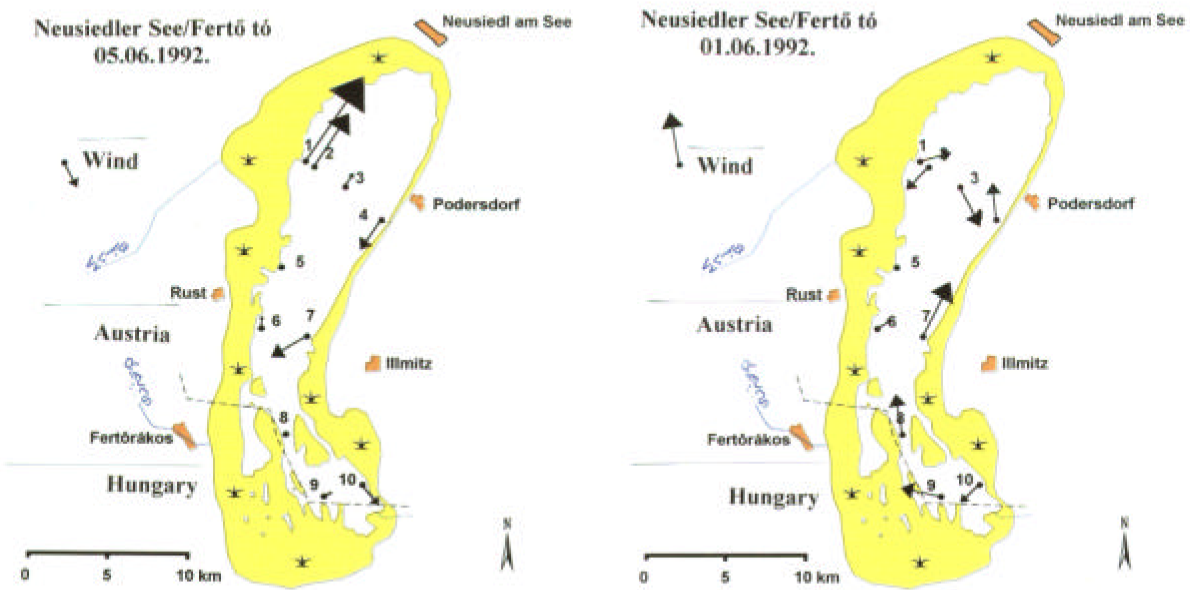
The Neusiedler See/Ferto tó region is prevailed by NW and SE winds throughout the year. This wind pattern affects the general circulation of the lake.



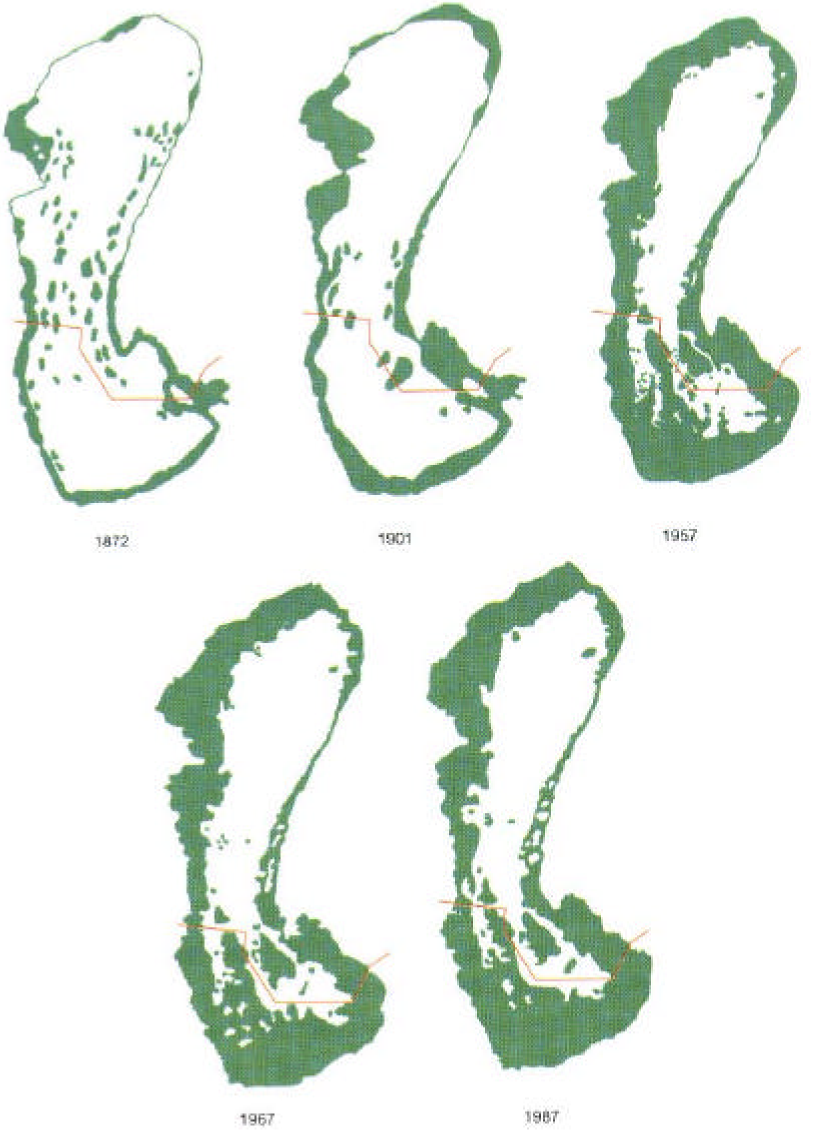
Distribution of the wind directions.

Currents:

The importance of the currents was early recognised due to the movement of sediment and changes of water between the reed belt and open lake water. The current measurements are important from the limnological point of view. The scientific observations and measurements are available since the 1990s.



The open water area is surrounded by an extensive reed belt (180 km^2), the largest closed monoculture of *Phragmites* in Central Europe. The reed belt covers more than 50 % of the whole lake surface area and as much as about 85 % of the Hungarian part. The expansion of the reed belt was stopped by rising and stabilising of the water level. The reed belt has shown the following pattern of change during the last 100 years:



Changes of the reed belt during the last 100 years (Kopf 1986 and Fischer-Nagel 1987).

Major uses and functions of the lake:

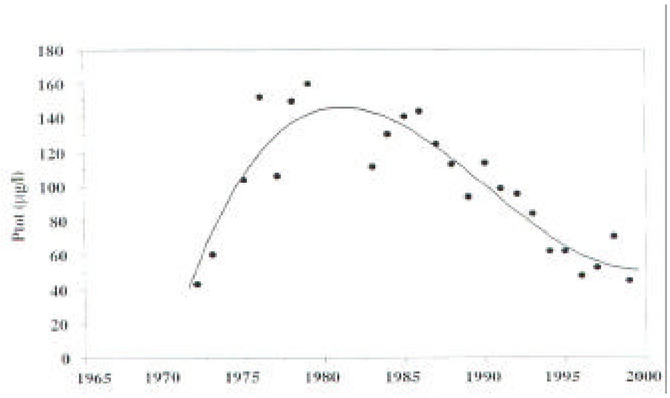
Fishery, reed harvesting, recreation, and scientific studies. National Parks on both sides of the lake. Biosphere Reserve.

Long-term water quality changes / the present state of the lake:

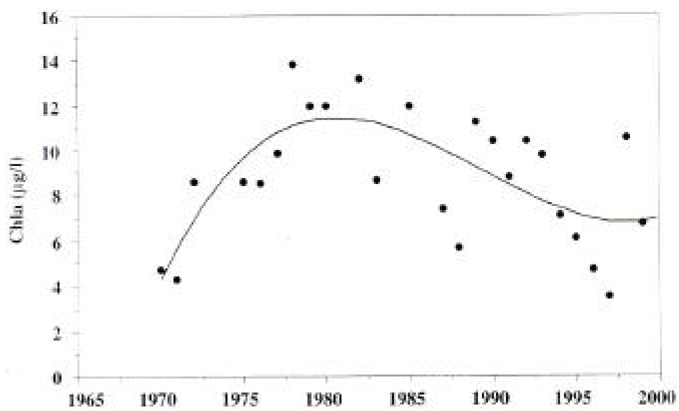
Slightly polluted by non-point and point source loading. A gradual but slow deterioration has been observed during the early 1980s. A significant decrease of nutrient loading since the 1990s refers partly to the effective elimination of phosphorus from sewage waters and partly to the introduction of phosphorus-free detergents.

The high salts concentration, more than 2,000 mg/l, as well as the high pH and high dissolved organic matter content (COD) are original characteristics of the lake. The dominant cations are Na^+ and Mg^{++}, and the anions HCO_3^-, $SO4^=$ and Cl^-. The oxygen concentration in the open lake water is fairly good. However, within the reed belt the lack of oxygen can be observed in the water.

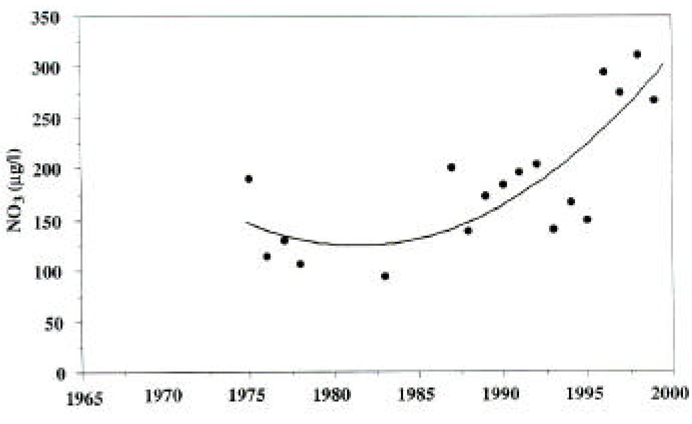
The overall trophic state of this shallow lake is meso-(eutrophic). The transitional area between the reed belt and the open water is eutrophic. From the bacteriological point of view the lake is of excellent state for recreational purposes.



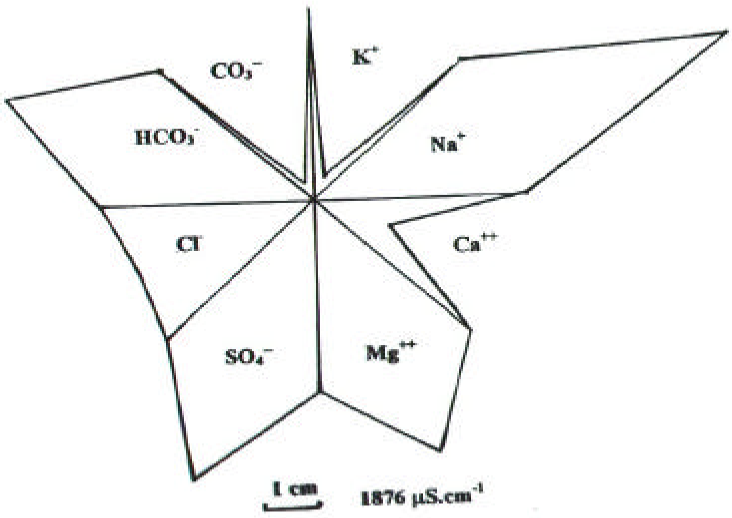
Changes of total phosphorus concentration in the open lake water in 1970-1999.



Changes of chlorophyll *a* concentration in the open lake water in 1970-1999.



