

Published for the  
International Biological  
Programme by  
Blackwell Scientific  
Publications, Oxford  
and Edinburgh

IBP Handbook No 21

# **Project Aqua**

a source book of  
inland waters  
proposed for conservation

Published with the  
assistance of UNESCO

H Luther  
J Rzóška



**IBP HANDBOOK No.21**

**IUCN OCCASIONAL PAPER No.2**

**PROJECT AQUA**  
**a source book of inland waters**  
**proposed for conservation**

Sponsored by  
INTERNATIONAL BIOLOGICAL PROGRAMME (IBP)  
SOCIETAS INTERNATIONALIS LIMNOLOGIAE

General Secretary: R.G. Wetzel  
Kellogg Biological Station  
Michigan State University, U.S.A.

INTERNATIONAL UNION FOR THE CONSERVATION  
OF NATURE AND NATURAL RESOURCES(IUCN)  
Morges, Switzerland

Compiled by

H. LUTHER  
Helsinki

J. RZÓSKA  
London

INTERNATIONAL BIOLOGICAL PROGRAMME  
7 MARYLEBONE ROAD, LONDON NW1

BLACKWELL SCIENTIFIC PUBLICATIONS  
OXFORD AND EDINBURGH

TD388.5

L87

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ISBN 0 632 08730 7

First Published 1971

Distributed in the U.S.A. by  
F.A. Davis Company, 1915 Arch Street,  
Philadelphia, Pennsylvania

Printed in Great Britain by  
Avon Litho Limited, Stratford-upon-Avon  
and bound by  
The Kemp Hall Bindery, Oxford



## Foreword

This is a source book of information on more than 600 inland water bodies throughout the world which are judged to be worthy of conservation. Some are classical sites of research, some are spectacular or of special importance on account of geographical or biological attributes, some are as yet little known and spared from human interference. Project Aqua was initiated by SIL (Societas Internationalis Limnologiae) in 1959 and was developed by Section PF (Production Freshwaters) of IBP which made a provisional issue of the List in 1969. The revised and enlarged List is now published under the joint sponsorship of IBP, SIL and IUCN.

The IBP is a world-wide plan of co-ordinated research concerned with "the biological basis of productivity and human welfare". It commenced in 1964 and continues for a decade until 1974. The handbook series of IBP consists of volumes which are needed by biologists who are participating in the programme around the world. This is the fifth in the handbook series to have come from Section PF. The others are No. 3: *Methods for Assessment of Fish Production in Freshwaters*, edited by W.E. Ricker; No. 8: *Methods of Chemical Analysis of Freshwaters*, edited by H. Golterman with the assistance of R.S. Clymo; No. 12: *A Manual on Methods for Measuring Primary Production in Aquatic Environments*, edited by R.A. Vollenweider; and No. 17: *Methods for Estimation of Secondary Productivity in Freshwaters*, edited by W.T. Edmonson and G.G. Winberg. The present book, while it deals with the sites of research, not the methods, is a worthy addition. We are deeply indebted to Professor Hans Luther who is chairman of Finland's national committee for the IBP as well as of the Project Aqua committee, and Dr. Julian Rzóška, Scientific Co-ordinator of Section PF, for the hard and sustained work which they have put into it.

The IUCN, which was founded in 1948 and has its headquarters in Morges, Switzerland, is an independent international body which represents those who are concerned at man's modification of the natural environment. This comes from the rapidity of urban and industrial development and the excessive exploitation of the earth's natural resources, upon which rest the foundation of man's survival. IUCN's main purpose is to promote or support action which will ensure that the perpetuation of wild nature and natural resources is on a world basis, not only for their intrinsic cultural or scientific values but also for the long-term economic and social welfare of mankind.



Thus, IUCN is the appropriate body to follow up and to stimulate action by governments and other agencies on the conservation work which has been initiated by SIL and IBP. It is anticipated for example that the international convention on wetlands which has recently reached the stage of agreement following much preparatory work by IUCN and ICBP (International Council for Bird Preservation) may provide an appropriate legal framework of protection for some of the sites mentioned in this volume. The SIL and its numerous members in many parts of the world will, no doubt, help also in the defence of endangered waters. Other sites may receive national and international recognition through other means.

