JAPAN INTERNATIONAL COOPERATION AGENCY

MINISTRY OF ENVIRONMENT PROTECTION AND REGIONAL DEVELOPMENT
REZEKNE REGIONAL ENVIRONMENTAL BOARD
REZEKNE DISTRICT COUNCIL
THE REPUBLIC OF LATVIA

THE STUDY
ON
ENVIRONMENTAL MANAGEMENT PLAN
FOR
LUBANA WETLAND COMPLEX

FINAL REPORT

VOLUME II
MAIN REPORT

DECEMBER 2000

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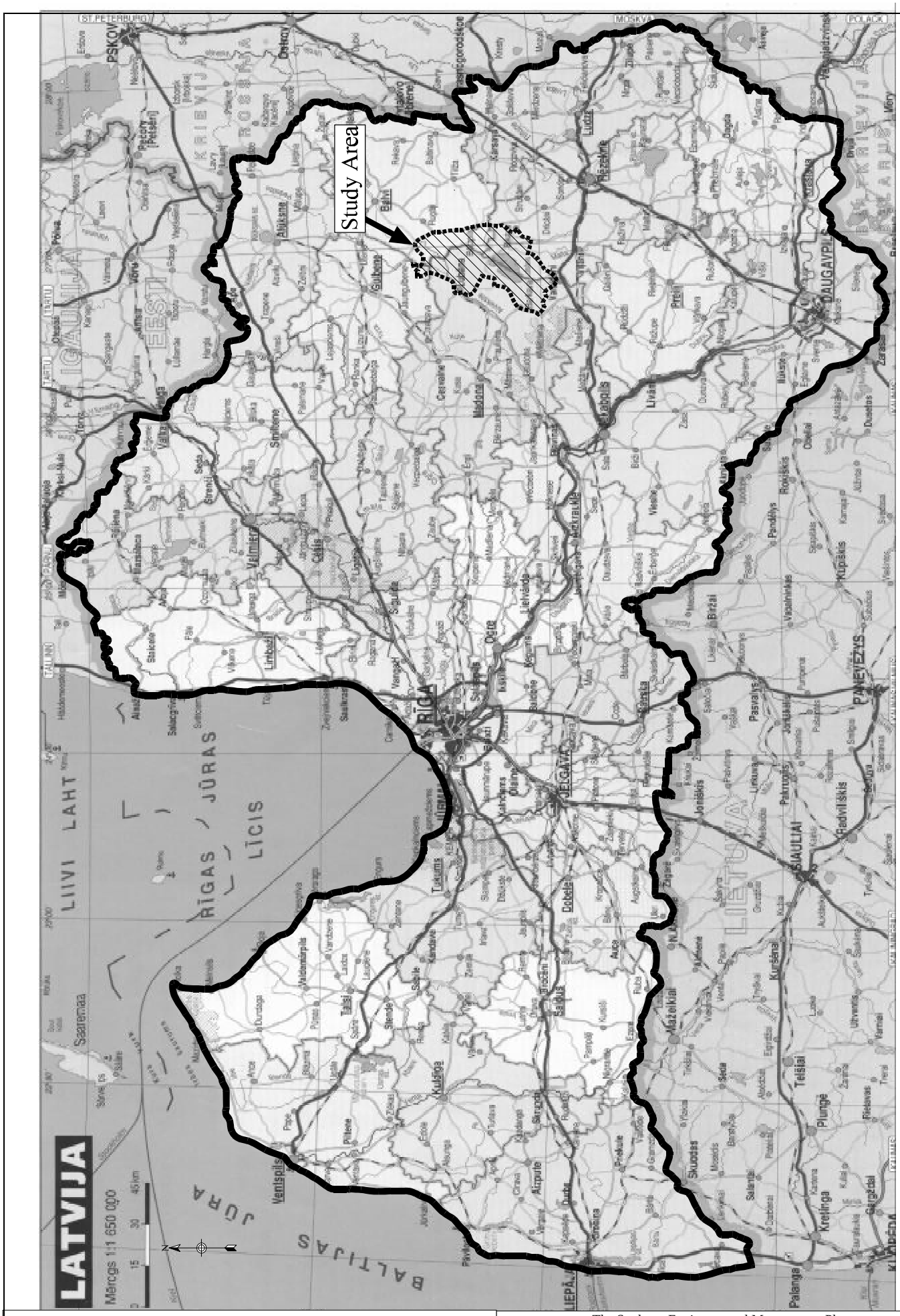


Location of Study Area

The Study on Environmental Management Plan
for Lubana Wetland Complex in the Republic of Latvia

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to a request from the Government of the Republic of Latvia, the Government of Japan decided to conduct a master plan study on Environmental Management Plan for Lubana Wetland Complex and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Yoichi Iwai of Nippon Koei Co., Ltd. and consisting of Nippon Koei Co., Ltd. and Kokusai Kogyo Co., Ltd. to Latvia, three times between August 1999 and October 2000. In addition, JICA set up an advisory committee headed by Mr. Masahiro Ota, JICA Development Specialist between July 1999 and December 2000, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of Latvia and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Latvia for their close cooperation extended to the Team.

December 2000

Kunihiko Saito
President
Japan International Cooperation Agency

December 2000

Mr. Kunihiko Saito
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Sir,

LETTER OF TRANSMITTAL

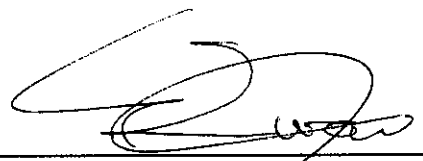
We are pleased to submit to you the Final Report on the Study on Environmental Management Plan for Lubana Wetland Complex in the Republic of Latvia. This report presents the results of all works conducted in both Latvia and Japan during a total period of 17 months from August 1999 through December 2000.

This is an environmental management plan to achieve sustainable development in the Lubana Wetland Complex area for the target year 2010. This management plan includes the wetland conservation projects, the water level management projects, and the development projects for eco-tourism and fishery.

These projects will preserve the internationally important wetland ecosystem, and contribute to regional development in and around the study area. We are confidence that the projects, once implemented, will greatly help conserve the environment and improve the socioeconomic development in the Lubana Wetland Complex area. Hence, we recommend to implement the projects as early as possible.

We wish to express our deep appreciation and sincere gratitude to your Agency, the Advisory Committee, the Ministry of Foreign Affairs, and the Environmental Agency of Japan for the courtesies and cooperation kindly extended to our team. We also wish to express our hearty appreciation and gratitude to the Government of the Republic of Latvia and the Embassy of Japan in Latvia for close cooperation and assistance extended to us during our field investigation and study in Latvia.

Very truly yours,



Yoichi Iwai
Team Leader
The Study on Environmental Management
Plan for Lubana Wetland Complex

THE STUDY
ON
ENVIRONMENTAL MANAGEMENT PLAN FOR
LUBANA WETLAND COMPLEX IN
THE REPUBLIC OF LATVIA

FINAL REPORT

Volume II Main Report

Table of Contents

PART II REGIONAL DEVELOPMENT AND LAND USE

PART III ENVIRONMENTAL MANAGEMENT PLAN

List of Tables

List of Figures

ABBREVIATIONS

<Places>

LWC	Lubana Wetland Complex

<Organizations>

ALRSA	Aiviekste Land Reclamation System Administration
CESAMS	Center for Environmental Science and Management of the University of Riga
CNREE	Center for Nature Research & Environmental Education
CSB	Central Statistical Bureau
DC	District Council
DPU	Daugavpils Pedagogical University
EEC	European Economic Committee
EU	European Union
FAO	Food and Agriculture Organization
JICA	Japan International Cooperation Agency
LEDC	Latvian Environmental Data Center
LFN	Latvian Fund for Nature
LFRI	Latvia Fishery Research Institute
LOS	Latvian Ornithological Society
LRDA	Latgale Regional Development Agency
MEPRD	Ministry of Environmental Protection and Regional Development
MOA	Ministry of Agriculture
MOE	Ministry of Economy
MREB	Madona Regional Environmental Board
NBF	National Board of Fishery
NGO	Non-governmental organizations
NPO	Non- profit Organizations
RDC	Rezekne District Council
REB	Regional Environmental Board
RREB	Rezekne Regional Environmental Board
SHMA	State Hydro-meteorological Agency
TNR	Teici Nature Reserve
ULEC	University of Latvia Ecological Center
WWF	World Wildlife Fund for Nature

<Plan, Policy, and Project>

NEPP	National Environmental Policy Plan
NEAP	National Environmental Action Plan
NPBD	National Program on Biological Diversity
UNDP	United Nations Development Program
WCP	Wetland Conservation Plan
WQCP	Water Quality Conservation Plan

<EMP terms>

AMZ	Active Management Zone
DZ	Development Zone
EE&T	Environmental Education and Training
EMC	Environmental Management Center
EIMS	Environmental Information Management System
EMP	Environmental Management Plan
IC	Implementation Committee
NPZ	Nature Preservation Zone

<Eco- tourism terms>

EDP	Eco-tourism Development Plan
LETA	Lubana Wetland Complex Eco-tourism Association
TIC	Tourism Information Center

<Economic and Financial terms>

CVM	Contingent Valuation Method
EIRR	Economic Internal Rate of Return
FF	Fish Fund
FIRR	Financial Internal Rate of Return
GDP	Gross Domestic Product
GNP	Gross National Product
LEPF	Latvian Environmental Protection Fund
LVL	Latvian Lat(s)
NPV	Net Present Value
OVA	Objective Valuation Approach
PIP	Public Investment Program
SAPARD	Special Accession Program for Agriculture and Rural Development
SMEB	Special Municipalities Environmental Budget
SVA	Subjective Valuation Approach
TCM	Travel Cost Method
WTP	Willingness to Pay

<Information terms>

CORINE	Coordination of Information on Environment
EDIS	Environmental Data Information System
EIMS	Environmental Information Management System
EIONET	Environmental Information and Observation Network
GDCN	Government Data Communication Network
GIS	Geographical Information System
GPS	Global Positioning System
IT	Information Technology
WWW	World Wide Web

<Chemical terms>

BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
PCB	Polychlorobiphenyl
SS	Suspended Solid
T-N	Total Nitrogen
T-P	Total Phosphorus

<Others>

AS	Accelerated Scenario
BS	Basic Scenario
CES	Children Environmental School
CP/T	Counterpart Team
CPUE	Catch per Unit Effort
DF/R	Draft Final Report
F/R	Final Report
HPS	Hydroelectric Power Station
It/R	Interim Report
O/M	Operation and Maintenance
P/R	Progress Report
RC	Reinforced Concrete
S/C	Steering Committee
S/W	Scope of Work
WWTP	Waste Water Treatment Plant

CHAPTER 1

PART I CURRENT SITUATIONS OF THE STUDY AREA

CHAPTER 1 SCOPE OF THE STUDY

1.1 Objectives

The objectives of the Study on the Environmental Management Plan for Lubana Wetland Complex in the Republic of Latvia (the Study) are:

a) To formulate an Environmental Management Plan (EMP) for conservation of environmental assets and sustainable use of natural resources in the study area with the target year of 2010, and

b) To transfer technology on the formulation of the EMP to the Latvian counterparts.

1.2 Study Area

The study area covers the whole Lubana Wetland Complex (LWC) with about 81,000 ha as shown in Figure 1.2.1. The up- and downstream areas of the study area are also taken into account for an integrated hydrological analysis.

1.3 Framework of the Study

In accordance with the agreement between the Ministry of Environmental Protection and Regional Development (MEPRD) and the Japan International Cooperation Agency (JICA) on March 18, 1999, the Scope of Work (S/W) for the Study is set as follows and the study framework is shown in Figure 1.3.1.

Phase I: Basic Study

a) Collection and analysis of data and information concerned with environmental and socio-economic aspects of the Study area in order to grasp actual situations and issues,

b) Consideration of the future economic development, land use and water management in the study area, and

c) Field surveys to obtain additional data and information for supporting the above work.

Phase II: Plan Conceptualization

a) Analysis on the rich and diverse ecosystem in the study area,

b) Assessment of the past impacts of human activities on the ecosystem, and

c) Conceptualization of the conservation strategies and development framework.

Phase III: Formulation of the EMP

a) Review and finalization of the study results of Phases I and II,

b) Formulation of the EMP, and

c) Evaluation of the plans/programs and development of the implementation schedule.

The study schedule is tabulated below:

Phase	Works	Study Period
Phase I	The First Works in Latvia	August 1999 ~ November 1999
	The first half of the First Works in Japan	December 1999 ~ January 2000
Phase II	The second half of the First Works in Japan	January 2000 ~ February 2000
	The first half of the Second Works in Latvia	May 2000 ~ June 2000
Phase III	The second half of the Second Works in Latvia	June 2000 ~ July 2000
	The Second Works in Japan	August 2000 ~ October 2000
	The Third Works in Latvia	October 2000
	The Third Works in Japan	November 2000 ~ December 2000

1.4 Organization for the Study

MEPRD is the national level counterpart to back up the implementation of the Study. MEPRD coordinates the Steering Committee (S/C) and supports the implementation of the Study. The S/C members are shown below:

Position in S/C		Name	Organization
1	Chairman	Ms. Ilona Jepsen	Director, MEPRD
2	Member	Ms. Rasma Ivanovska	Secretary, Ministry of Foreign Affairs
3	Member	Mr. Normunds Riekstins	Director, National Board of Fisheries, MOA
4	Member	Ms. Alda Nikodemusa	Senior Officer, Spatial Planning Division, MEPRD
5	Member	Mr. Imants Tiesnieks	Head, Capital Market Policy Division, MOF
6	Member	Mr. Andis Zeikars	Department of Agricultural Strategy and Co-operation, MOA
7	Member	Ms. Lasmo Abrolina	National Board of Forestry, MOA
8	Member	Mr. Juris Kalnins	Director, State Company of Projecting and Information, MOA
9	Member	Dr. Arturs Skute	Head, Laboratory of Ecology, DPU

Note: MEPRD: Ministry of Environmental Protection and regional Development
MOA: Ministry of Agriculture
MOF: Ministry of Finance

The regional level counterpart team (CP/T) was set up for the Study and consists of the following 9 members:

Position in CP/T		Name	Organization
1	Chief CP	Ms. Erika Ruskule	Deputy Director, RREB
2	Member	Ms. Sandra Ezmale	Senior Specialist, Territorial Planning Department, RDC
3	Member	Mr. Arkadijs Sluckis	Head, Draining Department, ALRSA
4	Member	Ms. Vija Kreile	Teici Nature Reserve
5	Member	Mr. Juris Zvidrins	Territorial Development, RDC
6	Member	Mr. Normeends Vejois	Deputy Director, MREB
7	Member	Ms. Guntor Ozolina	Deputy Director, National Fishery Board, MOA
8	Member	Ms. Brigita Dreimane	Territorial Development, RDC
9	Member	Mr. Ivars Ruzans	Fishery Inspector, RREB

Note: RREB: Rezekne Regional Environmental Board
RDC: Rezekne District Council
ALRSA: Aiviekste Land Reclamation System Administration
MREB: Madona Regional Environmental Board
MOA: Ministry of Agriculture

The JICA study team is comprised of 12 members as listed below:

	Designation / Work Assignment	Name
1	Team Leader / Regional Conservation	Yoichi IWAI
2	Land Use / Regional Development	Hiroshi HASEGAWA
3	Water Management / Hydrology	Manabu MASAKI
4	Wildlife / Ornithology	Ugis BERGMANIS
5	Wetland Vegetation	Isao SAKAI
6	Protected Area Management	Motokazu ANDO
7	GIS	Kenichi SHIBATA
8	Tourism / Eco-tourism	Toshiro HAMADA
9	Agriculture / Fishery	Shouji MASUMURA
10	Fishery	Masanori DOI
11	Socio-economy / Financial Analysis	Tomoo AOKI
12	Coordinator	Yukiyasu SUMI / Kengo NAGANUMA

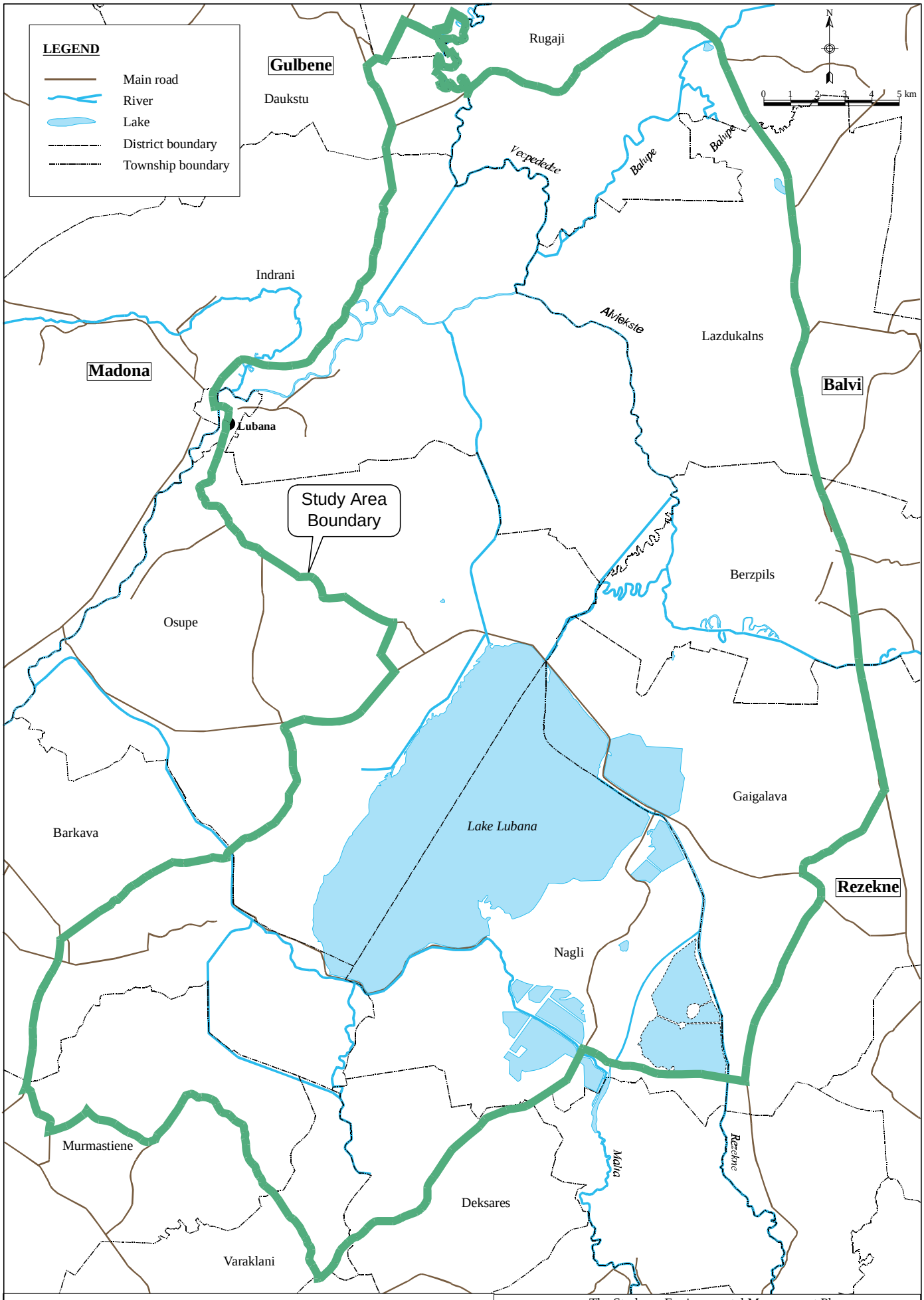


Figure 1.2.1 Location of the Study Area

The Study on Environmental Management Plan
for Lubana Wetland Complex in the Republic of Latvia
JAPAN INTERNATIONAL COOPERATION AGENCY

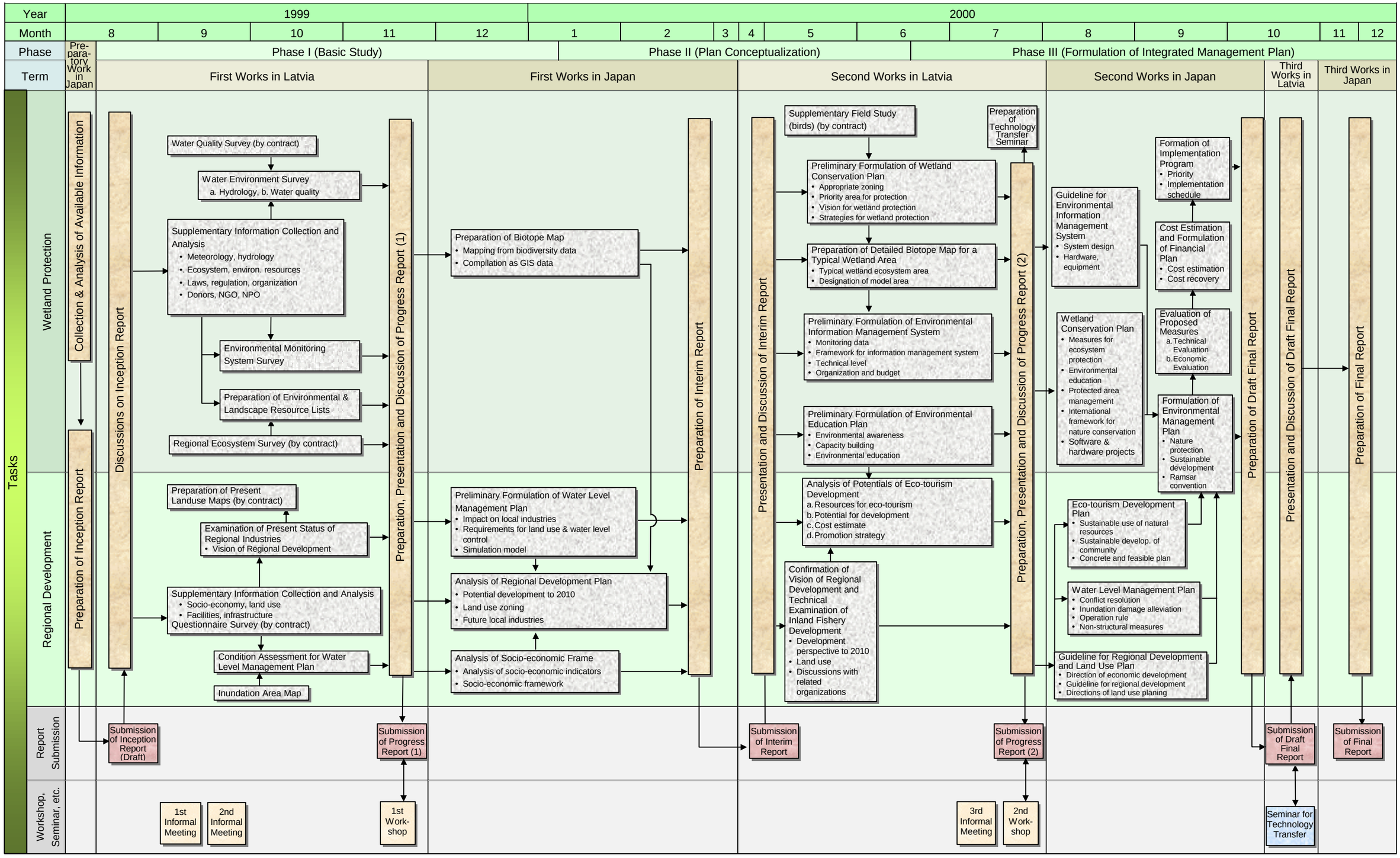


Figure 1.3.1 Work Flow of the Study

CHAPTER 2

CHAPTER 2 CONDITIONS OF REGIONAL DEVELOPMENT

2.1 Regional Economic and Financial Conditions

2.1.1 Social and Economic Conditions

(1) Population in LWC

Population in the concerned four districts has decreased following the national demographic tendency. The total population of the districts amounted to 150,000 residents in 1998, which means about 4 % decrease compared with the 1991's figure. The population in LWC is approximately 6,500, which can be regarded as a maximum level considering the high percentage of the area that are covered by bodies of water. Historically, LWC belonged to the most populated lands of Latvia in the beginning of the 20th century. During the last decades, the number of residents decreased so that LWC has become less densely populated. This decreasing tendency can be explained not only by the residents' low birthrate but also by residents leaving the area to other economically favorable places for living.