Changes of nitrate nitrogen concentration in the open lake water in 1975-1999.



Salt distribution in the open lake water in 1998.

Main problems/threats:

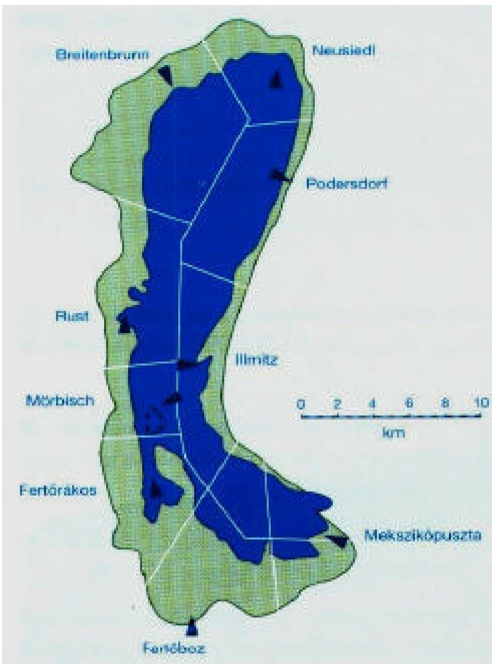
Eutrophication/overuse

International agreements concerning water use and water protection:

1956 Hungarian-Austrian Agreement on Water Management Issues in Border Area
1956 Establishment of the Hungarian-Austrian Water Commission based on above agreement, UNESCO Biosphere Reserve
European Biogenetic Reserve
Since 1993 IUCN National Parks
Convention on the Protection and use of Transboundary Watercourses and International Lakes, 1992

Monitoring programmes:

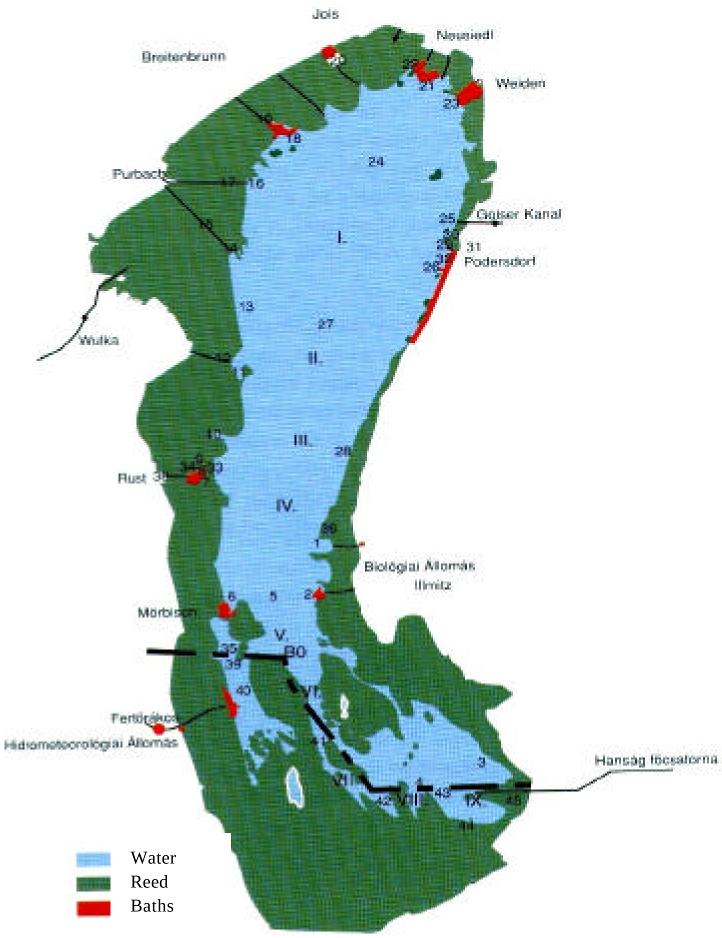
Precipitation data: Since 1901 Halbturn (A)
Gauging station: Since 1930 Neusiedl am See (A), since 1957 Mekszikópuszta (H)



Intensive data gathering: since 1968 (A and H).

Ground water observations: Since 1953 (A and H)

Water quality monitoring: First investigation 1902, national monitoring since 1968 (H), 1963 (A), bilateral monitoring since 1973, local monitoring since 1975 (H), 1982 (A), ad hoc scientific investigations



Sampling sites in Lake Neusiedler See/Ferto tó. The sites 1-38 are national or local in Austria, 39-45 national or local in Hungary, and I-IX bilateral between Austria and Hungary.

Reason for monitoring: Belongs to bilateral, national and local monitoring programme networks. Statutory monitoring is based on local needs for maintaining and using the lake. Monitoring is also based on the requirement by the Hungarian Standards for national qualification as well as on the resolution of the Hungarian-Austrian Water Commission for water quality control and assessment.

Sampling activity: National and local 26 times/year, bilateral 12 times/year

Physical and chemical analyses: Optical properties, colour and turbidity, temperature, pH, conductivity, oxygen conditions, biological and chemical oxygen demands, TOC, salt components, nutrients, inorganic and organic micropollutants

Biological analyses: Chlorophyll *a*, phytoplankton, zooplankton, and fish

Microbiological investigations: Coliform bacteria, total bacteria, salmonella

Special surveys: Sediment investigations, reed analyses

Reporting activity / exchange of information:

Statutory, bilateral reporting based on the minutes of the Hungarian-Austrian Water Commission. National monitoring results are reported every year in a short report by the Ministry for Environment (H) also in English . Local programmes are repeated less frequently for the decision-makers. In Austria the so-called Gewaesserschutzberichten (Water quality Control Report) is published occasionally, the last edition being from the year 1999.

Data availability:

Water quantity and quality data are stored in the national Environment Data Systems (EDS) and at the local water authority and environment inspectorate, in Austria in the Biologische Station Illmitz. The data are used as basic tools for environmental control, monitoring and assessment. Environmental authorities at all organisational levels use EDS. EDS is also open to users outside the environmental administration.

Use of reports for the management purposes:

Reports are mainly used by local, regional and national environmental authorities for inspections, supervision and enforcement of water management related issues. Reports are also used by water authorities when giving permissions to major point source loaders in terms of the amount and quality of waste waters allowed to be discharged into the recipient waters. Monitoring reports are also used as background documents in the process of determining appropriate compensation levels polluters are obliged to pay because of their undesirable environmental effects. The data are also used for local and regional plans.

Organisation(s) responsible for the monitoring programmes / contact person(s) :

North-Transdanubian Water Authority, H-9021 Gyor, Árpád út 28-32.
North-Transdanubian Environment Inspectorate, H-9021 Gyor, Árpád út 28-32.
Biologische Station Neusiedler See, A – 7142 Illmitz.
Bundesamt für Wasserwirtschaft, Institut für Wassergüte, A – Wien1220, Schiffmühlenstr.120.

Main publications/references:

Löffler. H. Neusiedlersee: The limnology of a shallow lake in Central Europe. Dr.W.Junk bv Publishers TheHague-Boson-London 1979.

Magyar-Osztrák Vízügyi Bizottság 40 éves tevékenysége. Jubileumi kiadvány.1996. Budapest/Wien.

Pannonhalmi, M. A Ferto tó vízgazdálkodása. Vízügyi Közlemények. 1999/2.

Herzig, A. and Dokulil, M. Neusiedler See: Ein Steppensee in Europa. In Dokulil,M., A.Hamm et.J.G. Kohl (eds.), 2000. Ökologie und Schutz von Seen. UTB/Faculta.

Herzig, A. Monitoring of Lake Ecosystems. STAPFIA 31 (1994), IWRB 30, 1994.

LAKE NUIJAMAANJÄRVI (Finland/Russia)

Name of the lake:

Lake Nuijamaanjärvi

Nature/history of the lake:

Natural lake formed/reshaped by the last Ice Age ca 10 000 - 15 000 years ago

Location of the lake:

Countries:	Finland/Russia
River basin:	The Juustilanjoki river basin
Geographical region:	South Karelia/Finland, Karelian Republic/Russia
Coordinates:	Latitude: 60^0 57' (N) Longitude: 28^0 34' (E)

Physical dimensions:

Area:	7.65 km^2 (4.92 km^2 in Finland, 2.73 km^2 in Russia)
Volume:	28(10^6 m^3
Mean depth:	3.7 m
Max. depth:	11.6 m
Elevation:	49 m asl

Catchment area:

Total area:	112 km^2
Natural features:	A small lake situated to the south of the Salpausselkä ridge. The Saimaa canal, an intensively used shipping route from Finland to Russia, runs through the lake.
Population density:	24 inhabitants/km^2
Important cities:	City of Lappeenranta
Agricultural area:	28.2 % of the catchment area
Industrial activities:	The pulp and paper industry partly discharges its wastewaters to the lake via the Saimaa Canal
Total loading:	From point sources: 0.5 t/a phosphorus, 14 t/a nitrogen From non-point sources: 4.5 t/a phosphorus, 33 t/a nitrogen

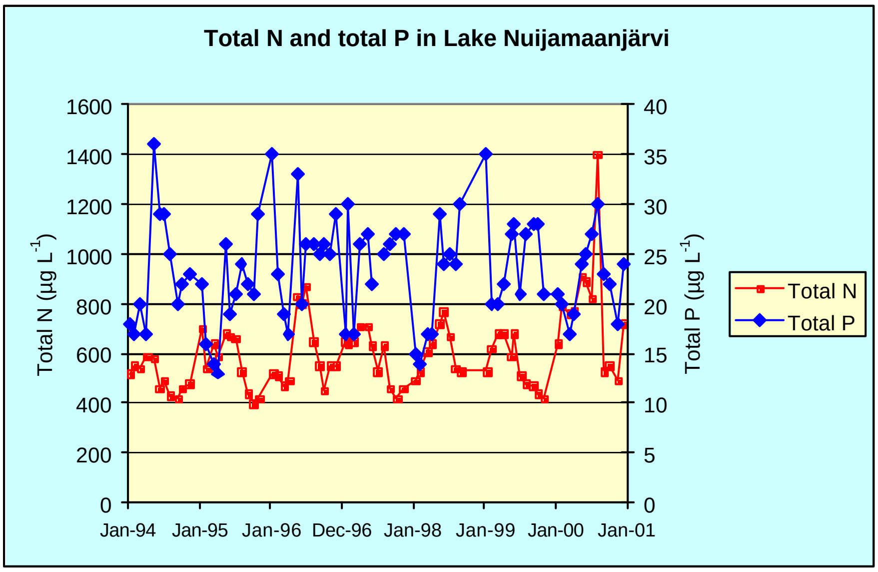
Climatic and hydrological conditions:

Temperature:	Annual mean 3.6 ºC
Precipitation:	Annual mean 602 mm (City of Lappeenranta, 1961 - 1990)
Inflow:	2 - 3 m^3/s
Outflow:	2 - 3 m^3/s
Residence time:	about 100 days

Major uses and functions of the lake:

Boat and freight traffic from Lake Saimaa to the Gulf of Finland in the Baltic Sea, and vice versa. An important lake for several recreational uses in summer.

Long-term water quality changes / the present state of the lake:



The basic levels of total nitrogen and total phosphorus concentrations suggest Lake Nuijamaanjärvi being mesotrophic. This kind of intra-annual fluctuating pattern of nutrient concentrations, best seen for total N, is typical for most Finnish lakes.