Limnologists, who have contributed so much to the understanding of ecosystems, began thinking about conservation issues at a rather later time than terrestrial ecologists. This is unfortunate, because lakes and rivers are in some respects more sensitive to the encroachment of man and of despoliation than are terrestrial sites. However, the battle for their conservation is now engaged and is proceeding with increasing intensity, especially in the highly developed and industrialised countries. Therefore, this book is timely, and even in its earlier provisional issue has helped to save several key sites. The list is not a final one because as long as human activities encroach on nature and as long as limnology develops as a progressive science, there will be additions and perhaps some deductions from the list. Thus, Project Aqua is dynamic, not static, in the sense of a continuously alert action for the protection of endangered water bodies. IBP, SIL and IUCN will be happy to receive proposals for its improvement, particularly from those countries which do not yet figure in the list.

The cost of preparing and publishing this volume has been met mainly by the IBP but with contributions from UNESCO and IUCN which are gratefully acknowledged.

E.B. Worthington  
*Scientific Director*  
*International Biological Programme*

## Introduction

The existing world network of national parks and equivalent reserves consists mainly of land habitats. Many such areas are important for research, and the establishment of the UN List\* has been of great assistance in securing their adequate conservation.

Aquatic habitats are also worthy of protection, partly because they show a great variety of types, and partly because research on some of them has founded an important new branch of biology. Yet lakes and rivers have to a large extent remained without any real protection. Some of them have already been ruined or partly lost their natural state, and many of the others are threatened in different ways by contamination or by technical plans for utilisation. The needs of conservation of aquatic sites listed here are, however, becoming ever more pointed. All over the world, human encroachment on the environment is startlingly visible and has caused reaction, not only from conservationists and scientists, but also from the general public and, indeed, from Governments.

This list is the first stage towards the comprehensive registration of those aquatic sites throughout the world which, in the interests of science and of posterity, should be given some kind of conservation status, comparable with national parks, nature reserves or equivalent areas of land. This would not prevent the natural resources of lakes and rivers being used in a rational way, including their use for recreation. The ultimate aim is international recognition of an agreed list and national action in conservation.

With this in mind, at the final assembly of the XIV Congress of the *Societas Internationalis Limnologiae* (SIL) in Salzburg, Austria, 2 September 1959, the following recommendation was proposed by Dr. E.B. Worthington and unanimously accepted:

"SIL should prepare a list of lakes and rivers whose preservation and protection is particularly desirable and ask the United Nations Organisation to recognise them".

In May 1961 the Commission on Ecology of the International Union for the Conservation of Nature and Natural Resources (IUCN), meeting in Zurich, decided to participate in the preparation of such a list for which the title Project Aqua was

\* *United Nations List of National Parks and equivalent reserves*. English version, 2nd edition, Brussels 1969.



subsequently adopted. Thus a tie was established between aquatic and conservation interests. At the same time IUCN decided to compile a list of temperate wetlands of international importance, which later adopted the name "Project Mar".

When the International Biological Programme (IBP) was established in 1964, it was agreed that one of the first tasks of its Freshwater Productivity Section (IBP/PF) was to participate in Project Aqua and, before long, the operative centre of the project, which had been started at Helsinki, moved to the PF office of IBP in London. From both these centres a heavy bulk of correspondence was undertaken in order to produce the list as it is today.

The present book is thus the outcome of several years of preparation which, in 1969, reached the stage of provisional issue. Its circulation stimulated numerous further entries and corrections, and so the work has reached the stage of publication.

### *Purpose of the List*

Project Aqua intends ultimately to get international recognition for a list of freshwater and brackish water areas which are of agreed international importance for research, education or training, and where therefore the countries should accept national responsibility for conservation.

Some of the sites are in a natural state, others are modified by man and still others are entirely created by man. Some reservoirs have been included in the list e.g. the great African man-made lakes and those in the Soviet Union, because they can be regarded as large scale experiments on the nature of water bodies and their development.

Marine sites are excluded, but are planned to be treated in a similar list, for which the name "Project Talatta" has been suggested. Inland brackish waters are included in Project Aqua, and also a few coastal brackish waters, where they naturally link up with connecting freshwater habitats.