(2) Regional economy

Due to small farms, unsuitable household buildings and facilities, absence of information about possibilities to sell products as well as high production cost, the income is low and economic activity is unprofitable in rural areas. Therefore, agricultural activity is carried out mainly in order to supply needs of one's own family. Lack of possibilities for employment has motivated educated and young people to leave the rural areas. Economic activity in LWC mainly consisting of the primary industries has the economic conditions same as or more severe than the above mentioned situations.

(3) Employment and income

Based on the statistics for the 4 districts concerned, it is supposed that situation of LWC is worse than the district averages because a considerable number of residents are involved in agricultural, forestry, and fishery sectors. The origin of the unemployment is the state-owned industrial companies which have discontinued their activity or limited their production, and jobless people who do not possess their own farm after the re-organization of the collective farms.

Registered Unemployment Rates and Wages in the 4 Districts

District	Year	Rezekne	Balvi	Madona	Gulbene
Unemployment rate	1997	29.0	21.6	13.1	9.9
(%)	1998	28.2	22.1	12.5	10.2
Average gross wage	1997	74	82	83	84
(LVL/month)	1998	80	92	92	92

Source : Administrative Districts and Major Cities of Latvia : Statistical Yearbook (CSB, 1998 and 1999)

(4) Industry

1) Agriculture

Agricultural sector is of great importance in LWC. The effectiveness of farming is influenced by peculiarities of local relief and soils. In this sense, more convenient situation is in the Lubana lowlands, although hydrological route is rather risky for agriculture with poor fertile and moisture areas. The peasant farms predominate among agricultural land users. Main activities are production of wheat, rye, barley, potato and flax as well as cattle breeding for meat and milk. But, there is a lack of meat processing enterprises around LWC. Agricultural land division in LWC reflects economical situation in the country. The present agriculture is mostly subsistence farming, which is not engaged into agricultural processing route. This kind of management is unprofitable and endangers the liquidation of many farms. However, it has an important role in the local economy securing the existence of unemployed countrymen.

2) Forestry

Forests cover about 30 % and idle land comprises about 15 % of Latgale region. The dominating tree species are pine (40 % of the inventory), spruce (20 %) and birch (25 %). The timber is mainly used for the paper and construction industries. Modern manufacturing facilities, such as paper-mills and sawmills, are only in the course of establishment. Wood products represent the biggest group of exports, reaching about a third of total exports in 1997. Forests are a great part of natural resources in LWC, protecting biological habitat and giving working places. There is enough area of woods which is a good stimulus for the new wood processing enterprises. Wood processing around LWC is very disunited and seldom effective, and production of wood goods depends on requirements. The part of production is sown materials for export needs. Places for wood sawing are placed in each township. Wood craft industry exists around LWC, being mainly oriented to the domestic market.

3) Fishery

Fishery in LWC is largely connected with Lake Lubana. However, catching of fish is now an additional activity mostly for home consumption and also for sales on the local market. The aquaculture is limited to the Nagli fishponds. In 1980s, about 700 to 1,000 tons of carps were produced. Due to privatization and lack of capital and market development, the production decreased to about 150 tons in 1998. The demand for carps is quite good but the decreasing purchasing power resulted in lower prices and poor profitability. In the mid and long term, perspectives are rather good and restocking is necessary. In this way the managers of Nagli look for foreign direct investment. Another positive point to improve the technical and economic opportunity of aquaculture is the training of specialists in the “Razna Vocational School”. Also, these is a local idea to start some processing of fish

around LWC. In addition, good infrastructure and facilities for angling around the lake are important for further development including eco-tourism and rural tourism.

4) Tourism

Tourism in LWC and even in the entire Latgale region has not well developed so far. Geographical situation, nature peculiarities, culture objects, and unpolluted environment of the study area will promote eco-tourism and rural tourism industry. In particular, there are possibilities to develop water active tourism around Lake Lubana. But there is a lack of trained staff in tourism industry, and limited knowledge of languages is an obstacle. There are information centers in the four districts concerned, which were established by each district council. They are concerned with the information generalization and the research of tourism objects. The main problem of the centers is lack of any united information system of tourism in the entire area.

2.1.2 Financial Sources for Environmental Management

(1) Fund sources for environmental investment projects in Latvia

1) Public Investment Program (PIP)

PIP was established and started in 1995 to fund high priority projects and programs set by the government. The main objective of PIP is to coordinate finances in the country with investment needs for infrastructure. The priority sectors are designated as energy, transport, and environment. As for the environmental sector, PIP focuses on the improvement of water supply and waste water treatment, establishment of municipal and hazardous waste management, and modernization of hydrometeorology network. MEPRD coordinates and supervises the funding allocated from PIP to environmental sector as state subsidies to municipalities and ministry investment projects.

2) Natural Resources Tax

Based on the Law on Natural Resources Tax (1995, revised in 1996), the tax is imposed on use of natural resources polluting the environment, pollutants, and products harmful to the environment including imported products and packaging. REBs verify the calculations and sign the completed form based on the resource use declared by user. The tax is collected by the Income Department of MOF, and it is used for environmental protection purposes. The Natural Resources Tax was mostly used for following purposes.

- Purchase, repair, and reconstruction of water purification equipment,
- Repair of water supply and sewerage system, purchase of water pump,
- Maintenance of dumping sites, solid waste collection, and
- Analysis of drinking water.

Collected tax is allocated to municipal governments as Special Municipalities Environmental Budget (SMEB) and channeled to the Special State Environmental Budget accruing to the Latvian Environmental Protection Fund (LEPF).

3) Grant and loan

Funds for environmental projects are provided from donor countries and EU Phare as grant or loan scheme. MEPRD coordinates and allocates the grant and loan to the priority environmental investment projects in whole country. Main donor countries are Sweden, Denmark, Finland, Norway, Germany, Belgium, Netherlands, USA, and Switzerland. Main international financing institutions include Nordic Environmental Finance Cooperation (NEFCO), World Bank, Nordic Investment Bank, and European Bank for Reconstruction and Development.

(2) Financing mechanism for environmental investment project

1) LEPF

LEPF is a state-administered establishment subordinated to MEPRD. LEPF revenue is accrued from the use of natural resources tax as Special State Environmental Budget. The main objectives of the fund are:

- to provide additional financial resources in grant-base for funding environmental protection activities and projects,
- to ensure proper use of these funds and supervision of projects, and
- to provide financial resources in order to soften loans for the environmental protection projects.

Public and private organizations that want to apply for LEPF have to submit the application form. The private company who wants to apply to the LEPF needs recommendation letter from REBs to get approval. However, in the case where the proposed project is not suitable from an environmental viewpoint, REBs refuse it and the company can not get approval of LEPF. Total annual investment provided by LEPF to Rezekne REB are shown as follows.

Investment by LEPF to Rezekne REB

(Unit: LVL)

Year	1997	1998	1999
LEPF	27,529	5,699	6,939

Source: Rezekne Regional Environmental Board, Nov. 1999

2) LEIF

With assistance from the EU Phare National Program 1995, a feasibility study about the necessity of the investment fund, target groups and methods of management has been made. On the basis of the feasibility study, LEIF was established by the decision of Cabinet of Ministers in April 1997 as a non-profit limited liability company.

Projects supported from LEIF are in line with the national environmental policy and the annual priorities of MEPRD. Other criteria look at foreseeable improvements in the environmental sector for both public and private projects, financial viability after implementation of projects and ability of project to take soft loans from LEIF. NEFCO and LEIF have signed an Intention Protocol in 1998 about cooperation in order to distribute NEFCO loans with assistance of LEIF. A representative of NEFCO is a member of the Board of Supervisors of LEIF. Financing sources of the LEIF are shown as follows. Interest rate for financing by LEIF ranges from 5 to 8 %.

Financing Sources of LEIF

(Unit: million Euro (million LVL))

Name of Source	Investment*	
1) Latvian Environmental Protection Fund (LEPF)	5.0	(8.3)
2) EU Phare	2.0	(3.3)
3) Nordic Environmental Finance Corporation (NEFCO)	3.5	(5.8)
4) Danish Environmental Protection Agency	0.2	(0.3)
5) Technical Assistance from EU	1.0	(1.7)
Total	11.7	(19.4)

Note : * total investment as of Nov.1999

Source : Investment Department of MEPRD, 1999

3) Fish Fund (FF)

The FF established in 1996 funds for fishery-related projects and activities. Fish breeding and plant cultivation, fish transport and import are subject to a fee and a license. The Law on Fishing (1995) requires those fees to be paid into the fund. FF can be applied for some kinds of environmental project, which contribute the fish resources protection such as river water quality improvement project. Annual total amount of FF provided to Rezekne REB is shown as follows.

Investment by Fish Fund to Rezekne REB

(Unit: LVL)

Year	1997	1998	1999
Fish Fund	7,055	15,675	5,500

Source : Rezekne Regional Environmental Board, Nov. 1999

4) Special Accession Program for Agriculture and Rural Development (SAPARD)

This new financial program sponsored by EU is planned to support small enterprises or farmers to improve the quality of the services in the rural area for such development fields as agriculture, forestry, fish-breeding, and rural tourism. The financial subsidies from the program will be EUR 2,000 (1,150 LVL)~EUR 100,000 (57,500 LVL)/project. The expected total financing of EU to Latvia will be about 22 million EUR (or 13 million LVL)/year. The subsidy amount for profitable and non-profitable projects is 50% and 80 % of the total project cost, respectively. But the remaining expenses must be covered by the proposing individuals or enterprises themselves.

2.1.3 Land Use

(1) Present land use conditions

The greatest treasure in LWC is its natural resources. Forests cover 47 % of the area, which is higher than the national forest ratio of 44.6 % figured out by MEPRD in 1998. Wetlands and water bodies (Lake Lubana and fishponds) account for 13 % and 12 % respectively. The water surface of Lake Lubana belongs more to Rezekne district than to Madona district. The rest (28 %) of the area is mainly agricultural land that is regarded as a kind of semi-natural resources. This land use structure dominated by such natural resources provides local people with environmental goods and services, while LWC carries the agrarian characteristics and landscapes because of the agricultural areas. Turf bog and marsh soils prevail in the lowlands.

Land Use Situation of LWC in 1998

(Unit : km^2)

Township /Town	Whole Area	Land Use in LWC									
		Forests		Wetlands		Water Bodies		Agriculture Lands		Total	
		Area	%	Area	%	Area	%	Area	%	Area	%
Rezekne											
Gaigalava	193	44	46	18	19	12	12	20	23	94	100
Nagli	138	38	29	30	22	52	39	13	10	133	100
Deksare	103	14	66	2	12	0	0	5	22	21	100
Balvi											
Rugaji	318	39	78	2	5	0	0	9	17	50	100
Lazdukalns	195	33	41	20	25	0	0	27	34	80	100
Berzpils	128	20	33	11	18	0	0	28	49	59	100
Madona											
Lubana Town	3	0	10	0	0	0	0	2	90	2	100
Varaklani	99	5	37	0	0	0	0	7	63	12	100
Indrani	343	101	81	7	6	0	0	17	13	125	100
Osupe	224	44	32	12	9	30	22	48	37	134	100
Barkava	188	16	29	6	11	0	1	32	59	54	100
Murmastiene	175	17	44	0	0	0	0	21	56	38	100
Gulbene											
Dauksti	165	8	67	0	0	0	0	4	33	12	100
Total	2,272	379	47	108	13	94	12	233	28	814	100

Notes: 1) Forests include broad-leaved forest, coniferous forest, mixed forest, natural grassland, transitional woodland & scrub, and sparsely vegetated area;
2) Wetlands include inland marshes, and peat bogs;
3) Water bodies include lakes, and fish ponds;
4) Agricultural lands include non-irrigated arable land, pastures, complex cultivation patterns, and land principally occupied by agriculture with natural vegetation, in addition to urban area of 2 km^2.

Sources: Satellite "SPOT" data in 1998, and 1 : 50,000 Topographical Maps

(2) Present land use plan

The Law on Spatial Development Planning of Latvia was adopted in October 1998. According to this new law, land use planning in Latvia is to be carried out, as such:

1) Local governments of districts, state cities, towns, and townships should prepare land use plans of their administrative areas;

2) Land use plans of higher level should be observed when producing the plans of lower levels; and

3) Land use plans of regional and local municipal levels should be prepared in accordance with the relevant development plans.

Land use plans for LWC therefore has to observe and coordinate with the directions and strategies mentioned in the existing national-level, regional-level,, district-level and township-level plans. There is no land use plan exclusively for LWC, while land use concept of Latgale region and land use plans of Osupe and Murmastiene townships have been drafted. In LWC, individual regulations on protection and management have been recently prepared for 3 out of 11 nature protection areas designated by the state. These regulations implicate land use directions with a zoning map attached for the protection areas from the environmental point of view.

2.2 Current and Potential Regional Development

2.2.1 Policy on Regional Development

(1) National development strategies

The long-term goal of development strategy for Latvia is to become a socially harmonized country with a dynamic, open and equal opportunity as well as its own national identity. Task for long-term economic development is to create dynamic, effective, flexible and environmentally friendly economy. Basic attention is intended to be paid to the development of manufacturing using local resources. This relates to food and fish processing, construction industries, and wood processing. The other potential branches can be transit transport and tourism.

The Latvia's medium-term economic strategy up to the year 2003 is to define the economic policy priorities and to outline a set of consistent economic and social policies required to complete the economic transformation of the country and to prepare its economy for accession to EU. The tasks based on the medium-term strategy are to ensure a) sustainable economic growth and real convergence in accordance with EU's objectives of economic and social cohesion, b) greater competitiveness of the Latvian economy, c) normal convergence of the Latvian economy compatible with the ultimate goal of adaptation of the euro, and d) economic development that is environmentally friendly and socially appropriate.

(2) Rural development policy

Sustainable rural development has become a basic principle that supports regional development policies in Latvia. Its objective is to lessen and prevent migration from rural areas, to reduce poverty of rural citizens, to pay maximum attention to the stimulation of employment, and to ensure equal possibilities. According to the Rural Development Program of Latvia approved in June 1998, sustainable rural development means increase in welfare of citizens and reacting on growing demands for better quality of life, health, security, and possibilities for personal development. Preservation of the quality of rural environment and its improvement is also one of the main demands of EU policy to its member states, as below :

"There must be a fairer balance of public spending, infrastructure investments and educational, health and communication services between rural and urban areas. A growing share of available resources should be used for promoting rural development and securing environmental objectives." (Art.1 of Cork declaration "Rural Preference")

These rural development policies can be good guidelines to consider development concepts and directions for LWC, since all the area belongs to rural land where the existing major economic activities are agriculture, forestry,and fishery.

(3) Current regional development plans

After the independence of Latvia, establishment of new systems of development planning began. Instead of directive and centralized planning system prevailing during the Soviet period, a system of open and democratic planning has appeared. It is based on the initiative of local municipalities, ascertaining of local development preconditions and possibilities as well as agreement on objectives and priorities of development. Recommendations for strategic planning have been worked out by MEPRD, which are suitable for the preparation of district and regional development plans. Local municipalities should publish reports about spatial development planning progress or the implementation of the plans annually by the end of March. The municipalities of state cities and district councils insert their reports in the official newspaper "Latvijas Vestnesis" and local newspapers.

The next table shows availability or preparation progress of development and land use plans for the local municipalities related to LWC. Development concepts or plans for Latgale region as well as all the four districts concerned have been already prepared, while only four townships in LWC have the plans, at present. Reviewing these existing development documents related to LWC, target fields stressed commonly are income improvement, unemployment problem, agricultural and wood processing, creation of business opportunities, environmental preservation, educational and infrastructure improvement, and collaboration with neighboring municipalities. But none of them set out any socioeconomic targets in a quantitative way for their future development.

Availability Status of Development and Land Use Plans for Related Local Municipalities

Region	District	Town or Township	Development Plan		Land Use Plan	
			Concept	Plan	Concept	Plan
Latgale			O (1998)	O (1999)	O (1999)	X
	Rezekne		O (1997)	△	X	X
		Gaigalava	△	△	△	△
		Nagli	△	△	△	△
		Deksare	X	X	X	X
	Balvi		O (1998)	O (1998)	X	X
		Rugaji	△	△	X	X
		Lazdukalns	X	X	X	X
		Berzpils	X	X	X	X
Vidzeme			△	△	X	X
	Madona		O (1997)	O (1997)	X	X
		Lubana Town	X	X	X	X
		Varaklani	X	X	X	X
		Indrani	O (1998)	O (1998)	△	△
		Osupe	O (1998)	O (1998)	O (1998)	O (1998)
		Barkava	O (1998)	O (1998)	△	△
		Murmastiene	O (1998)	O (1998)	O (1998)	O (1998)
	Gulbene		O (1996)	O (1996)	X	X
		Dauksti	X	X	X	X
National Level of Latvia			O (1996)	O (1998)	△	△

Note: O = Formulated (approved year), △= Under preparation, and X = No action at all

2.2.2 Agriculture

(1) Trends and characteristics

Agricultural production in LWC experienced a significant decline during the years after independence. The following table indicates the trend of agricultural production in the Rezekne district during 1990 to 1998. All the main production dropped sharply after 1990.

Agricultural Production in Rezekne District (1990~1998)

(Unit: tons)

Main Products	1990	1994	1995	1996	1997	1998
Cereals	92,800	37,182	25,537	35,560	35,804	21,000
Milk	84,000	99,500	43,170	45,640	45,835	45,000
Cattle and Poultry	15,700	4,100	3,677	3,420	3,010	2,500

Source: Rezekne District Development Plan (RDC, 1999)

The decrease of the agricultural production after 1990 was caused by fast changes in the agricultural system such as the closing of the state collective farms and large-scale agro-processing industries as a result of the land reform without agricultural subsidies. The most serious issue in agriculture has been lower prices of agricultural products than prices of agricultural machinery and fuel. With the narrowing of Russian market and elimination of state purchases of agricultural commodities, most agricultural products lost the market to be sold. As a result, most farmers lost their incentives for agricultural activities.

In Gaigalava, Deksare, Osupe, and Murmastiene townships, farmers constitute more than 50% of the labor force. The land reform and privatization of agriculture has led to fundamental changes in farming. The result has been the fragmentation of agriculture into small-scale producers with the average size of holdings estimated to be 20 hectares and the great majority (64.8%) of small farms (2 to 10 ha). Large farms (over 30 ha) form only 6.4%. In Rezekne district, small farms constituted 84.9% of all farms, which was the second highest percentage among 26 districts in Latvia.

Most land was returned to private individuals. Private farms, including peasant farms and household plots, accounted for over 80 % of the total agricultural area in Gulbene and Madona districts. The share of private farms in Balvi and Rezekne is lower compared to that in Madona and Gulbene districts as indicated in the following table.