Main problems/threats:

Eutrophication, pollution by the pulp and paper industry, canal traffic + harbour activity of the Saimaa Canal

International agreements concerning water use and water protection:

The Agreement between Finland and the USSR on frontier watercourses (signed in 1964 and entered in force in 1965

Monitoring programmes:

Reason for monitoring: Stationary monitoring + national transboundary monitoring

Duration of monitoring: Since the 1960s

Sampling activity: Stationary monitoring: 2 x year (February/march + august), 2 sampling stations; national transboundary monitoring: 1 x month, 1 sampling station

Physical and chemical analyses: Stationary monitoring: temperature, transparency, oxygen, pH, conductivity, colour, COD-Mn, tot-P, tot-N, Na, and in august: NO_2+NO_3-N, NH_4-N, PO_4-P

National transboundary monitoring: Temperature, transparency, oxygen, pH, conductivity, turbidity, suspended solids, colour, COD-Mn, BOD-7, tot-P, tot-N, Fe, Mn, Na, Zn, Ni, Pb, Cu, Cr, Cd, As, Hg, phenols, mineral oils

Biological analyses: Stationary monitoring: chlorophyll *a*; National transboundary monitoring: chlorophyll *a*

Microbiological analyses: Stationary monitoring includes microbiological analyses

Radiological analyses: None

Reporting activity / exchange of information:

Stationary monitoring: yearly, National transboundary monitoring: less frequently

Data availability:

The data is stored in the Environment Data System of Finland (EDS) that is the basic tool for environmental control, monitoring and assessment. It is used by environmental authorities at all organisational levels through the Finnish Environment Network. EDS is also open to other users outside the environmental administration..

Use of reports for the management purposes:

Reports are mainly used by local, regional and national environmental authorities for inspection, supervision and enforcement of water management related issues. Reports are also used by the Environmental Permit Authorities when giving permissions to major point source loaders in terms of the amount and quality of waste waters allowed to be discharged into the recipient waters. Monitoring reports are also used as background documents in the process of determining appropriate compensation levels polluters are obliged to pay because of their undesirable environmental effects.

Organisation(s) responsible for the monitoring programmes / contact person(s) :

Southeast Finland Regional Environment Centre / Marja Kauppi, Pentti Välipakka, Oili Toroi
e-mail: marja.kauppi@ymparisto.fi

Main publications/references:

Kuusisto, E. (ed.) 1999. Saimaa: a living lake. Helsinki. Tammi. 205 pp.

LAKE OHRID (Albania/Macedonia)

Name of the lake:

Lake Ohrid

Nature/history of the lake:

Two to three million years old lake including many endemic species of flora and fauna

Location of the lake:

Countries:	Macedonia/Albania
Geographical region:	Southwest Macedonia/East Albania
Coordinates:	Latitude: 40°54' - 42°11' (N) Longitude: 18°18' - 18°2' (E)

Physical dimensions:

Area:	358.18 km^2 (approx. 240 km^2 in Macedonia, approx. 120 km^2 in Albania)
Volume:	586,400(10^6 m^3
Mean depth:	163.7 m
Max. depth:	288.7 m (in Macedonia)
Elevation:	693.17 m asl

Catchment area:

Total area:	1,042 km^2 (650 km^2 in Macedonia, 392 km^2 in Albania)
Natural features:	Situated in Shara-Pindos carstic massif, north Mediterranean vegetation zone
Population density:	In Macedonia: Ohrid & Struga 81 inhabitants/km^2 (1994), in Albania: Pogradec, 117 inhabitants/km^2 (1992)
Important cities:	….
Agricultural area:	5 % of the catchment area
Industrial activities:	Metal & textile industry
Total loading:	….

Climatic and hydrological conditions:

Temperature:	Annual mean 11.4 ºC
Precipitation:	Annual mean 755 mm
Inflow:	12.44 m^3/s (the Macedonian side without torrents, the Albanian side unknown)
Outflow:	22.4 m^3/s
Residence time:	83.6 years

Major uses and functions of the lake:

Scientific studies, fishery, tourism, recreation, irrigation, hydroelectric power production, and World natural heritage site (1980)

Long-term water quality changes / the present state of the lake:

….

Main problems/threats:

….

International agreements concerning water use and water protection:

Convention for the protection of the world cultural and natural heritage 1974

Monitoring programmes:

Reason for monitoring: Bilateral Lake Ohrid monitoring programme from 1999

Duration of monitoring: From the beginning of 1999

Sampling activity: Sediment core analysis every ten years. 7 sampling station (5 in the Macedonian side, 10 sampling depths, and 2 in the Albanian side) with monthly and bimonthly intervals. 9 Sampling sites for local pollution by monthly intervals (7 in the Macedonian and 2 in the Albanian side).

Physical and chemical analyses: Temperature, conductivity, secchi depth transparency, P_{total}, PP, $P_{sol.}$ heavy metals in macrophytic vegetation and heavy metals and pesticides in fish (every 5 years)

Biological analyses: Phytoplankton: composition, chlorophylls *a, b, c*, pheophytin, primary production (C-14), zooplankton, macrophytic vegetation list and distribution (every 10 years), benthic community species inventory (every 10 years), changes of fish spawning grounds: littoral and sublittoral (yearly)

Microbiological analyses: Bacteria (*Escherichia coli*) near polluted areas (7 in the Macedonian side & 5 in the Albanian side

Radiological analyses: None

Reporting activity / exchange of information:
Yearly

Data availability:
….

Use of reports for the management purposes:
By municipal and state environmental authorities, for inspection and water management

Organisation(s) responsible for the monitoring programmes / contact person(s) :
In Macedonia: Hydrobiological Institute, Ohrid 6000./ Trajce Naumoski

Main publications/references:
….

LAKE PEIPSI/PSKOVKO-CHUDSKOE OZERO (Estonia/Russia)

Name of the lake:

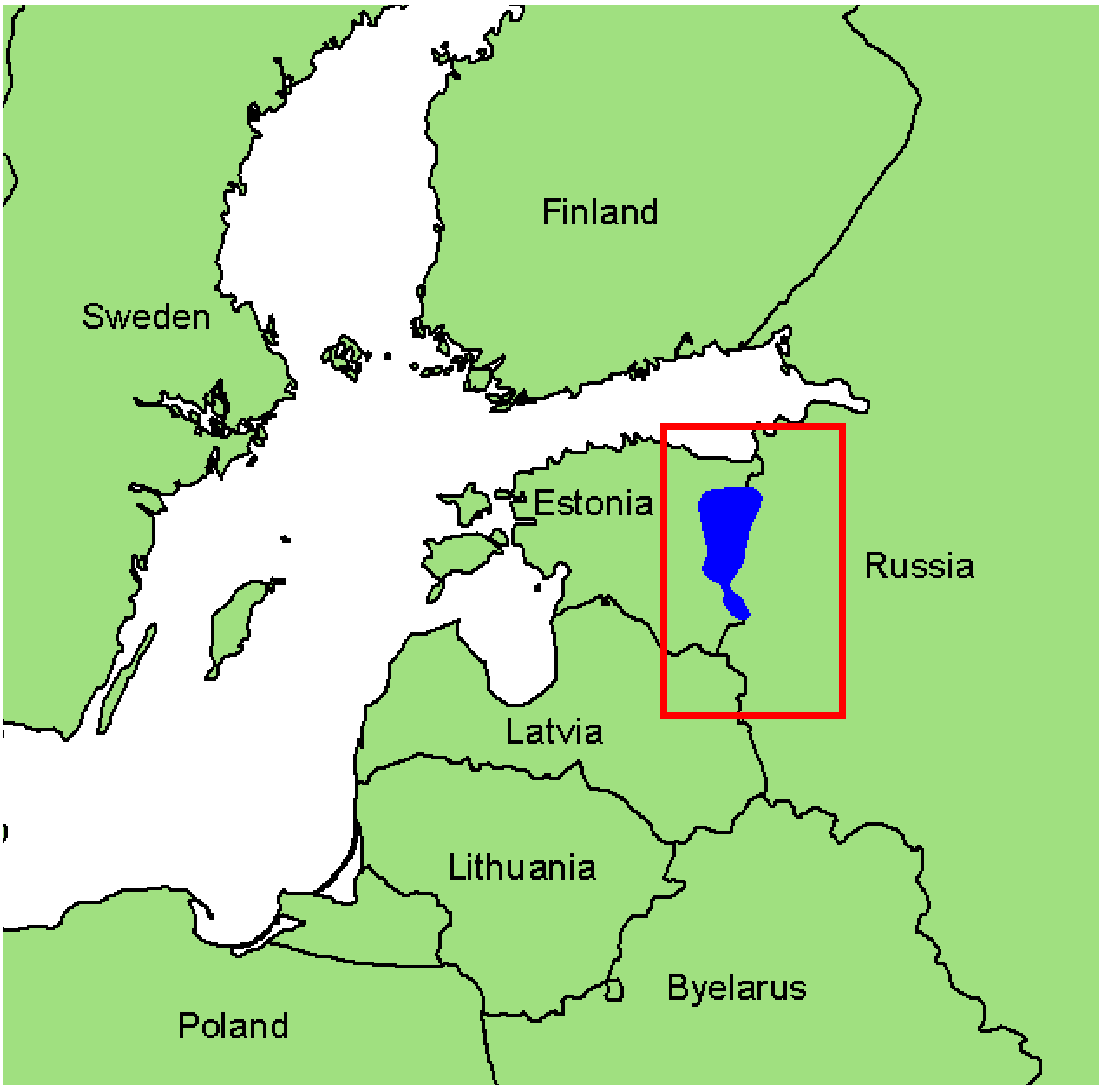
Lake Peipsi/Chudskoe Ozero

Nature/history of the lake:

Lake Peipsi/Chudskoe is the fourth largest lake in Europe and the biggest transboundary lake in Europe. The lake consists of three unequal parts: the biggest northern L. Peipsi s.s., the southern L. Pihkva /Pskovskoe and the narrow strait-like L. Lämmijärv/Teploe connecting L. Peipsi s.s. and L. Pihkva.

Location of the lake:

Countries:	Estonian Republic/Russian Federation	
Geographical region:	Lake Peipsi Lowland (eastern border of Estonia) and East-European Plain (Russia)	
Coordinates:	Latitude: 57°51' – 59°01' (N)	Longitude: 27°30' – 27°56' (E)



Location of Lake Peipsi, a transboundary watercourse shared by Estonia and Russia.

Physical dimensions:

Area:	L. Peipsi proper	2,611 km^2 (1,387 km^2 in Estonia, 1,224 km^2 in Russia)
	L. Pihkva/Pskovskoe	708 km^2 (25 km^2 in Estonia, 683 km^2 in Russia)
	L. Lämmijärv/Teploe	236 km^2 (118 km^2 in Estonia, 118 km^2 in Russia)
Volume:	L. Peipsi	21,790 • $10^6 m^3$
	L. Pihkva	2,680 • $10^6 m^3$
	L. Lämmijärv	600 • $10^6 m^3$

Mean depth:	L. Peipsi	8.4 m
	L. Pihkva/Pskovskoe	3.8 m
	L. Lämmijärv/Teploe	2.5 m
Max. depth:	L. Peipsi	12.9 m
	L. Pihkva/Pskovskoe	5.3 m
	L. Lämmijärv/Teploe	15.3 m
Elevation:	All parts	30.01 m asl

Map over the Lake Peipsi region.