### *The materials of the present list*

Almost twelve years have elapsed since the SIL recommendation on Project Aqua was adopted in Salzburg. To begin with, the work was rather slow and did not receive much support but later recognition of the disastrous rate at which waters are being polluted or otherwise altered has stimulated wider interest. The first nucleus of a list was compiled from opinions expressed by limnologists with knowledge of a broader area than their own country. Later on, IBP National Committees were approached.

The two ways of collecting the material have been through the opinions of well-known limnologists and the judgement of national authorities. To some extent these are difficult to correlate because the latter are apt to avoid sites which might



become controversial from a practical point of view, whilst the former look primarily to the needs of international science.

The list of lakes, rivers and other aquatic sites is by no means complete and there are some gaps for whole countries. However, other countries have advanced the idea of conservation and care for the aquatic environment in a vigorous way. In some countries where aquatic biomes have been worked over thoroughly by limnologists, the entries may be more or less definitive. For some less studied countries, however, proposals entered in the list may have come from a brief and superficial study made by one or two visiting scientists. Thus the lists for different countries are not strictly comparable. It will also be evident from this book that Latin America, Africa and parts of Asia, are not yet sufficiently represented. It is hoped that publication will stimulate further additions, and that a revised list will be called for in due course. A series of air photos of classical lakes or of waters of special interest is added. Simple location maps show the distribution of sites in countries or continents.

The full pattern of information requested and the classification adopted is given here for convenience on a fold out page at the end of the volume which will allow for easy reading of symbols and numbers in the text. Documentation concerning the sites is in many cases inadequate or lacking. This is especially so in the case of sites which lie in less accessible places or in countries where the problem of conservation is not yet recognised as acute.

The IBP has undertaken, with the co-sponsorship of IUCN and SIL, the work of preparing and publishing this List, but hopes that the initiative will now pass to other bodies which are especially concerned with aquatic science and conservation; at the international level to SIL, to IUCN and to the appropriate specialist agencies of United Nations, and at the national level to appropriate government departments and to universities.

The book has uses and implications other than only conservation. The inclusion of selected bibliographies about many sites makes it a useful source book of limnological information. Furthermore, it is clear that some of the lakes, so far little touched by human interference, could be 'Baseline' sites for monitoring the changes of the environment, now accelerated by human influence. The book, in some ways, is also a contribution to the International Hydrological Decade (IHD), which though mainly concerned with the assessment of water resources in the world, has recently paid attention to the quality of water in addition to its quantity, and therefore impinges on biological as well as physical limnology.

The two official languages of IBP are English and French, so that contributions received in other languages have been translated.

Many people have helped us in the compilation of this book and we acknowledge this help with many thanks.

The first entries to this book were supplied by the late Professor Vittorio Tonolli who, during the 15th International Congress of Limnology at Warsaw in 1965 made

a plea for support for this work. We, therefore, dedicate this book to his memory.  
The financial help of IUCN for the provisional issue (1969) and that of UNESCO for this book is gratefully acknowledged

Hans Luther,  
*Chairman,*  
*SIL and IUCN Project Aqua Committees*

Department of Botany,  
University of Helsinki,  
Unioninkatu 44,  
Helsinki 17,  
FINLAND.

Julian Rzóška,  
*Scientific Co-Ordinator IBP/PF*

IBP Central Office,  
7 Marylebone Road,  
LONDON NW1 5HB.

## NOTE

Since the publication of the previous edition of the Project Aqua list in 1969, outline plans for the Man and Biosphere Programme of UNESCO have been formulated.\*

Considerations of aquatic ecosystems form an important part of these plans which include both the conservation and the study of the structure and function of a wide range of water bodies.

Project Aqua is clearly relevant to the development of such future international programmes and the completion of this edition of the list has been carried out within the framework of the programme of IBP/UNESCO Joint Projects.

\*Plan for a Long-Term Intergovernmental and Interdisciplinary Programme on Man and the Biosphere. UNESCO Document 16C/78. Paris, 6 October 1970.