Agricultural Land by Farm Category

(Unit: Area in 1,000 ha)

District	Agricul-tural Land	State Farms and Statutory Companies		Peasant Farms		Private Subsidiary Farms		Household Plots	
Gulbene	68.9	6.8	9%	23.2	34%	1.8	3.0%	37.2	54%
Madona	123.9	10.7	9%	74.8	60%	3.7	3.0%	34.7	28%
Balvi	94.1	25.3	27%	22.7	24%	0.5	0.5%	45.5	48%
Rezekne	122.4	29.1	24%	27.1	22%	1.9	2.0%	64.2	52%

Source: Statistical Yearbook (CSB, 1998)

Large farms with the landholding of more than 100 ha are producing grain and crops based on the mechanized farming system. The main income source of the medium size farms (30 to 50 ha) is from a combination of livestock and grain production. Most households with the small family plot of less than 10 ha are mainly involved in livestock production and

vegetable gardens for personal use and small-scale direct marketing. Crop production in 5 townships is presented in Table 2.2.1.

(2) Potential and constraints

1) Agricultural production

Agricultural land constitutes more than 30% in most townships except Nagli where agricultural land constitutes only 11% of the total area. There are 11,472 ha of agricultural land in Osupe township which are extending to the west of Lake Lubana. Although the soil condition in LWC is not so fertile as Dobele and Jelgava districts in the central part of the country, soils are still able to generate good cereal, grass, and legume crops. Production of cereals such as rye, winter wheat, barley, spring wheat and oat has been the main agricultural activities in LWC. Crops produced have been used for both human consumption and animal feed. Dairy farming including milk and meat production has long been conducted in LWC. In addition, potatoes, legumes and vegetable cultivation and tree crops such as apples and pears have also been conducted. Supplementary agricultural activities include bee keeping, and berries picking.

In addition to traditional production activities, some additional activities can be considered for the improvement of income level of the individual households. Cranberry is one of the important income sources for the rural population residing nearby Lake Lubana. In addition to picking of natural cranberry, MOA is promoting cranberry cultivation through AAS. Cranberries usually grow in swamp area. The high bogs with sand bases, small peat layer, and low ground water level are the best soils for growing cranberries. The sand has the drying function. It is not necessary to build the additional draining pipes. The berries also grow in peat, light sand clay, clay sand and sand soils with average acid of pH 3 to 6.5. It is possible to get 5 kg of cranberries per 1 m^2 in very good weather. It is enough, therefore, to have a 25 m^2 garden for family needs. The profit appears even from the 0.1 ha (20m x 50m) field that gives about 2-3 tons of berries every year. The average productivity can be 10 to 15 tons per ha. Under very good weather conditions, it could be 20 tons per ha.

Some local people like to collect mushrooms in the forest area. In addition to collection of natural grown mushrooms, it is advisable to cultivate some edible mushroom species such as the Champignon de Paris (*Agaricus bisporus*), shiitake (*Lentinus edodes*), and oyster mushroom (*Pleurotus* species). Promotion of mushroom cultivation is considered to give good opportunity for rural people to get additional income in future. Flax production level dropped sharply after 1990 due to high cost of production inputs, lack of specialized machinery and unattractive producer prices. However, the prices have recently been improved. The Selection and Experimental Center at Vilani town in Rezekne district, a joint stock company, is producing linen oil from seeds of flax. Stalks of flax are usually sent to a processing company at Ludza district to extract fiber for making linen products. Flax cultivation is considered to have good marketability in and around LWC in near future. On-farm production of dairy products such as cheese, yogurt, and butter also has potential to be promoted for additional income for rural population. On-farm dairy

production aims to produce dairy products not only for self-consumption but also for marketing outside of LWC. Although the existing milk processing company is producing dairy products, possibility will arise for rural people to produce different type of dairy products to meet the local requirement.

2) Constraints on agricultural development

A number of constraints for agricultural development have been identified in LWC. Main constraints are related to the market system such as reduced market demand, lack of market information, and low product prices. Low production level in LWC is due mainly to reduced demand in both domestic and export markets. Domestic demand has been reduced due to lower income level of the people. Export demand has been reduced due mainly to the closing of Russian market. Export possibility of agricultural products are very limited due to higher production costs including oil, chemical fertilizers, and machinery.

The problem of lack of market information has been expressed by township leaders as well as rural people. Dissemination of market information under the current information system will not be applicable to private farmers who account for the majority of rural society. Many farmers in LWC are not in a position to get profit from agricultural production due to unattractive producer prices and higher production costs. Therefore, it is very difficult for them to obtain credit services for agricultural activities. The current interest rate of 15% to 20% per annum is also a heavy burden to them. Most farmers have long been sealed off from the outside world under planned economy during the Soviet times. Therefore, they are not accustomed to free market system. Farmer education on farm management and farm business planning skills will be greatly needed.

2.2.3 Forestry

(1) Trends and characteristics

In 1997, forestland constituted about 86,800 ha in Rezekne district, of which the state forest accounted for 34,800 ha (40% of the total forest land) and the remaining (52,000 ha) are private and other forest. Gaigalava is one of the most densely forested township in the district. A greater part of the forests (69,200 ha) can be categorized as economic forests and the remaining includes restricted and protected forests. Coniferous trees constitute 57% and broad leaved species 43% which include hard broad leaved species such as oak and maple. The most frequent species are pine (37%), birch (32%), and spruce (20%). The annual production of round logs from the state forests in Gaigalava and Nagli townships is estimated to be 12,600 m^3, of which coniferous trees such as pine and spruce constitute 40 % and broad-leaved trees such as birch and elm 60%. Most pine and spruce logs are processed in the sawmills and sent by truck to Riga for export to Great Britain, Germany, and other European countries.

Forestland constitutes about 48.8% of the total area of Madona district, slightly above the average (48.4%) in Latvia. Madona is one of leading districts of wood resources in Latvia.

The total reserves are estimated to be 16.7 million m^3 in the district. A part of the woods is forbidden to use for economical activities because they are located within the restricted areas where they are objects of scientific resources. The sawn timber and paper wood is exported to Denmark, Germany and Great Britain. There are about 190 small companies and farms that have the wood processing business. The local people collect wild berries, nuts, mushrooms, herbs, Christmas trees and other decorative materials in the state and private forests. It is allowed for the local people to collect berries in the state forest. The most popular are cranberries. One of the important roles the forests and wood could play is a tourism and recreational object. The need for tree plantation is felt by administrative staff in some townships. In Osupe township, tree plantation in the eastern part of the township, nearby Lake Lubana, is planned on the unutilized agricultural land. The township office is planning to discuss it with the landowners.

Forests account for 38% of the district area of Balvi, and the major part of the forests belongs to the state. Reserves of wood are on the average level in Latvia. The forests are evenly distributed in the district. However, there are areas with the increased wooded productivity, particularly in the western part of the district. In Rugaji township, tree plantation is also planned in the far western part of the township. Private persons or companies will be involved in this plan. Wood industries are one of the fast growing industries in Balvi district. There are 40 enterprises concerned with wood processing in the district. The biggest are Ziguri MRS and Balvi-Holm, which annually produce 85,000 m^3 and 30,000 m^3, respectively.

(2) Potential and constraints

1) Forestry production

LWC is endowed with forest resources. There are approximately 380 km^2 of forest land in LWC, of which Indrani township accounts for 27%, Gaigalava 12%, Osupe 12%, Rugaji 10%, and Nagli 10%. On the assumption that the tree volumes cut in a year are equivalent to the removal of 1.6 m^3/ha, round logs production from the forests in LWC is estimated to be about 45,000 m^3/year. Based on average growth of forests of 3.1 m^3/ha/year, total annual growth amounts to nearly 90,000 m^3, exceeding the tree volumes cut in a year. The average age of trees is estimated at 50 to 60 years. The chief forester offices of MOA are in charge of forest management in state-owned forests. In addition, the offices also perform general control over all Latvian forests. They have responsibilities in the field of forest management towards the new private forest owners, e.g. restriction of illegal activities and offering consulting services. The offices sell felling rights to these forests, negotiate long and short term logging contracts and organize timber auctions.

Coniferous species such as pine and spruce have a good marketability for domestic as well as foreign market. Sawn timber from pine and spruce are exported to Britain, Germany and Nordic countries. Afforestation of abandoned or unutilized agricultural land is one of the major goals of national forestry policy. It is suitable to plant conifers (e.g. pine and spruce)

and such deciduous trees as birches and fast growing aspens to obtain input for wood processing industries, pulp, and energy.

2) Constraints on forestry development

Forestry in Latvia has a large development potential, although forestry is considered as matter of a national level in the Latvian forestry policies, not subject on the local levels. The constraints on this industrial sector are more concerned with institutional and financial capabilities for forestry management.

The existing legal system regulating forestry does not really correspond to the present structure of forest property, so that it does not fully balance ecological and economic interests in forests. There is no long-term strategy of land use in Latvia; therefore, there is no clear idea about areas to be afforested and their structure. It is necessary to work out action programs based on the forest policies, including legal and institutional actions for financial support. Many enterprises operating in forestry are in a small size, limiting their capital saving to make long term investments in forestry. On the other hand, private forest owners lack the associative structure and forest management experience and knowledge.

2.2.4 Fishery

(1) Trends and characteristics

The fishery production of Lake Lubana was 10 - 30 tons during 1960s and 70s, which increased largely in late 1980s with a peak of 136 tons in 1987 (see Figure 2.2.1). This could be related with construction of the Aiviekste sluice and application of the present water level management system in 1983, which contributed stable seasonal fluctuation of the lake water level. Major species caught in Lake Lubana are divided into pike (Salmoniforms), carps (Cypriniforms) and perches (Perciforms). A production of these three taxa groups corresponds to nearly 100% of fish production of the lake. In late 1980s, carps were dominated sharing about 65%, while in recent years share of pike and perches (pikeperch and perch) increased mainly due to reduction of carp production as shown in Figure 2.2.1. A species composition is pike 47%, perches 21% and carps 32% in 1998 reflecting effect of market economy. Although the bream, white bream and roach stocks are more sizable, the commercial fishery is targeted for the catch of economically valuable species like pike, pikeperch and perch. Table 2.2.2 shows the production of the above 3 species groups in Lake Lubana during the period from 1994-1998. One of the important characteristics of fish catch in the lake is high production share of pike and pikeperch of the country being 55% and 21% in average respectively.

The recent years‘ cumulative net length of fishing right for Lake Lubana of 3 townships are constantly about 17,500 m. Number of licensed fishermen is 17 in Nagli, 6 in Gaigalava and 37 in Osupe, and total net length allocated are 6,565, 2,000 and 8,770 m, respectively. In Nagli and Osupe, allocated net length per licensee differs largely from 30 m to 1,500 m. Very small-scale fishermen who are licensed with less than 100 m net length consist 25% in number but their cumulative net length is only 6%. On the other hand, there are 2

fishermen (3%) who operate each 1,500 m net or 17% of share in cumulative net length. In Gaigalava, there are only medium-scale fishermen operating 200-500 m net each. These licensed fishermen usually operate fishing with other licensed fishermen or several assistants who have no fishing right at actual base. Although exact number is not available, roughly about 100-150 people are estimated to engage in commercial fishing activities in the lake.

Although allocated length of net is longer in Osupe township, the actual fish catch is much larger in Rezekne district than that of Madona district for almost all species as shown in Figure 2.2.2. Based on the inquiry survey to fishermen in Nagli township, 1.0-1.5 kg of fish can be caught per 50 m net in fishing season from 20 June to the next 15 March. Based on an average total fish catch from 1994-1998, a catch per unit effort (CPUE) is calculated to be 4.5 kg/m/year for Rezekne (Nagli and Gaigalava) and 1.7 kg/m/year for Madona (Osupe). This estimation corresponds to the result of inquiry survey and natural conditions of the lake approximately.

(2) Potential and constraints

1) Fishery production

Since 1992, the fishery production level in Latvia dropped sharply mainly due to privatization of the fish farms and closing of the Russian market upon the Latvian independence. At present, most of the fishery products are directly consumed in the country, not exported with value added through the processing systems. A large expansion of the foreign and domestic fishery markets can not be expected because of the saturated demand for fish products. But it will be only possible to grow and export crayfish to many European countries, which have a high demand.

Fishery and fish processing industry have a potential profit around Lake Lubana, if a large investment for reconstruction of equipment is provided. Fish letting into the lake is not necessary, because there are rather good conditions for fish reproduction. Hydro technical buildings exploitation for the increase of fish resources should be made to provide fish spawning time and wintering with good conditions. Fish can use the whole lake territory for the spawning practically.

On the other hand, fishery development perspectives are connected with an overall rural development of the national level, especially considering development possibilities of angling both in public and private water-bodies. It will depend on development of service sector connected with angling in the countryside, such as establishment of network of private hotels near rivers and lakes, rent of boats and fishing tackle, informative and guide services, as well as cooking facilities for the caught fish.

Since the Soviet time, the Nagli fish farm has been producing common carp of marketable size, and its production was 1,500 tons using a total of 3,200 ha of fishponds with more than 300 employees. However, the fish production is recorded to be only 223 tons in about 1,500 ha fishponds with 56 employees in 1988. A carp production of the farm could

contain several disadvantages about unfavorable natural conditions such as severe cold winter of no fish growth expected. Fish have to spend at least 2 winter periods in wintering ponds with maximum depth of 4 m. It compels to take 3 - 4 years from larvae to market size of 0.5-1.0 kg.

As for an alternative aquaculture practice, the farm started seed production of pike and crucian carp for re-stocking purpose. Spawners of these species are caught from Lake Lubana, and eggs are obtained by artificial fertilization at the hatchery of the farm. Produced fry are sold to municipalities for re-stocking, for which the Fish Fund provides subsidy. The price of fry is 2.95 LVL/1,000 fry (swim-up larvae) for pike, and 0.24 LVL per fry of 10g size for crucian carp. The Nagli fish farm has received 4,000 LVL from the Fund in 1999 by fry production and re-stocking activities. In the year 2000, about 2 million pike hatchlings (swim-up larvae) were produced and released to lakes in Latgale Region except for Lake Lubana and Lake Razna where subsidy is not provided from the Fund at present.

2) Constraints on fishery development

a) Low market demand for freshwater fish

This is particularly for major carp species caught in the lake. Bream usually is unsold, meaning to be sold together with more valuable fishes like pike and pikeperch.

b) No local organization responsible for fishery resource management

REBs are responsible for law enforcement about fishing activity, but not responsible for fishery development and fishery resource management which are tasks of NBF and LFRI. Up to now fishermen have not been organized only appealing their opinion at random. Complicated administrative boundary applied for the lake historically seems to be another constraint for overall resource management of the lake.

c) Illegal fishing

There is significant number of illegal fishermen who operate gears during fishing closed season or who use prohibited fishing method like electric fishing and fine mesh net. These include anglers who come from Rezekne, Riga and other regions.

d) Fish mortality during winter

This phenomenon was observed in 1995 - 1996 when water level was too low for fish to survive. Some fishermen believe that it is caused by water demand of the Aiviekste hydroelectric power station. However, it seems mainly due to exceptionally small rainfall in the former autumn.

e) Fish damage by cormorants

Apart from the financial problem in carp culture, invasion of cormorants could be serious. They are mostly flied from Russia from April to September and feed on a lot of fishes of ponds. Supposing that one bird eats 0.5 kg fish/day and average 500 birds attack the fishponds for 150 days (5 months), loss of fish is estimated 37.5 tons or about 26,000 LVL

(0.7 LVL/kg). This is equivalent to 17% of the present annual production amount of the farm. These problems concerning the cormorants could be supplemented by long-term research data of the Institute of Biology of the University of Latvia, which has elaborated more detailed analysis about physical losses caused by the birds and envisaged counter measures to be implemented by the fish farms. In case when those measures result in failure, state financing will be considered in order to compensate the losses. In 2000 the state is going to allocate some subsidies for the purchase and installation of equipment to protect the farms from birds and other predators.

2.2.5 Tourism

(1) Trends and characteristics

Figure 2.2.3 shows the points of entrance of foreign tourists to Latvia. It shows that only 10% of total tourists are coming through Riga. There are 6 entrance points closer to LWC. The total number of tourists coming from these 6 points is over 2 millions. Considering this figure and the fact that Rezekne city is the crossing point of two major railways of Riga-Moscow line and St.Petersberg-Warsaw line, Rezekne city has a good possibility of receiving a larger number of tourists.

LWC is also new to tourism markets. Even bird watchers and conservationists in Europe knew very little about LWC. There is no statistics of the tourists to LWC, since neither districts nor townships take their own statistics related to local tourism. At present local municipalities are seeking a possibility of developing LWC as an eco-tourism and rural-tourism destination. Among the 13 townships/town belonging to LWC, Indrani and Gaigalava townships as well as Lubana town have shown their vital interests in the eco-tourism development. Gaigalava township currently has a plan to develop a small project to encourage eco-tourism at Lake Lubana. This contains bird observation places, boat mooring, car park, and improvement of the existing structure and roads. Indrani township has prepared by themselves a draft brochure of interest points for the eco-tourism within the township. Lubana town used to have a plan of constructing a museum to exhibit the archeological findings in LWC, although it was not implemented because of financial difficulty.

(2) Potential and constraints

1) Tourism resources

Among bird species, tourists usually can expect to see beautiful corncrakes, thousands of swans, black storks and white storks, geese, wild ducks, cranes, and birds of prey. Black stork is rarely observed in the other part of Europe, but here it is not difficult to see. White storks can be observed almost everywhere in LWC during the season. This situation itself can be a potential resource of eco-tourism, since white storks are becoming rare in the other parts of Europe. It is not easy for usual tourists to see mammals directly, but beaver, otter, elk, and doe can be expected to be observed. There are many beaver dams along the

Balupe river flowing through the northern part of LWC, though beavers can not be seen during the daytime. The species of fish in LWC are not rare species, but can be utilized for angling which is a potential product of tourism. There are several fishponds in LWC, and the way of catching fishes in a pond is dynamic such as catching of all fishes by draining water in a fishpond. This can be a potential attraction for tourism. There are extended raised bogs that should be carefully preserved. These sites should not be open to mass tourists, but can be used as a board walk area. The Teici nature reserve and Lake Razna are also rich in eco-tourism resources, so that the attractiveness of LWC can be multiplied by providing eco-tour objects jointly with them.

Archeological ruins are other tangible resources for tourism. As it is shown in Figure 2.2.4, archeological sites in Latvia are concentrated in the eastern part of the country, especially around LWC area. So far 25 sites have been found in the area. This area has been producing amber products since the stone age, and the amber products were exported to the other parts of Europe as far as Greece since the beginning of AD.

Various landscapes in LWC can be characterized by land use and wetland vegetation. On the whole, distinctive landscape in LWC has potential to attract tourism development. Wide agricultural field and meadow with studded farmhouses on the flat topographic condition can be seen in and around LWC as a peaceful rural landscape. Natural and afforested forest are mixed and extended in LWC. Deciduous forest makes beautiful scenery in fall. Many abandoned fishponds and its facilities are located on the southern part of Lake Lubana, while some fishponds are being operated. Many waterbirds are observed in these fishponds as well as Lake Lubana. People enjoy angling in riverside of the Aiviekste river and other small streams with calm flow.

Wetland vegetation and various kinds of animals create a landscape of nature in LWC. Raised bog area locating within LWC create a distinguished landscape. Thousands of migratory birds come flying into LWC in the spring. Waterbirds are crowded on the surface of Lake Lubana and flying away, and remarkable landscape is created. It will fascinate not only bird watchers, but also urban tourists in and outside of Latvia. Also, it is noted that many white storks can be seen from spring to fall in and around LWC. Their nests are placed in any places at high points such as top of the electricity poles, on the roof of farmhouses, and trees near farms. They get on well with local community and create peaceful landscape.

2) Constraints on tourism development

a) Lack of information and advertisement

The publicity about LWC is very limited and not easily available to most people who can be potential tourists. Even though LWC is unique in ecosystem and many special birds and animals can be observed here, people hardly know about this fact. Only few people, who have a special connection to specific information source such as ecological societies in Latvia, can have an opportunity to know about this area.

b) Difficult access to LWC

Since LWC is quite large (about 814 km^2) and open, there are many roads going into the site. But tourists access routes to the site are mainly from Rezekne city via Gaigalava township and from Madona town via Lubana town. Both routes take approximately one hour by car to the LWC entrance points. From there it is about 7~10 km to Lake Lubana. The road pavement to Gaigalava township and Lubana town is not in good condition. Most roads inside LWC are unpaved. The other two entrance points at Barkava and Varaklani townships are used by one-day-trip tourists from Riga.

c) Insufficient tourism facilities

There are not sufficient accommodations around LWC. Within 60 km radius from Lake Lubana there are 5 hotels (309 beds), 2 motels (14 beds), 8 youth hostels (380 beds), and 4 private lodges (22 beds). But these accommodations are neither well publicized nor easy to find for general tourists. Among these there is only one hotel which is good enough for foreign tourists to use. Besides, qualities of services to tourists are generally at a low level which has been taken over from the Soviet time.

d) Limited flow of tourists

Tourists who come to Rezekne city from Riga tend to go to the southern part of Latgale region, which has more attractive tourism products, many beautiful blue lakes, nature park, and famous cathedrals. General tourists coming all the way to Lake Lubana are very limited.

e) Weak magnet for tourism

Although LWC is unique in its ecosystem not only for Europeans but also for Latvians, tourism resources are very special ones, which attract specific people who are oriented to or have special interest of the local environment. It is not a kind of product which will attract a large number of general tourists. In this sense similar products can be found in the Teici nature reserve though it is much more restricted to enter and to utilize the reserve than LWC.

f) Inefficiency cooperation among tourism organizations

Cooperation between central and local governments, Tourism Information Center (TIC), entrepreneurs providing services for tourists, tourism associations and tourism marketing companies is not efficient. There is a lack of understanding that they all are in one chain for development of complete tourism product. There is no common understanding of what kind of tourism product should be developed and what is the potential for development.