Morphometric data on Lake Peipsi at the water level of 30 m above the sea level (Jaani, 2001):

	L. Peipsi s.s. (Chudskoe)	L. Lämmijärv (Teploe)	L. Pihkva (Pskovskoe)	The whole Lake Peipsi
Area, km^2	2,611	236	708	3,555
Estonia / Russia	1,387 / 1,224	118 / 118	25 / 683	1,564 / 1,991
Percentage of surface area	73	7	20	100
Volume, km^3	21.79	0.60	2.68	25.07
Percentage of total volume	87	2	11	100
Medium depth, m	8.3	2.5	3.8	7.1
Maximum depth, m	12.9	15.3	5.3	15.3
Length, km	81	30	41	152
Medium width, km	32	7.9	17	23
Maximum width, km	47	8.1	20	47
Length of shoreline, km	260	83	177	520
Percentage of total length	50	16	34	100
Distribution of the waters Between Estonia and Russia, %	55/44	50/50	1/99	44/56

Catchment area:

Total area:	47,800 km^2 (16,320 km^2 in Estonia, 27,910 km^2 in Russia, 3,570 km^2 in Latvia)
Natural features:	Genetically, the lake basin is a land form, scoured mainly by the Pleistocene glacier. In the north some features of the bedrock topography have been inherited from the pre-Middle Devonian and were slightly modified by the glaciers. Northern boreal zone of Coniferous forests and swamps. Shores of L. Peipsi are scarp (cliffed, sandy, morainic, peaty) and flat (till, sandy, peaty, silty). Scarp sandy beach is prevailing in the northern part of the lake. Flat shores are usually swampy, with reed and bulrush. This kind of shores spreads mainly in the western part of the lake. Lake Peipsi belongs to the watershed of the Narva River, a 77 km long watercourse, which connects L. Peipsi with the Gulf of Finland of the Baltic Sea. The mean annual water discharge via the Narva River into Gulf of Finland is 12.6 km^3 (approximately 50% of the average volume of L. Peipsi).
Population density:	Different in various parts of the basin: 24 inhabitants/km^2 in Estonia and Pskov region, 11 inhabitants/km^2 in sparsely populated eastern seashore of the lake
Important cities:	Pskov in Russia, with 204,000 inhabitants, Tartu in Estonia, with 103,000 inhabitants
Agricultural area:	Approximately 35% of the catchment area (1999)
Industrial activities:	Oil-shale mining (Estonia and Viru mines with 9 - $10*10^6$ tonnes of oil-shale per year) in the northern part of the basin
Total loading:	910 t/a phosphorus, 20,500 t/a nitrogen (1995 - 1998; Stålnacke *et al. 2000)*

Climatic and hydrological conditions:

Temperature:	Annual mean 4.6 ^{o}C (long-term mean of the Tiirikoja Meteorological Station, near Mustvee city on the west coast of the L. Peipsi)
Precipitation:	Annual mean 575 mm in 1929-1998 at Tiirikoja Meteostation (Keevallik, 2001)
Inflow:	387 m^3/s
Outflow:	399 m^3/s (via Narva River)
Residence time:	2 years

About 240 rivers and streams flow into L. Peipsi. The major rivers are Velikaja (in Russian Federation and Emajõgi (Estonia) with catchment areas 25,200 km^2 and 9,745 km^2, respectively.

Major uses and functions of the lake:

Fishery, recreation, shipping. Internationally important wetlands in the lake-shore areas (Ramsar sites Remda/Remedovsky in Russia and Emajõe-Suursoo in Estonia).

Long-term water quality changes /present state of the lake:

According to total P, total N and chlorophyll *a*, the trophic state of the three parts of L. Peipsi is different: L. Peipsi *s.s.* is an eutrophic lake while L. Pihkva/Pskovskoe ozero is close to be hypertrophic.

Indices reflecting trophic status of L. Peipsi (modified from Laugaste et al., 2001; Starast et al., 2001)

Parameter	Units	Years	Mean	L. Pihkva	L.Lämmi-järv	L. Peipsi s.s.
P_{tot}	mg m^{-3}	1985-96	42	63	53	35
N_{tot}	mg m^{-3}	1985-96	768	1010	923	678
Chl a	mg m^{-3}	1983-97	17.3	26	25	14
Secchi depth	m	1983-2000	1.76	1.25	1.42	1.8

The average primary production in the growing period is 204 g C m^{-2}. Diatoms and blue-green algae prevail in phytoplankton biomass. The blue-greens *Gloeotrichia echinulata* and *Aphanizomenon flos-aquae* dominate in summer causing algal blooms. Zooplankton is remarkably rich in species, the average biomass in the vegetative period is 2-3 g m^{-3} and production 22 g C m^{-2}. The proportion of rotifers in production is 53% followed by the cladocerans (30%), copepods (16%) and *Dreissena polymorpha* larvae (1%). The average abundance of macrozoobenthos (without big molluscs) is 2,617 ind. m^{-2}, and their biomass 12.34 g m^{-2} are considered to be the highest among the large lakes of North Europe. Macroflora occupies a small precentage of the total lake area but is rich in species. Taxa forming communities are *Potomogeton perfoliatus, Phragmites australis, Shoenoplectus lacustris, Potomogeton lucens, Eleocharis palustris* and *Polygonum amphibium* (Nõges, *et al.* 1996).

The content of total nitrogen, nitrite (NO_2^-), ammonia (NH_4^+), total phosphorus, silicon (Si), orthophosphate, chlorophyll *a*, chemical oxygen demand / dichromate digestion method (COD_{Cr}) and chemical oxygen demand / permanganate digestion method (COD_{Mn}) decrease from south to north, while water transparency, alkalinity (HCO_3^-), sulphate (SO_4^{2-}), chloride (Cl^-), calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions have the opposite trend. The first trend is caused by the impact of the pollution loads from big cities, Pskov (mainly to L. Pihkva/Pskovskoe) and Tartu (to southern part of L. Peipsi *s.s.* and to L. Lämmijärv/Teploe.

The content of nutrients in the rivers of L. Peipsi basin was high at the end of the 1980s causing eutrophication of water bodies. Since the beginning of the 1990s the nutrient content in small rivers has continuously decreased due to lower agricultural production and smaller amounts of waste water discharged into the rivers.

A slight increasing trend of Ntot and an increasing trend of Chl a has been revealed.

Main problems/threats:

Eutrophication

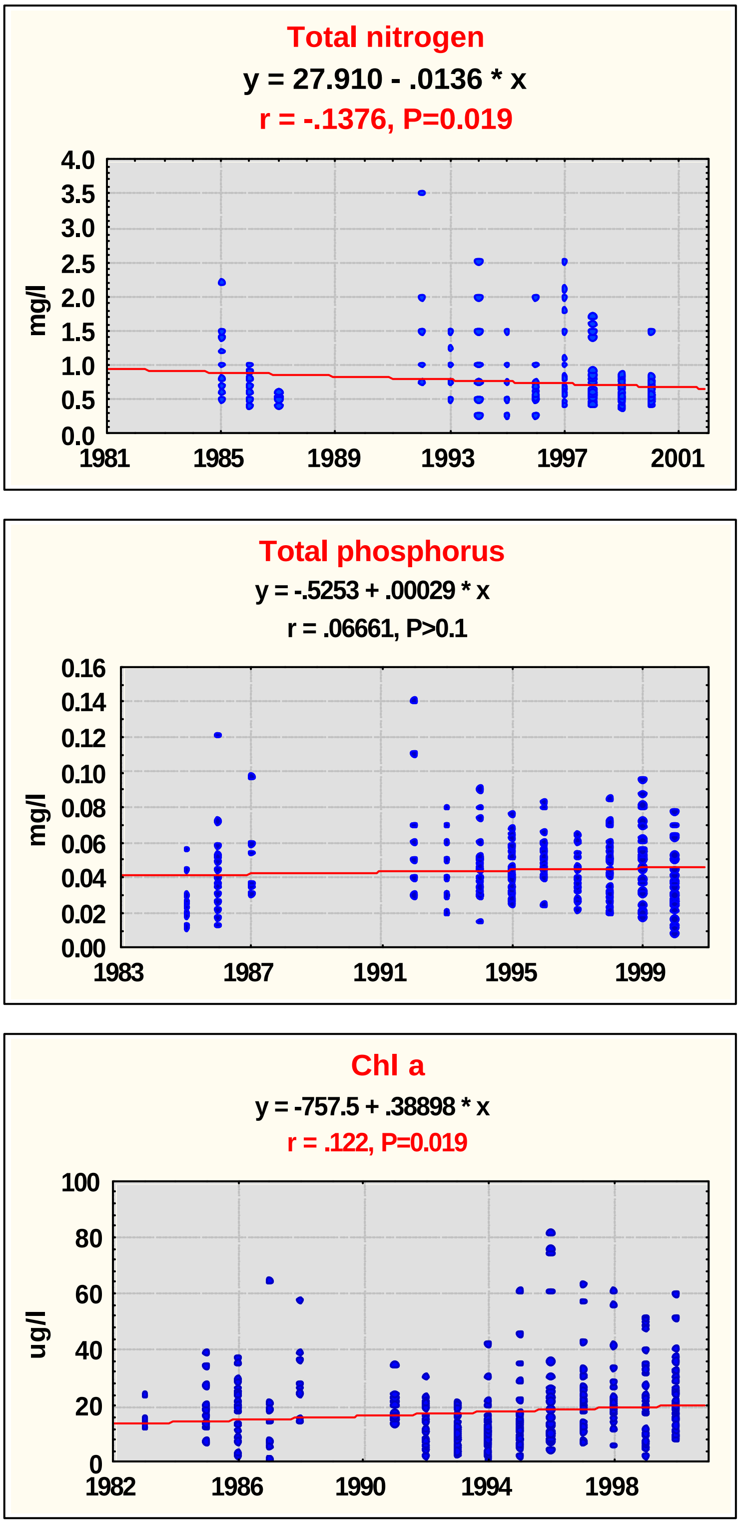
International agreements concerning water use and water protection:

Convention on the Protection and use of Transboundary Watercourses and International Lakes, 1992

The Estonian-Russian Agreement on Fisheries on Lakes Peipsi, Lämmi and Pihkva/Pskovskoe, 1994

The Agreement between the State Committee of the Russian Federation on Ecology and the Use of Natural Resources and the Ministry of Environment of the Estonian Republic on Environmental Protection of the Lakes Peipsi/Chudskoe, Lämmi/Teploe and Pihkva/Pskovskoe, 1996

An intergovernmental Agreement on the Protection and Sustainable Use of Transboundary Water Bodies signed in 1997



Changes of the concentrations of total nitrogen, total phosphorus and chlorophyll *a* in Lake Peipsi (Nõges, 2001b).

Monitoring programmes:

Regular water chemistry monitoring on L. Peipsi started in 1950. Hydrobiological investigations had been carried out since 1962. In 1950-1991, the Estonian Hydrometeorological Survey conducted national monitoring on the lake, following the programmes and methods of the former U.S.S.R. The monitoring was a complex and integrated at the very beginning because it was a part of the surface monitoring program. The assessment of the results of lake water analyses has been done together with those from rivers in the catchment area of the lake.