- graphy of springs. *Hydrobiol.* 2, 313–319
- Nielsen A. (1955) Productivity of five Danish waters. *Verh. Int. Ver. Limnol.* 12, 123–133
- Thorup J. (1963) Growth and life-cycle of invertebrates from Danish springs. *Hydrobiologia* 22, 55–84
- Wesenberg-Lund C. (1917) Fureso-studier. K. Danske Vidensk. Selsk. Skr. 8 Rk. 3, 1–208

## FINLAND

Information: H. Luther

- 1 1 The Pojoviken – Tvärminne Al  
Brackish Water Area
  - 2 Finland, on the northern coast of the Gulf of Finland (transition area to the open Baltic)
  - 3 59° 44'–60° 06' N, 23° 09'–23° 33' E
  - 4 Sea level
  - 5 The area may be divided in two parts:  
The Pojoviken proper – 22.9 km<sup>2</sup>;  
The Archipelago, area not calculated
  - 6 The Pojoviken proper: Max 40 m;  
mean 10.5 m  
The archipelago: max 75 m; mean unknown
  - 7 Cleft valley with a sand moraine threshold (depth 6 m) at the mouth of the Pojoviken proper. The archipelago is a towards S sloping hilly peneplane with a land upheaval of 42 cm per century.
  - 8 Brackish water area with a slight and stable decrease of salinity over a distance of 40 km from 0.6‰ to fresh water, and an abundance of rock pools with a great diversity in ecological conditions
  - 9 The slight salinity decrease is a rather unique feature
  - 10 A good deal of hydrobiological and hydrological work has been done since 1900 (over 150 publications dealing with the area)
- References:  
Luther, Alex (1957) Tvärminne zoologiska station. *Acta Soc. F. FL. Fenn.* 73, 1–128  
Segerstale S.G. (1964) Literature on the marine biology in the Baltic area published in the years 1953–1962. *Comm. Biol. Soc. Scient. Fenn.* 27 (3), 1–44
- 11 Various owners
  - 12 Only the area around the Tvärminne Zoological Station, owned by the Helsinki University, is under nature protection
  - 13 Fishery; receives sewage from several smaller townships
  - 14 A planned water supply for Helsinki from the upper water courses will decrease the inflow of fresh water, and may threaten the salinity equilibrium in the Pojoviken; sewage from planned industries.
- 
- 2 1 Hormajärvi Bill
  - 2 Finland, Uusimaa (Nyland) Lohja commune
  - 3 60° 18' N, 24° 01' E
  - 4 34 m a.s.l.
  - 5 5.11 km<sup>2</sup>
  - 6 Maximum: 21m; mean unknown
  - 7 Bedrock depression surrounded by moraine and clay district
  - 8 Oligotrophic, but eutrophication in progress
  - 9 Tracing the eutrophication
  - 10 Annotations available from a period of fifteen years, only a few published:  
Järnefelt H. (1963) Zur Limnologie einiger Gewässer Finnlands. XIX. *Ann. Zool. Soc. "Vanamo"* 24, 7, 1–118
  - 11 Various owners
  - 13 Recreation
  - 14 Development of recreation areas
- 
- 3 1 Pääjärvi Alla
  - 2 Finland, District of Häme
  - 3 61° 01'–61° 05' N, 25° 03'–25° 13' E
  - 4 102.7 m
  - 5 1348.4 ha
  - 6 Maximum: 84 m; mean ca 14.4 m
  - 7 Rift valley
  - 8 Dys-oligotrophic
  - 9 Unusually deep, glacial relicts
  - 10 Järnefelt H. (1929) Zur Limnologie einiger Gewässer Finnlands VI. *Ann. Soc. Vanamo* 8 (8), 105–167
  - 11 Various owners
  - 13 Fishery, recreation