Table 2.2.1 Crop Production and Productivity by Township in 1998

Crops	Productivity	Gaigalava	Nagli	Deksare	Rugaji	Lazdukalns
Rye	Area (ha)	50	40	52	146	75
	Production (ton)	75	80	117	292	135
	Productivity (ton/ha)	1.5	2.0	2.3	2.0	1.8
Winter	Area (ha)	150	61	41	235	19
Wheat	Production (ton)	225	150	86	517	38
	Productivity (ton/ha)	1.5	2.5	2.1	2.2	2.0
Spring	Area (ha)	50	35	130	35	20
Wheat	Production	75	105	221	71	40
	Productivity (ton/ha)	1.5	3.0	1.7	2.0	2.0
Oat	Area (ha)	30	31	60	140	101
	Production (ton)	45	62	108	214	192
	Productivity (ton/ha)	1.5	2.0	1.8	1.5	1.9
Legume	Area (ha)	250	23	50	174	0
	Production	300	31	150	350	0
	Productivity (ton/ha)	1.2	1.3	3.0	2.0	0.0
Barley	Area (ha)	400	96	247	130	82
	Production (ton)	1,000	288	325	208	131
	Productivity (ton/ha)	2.5	3.0	1.3	1.6	1.6
Flax	Area (ha)	5	0	15	6	0
	Production (ton)	15	0	39	12	0
	Productivity (ton/ha)	3.0	0.0	2.6	2.0	0.0
Potatoes	Area (ha)	50	33	86	123	110
	Production (ton)	750	660	430	1,840	2,420
	Productivity (ton/ha)	15.0	20.0	5.0	15.0	22.0
Vegetables	Area (ha)	30	11	5	15	40
	Production (ton)	600	0	0	0	800
	Productivity (ton/ha)	20.0	0.0	0.0	0.0	20.0
Total	Area (ha)	1,015	330	686	1,004	441
	Production (ton)	3,085	1,376	1,476	3,504	3,740

Sources : Department of Agriculture of Rezekne, and each township office

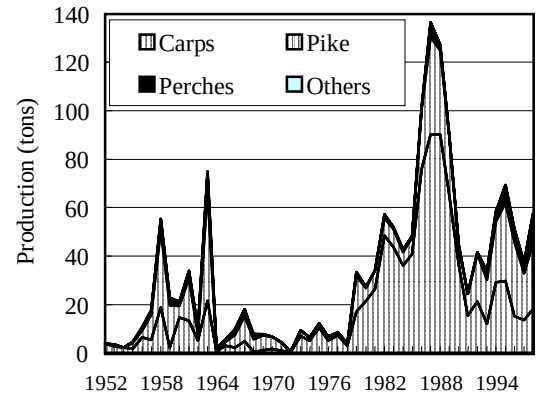
Table 2.2.2 Freshwater Fish Catch by Major Species and Share of Lake Lubana

(Unit:tons)

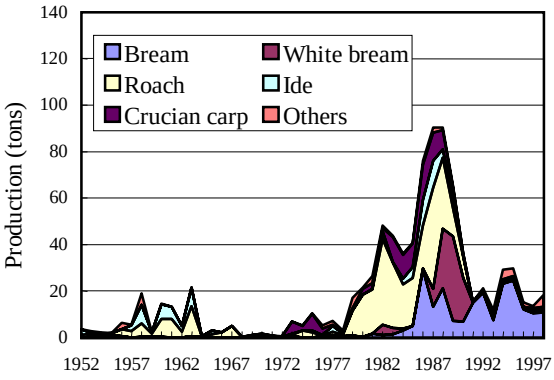
Major Species			1994	1995	1996	1997	1998	Average
Latvia (*)			1,091	1,030	853	811	842	487
	Pike		41	52	49	47	55	49
	Carps	Bream	145	149	134	172	135	147
		Common carp (*)	550	520	364	345	412	438
		Other carps	74	87	74	88	78	80
	Perches	Pikeperch	26	28	18	20	21	23
		Perch	20	38	22	29	34	29
	Others (*)		235	156	192	110	107	160
Lake Lubana			58	69	51	37	57	55
	Pike		25	32	31	19	27	27
	Carps	Bream	23	24	12	10	11	16
		Common carp	4	3	2	1	4	3
		Other carps	3	2	1	2	3	2
	Perches	Pikeperch	3	6	4	2	8	5
		Perch	1	1	1	2	5	2
	Others		0.12	0.00	0.00	0.01	0.01	0.03
Share of Lake Lubana			-	-	-	-	-	-
	Pike		61%	61%	63%	41%	49%	55%
	Carps	Bream	16%	16%	9%	6%	8%	11%
		Common carp	-	-	-	-	-	-
		Other carps	3%	3%	2%	3%	4%	3%
	Perches	Pikeperch	12%	23%	22%	12%	36%	21%
		Perch	5%	3%	6%	7%	14%	7%
	Others		-	-	-	-	-	-

Note : (*) include production of aquaculture.

Source : 1) Fishery of Latvia '99, 2) Regulations of fishery exploitation of Lake Lubana, 1998 LFRI.

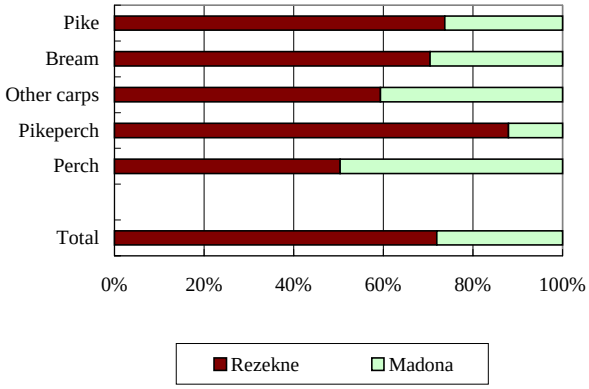


Fish catch by species group



Breakdown of carp species

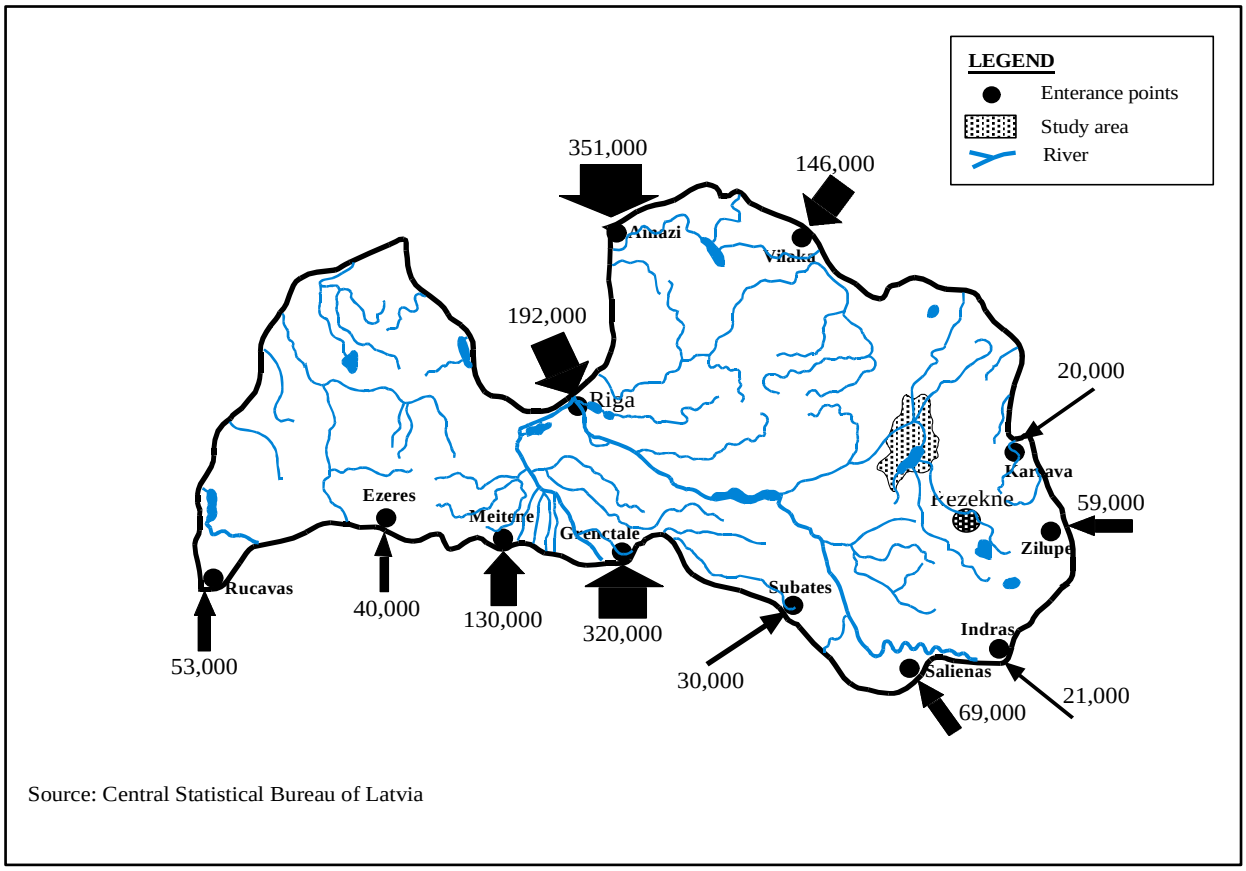
Figure 2.2.1 Species Composition in Fish Catch of Lake Lubana(1952-1998)



Note: Average production during 1994-1998 is used.

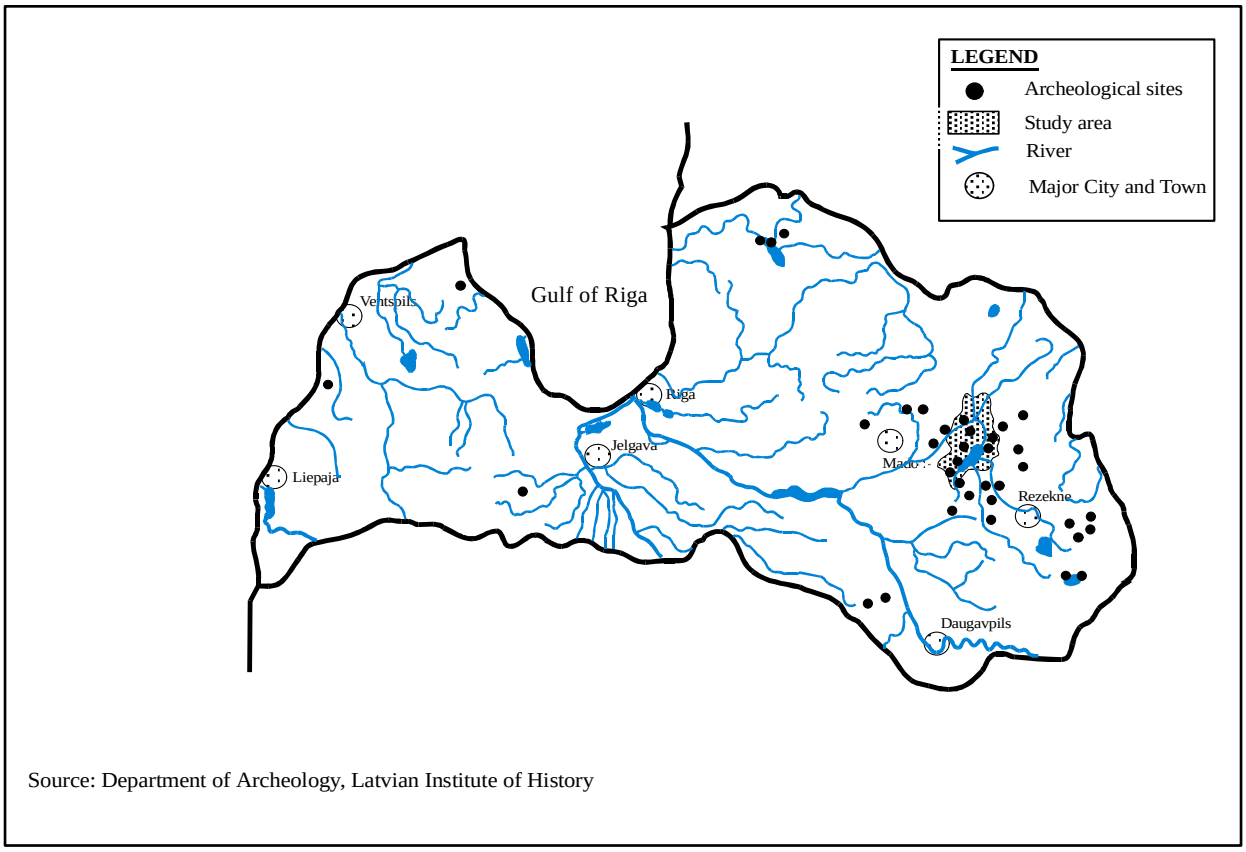
Source: Rezekune and Madona REBs

Figure 2.2.2 Proportion of Fish Catch of Lake Lubana in Two Districts



Source: Central Statistical Bureau of Latvia

Figue 2.2.3 Points of Enterance of Foreign Tourists to Latvia and their Number in 1998



Source: Department of Archeology, Latvian Institute of History

Figure 2.2.4 Distribution of Archeological Sites in Latvia

CHAPTER 3

CHAPTER 3 CONDITIONS OF NATURAL ENVIRONMENT

3.1 Water Quality Conditions

(1) Current Water Quality

A water quality survey was conducted in October 1999 and June 2000 at 18 survey points as shown in Figure 3.1.1, and results are shown in Table 3.1.1. The water quality survey conducted in October 1999 found COD_{Cr} of 42 to 80 mg /l and T-N of 1.3 to 1.6 mg/l at Points 3, 4, 5, 6, and 7, and T-P of 0.10 mg/l at Point 6 in the lake. Lake Lubana belongs to the shallow lakes where ammonia and phosphate should be kept less than 0.5 and 0.04 mg/l, respectively. In October 1999, Point 6 showed low water quality with P/PO_4 of 0.09 mg/l, while Point 5 bore N/NH_4 of 0.5 mg/l.

The October 1999 survey revealed that Points 10 and 18 of the Rezekne river which had a current velocity of less than 0.2 m/s, did not meet the requirements for good water quality of the Latvian ambient water quality standards: the respective T-P concentrations of 0.23 and 0.50 mg/l at Points 10 and 18, and N/NH_4 of 1.18 mg/l and N/NO_2 of 0.14 mg/l at Point 18 just downstream from the waste water treatment plant (WWTP) of the Rezekne city. Though the Meirani canal showed a N/NH_4 concentration of 0.40 mg/l at Point 17 due to the water from the upstream Nagli fishpond, the overall water quality of the rivers in LWC, except for the Rezekne river, was found to be good according to the ambient water quality standards for rivers.

Comparing the data in June 2000 with October 1999, the DO levels in Lake Lubana and fishponds presented satisfactory results for fish showing from 77-92 % of the saturated O_2 levels in June 2000 and from 82-100 % in October 1999. Lake Lubana and most fishponds still belong to alpha- or beta-mesosaprobic conditions indicating moderate eutrophication levels and progress of organic oxidation and decay. From 12 to 25 mg/l in June 2000, and from 16 to 33 mg/l in October 1999 in terms of COD_{Mn} for lakes and fishponds. The concentrations of T-P and T-N in June 2000 were still more or less eutrophic at Point 1 and 20 (about 0.05 T-P mg/l).

The requirements of total coliform, oil, phenol should follow the guidelines of the EU Directive concerning the quality of bathing water (76/160/EEC). Overall concentrations of total coliform and oil were safe both in 1999 and 2000. The concentrations of phenol, however, did not meet the mandatory requirement (0.005 mg/l) in Lake Lubana and many fishponds and rivers. Safe bathing water is necessary especially in Lake Lubana, the Kvapani and Orenisi fishponds, the Pededze river, and the Idena canal for eco-tourism development. The levels of PCB, Cr^{+6}, Pb, Cd, As, and Hg did not indicate significant threats on the human health at all the points in both years.

(2) Conditions of wastewater treatment facilities and plans

The National Environmental Policy Plan for Latvia (NEPP) sets the national goal to deal with eutrophication of watercourses: to reduce T-N emissions into water from point sources by 50% of the 1994 level by the year 2010. Taking into account that the Baltic

Sea is an almost closed and shallow sea with brackish water with an exchange rate of 30 years, the water quality target is of significance. In response to NEPP, which regards eutrophication as a priority problem in Latvia, MEPRD commenced the project "800+" in 1995 to reconstruct or establish more than 800 WWTPs in small and medium-sized towns and rural areas in Latvia.

In association with the 800+ project, the project "Improvements to Water Supply and Wastewater Management in Five Municipalities in Eastern Latvia" financed by Denmark is now in progress. Rezekne city, Vilani town, and Malta township are included in the five municipalities and located in Lake Lubana's catchment area. In addition, there are two projects related to the rehabilitation of WWTPs in Stolerova and Sokolku townships. All the projects are targeted to improve efficiency in biological treatment and need concrete recommendations on it.

(3) Direction for water quality conservation

With the unsatisfactory water quality in Lake Lubana, the formulation of a water quality conservation plan (WQCP) is highly recommended to integrate the water quality management in the Lake Lubana catchment area and to promote eco-tourism development for LWC. The following two basic principles are to be set in mind to formulate the plan:

- To make the best use of wetlands' self-purification ability, and
- To abate upstream pollution

As waters flow across wetlands, chemicals that otherwise would contaminate waterways are removed through natural processes that assimilate pollution. The WQCP for LWC should be closely linked to the fundamental vision of EMP "Wise use of LWC". Considering the importance of sustainable development of LWC, the ability of self-purification of wetlands should be optimized as a result of WQCP. The annual usage of agricultural fertilizers in Latvia in 1997 had decreased by 91%, and that of pesticides by 88%, in comparison to their levels of 1990. However, nutrients runoff from non-point sources in Latvia has remained at the same level as in the beginning of the 1990s due to the washing-out of accumulated pollution of N and P. Strengthening the self-purification ability of LWC itself is a promising measure to tackle with non-point sources. As wetlands themselves have a great potential of water purification, the maximum utilization of the ability becomes the fundamental strategy for LWC with the help of the upstream water quality management.

Though a self-purification ability of wetlands is undeniable, overburdened pollution loads from the upstream areas make overall water quality management quite difficult to succeed. The upstream water pollution abatement measures are preconditioned to formulate WQCP for LWC. The following directions are to be set for the proposed WQCP:

- to make the effluent N and P concentrations from the upstream point sources abide by the requirements of the EU directive (15 mg/l T-N and 2 mg/l T-P for municipal WWTP) by the year 2010,

- to reduce upstream N and P emissions from non-point sources as much as possible, and
- to restore and strengthen the self-purification ability of aquatic ecosystems in and around Lake Lubana.

While nine possible cause-oriented measures of WQCP are mentioned to tackle with point sources, three candidates are considered to handle non-point sources. three measures are proposed for the effect-oriented approach as shown the table below, and measures with "A"(more applicable) are recommended for the water quality conservation in LWC.

Possible Measures and Applicability

Measure	Location*	Applicability**
(1) Tariff reform	upstream	A
(2) Facility construction	upstream	B
(3) Chemical treatment for WWTP	upstream	C
(4) Biological treatment for WWTP	upstream	A
(5) Aeration	onsite	C
(6) Change in feeding	onsite	A
(7) Sewer system	upstream	B
(8) Soil infiltration trench	upstream	B
(9) Ban on P-containing detergents	upstream	B
(10) Dredging	onsite	C
(11) Restoring of aquatic plants	onsite	A
(12) Lagoon	onsite	B

Notes: * Onsite means the project within the study area, while some projects need to be done upstream from the study area.
** Applicability: A = more applicable, B = applicable, and C = less applicable

3.2 Birds and Wildlife

3.2.1 Current Situations

(1) Bird

Over the period 1974-1999, 224 bird species (16 orders and 48 families) were recorded in LWC as shown in Table 3.2.1. There are 185 species of breeding birds recorded in LWC. Several species were observed to breed for the first time in Latvia, for example, Marsh sandpiper, Terek sandpiper, Cormorant, and Whiskered. For some bird species such as Spotted eagle, their habitats can be found only in LWC (Petrins et al. 1997, Bergmanis et al. 1997).

In 1974, the Laboratory of Ornithology of Latvia USSR Academy of Science, currently called the Ornithological Laboratory of the Institute of Biology at the University of Latvia started investigations on ecology of water bird populations and trends in the fishponds of the Nagli fish farm. The Teici nature reserve has initiated monitoring of rare diurnal raptors as well as building of artificial nests for them in LWC since 1984. The following table providing the numbers of water birds points out that the study area fully complies with the criteria of the Ramsar Convention.

Population of Major Bird Species in LWC

Latin Name	English Name	Numbers during migration period		
		Spring (Apr. to Jun.)	Autumn (Sep. to Oct.)	Number of breeding pairs
Phalacrocorax carbo	Cormorant	n.a.	n.a.	300
Botaurus stellaris	Bittern	n.a.	n.a.	25
Cygnus columbianus	Bewichk's Swan	200	n.a.	n.a.
Cygnus cygnus	Whooper Swan	1,700	n.a.	14
Anser fabalis	Bean Goose	1,000	1,000	n.a.
Anser albifrons	White-fronted Goose	1,000	1,000	n.a.
Anas penelope	Wigeon	4,000	n.a.	n.a.
Anas crecca	Teal	4,000	n.a.	n.a.
Anas acuta	Pintail	3,000	n.a.	n.a.
Aythya ferina	Pochard	4,000	n.a.	n.a.
Mergus albellus	Smew	200	n.a.	n.a.
Total		19,100	2,000	339

Source: Opermanis 1998 Note: "n.a" means that data are not available.