In addition to water chemistry analyses the hydrobiological investigations in the lake and in river had been carried out. From the hydrobiological investigations the following should be mentioned:
Phytoplankton (species composition and biomass), chlorophyll *a, b and c,* zooplankton (main species, primary production), bacterioplankton (total count of bacteria, number of saprophytic bacteria, total Coliforms and Enterococcia, macrozoobenthos, macrophytes, fishes and fisheries management (34 various species, productivity 25-34 kg ha^{-1}).

The following short description of the main procedures will give an overview of the sampling, water chemistry analyses, hydrobiological investigations, data collection and reporting, and quality assurance problems.

Sampling and transport of samples to the laboratory: Sampling for water chemistry and hydrobiological investigations has been taken from sampling stations (see the map) by motor-boat once every month in summer period, *e.g.* seven - eight times per year, plus one expedition in winter-period (December-March). The possibility of the last-mentioned expedition depends on the thickness of the ice-cover on the lake.

Water samples were taken from the surface and near the bottom, the dissolved oxygen was measured in each sampling station after every metre from the surface to the bottom twice a year, as minimum (in summer, July-August, and at the end of winter, March-April). Persons, responsible for sampling must have periodical training and intercomparison-tests (2 year interval). The samples must be hold in cooling-box and transported to the laboratory during 24 hours after the end of sampling.

Water-chemistry analyses had been made in different laboratories. The following components have been measured in each water sample: water temperature, pH, dissolved oxygen (in field), smell, colour, transparency, Ca^{+}, Mg^{+}, total hardness, Na, K, SO_4^{2-}, HCO_3^-, Cl^-, NH_4^+, NO_2^-, NO_3^-, N_{tot}, PO_4^{2-}, P_{tot}, Si, Fe_{tot}, COD_{Mn}, BOD_7. Once a year the analysis of oil products and heavy metals (Cd, Cu, Hg, Pb, Zn) has been performed.

The water-chemistry laboratory of the Tartu Environmental Research Ltd. (former South-Estonian Environmental Protection Laboratory) had made all chemical analyses during the whole monitoring period in Estonia since 1992. Since 1991 there have been two laboratories in Russia (in Pskov), and it is not clear which of them will be responsible for water-chemistry analyses. One laboratory belongs to the Institute of the Hydrology and Meteorology of Russian Federation (located in St.- Petersburg), another to the Pskov Regional Environment Protection Committee. The equipment in the Tartu Laboratory is new and modern but not in the laboratories in Pskov. The analyse methods used in the laboratories, mentioned above, are also different. The modified ISO-, SFS- (Finnish-) and SS- (Swedish-) methods are in use in Tartu Laboratory.

The laboratories in Russia are still using the old Soviet-period analyse methods and standards. It is quite difficult therefore to compare the results of water-chemistry monitoring. Since 2000 the Estonian and Russian authorities have coordinated their monitoring programmes. The intercomparison tests have been organised by the Ministry of Environment in Estonia (4 different intercomparisons every year: surface water, groundwater, wastewater, drinking water) and in Russia as well (wastewater and surface water).

The Swedish Environmental Protection Agency has organised some parallel analyses for Estonian, Russian and Swedish laboratories during the last 4 years, using for this the money from co-operation projects. The Tartu Environmental Research Ltd. had possibilities to participate in some special international comparison tests (heavy metals, *etc.*) for 40-50 laboratories in Europe in the frame of PHARE-projects.

Hydrobiological investigations have been fulfilled by scientists of Võrtsjärv Limnological Station by Estonian Agricultural University (Estonia) and Pskov Department of Russian Inland Waters Fishery Research Institute (Russia). Parallel analyses and intercomparisons have not been organised.

Data handling and reporting has been done primarily by the laboratories and sent to the Information Centre by the Ministry of Environment in Estonia, and to the Institute of Hydrology and Meteorology in Russia. The Estonian Information Centre has published the results of environmental monitoring every year (Keskkonnaseire 1999 *e.g.*), and they are available in Internet very soon. The availability of the Russian monitoring data is not clear because the system of environment control has been reorganised many times every year.

Pollution load from the watershed was extremely high in the 1980s, which caused eutrophication of the lake. The first complex estimation of the nutrient load to Lake Peipsi was carried out in 1989-90s. The results of those investigations were published by the Institute of Zoology and Botany of Estonian Academy of Sciences in 1990 and 1991 (Loigu *et.al* 1991). Those publications are in Estonian, with summaries in English. According to those investigations 74% of the total nitrogen load and 46% of the total phosphorus load was of agricultural origin. The very essential pollution sources were two big towns Pskov in Russia and Tartu in Estonia.

The second complex estimation of the nutrient load to the Lake Peipsi was carried out in co-operation with Estonian, Russian and Swedish scientists and specialists on water ecosystems monitoring. The results of those investigations and evaluations show that the lake received approximately 19,000 tonnes of nitrogen and 580 tonnes of phosphorus annually during the period 1995-1998. Riverine transport is the most important pathway for the input of nutrients to Lake Peipsi. Examination of the spatial variation of nutrient loads showed that the Velikaya River alone accounted for approximately 65% of the total riverine load.

The working group on monitoring and research of the Estonian-Russian Joint Commission on Transboundary Waters, established in 1997, achieved the harmonization of monitoring programmes in Estonia and Russia.

Reporting activity / exchange of information:

Statutory monitoring results reported yearly or after 2- 3 years interval

Data availability:

Water quantity and quality data is stored in the Information and Technical Centre by Ministry of Environment of Estonia and are used as basic tools for environmental control, monitoring and assessment in Estonia. Some problems need to be solved via information exchange and early warning between Estonia and Russia. Environment quality data is available for public via Internet.

Use of reports for the management purposes:

Reports are mainly used by local (parish and town administrations), regional (counties) and national environmental authorities for inspections, supervision and enforcement of water management related issues (water management plans, water supply and waste water treatment planning, etc.). Reports are also used by the Environmental Permit Authorities when giving permissions to point source loaders in terms of the amount and quality of waste waters allowed to be discharged into the recipient water bodies. Monitoring data and calculations of nutrient loads are used as background information by NGO's, universities and other scientific organisations in public participation process when risks to environment need to be clarified.

Organisation(s) responsible for the monitoring programmes / contact person(s) :

Estonia:
Responsible organisation : Ministry of Environment of Estonia, Toompuiestee 24, 15172 Tallinn, Estonia
Contact person responsible for monitoring: Dr. Tiina Nõges, Limnological Station, Rannu, Tartu County, Estonia, 61101, tnoges@zbi.ee
Contact person: Ülo Sults/Center of the Transboundary Cooperation, Veski 69, Tartu, Estonia

Russia:
Responsible organisation: Russian Federation Hydrometeorological Service, Vassilyevsky ostrov,23 linija 2-a, 199026 St.-Petersburg and Pskov, Butyrskaya ul, 34
Contact person: Ms. Zoja Mokroussova

Main publications/references:

Jaani, A., 2001. The location, size and general characterization of Lake Peipsi. In: Nõges, T. (ed.) 2001. Lake Peipsi. Hydrology, Meteorology, Hydrochemistry. Sulemees Publishers, Tallinn.

Jaani, A., Kullus, L.-P., 1999. Hydrological regime and water balance. In: Pihu, E. & A. Raukas (eds.) Peipsi. Tallinn, Keskkonnaministeeriumi Info- ja Tehnokeskus (in Estonian), 27-55.

Keevallik, S, Loitjärv, K. Rajasalu, R & V. Russak, 2001. Meteorological regime. In: Nõges, T. (ed.) 2001. Lake Peipsi. Hydrology, Meteorology, Hydrochemistry. Sulemees Publishers, Tallinn.

Laugaste, R., Nõges, T., Nõges, P., Yastremskij, V., Milius, A., Ott, I., 2001. Algae. L. Peipsi. Flora and Fauna. E. Pihu & J. Haberman (eds.): 31-49.

Loigu,E., Pärnapuu, M., Hansen, V., 1991. The balance of polluting substances and pollution load of Lake Peipsi. In: Peipsi järve seisund II, Tallinn, 6-13.

Miidel, A. & A. Raukas (eds.), 1999. Lake Peipsi. Geology. Sulemees Publishers, Tallinn.

Nõges, T, Haberman, J., Jaani, A., Laugaste, R., Lokk, S., Mäemets, A., Nõges, P., Pihu, E., Starast, H., Timm, T & Virro,T., 1996. General description of Lake Peipsi-Pihkva. In Hydrobiologia 338: 1-9, 1996.

Nõges, T. (ed.) 2001a. Lake Peipsi. Hydrology, Meteorology, Hydrochemistry. Sulemees Publishers, Tallinn.

Nõges, T. 2001b. State monitoring of Estonian large lakes. Presentation on the Scientific Forum on Environmental Monitoring in the Baltic Sea Region. Lund, 02-04 April 2001.

Pihu, E. & A. Raukas (eds.) 1999. Peipsi. Tallinn, Keskkonnaministeeriumi Info- ja Tehnokeskus (in Estonian).

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Stålnacke, P.,1999. Nutrient loads to the Lake Peipsi - experiences from a joint Swedish/Estonian/Russian project.

Starast, H., Milius, A., Möls, T. & A. Lindpere, 2001. Hydrochemistry. In: Nõges, T. (ed.) 2001. Lake Peipsi. Hydrology, Meteorology, Hydrochemistry. Sulemees Publishers, Tallinn.

Timm, T. & T. Nõges (Eds) 1996. Biology of Lake Peipsi. - Kluwer Academic Publishers. Dordrecht. (Hydrobiologia, Vol. 338, No 1-3.) 199 pp.

LAKE PRESPA (Albania/Macedonia/Greece)

Name of the lake:

Lake Prespa

Nature/history of the lake:

….

Location of the lake:

Countries:	Macedonia/Greece
Geographical region:	Southwest Macedonia / East Albania / Northwest Greece
Coordinates:	Latitude: 40°46' - 41°10 (N) Longitude: 20° 54' - 21°70' (E)

Location of Lake Prespa, a transboundary lake shared by Macedonia, Albania and Greece.

Physical dimensions:

Area:	274 km^2 of which 178 km^2 (65%) in Macedonia, 47 km^2 (17%) in Greece, 49 km^2 (18%) in Albania
Volume:	$5(10^6$ m^3
Mean depth:	16 m
Max. depth:	47 m
Elevation:	846 m asl

Catchment area:

Total area:	2,800 km^2 (1,200 km^2 in Macedonia)
Natural features:	Situated at the tuck of two different geological massifs, the Shara-Pindos carstic massif on the West and granite massif in the East, North Mediteranian vegetation zone. Most south alpine vegetation on “Pelister” national park in Macedonia (east shore) and “Prespa” national park in Greece, (southeast shore) of Lake Prespa. The ownership of the lake area and shores: Lake area state (Republic of Albania, Republic of Greece & Republic of Macedonia) ownership; shores mostly state owned, and small parts owned by tourist enterprises, national park “Galicica” authority and private (in the Macedonian side).
Population density:	In the Macedonian side of the watershed 20 inhabitants/km^2
Important cities:	….
Agricultural area:	6 % of the catchment area
Industrial activities:	Metal, textile and food industry
Total loading:	….

Climatic and hydrological conditions:

Temperature:	….
Precipitation:	….

Inflow: ….
Outflow: ….
Residence time: ….

Major uses and functions of the lake:

Scientific studies, fishery, tourism, recreation, irrigation, and protection of the Ezerani area.

Long-term water quality changes / the present state of the lake:

….