- 4 1 Lakes, Tarns and Brooks of Alla  
The Evo District  
2 Finland, South Häme, Lammi  
commune  
3  $61^{\circ} 13' - 61^{\circ} 15' \text{ N}$ ,  $25^{\circ} 08' - 25^{\circ} 15' \text{ E}$   
4 150 m a.s.l. (Hakojärvi)  
5 Various sizes  
6 Maximum: 15.9 m (Hakojärvi)  
7 Depressions in bedrock and moraine  
8 28 oligotrophic small lakes and tarns with variation in humus contents, 14 km of brooks  
9 The first field station for fishery investigations in Finland (1892). The area for the investigations of the polyhumose lakes  
10 Publications:  
Homén Th. (1903) Die Temperature hältnisse in den Seen Finnlands. *Compt. rend. congr. natural. & medicines du Nord 1902*, Helsingfors  
Levander K.M. (1905-1906) Beiträge zur Kenntnis des Sees Valkea-Mustajärvi der Fischereiversuchsstation Evois. *Acta Soc. F. FL Fenn.* 28  
Levander K.M. (1906-1908) Beiträge zur Kenntnis des Sees Pitkäniemen järvi der Fischereiversuchsstation Evois. *Acta Soc. FL Fenn.* 29  
Brofelt P. (1920) Evon kalastusko-casema. 25-vuotinen toiminta ja tulokset. *Suomen Kalatalous* 6  
Valle K.J. (1924) Fischwasseruntersuchungen im Staatsrevier Evo. *Acta Forest. Fenn.* 25  
Ryhänen R. (1967) Evon kalastusko-casema. *Vedet ja kalat*, in press  
11 State and private owned  
13 Fishery and fish culture
- 5 1 Valkiajärvi Alla  
2 Finland, South Häme, commune of Ruovesi, district of Pihlajajärvi village  
3  $61^{\circ} 54' \text{ N}$ ,  $23^{\circ} 53' \text{ E}$   
4 110 m a.s.l.  
5 0.08 km<sup>2</sup>  
6 Maximum: 24.5 m; mean: 8.4 m  
7 Soil moraine, catchment area dominated by coniferous forest, and small *Sphagnum* bogs border the lake  
8 Iron meromictic  
9 No pollution in the drainage area  
10 Collecting of physical, chemical and biological data is in progress.  
Literature:  
Kaila E. (1964) Sellulosa-tehtaiden ja asutuksen vaikutus Näsijärven vesistöön (Summary: Effect of chemical pulp mills and settlement on the lake Näsijärvi water system). *Paperi ja Puu* 1  
Meriläinen J. (1967) On the primary production of the meromictic Lake Valkiajärvi, Central Finland. *Ann. Bot. Fenn.* 4  
Toivonen J. & Tuunainen P. (1964) Rotenonmyrkytysten avulla saatuja tietoja eräiden lampien kalakannoista ja niihin vaikuttavista tekijöistä. *Suomen Kalastuslehti* 6  
11 Owned by the G.A. Serlachius Company, Lielähti  
13 Treated with rotenon in 1963
- 6 1 Pihlajavesi (and its drainage Alla system)  
2 Finland, Middle-Finland, Pihlajavesi commune  
3  $62^{\circ} 22' \text{ N}$ ,  $24^{\circ} 18' \text{ E}$  (lake Pihlajavesi)  
4 138 m a.s.l.  
5 c. 10 km<sup>2</sup> (lake Pihlajavesi)  
6 Maximum: 20 m; mean unknown  
7 Depression in archaean bedrock  
8 Polyhumose-oligotrophic  
9 Chosen as investigation object as example of a typical Finnish polyhumose-oligotrophic lake, still undammed and in a natural status.  
10 No publications yet  
11 Various owners  
13 Fishery
- 7 1 Isojoki-Lapväärtinjoki (Lappfjärda)  
2 Finland, south Ostrobothnia, communes of Isojoki and Lapväärtti (Lappfjärd)  
3 Runs from  $62^{\circ} 16' \text{ N}$ ,  $22^{\circ} 20' \text{ E}$  to the Gulf of Bothnia  $62^{\circ} 13' \text{ N}$ ,  $21^{\circ} 29' \text{ E}$   
4 From 200 m a.s.l. to 0 m  
5 Flows over moraine and through large forest and bog areas  
6 Polyhumus  
9 River in natural status, chosen as object for the investigation of the humic running water, spawning areas