(2) Mammal

An overall investigation on mammals has not yet been implemented in LWC. Therefore, species of insectivores, bats and most of rodent species found in Latvia are not included in the list shown in Table 3.2.2. The list of mammal species (5 orders, 12 families and 23 species are recorded) is being prepared to include the numbers of hunted mammals. Fauna of mammals in LWC is very similar or even identical to that of the Teici nature reserve where 42 species were recorded because LWC and the Teici nature reserve have similar biotopes (Bergmanis 1996).

In LWC, the only information source for mammal population is hunting statistics that is compiled from the statement of hunter groups in respective hunting territories. Brown bear is near to extinction. The only sighting was a foot print at Vilani, and the individual is thought to be a transit one. Beavers are increasing and populations of wolf, lynx, and otter seem not to bedecreasing. Increase of forested areas also functions positively as most game animals are forest dwellers. Consequently, there are no specific mammal species to be protected in LWC.

(3) Fish

There are 42 fish and 3 lamprey species in inland waters of Latvia, of which 24 fish species are found in LWC as shown in Table 3.2.3 based on the published book on Latvian fishes, study reports of the Latvia Fishery Research Institute (LFRI), and results of inquiry survey. There are no endangered fish species for strict conservation in LWC. Common carp (*Cyprinus carpio*) and pikeperch (*Stizostedion lucioperca*) are exogenous species introduced artificially to the lake. There are three migratory species, namely asp (*Aspius aspius*), Vimba (*Vimba vimba*) and eel (*Anguilla anguilla*). They are rarely caught in recent years mainly due to physical interruption by dams in the Daugava rivers.

Relative abundance of fish was studied by LFRI in 1997 by means of control net fishing. Most common species in three townships of the lake are Bream (*Abramis brama*), White bream (*Blicca joerkna*), and Roach (*Rutilis rutilis*) which are medium-size Cyprinidae species. These species occupied about 70 - 90% in number of individuals on

the control fishing. Followed by these species, Perch (*Perca fluviatilis*), and Rudd (*Scardinitus erythrophthalmus*) are caught frequently. Pike (*Esox lucius*) and Pikeperch are the highest trophic level predators in the lake, and they are also caught in this control fishing

3.2.2 Important Species and Habitats

(1) Endangered Species

Thirty-seven bird species are selected within the study area using the above-mentioned criteria as shown in Table 3.2.4. Among them, 30 species are included in the Red Data Book of Latvia and 32 species in the European Threat Status. Seven species (Black Brouse, Redshank, Wood Sandpiper, Little Gull, Whiskered Tern, Black Tern, and Nightjar, are not included in the Red Data Book, but they are listed up in the List of European Endangered Species. Although Capercaillie is not found in any lists for protected species, it is added to the important species group as the species is still important as a game bird. According to the criteria of Latvia Red Data Book and EU Directive 92/43/EEC, following 7 mammal species in LWC correspond to rare and endangered: beaver, wolf, brown bear, lynx, otter, stoat, weasel. Brown bear is especially rare and endangered, but population numbers of other species seem not so much threatened as far as LWC area is concerned.

(2) Distribution of Precious Biotopes

Possible locations of nesting and breeding for birds, which characterize the LWC ecosystem, such as storks *(Ciconiidae)* and diurnal raptor birds as well as waders and waterfowls are shown in Figure 3.2.1. Based on the mutual decision between the Ministry of Environmental Protection & Regional Development (MEPRD) and the JICA study team, however, the habitat map of those species are not printed on this report for the purpose of strict protection of endangered species. Analysis of breeding and feeding biotopes of the most important bird species leads to the conclusion that each wetland type has greatest importance. Most species are bound in bogs (52% of the total bird species), fishponds (52%), flood grasslands (47%), and lakes (35%). Wetland biotopes are considered as the only breeding places for 25 bird species (about 70% of the total breeding species).

Migrating water birds preferably feed and rest in such wetland biotopes as lakes, fishponds and flood grasslands in spring, especially, for Black stork (*Ciconia nigra*), White-tailed eagle (*Haliaeetus albicilla),* Short-toed eagle (*Circaetus gallicus*) and Spotted eagle (*Aquila clanga).* Density of Corncrake (*Crex crex)* in flooded grasslands is significantly higher than in other biotopes.

Wetland forests and deciduous forests, especially, broad-leaved forests with hard woods, black alders and birches, have great importance in conserving a variety of bird and animal species. Such forests are main breeding and feeding biotopes for Middle spotted woodpecker (*Dendrocopus medius*) and White-backed woodpecker (*Dendrocopus*

leucotos). Lesser spotted eagle (*Aquila pomarina)* and Spotted eagle (*Aquila clanga*) also preferably reside in those forests.

Thus, vegetation types essential for bird species in LWC are: 1) raised and transitional bogs, 2) fens, 3) all types of forest stands on islands in bogs, 4) broad-leaved forests, 5) natural coniferous forest, 6) water, and 7) inundated grasslands.

3.2.3 Directions for Nature Protection

(1) Impacts on Habitats

There are specific drainage and surface runoff conditions in LWC. Several rivers once discharging into Lake Lubana now discharge into the Aiviekste river as a result of dyke construction around the lake. Therefore, flows and hydrological regimes of the lake have changed. Blocking of the Pededze river in one spot has stopped water flowing in the lower part of the river over 6 km long, which has contaminated its riverbeds with organic matters that worsen water quality.

The tributaries to Lake Lubana and the Aiviekste river gather a lot of surface runoff waters from the surrounding highlands. Due to the limited discharge capacity of the Aiviekste water gate, it cannot divert floodwaters very quickly. Long flooding duration has developed bogs and wetlands in the vicinities of Lake Lubana providing preferable habitats for fauna. The presence and dynamics of biotopes crucially depend on water level changes and flooding duration.

The drainage systems in LWC changed surface water runoff from wetland areas, and decreased thickness of water-saturated soil layers. A change in hydrological conditions causes transformation of wetland vegetation. Thus, its biodiversity is influenced by changes in typical structures of wetlands in LWC. Human activities and their ecologically negative impacts mentioned below should be kept in mind, especially, in LWC.

1) Due to drainage in bogs, especially, in the Solagala and Sala bogs, changes in vegetation types have been observed in the belts of wet forests typical for peripheries of bogs. Growing conditions for forests and composition of tree species have also changed as well as invasion of trees, such as birches and pines, into the bogs is observed. Areas with small lakes and water pools disappeared in the Sala bog.
2) Drainage of marshy grasslands facilitates less moisture content in the grasslands, and causes more trees and bushes, especially along the drainage ditches, with their seeds encouraging further distribution of trees and bushes in the grasslands.
3) Drainage activities in the wetland forests and road construction change growing conditions for forests into those for drained soils (mineral or peat soils).
4) Flooding areas and marshy grasslands have shrunk due to delimitation of Lake Lubana with dykes.
5) Construction of water gates in the Aiviekste river and Lake Lubana has interrupted and cut off traditional fish migration routes, especially for Ide and Pike. The two species used to spawn in the lake. Mainly due to shortened flood duration in Lake

Lubana and the surrounding areas, fish spawning in marshy grasslands along the Aiviekste river has been unsuccessful. Therefore, fish resources in Aiviekste river become scarce.

6) With the high water levels of Lake Lubana in summer, the study area is not so attractive as used to be as a game spot for water birds. LWC has diminished its previous importance as a place for hunting.

7) Forestry activities destroyed the only one recorded breeding place for the Spotted Eagle (World Threat Status) in Latvia.

8) There are some human activities that cause positive ecological effects. The fishponds of about 3,000 ha around the lake has positively influenced biodiversity of bird species in the study area. The fishponds provide water birds with shallow water levels, rich vegetation in water plants, and abundant fish resources.

(2) Existing Conservation Frame

Lake Lubana and the surrounding mires, forming LWC, are ecologically united and unique in view of biodiversity. The study area has been attracting much attention from scientists and environmental protectionists. As a result of biological investigations carried out by the Institute of Biology, the Teici nature reserve, the Latvian Nature Fund, and the Latvian Ornithological Society (LOS), the areas to be protected are proposed to the Cabinet of Ministers. The proposal was adopted by the Cabinet of Ministers of the Republic of Latvia on June 15, 1999 (Regulations No. 212/199). The locations and the areas of the current nature protection territories are shown in Figure 3.2.2 and the following table. On the other hand, the Department of Forestry established 24 protected forest plots for protection of breeding habitats of rare raptor birds in LWC based on the approved areas to be protected mentioned above. Based on the mutual decision between the Ministry of Environmental Protection & Regional Development (MEPRD) and the JICA study team, however, those plots are not printed on this report for the purpose of strict protection of endangered species.

Current Nature Protection Territories in LWC

No.	Name of Restricted Area	Area (ha)
1	Barkava oak stand	62
2	Berzpils bog	3,319
3	Idinu bog	818
4	Idena and Kvapani ponds	1,116
5	Lagazas-Snitku bog	3,386
6	Lubana depressions	5,905
7	Lubana and Solagala bog	2,899
8	Parabaine	9,822
9	Pededze river lower stretch	4,147
10	Sala bog	3,862
11	Tirumnieki bog	266
Total		35,602

Note: The numbers shown here correspond to the numbers in Figure 3.2.2.
Source: The Cabinet of Ministers of the Republic of Latvia on June 15, 1999 (Regulations No 212/199)

(3) Directions for Birds and Wildlife Protection

1) Water level control of Lake Lubana for birds:

By analyzing dynamics and consequences of water level changes and applying the water levels at the beginning of the 1980s, reasonable water levels for such water birds as dabbling ducks should be kept at least from June to September. The important features of Lake Lubana as habitats for breeding and summering water birds, and a hunting activity should be restored. It is recommended that depths of the peripheries of the lake be not deeper than 0.5 m.

2) Drainage activity control for bogs:

Administrative measures should be developed and implemented to ensure any kinds of drainage activities. Water runoff from bogs to drainage ditches should be limited. Water flows in the old and natural Pededze riverbeds should be restored. An analysis of the existing conditions in bogs and their surrounding areas should be carried out.

3) Fauna monitoring program:

The table below lists up the monitoring systems necessary to LWC. This list can be revised and made more detailed if there are pre-conditions for establishment and realization of a united monitoring system. At present, investigations are being carried out by different institutions for their own purposes.

Necessary Monitoring Systems in LWC

Monitoring Objects	Targets and Periods
Water quality	Lake Lubana and its surrounding rivers
Water levels	Lake Lubana
Groundwater table	Bogs and fens
Flooded areas	During spring
Water birds	Fishponds
Rare diurnal raptors	LWC
Colonial bird species	Lake Lubana and Gomelis
Migrating water birds	Gomelis and fishponds in spring
Waders	Mires
Corncrake and Great Snipe	LWC
Woodpeckers	Broad-leaved and wet deciduous forests
Typical vegetation of marsh grasslands	LWC
Game mammals	LWC
Productivity of fish	Lake Lubana

4) Program preparation of nature protection plans:

Nature protection plans are not developed for all particularly protected nature areas in LWC. Therefore, it is necessary to develop the nature protection plans for other protected nature areas. There are territories important for birds outside the protected nature areas as well (e.g., Lubana Lake, fish ponds of Orenisi and Zvejsala parts in Nagli fishery, parts of inundated grasslands - *Klani*). Protection concept for those areas should be also elaborated within the frames of nature protection plans.

5) Establishment program of forest biotope sites:

Forest biotope sites for protected bird species are established just in some part of LWC, according to the instructions of State Forest Survey. Several localities of rare bird species are located outside the protected nature areas and so remain unprotected. So it is recommendable to establish new forest biotope sites for protected bird species, where they are not established and are required in LWC.

6) Habitat protection program:

It is recommendable to facilitate abidance of regulations on protection of species and biotopes by co-operating with State Environmental Inspection and State Forest Survey. Besides, a grass cutting activity on marshy (flood) grasslands is recommended to avoid unique habitats from vanishing and to prevent trees and bushes from overgrowing.

(4) Directions for Fish Conservation

1) Proper management of water level:

From the viewpoint of fish conservation and fishery resource management, it is favorable to keep a high water level in the whole year following the current rule described in "The Regulations of Exploitation of Lake Lubana and Hydro Technical Buildings". This regulation indicates the determined elevation levels of the lake water; maximal level in an extreme situation of 95.3 m; normal water level of 92-93 m, and minimal level of 91.75-91.20 m.

Fishermen and fish inspectors of REBs suggest that fishes could be conserved as far as water level is managed in accordance with the current regulation. However, the minimal elevation level (91.2 m) means only 1.2 m water depth even in the deepest area of the lake. There is a little doubt that fishes can survive over the winter under such a shallow water level.

According to the hydrological data obtained, the lowest water level during the period from 1984-1995 was 91.7 m on October 1991. This water level is higher than that of the regulation, but the fishermen complained the damage of winter period. This means that the required water level by fishermen must be more than 91.7 m. Re-examination of the lakebed elevation and update of the topographical map would be necessary to clarify this argument. Besides, a quick decrease of water level should be avoided for movement of fish juveniles from the shoal, as suggested less than 2-3 cm / 24 hours in the regulation.

2) Conservation and monitoring of aquatic environment:

In general, water quality of Lake Lubana is well maintained. However, water circulation in the southern part of the lake could be stagnant and would cause deterioration of fish habitat. It is recommended to increase water flow toward the Kalnagala sluice during the spring period for enhancement of water exchange in the southern part.

Conservation of fish spawning activity is now regulated by the closure of fishing activities for the whole lake. When the intensive spawning ground is specified by species in future, spatial regulation such as fish sanctuary should be applied in combination with the existing regulation. Overall, periodical monitoring on aquatic environment not only water quality but also living organisms should be conducted through institutional strengthening and provision of relevant analytical equipment.

3) Expansion of fish wintering place:

A fish mortality due to insufficiency of fish wintering places in the lake has been observed in some dry years. Considering that the ice layer of the lake extends to be 0.8-1.0 m, fish wintering place must contain the depth more than 2.5 m in winter. An availability of continuous water current to supply dissolved oxygen to fish is another important factor restricting the wintering place. At present, the place satisfying these conditions in the lake is limited to the river mouth area of the Rezekne river. The lower reach of the Rezekne river could be also wintering place sustained by water flow. A physical expansion of fish wintering places by dredging is recommended for fish to overcome winter safely.

4) Fish way construction:

As a countermeasure for present interruption of ecosystem at the Aiviekste sluice, there is an idea of construction of fish way. However, the effectiveness of this fish way seems to be restricted only for fishes inhabiting the upstream of the Plavinu Hydroelectric Power Station (HPS) in the Daugava river, because the fish movement has been interrupted by the existing HPS sites as shown below. Thus, a recovery of highly migratory fish species such as salmon and eel cannot be expected even though a fish way is constructed at the Aiviekste sluice.

The Hydroelectric Power Stations (HPS) Sites

Hydroelectric Power Stations (HPS)		Facility of fish way
Daugava river		
1)Riga HPS	Public	No.
2)Kegums HPS	Public	Yes (but not used)
3)Plavinu HPS	Public	No (although it was planned)
Aiviekste river		
4)Aiviekste HPS	Private	Yes

The fish way may improve fish stock of migratory carps such as Asp and Vimba in the Aiviekste river stretch and Lake Lubana to some extent. However, it is considered that Pike and these carp species ready have their own spawning areas in the river, especially in the upstream meandered area in LWC. From viewpoint of fish conservation in the Aiviekste river, it seems to be important to protect existing spawning areas rather than construction of a new fish way. Moreover, no commercial fishing is allowed in the Aiviekste river, and the target migratory carps (Asp and Ide) are low price in the market. Therefore, it is not recommended to construct a fish way at the Aiviekste sluice.

5) Establishment of Lake Lubana Fishery Management Authority:

One of the constraints on management and development of fishery in Lake Lubana is complexity of government administration. There is no scientific reason that limit of fishing right, which is allocated to the lake as a whole, is divided into the three township waters.

Rezekne and Madona REBs seem to carry out fish control activities without close collaboration. For example, the fry restocking of pike to Lake Lubana was conducted by the fishermen of Osupe township who asked artificial seed production to the state-own Serene fish farm in Plavinas, while the Nagli fish farm produced pike fry but sold them to the other lake.

It is strongly recommended to establish an integrated coordinating authority about overall management of fishery-related activities in Lake Lubana, tentatively named "the Lake Lubana Fishery Management Authority". Major function of this organization is as follows:

- Allocation of commercial fishing right to fishermen,
- Issue of commercial fishing license, and of specific angling card on LWC,
- Coordination of fish control activity and arbitration of conflicts on fishery,
- Preparation and execution of overall fishery development plan, and
- Support establishment of fishermen's and angler's organization.

Board members of this organization should be composed of the following representatives of a) Rezekne and Madona DCs and relevant townships, Rezekne and Madona REBs, the fishermen's and angler's organizations (to be established), the hatchery complex (to be established). Representatives from NBF and LFRI should attend regular board meetings as advisors.

6) Encouragement fishermen's organization and angler's organization:

At present, there is no functional organization regarding commercial fishing or recreational fishing, and this situation often causes inefficiency and misunderstanding on fishery activities. A spontaneous formation of integrated fishermen's organization seems to be difficult without some incentives. In this context the proposed facilities and equipment could be one of incentives for them to formulate organization.

Possible people who join the fishermen's organization are the licensed fishermen (60 persons), their family members and assistants, and employees of the Nagli fish farm (56 persons). Few informations are now available about anglers number to be organized. Possibility of exclusive fishing right system, like the one applied for the Leici Co. of Lake Razna, should be discussed in the proposed integrated coordinating authority.

7) Introduction of specific angling card system:

The specific angling card system has been ruled out in the nationwide fishery regulation. The municipality or designated organization that are responsible for fishery

management of particular water can issue specific angling card aside from common angling card as a budget source for specific fishery resource management and propagation activity. In the case of specific angling card, 74% of sales are transferred to the Fish Fund for possible refunding. Introduction of this system would be essential for operation of hatchery and other activities on fishery resource management in LWC.

8) Future balance of commercial fishing and angling:

In the near future when the number of anglers are increased, there may be some conflicts between anglers and commercial fishermen, because those two parties use the same fish resources. Some lakes in Latvia, for example Lake Burtnieks, apply time sharing and spatial segregation system. This new system is able to apply for Lake Burtnieks because this lake has not experienced any commercial fishing before. Appropriate institutional and regulative measures for balancing commercial fishing and angling of Lake Lubana should be discussed in the proposed integrated coordinating authority.

3.3 Wetland Vegetation

3.3.1 Current Situations

The vegetation of the study area is classified into eight categories by dominant plant species, namely a) raised bogs and transitional bogs, b) fens, c) inundated grasslands (Klani), d) coniferous forests, e) deciduous forests (small-leaf forests), f) broad-leaved forests, g) dry grasslands and agriculture lands, and h) water bodies. On the basis of an interpretation of satellite images and air photographs, topographic maps and a field observation, a vegetation map is prepared in scale of 1:50,000 and a reduced map is produced as shown in Figure 3.3.1.

(1) Development of vegetation in relation with hydrology

In LWC, wet types of vegetation such as bogs and fens have been well developed. It is assumed that at the early stage of succession inflow water carried soil and debris into an ancient lake and the accumulation of them made the lake shallower. When the lake became shallow enough, aquatic plant species intruded and aquatic plant communities were developed. Dead body of plants accumulated on a lake bed little by little with developing a peat layer under cool temperature. As a result, fens and bogs have been developed finally as they are today.

A sketch of cross section of LWC is shown in Figure 3.3.2. The section is laid from west to east at the confluence of the Aiviekste river and the Ica river. The Lielais bog and Berzpijs bog occupy on mounds where influence of groundwater is low. Fens occupy lower flat area. Inundated grasslands are along a river where an influence of flooding is strong and accumulation of peat layer is disturbed. Forests are distributed around bogs or higher places than fens and inundated grasslands.

(2) Hydrological requisition for each vegetation

Raised bogs rely on only precipitation for their water supply. Annual flood, surface water, and groundwater are not suitable for their survival. On the other hand, fens are adapted to an annual flood but not necessarily. Wet ground condition which fens require can be guaranteed either by inflow surface water or groundwater. Transitional bogs have intermediate hydrological requisition between raised bogs and fens.

Inundated grasslands require annual flood in early spring for its survival, which prevents invasion of tree species. But constant surface water cover through a year is not desirable. The inundated grasslands seem to require groundwater level not high as fens' but not low as permitting the propagation of tree species after the flood retreats.

Forests can accept annual flood but in short period. Acquisition of surface water and groundwater varies from forest types. Constantly high groundwater level is not desirable for tree growth but some species can adapt even on such environment. Dry grasslands/agricultural lands cannot accept flood and surface water in principal. Groundwater level must be kept low for root growth and heavy machinery operation.

(3) Effects of annual flood

The most remarkable hydrological event of LWC is annual flood in spring caused by snow melting. Then the vegetation is basically established under the influence of flood and its distribution reflects the intensity of inundation. The duration period of inundation differs from place to place determined by topography, elevation, and location.

Inundated area by annual flood is shown in Figures 15.2.2 to 15.2.4 of the Supporting Report. It is clear that most bogs are free from annual flood. Since the dike was constructed in 1982, one bog at the west coast of Lubana Lake seems to be affected by the flood with once per 10 years possibility. Some fens are not inundated annually. As fens accept annual flood but not necessarily required, they are located in depression areas assuming to be nursed by inflow surface water or groundwater during a year. Most part of the inundated grasslands is submerged once every two years. Some forest areas are also inundated. Long inundation is not desirable for tree growth, but tree species in these forests adapt their nature for periodical inundation with tolerance.