Main problems/threats:

Eutrophication, industrial pollution, toxic substances, other relevant pollution factors

International agreements concerning water use and water protection:

Convention for the protection of the world cultural and natural heritage 1974

Monitoring programmes:

Reason for monitoring: Bilateral Lake Prespa monitoring programme since 1999

Duration of monitoring: From the beginning of 2000

Sampling activity: Sediment core analysis every ten years. One sampling station in the Macedonian side (10 sampling depths) and one station in the Albanian side. Sampling with monthly and bimonthly intervals.

Physical and chemical analyses: Temperature, conductivity, Secchi depth transparency, P_{total}, PP, $P_{sol.}$ heavy metals in macrophytic vegetation and heavy metals and pesticides in fish (every 5 years)

Biological analyses : Phytoplankton composition, chlorophyll *a*, *b*, *c*, pheophytin, primary production (C-14); zooplankton; macrophytic vegetation list and distribution (every 10 years); benthic community species inventory (every 10 years); changes of fish spawning grounds: littoral and sublittoral (yearly)

Radiological analyses: none

Reporting activity / exchange of information:

Yearly

Data availability:

….

Use of reports for the management purposes:

By municipal and state environmental authorities, for inspection and water management

Organisation(s) responsible for the monitoring programmes / contact person(s):

In Macedonia: Hydrobiological Institute, Ohrid 6000 / Trajce Naumoski
In Albania: Hidrometeorological Institute, Tirana / Veli Puka

Main publications/references:

….

LAKE PYHÄJÄRVI (Finland/Russia)

Name of the lake:
Lake Pyhäjärvi, often called Lake Karelian Pyhäjärvi

Nature/history of the lake:
Natural lake formed/reshaped by the last Ice Age ca 10 000 - 15 000 years ago

Location of the lake:

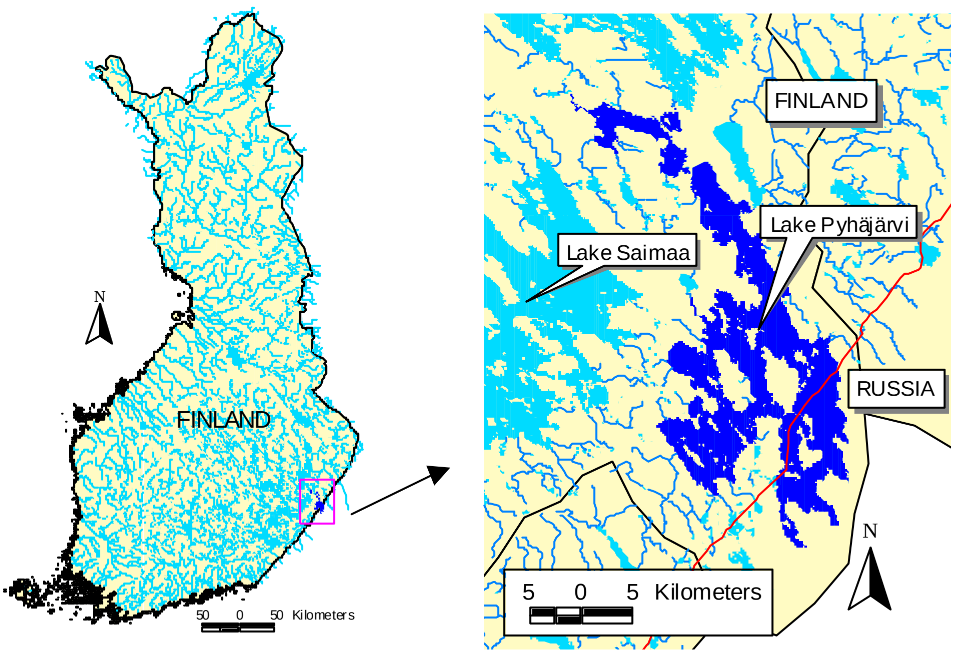
Countries:	Finland/Russia
Geographical region:	North Karelia and South Karelia /Finland, Karelian Republic/Russia, the Vuoksi River basin
Coordinates:	Latitude: 62^0 00' (N) Longitude: 30^0 00' (E)

Physical dimensions:

Area:	248 km^2 (207 km^2 in Finland, 41 km^2 in Russia)
Volume:	1,660(10^6 m^3
Mean depth:	8 m
Max. depth:	27 m (Finnish side)
Elevation:	79 m asl

Catchment area:

Total area:	1,019 km^2 (804 km^2 in Finland, 215 km^2 in Russia)
Natural features:	Situated between the Salpausselkä eskers, the bedrock mainly archaic granites; belongs to the northern boreal zone and the Ladogan - Karelian vegetation zone.
Population density:	Approximately 9 inhabitants/km^2 (1999)
Important cities:	Kitee
Agricultural area:	Approximately 5 % of the catchment area (1992)
Industrial activities:	No factories, only one fish farm (water court permit for 50 t/a fish production till 31.3.2002, only 2 t/a produced in 1999)
Total loading:	10 t/a phosphorus, 310 t/a nitrogen, 33 t/a BOD_7 (1994)



(© Maanmittauslaitos lupa nro 7/MYY/02)

Location of Lake Pyhäjärvi, a transboundary lake shared by Finland and Russia.

Climatic and hydrological conditions:

Temperature:	Annual mean 2.2 °C (1961-90 mean in the city of Joensuu, about 70 km north from Lake Karelian Pyhäjärvi)

Precipitation:	Annual mean 612 mm (1961-90 mean in Joensuu)
Inflow:	Unknown
Outflow:	8.2 m^3/s (via Puhos rapid and Hiiskoski River)
Residence time:	7.5 years

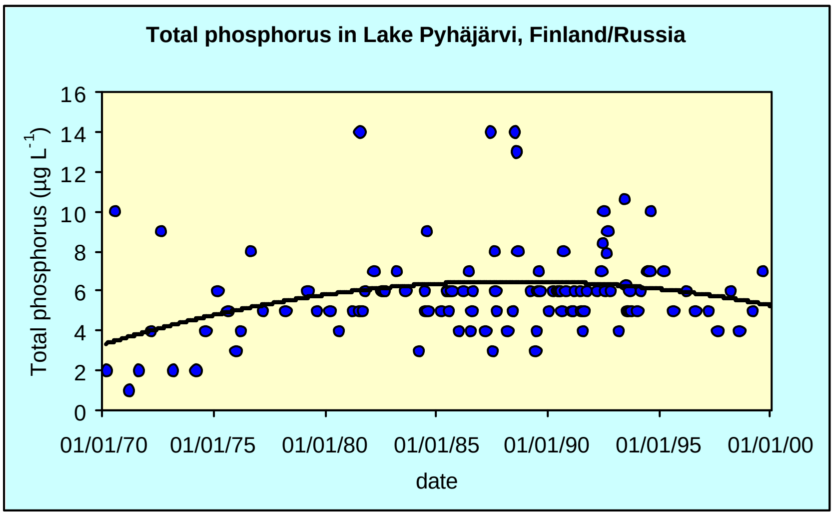
NOTE 1.	The water level was lowered by 1.5 m in 1828 - 1839.
NOTE 2.	The lake has been regulated by the Puhos water power plant from 1960 onwards, the water level regulated within the range of N60+79.18 - 80.07 m.

Major uses and functions of the lake:

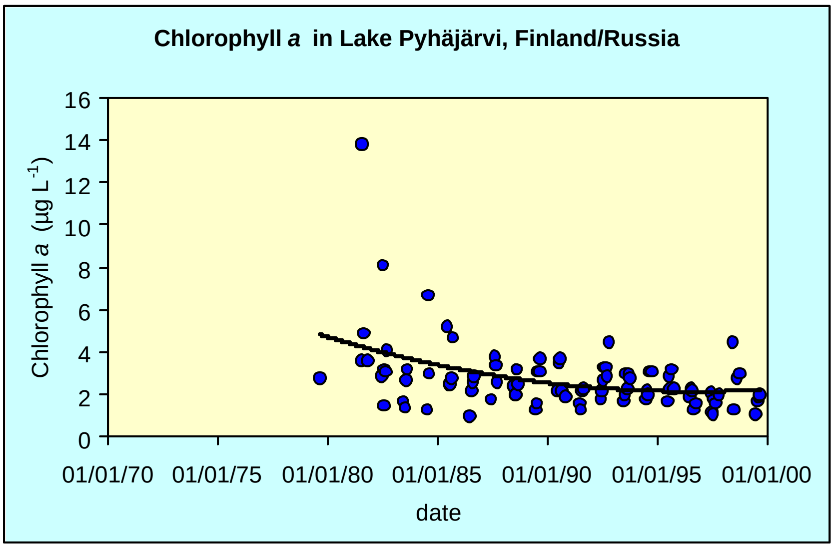
Fishery, recreation and hydroelectric power production. Scientific studies. Belongs to the Natura 2000 conservation network.

Long-term water quality changes / the present state of the lake:

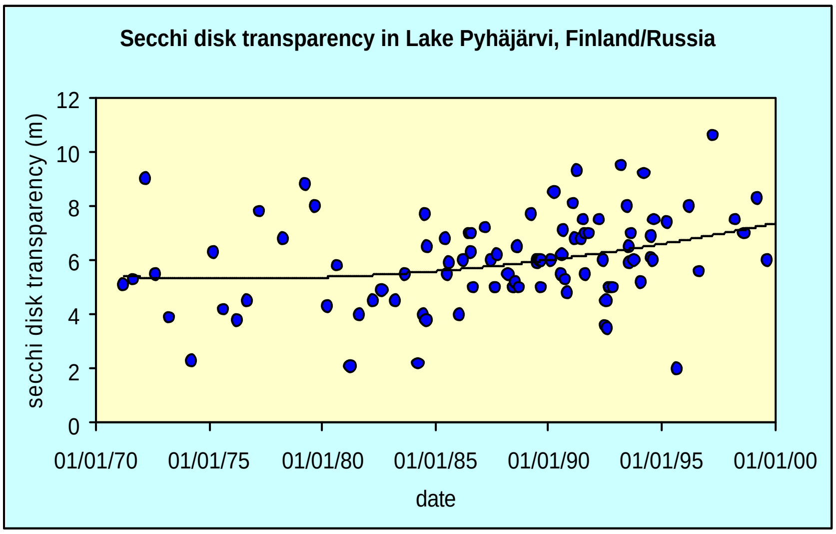
Slightly polluted by non-point and point source loading. A gradual but slow deterioration has been observed during the 1990s. The overall water quality of the lake is classified as excellent.



Total phosphorus concentrations increased from the early 1970s until to the beginning of 1990s. Since then phosphorus concentrations have shown a slight decrease. The improvement is mainly due to the reduced loading of phosphorus caused by diffuse sources (forestry, agriculture).



Chlorophyll *a* concentrations were clearly higher at the beginning of 1980s than at the turn of the 21st century. The downward trend of chlorophyll *a* is due to the decrease of agricultural phosphorus loading.



Secchi depth (visibility depth) has slightly increased since the 1970s. The basic reason for the better visibility depth is the diminished loading of nutrients and organic matter (humic substances).