- of the sea trout
- 10 Ryhänen R. (1959) Summary of observations on trout in the Isojoki (Finland). *Cons. int. Explor. de la Mer.* 148
- 11 Various owners
- 13 Fishery
- 15 Drainage area 1,125 km<sup>2</sup> (0.4% of lakes)
- 8 1 **Kiiminginjoki** AIIb
- 2 Finland, north Ostrobothnia, communes of Puolanka, Utajärvi, Yli-Kiiminki and Haukipudas
- 3 Runs from Kivarijärvi (Puolanka) 64° 55' N, 27° 38' E to the Gulf of Bothnia 65° 11' N, 25° 24' E
- 4 From 150 m a.s.l. (Kivarijärvi) to 0 m
- 7 Flows through moraine and bog areas on archaean bedrock
- 9 Polyhumic, undammed river
- 11 Various owners
- 14 Flow regulation dams planned for the upper course
- 15 Drainage area 3,880 km<sup>2</sup> (3.4% of lakes)
- 9 1 **Kittkäjärvi** AIIb
- 2 Finland, Kuusamo, communes of Posio and Kuusamo
- 3 60° 30' N, 29° 30' E – 66° 04' N, 28° 05' E
- 4 240 m a.s.l.
- 5 ca. 280 km<sup>2</sup>
- 6 Maximum: 30 m; mean unknown
- 7 Depressions in archaean bedrock peneplane
- 8 Oligotrophic
- 9 Still undammed large oligotrophic lake
- 10 Field station of University of Oulu
- Publications:
- Hänninen K. (1915) Drumlinmaisemi-en järvistä ja reiteistä Oulankajoen alueella Kuusamossa. *Suomen Maantiet. Yhd. Julkaisu* 11
- Maristo L. (1941) Die Seetypen Finnlands auf floristischer und vegetationsphysiognomischer Grundlage. *Ann. Bot. "Vanamo"* 15
- 11 Various owners
- 14 Plans have been made for the diversion of the water to the Gulf of Bothnia for power purposes. It now runs to the White Sea.
- 10 1 **Oulankajoki** AIIc
- 2 Finland
- 3 Runs from Avenolampi 66° 54' N, 29° 15' E, crosses the USSR border at 66° 15' N, 29° 45' E
- 4 From 200 m to 140 m a.s.l.
- 7 Flow on moraine and bogs
- 8 Oligotrophic
- 9 Undammed river in natural condition in the catchment area of the White Sea
- 13 Recreation, fishery
- 15 Drainage area 3,739 km<sup>2</sup> in Finland (12.7% of lakes)
- 11 1 **Kilpisjärvi** Alla
- 2 Finland and Sweden, Lappland, Enontekiö commune (in Finland)
- 3 69° 00' N, 20° 55' E
- 4 463 m a.s.l.
- 5 33.7 km<sup>2</sup>
- 6 Maximum: c. 50 m; mean unknown
- 7 Bedrock depression in fjäll area
- 8 Oligotrophic
- 9 Mostly monomictic lake in natural condition
- 10 Publications:
- Lagercrantz H. (1953) An essay on the hydrography of Lake Kilpisjärvi. *Fennia* 75
- Järnefelt H. (1956) Zur Limnologie einiger Gewässer Finnlands. XVII. *Ann. Soc. "Vanamo"* 18
- Simojoki H. (1956) Über einige Temperaturverhältnisse einiger finnischen Seen. *Fennia* 80
- 12 1 **Peerajärvi** Alla
- 2 Finland, Lappland, Enontekiö commune
- 3 68° 53' N, 21° 08' E
- 7 Moraine Area
- 8 Oligotrophic
- 9 Observation object for the IHD
- 11 State owned
- 13 1 **Könkämäeno, Muonionjoki, Tornionjoki** AIIb
- 2 Border rivers between Finland and Sweden, Lappland, communes of Enontekiö, Munnio, Kolari, Pello, Yli-Tornio, Karunki and Alatornio (in Finland)
- 3 Könkämäeno: Runs from Kilpisjärvi 68° 56' N, 20° 56' E to Muonionjoki 68° 29' N, 22° 18' E
- Muonionjoki: Runs from 68° 29' N,



22° 18' E to Tornionjoki 67° 10' N,  
23° 37' E

Tornionjoki: Runs from 67° 10' N,  
23° 37' E to the Gulf of Bothnia  
65° 48' N, 24° 27' E

4 463 m a.s.l.