3.3.2 Precious Species and Communities

Although there is little literature mentioned about a concrete list of flora in LWC, all available data are summed up about rare and protected species found in LWC and 34 rare and protected species are listed in the next table.

Protected Plants Found in LWC

Species	Category	Species	Category
1. Carex aquatilis	1	*18. Gladiolus imbricatus*	3
2. Equisetum scirpoides	1	*19. Glyceria lithuanica*	3
3. Juncus stygius	1	*20. Hammarbia paludosa*	3
4. Ligularia sibirica	1	*21. Liparis loeselii*	3
5. Saxifraga hirculus	1	*22. Malaxis monophyllos*	3
6. Thesium ebracteatum	1	*23. Nuphar pumila*	3
7. Carec scandinavica	2	*24. Orchis mascula*	3
8. Cnidium dubium	2	*25. Salix myrtilloides*	3
9. Cypripedium calceolus	2	*26. Salix phylicifolia*	3
10. Galium schultesii	2	*27. Scirpus radicans*	3
11. Gentiana pneumonanthe	2	*28. Scolochloa festucacea*	3
12. Iris sibirica	2	*29. Dactylorhiza baltica*	4
13. Onobrychis arenaria	2	*30. Dactylorhiza incarnata*	4
14. Primula farinosa	2	*31. Dactylorhiza maculata*	4
15. Viola persicifolia	2	*32.Diphasiastrum complanatum*	4
16. Allium ursinum	3	*33. Platanthera bifolia*	4
17. Cinna latifolia	3	*34. Pulsatilla patens*	4

Notes: **category 1**: danger for extinction, **category 2**: sensitive, **category 3**: rare, and **category 4**: commercially threatened
Sources: Chronology of Latvian flora, Data base "Location of protected plants in Latvia", List of vascular plants geobotanical region of NE Latvia, Personal data of D.Rakvicha, L.Engele and B.Bambe

The EU Habitat Directive (1992) listed natural biotope types which EU considers to be important and necessary to be designated as special protection areas for their conservation. Among the list, the biotopes possibly concerned with LWC are as following. (The code number is used in the list of the EU Directive.)

71. Sphagnum acid bogs
    7110 Active raised bogs
    7120 Degraded raised bogs still capable of natural regeneration
    7130 Blanket bogs
    7140 Transition mires and quaking bogs
    7150 Depression on peat substrates
90. Forest of boreal Europe
    9020 Fennoscandian hemiboreal natural old broad-leaved deciduous forest (*Quercus* (oak), *Tilia* (lime), *Acer* (maple), *Fraxinus* (ash), *Ulmus* (elm)) rich in epiphytes
    9080 Fennoscandian deciduous swamp woods
91. Forests of temperate Europe
    91D0 Bog woodland
    91E0 Alluvial forests with *Alnus glutinosa* (alder sp.) and *Fraxinus excelsior* (ash sp.)

Although more precise field survey is required to determine if some plant communities coincide with the biotopes in the list, bogs and broad-leaved forests in LWC may have a priority for conservation in the European level.

(1) Essential vegetation for bird and wildlife

Among mammal species recorded LWC, seven species are listed in the Red Data Book of Latvia or the EU Habitat Directive. Water bodies especially shore areas are important habitats for aquatic mammals such as beavers and otters. Beavers often use some big drainage canals. Forests are important for large mammals such as wolves, lynx, and brown bears. They use forests and the fringe of adjacent grasslands for hunting, resting, and moving. Their habitat range varies depend on the amount of their prey and possibly

extend towards outside of LWC. Stoats and weasels are also carnivorous feeding on smaller mammals and require comparatively small area for their survivals. In addition, an inundated grassland offer good grazing site for big herbivorous mammals such as *Alces alces* (elk) although they usually hide themselves in forests during daytime.

On the other hand, 33 bird species are selected as rare species on the basis of the List of World Thread Status, the Red Data Book of Latvia, and the List of Europe's Endangered Species. Although their habits for breeding and feeding vary from an agricultural land to a forest, the relation with wet type vegetation seems to be especially high. For example, 18 species of 33 are bound to bogs for breeding and feeding, 16 species to inundated grasslands, and 19 species to water bodies. In addition, inundated grasslands are highly important as breeding sites of globally endangered great snipes.

(2) Species with economic value

Tree species for timber with long and straight stems such as pine and spruce have high economic value in LWC. Commercially valuable conifer stands mainly distribute in the northern part of LWC on the left bank of the Aiviekste river. Conifer stands with dwarf form around bogs are less valuable economically. A birch is mainly used for fuel wood.

Berry (raspberry, cranberry) and mushroom picking is common outdoor activities for local dwellers. The harvest is consumed at home or sold in local market to benefit household economy, does not seem to have a huge demand for commercial industry. Dried sphagnum is used for an adiabatic material of local houses, but the demand is limited.

(3) Important vegetation for eco-tourism and recreation

Because wetlands in Europe have intensively been reclaimed for cultivation and decreased the areas through the history, wetlands are regarded as one of the important vegetation especially in the Western Europe. Then wetland vegetation such as bogs and fens can be an interesting attraction for foreign tourists. Forests with berries and mushrooms are another tourist attraction besides for local recreation.

Banks crossing though the Kvapanu fishpond (northeast from Lake Lubana) provide pleasant view of wetlands. Landscape from Aiviekste river is beautiful if water level is high enough for boating. Small hills among bogs can be other good viewpoints, but habitats of some endangered species must be carefully avoided.

3.3.3 Protection of Wetland Vegetation

(1) Evaluation of wetland vegetation

The ecosystem of LWC is totally evaluated as shown in the table below and Figure 3.3.3. According to the evaluation, good ecosystem mainly distributes in the central part of LWC around Lubana Lake and along Aiviekste river, and degraded ecosystem surrounds it. Then, the good ecosystem seems to be isolated from the other good ecosystems outside of LWC.

Classification of Evaluation of Ecosystem

Class	Evaluation of Ecosystem of LWC
A	Excellent ecosystem distributes. Be important as a core of natural environment in the area.
B	Good ecosystem distributes in certain extent. Be important as a corridor and also important as a buffer for the core area.
C	Good habitat for wildlife distributes continuously although it is secondary or artificial.
D	Habitat for wildlife is almost continuous although it is artificial. Disturbance of ecosystem is higher than C.
E	Ecosystem with intensive disturbance. Habitat for wildlife is divided.

(2) Vegetation to be protected

Considering the actual distribution and characteristics of the vegetation biotopes in LWC, those are mainly classified into four types, bogs type, forest type, wet grassland type, and dry grassland type. Among each of the type, areas with grade A and B by the evaluation could have a priority to be protected.

Bog type mainly consists of raised bogs and transitional bogs with surrounding natural forest. The bogs and the forests gradually change their botanical component each other in the transitional zone. Most of this type is regarded as protected areas. Forest type contains the forest excluded from the bog type. Broad-leaved forest patches are the most important for conservation. The forest used for a nesting site of some precious birds can also be chosen as a protected area. Wet grassland type mainly consists of inundated grassland, fen and water body. Among them, areas along the shores of rivers and lakes are important for providing a habitat for aquatic mammals. The areas for nesting and breeding sites of precious bird species are also important. Dry grassland type mainly consists of agricultural lands. It is less important for botanical interest and wildlife's habitat.

(3) Ecological planning

Figure 3.3.4 shows delineation of LWC for considering the protection of the vegetation biotopes. LWC is divided into three areas. Those are protected area, transition area, and development area. Most of the bog type is selected as protected area because of their botanical importance. Protected areas of forest type are broad-leaved forest and other natural forest providing nesting sites for important bird species. Shore of Lake Lubana and banks of Aiviekste River form protected areas of wet grassland type.

Transition area surrounds protected areas functioning as a buffer and corridor. Development area should be on a fringe of LWC consisting of most of the dry grassland type and a part of forest type.

Figure 3.3.4 shows network of land ecosystem supposing for migration or moving of large land mammals. The network is sometimes disconnected by physical or mental barrier for their migration such as housing area and intensive farmland. The land ecosystem of LWC seems to be roughly divided into the northern part and the southern part. In addition, LWC does not well connect with adjacent the Teici nature reserve by the network of land ecosystem.

The aquatic network shown in Figure 3.3.4 provides corridors for fish and aquatic mammals. The network is mainly divided into three parts by a dike along the southern edge of Lake Lubana and by the Aiviekste water gate. In the northern part of the study area, the old (natural) Pededze river malfunctions as an ecological corridor because the main stream flowing into the Pededze canal. A stream connects LWC with the Teici nature reserve to the south, but the stream is so small and flows in agriculture land that it would not be a good corridor for aquatic wildlife.

(4) Wise use possibility of protected area

In the protected area, all vegetation should be carefully protected. Intensive cutting and reclamation is not allowed. Permanent structure is not also recommendable. On the other hand, individual activities of local residents such as hunting and berry picking are allowable if the activities do not disturb a breeding of some important species. Visiting by tourists is also acceptable if the number of them is not very high for degrading the quality of the vegetation biotope. Some activities to rehabilitate the vegetation such as filling us drainage in bogs must be planned. Some activities for maintaining the quality of the vegetation biotope such as periodical grass cutting in inundated grassland could be allowed.

In transition area, small scale cutting and farming are allowed, but intensive agriculture and extensive sylviculture are not acceptable since this area is expected to function as a buffer and a corridor. Some rehabilitation activities are recommended in some places such as filling up drainage to recover former ground water level as a result of precise field survey. In the fringe area, intensive agriculture and sylviculture are acceptable. Even plowing is possible under careful attention to soil erosion. Constructing activities are also allowed.

(5) Protection direction for wetland vegetation

The following actions under the two programs are necessary for conservation of the vegetation.

1) Vegetation research program

Precise research including field survey is required to clarify the botanical characteristics in LWC in detail. The research is also necessary to identify the distribution of precious species. Experts for wetland and forest vegetation are necessary to carry out the intensive survey. Monitoring of succession in relation with ground water level is also important theme of the study to clarify the effect of drainage.

2) Vegetation protection program

To rehabilitate the vegetation of LWC, some works may be required as a result of precise vegetation survey. Filling up drainage to keep suitable groundwater level in and around bogs and inundated grasslands is one of the priority works. Dehydration of agriculture lands and sylviculture lands must be considered in that time. It is also recommended that the improvement of ecological network should be considered.

Environmental education is essential for wise use including nature conservation for a long term. Many approaches are possible for it such as notice board, leaflet, school expedition, seminar and visitor center. Nature guards mentioned above are possible tutors on it. Besides them, continuous supervision of LWC by some nature guards is necessary to prohibit illegal activities.

Finally, it must be reminded that all vegetation has hydrological and biological relation each other. For example raised bogs and transitional bogs have different hydrological character but normally distributed in mosaic in LWC. Bogs and surrounding pine forests gradually change their botanical components and strongly tied hydrologically. When conservation measures for certain vegetation are planned, the consideration on hydrology and biology must be extended to surrounding areas.

3.4 Biotope Map of the Study Area

3.4.1 Distribution of Biotopes

(1) Selection of Biotope Type

LWC is divided into 9 biotope types as listed in the next table. To enable comparison between different classification system, the table indicates the relevance of biotope classification in this JICA study with that of the EU Directive and wetlands types of the Ramsar Convention.

Biotope Classification

No	Biotope type in JICA study	Biotope type by EU Directive	Wetland types by the Ramsar classification system
1	Raised/Transitional bogs	7110, 7140	U
2	Fens	6430	U
3	Inundated grasslands	6430	Ts, W, 4, 9
4	Coniferous forests	91D0, 91E0	Xp, Xf, 9
5	Deciduous forests (small-leaf forests)	9080	Xf, W, 9
6	Broad-leaved forests	9020	Xf, W;9
7	Dry grasslands/Agricultural lands	None	None
8	Lakes, rivers and canals	3150	M, O,9
9	Fishponds	None	1

Notes: Biotope type by EU Directive are,

3150: Natural eutrophic lakes
6430: Marshy grasslands and flood grassland
6440: Alluvial meadows of river valleys
7110: Active raised bogs
7140: Transition mires and quaking bogs
7150: Depressions on peat substrates
9020: Broad-leaved deciduous forests
9080: Deciduous swamp woods
91D0: Bog woodland
91E0: Alluvial forests

Wetland types and codes of the Ramsar Classification System for Wetland Type are,

M: Permanent rivers/streams/creeks.
U: Non-forested peat lands; includes open bogs and swamps.
O: Permanent freshwater lakes (over 8 ha).
Ts: Seasonal/intermittent freshwater marshes/pools on inorganic soils; includes sloughs, seasonally flooded meadows, sedge marshes.
W: Shrub-dominated wetlands; shrub swamps, shrub dominated freshwater marshes, alder thicket on inorganic soils.
Xp: Forested peatlands; peatswamp forests.
Xf: Freshwater, tree dominated wetlands; includes freshwater swamp forests, seasonally flooded forests, wooded swamps on inorganic soils.
1: Aquaculture ponds
4: Seasonally flooded agricultural land (including intensively managed or grazed wet meadow or pasture).
9: Canals and drainage channels, ditches.

Since distributions of most animal species are bound by vegetation types, terrestrial biotopes of LWC is delineated by modifying vegetation map from the viewpoint of animal distributions. Aquatic biotopes were classified based on values as fish habitat. Thus, the respective biotopes are defined as follows:

Raised/Transitional bogs: It is difficult to draw clear lines between raised and transitional bogs, so they were dealt collectively. Faunas of those bogs are also similar. In view of the habitat use of birds and mammals, fringing forests around bogs are regarded as a part of this biotope.

Fens: A fen is characterized by reed with constantly high groundwater level. A thick peat derived from dead plant of reed is developed in the area. Topographically, the fen distributes where water flow of an annual flood is not so fast for disturbing accumulation of peat in LWC.

Inundated grasslands: Inundated grassland is characterized by annual inundation. Comparatively fast water flow during annual flood is maintaining the grassland by disturbing an invasion of bush species in natural ecosystem.

Coniferous forests: Natural and afforested coniferous forests are also collectively dealt due to insufficient faunal data to characterize both vegetation types. Though it seems appropriate to distinguish soil woodland and bog woodland as separated biotopes, faunal data and soil type distribution is unclear presently.

Deciduous and Broad-leaved forests: Reflecting vegetational difference, small-leaved forest and broad-leaved forest are dealt as separated biotopes. Faunal characteristic of the latter, however, is unclear because the area is limited in LWC.

Dry grasslands/Agricultural lands: These include a land with vegetation cover, including natural grassland, pastures, and abandoned agricultural fields, and agricultural lands without vegetation cover.

Lakes, rivers and canals: Because many fishes migrate between Lake Lubana and adjoining rivers, the lake and rivers are included in the same biotope. Large canals with persistent water are regarded almost identical with natural rivers. Drainage channels and ditches with seasonal water are not included as they are not fish habitat.

Fishponds: Due to fully artificial fish fauna and shallow water depth independent from seasonal flooding, they should be dealt as independent biotope from other water bodies.

(2) Distribution of Biotopes

The distribution of biotopes in LWC is shown in the biotope map of Figure 3.4.1. It is noted that distribution of waterbirds and nesting places of raptors in LWC are not linked with the evaluation of vegetation. Conservation values of respective biotopes are shown in the following table, as a result of the examination of fauna and flora situation of LWC.

Conservation Values by Biotope Types

No	Biotope type in JICA study	Vegetation	Mammals	Water birds	Raptors	Other birds	Fishes
1	Raised/Transitional bogs	++	+	-	++	++	-
2	Fens	+	+	+	-	+	+
3	Inundated grasslands (Klani)	+	+	+	+	+	+
4	Coniferous forests	+	+	-	+	+	-
5	Deciduous forest (small-leaf forest)	+	++	-	++	+	-
6	Broad-leaved forests	++	++	-	+	+	-
7	Dry grasslands/Agricultural lands	+	+	+	+	+	-
8	Lakes, rivers and canals	+	++	++	+	+	++
9	Fishponds	+	++	++	+	-	-

Note: ++, highly valued; +, relevant; -, not relevant.

(3) Birds

Out of 325 bird species found in Latvia, 224 species have been recorded in LWC. Long-term trends in bird fauna in LWC reveal that population of birds decreases mostly linked with habitat loss by drainage activities that started in the 1920s. Affected species were bog dwellers. Presently, a vegetation type of inundated grassland is rapidly changing by abandoning of haymaking. In the near future, this may affect to bird species like the great snipe that breed in such a place. On the other hand, a population increase is remarkable in some waterfowls after the 1980s. Such increase is mainly due to fishpond construction near Lake Lubana in the 1970s. In some species such as gray heron and mute swan, the population increase seems to be linked with pan-European trends.

Distribution of raptor nesting places shows quite different aspect. Their nests tend to distribute unevenly in LWC, and the distribution does not necessarily reflects naturalness of vegetation. It is certain that big trees are their favorable nesting places. Bird species living bushes to forests seem not to be so much affected. Therefore, it is concluded that priority places for bird conservation are bogs and fishponds for the reason that the former is a vulnerable habitat and the latter is serving a core of waterbird distribution.

(4) Mammals

Many mammal species in LWC prefer areas mixed with forests and grasslands. Species solely dependent on bogs are few. Although the list of mammal species does not include small mammals like Muridae (voles and mice) and Chiroptera (bats), their distribution seems to be linked with that of soil woodlands. Aquatic mammals like otters and beavers occur along watercourses. Therefore, construction of drainage canals and ditches as well as plantation functioned favorably to expand their habitats, increasing foods animals like frogs. Although several endangered mammal species do occur in LWC, aquatic species seems not so much endangered. According to the decrease of hunter population, hunting pressure is declining. In that place, road kill seems increasing though there is no statistical data.

(5) Reptiles and Amphibians

The species number of those poikilothermic animals is not rich in Latvia. But frog population is abundant at various water bodies including drainage canals and ditches.

(6) Fishes

Fish composition and abundance in Lake Lubana is changing due to flood measures and commercial fishery activities. In particular, construction of water gates impeded migration of many species for spawning. Little is known about their underwater habitat preference and quantitative influence of the above aspects. Further investigation is necessary for fishes.

3.4.2 Detailed Biotope Map of the Model Area

The detailed biotope map is prepared to use it as a) decision-making tool to formulate conservation measures, b) standardization of ecological monitoring procedures, c) specification of educational and eco-tourism resources, and d) formulation of biotope mapping process.

The detailed biotope map consists of 14 biotopes as shown in the next table and Figure 3.4.2. Raised and transitional bogs can be found in the northeastern part of the model area, which is on the edge of Sala bog. Shrub bogs tend to be rather dry comparing with the raised and transitional bogs, so sporadic pine shrub of 3 - 6 m high can be observed. Reed and sedge fens are found in Gomelis, Idena and Kvapani fishponds. The area of fens in Idena fishponds is much larger than that of Kvapani fishponds. Inundated grasslands are found mostly in Gomelis which being affected by spring flood. Dry pine, wet pine, and birch forests are observed between bogs and fishponds. Besides, willow bushes are located in border areas between forests and fens near the fishponds. Agricultural land and dry grassland are found around Idena township. Rye is mainly cultivated in agricultural lands, and the dry grassland is covered with herbaceous species on dry soil.