Main problems/threats:

Eutrophication

International agreements concerning water use and water protection:

Convention on the Protection and use of Transboundary Watercourses and International Lakes, 1992

The agreement between Finland and the USSR on frontier watercourses (signed in 1964 and entered in force in 1965)

Monitoring programmes:

Reason for monitoring: L. Pyhäjärvi belongs to national and regional monitoring programme networks. From 1998 onwards the lake has been included in a nation-wide algae monitoring network with a weekly voluntary algae monitoring in summer in one observation point. From 2000 onwards one station has been in the Finnish Eurowaternet monitoring network. The lake is also monitored for scientific purposes on both national and international (bilateral) basis. Statutory monitoring, based on the Water Act, is performed in the loaded areas of the lake.

Duration of monitoring: Since the early 1960s. National and regional monitoring programmes are revised/renewed every three years.

Sampling activity: Yearly, at least once in late March (winter stagnation), once in late August (summer stagnation) and once in October (autumn circulation). Approximately every third year the algae are monitored in one station once a week during summer. Voluntary transparency measurements are performed in about 10 stations once a month / biweekly from 1997 onwards in cooperation with the North Karelian Regional Environment Centre.

Physical and chemical analyses: Temperature, transparency (Secchi depth), oxygen, total phosphorus, PO_4-P, total nitrogen, NO_{23}-N, NH_4-N pH, colour, alkalinity, COD_{Mn}, conductivity, Fe, Mn, Na, K, Ca, Mg, Al, turbidity, Cl, SO4, org.C/TOC, SiO2

Biological analyses: Chlorophyll *a* is measured every year both in summer and autumn, phytoplankton every year in July, and benthic animals every three years in late autumn. Fish populations are irregularly studied.

Microbiological analyses: Used only in the loaded areas near fish farms and municipal wastewater outputs

Radiological analyses: Not performed

Reporting activity / exchange of information:

Statutory monitoring results reported yearly, regional and national programmes less frequently (approx. 4 - 5 year intervals).

Data availability:

Water quantity and quality data is stored in the national Environment Data System of Finland (EDS) and are used as basic tools for environmental control, monitoring and assessment. Environmental authorities at all organisational levels use EDS. EDS is also open to users outside the environmental administration. In addition to the water related data, EDS contains information, for example, on chemicals, land use and nature conservation.

Use of reports for the management purposes:

Reports are mainly used by local, regional and national environmental authorities for inspections, supervision and enforcement of water management related issues. Reports are also used by the Environmental Permit Authorities when giving permissions to major point source loaders in terms of the amount and quality of waste waters allowed to be discharged into the recipient waters. Monitoring reports are also used as background documents in the process of determining appropriate compensation levels polluters are obliged to pay for because of their undesirable environmental effects.

Organisation(s) responsible for the monitoring programmes / contact person(s) :

Responsible organisation: North Karelia Regional Environment Centre, P.O. Box 69, FIN-80101 Joensuu, Finland.

Contact persons: North Karelia Regional Environment centre: Mr Hannu Luotonen (hannu.luotonen@vyh.fi), Ms Riitta Niinioja (riitta.niinioja@vyh.fi) and Ms Paula Mononen (paula.mononen@vyh.fi).

Main publications/references:

Finnish Fisheries Research 8, 1987. Special issue comprising Finnish and Soviet studies on Lake Pyhäjärvi (Karelia). 62 pp.

Meriläinen, J. & Kokko, H. 1982. Karjalan Pyhäjärven tila kesällä 1981 levästöjen ja suurkasvillisuuden ilmentämänä. Loppuraportti 15.2.1982. Joensuun korkeakoulu. Joensuu. 16 p. (Evaluation of the state of Lake Karelian Pyhäjärvi in summer 1981 based on the results of algae and macrophytes communities studies).

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Ollikainen, M. 1992. Karjalan Pyhäjärven tila 1980-luvulla sedimentin piilevien ilmentämänä.Vesi- ja ympäristöhallinnon julkaisuja - sarja A 87. 60 pp.

Ollikainen, M., Simola, H. & Niinioja, R. 1993. Changes in Diatom Assemblages in the Profundal Sediments of Two Large Oligohumic Lakes in Eastern Finland. Hydrobiologia 269/270: 405-413.

Piirainen, T. & Vänskä, T. 1994. Karjalan Pyhäjärven valuma-alueen maankäyttö. Pohjois-Karjalan vesi- ja ympäristöpiirin monisteita nro 4.

LAKE SAIMAA (Finland/Russia)

Name of the lake:

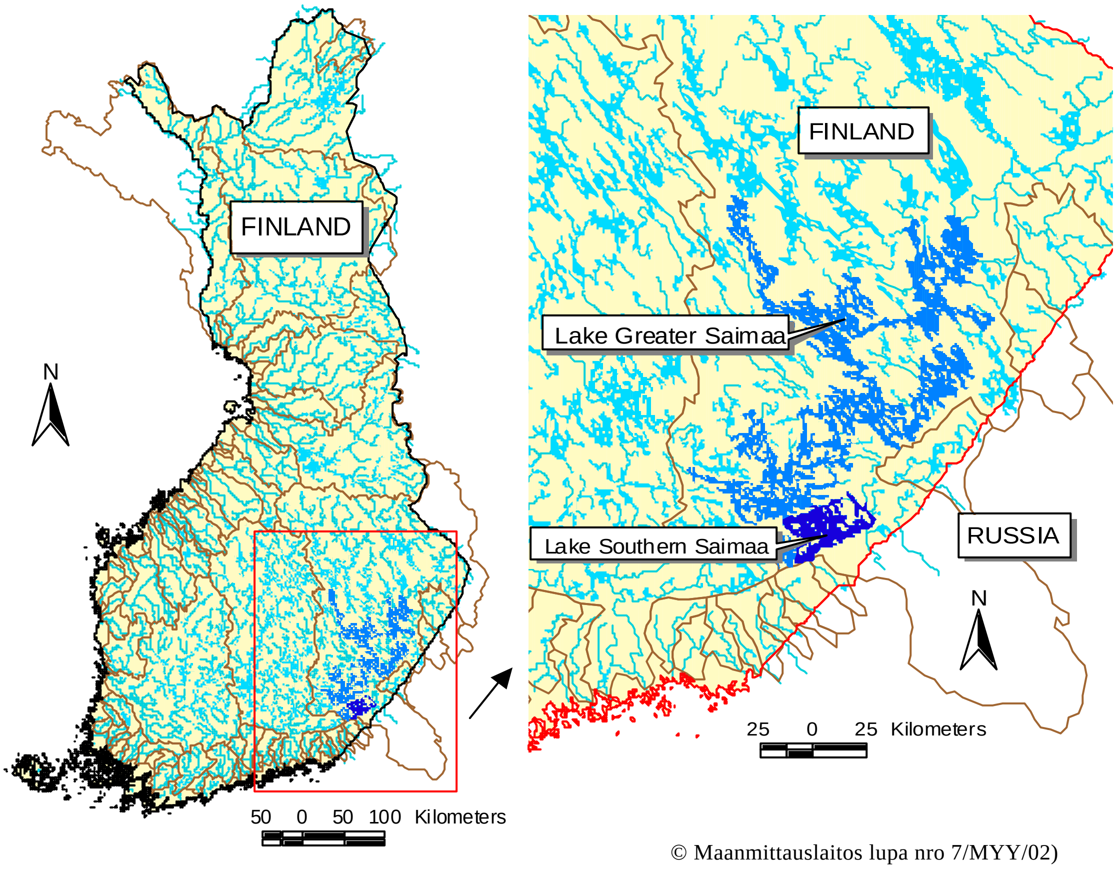
Lake Saimaa (= L. Southern Saimaa, a sub-basin of L. Greater Saimaa)

Nature/history of the lake:

Natural lake formed/reshaped by the last Ice Age ca 10 000 - 15 000 years ago

Location of the lake:

Countries:	Finland/Russia
Geographical region:	South Karelia/Finland and Karelian Republic/Russia, the Vuoksi river basin
Coordinates:	Latitude: $61^0 15'$ (N) Longitude: $28^0 11'$ (E)



Location of Lake Southern Saimaa, a sub-basin of L. Greater Saimaa.

Physical dimensions:

Area:	386 km^2 (totally in Finland)
Volume:	3,900,000(10^6 m^3
Mean depth:	10.1 m
Max. depth:	67 m
Elevation:	76 m asl

Catchment area:

Total area:	L. Greater Saimaa: 61,054 km^2 (51,941 km^2 in Finland, 9,113 km^2 in Russia) L. South Saimaa: 3,597 km² (the closest drainage area of L. South Saimaa)
Natural features:	Situated near the two Salpausselkä eskers, the bedrock mainly archaic granites; belongs to the northern boreal zone
Population density:	21 inhabitants/km^2
Important cities:	Lappeenranta, Imatra
Agricultural area:	5.1 % of the L. South Saimaa catchment area

Industrial activities:	Three pulp and paper mills, peat mining
Total loading:	From industry: 35.1 t/a phosphorus, 527 t/a nitrogen, 3,918 t/a BOD_7, 4,049 t/a suspended solids
	From non-point sources: 63.8 t/a phosphorus and 1,795 t/a nitrogen

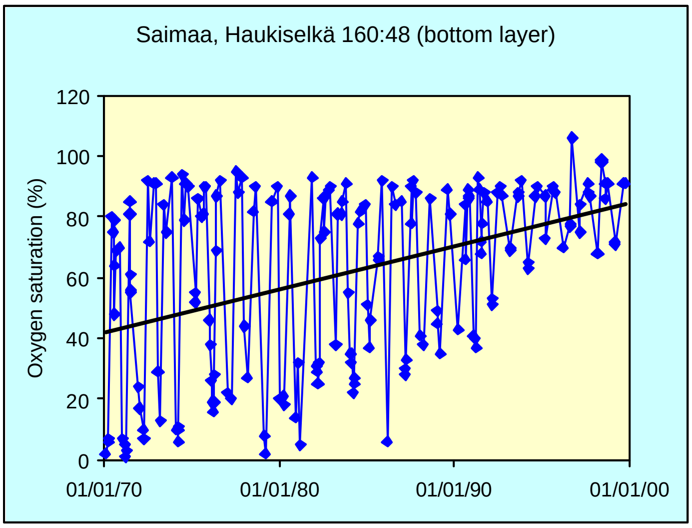
Climatic and hydrological conditions:

Temperature:	Annual mean 3.6 ºC (1961-1990)
Precipitation:	Annual mean 602 mm (1961-1990)
Inflow:	approx. 500 m^3/s
Outflow:	approx. 500 m^3/s
Residence time:	0.22 years

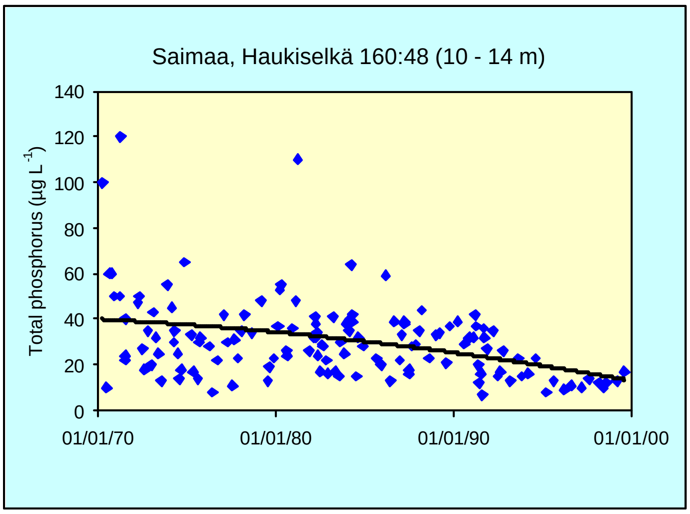
Major uses and functions of the lake:

Recreational use, water abstraction for urban and industrial use, fishing, and boat traffic via the Saimaa Canal from L. Saimaa to the Baltic Sea).