8 Upper courses oligotrophic

9 One of the last undammed big rivers  
in Scandinavia

10 References:

Cajander A.K. (1909) Beiträge zur  
Kenntnis der Alluvionen des  
nördlichen Eurasiens. III. Die  
Alluvionen der Torni- und Keim-  
Thäler. *Act. Soc. Sci. Fenn.* 37, 5

Pekkari S. (1961) Preliminär  
förteckning över litteratur  
behandlande floran inom den av  
Torne och Kalix alvar avvattnade  
delen av nordligaste Sverige och  
Finland med undantag av Torne-  
träskområdet. Stencilled. Uppsala.

11 Various owners

13 Fishery

15 Drainage area 14,255 ha (in Finland)  
(4.6% of lakes)

14 1 Inarinjoki (Anarjokka). Alle  
Tenojoki (Tanaelv) and its  
tributaries in Finland: Kevonjoki  
and Vetsikkojoki (Vetsikkojärvi)

2 Border rivers between Finland and  
Norway, Lappland, communes of  
Inari and Utsjoki (Finland)

3 Inarinjoki: Runs from 68° 56' N,  
25° 42' E to Tenojoki 69° 27' N,  
25° 50' E

Tenojoki: Runs from 69° 27' N,  
25° 50' E crosses the Norwegian  
border at 70° 06' N, 28° 00' E

Kevonjoki: Runs from 69° 30' N,  
26° 30' E to Tenojoki 69° 54' N,  
27° 04' E

Vetsikkojoki: Runs from Vetsikko-  
järvi 69° 42' N, 27° 30' E to Teno-  
joki 69° 58' N, 27° 20' E

4 Vetsikkojärvi 290 m a.s.l.

8 Oligotrophic

9 Undammed salmon river in the catch-  
ment area of the Arctic Ocean

12 National Parks planned round the  
upper course of Inarinjoki

13 Fishery

15 Drainage area 5,095 km<sup>2</sup> (in Finland)  
2.5% of lakes

## FRANCE

Information: P. Vivier, L. Hofman,  
H. Laurent, F. Marazanof

### 1 Lac Pavin

2 France, Auvergne, Département du  
Puy de Dôme près de Besse en  
Chandesse

3 45° 30' N, 2° 53' E

4 1,197 m

5 44 ha

6 Maximum: 92 m; moyenne 52.2 m

7 Origine volcanique: cratère d'explos-  
ion

8 Méromictique

9 Alimenté par des sources, en parties  
profondes, ne peut être pollué.  
Présente en été de remarquables  
fleurs d'eau. Parfois à l'automne, une  
croûte d'éphippies. Sédiments formant  
une véritable diatomite. Inversion  
thermique en profondeur. Monimo-  
limnion très stable, particulièrement  
riche en silice (52 mg/l de SiO<sub>2</sub>) et en  
fer (51 mg/l de Fe<sup>2+</sup>), contenant de  
l'hydrogène sulfuré.

10 A été l'objet d'études surtout descrip-  
tives au début du siècle (voir Olivier  
1939). L'étude limnologique, débutée  
par L. Olivier, est poursuivie depuis  
lors et conduira à une série de  
monographies

Olivier L. (1939) Matériaux pour la  
connaissance limnologique des  
lacs mont-doriens. *Mem. Acad. de  
Clermont T.* 41

Pelletier J.P. (1968) Un lac  
méromictique, le Pavin (Auvergne)  
*Annls. Stn. biol. Besse*, 3, 147-  
170

11 Propriété de la commune de Besse,  
qui le loue aux enchères publiques  
en vue de la pêche et de l'exploitation  
touristique

13 Utilisé pour la pêche (Truite, Omble  
Chevalier, Ecrevisse) et le tourisme.  
La beauté du site est réputée, attire  
beaucoup de touristes

14 La construction d'un hôtel à proxi-  
mité immédiate, la transformation en  
restaurant d'une modest buvette ont  
pu jusqu'alors être évitées. Il est à  
souhaiter que l'exploitation touristi-  
que ne dépasse pas la niveau actuel,  
déjà très avancé



# Finland



# France

## Spain



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The colour photograph on the front of the book is of Lake Tchad and was taken from US satellite Gemini. Plate 18 gives more details (*Photo by courtesy of NASA.*)

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