Biotope Classification in the Model Area

No.	Biotope type in model area (1 : 10,000)	Biotope type in LWC (1 : 50,000)
1	Raised bog	Raised/Transitional bogs
2	Transitional bog	
3	Shrub bog	
4	Reed fen	Fens
5	Sedge fen	
6	Inundated grassland	Inundated grasslands
7	Dry pine forest	Coniferous forests
8	Wet Pine forest	
9	Birch forest	Deciduous forests
10	Willow bushes	Inundated grasslands or Dry grasslands
11	Agricultural land	Agricultural lands/Dry grasslands
12	Dry grassland	
13	Water bodies	Lakes and Fishponds
14	Bare ground and others	Urban area

Table 3.1.1 Results of Water Quality Surveys

(1) Data in 1999

sampling days : 3rd Oct - 7th Oct 1999

Parameter	Unit	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	No.13	No.14	No.15	No.16	No.17	No.18	No.19	No.20
pH	-	8.6	7.6	8.0	8.1	8.2	8.3	8.3	8.0	8.3	8.1	7.9	7.9	7.8	7.5	8.1	8.0	7.7	7.9	-	-
DO	mg / l	13.5	8.6	8.6	10.9	9.9	11.1	11.1	7.5	10.2	5.6	8.3	7.8	8.2	4.7	8.6	8.0	4.9	8.2	-	-
COD_{Mn}	mg / l	29.0	33.0	25.5	24.0	16.0	28.0	25.5	9.2	6.7	6.4	13.7	19.0	15.0	34.0	19.0	14.6	20.0	10.5	-	-
Total Nitrogen	mg / l	1.09	10.95	1.30	1.38	1.56	1.62	1.37	0.30	0.29	2.50	0.71	0.87	0.50	1.31	1.16	1.06	1.10	2.74	-	-
Total Phosphorus	mg / l	0.060	0.730	0.030	0.030	0.060	0.100	0.020	0.015	0.370	0.230	0.050	0.050	0.090	0.100	0.030	0.020	0.065	0.500	-	-
Coliforms	CFU / 100ml	12	10	5	1	5	110	1	21	2	71	5	38	2	1	5	14	5	400	-	-
Oil	mg / l	0.20	0.05	0.12	0.20	0.08	0.10	0.07	<0.05	0.24	0.15	0.21	<0.05	0.12	0.12	0.09	0.06	0.05	0.06	-	-
Phenol	mg / l	0.007	0.009	0.006	0.009	0.005	0.010	0.006	0.005	0.001	0.002	0.003	0.007	0.003	0.007	0.008	0.006	0.007	0.001	-	-
CN	mg / l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
PCB	mg / l	<0.0002	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	-	-
Cr^{6+}	mg / l	<0.03	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-
Pb	mg / l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	-
Cd	mg / l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
As	mg / l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-	-
Hg	mg / l	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	-

Remark : The survey was not conducted at No.19 and No.20 in Oct. 1999

(2) Data in 2000

sampling days : 7th June - 24th June 2000

Parameter	Unit	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	No.13	No.14	No.15	No.16	No.17	No.18	No.19	No.20
pH	-	8.97	7.7	7.6	7.7	-	7.6	7.6	8.0	9.0	8.6	8.5	8.5	8.3	8.3	8.7	8.6	8.3	-	7.6	8.7
DO	mg / l	8.68	7.9	8.1	7.3	-	8.3	8.0	7.4	9.0	8.0	7.5	8.6	7.1	7.8	7.4	7.5	6.6	-	8.3	8.4
COD_{Mn}	mg / l	23	12.2	18.0	19.8	-	21.0	22.4	8.6	6.4	5.6	12.8	12.8	12.0	25.6	16.2	10.7	16.0	-	25.0	22.0
Total Nitrogen	mg / l	0.8	0.40	0.58	0.60	-	0.65	0.50	0.20	0.25	5.50	0.50	0.60	0.30	1.10	1.30	0.72	0.90	-	0.51	0.48
Total Phosphorus	mg / l	0.052	0.010	0.020	0.010	-	0.020	0.010	0.015	0.040	0.191	0.070	0.040	0.080	0.040	0.022	0.030	0.060	-	0.020	0.050
Coliforms	CFU /100ml	5	7	14	4	-	17	2	100	39	430	5	48	20	10	110	140	120	-	1	150
Oil	mg / l	0.18	0.13	0.13	0.15	-	0.10	0.13	n.d.	0.07	0.05	0.05	0.05	0.07	0.09	0.11	0.05	0.07	-	0.07	0.20
Phenol	mg / l	< 0.001	<0.001	0.009	0.010	-	0.010	0.007	0.005	<0.005	0.001	0.002	0.008	<0.005	0.009	0.010	0.010	0.004	-	0.010	<0.005
CN	mg / l	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01
PCB	mg / l	< 0.0003	<0.0003	<0.0003	<0.0003	-	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	-	<0.0003	<0.0003
Cr^{6+}	mg / l	< 0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05
Pb	mg / l	< 0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02
Cd	mg / l	< 0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01
As	mg / l	< 2	<0.002	<0.002	<0.002	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-	<0.002	<0.002
Hg	mg / l	< 0.05	<0.00005	<0.00005	<0.00005	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	<0.00005	<0.00005

Remark : The survey was not conducted at No.5 and No.18 in June 2000

Table 3.2.1 BIRD SPECIES RECORDED IN LUBANA WETLAND COMPLEX (1/4)

	Latin Name	English Name	Status *	Red Data Book of Latvia (1)	European Threat Status (2)	SPEC category (2)	World Threat Status (3)	Birds Directive Annex (4)	Ramsar Conv. (5)	Trend (6)
	PODICIPEDIFORMES(ORDER)									
	Podicipedidae(Family)									
1	*Tachybaptus ruficollis*	Little Grebe	Br							
2	*Podiceps cristatus*	Great Crested Grebe	Br							
3	*Podiceps grisegena*	Red-necked Grebe	Br							
4	*Podiceps auritus*	Slavonian Grebe	Br					I		
5	*Podiceps nigricollis*	Black-necked Grebe	Br	3						
	PELECANIFORMES									
	Phalacrocoracidae									
6	*Phalacrocorax carbo*	Cormorant	Br					I	○	+
	CICONIIFORMES									
	Ardeidae									
7	*Botaurus stellaris*	Bittern	Br	3	V	3		I	○	
8	*Ixobrychus minutus*	Little Bittern	Br	3	V	3		I		
9	*Egretta alba*	Great White Egret	M					I		
10	*Ardea cinerea*	Grey Heron	Br	5						+
	Ciconiidae									
11	*Ciconia nigra*	Black Stork	Br	3	R	3		I		
12	*Ciconia ciconia*	White stork	Br		V	2		I		
	ANSERIFORMES									
	Anatidae									
13	*Cygnus olor*	Mute Swan	Br							+
14	*Cygnus columbianus*	Bewick's Swan	M	2	L	3		I	○	
15	*Cygnus cygnus*	Whooper Swan	Br	3	S	4		I	○	+
16	*Anser fabalis*	Bean Goose	M						○	
17	*Anser albifrons*	White-fronted Goose	M						○	
18	*Anser erythropus*	Lesser White-fronted Goose	M		V	1	V	I		
19	*Anser anser*	Greylag Goose	Br	3						+
20	*Branta canadensis*	Canada Goose	M							
21	*Tadorna tadorna*	Shelduck	M	3						
22	*Anas penelope*	Wigeon	Br						○	
23	*Anas strepera*	Gadwall	Br		V	3				
24	*Anas crecca*	Teal	Br						○	
25	*Anas platyrhynchos*	Mallard	Br							
26	*Anas acuta*	Pintail	Br		V	3			○	
27	*Anas querquedula*	Garganey	Br		V	3				
28	*Anas clypeata*	Shoveler	Br							
29	*Netta rufina*	Red-crested Pochard	M		D	3				
30	*Aythya ferina*	Pochard	Br		S	4			○	
31	*Aythya nyroca*	Ferruginous Duck	M		V	1		I		
32	*Aythya fuligula*	Tufted Duck	Br							
33	*Aythya marila*	Scaup	M		L	3				
34	*Clangula hymealis*	Long-tailed Duck	M							
35	*Bucephala clangula*	Goldeneye	Br							
36	*Mergus albellus*	Smew	M		V	3			○	
37	*Mergus serrator*	Red-breasted Merganser	M	1						
38	*Mergus merganser*	Goosander	Br	2						
	FALCONIFORMES									
	Accipitridae									
39	*Pernis apivorus*	Honey Buzzard	Br		S	4		I		
40	*Milvus migrans*	Black Kite	Br	3	V	3		I		
41	*Haliaetus albicilla*	White-tailed Eagle	Br	1	R	3	NT	I		+
42	*Circaetus gallicus*	Short-toed Eagle	Br	3	R	3		I		
43	*Circus aeruginosus*	Marsh Harrier	Br					I		
44	*Circus cyaneus*	Hen Harrier	PBr	1	V	3		I		
45	*Circus pygargus*	Montagu's Harrier	Br	3	S	4		I		+
46	*Accipiter gentilis*	Goshawk	Br							
47	*Accipiter nisus*	Sparrowhawk	Br							
48	*Buteo buteo*	Buzzard	Br							
49	*Buteo lagopus*	Rough-legged Buzzard	M							
50	*Aquila pomarina*	Lesser Spotted Eagle	Br	3	R	3		I		
51	*Aquila clanga*	Spotted eagle	Br	1	E	1	V	I		
52	*Aquila chrysaetos*	Golden Eagle	Br	1	R	3		I		
	Pandionidae									
53	*Pandion haliaetus*	Osprey	Br	3	R	3		I		+
	Falconidae									
54	*Falco tinnunculus*	Kestler	Br	2	D	3				
55	*Falco vespertinus*	Red-footed Falcon	M	3	V	3				
56	*Falco subbuteo*	Hobby	Br							

(continued)

Table 3.2.1 BIRD SPECIES RECORDED IN LUBANA WETLAND COMPLEX (2/4)

	Latin Name	English Name	Status *	Red Data Book of Latvia (1)	European Threat Status (2)	SPEC category (2)	World Threat Status (3)	Birds Directive Annex (4)	Ramsar Conv. (5)	Trend (6)
	GALLIFORMES									
	Tetraonidae									
57	*Bonasa bonasia*	Hazel Grouse	Br					I		
58	*Lagopus lagopus*	Willow Grouse	PBr	1						
59	*Tetrao tetrix*	Black Grouse	Br		V	3		I		
60	*Tetrao urogallus*	Capercaillie	Br							
	Phasanidae									
61	*Perdix perdix*	Grey Partridge	Br	2	V	3				
62	*Coturnix coturnix*	Quail	Br	3	V	3				
	GRUIFORMES									
	Rallidae									
63	*Rallus aquaticus*	Water Rail	Br							
64	*Porzana porzana*	Spotted Crake	Br		S	4		I		
65	*Porzana parva*	Little Crake	Br	4	S	4		I		
66	*Crex crex*	Corncrake	Br	2	V	1	V	1		
67	*Gallinula chloropus*	Moorhen	Br							
68	*Fulica atra*	Coot	Br							
	Gruidae									
69	*Grus grus*	Crane	Br	3	V	3				
	CHARADRIIFORMES									
	Haematopodidae									
70	*Haematopus ostralegus*	Oystercatcher	M	3						
	Glareolidae									
71	*Glareola pratincola*	Collared Pratincole	M		E	3		I		
72	*Glareola nordmanni*	Black-winged Pratincole	M		R	3				
	Charadriidae									
73	*Charadrius dubius*	Little Ringed Plover	Br							
74	*Charadrius hiaticula*	Ringed Plover	M							
75	*Pluvialis apricaria*	Golden Plover	Br	3	S	4		I		+
76	*Pluvialis squaturola*	Grey Plover	M							
77	*Vanellus vanellus*	Lapwing	Br							
	Scolopacidae									
78	*Calidris minuta*	Little Stint	M							
79	*Calidris temminckii*	Temminck's Stint	M							
80	*Calidris ferruginea*	Curlew Sandpiper	M							
81	*Calidris alpina*	Dunlin	M	1	V	3				
82	*Limicola falcinellus*	Broad-billed Sandpiper	M							
83	*Philomachus pugnax*	Ruff	Br	2	S	4		I		
84	*Lymnocryptes minimus*	Jack Snipe	M		V	3				
85	*Gallinago gallinago*	Common Snipe	Br							
86	*Gallinago media*	Great Snipe	Br	0	V	2	NT	I		
87	*Scolopax rusticola*	Woodcock	Br		V	3				
88	*Limosa limosa*	Black-tailed Godwit	Br	3	V	2				
89	*Limosa lapponica*	Bar-tailed Godwit	M		L	3				
90	*Numenius phaeopus*	Whimbler	Br	3	S	4				+
91	*Numenius arquata*	Curlew	Br	2	D	3				
92	*Tringa erythropus*	Spotted Redshank	M							
93	*Tringa totanus*	Redshank	Br		D	2				
94	*Tringa stagnatilis*	Marsh Sandpiper	Br							+
95	*Tringa nebularia*	Greenshank	M							
96	*Tringa ochropus*	Green Sandpiper	Br							
97	*Tringa glareola*	Wood Sandpiper	Br		D	3		I		
98	*Xenus cinereus*	Terek Sandpiper	Br							+
99	*Actitis hypoleucos*	Common Sandpiper	Br							
100	*Arenaria interpres*	Turnstone	M							
101	*Phalaropus lobatus*	Red-necked Phalarope	M					I		
	Laridae									
102	*Larus ichtyaetus*	Great Black-headed Gull	M							
103	*Larus minutus*	Little Gull	Br		D	3				+
104	*Larus ridibundus*	Black-headed Gull	Br							+
105	*Larus canus*	Common Gull	Br		D	2				
106	*Larus fuscus*	Lesser Black-backed Gull	M		S	4				
107	*Larus argentatus*	Herring Gull	Br							+
108	*Larus marinus*	Great Black-backed Gull	M		S	4				
	Sternidae									
109	*Sterna caspia*	Caspian Tern	M		E	3		I		
110	*Sterna hirundo*	Common Tern	Br		*			I		
111	*Sterna albifrons*	Little Tern	Br	3	D	3		I		
112	*Chlidonias hybridus*	Whiskered Tern	Br		D	3		I		+
113	*Chlidonias niger*	Black Tern	Br		D	3		I		+
114	*Chlidonias leucopterus*	White-winged Black Tern	Br							+
	COLUMBIFORMES									
	Columbidae									
115	*Columba livia domest.*	Feral Pigeon	Br							
116	*Columba palumbus*	Woodpigeon	Br		S	4				
117	*Streptopelia turtur*	Turtle Dove	Br		D	3				

(continued)

Table 3.2.1 BIRD SPECIES RECORDED IN LUBANA WETLAND COMPLEX (3/4)

	Latin Name	English Name	Status *	Red Data Book of Latvia (1)	European Threat Status (2)	SPEC category (2)	World Threat Status (3)	Birds Directive Annex (4)	Ramsar Conv. (5)	Trend (6)
	CUCULIFORMES									
	Cuculidae									
118	*Cuculus canorus*	Cuckoo	Br							
	STRIGIFORMES									
	Strigidae									
119	*Glaucidium passerinum*	Pygmy Owl	PBr	4				I		
120	*Strix aluco*	Tawvy Owl	Br		S	4				
121	*Strix uralensis*	Ural owl	Br	3						+
122	*Asio otus*	Long-eared Owl	Br							
123	*Asio flammeus*	Short-eared Owl	PBr	1	V	3		1		
124	*Aegoliuf funereus*	Tengmalm's Owl	Br	3				I		
	CAPRIMULGIFORMES									
	Caprimulgidae									
125	*Caprimulgus europaeus*	Nightjar	Br		D	2		I		
	APODIFORMES									
	Apodidae									
126	*Apus apus*	Swift	Br							
	CORACIIFORMES									
	Alcedinidae									
127	*Alcedo atthis*	Kingfisher	Br		D	3		I		
	Upupidae									
128	*Upupa epops*	Hoopoe	PBr	3						
	PICIFORMES									
	Picidae									
129	*Jynx torquila*	Wryneck	Br		D	3				
130	*Picus canus*	Grey-headed Woodpecker	Br		D	3		I		
131	*Dryocopus martius*	Black Woodpecker	Br					I		
132	*Dendrocopos major*	Great Spotted Woodpecker	Br							
133	*Dendrocopos medius*	Middle Spotted Woodpecker	Br	3	S	4		I		
134	*Dendrocopos leucotos*	White-backed Woodpecker	Br	3				I		
135	*Dendrocopos minor*	Lesser Spotted Woodpecker	Br							
136	*Picoides tridactylus*	Three-toed Woodpecker	Br	3	D	3		I		
	PASSERIFORMES									
	Alaudidae									
137	*Lullula arborea*	Woodlark	Br		V	2		I		
138	*Alauda arvensis*	Skylark	Br		V	3				
	Hirundinidae									
139	*Riparia riparia*	Sand Martin	Br		D	3				
140	*Hirundo rustica*	Swallow	Br		D	3				
141	*Delichon urbica*	House Martin	Br							
	Motacillidae									
142	*Anthus campestris*	Tawny Pipit	Br		V	3		I		
143	*Anthus trivialis*	Tree Pipit	Br							
144	*Anthus pratensis*	Meadow Pipit	Br		S	4				
145	*Motacilla flava*	Yellow Wagtail	Br							
146	*Motacilla citreola*	Citrine Wagtail	PBr							
147	*Motacilla alba*	Pied Wagtail	Br							
	Bombycillidae									
148	*Bombucilla garrulus*	Waxwing	M							
	Troglodytidae									
149	*Troglodytes troglodytes*	Wren	Br							
	Prunellidae									
150	*Prunella modularis*	Dunnock	Br		S	4				
	Turdidae									
151	*Erithacus rubecula*	Robin	Br		S	4				
152	*Luscinia luscinia*	Thrush Nightingale	Br		S	4				
153	*Luscinia svecica*	Bluethroat	Br	4				I		
154	*Phoenicurus ochruros*	Black Redstart	Br							
155	*Phoenicurus phoenicurus*	Redstart	Br		V	2				
156	*Saxicola rubetra*	Whinchat	Br		S	4				
157	*Oenanthe oenanthe*	Northern Wheatear	Br							
158	*Turdus merula*	Blackbird	Br		S	4				
159	*Turdus pilaris*	Fieldfare	Br		S	4				
160	*Turdus philomelos*	Song Thrust	Br		S	4				
161	*Turdus iliacus*	Redwing	Br		S	4				
162	*Turdus viscivorus*	Mistle Thrush	Br		S	4				
	Sylviidae									
163	*Locustella naevia*	Grasshopper Warbler	Br		S	4				
164	*Locustella fluviatilis*	River Warbler	Br		S	4				
165	*Locustella luscinioides*	Savi's Warbler	Br	3	S	4				
166	*Acrocephalus schoenobaenus*	Sedge Warbler	Br		S	4				
167	*Acrocephalus dumetorum*	Blyth's Reed Warbler	Br							
168	*Acrocephalus palustris*	Marsh Warbler	Br		S	4				
169	*Acrocephalus scirpaceus*	Reed Warbler	Br		S	4				
170	*Acrocephalus arundinaceus*	Great Reed Warbler	Br							
171	*Hippolais icterina*	Icterine Warbler	Br		S	4				
172	*Sylvia nisoria*	Barred Warbler	Br		S	4		I		
173	*Sylvia curruca*	Lesser Whitethroat	Br							
174	*Sylvia communis*	Whitethroat	Br		S	4				

(continued)

Table 3.2.1 BIRD SPECIES RECORDED IN LUBANA WETLAND COMPLEX (4/4)

	Latin Name	English Name	Status *	Red Data Book of Latvia (1)	European Threat Status (2)	SPEC category (2)	World Threat Status (3)	Birds Directive Annex (4)	Ramsar Conv. (5)	Trend (6)
	Sylvia									
174	*Sylvia communis*	Whitethroat	Br		S	4				
175	*Sylvia borin*	Garden Warbler	Br		S	4				
176	*Sylvia atricapilla*	Blackcap	Br		S	4				
177	*Phylloscopus trochiloides*	Greenish Warbler	Br							
178	*Phylloscopus sibilatrix*	Wood Warbler	Br		S	4				
179	*Phylloscopus collybita*	Chiffchaff	Br							
180	*Phylloscopus trochilus*	Willow Warbler	Br							
181	*Regulus regulus*	Goldcrest	Br							
	Muscicapidae									
182	*Muscicapa striata*	Spotted Flycatcher	Br		D	3				
183	*Ficedula parva*	Red-breasted Flycatcher	Br					I		
184	*Ficedula hypoleuca*	Pied Flycatcher	Br		S	4				
	Timaliidae									
185	*Panurus biarmicus*	Bearded Tit	PBr	3						
	Aegithalidae									
186	*Aegithalos caudatus*	Long-tailed Tit	Br							
	Paridae									
187	*Parus palustris*	Marsh Tit	Br							
188	*Parus montanus*	Willow Tit	Br							
189	*Parus cristatus*	Crested Tit	Br		S	4				
190	*Parus ater*	Coal Tit	Br							
191	*Parus caeruleus*	Blue Tit	Br		S	4				
192	*Parus major*	Great Tit	Br							
	Sittidae									
193	*Sitta europaea*	Nuthatch	Br							
	Certhiidae									
194	*Certhia familiaris*	Treecreeper	Br							
	Remizidae									
195	*Remiz pendulinus*	Penduline Tit	Br	3						
	Oriolidae									
196	*Oriolus oriolus*	Golden Oriole	Br							
	Laniidae									
197	*Lanius collurio*	Red-backed Shirke	Br		D	3				
198	*Lanius excubitor*	Great Grey Shrike	Br	2	D	3				
	Corvidae									
199	*Garrulus glandarius*	Jay	Br							
200	*Pica pica*	Magpie	Br							
201	*Nucifraga caryocatactes*	Nutcracker	Br							
202	*Corvus monedula*	Jackdaw	Br		S	4				
203	*Corvus frugilegus*	Rook	Br							
204	*Corvus corone cornix*	Carrion Crow	Br							
205	*Corvus corax*	Raven	Br							
	Sturnidae									
206	*Sturnus vulgaris*	Starling	Br							
	Passeridae									
207	*Passer domesticus*	House Sparrow	Br							
208	*Passer montanus*	Tree Sparrow	Br							
	Fringillidae									
209	*Fringilla coelebs*	Chaffinch	Br		S	4				
210	*Fringilla montifringilla*	Brambling	PBr							
211	*Carduelis chloris*	Greenfinch	Br		S	4				
212	*Carduelis carduelis*	Goldfinch	Br							
213	*Carduelis spinus*	Siskin	Br		S	4				
214	*Carduelis cannabina*	Linnet	Br		S	4				
215	*Carduelis flammea*	Redpoll	M							
216	*Carduelis hornemanni*	Arctic Redpoll	M							
217	*Loxia curvirostra*	Crossbill	Br							
218	*Carpodacus erythrinus*	Scarlet Rosefinch	Br							
219	*Pyrrhula pyrrhula*	Bullfinch	Br							
220	*Coccothraustes coccothraustes*	Hawfinch	Br							
	Emberizidae									
221	*Plectrophenax nivalis*	Snow Bunting	M							
222	*Emberiza citrinella*	Yellowhammer	Br							
223	*Emberiza hortulana*	Ortolan Bunting	PBr							
224	*Emberiza schoeniclus*	Reed Bunting	Br							

Status* Br- Breeding, PBr- Probable breeding, M- Passage migrant

(1) Lipsbergs et al. 1990: Popularzinatiska Latvijas Sarkana gramata. Dzivnieki
0 - extinct species, 1 - vanishing species, 2 - rare species, 3 - species with decreasing number of individuals, 4 - indeterminate species, 5-increasing species