Long-term water quality changes / the present state of the lake:



Development of oxygen saturation in the bottom water of a polluted sub-basin (Haukiselkä) of Lake Saimaa during the period 1970–1999. The intra-annual variation and the gradual but clear improvement of the late winter situation (the lowest values within each year) are obvious.



Total phosphorus concentrations have clearly decreased in a polluted sub-basin (Haukiselkä) of Lake Saimaa from the early 1970s until to the end of 1990s. The improvement is mainly due to the reduced loading of phosphorus caused by the pulp and paper industry.

Main problems/threats:

Eutrophication, waste waters from the pulp and paper industry

International agreements concerning water use and water protection:

Convention on the Protection and use of Transboundary Watercourses and International Lakes, 1992

The agreement between Finland and the USSR on frontier watercourses (signed in 1964 and entered in force in 1965)

Monitoring programmes:

Reason for monitoring: Stationary monitoring, regional and national monitoring, Eurowaternet monitoring (two stations), EU directives (two stations)

Duration of monitoring: Since 1960s

Sampling activity:
Stationary monitoring: Lake Southern Saimaa (effects of pulp mill effluents)
Physico-chemical monitoring: 31 stations, 4 times a year (March-April, May, August and October-November)
Biological monitoring: 6 times a year (May-September), chlorophyll *a* at 21 stations and phytoplankton + zooplankton at 4 stations; every three years, 6 times a year (May-September), phytoplankton + zooplankton and periphyton from 12 stations and at the same time total and mineral nutrients; bottom fauna from 12 stations every three years (late autumn); in 1997 also from sediment diatom analyses (5 stations) and harmful substances (5 stations) in sediment and in fish. Lake Maavesi (a part of Southern Lake Saimaa): 5 stations pysico-chemical monitoring 4 times a year (March-April, May, August and October) including chlorophyll *a* monitoring at summer time.

National monitoring: Eurowaternet (3 stations): physico-chemical monitoring: 3 stations, 3 times a year (March, August, October); biological monitoring: 1 station, yearly 5 times (May-August) + bottom fauna yearly in autumn

Regional monitoring: A regional network in the western part of Southern Lake Saimaa, 4 times a year. Monitoring of algae in summer every week (two stations)

Physical and chemical analyses:
Stationary monitoring: Lake Southern Saimaa: temperature, transparency, oxygen, pH, conductivity, turbidity (= FTU), colour, COD_{Mn}, tot-P, tot-N, Na, smell, NO_2+NO_3-N, NH_4-N, PO_4-P. Lake Maavesi: temperature, transparency, oxygen, pH, conductivity, suspended solids, colour, COD_{Mn}, tot-P, tot-N, Fe

National monitoring: Temperature, transparency, oxygen, pH, conductivity, turbidity, alkalinity, colour, COD_{Mn}, tot-N, NO_2+NO_3-N, NH_4-N, tot-P, PO_4-P, Fe, Mn, Na, K, Ca, Mg, SiO2, Al, Cl, SO4, TOC, BOD-7, HOCl, Zn, Cu, smell

Regional monitoring: Temperature, transparency, oxygen, pH, conductivity, turbidity, colour, COD_{Mn}, tot-P, tot-N

Biological analyses:
Stationary monitoring: Lake Southern Saimaa: chlorophyll *a*; phytoplankton + zooplankton (species and biomass); periphyton (chlorophyll *a*); bottom fauna (species + biomass). Lake Maavesi: chlorophyll *a*; bottom fauna (in 2000/2001).

National monitoring: Phytoplankton; bottom fauna; periphyton

Regional monitoring: Chlorophyll *a*

*Microbiological analy*ses: some information from swimming areas

Radiological analyses: none

Reporting activity / exchange of information:

Stationary monitoring: yearly; regional and national programmes less frequently

Data availability:

The data is stored in the Environment Data System of Finland (EDS) that is the basic tool for environmental control, monitoring and assessment. It is used by environmental authorities at all levels of organisation through the Finnish Environment Network. EDS is also open to other users outside the environmental administration.

Use of reports for the management purposes:

By municipal and environmental authorities, supervision and for enforcement of water management

Organisation(s) responsible for the monitoring programmes / contact person(s) :

Southeast Finland Regional Environment Centre / Marja Kauppi, Pentti Välipakka and Oili Toroi

Main publications/references:

Kahkonen, M.A., Suominen, K.P., Manninen, P.K.G & Salkinoja-Salonen, M.S. 1998. 100 years of sediment accumulation history of organic halogens and heavy metals in recipient and nonrecipient lakes of pulping industry in Finland. Environ. Sci. Technol. 32(12):1741-1746.

Kuusisto, E. (ed.) 1999. Saimaa: a living lake. Helsinki. Tammi. 205 pp.

Suominen, K.P., Wittmann, C., Kahkonen, M.A. & Salkinoja-Salonen, M.S. 1998. Organic halogen, heavy metals and biological activities in pristine and pulp mill recipient lake sediments. Water Sci. Technol. 37(6-7):79-86.

Many special reports by the Water Protection Society of Lake Saimaa (in Finnish).

LAKE STANCA – COSTESTI (Romania/Republic of Moldavia)

Name of the lake:
Lake Stanca-Costesti

Nature/history of the lake:
This reservoir, on the Danube River, is a part of the Hydro-technical knot System; Romania and the Republic of Moldavia built it between 1973 and 1978.

Location of the lake:

Countries:	Romania/Republic of Moldavia
Geographical region:	North-East (N-E) of Romania, N-E of the Moldova plain, in the Prut River basin, at 576 km upstream of the confluence with the Danube River
Coordinates:	Latitude: 47°50’ - 48°10’ (N) Longitude: 26°50’ - 27°15’ (E)

Location of Lake Stanca-Costesti, a transboundary lake shared by Romania and the republic of Moldavia.

Physical dimensions:

Area:	59 km^2
Volume:	735(10^6 m^3
Mean depth:	24 m
Max. depth:	40 m
Elevation:	45 m

Catchment area:

Total area:	12,000 km^2 (the Prut River basin area)
Natural features:	On the border between Romania and Republic of Moldavia, along 700 km
Population density:	Approximately 76.5 inhabitants/km^2 (in Romania)
Important cities:	Iasi and Botosani (in Romanian part)
Agricultural area:	70,050 ha – prepared for irrigation
Industrial activities:	No industrial activities near the lake
Total loading	Mean values for the period of 1995 - 2000: 13,488 t/a nitrates; 20,105 t/a COD_M; 257 t/a phosphorus)

Climatic and hydrological conditions:

Temperature:	Annual mean 9 °C
Precipitation:	Annual mean 23.1 dm^3/m^2
Inflow:	82.9 m^3/s
Outflow:	82.9 m^3/s
Residence time:	….

Major uses and functions of the lake:

Supply water for inhabitants, recreation, fishery, irrigation, hydroelectric power production, scientific studies, protection against floods, and regulation of the flow

Long-term water quality changes / the present state of the lake:

The overall water quality of the lake is classified as to the 1^{st} category, taking into consideration the Romanian STAS 4706/88, for the majority of indicators.

Main problems/threats:

Higher concentration for Zn and Cu, but the values are still in the 1^{st} category.

International agreements concerning water use and water protection:

Bilateral Convention (Romania/Republic of Moldavia) concerning the water management on the Prut River and the rules for exploitation of the hydro-technical knot system

Convention on the Protection and use of Transboundary Watercourses and International Lakes, 1992

Monitoring programs:

Reason for monitoring: Lake Stanca-Costesti belongs to national monitoring program networks

Duration of monitoring: Since 1984 in National programs

Sampling activity:

Sampling sites: Near the dam, in the middle of the lake and end of the backwater

Physical and chemical analyses: Temperature, pH, conductivity/TDS, dissolved oxygen, BOD_5, COD-Mn, COD-Cr, Cl, SO_4, Ca, Ma, ammonium, nitrates, nitrites, total nitrogen, mineral nitrogen, total Fe, PO_4-P, total P, Mn, Na, K, Zn, Cu, phenols, oils, suspended matters, turbidity, CO_3.

Biological analyses: phytoplankton, zooplankton, zoobenthos

Microbiological analyses: total coliforms, total germs

Radiological analyses: β global.

Sampling frequency: seasonally (4 times/year)

Reporting activity / exchange of information:

Statutory monitoring results reported 4 times per year to the Prut Water Directorate, and once per year to the National Company "Apele Romane"

Data availability:

Water quantity and quality data is stored in the national water data system (WDS) of Romania and are used as basic tools for water management (control, monitoring and assessment, etc), studies, synthesis and reports, bilateral conventions. WDS is used by water authorities at all organizational levels and is also open to users outside the water administration.

Organisation(s) responsible for the monitoring programmes / contact person(s):

Responsible organization: National Company "Apele Romane", Edgar Quinet, nr.6, sector 1, Bucharest, Romania

Contact person: eng. Rodica-Carmen OGNEAN, National Company “Apele Romane”, Edgar Quinet, nr.6, sector 1, Bucharest, Romania, tel 40-1-3155535; fax 40-1-3122174, mobil 095-052575, E-mail carmen@ape.rowater.ro

Main publication/references:

The technical book of the Stanca-Costesti Hydro-technical knot System
The rules for exploitation of the Stanca-Costesti Hydro-technical knot System
The register for exploitation of the Stanca-Costesti Hydro-technical knot System
The Water Quality Synthesis

ANNEX

QUESTIONNAIRE

LAKE …….. (Country 1/Country 2)

Name of the lake:

…..

Nature/history of the lake:

…..

Location of the lake:

Countries:	…..	
Geographical region:	…..	
Coordinates:	Latitude: …..°…..' (N)	Longitude: …..° …..' (E)

Physical dimensions:

Area:	…..km^2
Volume:	…..$*10^6$ m^3
Mean depth:	…..m
Max. depth:	…..m
Elevation:	…..m asl

Catchment area:

Total area:	…..km^2
Natural features:	…..
Population density:	…..inhabitants/km^2
Important cities:	…..
Agricultural area:	…..
Industrial activities:	…..
Total loading:	…..

Climatic and hydrological conditions:

Temperature:	Annual mean …..ºC
Precipitation:	Annual mean …..mm
Inflow:	…..m^3/s
Outflow:	…..m^3/s
Residence time:	…..

Major uses and functions of the lake:

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Long-term water quality changes / the present state of the lake:

…..

Main problems/threats:

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International agreements concerning water use and water protection:

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Monitoring programs:

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Reporting activity / exchange of information:

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Data availability:

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Use of reports for the management purposes:

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Organisation(s) responsible for the monitoring programmes / contact person(s):

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Main publications/references:…..

Monitoring of International Lakes

Background paper for the Guidelines on Monitoring and Assessment of Transboundary and International Lakes

This document presents the current monitoring and assessment practices used in 21 transboundary/international lakes in the ECE region. Furthermore, the document provides some basic information on the lakes, such as the location, physical dimensions, cathment area properties, climate, long-term water quality changes, and threats against the lakes.

The work was supervised by the Working Group on Monitoring and Assessment established under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki 1992).