(2) Tucker & Heath. Birds in Europe, 1994: E - Endangered; V - Vulnerable; D - Declining; L - Localised; S - Secured; R -Rare, SPEC category 1-4 (1-3 endangered)

(3) Collar et al., Birds to Watch 2 The World List of Threatend Birds, 1994: C - Critical; V - Vulnerable; C - Conservation Dependent; NT - Near-threatened

(4) EU Directive on the conservation of Wild Birds: I-species recorded in Annex I of this Directive and for which special conservation measures are necessary

(5) Ramsar Convention: ○-included in the convention

(6) Trend: + increasing, - decreasing

Table 3.2.2 Mammals Species Recorded in Lubana Wetland Complex

	Latin Name	English Name	Latvian Red Data Book (1)	EU Directive 92/ 43/ EEC (2)
	INSECTIVORA (ORDER)			
	Erinaceidae (Family)			
1	*Erinaceus europaeus*	Hedgehog	-	-
	Talpidae			
2	*Talpa europaea*	Mole	-	-
	LAGOMORPHA			
	Leporidae			
3	*Lepus europaeus*	Brown Hare	-	-
4	*Lepus timidus*	Blue Hare	-	-
	RODENTIA			
	Castoridae			
5	*Castor fiber*	Beaver	-	II
	Cricetidae			
6	*Ondatra zibethicus*	Muskrat	-	-
	Sciuridae			
7	*Sciurus vulgaris*	Red Squirrel	-	-
	CARNIVORA			
	Canidae			
8	*Nyctereutes procynoides*	Raccoon Dog	-	-
9	*Canis lupus*	Wolf	-	II
10	*Vulpes vulpes*	Fox	-	-
	Ursidae			
11	*Ursus arctos*	Brown Bear	2	II
	Felidae			
12	*Lynx lynx*	Lynx	-	II
	Mustelidae			
13	*Meles meles*	Badger	-	-
14	*Lutra lutra*	Otter	-	II
15	*Martes martes*	Pine Marten	-	-
16	*Mustela erminea*	Stoat	2	-
17	*Mustela nivalis*	Weasel	2	-
18	*Putorius putorius*	Polecat		-
19	*Mustela vison*	American Mink	-	-
	ARTIODACTYLA			
	Suidae			
20	*Sus scrofa*	Wild boar	-	-
21	*Capreolus capreolus*	Roe Deer	-	-
	Cervidae			
22	*Alces alces*	Elk	-	-
23	*Cervus elaphus*	Red Dear	-	-
	Total		3	5

Sources and Legends:
(1) Lipsbergs et al. 1990: Popularzinatiska Latvijas Sarkana gramata. Dzivnieki
0 - extinct species, 1 - vanishing species, 2 - rare species
3 - species with decreasing number of individuals, 4 - indeterminate species
(2) EU Directive on the Conservation of Natural Habitats of Wild Fauna and Flora, 1992.
II - species specified in Annex II of EU Directive
- : not mentioned

Table 3.2.3 Fish Species in Lake Lubana

	Latin name	English Name	1950s	1960s	1970s-80s	1990s
	SALMONIFORMES (ORDER)					
	Esocidae (Family)					
1	*Esox lucius*	Pike	x	x	x	x
	ANGUILLIFORMES					
	Anguillidae					
2	*Anguilla anguilla*	Eel	x			
	CYPRINIFORMES					
	Cyprinidae					
3	*Blicca gioerkna*	White bream	x	x	x	x
4	*Abramis brama*	Bream	x	x	x	x
5	*Rutilus rutilus*	Roach	x	x	x	x
6	*Scardinius erythrophthalmus*	Rudd	x			x
7	*Leucisus idus*	Ide	x	x	x	x
8	*Aspius aspius*	Asp		x		
9	*Vimba vimba*	Vimba	x			
10	*Alburnus alburnus*	Bleak	x			x
11	*Leucaspius delineatus*	Verkhovka				x
12	*Tinca tinca*	Tench	x			x
13	*Carassius carassius*	Crucian carp	x	x	x	x
14	*Carassius auratus*	Goldfish				x
15	*Cyprinus carpio*	Carp			x	x
16	*Cobitis taenia*	Spiny loach				x
17	*Misgurnus fossilis*	Pond loach	x	x	x	x
	GADIFORMES					
	Gadidae					
18	*Lota lota*	Burbot	x			x
	PERCIFORMES					
	Percidae					
19	*Perca fluviatilis*	Perch	x	x	x	x
20	*Stizostedion lucioperca*	Pike-perch	x		x	x
21	*Gymnocephalus cernua*	Ruffe	x	x	x	x
	Total		16	10	11	18

Note: species found in each period is marked with "x"
Source: Laboratory of Inland waters' Problems, "Regulations on Fishery Activities in Lake Lubana"

Table 3.2.4 Most Important Bird Species and Habitats in Lubana Wetland Complex

	Latin Name	English Name	Red Data Book of Latvia (1)	European Threat Status (2)	SPEC category (2)	World Threat Status (3)	All forests	Agri-cultural lands	Deciduous forests	Wet coniferous forests	Fish, ponds	Lakes	Inundated grasslands	Raised/ transitional bogs
	PODICIPEDIFORMES													
	Podicipedidae													
1	*Podiceps nigricollis*	Black-necked Grebe	3								B/F			
	CICONIIFORMES													
	Ardeidae													
2	*Botaurus stellaris*	Bittern	3	V	3						B/F	B/F		
3	*Ixobrychus minutus*	Little Bittern	3	V	3						B/F			
	Ciconiidae													
4	*Ciconia nigra*	Black Stork	3	R	3		B/F				/F		/F	
	ANSERIFORMES													
	Anatidae													
5	*Cygnus cygnus*	Whooper Swan	3	S	4						B/F	B/		
6	*Anser anser*	Greylag Goose	3								B/F	B/F		
	FALCONIFORMES													
	Accipitridae													
7	*Haliaetus albicilla*	White-tailed Eagle	1	R	3	NT	B/				/F	/F	/F	/F
8	*Circaetus gallicus*	Short-toed Eagle	3	R	3		B/F							B/F
9	*Circus cyaneus*	Hen Harrier	1	V	3								B/F	B/F
10	*Circus pygargus*	Montagu's Harrier	3	S	4			/F				B/	B/F	B/F
11	*Aquila pomarina*	Lesser Spotted Eagle	3	R	3		B/F	/F	B/F	B/F			/F	
12	*Aquila clanga*	Spotted eagle	1	E	1	V			B/F	B/F		/F	/F	
13	*Aquila chrysaetos*	Golden Eagle	1	R	3		/F						/F	B/F
	Pandionidae													
14	*Pandion haliaetus*	Osprey	3	R	3						/F	/F		B/
	GALLIFORMES													
	Tetraonidae													
15	*Lagopus lagopus*	Willow Grouse	1											B/F
16	*Tetrao tetrix*	Black Grouse		V	3			/F		B/F			/F	B/F
17	*Tetrao urogallus*	Capercaillie					B/F			B/F				B/F
	Phasanidae													
18	*Coturnix coturnix*	Quail	3	V	3			B/F						
	GRUIFORMES													
	Rallidae													
19	*Crex crex*	Corncrake	2	V	1	V		B/F					B/F	
	Gruidae													
20	*Grus grus*	Crane	3	V	3			/F		B/F		B/F	B/F	B/F
	CHARADRIIFORMES													
	Charadriidae													
21	*Pluvialis apricaria*	Golden Plover	3	S	4									B/F
	Scolopacidae													
22	*Philomachus pugnax*	Ruff	2	S	4						B/F		B/F	
23	*Gallinago media*	Great Snipe	0	V	2	NT					/F		B/F	
24	*Limosa limosa*	Black-tailed Godwit	3	V	2						/F			B/F
25	*Numenius phaeopus*	Whimbler	3	S	4									B/F
26	*Numenius arquata*	Curlew	2	D	3			/F					B/F	B/F
27	*Tringa totanus*	Redshank		D	2						B/F		B/F	B/F
28	*Tringa glareola*	Wood Sandpiper		D	3						/F			B/F
	Laridae													
29	*Larus minutus*	Little Gull		D	3						B/F	B/F		
	Sternidae													
30	*Chlidonias hybridus*	Whiskered Tern		D	3						B/F	/F		
31	*Chlidonias niger*	Black Tern		D	3						B/F	B/F		
	STRIGIFORMES													
	Strigidae													
32	*Strix uralensis*	Ural owl	3				B/F							
33	*Asio flammeus*	Short-eared Owl	1	V	3			/F					B/F	
	CAPRIMULGIFORMES													
	Caprimulgidae													
34	*Caprimulgus europaeus*	Nightjar		D	2		B/F							B/F
	PICIFORMES													
	Picidae													
35	*Dendrocopos medius*	Middle Spotted Woodpecker	3	S	4				B/F	B/F				
36	*Dendrocopos leucotos*	White-backed Woodpecker	3						B/F	B/F				
37	*Picoides tridactylus*	Three-toed Woodpecker	3	D	3		B/F							
38	*Lanius excubitor*	Great Grey Shrike	2	D	3			/F					B/F	B/F
	Total		*30*	*32*	*32*	*4*	*9*	*9*	*4*	*7*	*16*	*11*	*16*	*18*

Sources and Legends: (1) Lipsbergs et al. 1990: Popularzinatiska Latvijas Sarkana gramata. Dzivnieki
0 - extinct species, 1 - vanishing species, 2 - rare species
3 - species with decreasing number of individuals, 4 - indeterminate species
(2) Tucker & Heath. 1994: Birds in Europe
E - Endangered; V - Vulnerable; D - Declining; L - Localised; S - Secured; R - Rare
SPEC category 1-4 (1-3 endangered)
(3) Collar et al. 1994: Birds to Watch 2 The World List of Threatend Birds
C - Critical; V - Vulnerable; C - Conservation Dependent; NT - Near-threatened

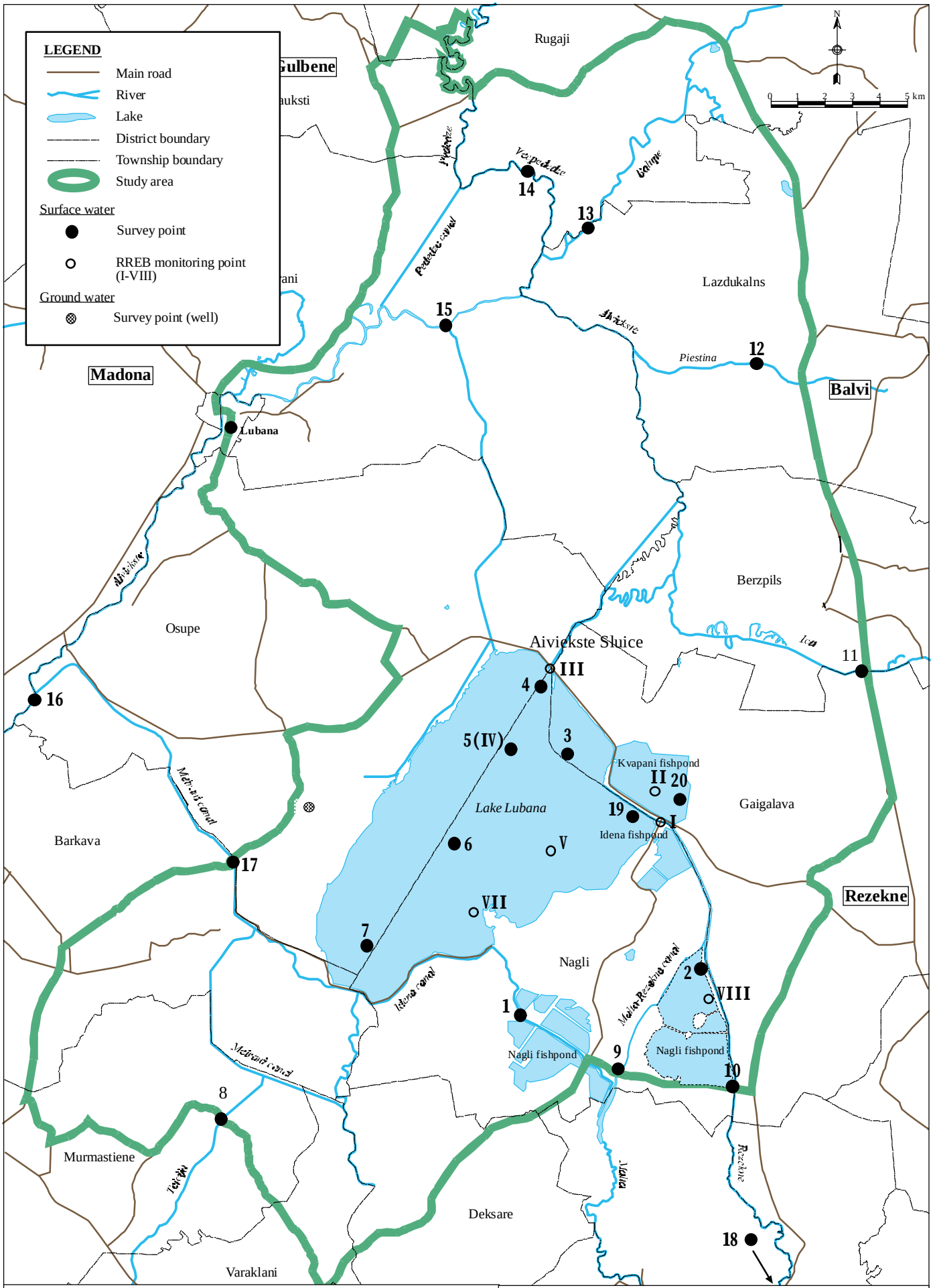


Figure 3.1.1 Survey Points of Water Quality

The Study on Environmental Management Plan
for Lubana Wetland Complex in the Republic of Latvia

JAPAN INTERNATIONAL COOPERATION AGENCY

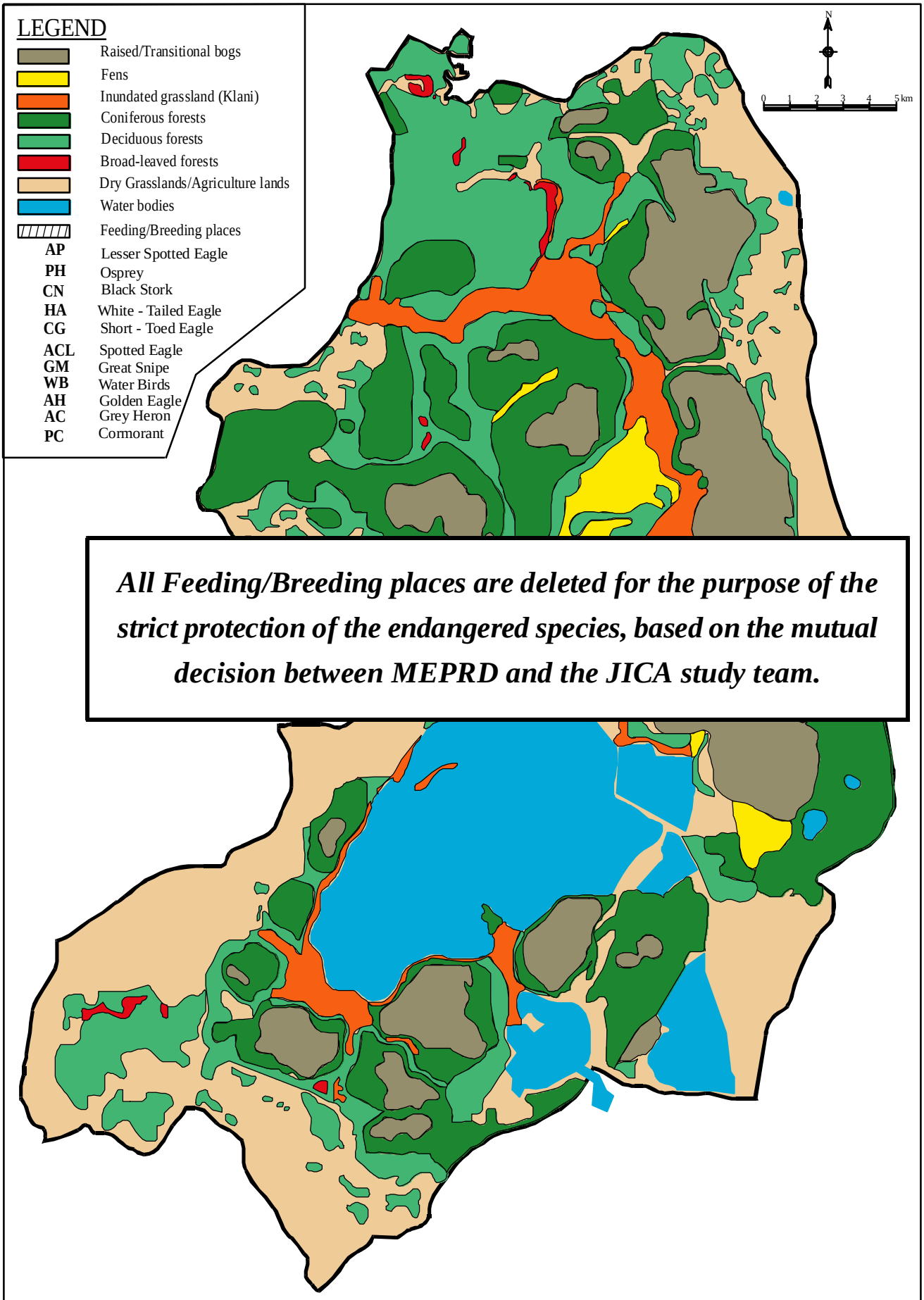


Figure 3.2.1 Feeding and Breeding Places for Important Bird Species in LWC

The Study on Environmental Management Plan for Lubana Wetland Complex in the Republic of Latvia

JAPAN INTERNATIONAL COOPERATION AGENCY

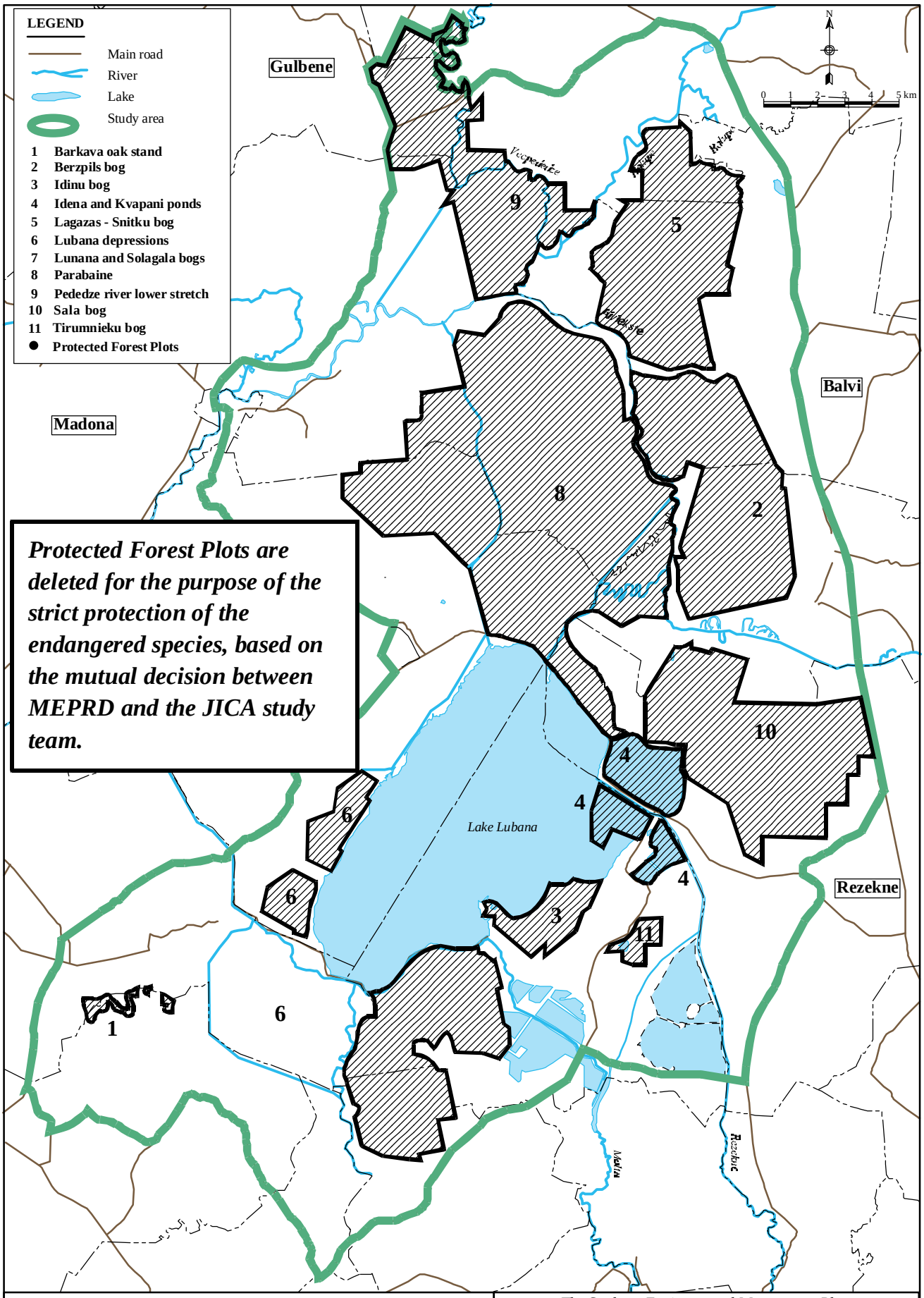


Figure 3.2.2 Current Nature Protection Areas in LWC

The Study on Environmental Management Plan
for Lubana Wetland Complex in the Republic of Latvia

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